

## TABLE OF CONTENTS

Unpacking Instructions .....	1
Features .....	3
AL-800 Technical Specifications .....	4
General Information.....	6
Safety Interlock.....	6
ALC .....	6
Dynamic Bias.....	7
Timer - Overload Circuits.....	7
Grid Overload Protection.....	7
Thermal Overload.....	8
Cathode Warm-up Timer.....	8
Power Supply.....	8
Heater Supply .....	8
Plate (HV) Supply.....	8
Meters .....	9
Current Meter (plate and grid):.....	9
Multimeter .....	9
Multimeter Functions .....	9
Wattmeter Circuit .....	10
Peak Envelope Power vs. Average Power .....	10
Tube Life .....	10
Export Modifications.....	12
Technical Assistance .....	12
Installation Guidelines and Suggestions.....	13
Location Of The Amplifier.....	13
Ventilation .....	13
Power Connections .....	13
Grounding.....	14
Transformer Connections .....	15
Jumper Connections.....	15
Interconnections.....	15
Operating Instructions And Guidelines .....	16
Front Panel Controls.....	16
Driving Power.....	17
Tube and Component Life.....	18
Additional SSB Notes.....	18
AM (Amplitude Modulation) Operation .....	19
Audio Distortion.....	19
FM (Frequency Modulation), RTTY, and DIGITAL OPERATION.....	19
ALC Metering, Controls, and Adjustments .....	19
ALC Metering Functions.....	19
ALC Controls.....	20
ALC Adjustments .....	20
Rear-panel "ALC LIMIT" control .....	21

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ALC Limit Adjustment (rear panel) .....	21
"ALC SET" control.....	22
Tuning.....	22
QSK Operation .....	25
Periodic Maintenance .....	26
Parts List.....	27
Timer / Overload Board (50-0117-2).....	27
Power Supply / SWR Board (50-0800-1).....	28
Meter Board (50-0800-3).....	29
Tuned Input Board (50-0800-2).....	29
AL-800 Tuned Input Chart .....	29
AL-800 Main Chassis Parts List.....	30
Frequency Coverage .....	31
Amplifier Tuning Log.....	31
Notes:.....	31
Schematics .....	32
Power Supply / SWR Board .....	32
Tuned Input Board.....	33
Meter Board.....	34
Timer / Overload Board.....	35
Main Chassis.....	36

## Ameritron AL-800 1200 Watt Linear Amplifier Instruction Manual

The Ameritron AL-800 is a 1200 watt PEP output linear amplifier that operates from 160 through 15 meters. The AL-800X and AL-800Y are export models that operate from 160 through 10 meters. Export modification instructions are only available with proof of a valid amateur radio license.

The AL-800 uses a single 3CX800A7 tube in a class AB2 grounded grid circuit. High-quality power supply and RF components combine with an accurate peak-detecting directional coupler, front panel adjustable true ALC circuit, electronic grid current and thermal overload protection, and automatic bias switching to make this the best featured and most reliable single 3CX800A7 amplifier available. The AL-800 and AL-800Y are factory-wired for 120 volt, 50/60 Hz ac line voltage. The AL-800X is factory wired for 240 volt, 50/60 Hz ac line voltage. All models are easily converted to other supply voltages between 90 and 250 volts ac.

### **WARNING:**

**NEVER APPLY POWER TO THIS AMPLIFIER WITH THE COVER REMOVED!  
CONTACT WITH THE VOLTAGES INSIDE THIS AMPLIFIER CAN BE FATAL!**

**PLEASE READ THIS MANUAL BEFORE ATTEMPTING TO OPERATE EQUIPMENT!  
Improper or abusive operation of this amplifier can damage the tube or other components in this amplifier. Damage caused by improper or abusive operation is *not* covered under the warranty policy.**

## Unpacking Instructions

Remove the 3CX800A7 tube from its shipping carton. Carefully unwrap the tube and inspect it for visible damage. Look for a dented anode cooler and broken or bent pins. Roll the tube over slowly and listen for loose internal materials. Contact either your Ameritron dealer or Ameritron immediately if any damage exists.

Carefully lift the amplifier from the shipping carton, and place it on a firm, level surface. Inspect the amplifier for shipping damage. Contact either your Ameritron dealer or Ameritron immediately if any damage exists. Remove the cover screws with a #2 Phillips screwdriver. Save the screws to re-secure the cover. Carefully lift the rear of the cover while sliding the cover back. **The AL-800 is shipped with the rubber chimney, fuses and fuse caps packed inside the amplifier.** Additional screws will be included in the fuse pack if they are required.

### **WARNING:**

**Never remove the cover while this amplifier is connected to the power mains!  
Contact with the voltages in this amplifier can be fatal.**

The tube must be installed in its socket prior to operation. Observe the pin configuration on the tube and the socket. Two of the pins are separated by a large space. Carefully observe the pin alignment

to be sure the tube pins are centered on the socket's metal contacts. Firmly press the tube into its socket. **Do NOT twist or force the tube into the socket.**

Install the rubber chimneys over the tube. The seam of the chimney must face the fiber panel. The bottom of the chimney has notches that must fit over the grid connectors near the base of the tube.

The heavy copper strap anode lead connects to the spacer on the center panel with the 6-32 screw and nut provided. Install the anode spring clip connector on the tube's anode cap.

The top cover should now be installed with the vent holes on side of the cover positioned near the electrolytics. The vent holes on the top of the cover should be on the right side of the amplifier (front view). Secure the cover by installing the corner screws first. Install all the screws loosely until every screw is in place. *Tighten the screws **after** they have all been installed.*

Install the fuses and fuse caps on the back of the amplifier. This amplifier uses two 20A fuses for standard 120 Vac operation. If you wish to operate the amplifier on a line voltage other than 120 V, the jumpers on the power transformer primary windings must be changed. If the line voltage wiring is changed, the correct fuses must be installed. See the **TRANSFORMER CONNECTIONS** section on page 15 for more information.

<p><b>CAUTION:</b> Always use fast-blow fuses rated at 250 volts or higher. NEVER use standard automotive fuses or slow-blow fuses.</p>
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Note: Ameritron will NOT be responsible for shipping damage due to improper packing. The packing materials used to ship this amplifier are specially designed to prevent damage. All packing materials should be retained for future shipping. Replacement packing materials may be purchased from Ameritron if original packing materials are unavailable.

## Features

1. The AL-800 uses a rugged **high-gain 3CX800A7 tube**.
2. A **time-delay circuit** provides a 180 second warm-up to eliminate potential damage to the tube cathode.
3. A **grid overload circuit** quickly disables the amplifier if the grid current becomes excessive. This feature prevents excessive grid current from causing distortion or damaging the tube or other components.
4. A **thermal overload** automatically disables the amplifier if excessive heating of the power transformer occurs.
5. A **dynamic bias circuit** eliminates hundreds of watts of unnecessary heat generation in the power amplifier tube. The result is cooler operation and longer component life.
6. A **multi-voltage heavy-duty transformer** with a unique "buck-boost" winding allows adjustment of the primary voltage to 14 different voltages centered on 115 and 230 volts. This versatile Ameritron feature allows the user to select the optimum primary voltage for maximum performance and life.
7. The tuning and loading controls have **vernier 6:1 reduction** drives for smooth tuning. Logging scales allow quick and repeatable control adjustments for rapid band changes.
8. The AL-800 has two **illuminated cross-needle panel meters**. The left meter provides a continuous reading of grid and plate currents. The right meter reads peak RF power output on one scale and Plate Voltage (HV), Reflected power and SWR (REF), ALC detector voltage (ALC), and ALC adjustment level (ALC SET) on the other scale.
9. Heater and plate voltages are maintained using the **"STBY/OPR"** switch. This allows the amplifier to be conveniently bypassed for "barefoot" operation.
10. A front panel **"ALC SET" control** allows convenient adjustment of the ALC threshold. The unique ALC circuit samples the grid current and power supply voltage.
11. **"XMT"** and **"OL"** LED's on the front panel indicate proper operation of the amplifier.
12. A rear panel **12 Volt auxiliary output jack** provides up to 200 mA at 12 Vdc for accessories such as the ATR-15 Antenna Tuner.
13. A **step-start circuit** limits the inrush current to the power supply and tube heater. This circuit extends the life of the amplifier components.

## AL-800 Technical Specifications \*

### Input:

Circuit type:	Pi-network, slug tuned coils
Maximum VSWR at resonance:	1.3:1 or less
Minimum 2:1 VSWR bandwidth:	20% of center frequency
Maximum drive power permissible:	100 watts PEP
Typical drive for full power output:	85 watts

### Output:

Circuit type:	Pi-L, Pi-network
Typical SSB PEP voice operation:	1200 + watts
CW continuous operation:	850 watts
1/2 hour PEP two-tone test:	1200 watts
1/2 hour continuous carrier (RTTY):	700 watts
Frequency Coverage:	1.8 to 21 MHz amateur Bands. (Export models include 24.5 and 28 MHz)
Third Order IMD:	-35 dB or better (at rated output)

### Efficiency:

CW:	approximately 65%
SSB:	approximately 65% ( <i>envelope crest</i> )

### Power Supply:

Circuit type:	Full wave voltage doubler
No load voltage:	2600 V
Full load voltage:	2250 V
Full load current:	1.2 A
Regulation:	12%
Transformer:	32 lb. E-I lamination grain oriented
Capacitors:	63 mFd total, computer grade
Normal line current at rated CW output:	16A at 120 Vac
Normal line current at 1200 watt PEP output:	17 A at 120 Vac
Power line current in standby:	0.9 A at 120 Vac

### Tube:

Type:	3CX800A7
Continuous dissipation:	800 watts total
Warm-up time:	180 seconds
Estimated life:	8,000 hours ICAS

\* Exact performance measurements may vary due to the accuracy of test equipment and the measurement methods used. (Prices and specifications subject to change without notices.)

**Metering:**

Multimeter: Peak forward power (continuously). The second scale switches between peak reflected power (and SWR), ALC threshold, ALC output voltage, and high voltage.

Current meter: Plate and grid current (simultaneously) on separate scales.

**ALC:**

Negative going, 0 to 10 volts, adjustable.

**Relay:**

Requires contact closure or sink of +12 Vdc at 100 mA. Back pulse protected.

**Connectors:**

RF: SO-239

Line: NEMA 5-15P, standard 120 V three wire

Others: RCA Phono

**Physical:**

Dimensions: 14-1/2"D x 14-1/4"W x 8-1/2"H

Weight: 68 lbs.

## General Information

### Safety Interlock

An interlock switch is closed while the amplifier's top cover is in place. This switch allows ac line voltage to reach the power transformer. The interlock will open and remove line voltage from the transformer primary if the top cover is removed.

#### **WARNING:**

**High voltage can kill!! Accidental contact with the voltages in this amplifier can be lethal.**

*For your personal safety please observe the following precautions:*

- 1.) **NEVER** defeat the interlock.
- 2.) **NEVER** remove the cover with the amplifier connected to the power line.
- 3.) **ALWAYS** allow the capacitors to discharge for several minutes *after* unplugging the amplifier and *before* removing the cover.
- 4.) **ALWAYS** select the high-voltage (HV) function of the Multimeter to check the high voltage potential. Do **not** remove the cover if voltage is indicated.
- 5.) **ALWAYS** ground the tube anode (outer metal surface) to the chassis through a low value, high wattage resistor before touching anything inside the amplifier.
- 6.) **ALWAYS** be cautious of heat. Many components inside the amplifier operate at high enough temperatures to cause burns.
- 7.) **NEVER** make any unauthorized component or circuit modifications to this product. The *only* acceptable source for modifications is Ameritron or a source approved by Ameritron. Unauthorized modifications almost certainly will **increase** the risk of equipment failure or personal injury.

### ALC

The AL-800 is one of the few amplifiers using a "true" automatic level control ALC circuit. In this amplifier, the ALC actually samples grid current and power supply loading to determine the ALC voltage. The front panel "ALC SET" knob adjusts the level of grid current where ALC action begins. The ALC action begins softly over a range of a few milliamperes to minimize distortion. This soft-touch ALC is an Ameritron exclusive.

The ALC circuit is located on the METER BOARD P/N 50-0800H-3 (behind the "MULTIMETER" switch). IC301 (pin 9) samples the voltage drop (caused by grid current) across R106 in the main power supply board. ALC voltage is derived by comparing the grid shunt voltage to the voltage from the power supply (pin 10).

Pin 8 of IC1 will go negative if the grid shunt voltage exceeds the voltage from divider R311 and R2 (chassis mounted control), or if the supply voltage sags from excessive line voltage drop. Pin 8 is followed by current buffer Q303 that sources the negative ALC voltage to the ALC output jack.

### Dynamic Bias

Conventional bias circuits allow high power linear amplifiers to dissipate hundreds of watts during low or no signal periods. This creates needless heat, since virtually no dissipation is required unless the amplifier is being driven with large signal levels.

The AL-800 contains an exclusive bias circuit that reduces the idling (quiescent) current very close to the tube's cut off region. The power amplifier tube in the AL-800 has a full resting period of very low dissipation between dots and dashes on CW and between words on SSB. The lower idling current dramatically reduces component temperatures on both CW and SSB. If only a few milliwatts of RF power are applied to the amplifier, the quiescent current will increase. Linearity remains excellent with this circuit because the tube's conduction angle is never reduced below class AB.

The dynamic bias circuit is located on the Power Supply Board P/N 50-0800-H1. Diodes D101 and D102 rectify a small sample of the RF drive voltage. This voltage is applied to the base of dc switch Q101. If Q101's base is driven with a few microamperes of current from the RF sampling circuit, Q101's collector will pull the base of PNP transistor Q102 low. This turns dc switch Q102 on.

When Q102 is on, zener diode D103 is connected between the collector and base of Q103.

D103 sets the operating bias. This zener applies forward bias to Q103's base whenever the collector voltage of Q103 exceeds the voltage of D103. This forward bias will turn Q103 on harder and will reduce the collector voltage. If the collector voltage is less than the breakdown voltage of D103, Q103 will move towards cut-off and the collector voltage will increase. Q103 is, in effect, a current buffer for zener diode D103.

## Timer - Overload Circuits

<b>CAUTION:</b> Never modify or disable protection circuits without factory approval. Doing so with void all manufacturer's warranties.
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### Grid Overload Protection

This amplifier contains a fast acting electronic grid protection circuit to enhance tube life. The amplifier will quit operating and the "OL" and "XMT" LEDs will both illuminate if the safe limit of grid dissipation is approached or exceeded. The grid overload protection circuit is reset whenever the "STBY-OPR" switch is placed in the "STBY" position.

Note: This circuit has a much faster response time than the grid meter. This circuit also measures the peak grid current. The operator may not observe the grid current meter climbing before the overload circuit responds and disables the amplifier.

This circuit is located on the Timer / Overload board P/N 50-0800-5. IC501 (pin 5) senses the voltage across the grid shunt (power supply board, R106) through terminal 1. If the voltage at pin 5 exceeds the regulated voltage at the junction of R505 and R511, the output of IC501 (pin 7) will go high and turn on Q504. Q504 will energize the coil of RL501. RL501 will latch "on" and remove the voltage from terminal 3 and relay RLY101 (power supply board).

### Thermal Overload

The transformer in this amplifier contains an internal temperature sensor. This sensor disables the transmit function if the transformer's temperature ever happens to approach the limit of safe operation. Thermal overload is indicated if the "OL" LED illuminates without the "XMT" LED being illuminated.

The amplifier will not operate during a thermal overload indication. The thermal protection system automatically resets after several minutes of a non-transmitting cool down period.

### Cathode Warm-up Timer

Indirectly heated transmitting tubes normally require a few minutes of "warm-up" time before plate current can be drawn. This protection is provided by IC501 (see **Tube Life** on page 10). Pin 2 of IC501 is connected to a regulated reference voltage. C509 begins to charge when the main power switch is placed in the ON position. The voltage at pin 3 of IC501 will exceed the voltage on pin 2 after approximately three minutes, causing the output of IC501 (pin 1) to go high.

Q503's collector pulls low whenever the output of IC501 (pin 1) is high. When the collector of Q503 is low, Q502 and Q501 are forward-biased. This allows 12 volts to appear at terminal 5. Terminal 5 supplies 12 Vdc to the keying circuits and the plate and grid current meter lamp.

## Power Supply

### Heater Supply

The heater circuit of this amplifier satisfies *all* requirements of the tube manufacturer related to tube performance and life. The heater voltage and inrush current are controlled by the power transformer's internal resistance and impedance, heater choke resistance, heater wiring resistance, and the step-start circuit. For maximum tube life, NEVER replace any circuit components or wiring with substitute parts. Always consult the factory before making modifications that may affect tube life.

### Plate (HV) Supply

The plate supply uses a full wave doubler circuit with 200 amp surge rated diodes and a heavy duty 32 pound grain oriented transformer with internal thermal protection. Filtering is accomplished by a bank of high quality computer grade capacitors totaling 63 mFd. Large 50k-ohm 7-watt bleeders are used for safety and superior voltage equalization. The transformer allows user selection of fourteen different line voltages (See the **Transformer Connections** section on page 15 for details).

Power is supplied through "OFF-ON" switch S2. A 10 ohm resistor (R27) limits the line current during the filter capacitor charge time to lower component stress. When the filter capacitor charging

current decreases sufficiently, RLY102 shorts the 10 ohm resistor. This applies full power line voltage to the transformer. The 10 ohm resistor is protected from high-voltage supply shorts by a two-ampere fast-blow fuse (F101) during start-up. If F101 or the 10 ohm resistor (R27) fails the amplifier will not start. If F101 fails from a momentary HV to ground fault, meter protection diode D117 may also fail. See the **Meters** section that follows for more information.

## Meters

### Current Meter (plate and grid):

The plate and grid current meter is located on the far left side of the front panel. This meter indicates the plate current ( $I_p$ ) on the right-hand meter scale. This scale has a small picket every 0.05 ampere, a large picket every 0.25 ampere, and indicates 1.5 amperes at full deflection.

The left-hand meter scale indicates the grid current ( $I_g$ ). The small pickets on this "I<sub>g</sub>" scale appear every 5 mA and the larger pickets appear every 25 mA. The full scale "I<sub>g</sub>" reading is 125 mA.

The plate and grid meters in this amplifier will normally indicate maximum grid current and maximum RF output near the same "PLATE" tuning setting during adjustments. Maximum grid current and *minimum* plate current also generally occur at or near the same "PLATE" tuning setting.

Note: If the grid and plate meters always track (move together in exact step) as the tuning controls are adjusted and if they show the same approximate amount of pointer movement, diode D117 on the power supply board could be shorted.

D117 protects the overload circuit and the meters. This diode is located near the electrolytic capacitors on outside edge of the main circuit board. D117 will usually short if there is a large high-voltage-to-chassis current fault. The grid and plate current meters will not read correctly if this diode fails. The overload circuit may repeatedly trip before full power is reached if D117 is shorted.

### Multimeter

The multimeter is the meter on the right. It continuously reads the forward *peak envelope power* on its left-hand scale (FWD). This scale is calibrated in 100 watt steps up to 2 kW.

The right-hand scale of this meter serves multiple functions, including measurement of the high voltage (HV), reflected power (REF), SWR, ALC voltage output (ALC), and relative ALC threshold (ALC SET). These four metering functions are selected by the "MULTIMETER" switch. See **Multimeter Functions** for more information.

### Multimeter Functions

**HV:** The multimeter will indicate the dc plate voltage of the PA tube when in the HV position. The correct scale to use is the ACL / HV scale, which has a picket every 100 volts. Two zeros must be added behind the numbers indicated on the meter scale (i.e. multiply by 100), so that "25"=2500

volts and "20"=2000 volts. Do not operate the amplifier if the high voltage is over 2700 volts with the amplifier on standby. See the **Transformer Connections** section on page 15 for information on correcting excessive high voltage.

**REF:** The multimeter measures the antenna (or load) peak envelope reflected power in the REF position. The full scale reflected power reading is 500 watts. This scale is marked every 10 watts below 100 watts, and every 100 watts from 100 to 500 watts.

Note: The SWR of the load can be measured when the "**MULTIMETER**" switch is in the REF position by observing the different red SWR curves. The forward and reflected meter pointers will cross each other on, or near, the correct SWR curve.

**ALC:** The multimeter measures the output voltage of the ALC detector when in the ALC position. The full scale ALC reading is 35 volts and is read directly from the ACL / HV scale. The meter should flick upwards occasionally during normal ALC action. See **ALC Metering, Controls, and Adjustments** operation on page 19 for more information.

**ALC SET:** The multimeter measures the *approximate* grid current that will produce ALC activity when the meter switch is in the "**ALC SET**" position. One zero must be added to the reading on the ACL / HV scale and the result divided by 2 for this function. For example, ALC action will begin at approximately 75 mA of grid current (typically between 60 mA and 90 mA) when the "**ALC SET**" control is adjusted until the meter reads "15."

### Wattmeter Circuit

The AL-800 wattmeter circuit uses an accurate directional coupler followed by a true peak detector circuit. This circuit will accurately determine the true peak envelope power (PEP) of normal voice waveforms. If the load SWR is high, the true power reading can be obtained by subtracting the reflected power from the forward power reading.

### Peak Envelope Power vs. Average Power

Peak envelope power (PEP) is often misunderstood. PEP *is not* associated with the sine wave or root-mean-square (RMS) power, and it has no fixed ratio to average power. There are no formulas that allow accurate conversions between average and peak voice waveform power.

PEP is the power at the crest (highest point) of the RF waveform. On SSB, the average power can vary from a few percent of the PEP to over fifty percent of the PEP. Generally, the PEP on SSB is two to five times greater than the average power. On CW or other constant amplitude modes (such as FM or RTTY), the PEP is *always equal* to the average power.

## Tube Life

The 3CX800A7 is a reasonably rugged tube. The anode can handle very large anode dissipation overloads for short periods of time due to the thermal mass of the external anode. Care must be taken to avoid exceeding the temperature ratings of the tube's ceramic-to-metal seals. The life of the tube in this amplifier may be prolonged if adjustment periods are kept short and a brief "cool-down" periods are provided between lengthy adjustment periods. Avoid shutting the main power off immediately after lengthy full power CW or RTTY transmissions. After lengthy full power RTTY or CW transmissions, allow a one or two minute "cool-down" period (without transmitting) before shutting off the ac power switch.

The most sensitive element in any indirectly heated oxide cathode tube will always be the control grid. A fraction of a second of incorrect tuning can cause control grid damage. This is especially true in amplifiers that use fuses or resistors to protect the grids. Fuses and resistors are much too slow and too unpredictable to adequately protect control grids. In this amplifier, the 3CX800A7 grid is protected by a fast-acting electronic circuit. This circuit rapidly disables the amplifier when excessive grid dissipation occurs. Never remove or defeat this circuit. Doing so will void the manufacturer's warranty.

In the AL-800, a grid current of 75 mA (at 100 watts of drive) produces the maximum rated grid dissipation of 4 watts. This amount of grid current will also safely disable the amplifier within a few milliseconds.

**WARNING:**

**NEVER drive this amplifier with more than 100 watts of short term average envelope power. NEVER remove, defeat, or modify the internal electronic grid protection circuits.**

Maximum power output normally occurs with a maximum of 15 to 20 mA of grid current on CW, or 12 mA indicated (25 mA peak) during a SSB two-tone test. The grid dissipation is well under one watt with 25 mA of grid current and 100 watts of drive.

The cathode of the 3CX800A7 must reach full operating temperature before the tube is operated. The cathode becomes fully operational 180 seconds after the application of the full heater voltage. The warm-up timer in this amplifier assures that the cathode reaches the proper operating temperature before the amplifier can be operated. Never defeat the warm up timer or alter the heater voltage.

The continuous commercial plate current rating of the 3CX800A7 is 600 mA. Brief periods of plate current exceeding 1.2 amperes (during tuning) will not cause loss of emission or shorten the amateur life of the tube in this amplifier. For maximum tube life, plate current should be maintained below 700 mA on normal amateur CW operation, 600 mA on FM, RTTY, and other "steady" carrier modes. *The life a metal oxide cathode is directly related to the accumulated heater operating time, not the transmitting time.*

The application of heater or filament voltage causes thermal stresses from rapid and uneven temperature changes in the tube's heater. Avoid unnecessary main power switch cycling to prevent needless heater life reduction.

An accumulation of gas (or stray debris) in the tube can cause the tube to arc between the anode and the other elements of the tube. The resulting "gas arc" will generally manifest itself as a loud "pop" when the amplifier is first turned on, or during conditions of high anode voltage. A "gas arc" will often damage diode D117 on the negative rail of the filter capacitor bank and open the fuses in the amplifier. If this problem occurs frequently, the tube should be tested or replaced. The use of low quality tubes, tube that have been stored for extended periods, or abused tube will increase the likelihood of a "gas arc". Ameritron recommends using only current code date Eimac 3CX800A7 tubes.

## Export Modifications

A simple modification will allow operation on frequencies above 15 meters. Instructions for this modification are available by sending a written request for "Export Modification Instructions" along with a copy of a valid amateur license. There is no charge for this information. Export models are shipped with this modification installed and have an "X" or "Y" following the serial number. Standard frequency ranges are indicated in the chart on page 32.

## Technical Assistance

Technical assistance is available during normal central standard time business hours on weekdays. Customer service is more effective when our engineers are provided the following information:

1. Model and serial number
2. Date of purchase and dealer
3. An accurate description of the problem

Meter readings at all stages of the tuning procedure are very important along with a complete description of the other equipment used with our product.

Written assistance is also available. Due to time delays in processing mail, please allow at least three weeks for a written reply. For service or written correspondence, use the following address:

AMERITRON  
116 Willow Rd.  
Starkville, MS. 39759  
Telephone (662) 323-8211  
FAX (662) 323-6551

Note: Service history has clearly shown that most problems are operating or installation errors, rather than equipment failures. Most problems can be resolved over the telephone. Please contact our staff before shipping parts or equipment to us.

The packing materials used to ship this amplifier were specially designed to prevent shipping damage. The original packing materials should be used to ship this amplifier. Replacement packing materials may be purchased from Ameritron if original packing materials are unavailable or damaged.

**CAUTION:** Never ship this amplifier with the tube installed. Ameritron will not be responsible for shipping damage caused by improper packing.

## Installation Guidelines and Suggestions

### Location Of The Amplifier

Do not install the amplifier in excessively warm locations or near heating vents or radiators. Be sure air can circulate freely around and through the amplifier cabinet. Provide an unobstructed cold air inlet for the amplifier. **DO NOT** place any books, magazines or equipment that will impede the free flow of air near or on the cabinet ventilation holes.

### Ventilation

The AL-800 ventilation system has been designed and tested to maintain tube seal temperatures safely below the tube manufacturer's rating at 1200 watts of continuous two tone test SSB PEP output, or 850 watts of continuous RTTY, FSK, FM or CW power output when the amplifier is properly tuned. The blower in the AL-800 is a permanently lubricated type that requires no maintenance in normal operation. To insure adequate cooling in your installation, please observe the following:

- 1.) Do not block or unduly restrict the ventilation holes in the cover. Be sure that the amplifier is located in an area so the ventilation holes have open air circulation. It is particularly important to avoid restricting the air inlet.
- 2.) The exhaust airflow is over 30 CFM. Do not "assist" the exhaust airflow with cabinet mounted fans.
- 3.) The most efficient way to improve airflow is to pressurize the air *inlet* area. Be sure that any fan used to assist the inlet airflow has *at least* a 60 CFM rating.
- 4.) The exhaust air will become quite warm at high power levels. Do not place any heat sensitive objects in the exhaust air stream.

### Power Connections

The AL-800 is supplied with a NEMA 5-15P plug for 120 Vac operation. The **Transformer Connections** section on page 15 show the correct wiring for various supply voltages.

This amplifier has a current demand of approximately 16 amperes at 120 Vac with 1200 watts of carrier output and an absolute maximum draw of 20 amperes under severe operating conditions. The average power line current during voice peaks on SSB will be approximately 6 amperes at 1200 watts PEP output. Most normal residential power lines and house-wiring should meet this demand for current.

If the power mains have excessive resistance, the high voltage may sag to less than 2200 volts under load. Voltage sag will not hurt the life of the amplifier components if the fully loaded high voltage remains above 2000 volts. 240 volt operation will help improve performance if the power wiring is marginal.

**CAUTION:** Never allow the high voltage to exceed 2700 volts under any condition.

For 120 volt operation, the wiring between the fuse box and the amplifier ac outlet must be number 12 gauge (or larger) in order to supply the current required (16 A) without a significant drop in the line voltage. The 120 volt outlet should be fused properly for the gauge of house-wiring used, but never exceed 25 amperes.

## Grounding

Connect a good RF and dc ground to the ground post on the rear panel of the amplifier. Use the heaviest and shortest connection possible. The best materials to use for ground connections are (in order of effectiveness) smooth wide copper flashing, copper tubing, or solid copper wire. *Never use braided or woven conductors unless the lead needs to be flexible.* Braided or woven conductors offer a high impedance to both lightning and RF.

Water pipes, metal heating ducts, metal fences and other large metallic masses offer convenient RF grounds. If a water pipe ground is used, inspect all the pipe connections to be sure that no plastic or rubber connections are insulating the pipes. Insulated pipe connections will interrupt the electrical continuity to the water supply line. Install a jumper around any insulated pipe connections you find. Use heavy copper wire or flashing with stainless hose or pipe clamps for the jumpers.

*The following tips will help prevent lightning damage and RF grounding problems:*

- 1.) Avoid using braided or woven conductors, they have very high resistance to both RF and lightning currents. RF and lightning flows along the surface of conductors, almost no current flows in the center of the conductor. The lowest RF resistance occurs with wide, smooth conductors.
- 2.) Avoid routing a single small gauge grounding conductor along the various pieces of equipment (or to connect multiple ground sources). Instead, use multiple ground leads that connect to a single wide buss at the operating position. Keep all ground leads as short and wide as possible.
- 3.) Buried radials provide much better lightning and RF grounds than ground rods do, although both are needed for safety.
- 4.) Avoid sharp bends in ground leads. When changing the direction of a ground lead use a gradual radius turn.
- 5.) Avoid second story operation. A good ground is much easier to obtain on the first floor or in the basement of a structure.
- 6.) Air-core choke baluns should be used on all coaxial feedlines. The feedlines should be coiled into several 4" to 6" diameter turns *before* they enter the building. Either directly bury the feedlines a few inches deep in the ground for a minimum distance of ten feet or ground the shields to a separate outside ground on the antenna side of the choke.

## Transformer Connections

The power transformer of the AL-800 has fourteen different voltages available on the primary and is rated at full power with supply frequencies of 50 to 60 Hz and voltages above 100 volts. The **Jumper Connections** chart below indicates the proper placement of jumpers for various power line voltages.

### Jumper Connections

CONNECT A JUMPER FROM THE BOLD *COLUMN* HEADING LETTER ("A" - "F") TO THE LETTER OR NUMBER IN THE *ROW* NEXT TO THE DESIRED "HIGHEST LINE VOLTAGE". **DANGER:** *Never change jumpers with the power cord connected to an outlet.*

Highest Line-V	"A"	"B"	"C"	"D"	"E"	"F"	Line Fuse
205		C	(B)		3	1	12
215		C	(B)		3	2	12
220		C	(B)		2	1	12
230		C	(B)		F	(E)	10
240		C	(B)		1	2	10
245		C	(B)		2	3	10
250		C	(B)		1	3	10
90	(B)	A	(D)	C	3	1	25
100	(B)	A	(D)	C	3	2	25
110	(B)	A	(D)	C	2	1	25
115	(B)	A	(D)	C	F	(E)	20
125*	(B)	A	(D)	C	1	2	20
130	(B)	A	(D)	C	2	3	20
140	(B)	A	(D)	C	1	3	20

\* Factory wired

#### WARNING:

The AL-800 requires different back panel fuses for various line voltages. Use the fuse listed in the JUMPER CONNECTIONS chart for maximum protection.

### Interconnections

1. Connect the exciter's RF output to the "RF IN" connector on the rear of the AL-800 with 50 ohm coax. Use any good quality 50 ohm cable long enough to connect the amplifier to the exciter. This amplifier connection uses a standard SO-239 female that mates with a PL-259 male connector on the cable.

2. Connect the existing station antenna system to the "**RF OUT**" connector on the rear of the AL-800 with RG-8 type coax. This amplifier connection uses a SO-239 female that mates with a PL-259 connector on the cable.
3. Shielded audio type cable with a standard male phono plug should be used to connect to the "**RLY**" jack on the AL-800. This jack has positive 12 Vdc open circuit and supplies 100 mA of current when pulled to ground. The relay circuit has an internal back pulse canceling diode to protect sensitive exciter circuits from damage.
4. Connect a short, wide, and smooth ground lead from a good earth and RF ground to the rear panel "**GND**" terminal. Avoid using braided conductors for ground leads.
5. The "**12 V**" connection on the rear panel provides 12 Vdc at 200 mA maximum to operate external dial lamps or accessories such as the ATR-15 Antenna Tuner.
6. Connect the "**ALC**" jack to the ALC input of the exciter with a shielded cable and a phono plug. The proper connection point on the exciter should be indicated in the exciter's manual. The AL-800 ALC will operate with any exciter that uses a negative-going ALC voltage of up to 10 volts.

Note: Transceiver ALC response times and ALC voltage requirements vary with different manufacturers. The ALC section describes adjustment of this circuit in detail.

## Operating Instructions And Guidelines

### Front Panel Controls

#### "MULTIMETER" Switch

This four position switch selects either the plate voltage (HV) of 0-3500 volts, the reflected peak envelope power (REF) of 0-500 watts, the ALC detector output voltage (ALC) of 0-35 volts, or the approximate ALC grid current threshold (ALC SET) of 0-175 mA. See the **Meters** section on page 9 for more details.

#### "OFF-ON" Switch

This switch turns the main power off and on. When this switch is placed in the "**ON**" position the blower should start, the right-hand meter should be illuminated, and high voltage should appear. The left-hand meter should illuminate and the amplifier should operate after three minutes.

#### "STBY-OPR" Switch

This switch disables the amplifier's internal antenna relay and resets the grid protection circuit. In the "**STBY**" position the amplifier is bypassed without turning the tube's heater or the power supply off.

This switch will also reset the grid protection circuit if the "**OL**" LED is illuminated. The overload circuit is automatically reset whenever this switch is placed in the "**STBY**" position and returned to the operate position.

### "PLATE" Control

The "PLATE" control adjusts the output tank circuit to resonance. This control should *always* be adjusted for maximum RF output power. Maximum RF output power normally occurs simultaneously with maximum grid current and very close to the plate-current "dip."

### "LOAD" Control

This control adjusts the coupling of the amplifier to the antenna. This adjustment is necessary to insure optimum coupling to the load as the SWR of the load, the operating frequency, or the power level is changed. Advancing the "LOAD" control clockwise increases the RF power output capability and the linearity of the amplifier. Advancing the "LOAD" control also *decreases* the grid current and *increases* the plate current for a given amount of drive.

The efficiency of the amplifier and the grid current decrease if the "LOAD" control is rotated beyond the point of maximum output. The linearity, however, will increase. The proper position for this control is *slightly* clockwise from the setting that produces maximum output with full drive-power applied. Never use this control to adjust the output power.

**CAUTION:** Failure to adjust the loading control properly can result in excessive tank circuit voltages and damage to components.

The "PLATE" control should always be checked after the "LOAD" control is adjusted by more than one number. For example, if the "LOAD" is advanced from 1-1/2 to 2-3/4, the "PLATE" should be re-tuned. If the "LOAD" is touched up a small amount, the "PLATE" setting will not usually require re-adjustment.

### Driving Power

This amplifier is designed to operate at full ratings when it is driven by an exciter that has approximately 85 watts of RF output. An exciter with a lower output power may be used with a resulting decrease in amplifier output. Both the driving power and the "LOAD" control must be carefully adjusted when using an exciter that delivers more than 85 watts. Proper control settings will help prevent excessive grid current and spurious signals, which create needless interference to other operators. A monitor scope is recommended for continuous output observation. An oscilloscope is the best way of determining if the amplifier is "flat-topping" and producing excessive distortion products.

A second method of determining linear operation is to monitor the peak RF output power carefully on the AL-800's internal meter. Determine the maximum obtainable RF output power and reduce the exciter's power until there is a noticeable margin from the maximum output power. This will insure some reserve power is available for random voice peaks.

Note: Never increase the drive power beyond the point where the amplifier's output power stops increasing. This is also the point where the grid current will begin rising rapidly.

The amplifier being over-driven for a given "**LOAD**" setting when the grid current increases rapidly while the plate current and output power increase slowly. The amplifier "**LOAD**" control needs to be *advanced* to a higher number if this condition occurs. Non-linear operation, splatter, and

excessive grid current will occur if the "**LOAD**" setting is too low. Excessive plate current is the proper indicator that the drive power limit has been reached.

### Tube and Component Life

These guidelines will help prolong tube and component life, and minimize splatter.

- 1.) On SSB or other linear modes virtually *any* amount of power will cause splatter if the loading is too light ("**LOAD**" control too far counter-clockwise). Always tune for *maximum* output with *maximum* drive power. Reduce the *drive power* to reduce the output power on SSB, not the loading control.
- 2.) Lightly loading an amplifier will also result in large voltages building up in the tank circuit. Under-loading an amplifier is much harder on the tube and other components than operating a properly loaded amplifier into a high SWR or with excessive drive power.
- 3.) Never depend on *average* reading power or current meters to indicate proper operation on SSB or other linear modes. The best indicator of linearity is either an oscilloscope or the internal PEP RF output meter. Maximum linearity can be determined by finding the maximum output power possible and then reducing the *exciter power* for a slight reduction in output power.
- 4.) Never *exceed* 25 mA of grid current on CW carrier. The proper grid current during voice modulated SSB will range from 0 to 12 mA, and will typically be at 5 mA or less. The SSB grid current will vary with the operators voice, the amount of signal compression or processing, and the tube characteristics.

### Additional SSB Notes

The peak power output developed on SSB is limited by the amplifier loading, RF drive, and peak-to-average power of the RF wave form. The "**LOAD**" setting is the *single most critical adjustment* for proper operation. Properly loaded, this amplifier will produce excellent linearity with output powers of well over one kilowatt. Improperly adjusting the "**LOAD**" control can produce flat-topping and splatter with only a few hundred watts of RF output.

Note: Always remember that the "**LOAD**" control setting is much more important than any other parameter for good linearity!

To maintain linearity, *always* be sure that the "**LOAD**" control is adjusted far enough *clockwise* for the *peak* drive that will be applied.

Be considerate of others. NEVER "push" this amplifier into envelope clipping or to the point where the grid current approaches 12 mA on voice peaks. Envelope clipping can be also be avoided by adjusting the amplifier's "**ALC SET**" control until the peak output power drops slightly from the

power obtained with full microphone gain and a fully clockwise "**ALC SET**" adjustment. For the cleanest audio, the microphone gain can be reduced until the ALC meter just flickers on voice peaks.

### **AM (Amplitude Modulation) Operation**

The efficiency of *any* conventional linear amplifier must remain below half the peak efficiency under maximum signal conditions (less a safety factor) in AM operation. Since this linear amplifier has a

peak plate efficiency of nearly 65%, the carrier efficiency must be kept below 30% to maintain linearity. The power dissipated in the tube anode will be more than twice the carrier output power.

The carrier power must be kept below 150 watts for clean and safe AM operation. With 150 watts of carrier, the peak envelope power will reach 600 watts with 100% symmetrical modulation. The modulated AM power output should be limited to 1200 watts peak with non-symmetrical modulation that enhances the positive peaks.

### **Audio Distortion**

One problem that often occurs when using a linear power amplifier is SSB audio distortion on one or more bands. This distortion is usually caused by RF feedback from either a poorly designed antenna or poor RF grounding. *REMEMBER THAT A GOOD GROUND FOR DC IS NOT NECESSARILY GOOD FOR RF.* RF circuits require short connections with smooth, wide conductors. Braiding or woven wire has a very high RF resistance and should be avoided. See the "Grounding" section on page 14 of this manual. More detailed suggestions on grounding are available by requesting Ameritron's Tech Bulletin on RF Feedback.

### **FM (Frequency Modulation), RTTY, and DIGITAL OPERATION**

The efficiency of this amplifier will approach 65% in the FM, RTTY and DIGITAL OPERATION modes. Since these modes do not require linear amplification of complex waveforms, the tuning can be re-adjusted for maximum power at the desired output power level. This will keep the efficiency as high as possible.

## **ALC Metering, Controls, and Adjustments**

### **ALC Metering Functions**

The "**MULTIMETER**" switch in the AL-800 has two positions that indicate the functioning of the ALC circuit. These positions are as follows:

**ALC...**In this position the multimeter measures the output voltage of the ALC detector. The full scale reading of the ALC detector voltage is 35 volts. It is read directly from the "**ACL / HV**" scale of the multimeter. The multimeter will indicate the maximum value of ALC voltage available from the internal ALC circuit. The meter should flick upwards occasionally during normal ALC action in this position.

**ALC SET...**In this position the multimeter measures the *approximate* grid current that will produce ALC activity. One zero must be added to the reading on the "**ACL / HV**" scale and the result divided by 2 for this function.

For example: If the meter reads 15, add one zero (150) and divide by 2 (75). In this example ALC action will begin at *approximately* 75 mA of grid current.

### ALC Controls

The position of the "**ALC SET**" control determines the grid current value that will begin to produce ALC voltage. Rotating the "**ALC SET**" control counter-clockwise *reduces* the maximum grid current obtainable and the available RF power output. Rotating the "**ALC SET**" control clockwise *increases* the maximum grid current level.

The approximate grid current available before ALC action begins can be determined by placing the "**MULTIMETER**" switch in the "**ALC SET**" (far clockwise) position. The "**ALC SET**" control should normally be adjusted to produce a multimeter reading of 3 to 6 volts with the "**MULTIMETER**" switch in the "**ALC SET**" position. This will allow a maximum grid current of approximately 15 to 30 mA.

### ALC Adjustments

**During SSB operation**, two adjustments affect the ALC and the sound of the signal. One is the *exciter's* microphone gain (or RF output level) adjustment. It will control the "fullness" of the ALC and the average output power. It will have very little effect on the peak output power, however. The fullness of ALC action is indicated by the meter reading in the multimeter "**ALC**" position. More exciter audio gain or power output will drive the amplifier's ALC circuit harder, and produce a more constant meter reading. This produces RF compression that increases the "talk power" without increasing signal bandwidth or distortion.

Note: Audio background noise will increase while using heavy ALC levels on SSB.

Objectionable background noise levels may occur while using heavy amounts of ALC, especially if the heavy ALC levels are used in conjunction with other speech processing. In these situations, operating in a quiet room and "close talking" the microphone will minimize objectionable background noise.

The amplifier's "**ALC SET**" control determines the *level* of grid current that produces ALC activity. The maximum power output level. This amplifier has the best linearity when the "**ALC SET**" control is adjusted to limit the peak grid current to 20 mA or lower. This adjustment must be made with a carrier or single tone signal. When the "**ALC SET**" control is properly adjusted, it will be impossible to exceed 20 mA of grid current with any tuning or drive adjustment.

**During CW operation**, the "**ALC SET**" control voltage should be adjusted just high enough (clockwise) to allow the desired output power to be reached. The "**ALC SET**" control should *never* be adjusted to the point where the grid current can exceed 25 mA under any tuning or drive adjustment condition. During proper CW ALC operation, the exciter drive level control should be

adjusted until the ALC voltage meter slightly flickers (ALC position of the "MULTIMETER" switch) while operating with normal output power levels.

The ALC circuit will limit the amplifier's grid current to a safe value if anything accidentally changes in the station or the antenna. The CW keying waveform of the radio will remain unaltered when the ALC is adjusted in this manner.

Note: Caution should be exercised if the "ALC SET" is used to control the CW power output with the exciter power control set at maximum. Key clicks may be produced if the exciter has a poor ALC response time. Check for proper wave shape when using the ALC in the amplifier exclusively to control the RF output power.

### Rear-Panel "ALC LIMIT" Control

The "ALC Limit" control (rear panel) limits the maximum voltage available from the ALC circuit. This control is necessary only because the ALC response times and voltage requirements for exciters have never been standardized. The ALC voltage requirements may even vary between different models produced by the same manufacturer.

If the ALC response time of the exciter (transceiver) is faster than the rise time of the RF envelope, there will be no voltage compatibility problems. The ALC voltage from this amplifier will automatically adjust to the limit required by the exciter.

If the ALC voltage requirements are low and if the ALC attack time is slow, the ALC may cause the output power to "pump" at a very slow rate. The undesired "pumping" can be corrected by reducing the amplifier's ALC output voltage with the "ALC Limit" control (R1).

A full counter-clockwise "ALC Limit" setting will produce approximately 10 volts of maximum negative ALC voltage. A full clockwise setting (viewed from amplifier rear) will produce no ALC voltage. Always start with this control fully counter-clockwise before slowly advancing this control clockwise. The **ALC Limit Adjustment** section that follows gives adjustment details.

An external 1,000 to 5,000 ohm potentiometer can be added from the ALC output line to ground if the particular amplifier you are using does not have a rear panel "ALC Limit" control. The chassis (shield) of the amplifier's ALC output jack must connect to the clockwise (shaft end view) terminal of the ALC exciter voltage control. The ALC jack center pin on the amplifier must connect to the counter-clockwise terminal (shaft end view) of the external control. The center of the control connects to the ALC input of the exciter.

### ALC Limit Adjustment (rear panel)

This adjustment procedure should be used if "pumping" occurs from excessive transceiver ALC sensitivity and/or slow transceiver ALC response time:

- 1.) Load the amplifier for maximum output on any band (see tuning instructions later in this manual).

- 2.) Adjust the "ALC SET" control on the front panel and the rear panel "ALC Limit" potentiometer to their full counter-clockwise positions.
- 3.) Apply full exciter drive power, and adjust the rear panel "ALC Limit" potentiometer clockwise (rear view) until the amplifier's ALC output voltage meter (multimeter "ALC" position) indicates 6 to 10 volts. As an alternative, the potentiometer can be adjusted clockwise until the RF output power reaches 300-500 watts.

### "ALC SET" Control

Proper adjustment of the front panel "ALC SET" control accomplishes the following:

1. The exciter's power is limited to a value that will produce a fixed amount of grid current in the amplifier. The front panel "ALC SET" control determines the maximum grid current that can be produced.
2. The "LOAD" control setting will determine the maximum plate current and output power for a given grid current. Never exceed .8 A of short duty cycle (or .6 A of long duty cycle) plate current. Never exceed 25 mA of operating grid current.
3. For normal SSB operation, the exciter power should be reduced until the ALC voltage (measured in the ALC multimeter position) flicks upwards on occasional voice peaks. This will produce the best audio quality. The drive can be increased for DX or weak signal SSB operation until the ALC steadily registers voltage.

Also see the ALC section on page 6, and the **Multimeter** section on page 9.

## Tuning

Follow the instructions below in numerical order. Proper tuning will produce excellent output power, a clean signal, and good tube life. If the various meter readings are different than indicated in the text, check the external amplifier connections. Consult the manual for the exciter if necessary.

### **WARNING:**

**The transformer must be wired correctly for your line voltage. This amplifier is normally shipped wired for standard 120 Vac operation. See the Transformer Connections section on page 15 for details.**

### Tuning Procedure

**Important Note:** This amplifier contains an electronic grid protection circuit to prevent control-grid damage. This amplifier will quit operating and the "OL" LED will illuminate if the grid dissipation exceeds a safe pre-set limit. *The overload circuit responds much faster than the grid current meter.* The overload circuit will respond to excessive grid current before the operator can observe the

increase on the grid current meter. The grid overload circuit can be reset by momentarily placing the "**STBY-OPR**" switch in the "**STBY**" position.

Some exciters generate high-level RF pulses when first keyed. These short duration pulses may greatly exceed the exciter's steady-state operating output power. Unexplained activation of the grid overload circuit may indicate the existence of this exciter problem.

Never under-load the amplifier to reduce the output power. The amplifier "**LOAD**" control must be set to a high enough position (clockwise) to prevent excessive voltage and arcing in the tank circuit

or excessive grid current. Repeated tripping of the grid overload circuit probably indicates the "**LOAD**" control is set too low.

1. Set the AL-800 front panel switches as follows:

POWER	to	OFF
OPR-STBY	to	STBY
MULTIMETER	to	HV

2. Plug the ac line cord into the proper voltage outlet.
3. Place the main power switch in the "**ON**" position. The meter lamps should light and the blower should start. Read the 3500 volt scale on the multimeter. It should indicate 2500 volts nominal and no more than 2700 volts.
4. With the amplifier still on "**STBY**", tune the exciter into a normal 50 ohm load according to the manufacturer's instructions. Turn the exciter drive down after tuning.
5. Place the amplifier's "**BAND**" switch on the same band as the exciter. Set the "**PLATE**" control and the "**LOAD**" control as indicated below:

<b>CW</b>		
<b>Frequency</b>	<b>Plate</b>	<b>Load</b>
1.810	3-1/2	6-1/4
3.600	1-3/4	0-1/2
7.050	5	1-3/4
10.125	5-1/2	2-1/2
14.050	8	6
18.125	8	5-1/2
21.050	9	6-1/2
24.900	8-1/2	6-1/2
28.050	9	7-1/2

**PHONE (SSB)**

Frequency	Plate	Load
1.850	3-1/2	7
3.900	3	3-1/2
7.200	5-1/4	4-3/4
14.250	8-1/4	6
21.350	9-1/4	6-1/2
28.500	9	7-1/2

6. With the exciter's drive level still on zero, observe the 1.5 ampere  $I_p$  scale on the left hand meter. It should indicate zero (0) amperes.
7. Place the "**STBY-OPR**" switch in the "**OPR**" position. Place the exciter in the transmit mode with no RF output. The red "**XMT**" LED should light and the plate current ( $I_p$  on the left meter) should be close to zero (0).
8. With the exciter in the transmit mode, apply a very low amount of RF drive power (about 100 mW). The plate current ( $I_p$ ) should suddenly jump from zero to nearly 100 mA.

Note: Currents may vary up to 25% due to component and line voltage tolerances. If the current in this step is higher than expected, the RF level from the exciter may be too high.

If the exciter does not allow adjustment to very low CW power levels, the exciter can be placed in the SSB mode and the audio (microphone) gain control advanced from minimum while speaking until the plate current ( $I_p$ ) just flickers upwards. The plate current ( $I_p$ ) should be around 100 mA on these flickers.

9. Place the "**MULTIMETER**" switch in the "**ALC SET**" position. Adjust the front panel "**ALC SET**" control until the multimeter indicates 5 volts. This adjustment will limit the amplifier's grid current to approximately 25 mA.
  - > Steps 10a and 11a require a connection from the amplifier's ALC output to the exciter's ALC input.
  - > Steps 10b and 11b should be used if the exciter and amplifier ALC lines are not connected.

Note: Step number 10 requires the simultaneous observation of the plate current ( $I_p$ ) and the grid current ( $I_g$ ).

- 10a. If the ALC line is connected, adjust the exciter's drive or power output control to maximum. *NEVER ALLOW THE GRID CURRENT ( $I_g$ ) TO EXCEED 30 mA OR THE PLATE CURRENT ( $I_p$ ) TO EXCEED .6 AMPERES AT THIS STAGE OF TUNING.* If either current exceeds these limits, *reduce* the exciter's power. Adjust the "**PLATE**" control for maximum output power.

The plate current ( $I_p$ ) of the amplifier and the output power of the exciter should dip (decrease) when this adjustment is made.

- 10b. If the ALC is not connected, place the exciter in the transmit mode and gradually increase the drive until a *grid current* of 15 mA *or* a *plate current* of 0.3 ampere (whichever is higher) appears. The "**PLATE**" control should be adjusted until maximum grid current and maximum RF output power appear. The plate current ( $I_p$ ) should now dip slightly. The drive power should be removed.
- 11a. Increase the "**ALC SET**" voltage (if the ALC is connected) until 35 mA (7 volts) is indicated. Apply full drive (not to exceed 100 watts) and adjust the "**LOAD**" and "**PLATE**" controls for maximum RF output power. The grid current should not be allowed to go above 40 mA at this stage. The plate current should not be allowed to exceed 1 ampere during brief periods of tuning (30 seconds).
- 11b. Increase the exciter drive power (if the ALC is not connected) until 35 mA of grid current is indicated. Adjust the "**LOAD**" and "**PLATE**" controls for maximum RF output power. The grid current should not be allowed to go above 40 mA at this stage. The plate current should not be allowed to exceed 1 ampere during brief periods of tuning (30 seconds).
12. For CW operation, the output power should be reduced with the "**ALC SET**" control until the rated power of 850 watts CW is obtained. The "**LOAD**" control should be adjusted until minimum plate current is obtained without dropping below 850 watts. The exciter's power can be reduced until the multimeter shows a slight upward flicker with the "**MULTIMETER**" switch in the ALC position if the ALC is used.
13. For SSB operation, a two-tone generator or sustained "HEL-L-L-L-L-O" can be used. The exciter should be set to produce the maximum output power (not to exceed 100 watts of peak power). The amplifier's "**LOAD**" control is adjusted for maximum power on the internal peak reading RF wattmeter. The "**ALC SET**" control is adjusted until a peak power output of 1200 watts (or less) is obtained. Finally the exciter's audio gain or output power is adjusted until the multimeter "**ALC**" position indicates the desired ALC level.

Note: If the ALC is not connected, the amplifier should be fully loaded with maximum drive (not to exceed 100 watts). The exciter's output should then be reduced until 1200 watts is obtained.

## QSK Operation

The antenna transfer relay in the AL-800 takes approximately 15 milliseconds to change states. This precludes using the standard internal relay for QSK CW operation. Commonly available vacuum relays are specified at 5 to 7 milliseconds of switching time. Even expensive vacuum relays are less than ideal for high speed QSK operation. At 60 WPM, less than 50% of the receive-time is available with vacuum relays.

On PACKET, AMTOR, and other modes, delay can be added to the transmit and receive changeover to use either vacuum or our standard relay effectively. Ameritron offers two high-speed

PIN diode options that permit operation on modes requiring high speed receive-transmit switching. Both systems offer noiseless switching times of under one millisecond. Since these PIN diode systems are several times faster than vacuum relay systems, they will allow over 90% of the available receive time to be used at 60 WPM.

Ameritron highly recommends using the external QSK-5 switch. This stand alone PIN diode switch can be used with almost all types of amplifiers and transmitters. Modifications are not required in amplifiers used with the QSK-5 unit. The QSK-5 operates directly from 120 Vac power lines.

Ameritron also offers an internal QSK board as a space-saver for the AL-800. This internal board is slightly less expensive. However, it provides less flexibility and serviceability than the external QSK-5 unit. Factory installation of the QSK-5PC is highly recommend. Contact Ameritron for details on the QSK-5 and the QSK-5PC.

## Periodic Maintenance

The high voltage present on various parts of the amplifier will attract dust and dirt. The high voltage areas at the bottom of the plate choke and the plates and insulators of the air variable capacitors should be kept dust free. These areas should be inspected periodically, especially if the amplifier is operated in a dusty environment. These areas may be inspected by unplugging the line cord and waiting a few minutes for the power supply capacitors to discharge. The high voltage should then be checked with the internal multimeter by placing the meter switch in the HV position.

### **WARNING:**

**High voltages can kill!!! Accidental contact with the voltages in this amplifier can be lethal!**

*For your personal safety please observe the following precautions:*

- 1.) **NEVER** defeat the interlock.
- 2.) **NEVER** remove the cover with the amplifier connected to the power line.
- 3.) **ALWAYS** allow the capacitors to discharge for several minutes *after* unplugging the amplifier and *before* removing the cover.
- 4.) **ALWAYS** select the high-voltage (HV) function of the Multimeter to check the high voltage potential. Do **not** remove the cover if voltage is indicated.
- 5.) **ALWAYS** ground the tube anodes (outer metal surface) to the chassis before touching anything inside the amplifier.
- 6.) **ALWAYS** be cautious of heat. Many components inside the amplifier operate at high temperatures.

- 7.) **NEVER** make any unauthorized component or circuit modifications to this product. The *only* acceptable source for modifications is Ameritron or a source approved by Ameritron. Unauthorized modifications almost certainly will **increase** the risk of equipment failure or personal injury.

The cover should be removed and a low value (40 to 500 ohm) two-watt or larger resistor should be secured to the chassis. The other end of this resistor should be connected to the tube anode with an insulated clip lead.

**CAUTION: NEVER ground the anode directly to the chassis without a series resistor. Component damage may occur from the current surge.**

Note: This resistor is a safety device that must be installed when beginning service work and removed when the work is finished.

Dust and dirt can be blown out of the amplifier with a shop vacuum or a high-pressure air hose. A soft bristle brush dipped in alcohol can be used to clean particularly dirty areas. If the amplifier is operated in a dusty environment, a non-conductive low- restriction foam air filter can be placed over the ventilation holes on the left side of the cabinet near the filter capacitors. Placing an air filter over these air inlet holes will substantially reduce the amount of dust entering the cabinet. Most hardware stores stock suitable air filter material that are used as replacement filters for window air conditioners.

## Parts List

### Timer / Overload Board (50-0117-2)

Designator	Description	Ameritron P/N
C501-506	.01 uF 50 V disc	200-0416
C507,508	.47 uF tantalum	203-0530
C509	100 uF 25 V	203-0564
D501, 502	1N4001	300-0266
D503	5.6 V zener	301-710
IC501	LM 358 dual op-amp	311-0724
Q501	NPN transistor MJF3055	305-3055
Q502, 504	PNP transistor 2N3906	307-0722
Q503, 505	NPN transistor 2N3904	305-0645
R501-503	10k 1/2 W	101-0643
R504, 505	3.3k 1/4 W	100-0729
R506, 508	680 ohm 1/4 W	100-0532
R507	1.8k 1/4 W	100-0728
R509	1 meg 1/4 W	100-0730
R510	1k 1/4 W	100-0727
R511	180 ohm 1/2 W	101-0384
R512, 513	4.7k 1/4 W	100-3470
R514, 515	470 ohm 1/4 W	100-2470
RLY501	DPDT 12 V dip relay	408-2135

FB
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FB 73-801 Ferrite Bead
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10-15168
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**Power Supply / SWR Board (50-0800-1)**

Designator	Description	Ameritron P/N
D101, 102, 114, 115	1N34A	300-0346
D103	1N752, 5.6V	305-0710
D116 - 120	1N4001	300-0266
D104 - 113	1N5408	300-0145
C101	27 pF 500 V	208-5404
C102	.001 uF 1 kV	200-2120
C103	10 pF 1 kV	200-3531
C104	3-12 pF 500 V Trim	204-0150
C105,125,126,129,135 - 137	.01uF 50 V Disc	200-0416
C139	.47 uF	203-0530
C107 - 116	.01 uF 1 kV	200-2121
C118 - 123	380 uF 450 V Elect.	203-0682
C127	270 pF 500 V	208-5775
C106, 128, 138, 140	.1 uF 50 V	200-0754
C130, 131	.01 uF 250 Vac	200-2122
C133	2200 uF 25 V	203-0207
C134	220 uF 25 V	203-0565
R101	4.7k max 1 W	103-1747
R102	470k 1/4 W	100-0188
R103,104,122	10k 1/4 W	100-4100
R105	10 ohm 1/2 W	100-0727
R106	3 ohm 2 W 1%	103-3400
R107,131	0.6 ohm 3 W 1%	103-3399
R108,109	1M 3 W 1% special high voltage type	103-2223
R110,111	750k 2 W max 2%	103-1743
R113-118	50k 7 W 5%	103-7580
R120	51 ohm 2 W max 5%	103-2151
R121	6.8k 1/4 W	103-1747
R123	1.8k 1/4 W	100-0728
R124,125	50k trim pot	104-0400
R126, 128, 129	47k 1/2 W	101-0402
R127	10 ohm 10 W	103-9702
R130	47 ohm 1/2 W	101-4470
RLY101	3PDT 12 Vdc	408-6140
RLY102	SPST 12 Vdc	408-6148
RFC101	Choke 3 turns FB-73	10-15168
T101	Toroid	10-14134
Q101	2N3904	305-0645
Q102	2N3906	305-0722
Q3 (see main chassis)		
F101	2 A slow blow	755-1102

**Meter Board (50-0800-3)**

Designator	Description	Ameritron P/N
D301	1N34A	300-0346
C301, 302	.47 uF 50 V tantalum	203-0530
C303, 304, 307 - 311, 314, 315	.1 uF 50 V	200-0754
C305, 306	.001 uF 1 kV	200-2120
R301, 302	2.2M 1/4 W	100-6220
R303	390 ohm 1/4 W	100-0390
R304	2.2k 1/4 W	100-1200
R305	470k 1/4 W	100-0188
R306, 310	10k 1/4 W	100-4100
R307	100 ohm 1/4 W	100-2100
R308, 311	33k 1/4 W	100-3330
R309	4.7k 1/4 W	100-1470
R312	330 ohm 1/4 W	100-0330
R313	270 ohm 1/4 W	100-0600
R316	47k 1/4 W	100-4470
IC301	LM324	311-0324
Q301, 302	2N3904	305-0645
Q303	2N3906	305-0722
S301	Rotary 2P6T	500-0563

**Tuned Input Board (50-0800-2)**

Designator	Description	Ameritron P/N
C202 (tube side)	See input chart	
C201 (transmitter side)	See input chart	
L201	See input chart	
S201	Input switch	

**AL-800 Tuned Input Chart**

S201	BAND	Capacitor (pF) Input	Inductor	Capacitor (pF) Output
1	160	1600, (208-5455), C201	21.75, (405-1217), L201	1300, (208-5177), C202
2	80	1300, (208-5177), C203	18.75, (405-1187), L202	1000, (208-5176), C204
3	40	470, (208-5440), C205 220, (208-5175), C215	10.75, (405-1107), L203	500, (208-5691), C206
4	20/30	330, (208-5331), C207	5.75, (405-1057), L204	330, (208-5331), C208
5	15/17*	150, (208-5151), C209	3.75, (405-1037), L205	220, (208-5175), C210
6	10/12	100, (208-5174), C211	4.75, (405-1047), L206	68, (208-5395), C212

* 150pF, (208-5151), C214
220pF, (208-5175)
4T Air Coil, L207

**AL-800 Main Chassis Parts List**

Designator	Description	Ameritron P/N
B1	Blower	410-3590
C1, 6	170 pF Doorknob 7.5 kV	209-0559
C2, 3, 9	.001 uF 7.5 kV	200-7224
C4, 5, 17	470 pF 3 kV chip capacitor	210-0470
C7	Air Variable Load	204-2573-1
C8	Air Variable Plate	204-2112
C16, 21	.01 uF 1 kV disc	200-2121
C11-13, 18-19	.1 uF 50 V disc	200-0754
C 14, 15	.01 uF 250 Vac disc	200-2122
F1,2	See Line Voltage Chart, page 6	-----
50-0080-1	Power Supply / SWR Board Assembly	50-0800-1
50-0080-2	Input Circuit Assembly	50-0800-2
50-0080-3	Metering Board Assembly	50-0800-3
50-0080-4	RF Tank Board Assembly	50-0800-4
50-0117-2	Timer / Overload Board Assembly	50-0117-2
L1	"L " Coil	10-13800-LC
L2	LF Coil	10-13800-LF
L3	HF Coil	10-13108
M1	Meter (current, grid and plate)	400-3580
M2	Meter (multimeter and power output)	400-3581
R1	100 k pot (ALC limit)	105-1341
R2	1 k pot (ALC SET)	105-7301
R3	33 ohm 1/2 W	100-403
R4, 5	.6 ohm 3W	103-3399
R6	100 ohm 50 W	103-9588
PC1	Parasitic Choke	10-15106
RFC2	Plate Choke	10-15139
RFC3	2.5 mH Choke	402-1162
RFC4	Cathode Choke	10-15120
RFC5	Filament Choke	10-15120-1
S1	Band Switch	504-2135
S2	Lighted switch	507-1157
S3	Rocker Switch	507-1147
S4	Interlock Switch	504-3247
Q3	Transistor MJF3055	305-3055
T1	Transformer	406-1248
V1	3CX800A7 Tube	350-0800

## Frequency Coverage

AL-800		AL-800X	
160 meters	1.8-2.0 MHz	160 meters	1.8-2.0 MHz
80 meters	3.3-4.4 MHz	80 meters	3.3-4.4 MHz
40 meters	6.3-8.3 MHz	40 meters	6.3-8.3 MHz
20 meters	10.1-15.5 MHz	20 meters	10.1-15.5 MHz
15 meters	16.5-21.5 MHz*	15 meters	16.5-21.5 MHz*
		10 meters	24-29 MHz*

\* Operation on 11-13 MHz, 15.5-16.5 MHz, and 25-27.9 MHz will damage components.

## Amplifier Tuning Log

Band	"LOAD"	"PLATE"
160 CW		
160 SSB		
80 CW		
75 SSB		
40 CW		
40 SSB		
30 CW		
20 CW		
20 SSB		
17 CW		
17 SSB		
15 CW		
15 SSB		

Fill in this log with the amplifier settings to quickly change bands. Use a pencil as settings may change with different antennas.

### Notes:

## Schematics

### Power Supply / SWR Board

## **Tuned Input Board**

## **Meter Board**

## **Timer / Overload Board**

## **Main Chassis**