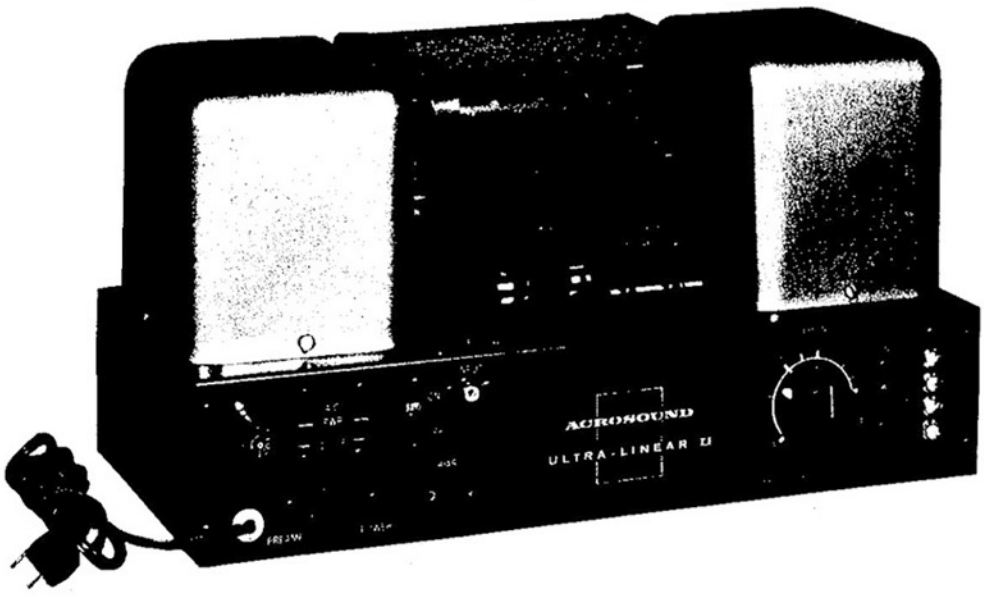
ACROSOUND

ULTRA-LINEAR II



SERIAL NO.

806622

ACRO PRODUCTS COMPANY • 369 SHURS LANE, PHILA. 28, PA.

SPECIFICATIONS

RATED OUTPUT POWER
60 watts continuous, 120 watts peak

IM DISTORTION
Less than 1% at 60 watts, less than .5% at 50 watts. These figures apply for any standard combination of test frequencies.

HARMONIC DISTORTION
Less than 1% at power ratings within 1 DB of 60 watts at any frequency between 20 CPS and 20 KC.

POWER RESPONSE
Undistorted sinusoidal power flat within 0.1 DB at any frequency between 20 CPS and 20 KC, and at any power level up to 60 watts.

Maximum power figures are given for damping control in off position. Max power should be derated 5 watts with damping control on.

FREQUENCY RESPONSE
At 1 watt ± 1 DB from 5 CPS to 85 KC. At 60 watts ± 1 DB from 18 CPS to 30 KC.

There is no peaking at any frequency; the rolloff is gradual and controlled above 85 KC for best transient response.

SQUARE WAVE RESPONSE
Undistorted square wave response from 20 CPS to 20 KC with a maximum overshoot of 5% and no ringing. Capacity loads will not cause ringing or any other type of circuit instability. Rise time of wave 1.5 microseconds.

SENSITIVITY
1.6 volts RMS for 60 watts output.

OUTPUT IMPEDANCES
4, 8 and 16 ohms.

DAMPING FACTOR
Variable from 0.5 to 10. Damping control may be switched out to provide a fixed damping factor of 15.

HUM
90 DB below rated output.

TUBE COMPLEMENT
1 - ECC83/12AX7, 1 - ECC82/12AU7,
2 - EL34/6CA7, 1 - GZ34/5AR4.

Type KT-88 or 6550 output tubes may be used with proper bias setting.

SIZE
7" by 15-1/8" by 8" high.

WEIGHT
30 lbs.

POWER REQUIREMENTS
117 volts, 60 CPS, 250 VA max., 5 amp fuse.

PREAMP PROVISION
Any preamp can be used by making appropriate connections to preamp power socket.

GENERAL DESCRIPTION

Acrosound Ultra-Linear II is a complete 60 watt power amplifier designed to provide the most realistic amplification of sound in a high fidelity system. The circuit is a further development of the famous Ultra-Linear amplifier perfected by Acrosound, and recognized as the finest circuit for high fidelity amplification. The superlative specifications are exceeded only by the superior listening qualities of the amplifier particularly in transient sounds of a highly volatile nature. The quality of an amplifier in reproducing these sounds cannot be judged in terms of the steady state measurements which comprise present day specifications.

The precision with which an amplifier reproduces transient sounds is associated with the stability of the amplifier circuit under conditions of large and suddenly impressed input signals. In an amplifier which uses a large amount of negative feedback the problem is magnified, since negative feedback is prone to become positive feedback at very low and very high frequencies unless certain design techniques are used to prevent this. There is another type of instability which can be present in an amplifier of good feedback stability which will generate large amounts of instantaneous distortion. This is caused by shifts at different rates of supply voltages and biases within individual stages.

Ultra-Linear II overcomes both types of instability by its unique circuit arrangement. The first two stages of the amplifier are each push-pull to minimize distortion, and are directly coupled to eliminate a low frequency time constant in the feedback loop. The first stage is a cathode coupled phase inverter–amplifier, and the second a push-pull driver stage. Operating conditions have been carefully chosen for these two stages to maintain constant low distortion output over large variations of supply voltage and bias.

The output stage employs the Ultra-Linear circuit, well known for its low distortion, high efficiency characteristics. The output transformer, the Acrosound TO-600 is especially designed to complement the circuit, and is built to the high standards of Acrosound quality. The finest and costliest materials are used, and the coils are wound on specially designed winding machinery. The design is unique and protected by patent.

The feedback arrangement of the Ultra-Linear II is new in high fidelity use, and provides important benefits with regard to feedback stability. Feedback voltage is taken from a separate winding on the output transformer termed a Hybrid winding. The complete feedback system is technically known as Hybrid feedback,* and provides the important property of achieving isolation between the load impedance of the amplifier and the feedback circuit. Feedback stability is therefore of a much higher degree than that of the more conventional amplifier in which feedback is taken across the output winding of the output transformer. Hybrid feedback makes it possible for the Ultra-Linear II to maintain complete stability and excellent square wave response on all types of output loads, even on loads which are purely capacitive.

The use of Hybrid feedback makes it possible to include an effective speaker damping control for optimum speaker match. This control has no effect on overall feedback, consequently does not change volume or increase distortion. Furthermoré transient response is excellent at all settings of the control.

The amplifier is available from your jobber either in kit form or supplied wired and assembled. The clean simplicity of design plus the economies of printed circuits makes it possible to own the finest of amplifiers at nominal price. Moreover, the printed circuit assures speed of assembly with exact duplication of performance specifications.

*PAT. PENDING

GENERAL INSTRUCTIONS

Before proceeding with the actual construction of the amplifier we recommend that the constructor read through and understand the following instructions thoroughly.

At the completion of work, we recommend that this manual be retained since it contains essential servicing information which will be needed by any person who undertakes to service the amplifier.

Care taken in the construction of this amplifier will reward the constructor with many years of satisfactory service, and greater confidence in the amplifier. We urge you not to rush the construction, but take all the time necessary for proper assembly and wiring.

We strongly urge you to follow the wire and parts layout shown in the pictorial diagram as closely as possible. Very often wires are placed as shown for a good reason, and certainly the appearance of the completed amplifier will be improved and the difficulty of finding a wiring error will be reduced by following the wiring and parts layout shown.

Even though you may have considerable experience in the construction of electronic equipment, we urge you to take a few minutes and read through the complete manual to familiarize yourself with procedure.

To expedite the work, wiring should be installed as given in the step by step procedure outlined.

UNPACKING

Unpack the kit carefully and check each part against the parts list in the back of this manual. Any shortages should be promptly reported to the dealer from whom the kit was purchased, and he will supply the necessary parts. If you have trouble identifying any of the parts, refer to the pictorial diagrams. In this manual the Greek letter μ equals micro and Ω equals ohms.

TOOLS AND SUPPLIES

Tools required for construction are listed as follows:

Pair of long nose pliers
Pair of diagonal cutters
Pair of gas pliers
Medium screw driver
Set screw driver
Pencil type soldering iron, 35-50 watts
50-50 or 60-40 rosin core solder, radio grade.

CONSTRUCTION HINTS

Use the best grade of rosin core solder, either 50-50 or 60-40 alloy. UNDER NO CIRCUMSTANCES USE ACID CORE SOLDER, SOLDERING PASTE, OR ACID FLUX, since this material can cause failure due to corrosion or low leakage resistances between various sections of the circuit. Use a clean, freshly tinned soldering iron preferably a 35 watt pencil iron. Before soldering make certain that connections are clean and free of grease or dirt.

When soldering, place the soldering iron in contact with the joint to heat it, then melt the solder against the heated joint. Continue to hold the iron against the joint until the solder flows freely and fills in. The joint should be smooth and shiny when the solder has cooled. There are two extremes to be avoided-too much or too little heat. If too little heat is applied, the joint will appear pitted and grey indicating an incomplete or rosin joint. Too much heat will also result in a similar appearance. Avoid the use of too much solder since an excess will run and short to adjacent terminals or wiring.

Crimp wire ends in lugs when making connections. Leads on condensers or resistors are supplied excessively long. These should be shortened to correct length when installed to agree with the general arrangement shown on the pictorial diagrams.

Where it is indicated that a wire is to be stripped, it is rarely necessary to trim more than 1/4 inch of insulation from the wire. Transformer leads are supplied precut to length with wire ends tinned and ready for installation.

When making a connection to the printed circuit board observe that a numbered eyelet is installed on the board to receive the wire. Pre-tin end of lead wire. Heat the eyelet with a light iron (35-50 watts) until the solder filling is melted. With the soldering iron still in contact push the lead wire into the hole, and add a small amount of fresh solder if required. Allow only 1/8 inch or less of excess wire to project above the top surface of the board. Avoid overheating each connection, also avoid dropping molten solder on printed circuit lines.

Parts are identified by code letters and numbers as noted on the pictorial diagrams. Terminals of each part are identified by letters a, b, c, etc.

Where a connection is to be made and soldered it will be noted by (s). Where a connection is noted by (c) the wire shall be crimped in position but not soldered until specified in a subsequent operation.

FRONT PANEL PREASSEMBLY

Refer to Fig. 1

1. ( ) Mount output terminal strip TB1 as shown. Use two 6-32 brown oxidized screws, two #6 lock washers, two #6 hex nuts.

2. ( ) Mount the SPDT slide switch S2. Position as shown. Use two 6-32 brown oxidized screws, two #6 lock washers, two #6 hex nuts.

3. ( ) Mount damping control P1 as shown. Pass a 3/8 lock washer over the bushing, and place the bushing through the panel. Use a 3/8 flat washer, and tighten with 3/8 hex nut.

4. ( ) Mount input jack J1 as shown. Use two 6-32 brown oxidized screws, two #6 lock washers, two #6 hex nuts.

5. ( ) Mount the DPST slide switch S1. Position as shown. Use two 6-32 brown oxidized screws, two #6 lock washers, two #6 hex nuts.

6. ( ) Mount pin jack J2 as shown. Remove hex nut and insulating washer from shank, pass jack through hole, replace washer with shoulder inserted into hole, thread nut and tighten.

7. ( ) Following the above procedure mount pin jack J3 as shown.

8. ( ) Mount power receptacle J4 as shown. Use two 6-32 brown oxidized screws, two #6 lock washers, two #6 hex nuts.

9. ( ) Following the above procedure mount power receptacle J5 as shown.

10. ( ) Mount octal socket J6 as shown. Use two 6-32 brown oxidized screws, two #6 lock washers, two #6 hex nuts.

11. ( ) Mount fuse holder F1 as shown. Place rubber washer over shank, insert through panel, place lock washer on shank, thread on hex nut and tighten.

12. ( ) Insert rubber grommet into hole as shown.

13. ( ) Pass line card through grommet and tie knot 2 1/2" from end.

FRONT PANEL WIRING

Refer to Fig. 2

1. ( ) Connect one lead of line cord to J5-A(C).

2. ( ) Connect other lead of line cord to J5-B(C).

3. ( ) Connect a 1-3/4" lead from J5-A(S) to J4-A(C).

4. ( ) Connect a 3" lead from J5-B(S) to S1-C,D. (S). Pass wire end through S1-C and crimp to S1-D.

5. ( ) Connect a 2" lead from J4-B(S) to S1-A,B. Pass wire end through S1-A(C) and crimp to S1-B(S).

6. ( ) Connect a 4" lead from F1-B(S) to S1-A (S).

7. ( ) Connect a 16-1/4" lead to J2(S), also connect a 13-1/2" lead to J3(S). Twist leads loosely together and leave other ends free.

8. ( ) Connect a 1-1/2" lead to J1(S), leave other end free.

9. ( ) Connect a 2" lead from TB1-A(S) to S2-B(C).

10. ( ) Connect a 3" lead from S2-A(S) to P1-A (C).

11. ( ) Connect a 2-1/2" lead from S2-B(S) to P1-B,C. Strip 7/8" of insulation from end, pass through P1-C(S) crimp to P1-B (C).

12. ( ) Connect an 8" lead to P1-B(S), leave other end free.

AMPLIFIER ASSEMBLY

Refer to Fig. 3 and 4

1. ( ) Mount side panels to front panel as shown. Use a 6-32 brown oxidized screw, #6 lock washer and #6 hex nut at each hole location.
2. ( ) Following the above procedure mount rear panel to side panels.
3. ( ) Mount power transformer T1 as shown with green, yellow and black leads closest to side panel. Use four #10 lock washers and four #10 hex nuts, one cable clamp. Dress transformer leads through cable clamp as shown in Fig. 4.
4. ( ) Following the above procedure mount output transformer T2 with black, brown, orange and yellow leads closest to side panel. Dress transformer leads through cable clamp as shown in Fig. 4.
5. ( ) Mount printed circuit board PC1 as shown. Use six 6-32 cad plated screws, six #6 lock washers, six #6 hex nuts, one soldering lug, one 2 post terminal strip TB2. Note that PC1 is mounted inside the chassis.

FINAL WIRING

Refer to Fig. 4.

1. ( ) Connect blue leads from T1 to PC1-12A(S) and PC1-13(S), one lead to each terminal.

Note:-Where leads of similar color are employed, lead length will determine terminal to which it is connected.

2. ( ) Connect yellow leads from T1 to PC1-5(S), one lead to each terminal.
3. ( ) Connect red leads from T1 to PC1-4(S), one lead to each terminal.
4. ( ) Connect green leads from T1 to PC1-6(S), one lead to each terminal.
5. ( ) Connect orange lead from T1 to PC1-7(S).
6. ( ) Connected red-white and green-black leads to ground lug PC1-2A(S).
7. ( ) Connect one black lead from T1 to F1-A(S) as shown.
8. ( ) Connect other black lead from T1 to J4-A(S) as shown.
9. ( ) Connect green lead from T2 to PC1-11(S) as shown.
10. ( ) Connect blue lead from T2 to PC1-10(S) as shown.
11. ( ) Connect green-white lead from T2 to PC1-9(S) as shown.
12. ( ) Connect blue-white lead from T2 to PC1-8(S) as shown.
13. ( ) Connect red lead from T2 to PC1-12B(S) as shown.
14. ( ) Connect yellow lead from T2 to TB1-D(S) as shown.
15. ( ) Connect orange lead from T2 to TB1-C(S) as shown.
16. ( ) Connect brown lead from T2 to TB1-B(S) as shown.
17. ( ) Connect black lead from T2 to P1-A(S) as shown.
18. ( ) Connect black-white lead from T2 to TB2-B(C) as shown.
19. ( ) Connect 8" lead from TB2-A(C) to PC1-3(S) as shown. Take care that excess solder does not short to adjacent wiring on PC1.
20. ( ) Connect 470 ohm resistor R-24 (yellow, violet, brown) from TB2-A(S) to TB2-B(C) as shown.
21. ( ) Connect .8 ohm 5 watt resistor R-23 from S2-C(S) to TB2-B(S).
22. ( ) Connect leads from J2, J3, to PC1-15(S) PC1-14(S) respectively. Run through cable clamp of T2 as shown.
23. ( ) Connect lead from J1 to PC1-1(S) as shown.
24. ( ) Connect lead from P1-B,C to ground lug PC1-2B(S).

This completes all wiring. Note no leads are connected to preamp power socket. This will depend upon preamp used, and application notes are given in a subsequent section.

INITIAL ADJUSTMENT

After you have completed the wiring inspect to make certain that all connections are properly soldered and that wire ends are trimmed and not shorting to adjacent terminals. If an ohmmeter is handy make a resistance check from PC1-13 to ground. The resistance should measure about 80,000 ohms.

Adjust the Balance control P3 on PC1 to approximately mid-position. Turn Bias control P2 to full left rotation then turn right approximately one quarter of full rotation with this adjustment made from the underside of the printed circuit board. Set control P4 in mid-position.

Plug in all tubes with the exception of the GZ34. Ease tubes into their sockets, do not push in abruptly. Make certain that tubes are in correct location as given by Fig. 5. Place 5 amp fuse in fuseholder. Plug line cord into 117V outlet (60CPS AC only) and turn on switch.

To adjust bias proceed as follows. Connect a vacuum tube voltmeter or a multitester between either point A or B on the printed circuit board and ground. Adjust the Bias control P2 to obtain 36 volts. Plug in the GZ34 rectifier tube, and allow it to warm up.

Balance the output tubes by connecting a voltmeter on its lowest range to pin jacks J2 and J3. If the meter deflects to the left of zero, reverse the leads. Rotate the Balance control P3 until the meter reads zero. Disconnect one meter lead, and connect it to ground. Re-adjust the Bias control P2 to obtain a meter reading of 0.34 volts. If the lead now connected to one pin jack is shifted to the other pin jack, the same voltage reading should be obtained. If this is not the case, change the setting of the Balance control to obtain this. When these adjustments have been made, the plates of the output tubes will normally show a dull red glow.

If it is desired to use KT-88 or 6550 output tubes, proceed as above. Initially set Bias control P2 to full right hand rotation as viewed from the underside of the printed board, and with the GZ34 removed. Plug in line cord, turn on switch, and adjust Bias control P2 to obtain 54 volts at point A or B. Plug in the GZ34, and balance the output tubes as above. Reset the Bias control to obtain 0.4 volts between pin jacks and ground.

It will be noted that there is another control on the printed circuit board, potentiometer P4. This control provides a means of reducing residual traces of distortion to a minimum by dynamically balancing driver and output tubes. If test equipment is not available to make this adjustment, set the control in the mid-position of its rotation. Intermodulation distortion will then be approximately 1% at 60 watts output using an average set of output tubes.

If an intermodulation test set or a harmonic distortion instrument is available, adjust P4 as follows. With the damping control switch in the "off" position, and with a 16 ohm load resistor connected across the 16 ohm output terminals, feed in the input test signal and adjust to obtain output voltage slightly below maximum output power. For a 4:1 intermodulation test signal this will be about 24 volts, for sine wave input, 29 volts. Adjust P4 to obtain minimum distortion. This will result in intermodulation distortion of the order of 0.4% for 60 watts output.

The amplifier is now ready to put into operation. Plug the rubber feet into the bottom cover and attach to the bottom of the amplifier using eight sheet metal screws. Attach the dust cover using four sheet metal screws. Attach knob to damping control P1. Align index with ends of scale.

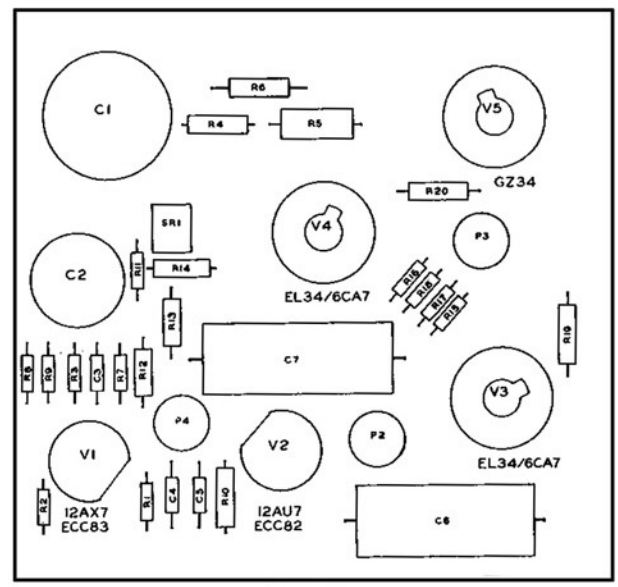


FIG. 5

INSTALLATION AND OPERATION

Since the tubes of the amplifier develop considerable heat, it should be installed in a location that assures adequate ventilation. It may be installed in an open back console provided that the top of the amplifier is at least two inches below any shelf. Do not, under any circumstances, place magazines or other matter on top of the unit.

High voltage points are located on the top surface of the printed circuit board. Therefore, do not put the amplifier into operation without first attaching the dust cover.

INTERCONNECTION PROCEDURE

Most speakers are rated in terms of three standard impedance values 4, 8 or 16 ohms. The speaker leads may be connected between the common connection and the appropriate value marked on the panel. When tightening connector screws make certain wire ends are not shorting to adjacent terminals. Some imported speakers may be rated at odd values such as 12 ohms. These may be connected to either the 8 or 16 ohm tap. In general speaker impedances may be mismatched 50% with little effect on performance. Two or more speakers may be connected to the amplifier with appropriate connections. For example, two 16 ohm speakers may be connected in parallel across the 8 ohm tap. It is preferable to parallel speakers rather than to connect them in series. The wire between the speaker and the amplifier may be lampcord or twin wire antenna lead.

PREAMP CONNECTION

The line from preamplifier output to amplifier input should be low capacity microphone cable. If a self powered preamplifier is used it may be plugged into convenience outlet #1, and switched from the power amplifier. Convenience outlet #2 which is not switched may be used to power the phono turntable or changer.

If the preamplifier is designed to take its power from the main amplifier the octal power socket J6 must be wired to accommodate the preamplifier. These connections depend upon the make of preamplifier used and the following instructions are given for two popular units the Eico HF-61 and the Heathkit WA-P2. The procedure will suggest the means of making connection to other units. The maximum auxiliary power that can be taken from the amplifier is 1-1/2 A, 6.3V AC, and 20MA., 485V DC.

1. Connect two wires each 14" long to eyelets H on the printed circuit board, one wire to each eyelet. Twist these loosely together and run down the inside corner of the front panel to the octal socket. Connect these to pins 1 and 2 respectively of the octal socket. These are the heater leads.

2. Connect a lead 3" long from pin No. 3 of the octal socket to the unused connection on the input jack J1. This is the ground connection.

3. Connect two wires 3-1/2" long to pins 6-7 of the octal socket, one wire to each pin. Twist loosely and connect to S1-B and D respectively. This connection will permit the amplifier to be turned on and off from the preamp with the switch on the amplifier in the "off" position.

4. Connect a lead 12" long from pin 8 on the octal socket to eyelet PC1-12 on the printed circuit. For the Eico preamp connect a 10K, 2 watt resistor (brown-black-orange) from pin 8 to pin 4. For the Heathkit unit connect a 15K 2 watt resistor (brown-green-orange) from pin 8 to pin 5. This is the B plus lead.

5. Cut the green black lead from T1 where it connects to the soldering lug at PC1-2 on the printed circuit board, fold the end back about 1" and insulate with tape.

TROUBLE SHOOTING AND OPERATING NOTES

Since all interstage wiring is supplied on the printed circuit board there should be a minimum amount of difficulty in getting the amplifier to operate properly. Faulty operation may be most directly tracked down by going through the step by step procedure to ascertain the correctness or possible omission of a connection. It is advisable to examine each connection to correct a possible cold soldered joint or to detect untrimmed wire ends that may be shorting to adjacent terminals. Also, examine the printed circuit board for particals of solder or for trimmings of wire that may be shorting.

If the trouble is excessively distorted output, try tube replacement. (Other than the option of using 6550 or KT-88 output tubes in place of the 6CA7/EL34, we recommend no substitutions in tube types.) The 12AX7 and 12AU7 tubes are standard everywhere, and most jobbers stock the 6CA7/EL34 and GZ34. These latter types are distributed nationally by the Amperex Electronic Corp. (230 Duffy Ave., Hicksville, L.I., N.Y.); Mullard Ltd. (International Electronics Corp., 81 Spring Street, New York 12, N.Y.); and Telefunken (M.V.M. Inc.-American Elite Inc., 7 Park Ave., New York 16, N.Y.). If necessary, replacements can be obtained directly from Acro.

The Ultra-Linear II is intended for operation on a line voltage of 117 volts, 60 CPS AC only. Line voltage may fluctuate between 110 and 125 volts, but if it exceeds these limits a voltage adjusting transformer or voltage regulator should be used of 250 VA capacity.

If there is excessive hum or noise, first ascertain whether it is in the amplifier or in associated equipment. If when the input plug is removed, the noise diminishes, the fault will be in the preamplifier or in equipment which connects to it. If the noise persists the amplifier is at fault. Examine, the connection of green-black lead to PC1-2. If this is not at fault substitute a new set of output tubes.

If these measures fail to correct hum, remove the 6-32 screw which holds down the ground lug at point PC1-2. Remove paint or surface dirt from the chassis under the head of the screw, and replace.

Hum and noise may be caused by a faulty blocking condenser. To check this, gap a new .15 mfd, 600 WV condenser across first one, and then the other blocking condenser, C6 and C7. If the hum or noise diminishes, the blocking condenser is at fault.

Hum and low output may be caused by a defective GZ34 rectifier tube. Noise may be caused by intermittent or poor contact between miniature tubes and sockets. To correct this, clean the tube pins with fine sandpaper.

DO NOT turn the amplifier on with either of the output tubes removed or with the bias disabled.

Component failure may be localized by checking voltages with a vacuum tube voltmeter on the electrodes of each tube and comparing these with values listed on the voltage chart. Resistance values should also be checked by referring to resistor chart. Note, all voltages and resistances may vary normally by plus or minus 15%.

Replacement of components on the printed circuit board may be carried out using a little care. To remove and replace a resistor, heat the soldered connection, and pry out, one end at a time. To replace, form the ends of the new resistor, again heat the solder, and push leads through the board. Solder the leads in place with fresh solder, and clip the ends.

Replacement of an electrolytic condenser is more complicated, and we recommend that the printed board be removed from the amplifier and returned to the factory for servicing.

ADJUSTMENT OF DAMPING CONTROL

The function of the Damping Control is to assure a smooth flow of power from the amplifier to the speaker without internal reflection. This phenomena is analogous to transmission line reflections that occur on misterminated lines. Speaker impedance is not constant over the entire audio range and may increase to many times nominal value at very low or very high frequencies. Connection to an amplifier of high damping factor does not absorb a reflected wave from the speaker consequently lows are apt to be unnatural and boomy. Bumpy lows also affect the quality of highs, and since all music is transient in nature, even a high frequency sound that might be generated by the shaking of maracas has a certain amount of low frequency content. The result is intermodulation in the speaker and the highs loose their character.

The Damping Control is calibrated in terms of damping factor for a speaker impedance of 16 ohms. For speakers of 4 or 8 ohms the damping factor can be found from the table below.

Control Setting	DF 4 ohms	DF 8 ohms
.5	.30	.41
.7	.43	.56
1	.54	.725
2	1.12	1.50
4	1.96	2.85
10	10	10

Adjustment of the damping control can best be effected by listening to a wide variety of program material containing both high and low frequency percussion, and setting the control for most natural reproduction.

Optimum setting can be rapidly made by listening to "white noise" which can conveniently be obtained as inter-channel noise on an FM tuner of the type which does not use a ratio detector. With the Damping Control set on 10 the noise will sound like a stream of compressed air projected into a barrel. Rotation of the control will eliminate the barrel like sound. When that point is reached, damping is optimum.

SERVICE

If trouble develops in your amplifier which you cannot remedy yourself write to our service department giving a full description of the fault. If desired, you may return the amplifier to the factory where it will be placed in operating condition for $6.00 plus the cost of parts replaced. Minor difficulties can often be diagnosed and corrected by correspondence, and we suggest that you write first to save the time and expense of returning the amplifier.

Components supplied with the Ultra–Linear II are guaranteed to be free of defects, and will be replaced without charge if failure occurs within a 90 day period from date of purchase. The power transformer and choke assembly TP-590, and the output transformer TO-600 carry a one year warranty except for failure caused by excessive line voltage or incorrect line frequency.

If the amplifier is returned to the factory make certain that it is packed securely using a large amount of padding. It is advisable to use an inner and an outer carton with a large amount of padding between each. Mark carton "Fragile". Return preferably via Railway Express prepaid to Acro Products Company, 369 Shurs Lane, Phila. 28, Pa. We assume no liability for loss or damage in transit.

Note:-Kits showing evidence of acid core solder, acid flux or soldering paste used in construction will be returned unrepaired.

Acro Products Company assumes no responsibility or liability for damages or injuries sustained in the assembly or operation of the Ultra–Linear II Amplifier. Acro Products Company reserves the right to make engineering modifications without notice.

PARTS LIST

1 ACROSOUND TO-600 Output Transformer
1 ACROSOUND TP-590 Power Transformer
1 Chassis front panel
2 Chassis side panels
1 Chassis back panel
1 Dust cover
1 Bottom plate
1 ECC82/12AU7 tube
1 ECC83/12AX7
2 EL34/6CA7 tube
1 GZ34/5AR4 tube
1 Printed circuit assembly
1 Fuseholder
1 Octal socket
2 AC Outlets
2 Pin jacks
1 Input jack
1 DPST Slide switch
1 SPDT Slide switch
1 2 ohm potentiometer
1 470 ohm, 1/2 w resistor
1 0.8 ohm, 5 watt resistor
1 Fuse, 5 amp.

1 Output terminal board
1 Terminal Strip
1 Knob
1 AC Line cord
1 Hank hookup wire
1 Rubber grommet
4 Rubber feet
2 Cable clamps
1 Solder lug
1 Instruction manual
1 1/2" rubber washer
1 1/2" lock washer
1 1/2" hex nut
1 3/8" flat washer
1 3/8" lock washer
1 3/8" hex nut
22 6-32 screws, bronze fin.
6 6-32 screws, cad plated
28 6-32 hex nuts
28 #6 lock washers
8 10-32 hex nuts
8 #10 lock washers
12 #6 sheet metal screws

VOLTAGE CHART

Tube	V-1 A,B 12AX7/ECC83	V-2 A,B 12AU7/ECC82	V-3, V-4 EL34/6CA7	V-5 GZ34/5AR4
Pin No.				
1	101	280	0	-
2	0	101	3.15 AC	485
3	.9	110	470	-
4	3.15 AC	3.15 AC	472	400 AC
5	3.15 AC	3.15 AC	-36	-
6	101	280	-	400 AC
7	0	101	3.15 AC	-
8	.9	110	.34	485
9	3.15 AC	3.15 AC	-	-

All measurements made with a VTVM. Unless otherwise indicated all voltages are DC, positive, and measured to chassis. Voltages on electrodes of V-1 and V-2 may vary normally by 15%.

RESISTANCE CHART (Unit Off)

Tube	V-1 A,B 12AX7/ECC83	V-2 A,B 12AU7/ECC82	V-3, V-4 EL34/6CA7	V-5 GZ34/5AR4
Pin No.				
1	210 K	125 K	0	NC
2	1 Meg	210 K	0	80 K
3	200 K	22 K	80 K	NC
4	0	0	80 K	40
5	0	0	120 K	NC
6	210 K	125 K	NC	40
7	235	210 K	0	NC
8	200 K	22 K	4.7	80 K
9	0	0	-	-

Resistance values may vary normally by 15%.

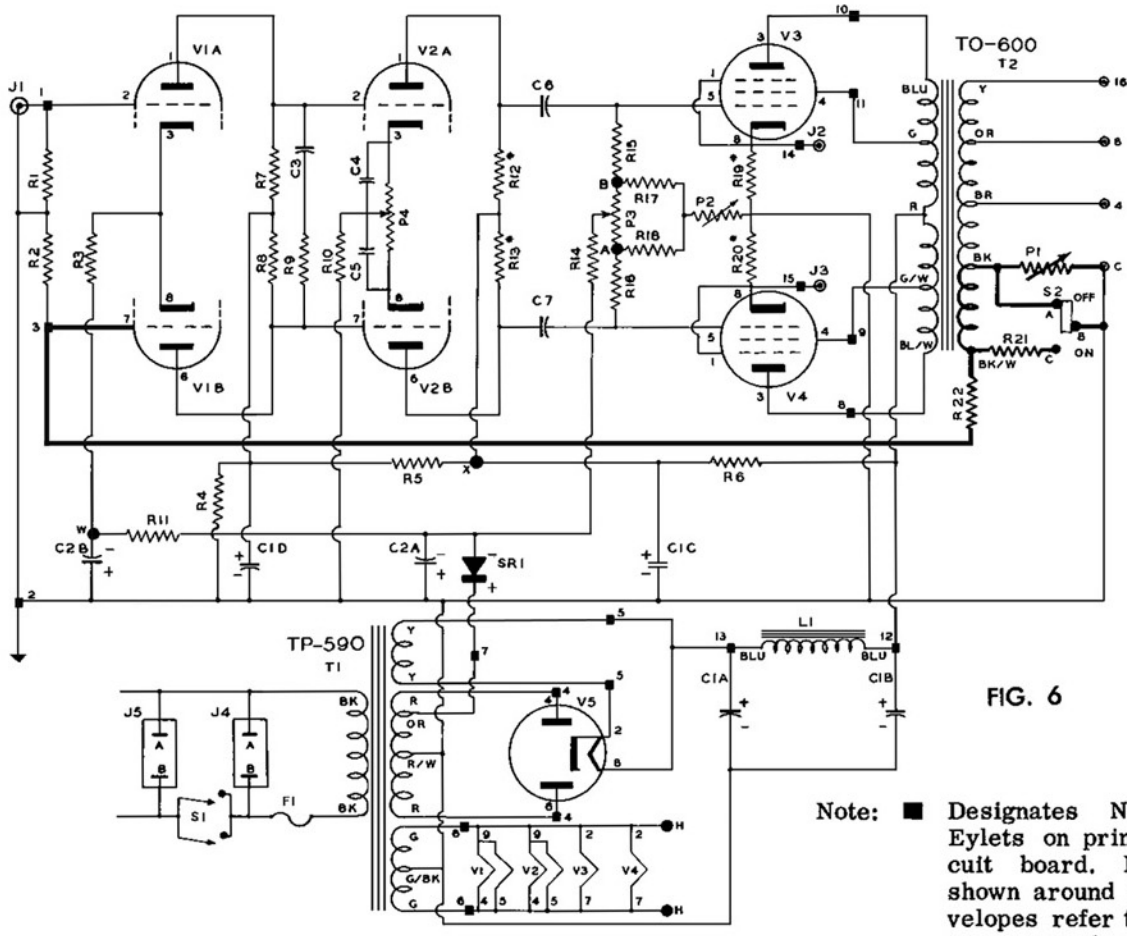


FIG. 6

Note: ■ Designates Numbered Eylets on printed circuit board. Numbers shown around tube envelopes refer to socket contact numbers.

SYM.	DESCRIPTION
R-1 Res.	1 MΩ 1/2 watt
R-2 Res.	470 Ω 1/2 watt
R-3 Res.	180 KΩ 1/2 watt
R-4 Res.	33 KΩ 1/2 watt
R-5 Res.	47 KΩ 1/2 watt
R-6 Res.	4.7 KΩ 2 watt
R-7 Res.	150 KΩ 1/2 watt
R-8 Res.	180 KΩ 1/2 watt
R-9 Res.	47 KΩ 1/2 watt
R-10 Res.	18 KΩ 1 watt
R-11 Res.	10 KΩ 1/2 watt
R-12 Res.	47 KΩ 1 watt
R-13 Res.	47 KΩ 1 watt
R-14 Res.	5.6 KΩ 1 watt
R-15 Res.	100 KΩ 1/2 watt
R-16 Res.	100 KΩ 1/2 watt
R-17 Res.	4.7 KΩ 1/2 watt
R-18 Res.	4.7 KΩ 1/2 watt
R-19 Res.	4.7 Ω 1/2 watt W.W.
R-20 Res.	4.7 Ω 1/2 watt W.W.
R-21 Res.	0.8 Ω 5 watt W.W.
R-22 Res.	470 Ω 1/2 watt
P-1 Pot.	2 Ω 2 watt W.W.

SYM.	DESCRIPTION
P-2 Pot.	5000 Ω 1 watt W.W.
P-3 Pot.	5000 Ω 1 watt W.W.
P-4 Pot.	5000 Ω 1 watt W.W.
C-1 A	Cap. 30 μf 500 WV electrolytic
C-1 B	Cap. 20 μf 500 WV electrolytic
C-1 C	Cap. 20 μf 500 WV electrolytic
C-1 D	Cap. 10 μf 350 WV electrolytic
C-2 A	Cap. 20 μf 150 WV electrolytic
C-2 B	Cap. 20 μf 150 WV electrolytic
C-3	Cap. 100 μμf 500 WV ceramic
C-4	Cap. 300 μμf 500 WV ceramic
C-5	Cap. 300 μμf 500 WV ceramic
C-6	Cap. .15 μf 600 WV paper
C-7	Cap. .15 μf 600 WV paper
SR-1	Selenium rectifier, 130 V, 30 ma.
T-1	TP-590 power transformer
T-2	TO-600 output transformer
L-1	Filter choke, part of TP-590
V-1	ECC83/12AX7 tube
V-2	ECC82/12AU7 tube
V-3	EL34/6CA7 tube
V-4	EL34/6CA7 tube
V-5	GZ34/5AR4 tube