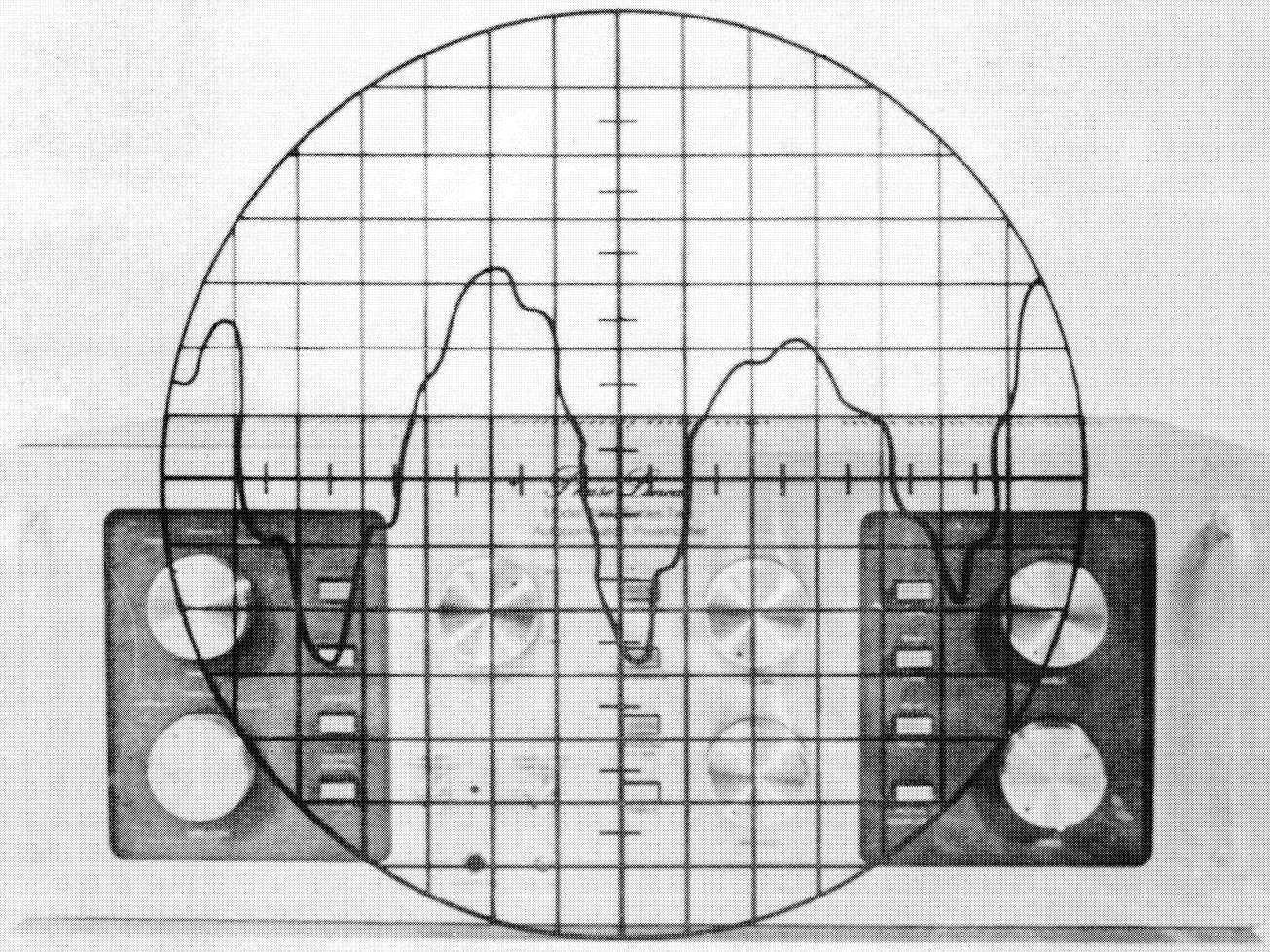
4000 SERIES TWO PREAMPLIFIER

Service Manual



Phase Linear

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FOR PARTS AND SERVICE

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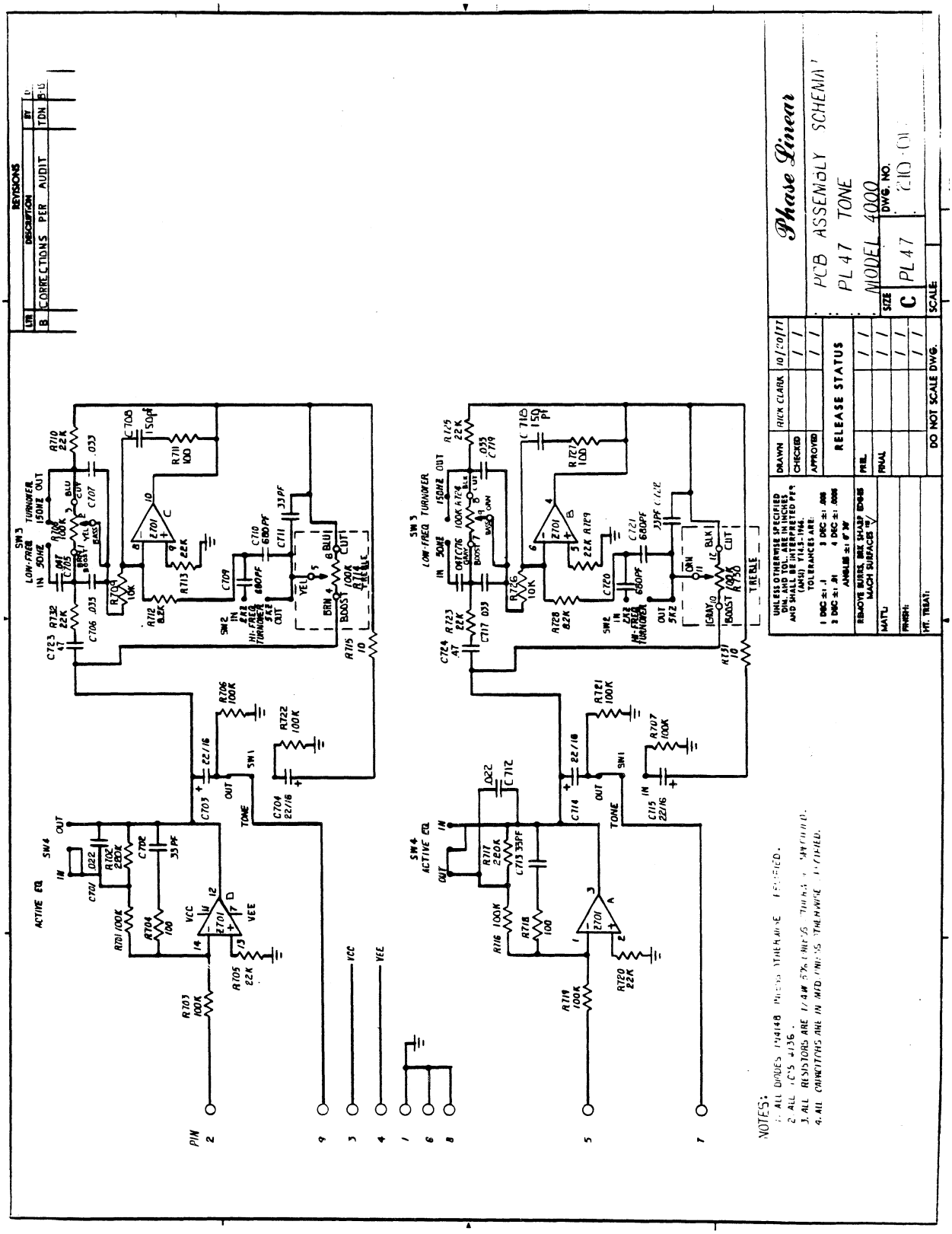


Diagram 2-20. Schematic, PL47 Tone PCB.

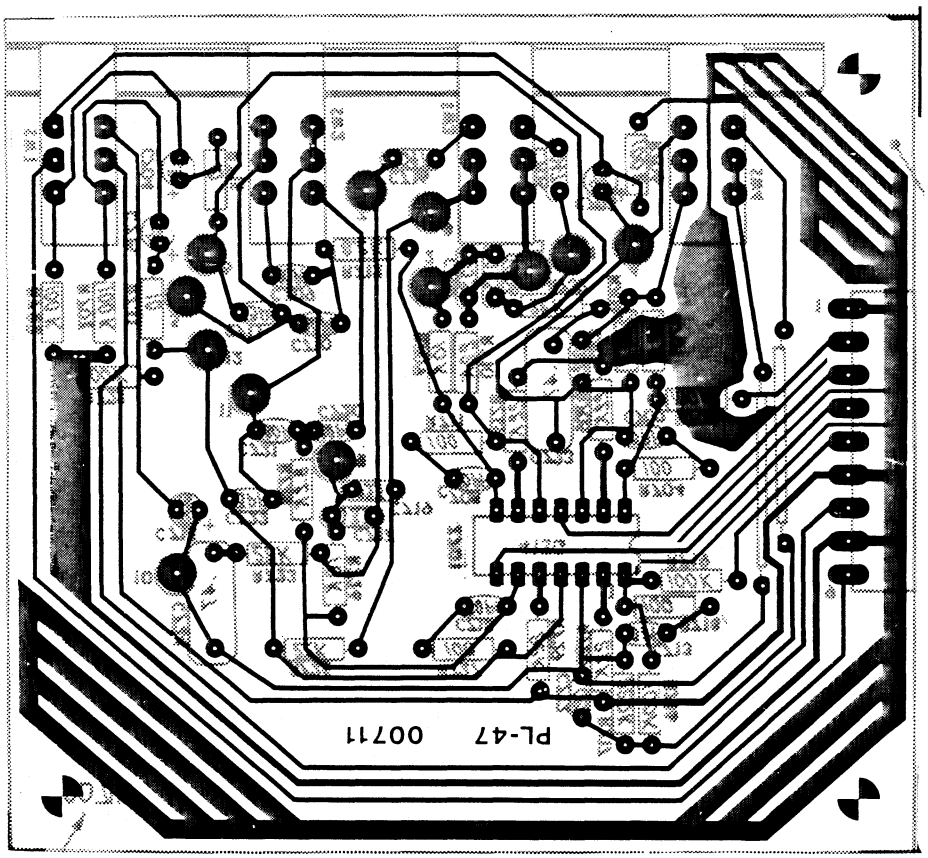


Diagram 2-22. X-ray view of PL47.

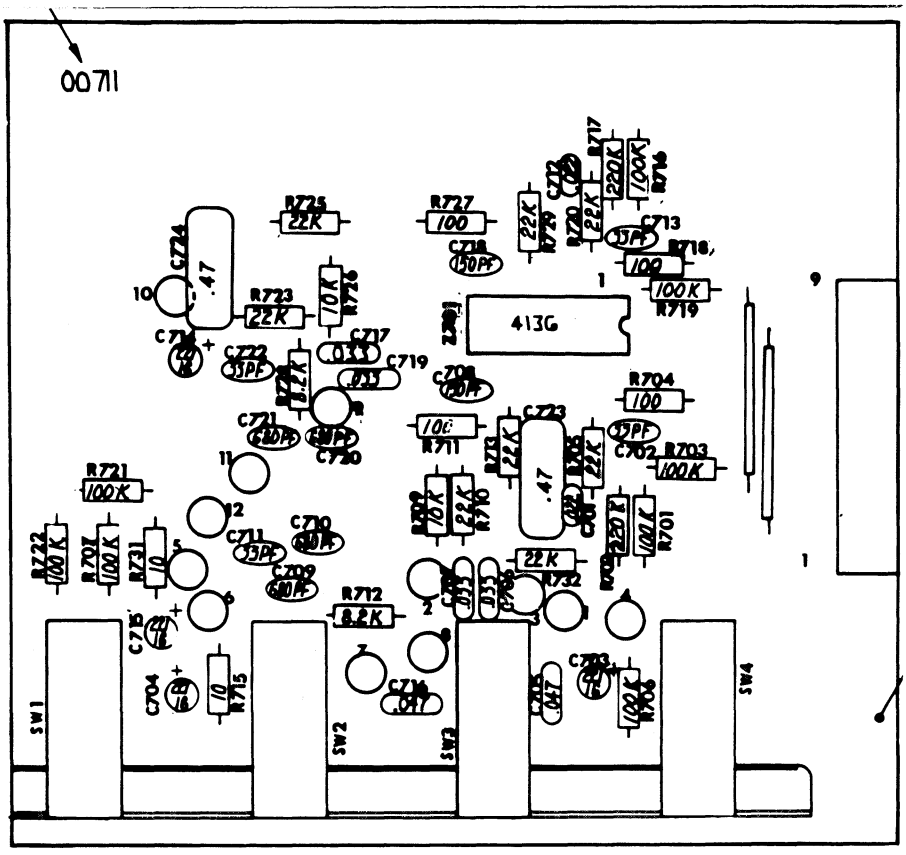


Diagram 2-21. Layout, PL47.

4000 SERIES TWO PREAMPLIFIER

SERVICE MANUAL

CONTENTS

********** CAUTION **********

THIS MANUAL IS INTENDED FOR USE ONLY BY QUALIFIED SERVICE PERSONNEL. HAZARDOUS VOLTAGES MAY BE ENCOUNTERED IN THE SERVICING OF THE 4000 SERIES TWO PREAMPLIFIER. USE EXTREME CAUTION: READ ALL INSTRUCTIONS CAREFULLY.

1-0. Technical Specifications

1-1.1. Performance Specifications

RATED OUTPUT VOLTAGE: 2.0 volts RMS

DISTORTION @ RATED OUTPUT: less than 0.04% (20 Hz-20K Hz)

TYPICAL THD @ 1K Hz @ RATED OUTPUT: less than 0.005%

S/N (IHF A-CURVE): Phono; greater than 80dB w/10mV input. High level; greater than 85db below 2 volt output.

SENSITIVITY FOR RATED OUTPUT: Phono; 2.0 mV High level; 200 mV.

FREQUENCY RESPONSE: Phono RIAA Deviation; ±0.4dB High level; 20Hz-20K Hz ±0.4dB.

INPUT IMPEDANCE: Phono; 47K ohms in parallel with 100pF High level; greater than 50K ohms.

MAXIMUM OUTPUT: Preamplifier; 10V into 600 ohms @ 1K Hz. Headphone; 100mV into 8-600 ohms.

PHONO OVERLOAD: (1K Hz, THD 0.1%) 100mV

VOLUME CONTROL TRACKING: ±0.5dB.

TONE CONTROLS: Bass, turnover freq. 50Hz, ±10dB @ 20Hz.
turnover freq. 150Hz, ±13dB @ 20Hz.
Treble, turnover freq. 2K Hz, +14dB @ 20K Hz.
turnover freq. 5K Hz, ∓10dB @ 20K Hz.

PEAK UNLIMITER: (Nominal peak unlimit rate attack threshold front panel variable) 0.5dB/microsecond for +1.5dB peak unlimit operation.

NOMINAL AMPLITUDE ATTACK THRESHOLD: 0.2 volts peak at input to peak unlimiter.

DOWNWARD EXPANDER: Downward expansion commences at -35dB. Ultimate limit is -41dB. Unlimiter window is 35dB wide, upper and lower thresholds are simultaneously variable by front panel unlimit threshold control.

AUTOCORRELATOR (NOISE REDUCTION SYSTEMS): High frequency noise reduction commences at 2K Hz and is 3dB, reaching 10dB from 4K Hz to 20K Hz. Low frequency noise reduction begins at 200 Hz, ultimately reaching 20dB @ 20Hz. Passive subsonic filter rejection of -35dB @ 5Hz. Weighted overall noise reduction is -10dB from 20Hz to 20K Hz.

1.1.2. General Specifications

SEMICONDUCTOR COMPLIMENT: 23 integrated circuits, 12 transistors, 92 diodes and 2 LEDs.

POWER CONSUMPTION: 15 watts.

POWER REQUIREMENTS: 60 Hz, 120v (domestic models) or 100-120/ 220-240v AC, 50/60Hz.

AC OUTLETS: 3 switched, 3 unswitched; 1100 watts total.

DIMENSIONS: 19W x 7H x 10D (48.3cm x 17.8cm x 25.4cm)

WEIGHT: 18 lb. (8.2 kg).

2-0. Schematics and Diagrams

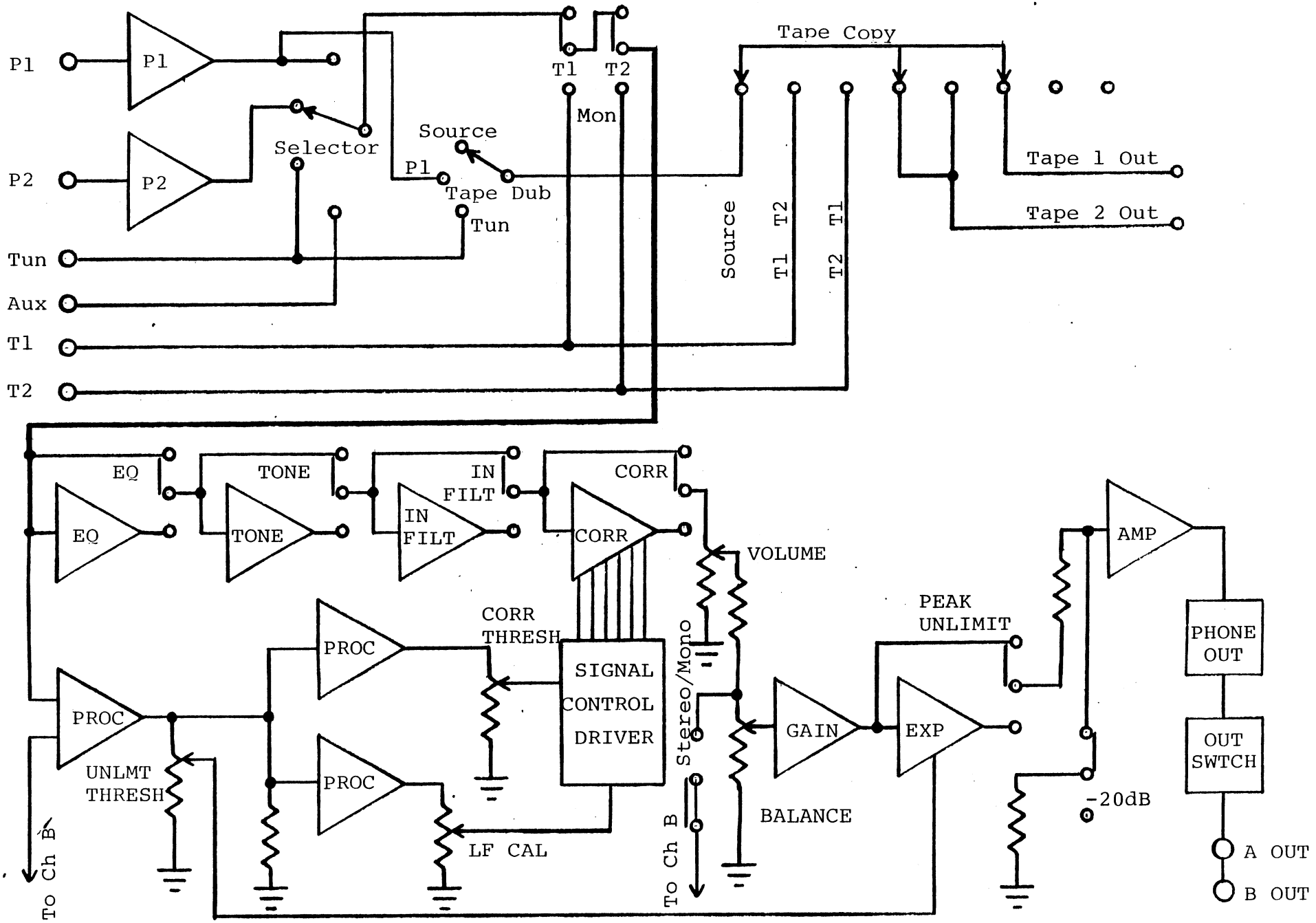


Diagram 2-1. Block Diagram

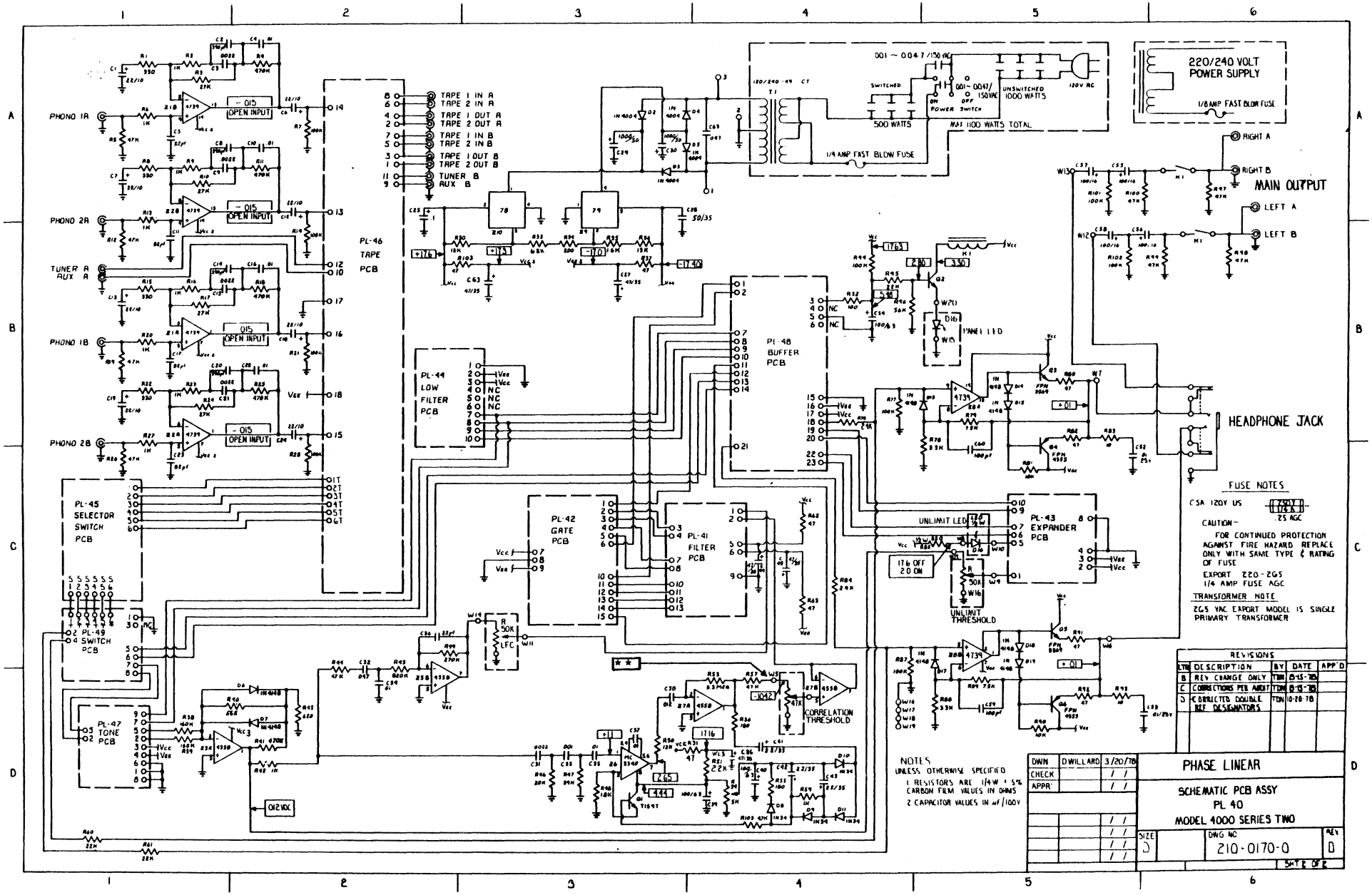


Diagram 2-2. Interconnect Schematic: Mother Board PL40. **Set trim pot R54 for 95 mV at point W5 shown above, with 200 mV input at 1K Hz, one channel driven.

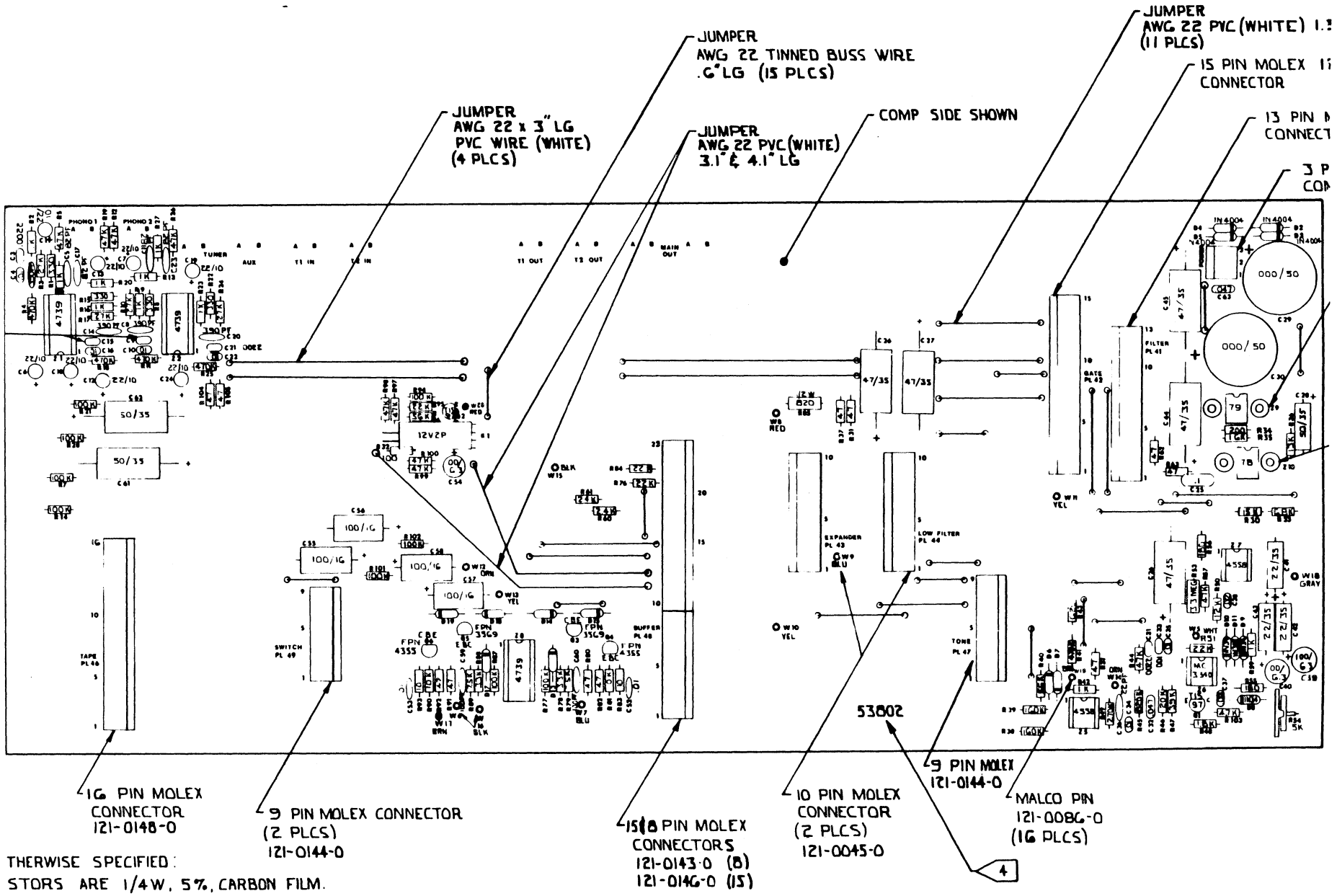


Diagram 2-3. Layout, PL40 Mother Board.

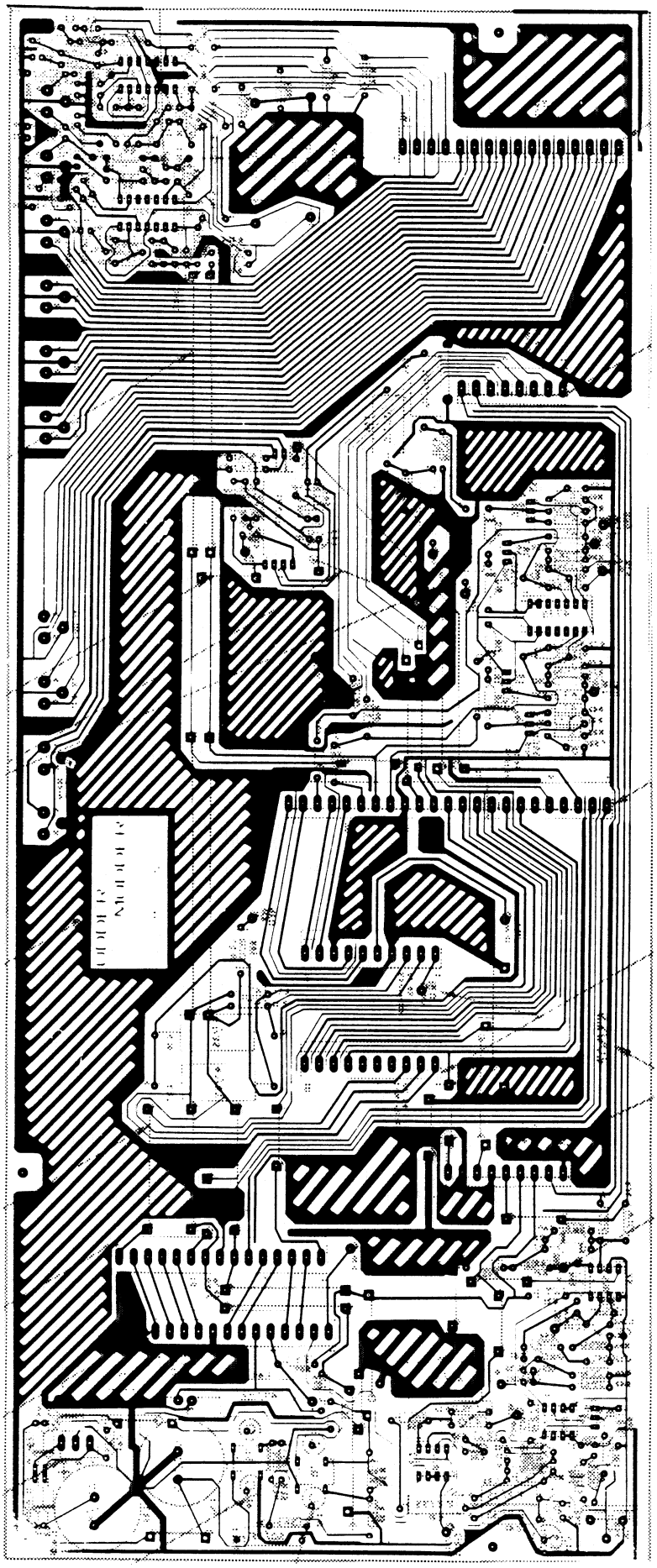


Diagram 2-4. X-ray view of PL40, from foil side.

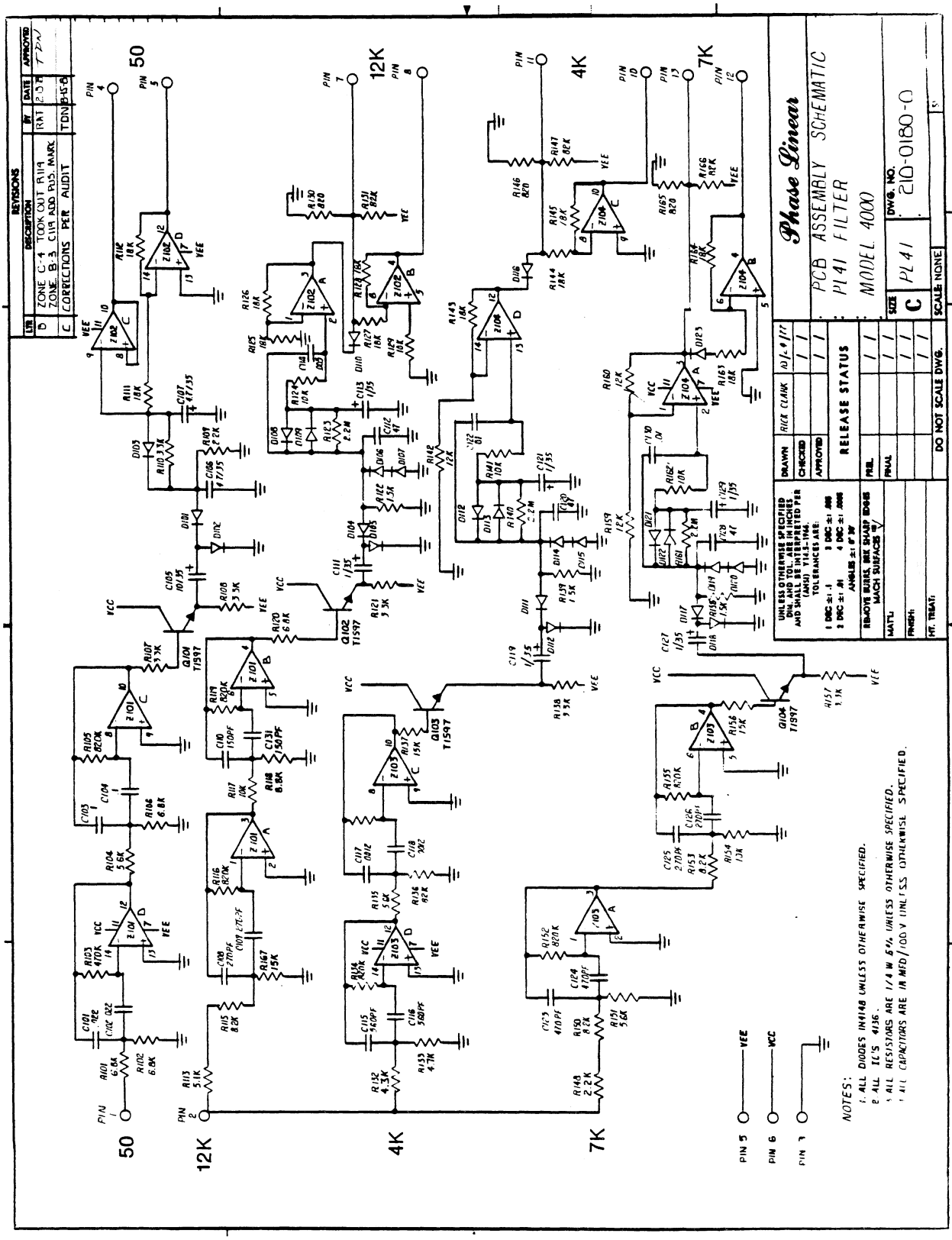


Diagram 2-5. Schematic: PL41 Filter Board.

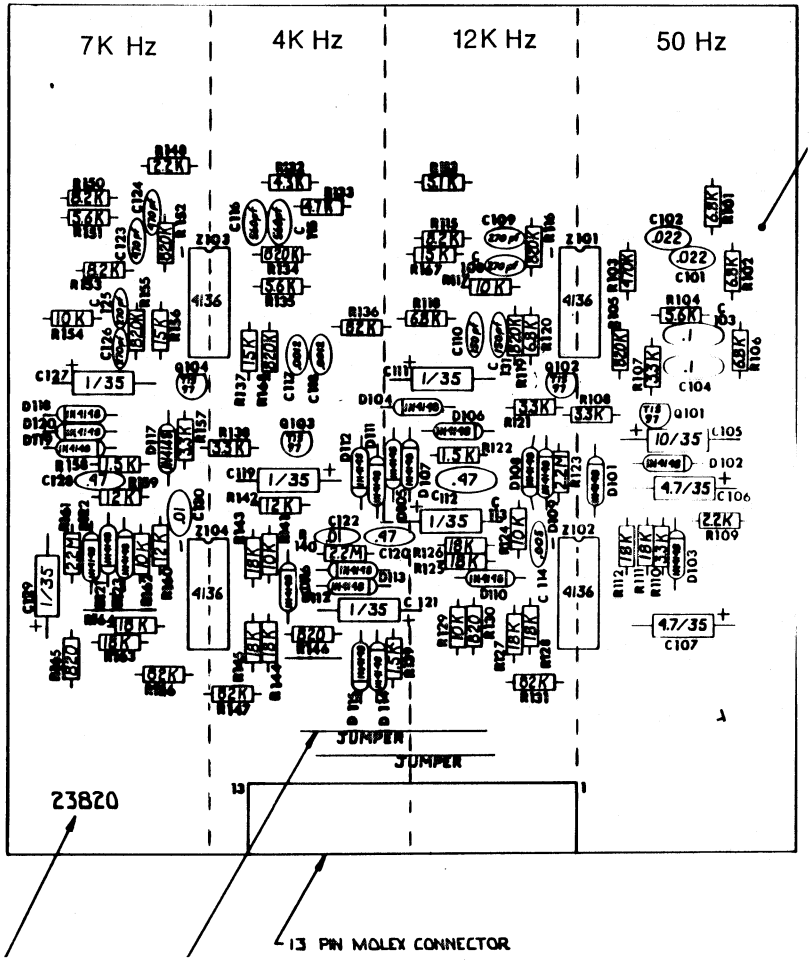


Diagram 2-6. Layout: PL41.

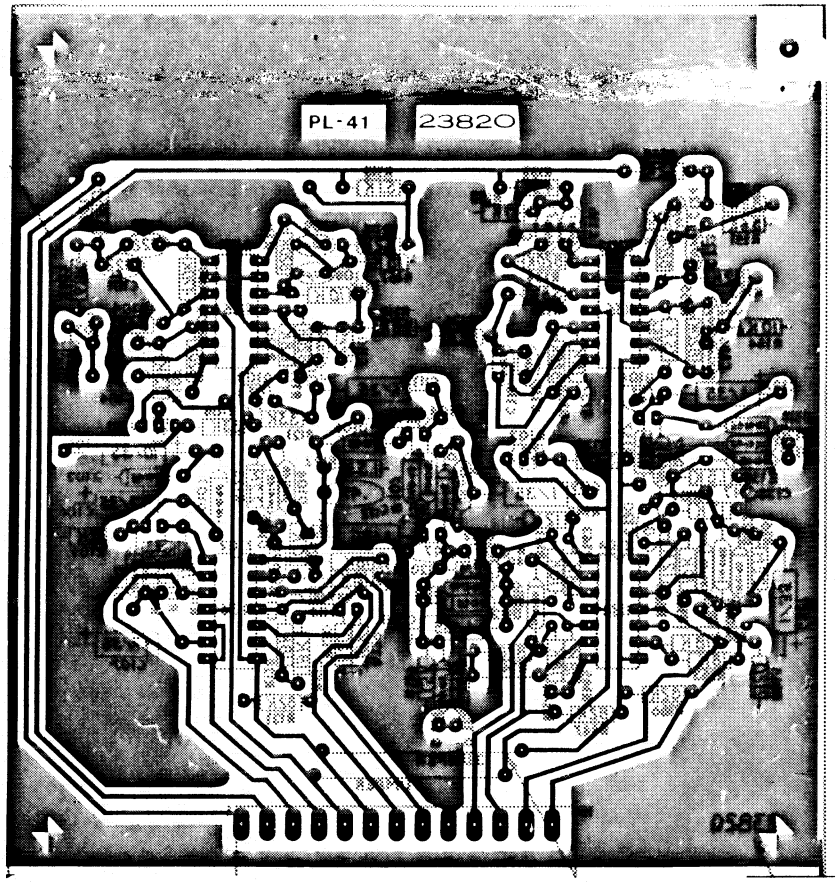


Diagram 2-7. X-ray view, PL41.

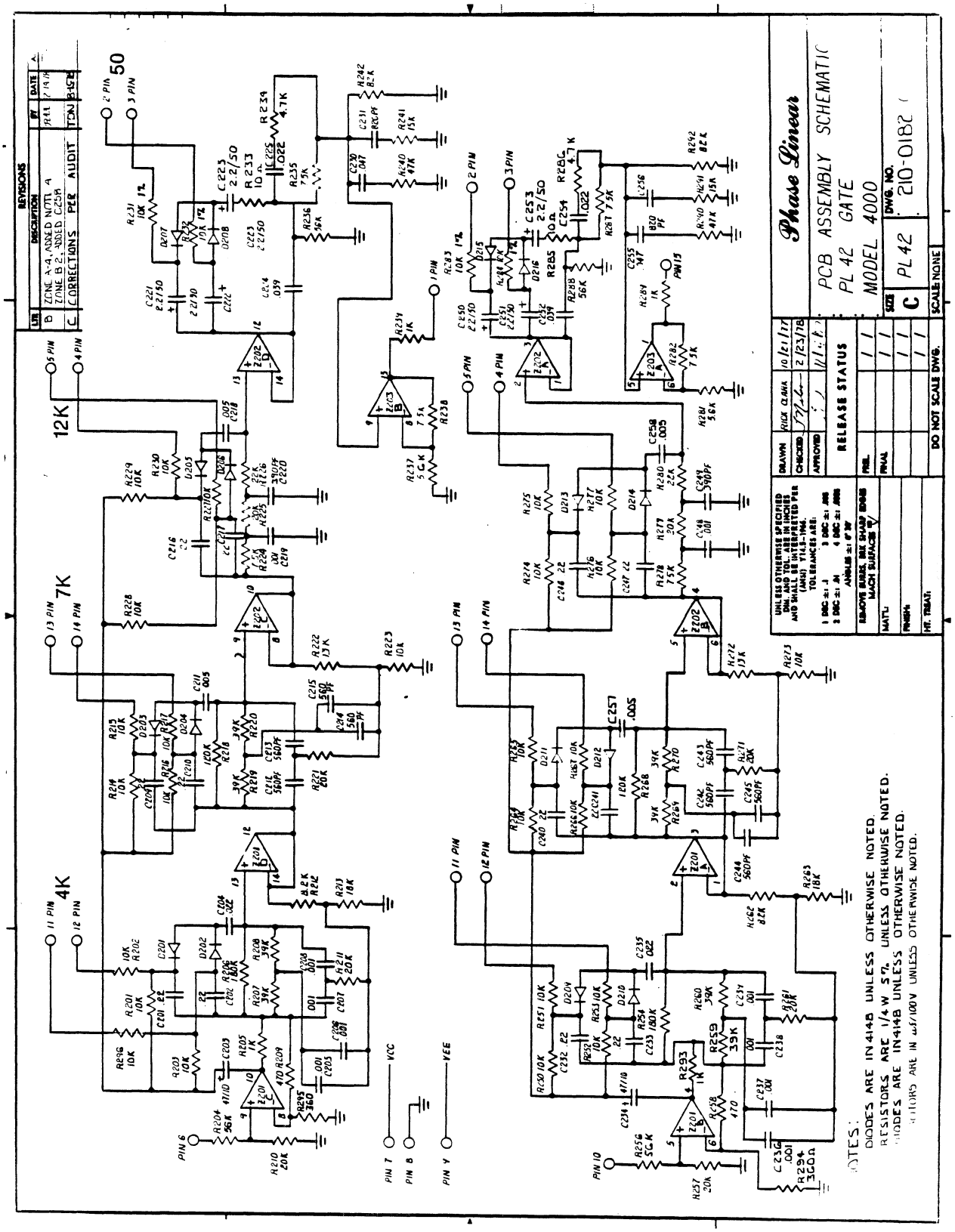


Diagram 2-8. Schematic, PL42 Gate Board (Correlator).

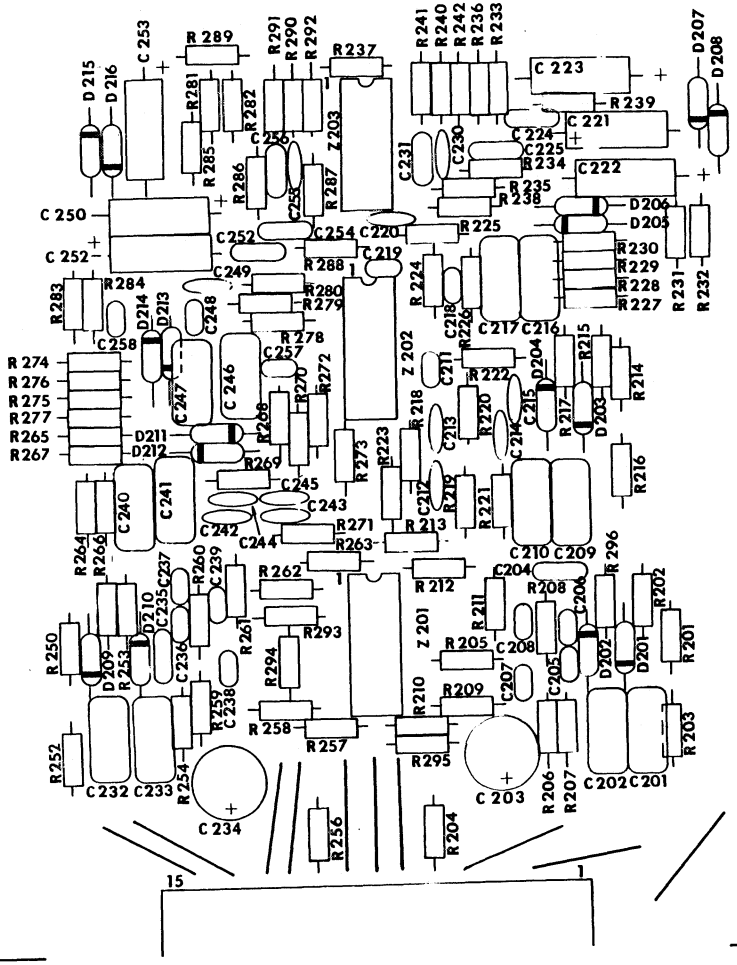


Diagram 2-9. Layout, PL42.

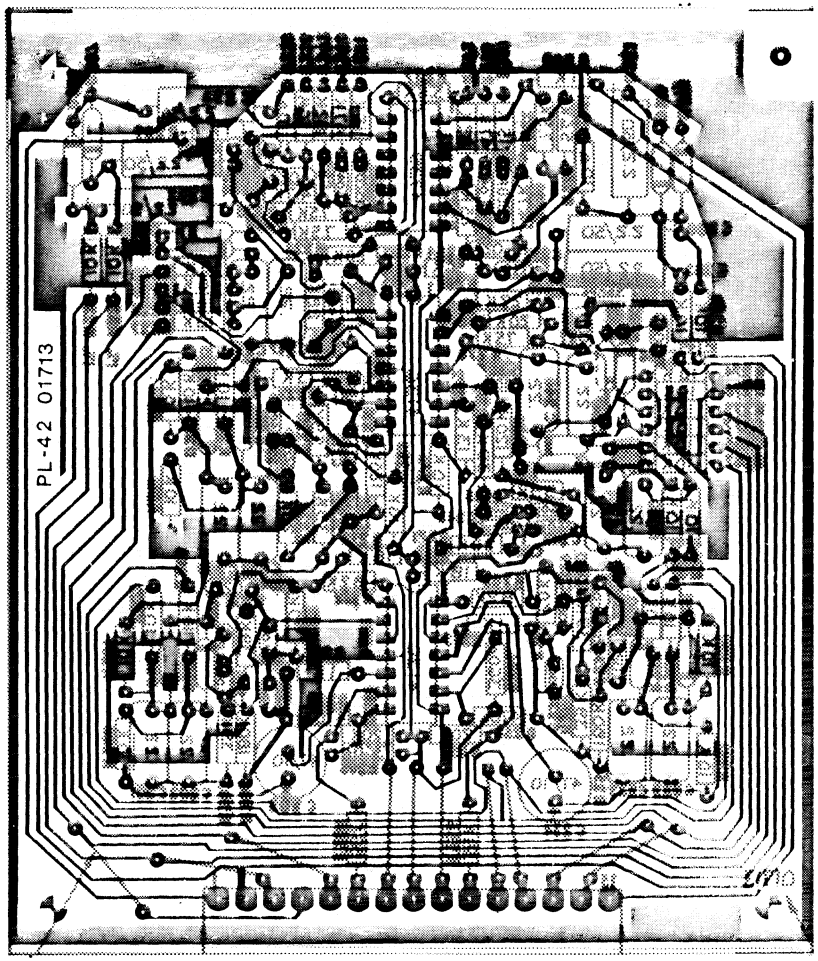


Diagram 2-10. X-ray view of PL42.

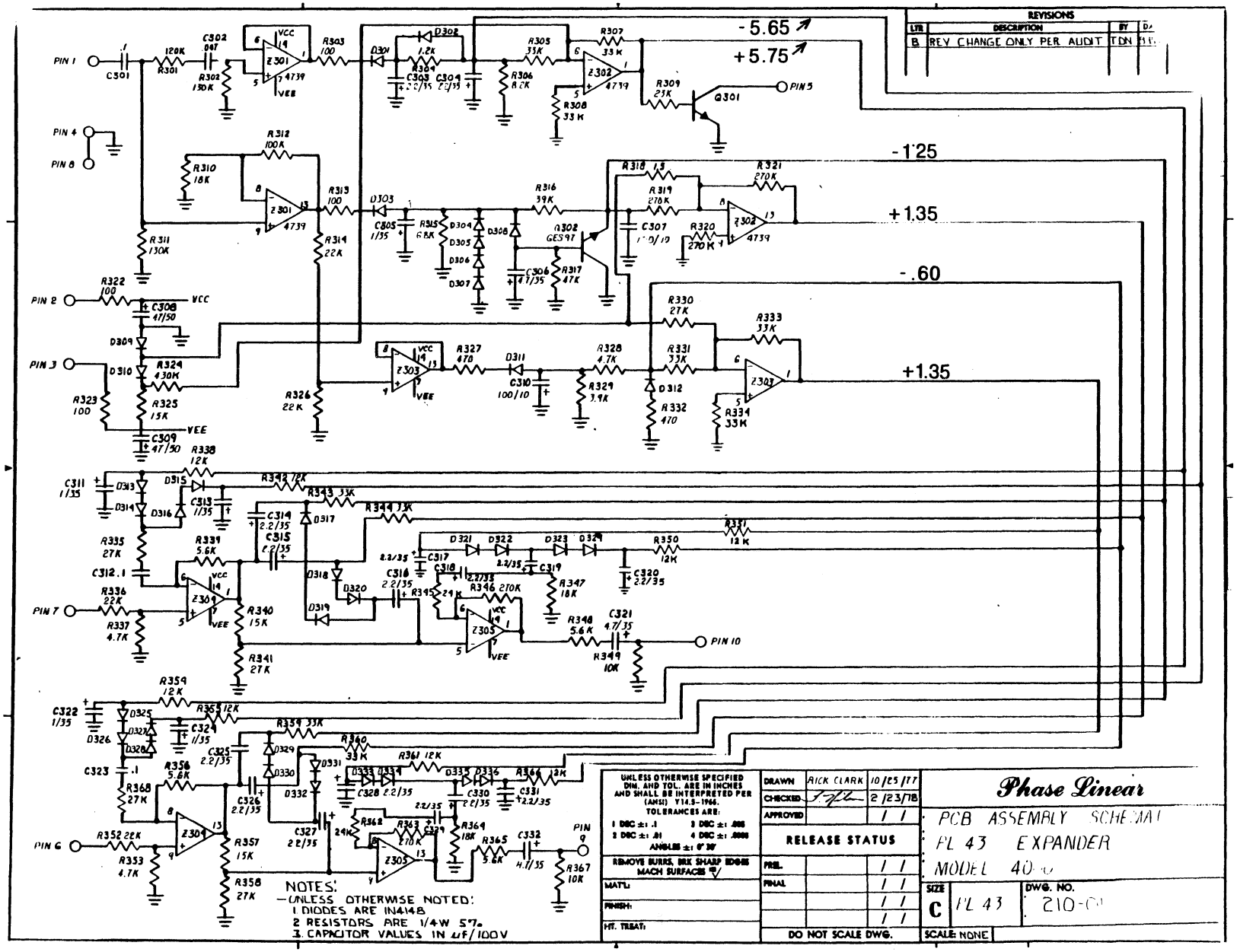


Diagram 2-11. Schematic, PL43 Expander Board.

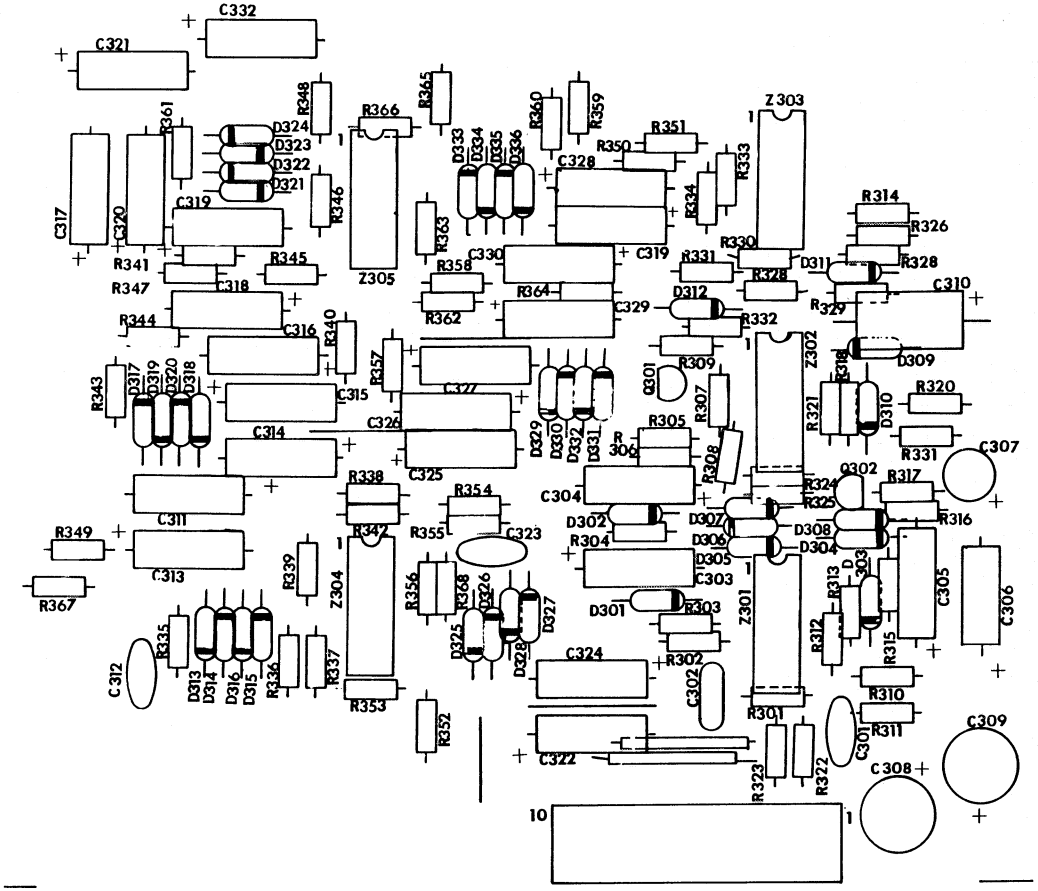


Diagram 2-12. Layout, PL43.

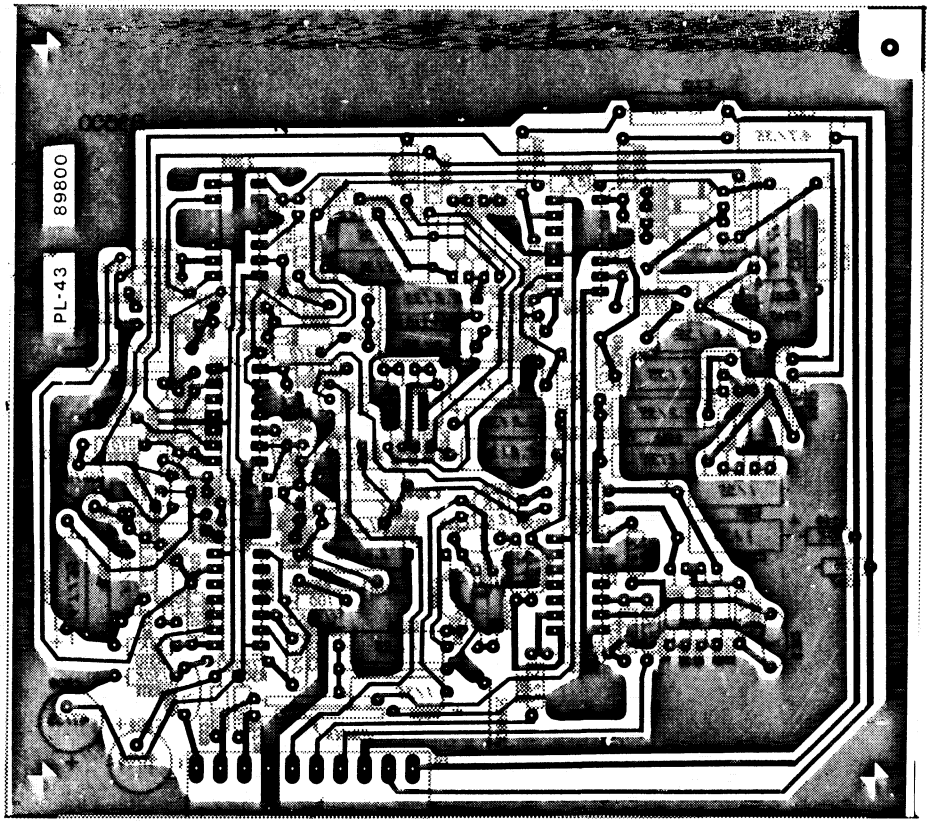


Diagram 2-13. X-ray of PL43.

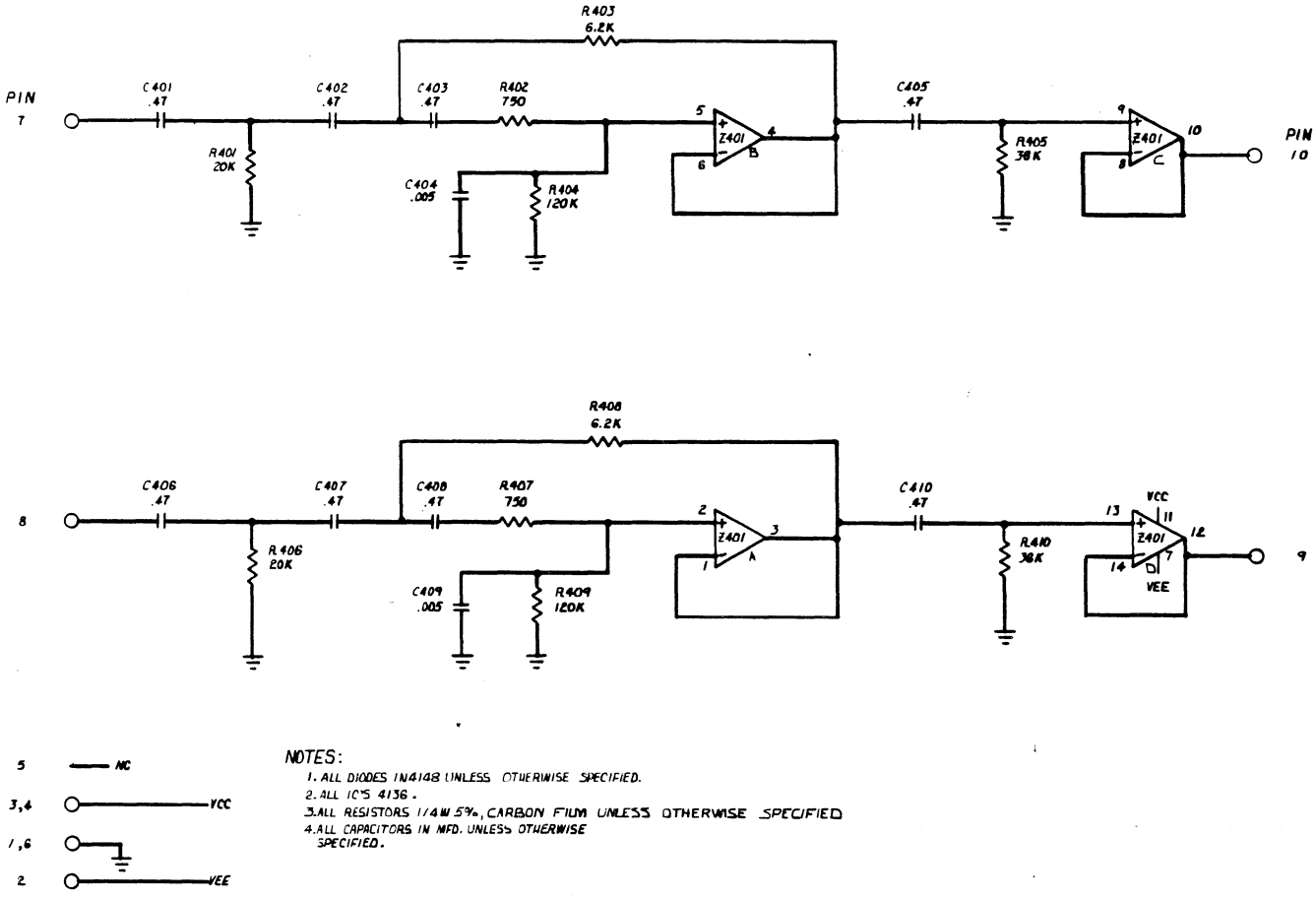


Diagram 2-14. Schematic, PL44 Low Filter Board.

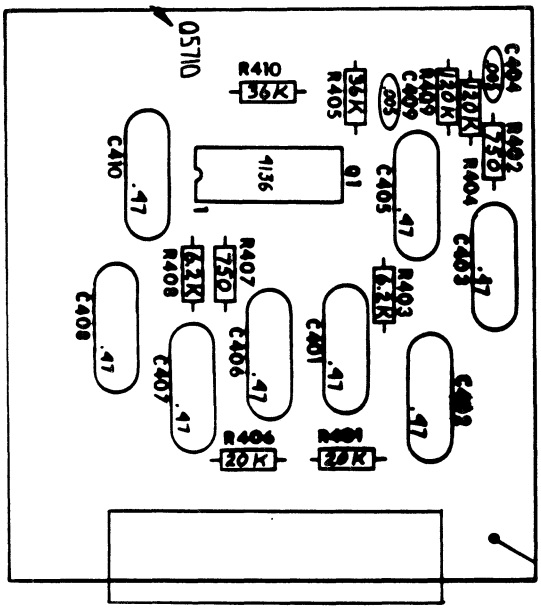


Diagram 2-15. Layout, PL44.

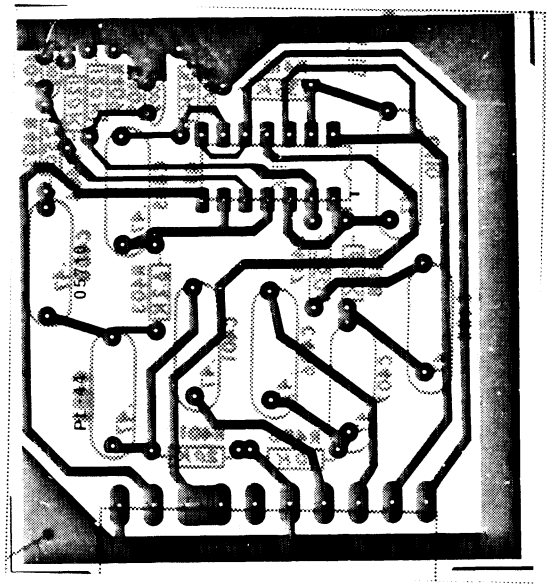
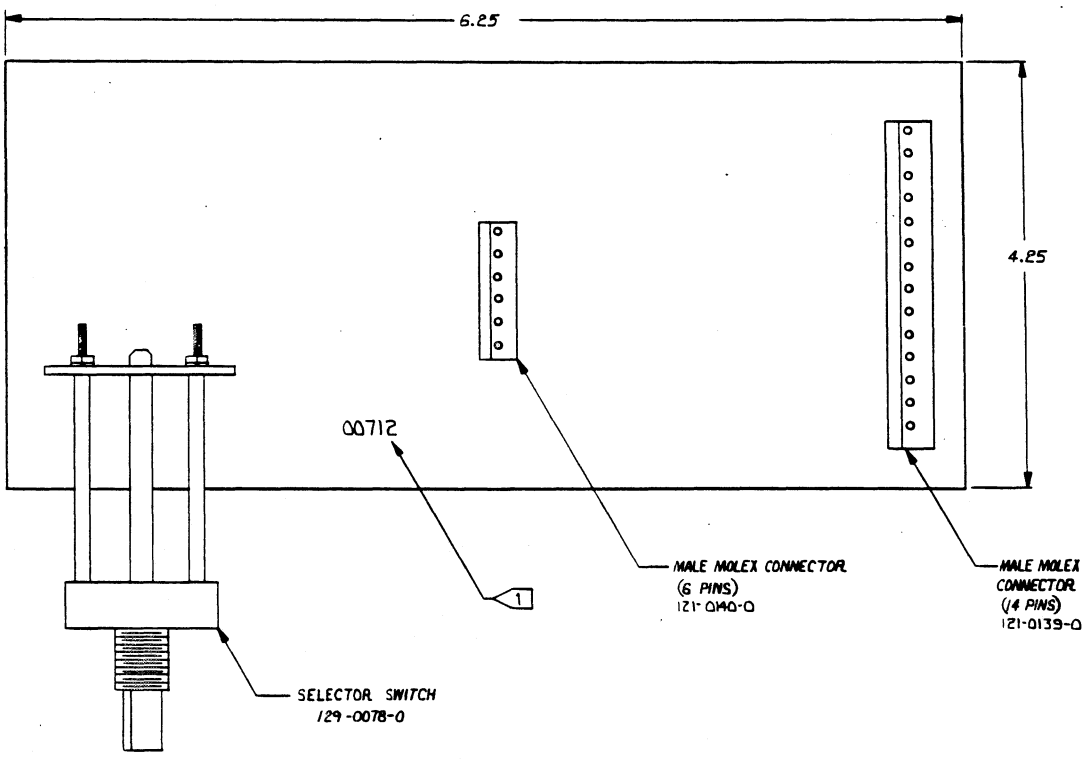


Diagram 2-16. X-ray view, PL44.



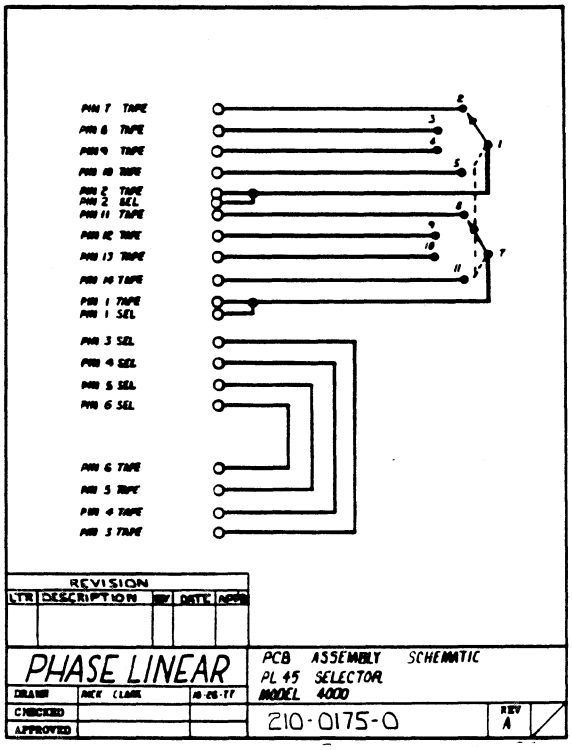


Diagram 2-17. Schematic and Layout, PL45.

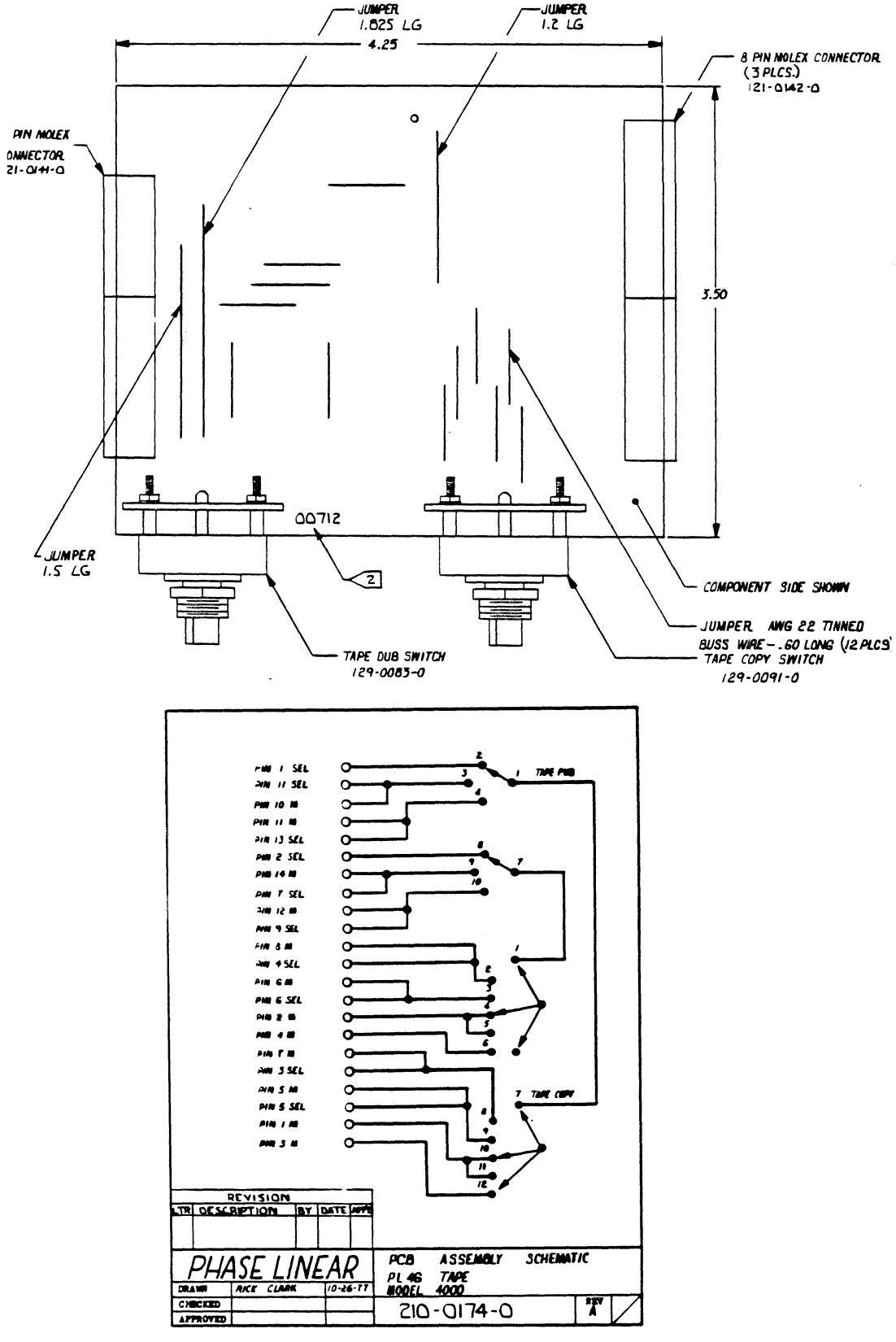
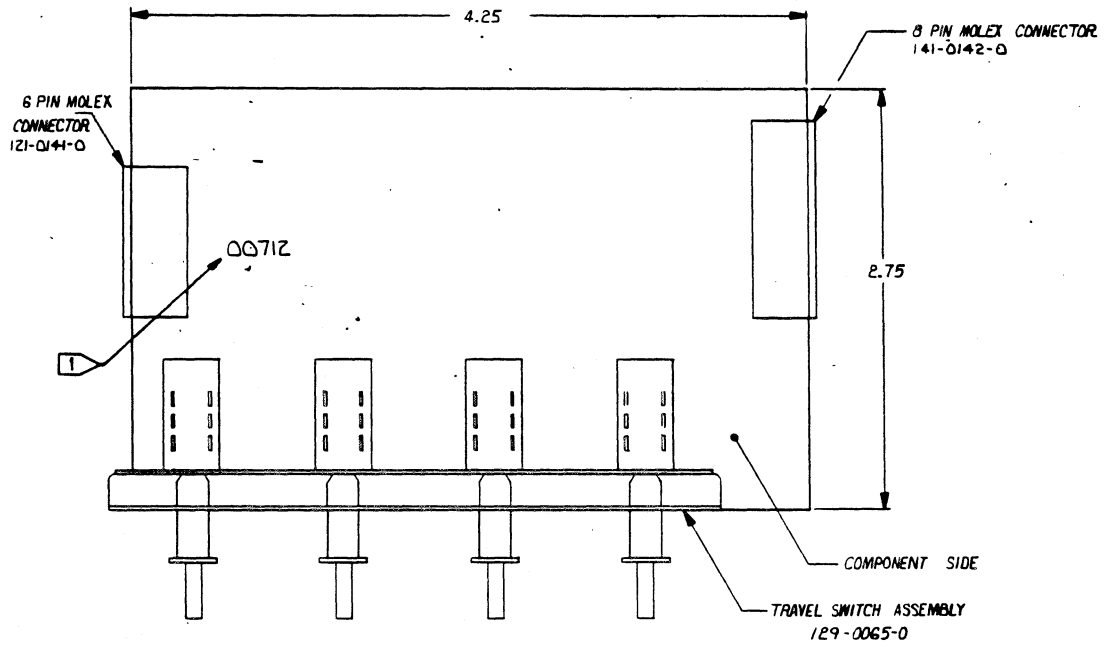


Diagram 2-18. Schematic and Layout, PL46.



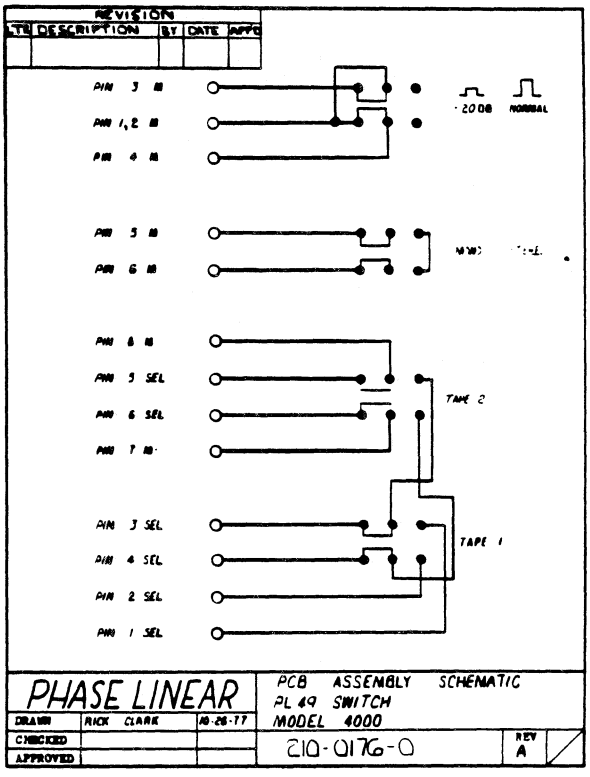


Diagram 2-19. Schematic and Layout, PL49.

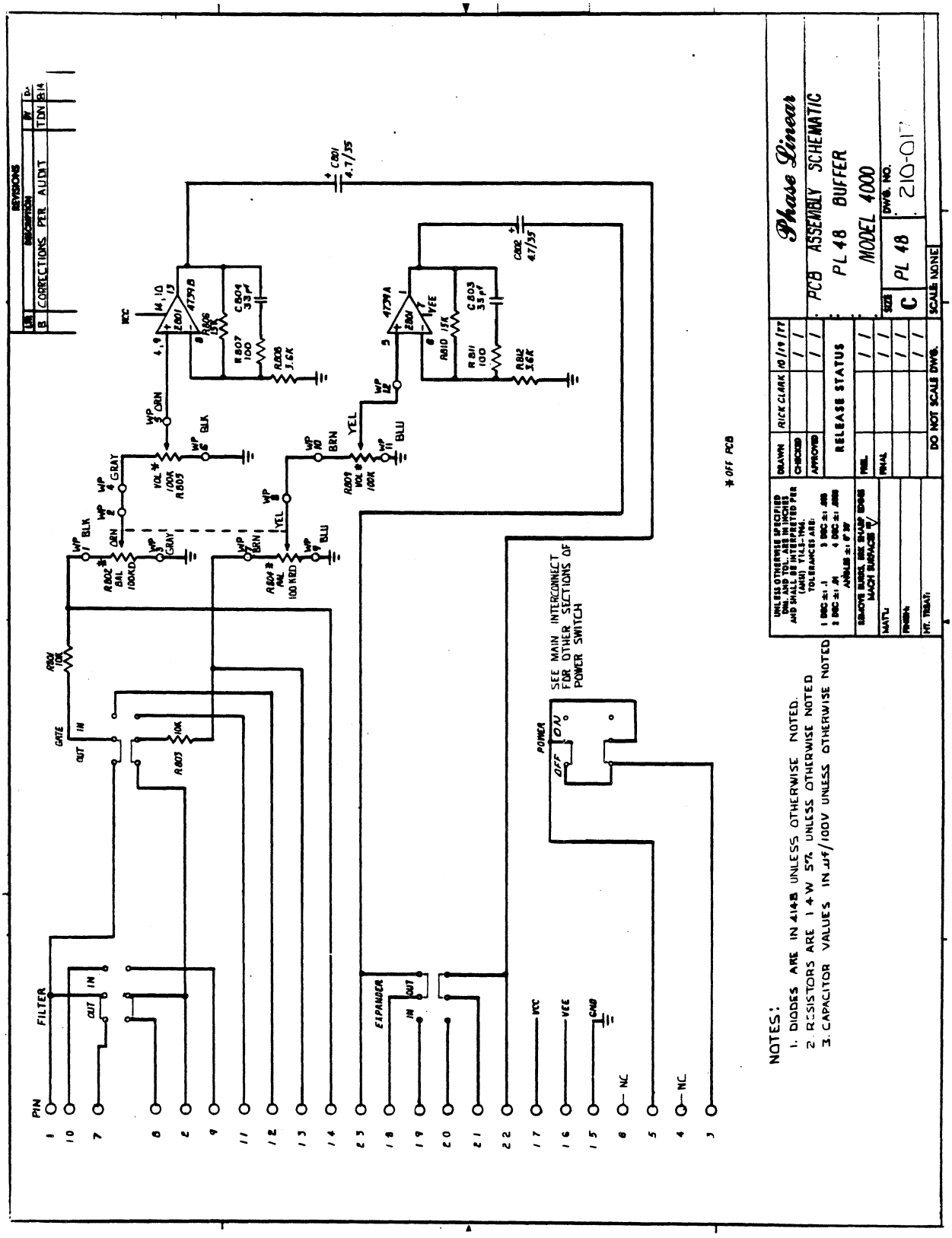


Diagram 2-23. Schematic, PL48 Buffer Board.

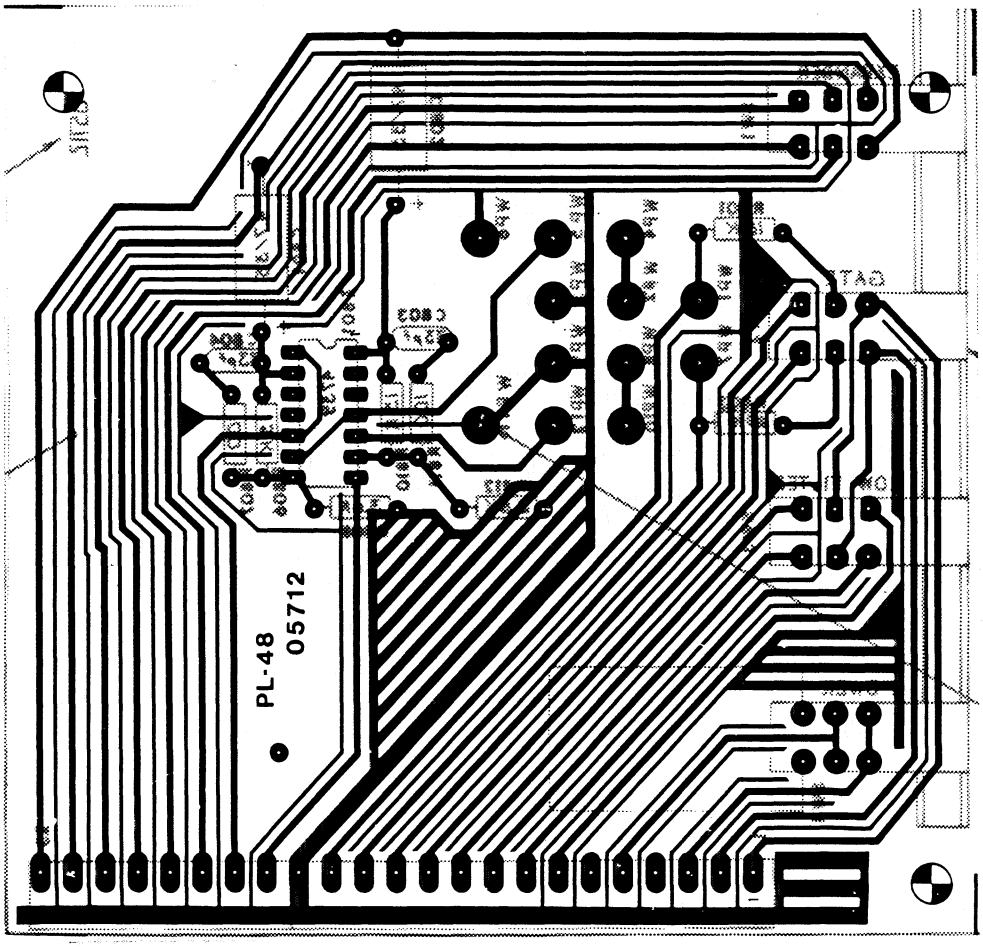


Diagram 2-24. Layout, PL48.

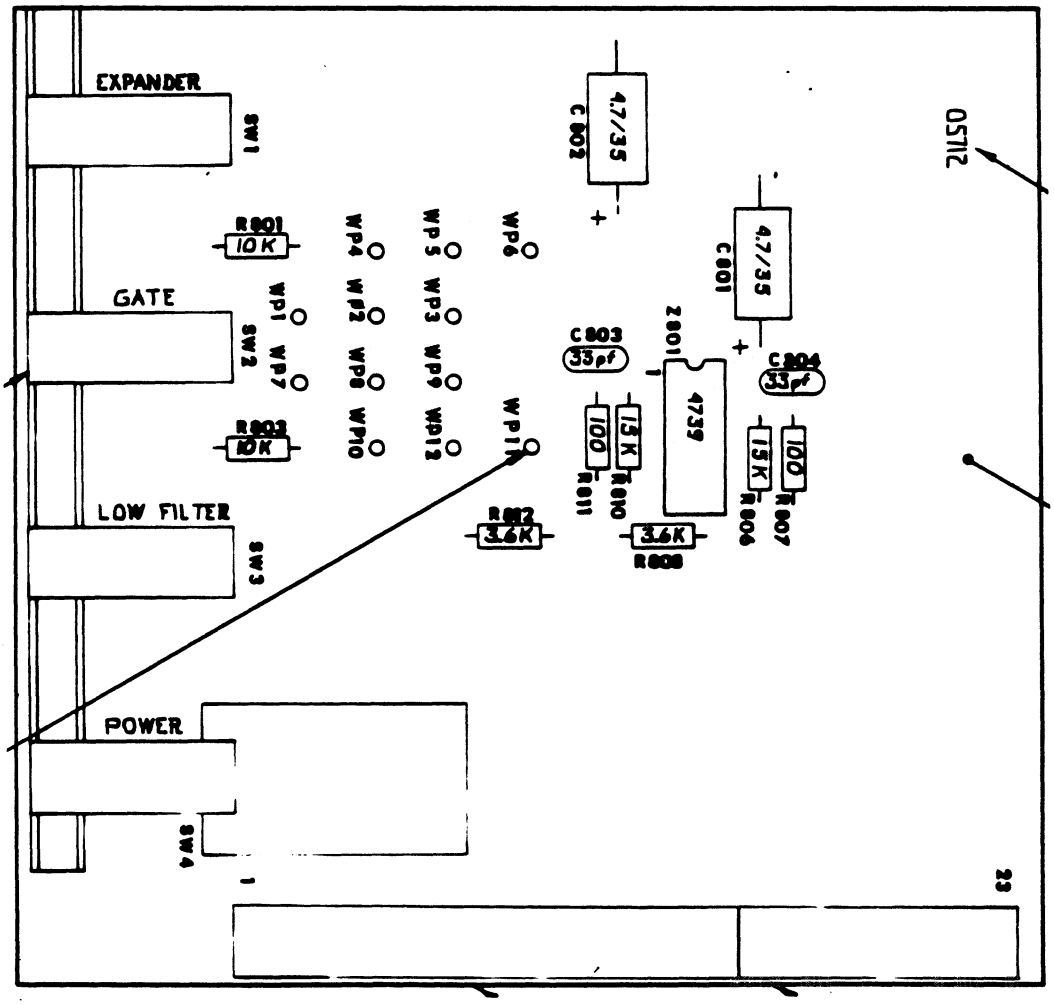


Diagram 2-25. X-ray view of PL48, from foil side.

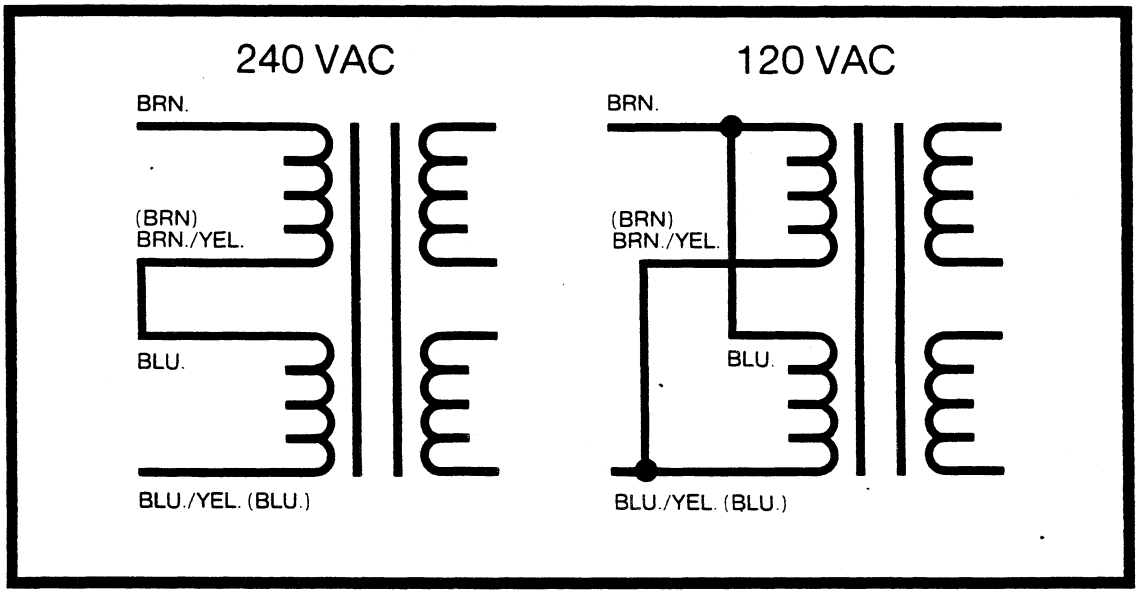


Illustration 1

IF THE PRIMARY VOLTAGE IS CHANGED, THE LINE FUSE MUST BE CHANGED AS FOLLOWS:

120 VAC: Use ¼ AMP
240 VAC: Use ⅛ AMP

Diagram 2-26. Transformer voltage configuration.

3-0. 4000II Circuit Descriptions.

3-1. Power Supply. Integrated circuits Z9 and Z10 form a dual tracking regulated supply giving ±17 VDC for all ICs and transistors.

3-2. Output Relay. Output relay K1 is activated by transistor Q2. Delayed turn on is accomplished by the R-C charge time of R94 and C54 while the quick turn off time is fixed by the discharge time constant of R32 and C54.

3-3. RIAA. Integrated circuits Z1 and Z2 form a non-inverting high gain amplifier equalized to the RIAA standard curve, with a gain of 40 dB at 1K Hz.

3-4. Tone Circuit. Integrated circuits Z701B and Z701C serve as active tone amplifiers while SW2 and SW3 switch the turnover frequencies.

3-5. Active EQ. At high frequencies C701 and C712 present an AC short giving the op amp unity gain. At low frequencies the reactance of C701 and C712 increases giving the stage a maximum boost of +8 dB at 20 Hz.

3-6. Low Filter. Integrated circuit Z401 forms an active high-pass filter giving a maximally flat Butterworth four pole response of 24 dB/octave, with a fixed corner frequency of 15 Hz.

3-7. Headphone Amplifier. The headphone amplifier consists of Z8 and current gain transistors Q3 and Q4. The output of each amplifier is sent to the stereo headphone jack which disconnects the main outputs when headphones are plugged in.

3-8. Log Amplifier.
General description: The log amplifier is a compression amplifier designed to drive the high and low frequency bandpass filters necessary for the autocorrelator.

Detailed description:
High frequency section: Signal from summing amplifier Z5A is high-pass filtered and applied to VCA Z6 (MC3340). The output of VCA Z6 is amplified by Z7A to restore gain lost in Z6. The output of Z7A is half-wave rectified and filtered with its corresponding DC voltage being indirectly applied to the DC control port of VCA Z6. The B+ voltage applied to R55 and D8 (which act as a logarithmic shunt) by trim pot R54 regulates the DC control voltage to emmitter-follower Q1 and, in turn, the control port of Z6. This gives the stage approximately 2:1 dB compression and allows the over-

all sensitivity (gain) of the autocorrelator to be adjusted by trim pot R54. The output of Z7A is also applied to the correlation threshold pot which, in turn, is applied to the High frequency filters.

Low frequency section: Signal from summing amplifier Z5A is low-pass filtered and applied to Z5B. The output of Z5B is applied to the low filter calibration pot and, in turn, to the low frequency bandpass filters.

3-9. Filter Board.

General description: The filter board contains the filters, buffers, DC rectifiers and inverters necessary to open the corresponding "windows" on the gate board.

Detailed description: The filter board contains four double tuned high gain active filters with center frequencies at approximately 200 Hz, 4K Hz, 7K Hz, and 12K Hz. The output of each filter is applied to an emitter-follower transistor. The output of the emitter-follower is half-wave rectified, filtered and applied to a buffer stage. The output of the buffer is a negative DC voltage corresponding to the presence or absence of music material in that frequency band. This DC voltage, along with an inverted (positive) voltage, is then applied to the corresponding diodes on the gate PCB.

3-10. Gate Board.

General description: The gate board contains the signal path filters which receive the control voltages generated by the filter board.

Detailed description: The gate board contains four twin-T bandpass filters (corresp. to the filter brd. center freq) separated by buffer stages. Each filter has two back-to-back diodes which, when forward biased by the DC control voltages generated by the filter board, allow the musical signal to bypass the twin-T filters unattenuated. When the diodes are not forward biased, the filters attenuate the incoming signal (noise). It takes the combined response of two or more twin-T filters to obtain a full 10 dB of noise reduction.

3-11. Expander.

General description: The expander consists of three expansion functions: peak unlimit, linear expand, and downward expand. Z304 and Z305 serve as the signal path voltage-controlled amplifiers (VCAs), while Z301-Z303 provide the associated control voltages.

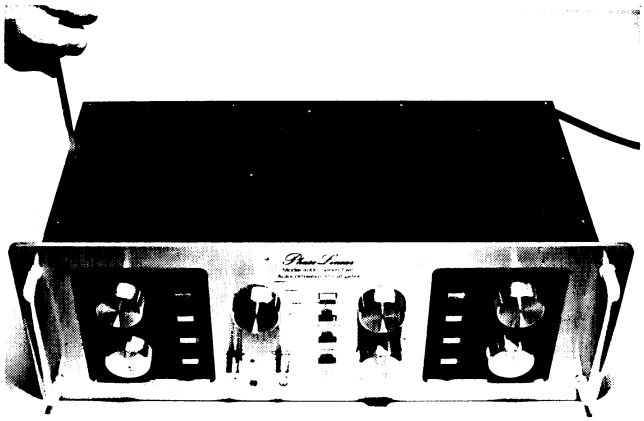
Detailed description: Peak unlimiting is accomplished by forward biasing D313-D316. This changes the resistance of the feedback network thus increasing the gain of Z304

by 1.5 dB.
Linear expansion is accomplished by forward biasing diodes D321-D324. This changes the resistance of the feedback network thus increasing the gain of Z305 by a maximum of 3 dB.
Downward expansion is accomplished by reducing forward bias on D317-D320. Diodes D317-D320 are in parallel with R340 (15K), so, when the resistance of diodes D317-D320 goes up, more signal is dropped across R340 and the output of Z304 is attenuated by a maximum of 3 dB.

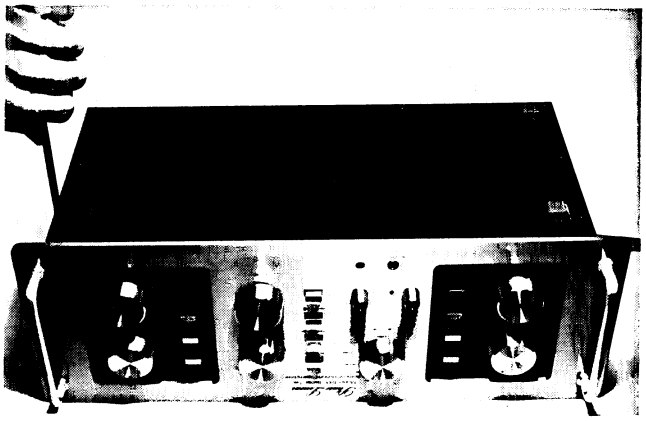
Control voltages are derived as follows: the summed audio signal from both channels (Z54) is applied to pin 1 through the front panel threshold control. This signal is buffered and half-wave rectified to create a DC control voltage proportional to the incoming signal. This DC voltage is applied, along with an inverted DC voltage, to the appropriate diodes. The buffers are scaled to generate control voltages at the appropriate expansion "windows".

4-0. Disassembly Procedure

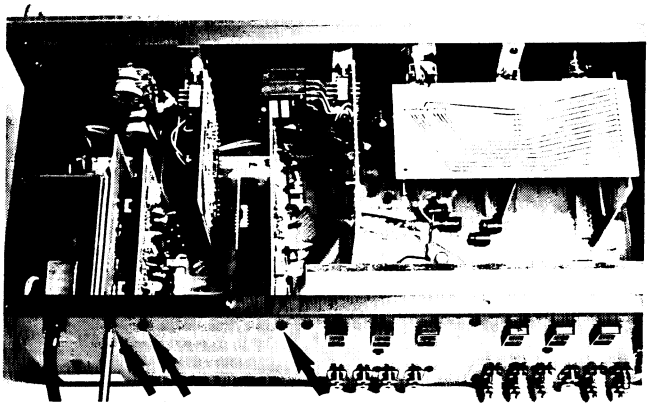
4-1. To gain access to all plug-in PCBs and mother board components, remove the top cover plate (8 phillips screws).



4-2. To gain access to the foil side of the mother board, remove the bottom cover plate (8 phillips screws).

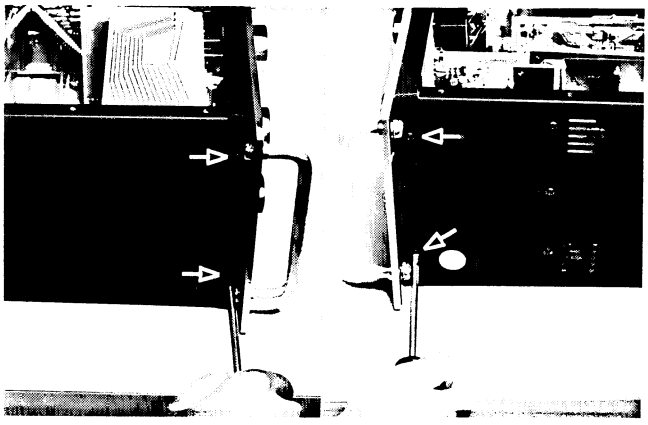


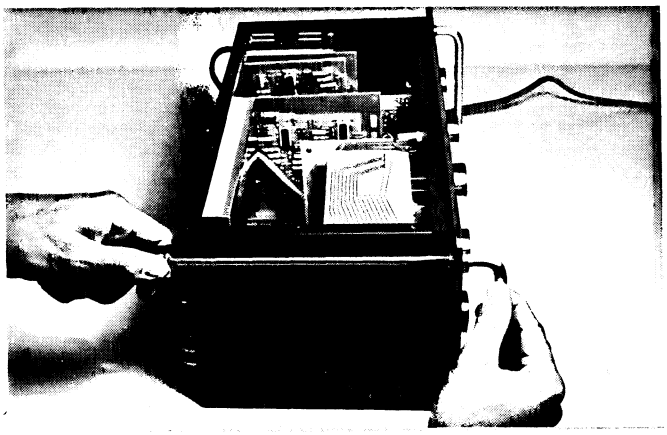
4-3. For removal of PCBs PL41, PL42, or PL43: remove the mounting bracket screw on the upper edge of the rear panel which fastens the upper rear corner of each PCB, then unplug the PCB.

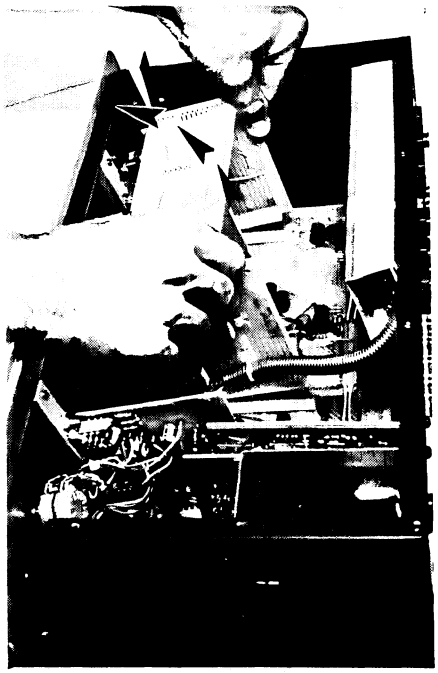


4-4. For removal of PCBs PL46, PL47, PL48 or PL49:

4-4.1. Remove all four sub-front mounting screws.

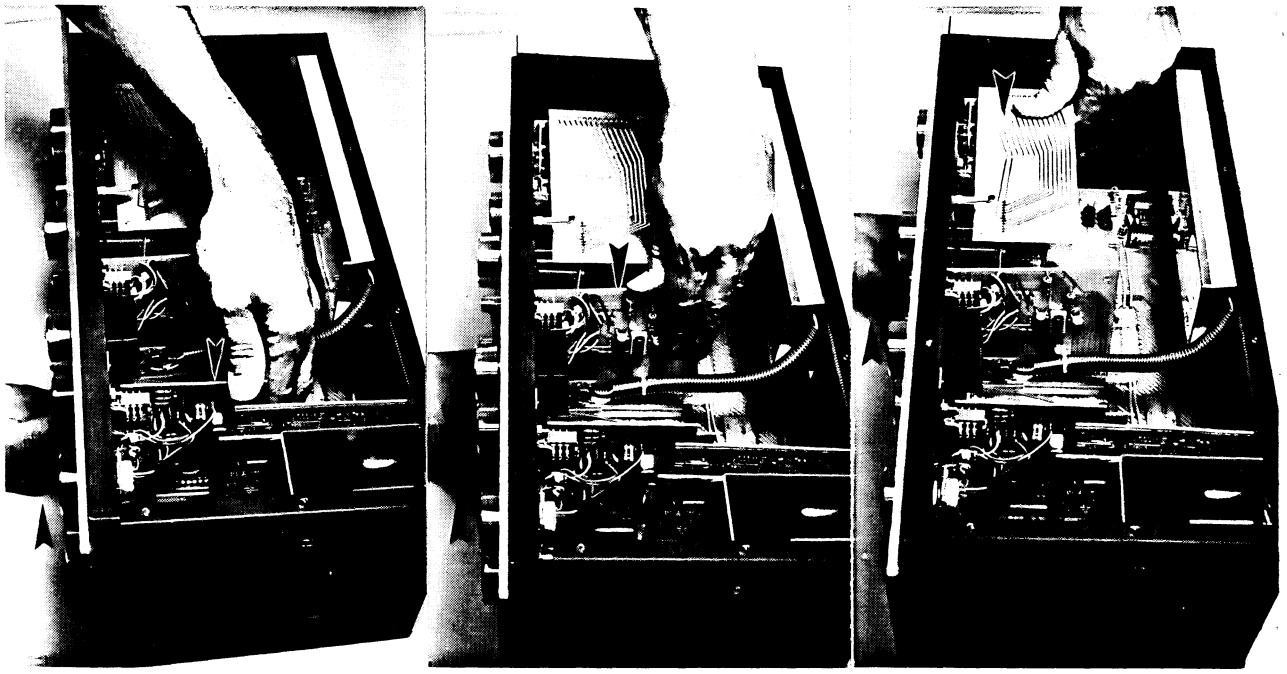






4-4.2. Remove both handle assemblies.

4-4.3. Firmly grasp PL46 and PL48 as shown and pull upward and forward to unplug the entire front panel assembly from the mother board. PL46 thru PL49 may now be removed from the front panel as necessary.



4-5. Re-assembly of PL46 through PL49.

4-5.1. Align the four PCB connectors carefully onto the male pins on the mother board. Press down on PL47, PL48, and then PL45 while pushing up on the mother board under each connector to to firmly seat each PCB.

4-5.2. Replace both handle assemblies and the four sub-front screws.

5-0. Test Procedure

Contents:

Recommended Equipment:

Dual Trace Scope
Two AC Voltmeters
Signal Generator
8 ohm Load Resistor

NOTE: Unless otherwise specified, all tests are to be performed with all auxiliary circuits (Tone, Active Equalizer, Filter, Peak Unlimit, and Correlator) switched OUT, Balance control centered, Output Normal.

5-1. Energizing. Insert the 4000 line plug into the proper line voltage source 117 or 230 VAC as determined by the voltage requirments labeled on the rear panel of the preamplifier. Push the 4000 Power switch to the ON position and verify that the power indicator LED slowly lights up within 10 seconds.

5-2. Tape Functions. Verify proper operation of the monitor, tape copy and tape dub circuits according to the chart below. Plug a signal generator at 250 mV of 2K Hz into the assigned input and monitor the assigned output with a scope. Verify an undistorted output signal with the switches set as described for each function.

Input	Output	Selector	Tape Dub	Tape Copy	Tape 1	Tape 2
Tape 1	Tape 2	Any	Any	T1-T2	Any	Any
Tape 2	Tape 1	Any	Any	T2-T1	Any	Any
P1	T1 & T2	P1	Source	Source	Any	Any
P2	T1 & T2	P2	Source	Source	Any	Any
Tun	T1 & T2	Tun	Source	Source	Any	Any
Aux	T1 & T2	Aux	Source	Source	Any	Any
P1	T1 & T2	Any	P1	Source	Any	Any
Tun	T1 & T2	Any	Tun	Source	Any	Any
Tape 1	Mains	Any	Any	Any	In	Out
Tape 2	Mains	Any	Any	Any	Any	In

5-3. Main Outputs and Volume Tracking. Select and drive Tuner inputs with 250 mV at 2K Hz and monitor the A outputs with a dual trace scope and AC voltmeters. Turn the volume control fully clockwise and then slowly turn down the 4000 volume control while observing the meters. Verify that the left and right channels track within $\pm$0.5 dB.

5-4. Stereo/mono, Separation. Select and drive the Tuner inputs with 250 mV at 2K Hz to obtain a 0dB reference on a pair of AC voltmeters connected to the A or B outputs. Unplug the left channel input and verify that the left output signal is removed with the 4000 in the Stereo mode. Press the Stereo/Mono switch to the Mono position and verify that both left and right outputs register at -6 dB. Switch back to Stereo mode and install a shorting plug into the left channel input. Verify that any signal present in the left channel output is -40 dB or more below the right channel output.

5-5. -20dB switch. Select and drive the Tuner inputs with 250 mV at 2K Hz to obtain a 0 dB reference at the A or B outputs. Depress the -20 dB switch and verify a drop in output of 18 dB, ±2 dB.

5-6. Peak Unlimit. Select and drive the Tuner inputs with 250 mV at 2K Hz to obtain a 0 dB reference on a pair of AC voltmeters connected to the A or B outputs. Turn the Peak Unlimit Threshold knob fully clockwise and verify that the Peak Unlimit LED is lit. Switch the Peak Unlimit IN and verify an increase in output level of 1.5 dB, ±1,0 dB. Now rotate the threshold knob slowly counterclockwise until the LED Peak indicator just goes off. Verify an output level of 0 dB, ±1.0 dB. Rotate the threshold knob fully counterclockwise and verify an output level of -6 dB, ±1.0 dB. When the threshold knob is then rotated quickly from full counterclockwise to full clockwise, the meter should react quickly to roughly the 0 dB position then rise slowly (about two seconds)to the +2 dB position. Total dynamic expansion should be 7.5 dB ± 1 dB.

5-7. Correlator. Select and drive the Tuner inputs with 250 mV at 12K Hz to obtain a 0 dB reference on a pair of AC voltmeters connected to the A or B outputs. Switch the Correlator IN and verify an insertion difference of no more than ± 1 dB. At each of the frequencies listed below, rotate the Correlator threshold knob from full clockwise to full counterclockwise and verify the designated amount of attenuation.

2K Hz	-2 dB, ±1 dB
4K Hz	-8 dB, ±1 dB
7K Hz	-10 dB, ±1 dB
12K Hz	-10 dB, ±1 dB
50 Hz	-10 dB, ±2 dB

With a 50 Hz input, rotate the LF Cal knob from full clockwise to full counterclockwise and verify a total attenuation of -12.5 dB, ±2 dB. Return the LF Cal knob to the full clockwise position.

5-8. Infrasonic filter. Select and drive the Tuner inputs with 250 mV at 20 Hz to obtain a 0 dB reference on a pair of AC voltmeters connected to the A or B outputs. Engage the Infrasonic Filter and verify an attenuation of -1.5 dB, ±.5 dB. Change the input frequency to 10 Hz and verify an attenuation of -13 dB, ±1 dB.

5-9. Balance. Select and drive the Tuner inputs with 250 mV 2K Hz to obtain 0 dB reference on a pair of AC voltmeters connected to the A or B outputs. Center the Balance control to the 12 o'clock position and verify that there is no more than 1 dB difference between the left and right channels. Rotate the Balance control fully clockwise, then fully counterclockwise and verify that the left only and the right only channels are fully attenuated respectively.

5-10. Tone Controls. Select and drive the Tuner inputs with the frequencies listed in the chart below and verify the indicated amounts of boost and cut by rotating the treble and bass knobs fully clockwise and counterclockwise with the indicated Tone Turnover Frequencies selected.

	Hz	Turnover	Amount of Boost & Cut	Variance
TREBLE	12K	8K	±8 dB	±2 dB
	12K	2K	±13 dB	±2 dB
BASS	50	40	±8 dB	±2 dB
	50	150	±13 dB	±2 dB

With the Tone Controls centered there should be no more than 1 dB insertion difference with the Tone circuit switched IN or OUT.

5-11. Active Equalizer. Select and drive the Tuner inputs with 250 mV at 20 Hz to obtain a 0 dB reference on a pair of AC voltmeters connected to the A or B outputs. Engage the Active Equalizer and verify a boost of 9 dB, ±1 dB.

5-12. Phono 1 & 2 Noise. Drive the Phono 1 inputs with 10 mV at 1K Hz and obtain a 0 dB reference with a pair of AC voltmeters connected to the Tape 1 outputs; be sure that both the Tape Dub and Tape Copy switches are set at Source. Remove the inputs and insert shorting plugs. Verify that any output from the right or left channel is at least -80 dB below the 0 dB reference. (IHF "A" weighted).

5-13. High Level Noise. Select and drive any high level input with a 1K Hz signal to obtain 2 volts at the A or B outputs with the 4000 volume control turned fully clockwise. Establish 0 dB reference on a pair of AC voltmeters connected to these outputs. Remove the inputs and insert a pair of shorting plugs. Verify that any output from the left or right channel is at least -85 dB below the reference (IHF "A" weighted).

5-14. Headphone Output. Select and drive any input with a 1K Hz signal and monitor the headphone outputs with a scope and AC voltmeters. Attach an 8 ohm load resistor in parallel with each headphone output and drive these outputs to clipping. Verify at least 0.9 V before clipping with the 4000 volume control turned fully clockwise. Verify also that signal is removed from the B outputs when the headphone plug is inserted.

6-0. Troubleshooting Guide

Contents:

6-1. Power supply malfunction.

6-1.1. Power LED will not light up.

a) Check for proper supply voltages and troubleshoot as necessary according to 6-1.2.

b) Check Q2 and associated circuitry; replace components as necessary.

c) Measure D16 (LED); replace as necessary.

6-1.2. Incorrect DC supply voltage(s):

a) Measure the DC supply voltages at the jumper wires indicated in Diagram 6-1.2a. These should be +17.3 VDC, ±.5V and -17.0 VDC, ±.5V. If both voltages are incorrect, refer to step b). If only one voltage is incorrect, refer to step c).

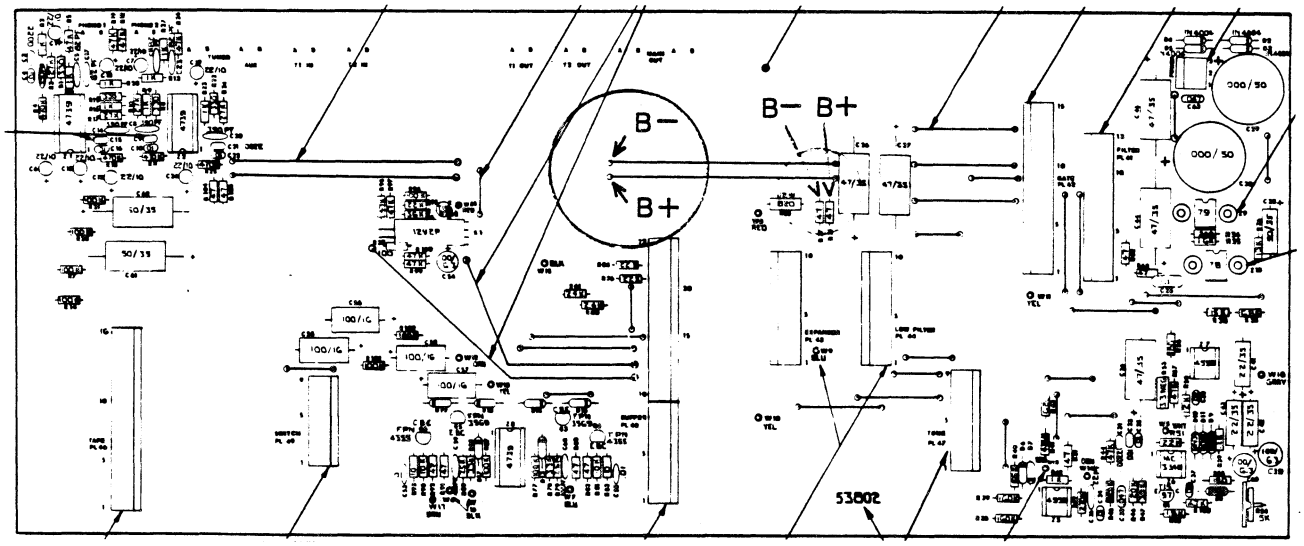


Diagram 6-1.2a.

b) Measure the secondary output of the power transformer as indicated in Diagram 6-1.2b, on the foil side of the mother board PL40. If there is less than 36 VAC (18V per half of secondary), check D2 through D5; if these measure good, and there is at least 117VAC (230VAC for overseas models) at the line cord, then replace the power transformer. If the secondary voltage measures good, then measure the unregualted DC voltages at pin 1 of Z10 and pin 4 of Z9: ± 17 VDC with a ± .5 VDC variance. If these voltages are within spec, but the regulated supply is still below spec, replace Z9 and/or Z10.

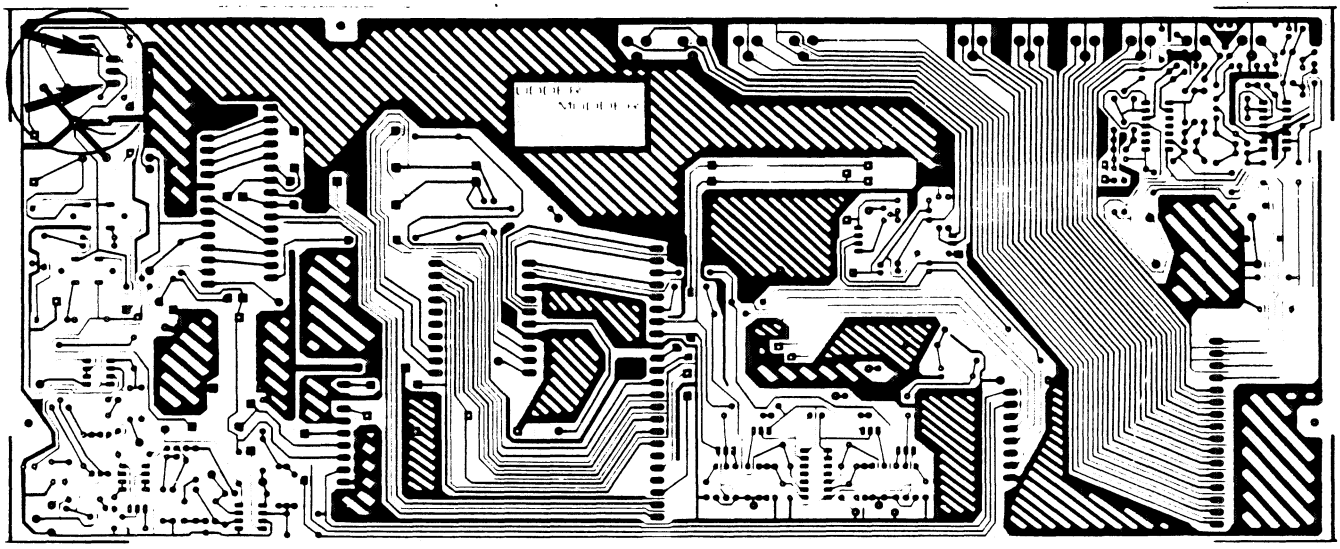


Diagram 6-1.2b

c) If either the positive or the negative regulated supply (but not both) is below spec, replace the respective regulator IC (Z9 or Z10). If the voltage is still low after replacement, some component or short must be loading the supply. Turn the unit off immediately to avoid damaging the regulators. Measure the impedance of the supply jumpers to ground (see Diagram 6-1.2a); if either reads less than 500 ohms, trace the supply routing to locate any solder bridges or shorted components. Desolder the white supply jumpers one at a time from left to right to aid in isolating the area which contains the short.

6-1.3. Excessive turn-on time: more than 10 seconds required for LED to become fully lit.

a) Check or replace C54, R32, R96; inspect all solder connections.

b) Replace Q2.

6-2. Tape circuit malfunction.

The Tape Dub, Copy, Monitor and Selector switching is accomplished on PCBs PL46, PL45 and PL49. If a problem of any kind developes with these circuits:

a) Verify proper customer use of these circuits.

b) Clean connectors on PL46 and PL49; verify that these are plugged in firmly.

c) Clean all selector switches.

d) Inspect PL45, PL46 and PL 49 for cracked or cold solder joints, broken foil, solder bridges or broken selector switch solder lugs.

6-3. Malfunction of Main Outputs.

6-3.1. No signal at main outputs.

a) Verify that all special circuits are OUT, with no headphones plugged in. Check for signal at the volume pot and inputs and outputs of buffer IC Z8.

b) Check for presence of signal at C57/C58 on PL40. If none is present, check continuity of the Headphone jack switches: clean or replace headphone jack. If signal is present at C57/C58 but not at Main outputs, troubleshoot relay K1 according to c) below.

c) Verify that output relay K1 is properly energized: there should be +14 VDC, ±1 V across the relay primary. Measure continuity between high sides of R100 and R97, R99 and R98. If proper voltage exists across the primary but the relay does not close, replace the relay. If no voltage is present across the primary, check Q2 and D16 (D16 should be lit), inspect foil pattern, solder connections.

6-3.2. Volume control mistracking: If tracking of volume control does not fall within spec, replace the volume control.

6-4. Stereo/mono malfunction; poor separation.

6-4.1. Stereo/mono malfunction.

a) Unit will not switch to mono: Check continuity of stereo/mono switch on PL49; clean or replace as necessary. Check for cold or cracked solder joints, broken foil patterns or dirty PCB connectors.

6-4.2. Poor separation: Separation is largely a function of design layout and shielding. Since this specification is checked on every unit that leaves the factory, it is highly unlikely that a separation problem will be encountered. If such is the case, however, check the following:

a) Be sure that any crosstalk is not originating from the source, such as cartridge mistracking, tape head mis-alignment, etc.

b) Check for solder bridges, poor ground connection, cold or cracked solder joints, metal filings or any other conductive matter which may be creating signal path between channels.

c) Bleedthrough is often confused with crosstalk. Although the same design criteria were employed to minimize bleedthrough, such a wide variety of source input levels may result in audible bleedthrough. An FM Tuner in a strong signal reception area may deliver a large output voltage to the 4000 Tuner inputs, which might be audible through the Phono circuits with a low output cartridge in use.

6-5. -20dB circuit malfunction.

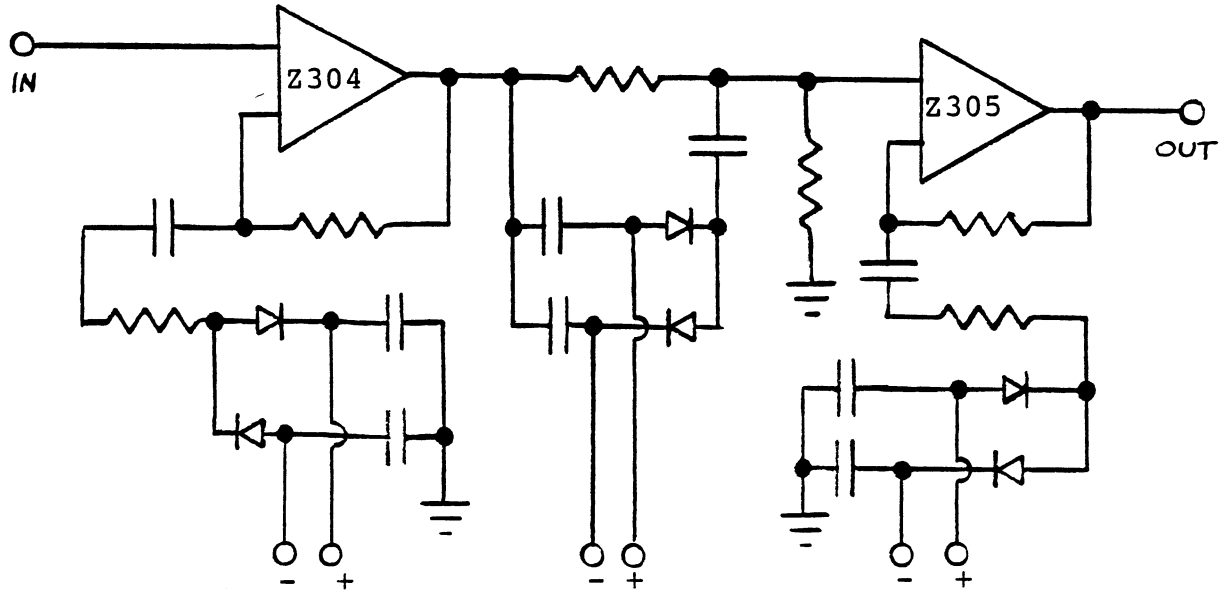
a) Check continuity of -20dB switch; clean or replace as necessary.

b) Clean PL49 PCB connectors. Inspect foil patterns for breaks, cold or cracked solder joints. Check R60 and R61.

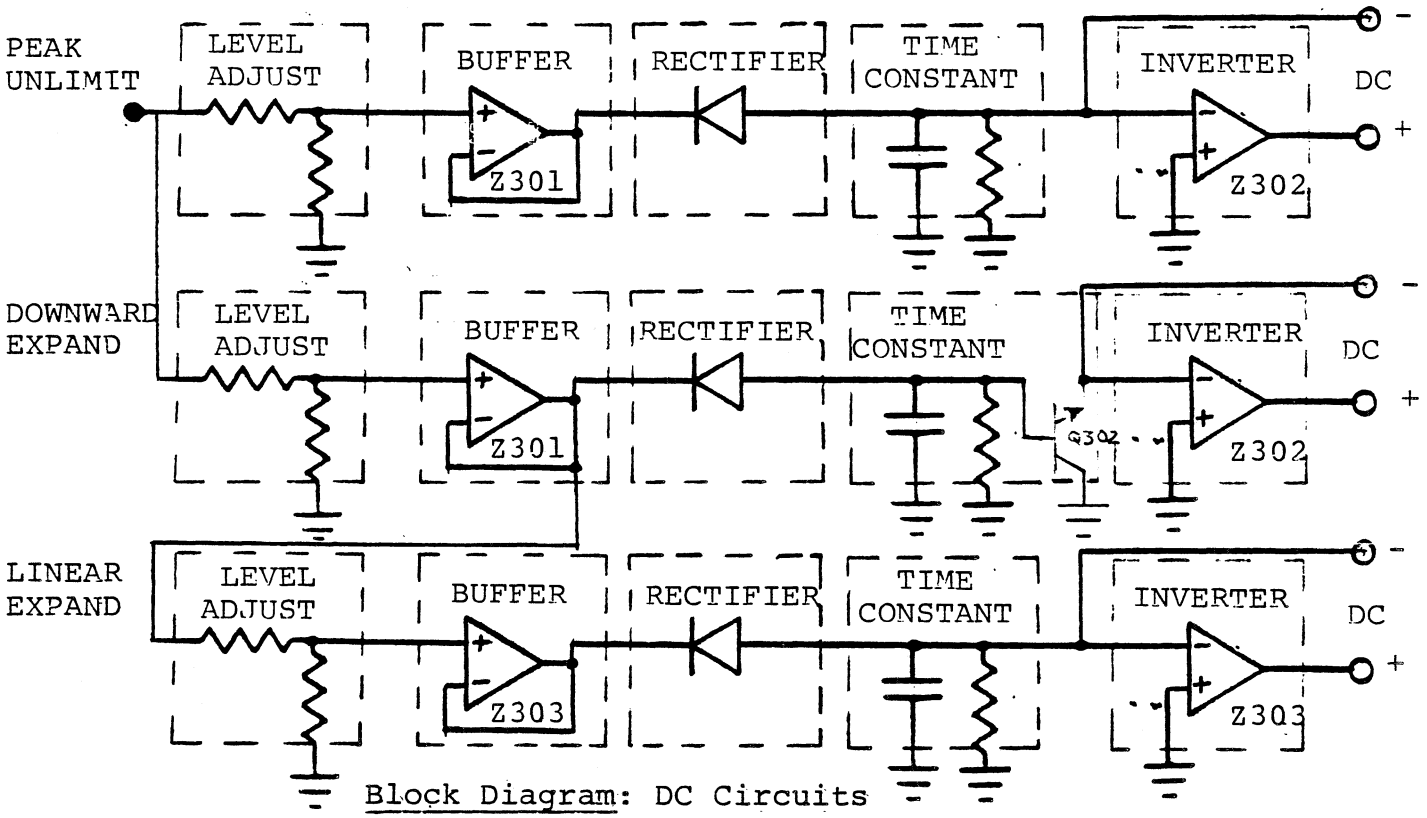
6-6. Peak Unlimit Malfunction

Contents:

The following block diagrams are provided as an aid to troubleshooting the Peak Unlimit circuitry.



Simplified Schematic: Signal Path



Block Diagram: DC Circuits

6-6.1. Loss of one channel.

a) Check the connectors on PL40 and PL43 for cracked or cold solder joints or oxidation.

b) With a scope probe check the input and output of each signal path op amp to determine which section is defective. Replace Z304, Z305 as necessary.

6-6.2. Excessive noise in one channel.

a) The fastest way to locate a noisy signal path IC is to replace each IC in turn with a new one. Since there are only two ICs in each channel, the entire process is relatively short.

6-6.3. Peak Unlimit LED out.

a) Perform the Peak Unlimit circuit test as outlined in section 5-6 to determine if the peak unlimiter is expanding the signal by the correct amount (1.5 dB, ±.5 dB).

b) If the Peak Unlimiter is expanding then check the LED drive transistor Q301 and LED D16; replace as necessary.

c) If the Peak Unlimiter is not expanding then check Z301, Z302, D301, D302 and replace as necessary. See also 6-6.4 below.

6-6.4. Loss of expansion.

a) Due to the psychoacoustic phenomenon that it is harder for the ear to hear changes in volume (expansion) at lower listening levels than at higher listening levels, customers may complain that the Peak Unlimiter does not work in the -20 dB gain mode. This is not a failure, and can be easily verified by performing step 5-6 with the 4000 in both the Normal and -20 dB modes.

b) Perform the Peak Unlimiter test 5-6 to verify that a malfunction does exist. While continuing to drive the inputs with the threshold fully clockwise, measure the DC control voltages at the proper points to determine which sections of the Peak Unlimiter have malfunctioned. Check and replace as necessary the inverter IC (Z302, Z303), timing transistor (Q302), rectifier diodes (D301, D303, D311), or the buffer IC (Z301, Z303). Refer to diagram 2-11 for typical control voltage values.

6-7. Correlator malfunction.

CONTENTS

6-7.1. Loss of high or low frequencies

a) Perform correlator circuit test as outlined in section 5-7. to determine which gates are down.

b) Failure of a single gate will result in attenuation of 4-6 dB centered at that associated gate frequency.

c) Failure of two or more gates will result in attenuation of 8-10 dB centered at those associated frequencies.

d) After determining which gates are down, proceed to the following section(s).

e) Signal path as outlined in block diagrams may be checked with scope probe at the output of the appropriate stage for more accurate troubleshooting.

6-7.2. All high frequency gates down.

a) Check molex connectors on filter, gate and mother board for cracked/cold solder joints. Check other solder joints on filter board and mother board.

b) Check/replace Z7 and Z6.

c) Check threshold pot.

6-7.3. One or two high frequency gates down.

a) Check molex connectors and other solder joints on filter, gate and mother board.

b) Check/replace appropriate ±DC IC, Z102, Z104.

c) Check/replace the appropriate emitter follower transistor and rectifier diodes.

d) Check/replace appropriate filter IC, Z101, Z103.

6-7.4. Low frequency gate down.

a) Check mother board in vicinity of log amplifier for cracked or cold solder joints.

b) Check/replace the log amplifier IC Z5.

c) Check/replace the filter IC Z101.

d) Check/replace the DC IC Z102.

e) Check the emitter follower transistor Q101 and rectifier D101 and D102.

f) Check the low frequency calibration pot.

6-7.5. All gates down.

a) Check the mother board in the vicinity of the summing amplifier for cracked or cold solder joints.

b) Check/replace Z5.

6-7.6. No noise reduction. (Rotating threshold does not remove noise.)

a) The failure (latchup) of Z102 or Z104 may cause the associated gate to stay up all the time. Perform correlator circuit test and replace appropriate DC IC.

6-7.7. Log amplifier adjustment and correlator sensitivity.

a) The log amplifier trim pot R54 can be set by driving one channel of any high level input with a 200 mV 1K Hz sine wave. With a scope probe, measure the voltage at the hi side (white wire, W8) of the correlator threshold pot and adjust R54 for 95 mVAC. Turning the trim pot counterclockwise will increase the output (sensitivity) of the log amplifier. Any fine tuning of the correlator such as setting the log amplifier for a specific cartridge output should be done by ear. Set the log amplifier such that the noise from your particular source drops out in the 11-2 o'clock range of the correlation threshold knob.

6-7.8. Loss of one channel.

a) Check solder joints on PCB and connector.

b) With a scope probe, check the output of each signal path op amp to determine which section has failed. Replace any defective IC (Z201, Z202, Z203).

6-7.9. Excessive noise in one channel.

a) The fastest way to locate a noisy signal path IC is to replace each IC in turn with a new unused IC. Since there are only two ICs in each channel, it shouldn't be too difficult to locate and replace the noisy one quickly.

6-8. Infrasonic filter malfunction.

6-8.1. Loss of one or both channels when filter is switched in.

a) Verify that PL44 is plugged into the mother board connector properly; clean connector.

b) Inspect PL44 for broken .47 capacitor leads, cold or cracked solder joints, broken foil.

c) Replace Z401.

d) Inspect Filter switch: clean or replace as necessary.

6-8.2. One or both channels become noisy when filter is switched in.

a) Replace Z401.

6-9. Channel imbalance.

6-9.1. Left and right channels are not balanced with the balance control centered.

a) Pull the balance knob off of the balance pot shaft. Rotate the pot shaft with fingers until the left and right channels are balanced. Without altering the shaft adjustment, loosen the ½" shaft nut and rotate the entire balance control assembly so that the flat portion of the shaft is lined up horizontally. Tighten the shaft nut, replace the knob and verify that the channels are now balanced with the knob dot centered.

6-9.2. Channel balance changes with volume control setting.

a) This is volume control mistracking; replace the volume control if the tracking error is greater than 1 dB.

6-10. Tone circuit malfunction.

6-10.1. Large insertion difference or improper amount of boost and cut.

a) Check PL47 for broken mylar capacitor leads, cold or cracked solder joints.

b) Check for broken tone pot pins, cracked substrate.

6-10.2. Loss of channel when tone circuit switched in.

a) Clean the PL47 plug-in connector.

b) Replace Z702.

c) Inspect PL47 and mother board for cold or cracked solder joints, broken leads.

6-10.3. Introduction of excessive noise when tone circuit switched in.

a) Replace Z701.

6-10.4. Tone turnover circuit malfuction.

a) Check continuity of the tone turnover switches; clean or replace as necessary.

b) Inspect C705, C709, C716, and C720 for cold or cracked solder joints, broken leads.

6-11. Active equalizer malfunction.

a) Check continuity of the Active EQ switch; clean or replace as necessary. Inspect the foil side of PL 47 for cracked or cold solder joints.

b) Check C701 and C712 for broken leads, cold or cracked solder joints.

6-12. Excessive noise in Phono circuit.

a) Replace Z1 on PL40 for excessive noise in Phono 1.

b) Replace Z2 on PL40 for excessive noise in Phono 2.

6-13. Excessive noise in High level input(s).
Be sure that all auxiliary circuits, Tone, Active EQ, Infrasonic filter, Correlator and Peak Unlimiter, are switched OUT. If noise is evident only when one of these are circuits is IN, then troubleshoot that circuit as outlined in the appropriate section.

6-13.1. Noise is affected by -20dB switch:

a) If the 4000 is coupled with a high-powered amplifier driving efficient speakers, normal listening levels will require low volume control position and a subsequent degradation of the signal to noise ratio. It is recommended that for optimum S/N ratio the -20dB circuit be utilized at all times except when higher volume levels are required.

b) If noise is excessive even with the -20dB circuit IN, replace Z801.

6-13.2. Excessive noise NOT affected by the -20dB circuit.

a) Replace Z8.

b) Verify proper contact of the headphone switches; clean and replace as necessary.

6-14. Headphone output malfunction.

6-14.1. Insufficient output into an 8 ohm load.

a) Verify proper power supply voltages according to section 6-1.2a. Check for proper line voltage at the 4000II line cord: at least 117VAC for domestic models and 230VAC for overseas models. Replace regulators Z9 and Z10 if the power supply voltage is too low but line voltage is sufficient.

b) If one-half of the sine wave clips before rated output, check D14, D15, D18 and D19; replace as necessary. Also check Q3, Q4, Q5 and Q6; measure the DC offset at pins 1 and 13 of Z8: if there is more than +.70 VDC or any negative offset, replace diodes D14, D15, D18, D19 as necessary, and/or Z8.

NOTE: It is normal for the output to clip negative before positive. This is not a malfunction unless the level of the negative clipping point is below 0.90 VAC.

c) Check for burned emitter resistors R80, R82, R91 and R92; replace if necessary with ½ watt resistors of same value.

7-0. 4000II Parts List

TRANSISTORS

4355.....126-0045-0
3569.....126-0046-0
TIS97.....126-0020-0
GES97.....126-0033-0

INTEGRATED CIRCUITS

4558.....126-0038-0
MC3340.....126-0043-0
78MG.....126-0040-0
79MG.....126-0041-0
RC4739.....126-0029-0
RC4136.....126-0027-0

DIODES

1N4148.....126-0002-0
1N4004.....126-0003-0
1N34.....126-0021-0
LED, Amber....126-0065-0

CAPACITORS

.001/100v myl.127-0062-0
.0047/100v myl127-0031-0
.005/100v myl.127-0094-0
.01/100v myl..127-0063-0
.022/100v myl.127-0059-0
.039/100v myl.127-0029-0
.047/100v myl.127-0058-0
.1/100v myl...127-0015-0
.22/100v myl..127-0028-0
.47/100v myl..127-0014-0
1/35v elec....127-0036-0
2.2/35v elec..127-0068-0
4.7/35v elec..127-0037-0
10/35v elec...127-0035-0
22/10v elec...127-0078-0
47/35v elec...127-0010-0
100/6.3v elec.127-0033-0
100/16v elec..127-0100-0
1000/50v elec.127-0131-0

SWITCHES

Dub Switch....129-0083-0
Copy Switch...129-0091-0
Selector Sw...129-0078-0
Buffer PCB....129-0065-0
Tone PCB.....129-0065-0

POTENTIONMETERS

5K Trim.....129-0001-0
Volume
(100K NL Dual)...129-0077-0
Tone
(100K L Dual)....129-0074-0
Threshold
(50K L).....129-0056-0
Balance
(100K CW/CCW)....129-0066-0
LF CAL
(50K NL).....129-0076-0

FRONT PANEL ACCESSORIES

Knob, 1.5" dia...142-0038-0
Knob, .5" dia...142-0040-0
Handle.....142-0029-0
Handle Ferrule...143-0015-0
Button, Switch...142-0028-0

METALWORK

Front panel.....220-0046-0
Sub-front panel..220-0051-0
Rear panel.....220-0047-0
Top Cover.....220-0048-0
Bottom Cover.....141-0108-0
Chassis.....220-0047-0

TRANSFORMER

117-220v/36 CT...125-0036-0

PRINTED CIRCUIT BOARDS

PL40 Mother.....210-0177-0
PL41 Filter.....210-0180-0
PL42 Gate.....210-0182-0
PL43 Expander....210-0181-0
PL44 Low Filter..210-0183-0
PL45 Selector....210-0175-0
PL46 Tape.....210-0174-0
PL47 Tone.....210-0179-0
PL48 Buffer.....210-0178-0
PL49 Switch.....210-0176-0

NOTE: When ordering replacement parts please specify model and serial number of unit.

8-0. Service Bulletins and Supplements.

This section of the 4000 Series Two Service Manual is reserved for the inclusion of any service bulletins, troubleshooting or other supplements which apply to the 4000 Series Two.