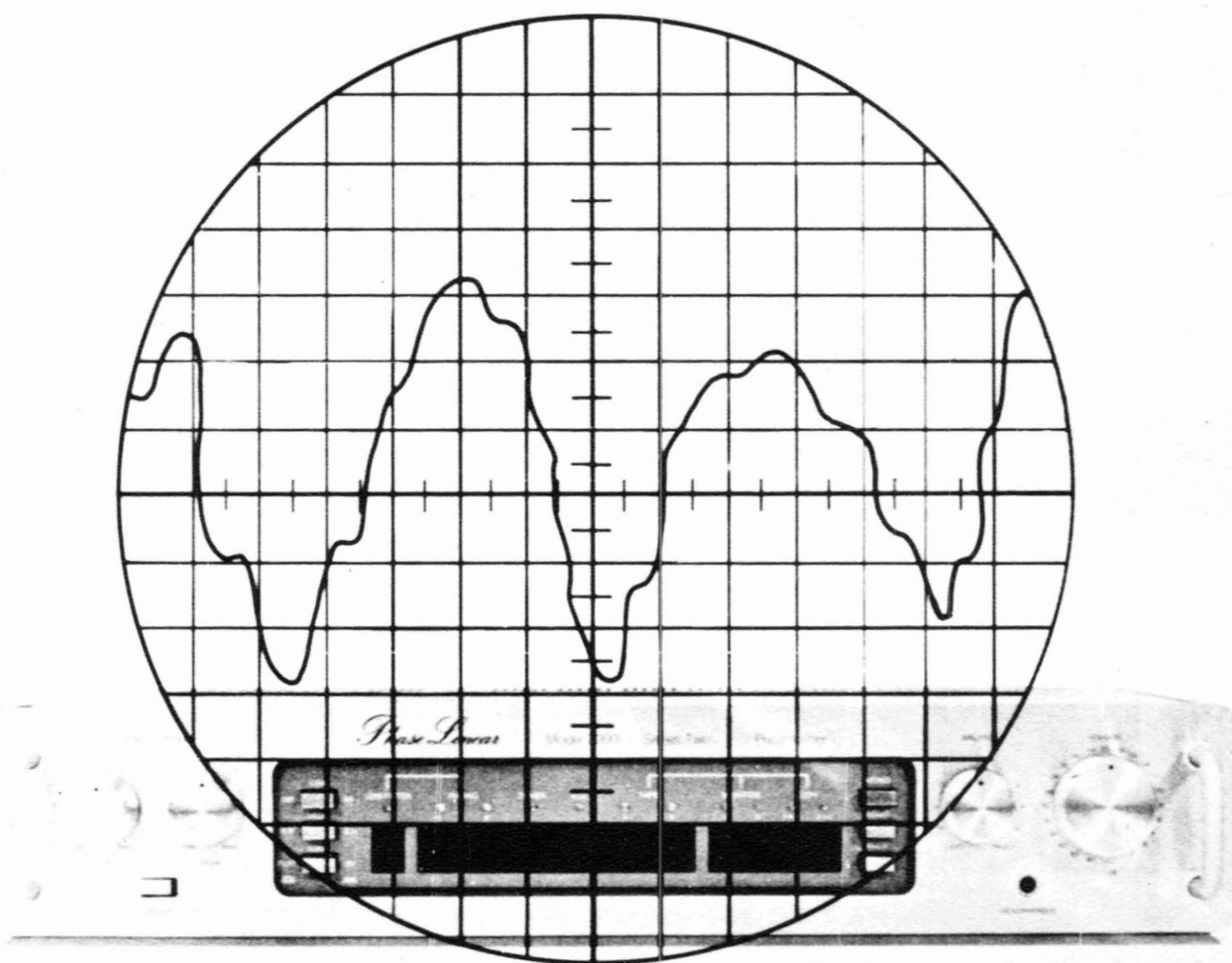


# 3000 SERIES TWO PREAMPLIFIER

## *Service Manual*



*Phase Linear*  
THE POWERFUL DIFF.

3000 SERIES TWO PREAMPLIFIER

SERVICE MANUAL

CONTENTS

1-0.	Specifications .....	3
2-0.	Schematics and Diagrams .....	5
3-0.	Circuit Descriptions .....	14
4-0.	Disassembly Procedure .....	17
5-0.	Test Procedure .....	20
6-0.	Troubleshooting Guide .....	23
7-0.	Parts List .....	32
8-0.	Service Bulletins and Supplements .....	33

\*\*\*\*\* CAUTION \*\*\*\*\*

THIS MANUAL IS INTENDED FOR USE ONLY BY QUALIFIED SERVICE PERSONNEL. HAZARDOUS VOLTAGES MAY BE ENCOUNTERED IN THE SERVICING OF THE 3000 SERIES TWO PREAMPLIFIER. USE EXTREME CAUTION: READ ALL INSTRUCTIONS CAREFULLY.

## 1.0. Technical Specifications

### 1-1.1. Performance Specifications

RATED OUTPUT VOLTAGE: 2.0V RMS.

TOTAL HARMONIC DISTORTION AT RATED OUTPUT: less than 0.04%  
(20Hz-20KHz).

TYPICAL THD AT 1K Hz and RATED OUTPUT: less than 0.005%.

SIGNAL-TO-NOISE (IHF A-CURVE):

Phono 1 (MM): greater than 90dB re 10mV input.

Phono 2 (MC): greater than 78dB re 1 mV input.

High Level: greater than 91dB below rated output.

INPUT IMPEDANCE:

Phono 1 (MM): 47K ohms shunted by selectable  
150pF, 225pF or 420pF.

Phono 2 (MC): selectable 50,200 or 500 ohms  
shunted by less than 20pF.

High Level: greater than 50K ohms.

INPUT SENSITIVITY FOR RATED OUTPUT:

Phono 1 (MM): 2.0mV

Phono 2 (MC): 0.2mV

High Level: 200mV

FREQUENCY RESPONSE:

Phono 1 & 2: RIAA Deviation; +0.3dB.

High Level: 20Hz-20K Hz,  $\pm 0.1$ dB.

RESIDUAL NOISE LEVEL:

Phono 1 (MM) less than 35uV

Phono 2 (MC): less than 135 uV

High Level: less than 55 uV

MAXIMUM OUTPUT AT CLIPPING: greater than 10V into 10K ohms  
at 1K Hz.

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

Phono 1 (MM): 120mV

Phono 2 (MC): 12mV

VOLUME CONTROL TRACKING:  $\pm 0.5$ dB

TONE CONTROLS: Low - turnover frequency 50Hz:  $\pm 7$ dB @ 20Hz.

turnover frequency 150Hz:  $\pm 9.5$ dB @ 20Hz.

High - turnover frequency 2K Hz:  $\pm 10$ dB @ 20K Hz.

turnover frequency 5K Hz:  $\pm 8.5$ dB @ 20K Hz.

LOW FILTER CHARACTERISTICS: 3-pole Butterworth with -18dB/  
octave (-60dB/decade) slope.

Corner Frequency: 15Hz

Attenuation: 20Hz - 0.5dB

15Hz - 3.0dB

4Hz - 35dB

HEADPHONE AMPLIFIER:

Power Output: 200mW into 8 ohms with less  
than 0.07% THD from 20Hz-20K Hz,  
both channels driven.

Signal-to-Noise: greater than 90dB re 200mW output.

1-1.2. General

POWER REQUIREMENTS: 120V 60Hz (USA & Canadian models) or  
100-120/220-240V AC, 50/60Hz.

POWER CONSUMPTION: 8 Watts (70mA)

AC OUTLETS: 2 unswitched, 600 watts maximum; 4 switched,  
600 watts max.

DIMENSIONS: 19"w X 3½"h X 8"d (48.3cm X 9cm X 20.3cm)

WEIGHT: 10lbs. (4.5kg)

SEMICONDUCTOR COMPLEMENT: 16 Integrated Circuits, 22 Transistors,  
37 Diodes, and 11 L.E.D.'s.



2-0. Schematics and Diagrams

- 2-1. Power transformer wiring diagram
- 2-2. Schematic: PL39 Mother Board
- 2-3. Layout: PL39 Mother Board
- 2-4. X-ray view, PL39
- 2-5. Layout: PL54 Switchboard A
- 2-6. X-ray view: PL54
- 2-7. Layout: PL53 Switchboard B
- 2-8. X-ray view: PL53
- 2-9. Layout: PL52 Button Board
- 2-10. X-ray view: PL52
- 2-11. Layout: PL51 Power Supply PCB
- 2-12. X-ray view: PL51

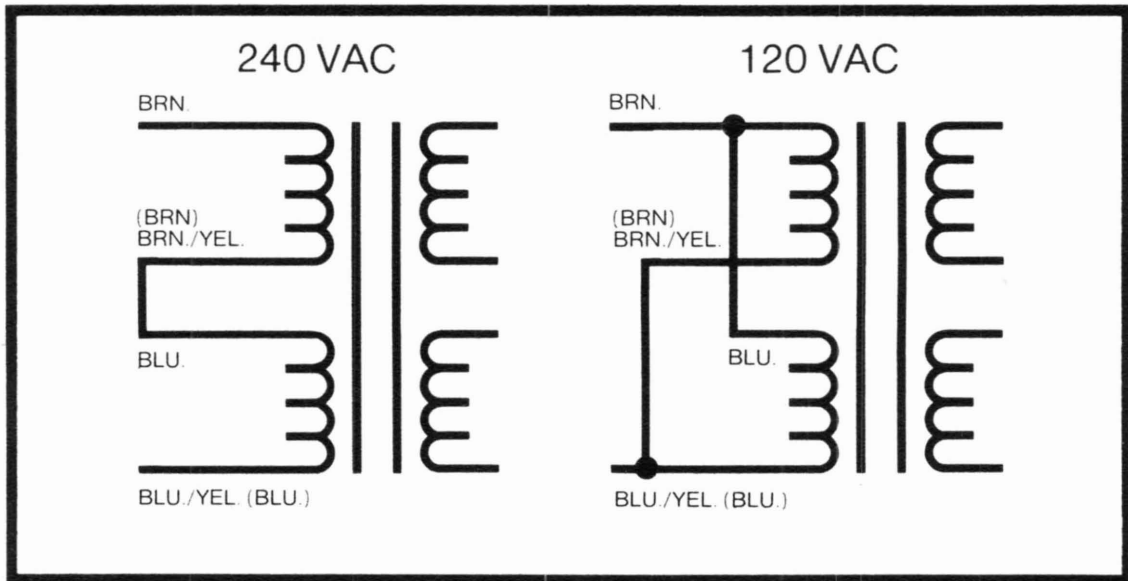


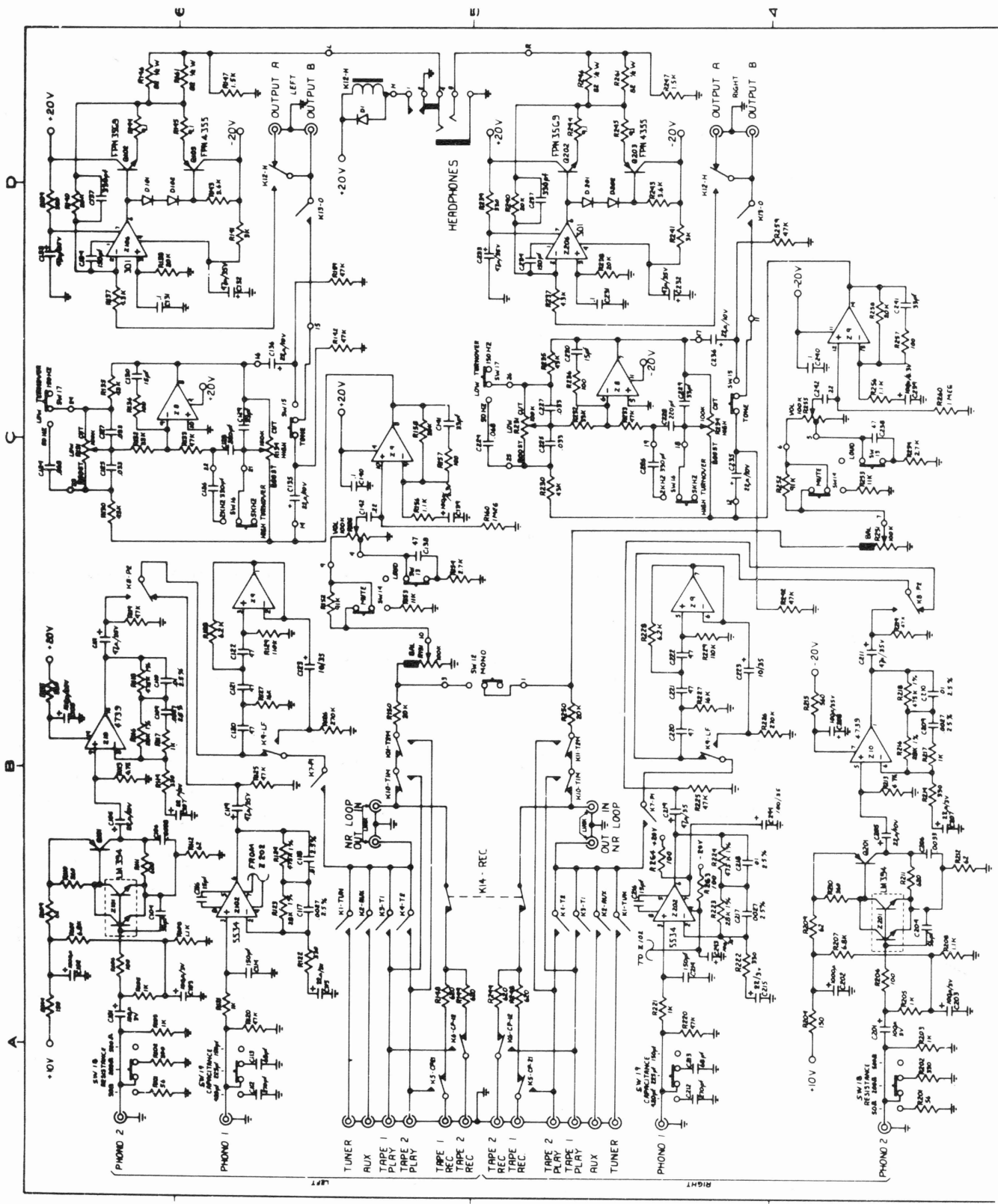
Illustration 1

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

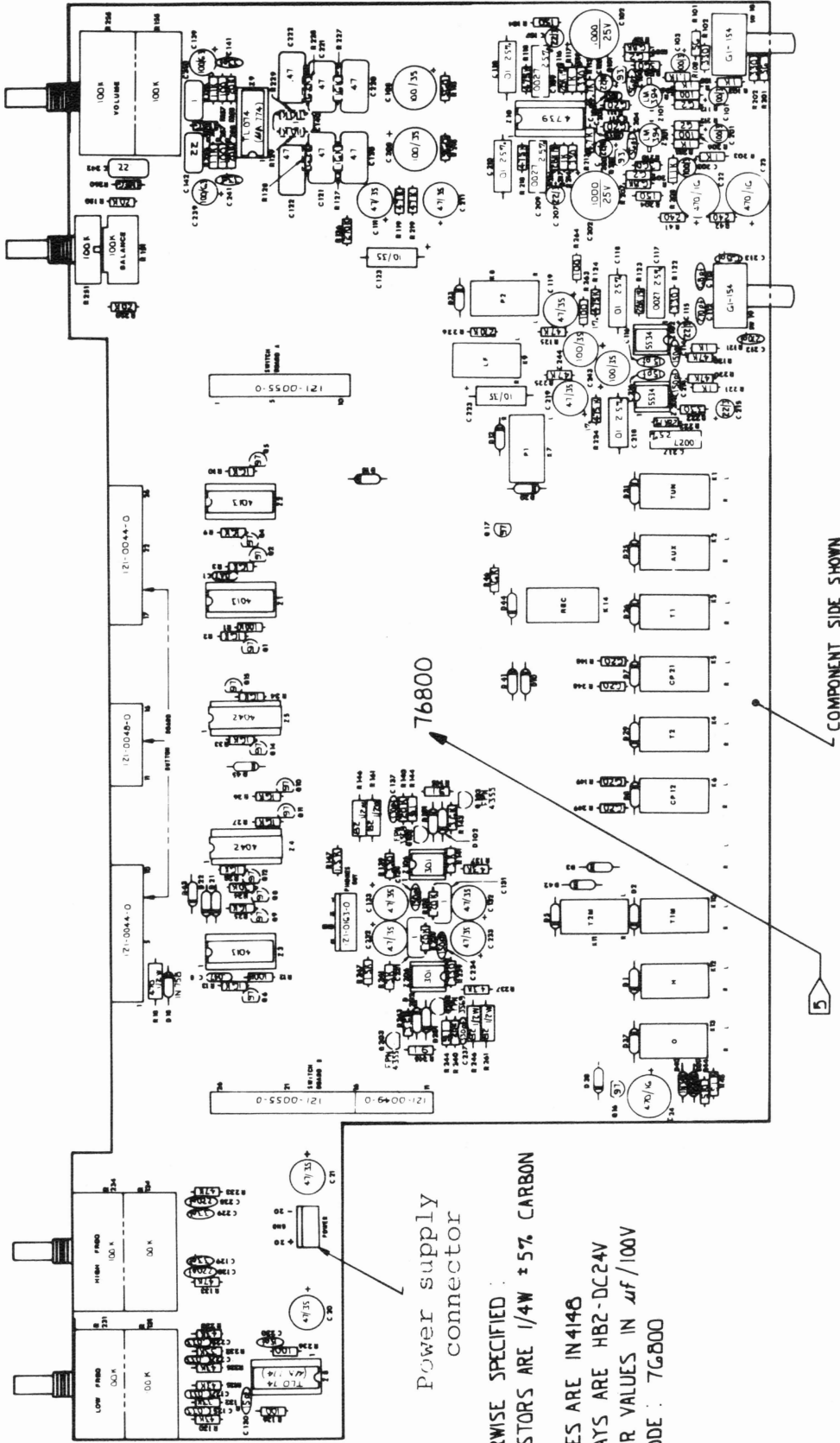
120 VAC: Use 1/2 AMP

240 VAC: Use 1/4 AMP

Diagram 2-1. Power transformer wiring diagram.







Power supply connector

NOTES

- UNLESS OTHERWISE SPECIFIED:
1. ALL RESISTORS ARE 1/4W ± 5% CARBON FILM
  2. ALL DIODES ARE IN 4146
  3. ALL RELAYS ARE HB2-DC24V
  4. CAPACITOR VALUES IN  $\mu\text{f}/100\text{V}$
  5. DATE CODE: 76800

Diagram 2-3. Layout: PL39, Mother Board.

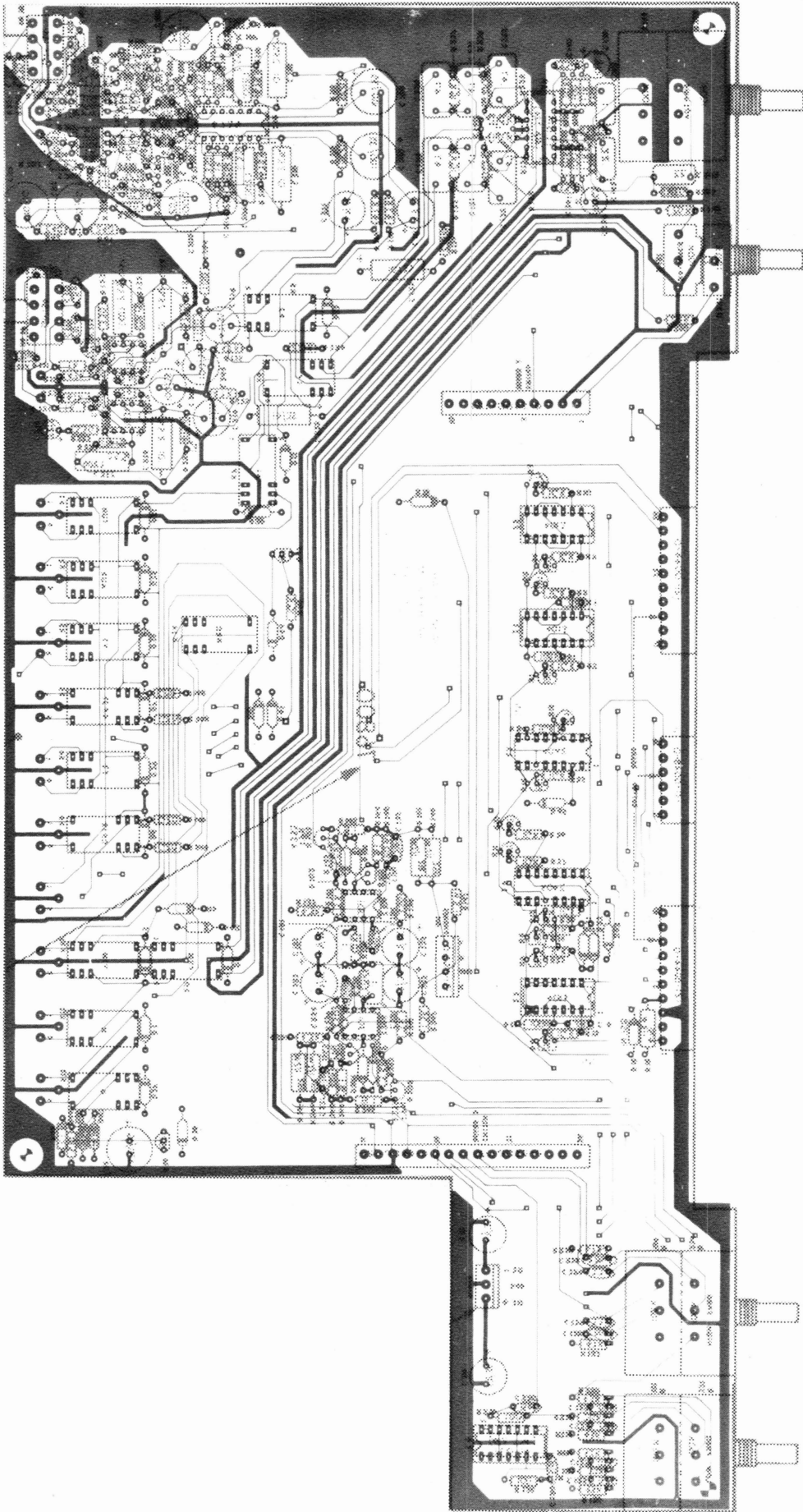


Diagram 2-4. X-ray view of PL39, from foil side.

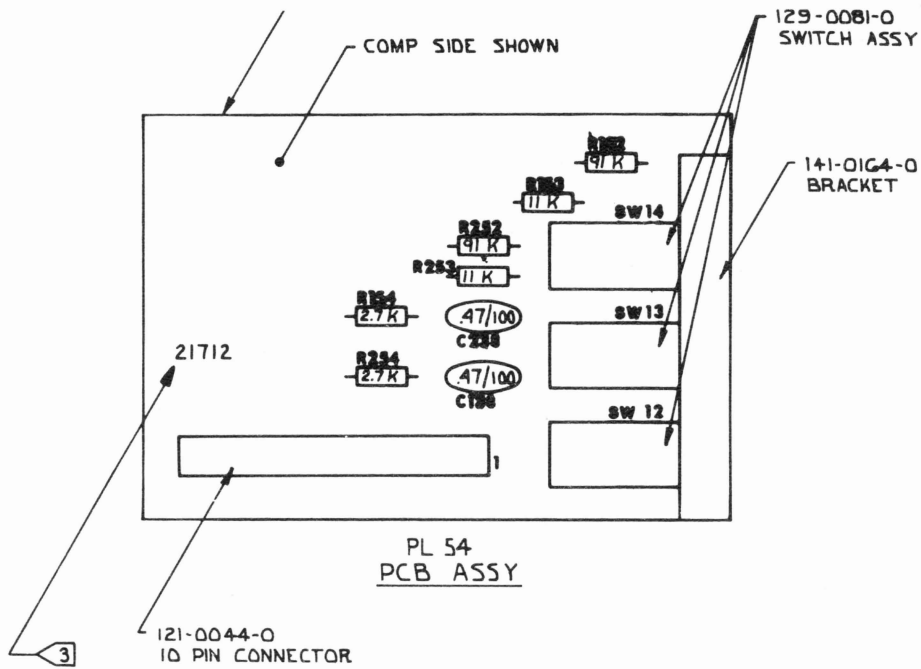


Diagram 2-5. Layout: PL54 Switchboard A

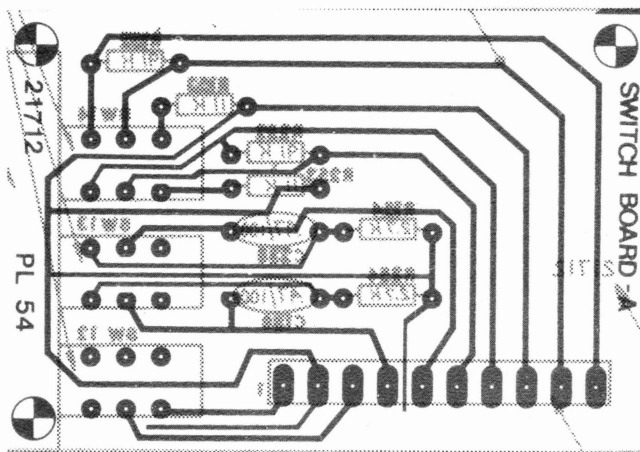


Diagram 2-6. X-ray view: PL54.

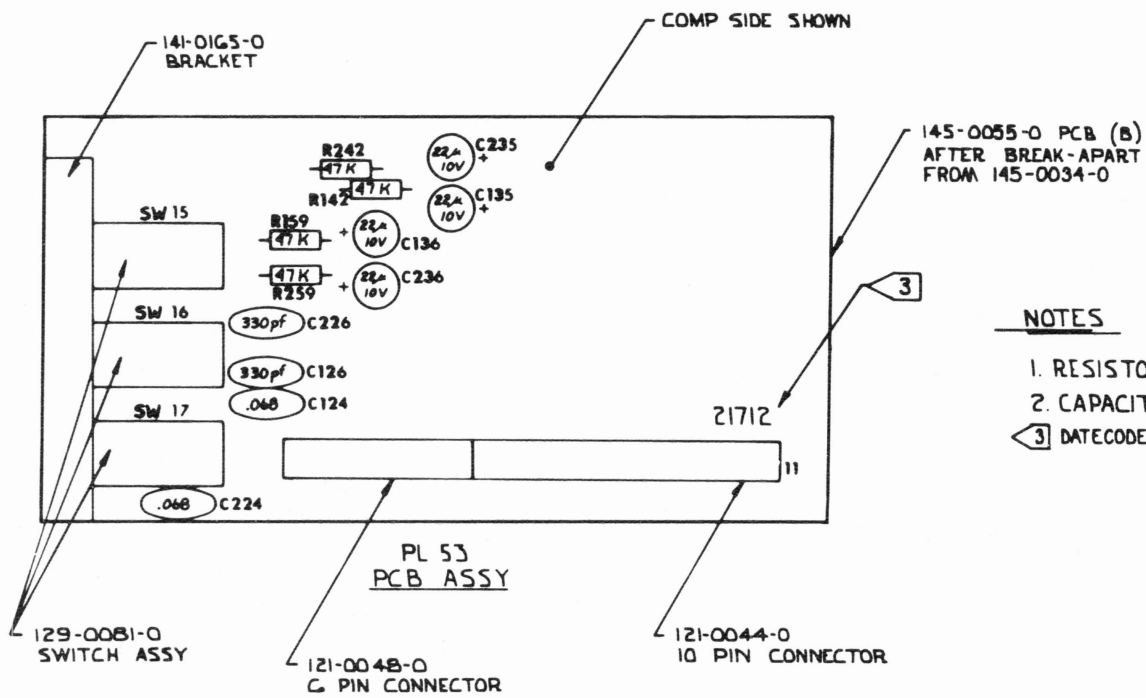


Diagram 2-7. Layout: PL53 Switchboard B.

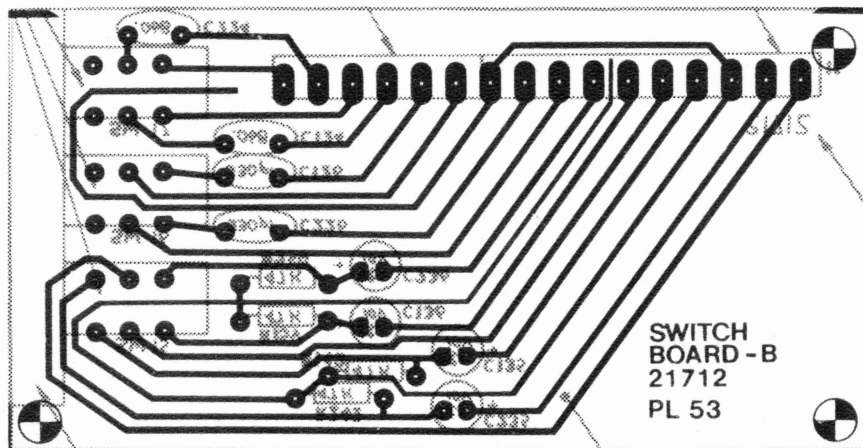


Diagram 2-8. X-ray view of PL53.

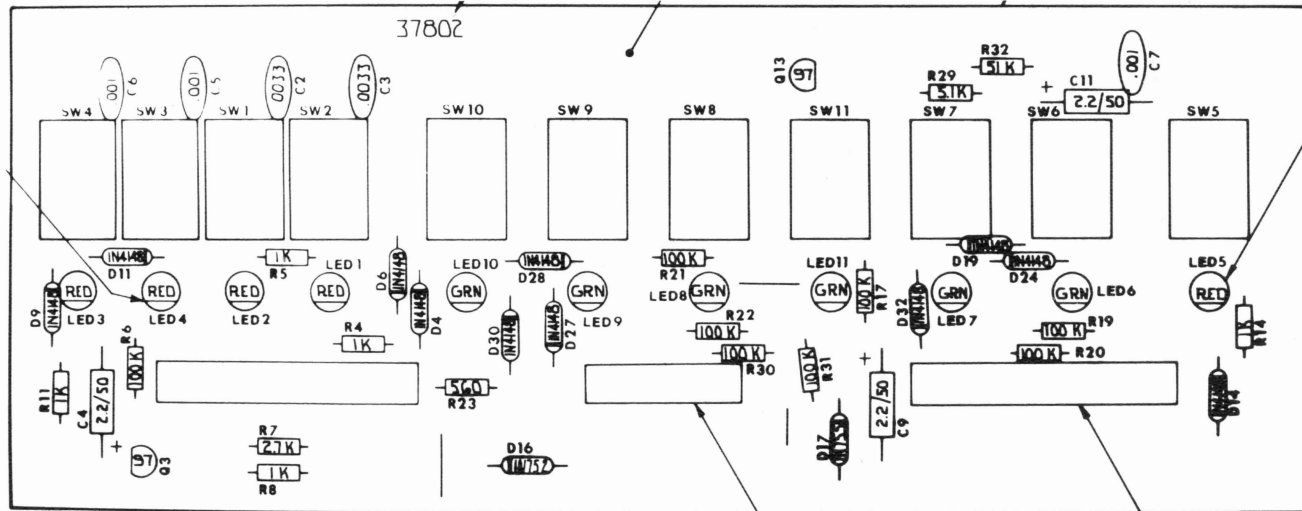


Diagram 2-9. Layout: PL52 Button Board.

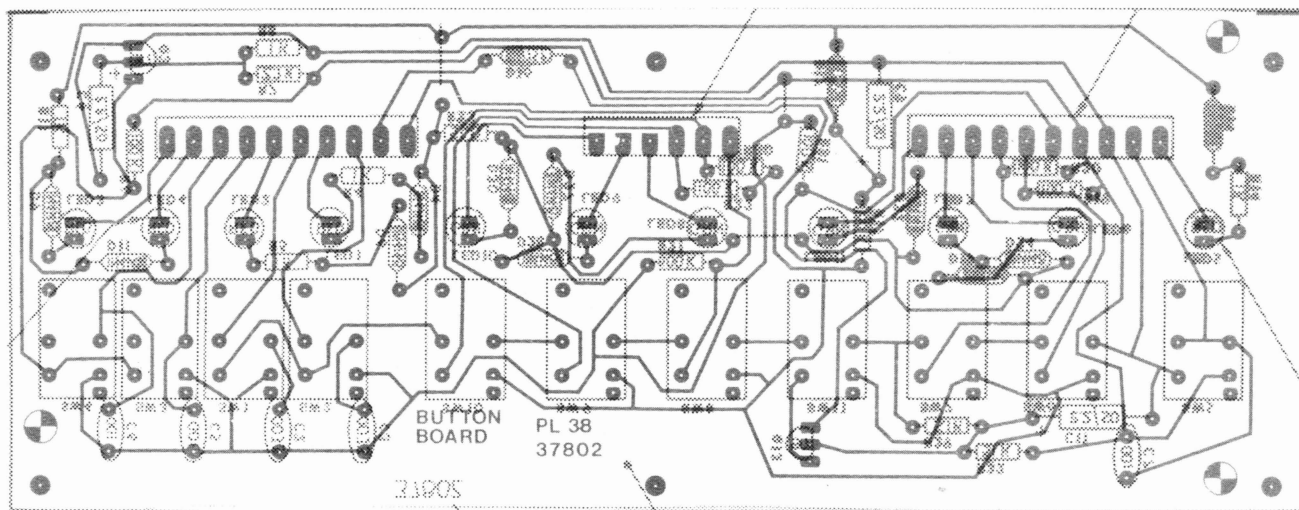


Diagram 2-10. X-ray view of PL52, from foil side.



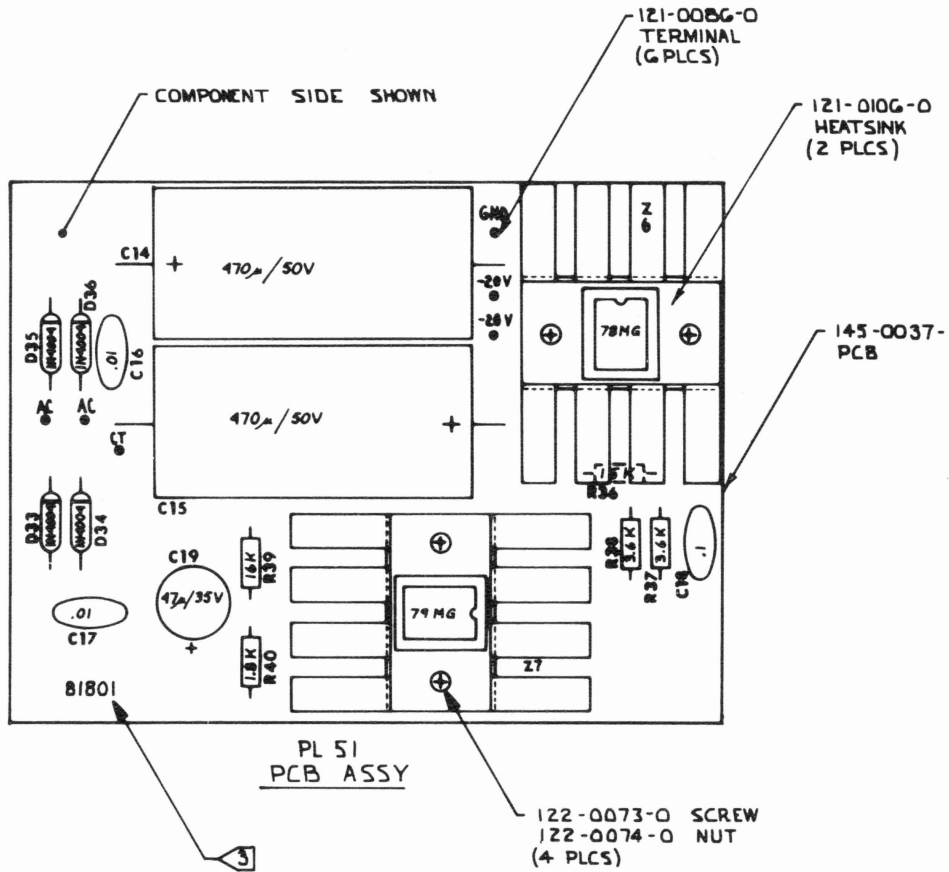


Diagram 2-11. Layout: PL51 Power Supply PCB.

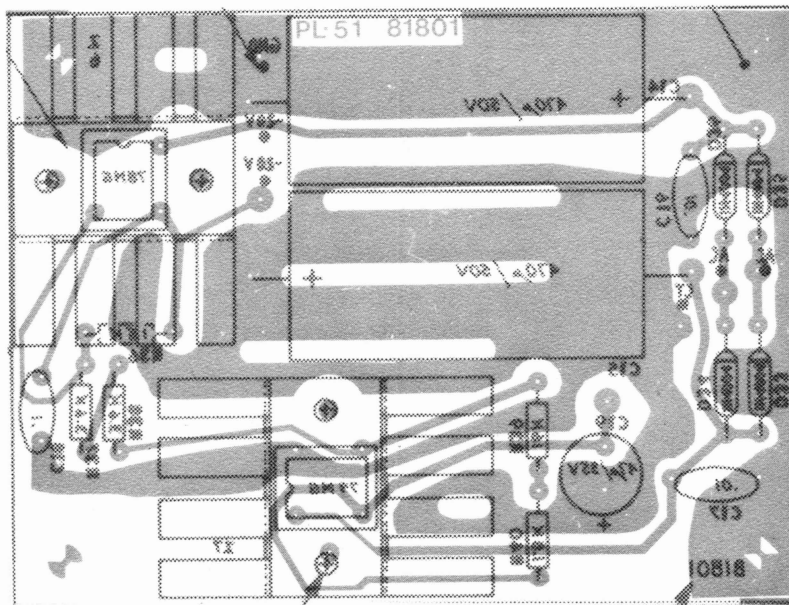


Diagram 2-12. X-ray view of PL51, from foil side.

### 3-0. 3000II Circuit Description

- 3-1. Power Supply. Integrated circuits Z6 and Z7 comprise a dual tracking regulator system giving +20 VDC for use by all ICs except the CMOS circuitry which operates from +10 VDC, regulated by zener diode D18.
- 3-2. Output Relay. Output relay K13-0 is controlled by transistor Q16. Delayed turn-on is accomplished by the R-C charge time of R45 and C24, while the quick turn-off time is fixed by discharge time constant R44-C24. Zener diode D39 guarantees K13-0 drops out when the power switch opens and inserts R35 in series with the power transformer, so that a small voltage is left to keep the CMOS logic circuits active. Once K13-0 drops-out then both A and B outputs are disconnected as well as the headphone jack.
- 3-3. Phono 1 and 2.  
Phono 1 inputs (moving magnet cartridges) are shunted by SW19 which adds additional parallel capacitance as required. Input resistance (and cartridge loading resistance) is fixed by R120 at 47K ohms. Phono equalization and gain is done by Z102 and its feedback network. The output of Z102 is routed through the normally-closed contacts of relays K8-P2 and K9-LF to the normally-open contacts of relay K7-P1.  
Phono 2 inputs (moving-coil cartridges) are shunted by SW18 which adds additional parallel resistance as required. The input signal is amplified 20 dB by the Class-A, series-series feedback pair comprised by Z101 and Q101. Z101 is shown as two paralleled NPN transistors but is actually 64 integrated transistors cross-coupled to produce one statistically matched pair, with extremely low shot noise. The output of Q101 is capacitively coupled to Z10 where the necessary RIAA equalization and gain is accomplished. The output of Z10 is routed through the normally-open contacts of K8-P2 and normally-closed contacts of K9-LF to the normally open contacts of K7-P1.
- 3-4. Low Filter. Any time that the Low Filter relay K9-LF is energized then the output of either phono stage is routed through the high-pass active filter made up of Z9 and three each, resistors and capacitors. The configuration shown is the multiple-feedback, infinite-gain variety giving a maximally flat Butterworth, three-pole response of 18 dB/octave, with a fixed corner frequency of 15 Hz.
- 3-5. Tone Controls. The active tone control consists of Z8 and its associated feedback elements. The topology used is a modified form of the classical Baxandall circuitry. Low frequency boost and cut is done via R131 and frequency

determining capacitors C125 and C127. Frequency shifting is done via SW17 and C124. Likewise, high frequency boost and cut is done with R134 and capacitors C128 and C126.

3-6. Headphone Amplifier. The headphone amplifier consists of Z106 and current booster transistors Q102 and Q103. Gain is set at 13 dB by feedback resistors R137 and R140. Power output is limited to safe levels for headphones by the parallel combination of R146 and R161. Power averaging is done by output parallel resistor R147 which limits the maximum load resistance seen by the amplifier. The output of each amplifier is delivered to the stereo headphone jack where relay K12-H is controlled by the auxiliary contact.

3-7. CMOS Switching Logic.

3-7.1. Memory.

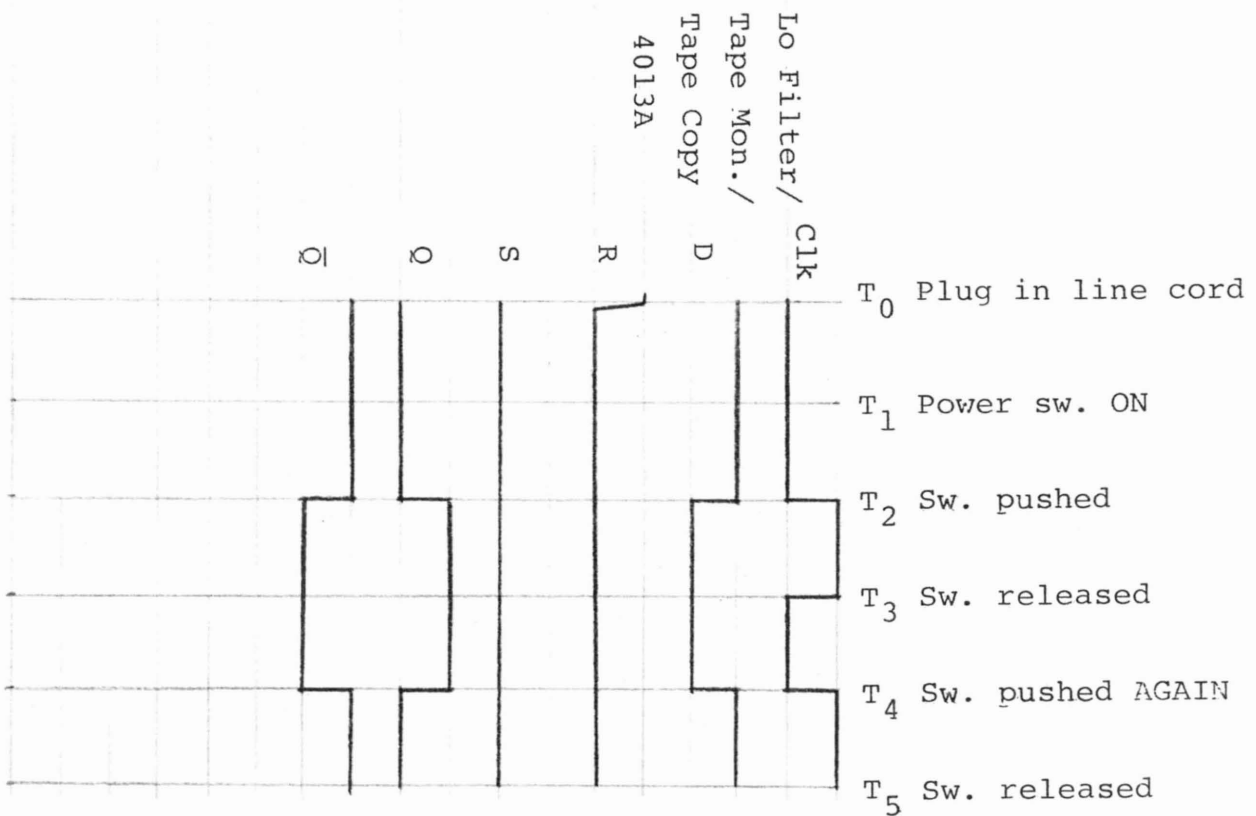
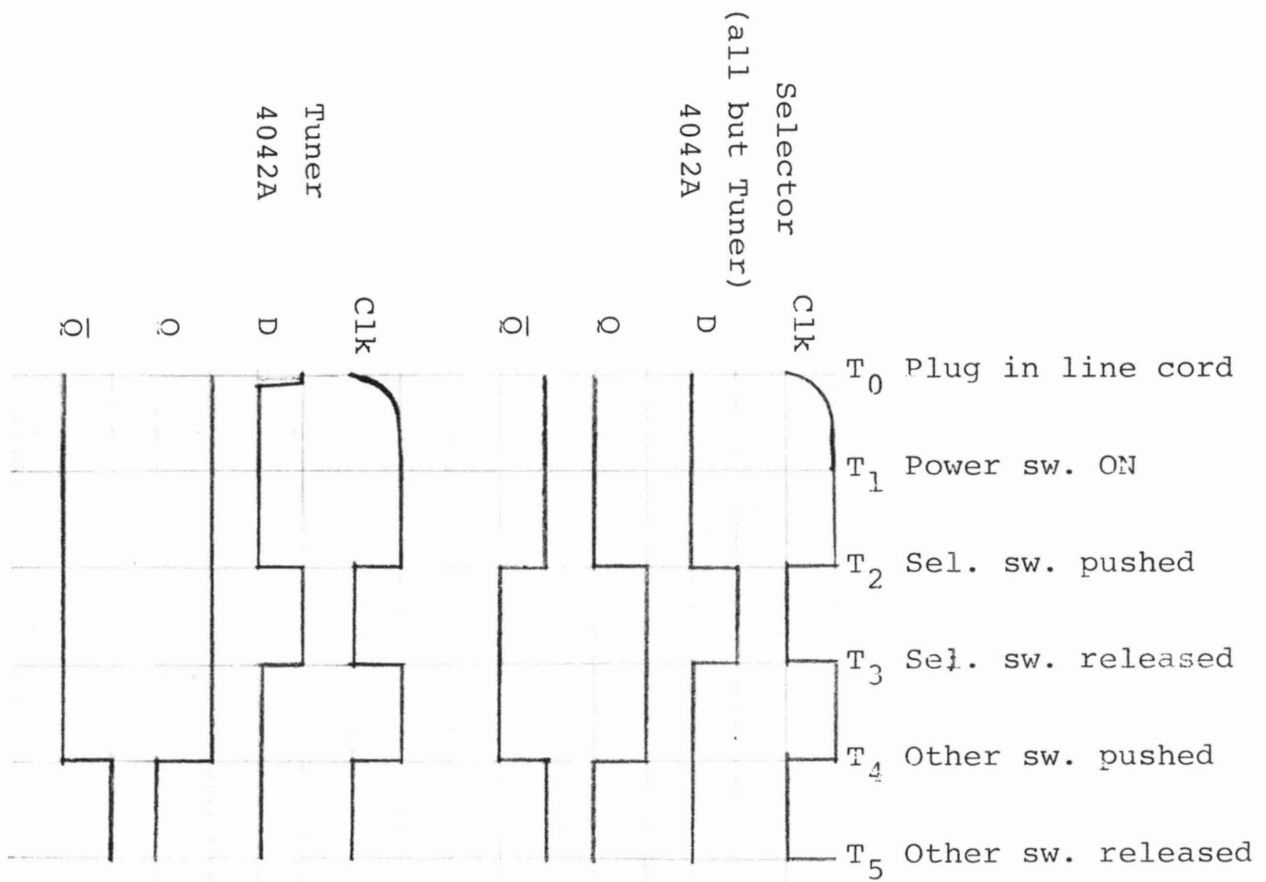
General description: Since all switching in the 3000 is done electronically, the logic must remain functional when the power is OFF in order to power up in the same mode as before.

Detailed description: The power switch is shunted by a resistor which keeps partial supply voltage to the ICs when the power switch is OFF. The supply voltage must be low enough to keep the logic ICs functional. The relays do not function with power OFF because the supply across them is not high enough.

3-7.2. Input Selection.

General description: Input selection relays are controlled by two 4042A Quad D latches. These Flip Flops (F/F) share a common clock line and in this application are programmed to respond to a falling clock pulse, (i.e., D goes to Q on a falling clock pulse). The logic must self cancel (interlock) to prevent two inputs from being selected at once.

Detailed description: In the normal OUT switch position the D inputs are low (ground) and the clock line is high. The tactile switches are the non-shorting (break-before-make) type. When a selector switch (SW6-11) is pushed it first breaks the D contact allowing it to be pulled high through a 100K resistor. Next it pulls the clock line low causing the high D input to go to the Q output. The high Q output turns on a transistor which energizes the corresponding LED and relay. Since the clock line is common, all other selector inputs are automatically cancelled. Since relay K8 is



Switching Logic Timing Diagrams

normally in the Phono 1 position, when Phono 2 is selected two relays must be activated. This is accomplished by forward biasing D22.

### 3-7.3. Power-up in Tuner.

General description: The 3000 switching logic is designed such that if the unit is unplugged it will power up in the Tuner mode.

Detailed description: When the 3000 is turned on from a totally discharged (unplugged) state, the base of Q13 will be held low for a period determined by the R-C charge time of R32, R29 and C11, thus the collector will be high. The D input will be held high long enough to energize tuner relay K1.

### 3-7.4. Low Filter.

General description: The Low Filter is controlled by a 4013A D F/F. D goes to Q on a high clock pulse.

Detailed description: The Q output will always power up low because the reset line is pulled high on turn on for a period determined by the R-C charge time of R12 and C8. In the normal (OUT) switch position the clock line is held low. The  $\bar{Q}$  output is tied to its own D input so when Low Filter switch (SW5) is depressed, the clock line is pulled high causing the Q output to change states. When Low Filter switch (SW5) is pushed, the output will go high thus turning on Q6, LED 5 and relay K9. When the switch is pushed again, the Q output will change to a low state.

### 3-7.5. Tape Monitor. Tape Monitor switching logic is the same as the Low Filter logic.

### 3-7.6. Tape Copy.

General description: The Tape Copy functions are also controlled by a 4013A dual D F/F and must self-cancel (interlock) when the other Copy switch is pushed.

Detailed description: Both Q outputs will power up low because both reset lines are pulled high until the R-C charge time of R7 and C4 causes Q3 to turn on and pull the reset and clock lines low. In the normal (OUT) switch position the clock line is held low. The  $\bar{Q}$  output is tied to its own D input. Interlocking is accomplished by connecting the clock input of one F/F to the reset input of the other F/F. When Copy switch SW3 is pushed, the clock input of F/F1 is tied high and the reset input of F/F2 is also tied high. This assures that only one Copy function can be selected at a time.

## 4-0. DISASSEMBLY PROCEDURE

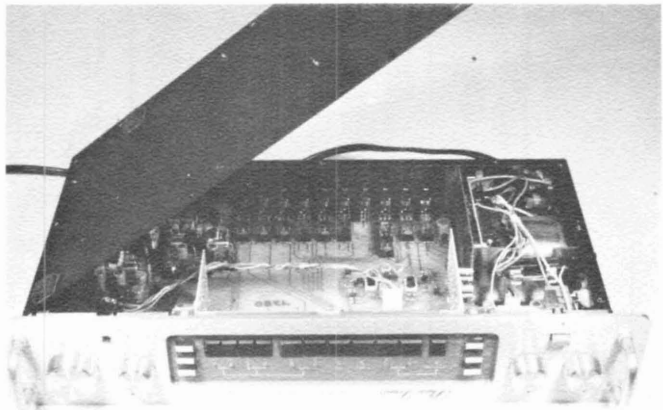
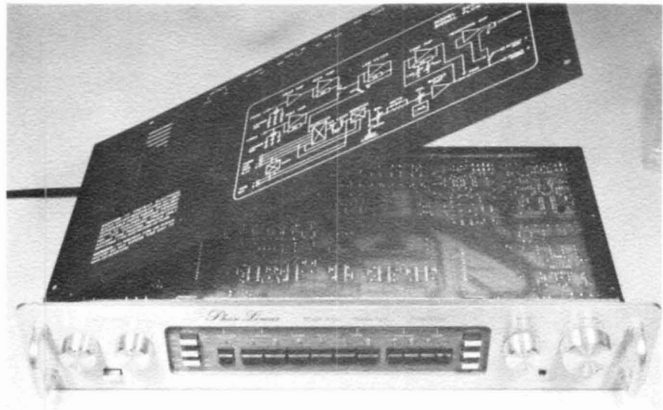
### CONTENTS

- 4-1. Main PCB access
- 4-2. Front panel disassembly
- 4-3. Re-assembly

#### 4-1. MAIN PCB ACCESS

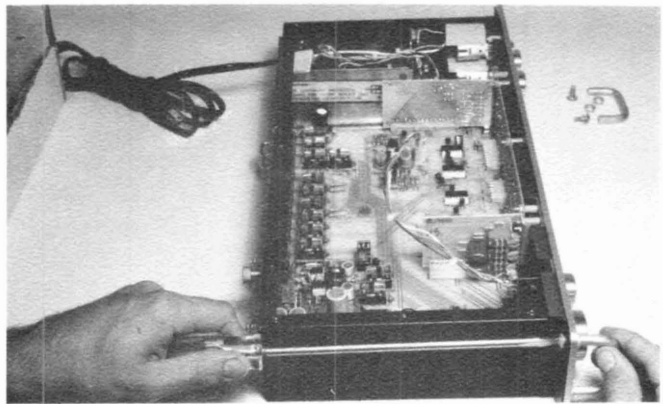
4-1.1. For access to the component side of the PCB, remove the bottom cover plate (9 phillips screws).

4-1.2. For access to the foil side of the PCB, remove the top cover plate (9 phillips screws).

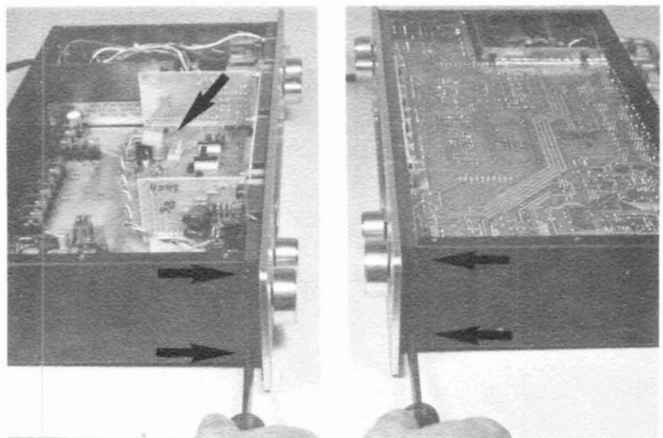


#### 4-2. FRONT PANEL DISASSEMBLY

4-2.1. Remove the handle screws, washers, ferrules, and set the handles aside.

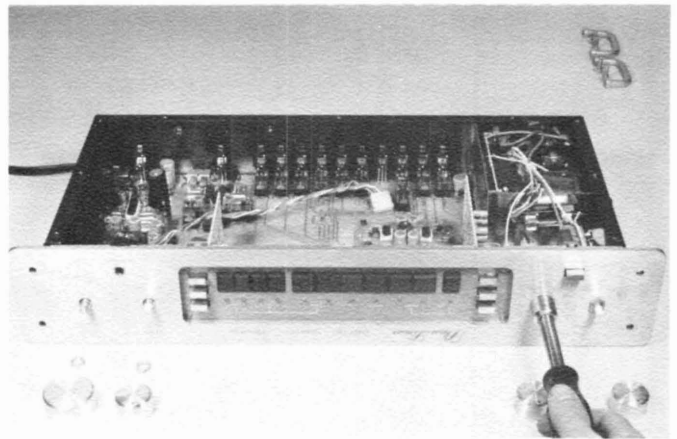


4-2.2. Remove the 4 sub-front mounting screws and unplug the headphone jack wire connector.

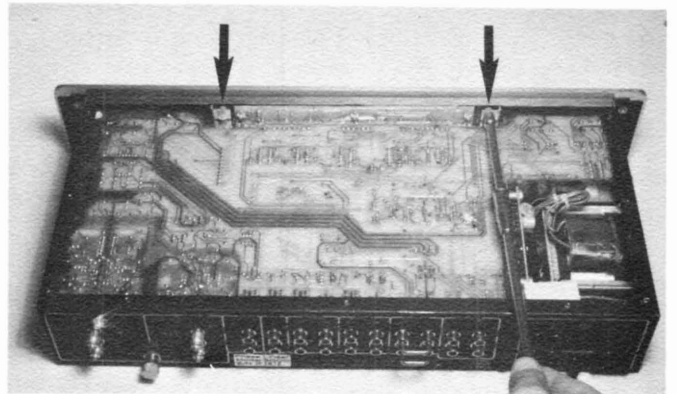
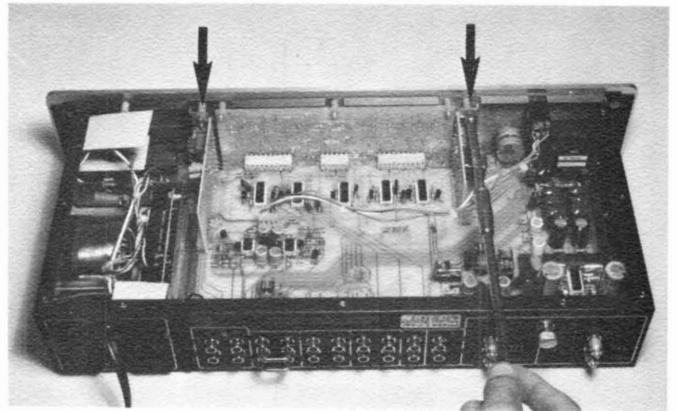




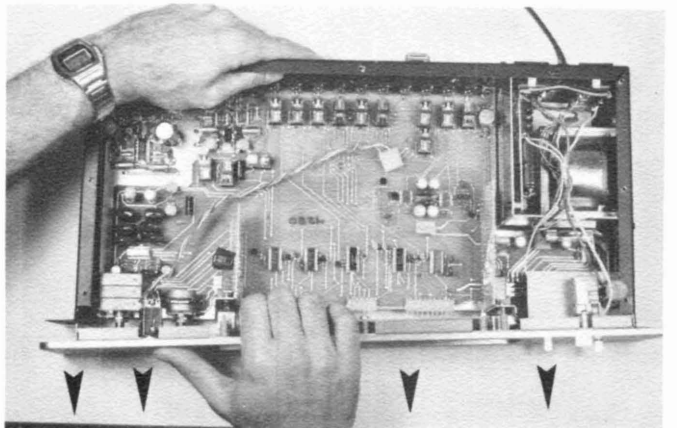
4-2.3. Remove the Volume, Balance and Tone control knobs and 7/16 shaft nuts.



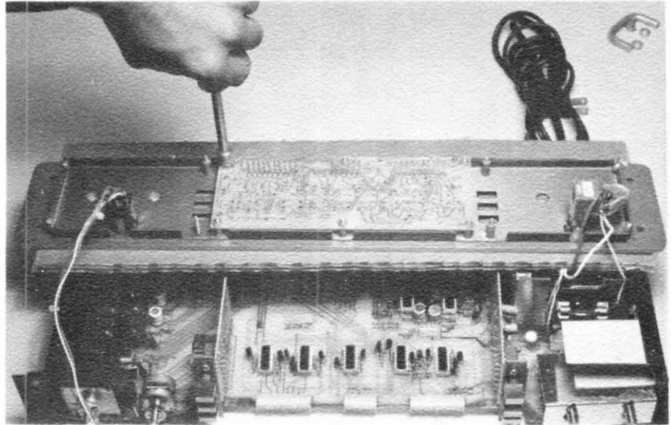
4-2.4. Remove the four keps nuts holding PL53 and PL54 circuit boards to the sub-front, as shown.



4-2.5. Grasp the front and sub-front panels firmly and pull forward to unplug the entire assembly from the mother board--do not strain any connecting wires.



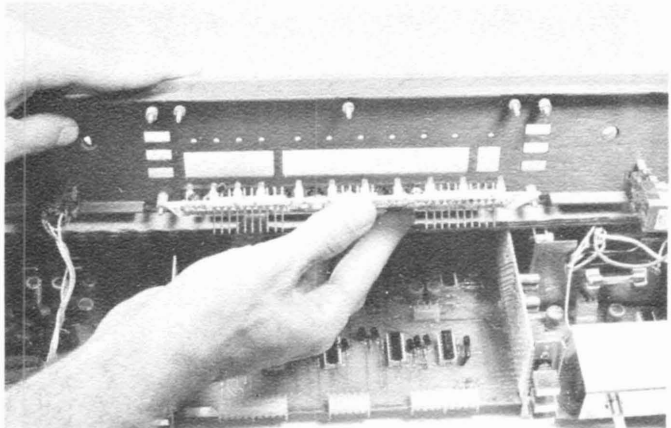
4-2.6. Set the front panel assembly face down on a non-abrasive surface resting on the chassis of the 3000, as shown. Remove the 6 kep nuts holding the switch board to the sub-front.



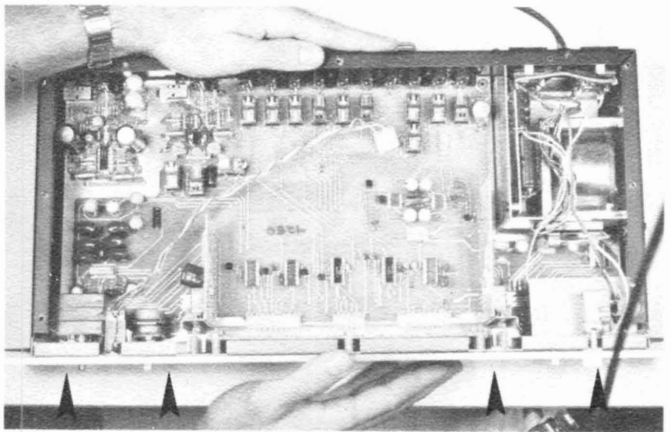
4-2.7. Lift the switch board off of the mounting bolts for switch, LED or other component replacement.

#### 4-3. FRONT PANEL RE-ASSEMBLY

4-3.1. Place the switch board onto the mounting bolts and carefully align all LED's into the sub-front holes. Secure the board in place with the 6 kep nuts.

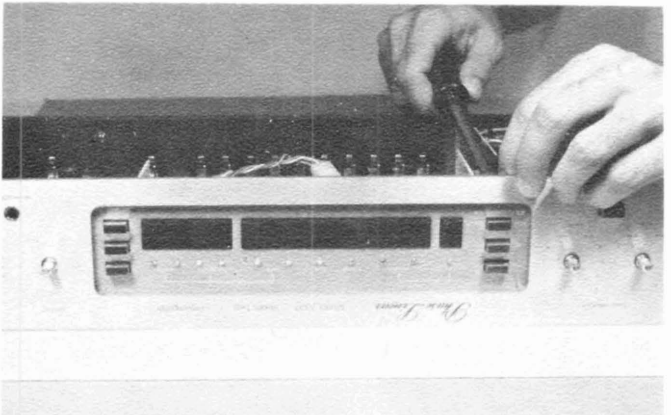


4-3.2. Slide the front panel assembly over the four pot shafts, switch buttons and PL53 and PL54 mounting bolts; then plug the switch board into the mother board connectors with a rocking motion. DO NOT FORCE THIS CONNECTION. Check the alignment of the pot shafts, switch buttons and mounting bolts continuously while plugging in the switch connectors.



4-3.3. Position the switch board so that the switch buttons are centered in the sub-front holes, then tighten the four kep nuts securing PL53 and PL54.

4-3.4. Replace the 4 pot shaft nuts, knobs, sub-front screws and handle assemblies.





5-0. TEST PROCEDURE

CONTENTS

- |                                       |                            |
|---------------------------------------|----------------------------|
| 5-1. Power supply                     | 5-9. Mute                  |
| 5-2. Switching Logic and Main Outputs | 5-10. Tone controls        |
| 5-3. Logic Memory                     | 5-11. Phono circuits       |
| 5-4. Tape circuits                    | 5-12. Low Filter           |
| 5-5. Volume tracking and balance      | 5-13. High level S/N ratio |
| 5-6. Separation                       | 5-14. Headphone outputs    |
| 5-7. Stereo/mono                      | 5-15. Output relay         |
| 5-8. Loudness                         |                            |

NOTE: Unless instructed otherwise, all tests should be performed with all amber LED's OFF, Tone, Loud and Mute circuits OUT, in Stereo with Balance control centered.

5-1. Power supply. With the 3000 power switch OFF, plug the line cord into an AC outlet of proper line voltage. Depress several of the tactile switches and verify that none of the LED's is lit or partially lit. Switch the 3000 power ON and verify that at least one LED lights up after pressing several of the tactile switches.

5-2. Switching Logic and Main Outputs. With the 3000 power switch ON, depress each of the tactile switches, left to right, verifying that each of the green and amber LEDs light up appropriately. All of the amber LED functions operate independently: press the switch once for ON, once again for OFF. All of the green LED functions are interlocking: pressing any of these function switches causes that green LED to light and any other green LED to go off.

NOTE: It is possible to cause two green LEDs to light at once by pressing two function switches exactly simultaneously--this is not a malfunction. Also, both Tape 1 and Tape 2 switches may be engaged simultaneously--this allows for greater flexibility of this circuit, with Tape 2 overriding Tape 1 since they are in series (refer to schematic).

Select and drive any high level input with 250 mV at 2K Hz. Turn the 3000 volume control to the 0 dB position and verify undistorted output signal at the Main outputs A and B.

5-3. Logic memory. Engage several of the amber and one green LED function, then turn the 3000 power switch OFF. Turn the power switch back ON and verify that the same functions are again indicated as prior to turn-off. Now unplug the 3000 line cord, wait a few seconds, then plug the line cord back in. Verify that only the green Tuner LED is now lit.

5-4. Tape circuits. Verify the proper tape circuit signal paths according to the chart below:

<u>FUNCTION</u>	<u>INPUT</u>	<u>OUPUT</u>
Tape 1	Tape 1 Play	Tape 1 Rec
Copy 1 2	Tape 1 Play	Tape 2 Rec
Tape 2	Tape 2 Play	Tape 2 Rec
Copy 2 1	Tape 2 Play	Tape 1 Rec
Tape 2	Tape 2 Play	Output A & B
Monitor 2	Tape 2 Play	Output A & B
Tape 1	Tape 1 Play	Output A & B
Monitor 1	Tape 1 Play	Output A & B

NOTE: Drive the appropriate inputs with 250 mV at 2K Hz and monitor the outputs with a scope and voltmeter.

- 5-5. Volume tracking and balance. Select and drive any high level input with 250 mV at 2K Hz. Turn the 3000 volume control to the 0 dB position and monitor the A outputs with a scope and AC voltmeter; set the AC voltmeter to read 0 dB. Turn down the volume control slowly and verify that the output level of both channels are within  $\pm 0.5$  dB of each other. Return the volume control to 0 dB then rotate the Balance control fully clockwise, then fully counterclockwise; verify that the left and then right channels respectively become fully attenuated.
- 5-6. Separation. Select and drive any high level left & right inputs at 2K Hz. Monitor the A outputs with the AC voltmeter and turn up the 3000 volume control to obtain a 0 dB reference level on the voltmeter. Unplug the left input and install a shorting jack. Verify that any signal output from the left channel is -45 dB or more below the right channel.
- 5-7. Stereo/mono. Select and drive any high-level left and right inputs with 250 mV at 2K Hz. Adjust the volume control for a 0 dB reference on an AC voltmeter connected to the left and right A outputs. Unplug the left input signal and verify that the left output signal is removed with the Mono switch OUT. Press the Mono switch to the IN position and verify that there is output from both left and right channels at a level of -3 dB.
- 5-8. Loudness. Set 3000 volume control at the -20 dB position and adjust an input level of 20 Hz to obtain 0 dB reference on an AC voltmeter connected to the A or B outputs. Press the LOUD switch to the IN position and verify an increase in output level of 15 dB, both channels.

- 5-9. Mute. With the 3000 set up as in step 5-8, press the MUTE switch to the IN position and verify a 20 dB decrease in output level.
- 5-10. Tone controls. Select and drive any high level input with 250 mV at 20 Hz. Adjust the 3000 volume control to obtain a 0 dB reference level on an AC voltmeter connected to the A outputs. Verify the proper operation of the tone controls and turnover switches according to the table below:
- 5-11. Phono circuits. Select and drive the Phono 1 inputs with 2.0 mV at 1K Hz. Verify 2.0 volts or greater at the A or B outputs with the 3000 volume control turned fully clockwise. Increase the input level to 10 mV and reference the output at A or B to 0 dB with the 3000 volume control still fully clockwise. Unplug both Phono 1 inputs and install shorting jacks. Now verify that any output material is -90 dB or lower.

Repeat the above procedure with the Phono 2 circuit, using a 0.20 mV input for 2 volts output, and a 1.0 mV input reference for a -78 dB noise level.

- 5-12. Low Filter. Select and drive the Phono 1 inputs with 2.0 mV at 15 Hz and obtain a 0 dB reference at A or B outputs. Now engage the Low Filter and verify a drop in output level to -3 dB.
- 5-13. High level S/N ratio. Select and drive any high level input with 1K Hz to obtain 2.0 V at the A or B outputs, with the 3000 volume control turned fully clockwise. Remove the inputs and install shorting jacks. Verify that any output present is now 91 dB or more below the 2.0 volt reference.
- 5-14. Headphone outputs. 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 1.25 V RMS before clipping with the 3000 volume control turned fully clockwise. Verify that with the headphone jack plugged in the signal is removed from the A outputs but remains at the B outputs.
- 5-15. Output relay. Select and drive any input and monitor the A and B outputs. Switch the 3000 power switch OFF and verify that the output signal is removed immediately. Turn the 3000 back ON and verify that the output signal returns after a delay of 5 to 10 seconds.

## 6-0. TROUBLESHOOTING GUIDE

### CONTENTS

- 6-1. Power Supply
- 6-2. Switching logic
- 6-3. Logic memory
- 6-4. Tape circuit malfunction
- 6-5. Malfunction of volume or balance controls
- 6-6. Poor separation
- 6-7. Malfunction of Stereo/mono
- 6-8. Malfunction of loudness circuit
- 6-9. Malfunction of mute circuit
- 6-10. Tone circuit malfunction
- 6-11. Phono circuit malfunction
- 6-12. Low filter malfunction
- 6-13. Excessive noise throughout high level inputs
- 6-14. Malfunction of headphone outputs
- 6-15. Malfunction of output relay

### 6-1. POWER SUPPLY

6-1.1. Power OFF mode. R35 shunts the opened power switch, supplying enough primary voltage to keep the logic circuitry ON but all other circuits (including the relays and their indicator LEDs) OFF.

- a) LEDs lit when power is off: check to see if there are two 3.3K resistors paralleled for R35. If so, clip one out. Perform step 5-3 to verify that logic memory still functions. Check the following:
  - D17 should be 7.5 V zener, with R23 at 560 ohms \*
  - voltage between the black and blue wires on power supply connector should be +12V,+1 V, with power off (refer to Diagram 2-3 p8). If not, check R35, and increase value as necessary.

6-1.2. Power ON mode. If the 3000 power switch is turned ON right after plugging the line cord into an AC outlet, without depressing any tactile switches, then it is probable that none of the LEDs will be lit at power ON. This is NOT a malfunction; simply depress one of the source switches to initiate the interlocking logic

\*Note: units with serial number greater than 3P1250 already contain this modification.

control.

- a) No LEDs light up after depressing all switches:
  - check the power supply voltages at the power supply connector wires (Diag. 2-3):  $\pm 20$  V with  $\pm 1$  V margin. If voltages are not as indicated:
  - Check the line fuse; replace if necessary
  - check for  $\pm 31 \pm 1.5$  VDC at pin 1 of Z6 and  $-32V \pm 1.5$  V at pin 4 of Z7. If the voltages are not good, check for 49 VAC  $\pm 3$  V across the transformer secondary. Replace the transformer if the secondary output is insufficient.
  - check diodes D33 through D36

## 6-2. SWITCHING LOGIC

6-2.1. One or more LEDs do not light up. Referring to Diagram 2-2 on p. 8,, observe the relay which should operate in the defective LED circuit and switch that circuit in and out (if the defective LED is green, alternate between that and another green LED function. If it is amber, simply repeat depressing that switch). If the relay does NOT respond to the switch, refer to 6-2.2. If the relay DOES respond to the switch, then the LED itself or the series diode is defective and should be replaced. If none of the green LEDs light up, but all relays work, then replace R23.

6-2.2. One or more relays will not operate. The elements involved in the relay switching network are: the relay and its flyback switching transistor, the logic IC, and the tactile switch. The following may be tested in-circuit:

- a) Relay operation: attach one end of a jumper lead to ground and carefully touch the other end briefly to the collector of that relay's drive transistor (refer to Diagram 2-3, p8. If the relay snaps in then refer to step b) below. If the relay does NOT respond to the jumper, check the flyback diode(s) (the amber LEDs have an additional flyback diode in series with the relay) and replace as necessary. If the relay will not snap in with good diodes, replace it and repeat the test.
- b) Relay drive transistor operation: utilizing an ohm meter set at 2K or RX10 scale (Note: the meter in use must have sufficient test voltage to turn on a silicon semi-conductor), attach the negative lead to ground and briefly touch the positive probe directly to the base of the drive transistor. If the relay does not snap in, replace the transistor and test again. If the relay DOES respond to this test, refer to 6-2.2.c) below.
- c) Tactile switch operation: check the continuity

of the tactile switch governing the defective circuit. Check both open and closed modes. Look for short to ground on the normally closed half of the switch. Repair or replace the switch as necessary. If the switch checks good, then by process of elimination the logic IC must be defective and therefore replaced. If replacement of the IC does not render the circuit operational, check the continuity of the foil patterns in the circuit and clean all connectors.

- d) Tape Monitor, Tape Copy or Lo Filter relays snap in and out again when tactile switch is pushed: install a 100K resistor from clock input to ground on Z1, Z2, or Z3 as necessary.

6-2.3. No signal through main outputs with switches operational. Troubleshoot the output relay network as outlined in 6-15.

### 6-3. LOGIC MEMORY

6-3.1. Memory malfunction when the 3000 power switch is used.

IMPORTANT: It is necessary that line voltage to the 3000 power cord NOT be interrupted at any time while the 3000 is switched off, otherwise the logic memory will be erased.

With the 3000 power switch OFF and the line cord plugged into the proper line voltage source, measure the B+ voltage at the power supply connector indicated in Diagram 2-3, p8. If it is less than +8 VDC, proceed to 6-3.1.a) below. If it is +8 VDC or greater, refer to 6-3.1.d).

- a) Measure B+ at pin 1 of Z6. If it is less than +9 VDC refer to step b) below. If it is +9 VDC or greater, then replace Z6 (check to see that R36 and R37 are not damaged).
- b) Measure the AC output of the transformer secondary on PL51.. If it is 20 VAC or greater, look for a defective D33 through D36 or C14, C15 to cause a voltage drop at pin 1 or Z6. If all of these check good, replace Z6. If the secondary output is LESS than 20 VAC, troubleshoot the power transformer circuit as outlined in step c) below.
- c) Power transformer circuit: Turn the 3000 power switch ON and measure the secondary output on PL51, Diag. 2-11. If it is less than 40 VAC, the transformer is good but the power-off bypass resistor R35 is defective or too large for the local line voltage. Replace R35 if defective, or reduce its value to accommodate lower line voltage. Note: If R35 becomes too small, the LED indicators will not extinguish completely at power-off.

- d) If the power-off B+ measures good in step 6-3.1. but memory still malfunctions, check R18, D18; there should be at least +6.5 VDC present at pin 16 of Z4 and pin 14 of Z1, Z2, and Z3. If all measure good, replace the logic ICs according to the chart below:

<u>MEMORY MALFUNCTION</u>	<u>REPLACE IC</u>
T1 Mon, T2 Mon	Z1
Copy 1-2, Copy 2-1	Z2
Low Filter	Z3
P1, P2, Aux, T1	Z4
T2, Tuner	Z5

- 6-3.2. Unit will not switch to Tuner when AC is applied to the line cord. Q13 and the associated circuitry ensures that pin 7 of Z5 is away from ground (high) during initial charge-up; pin 7 must be high to cause pin 10 to also go high, activating the Tuner relay circuit. Pin 5 must be low at turn-on, due to the initial low impedance of C9, to cause Z4 and Z5 to "look" at the data inputs and therefore engage or disengage the appropriate outputs. (Refer to section 3-7 for detailed description of logic functions).
- a) Check and replace as necessary Q13, C11, R29, R32.  
b) Check C9, R13.

- 6-3.3. One or more amber LEDs activates when AC is applied to line cord. OFF mode of all the amber circuits after energizing via the line cord is guaranteed by keeping the Reset pins 4 and 11 on Z1, Z2, and Z3 HIGH (at B+) during initial charge-up. This is accomplished through C1 and R1.
- a) Check for defective C1 (open, broken lead, bad solder).  
b) Check for shorted R1, solder bridge.

#### 6-4. TAPE CIRCUIT MALFUNCTION

- 6-4.1. Loss of signal path through one or more Tape functions.
- a) Switch back and forth between the defective Tape circuit and another amber LED function while observing the relay governing the defective circuit: refer to Diagram 2-3, p8. If the relay does NOT respond to switching, troubleshoot the relay circuit as outlined in 6-2.2. If the relay DOES respond to the tactile switch, double-check input/output connections as shown in 5-4. Inspect the foil pattern for broken lands, solder bridges,



or broken or cold solder joints. Inspect the input/output jacks for broken leads or either lead shorting to the ground lead. Check the input/output jacks themselves for possible short from hot to ground.

6-4.2. Distortion or feedback on tape recording through either of the 3000 tape circuits.

Some three-head tape machines do not disengage the record preamps when in the playback mode, resulting in feedback of the output signal to the record preamps when either the Tape 1 or Tape 2 Source function (green LED) is engaged. This problem can be avoided by utilizing the Tape Monitor circuits rather than the Source functions. If this arrangement is not feasible for the customer, contact the factory service department for further advice.

6-5. MALFUNCTION OF VOLUME OR BALANCE CONTROLS

6-5.1. Mistracking of volume control. The volume control is comprised of a series of vapor-deposited thick film resistors for precise step attenuation. If any mistracking, distortion, or intermittent operation occurs with the volume control, it must simply be replaced. If problems persist after volume control replacement, inspect the Loudness circuit, C138/238 and R154/254; also inspect C142/242 and R160/260. Check for broken foil, solder bridges, cold or broken solder connections. If one channel is consistently higher in output level, inspect Z9 and its feedback network; replace Z9.

6-5.2. Balance control malfunction.

a) Channels not balanced with Balance control centered:

- check balance at all volume control levels: if balance changes with different settings, suspect mistracking of the volume control --see 6-5.1.
- replace balance control

6-6. POOR SEPARATION

6-6.1. The 45 dB separation specification is largely a function of design layout and shielding. The use of relay switching, foil ground shielding, and many



other techniques have been designed into the 3000 to minimize crosstalk between channels. If a problem should develop concerning poor separation, check the following:

- a) Be sure any crosstalk is not originating from the source, such as cartridge mistracking, tape head misalignment, etc.
- b) If the unit does NOT meet the separation spec, check for solder bridges, poor ground or solder connections, metal filings or other conductive matter which may be creating signal path between channels.
- c) Bleedthrough is often confused with crosstalk. Although the same design criteria were used to prevent 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 3000 Tuner inputs, which might be audible through the Phono 2 circuit with a low output cartridge in use.

#### 6-7. MALFUNCTION OF STEREO/MONO

6-7.1. If this circuit displays intermittent operation, or will not switch to mono, clean or replace the switch. Inspect all solder connections and foil patterns.

6-7.2. If the unit will not switch out of the mono mode, test all inputs: if all inputs are mono, look for a solder bridge or other short circuit following the signal path from the NR Loop input to the main outputs. If the mono mode only persists in one set of inputs, check to see that the NR Loop buss connectors are not plugged into that input, then inspect for solder bridge or short following the signal path from the inputs to the NR Loop outputs.

#### 6-8. MALFUNCTION OF LOUDNESS CIRCUIT

6-8.1. Loudness will not switch in on one or both channels:  
a) Replace C138/238; inspect switch and foil pattern for short or solder bridge.  
b) Inspect volume control and replace if necessary.

6-8.2. Loudness will not switch out of one or both channels:  
a) Clean the loudness switch and inspect connections to the switch and the volume control. Replace switch.

6-8.3. One or both channels loud at all frequencies when Loudness switched in:  
a) Inspect C138/238 for bad solder connection; replace C138/238.

## 6-9. MALFUNCTION OF MUTE CIRCUIT

### 6-9.1. One or both channels will not mute:

- a) Clean mute switch SW14.
- b) Check R153/253 and solder connections, foil pattern.
- c) Check switch continuity and replace if necessary.

### 6-9.2. Both channels do not mute equally (more than +1 dB difference):

- a) Measure R153/253, R152/252 and replace as necessary.

## 6-10. TONE CIRCUIT MALFUNCTION

### 6-10.1. Distortion, hum or loss of signal when Tone circuit switched in:

- a) Clean the Tone switch SW15. Check continuity and replace if necessary.
- b) Replace Z8. Inspect IC sockets and foil pattern. Repair as necessary.
- c) Check the tone pots for broken leads, cracked or cold solder joints, or broken substrate.

### 6-10.2. Malfunition of tone turnover circuit in one or both channels:

- a) Check continuity of turnover switch, and clean or replace as necessary.
- b) Check the capacitors in the defective circuit for broken leads, bad solder joints, or broken foil, etc.

## 6-11. PHONO CIRCUIT MALFUNCTION

### 6-11.1. Excessive noise:

- a) In Phono 2: replace Z101/201 and recheck S/N. Replace Z10, Q101, and Q201. If noise still persists, it is possible that the cause is a noisy resistor. Replace resistors with the metal oxide low noise type, obtainable from the factory. (R111 and R211)
- b) In Phono 1: replace Z102/202 and recheck S/N. Replace Z9 and recheck S/N. If noise still persists, replace resistors with metal oxide low noise type available from the factory.

### 6-11.2. Distortion or loss of signal, one or both channels:

- a) Inspect inputs for proper ground connection-- pin jacks must fit tightly onto ground sleeve. Check the input jack pins for breakage, cold or cracked solder joints.
- b) Refer to Diagram 2-3 on p8 and observe the phono relay circuit to verify that all of the relays are switching properly; if they are not, troubleshoot the relay system as outlined in 6-2.2. If the relays are switching properly,

check for presence of signal at the inputs and outputs of the relays shown in Diagram 6-11.2(b). If there is no input at the appropriate relay, replace phono ICs as outlined in 6-11.1.a),b). If signal is present at the input of the relay but not at the output, replace the relay.

#### 6-12. LOW FILTER MALFUNCTION

First, a friendly reminder that the Low Filter operates only with the Phono circuits, and not with any of the high level inputs. If however, the Low Filter doesn't operate properly with Phono either, then check the following:

- 6-12.1. Proper operation of the Low Filter relay--refer to 6-2.2.
- 6-12.2. Inspect the low filter circuit for broken capacitor leads, cracked or cold solder joints.
- 6-12.3. Replace Z9.

#### 6-13. EXCESSIVE NOISE THROUGHOUT HIGH LEVEL INPUTS

- 6-13.1. Replace Z9.
- 6-13.2. If noise only occurs with the Tone circuit IN, replace Z8.

#### 6-14. MALFUNCTION OF HEADPHONE OUTPUTS

- 6-14.1. No output or distorted output from headphone jack.
  - a) Verify that the headphone relay K12-H snaps in when a ¼ inch headphone plug is inserted into the headphone jack--refer to Diagram 2-3. Measure across the primary of K12-H for +20 VDC. If no voltage is present, check continuity of the headphone jack switch; clean or replace as necessary. If there is +20 VDC across the primary, but the relay does not snap in, replace the relay.
  - b) If relay K12-H does respond to the insertion of the headphone plug, but there is no output signal:
    - verify input signal at R137/237; if none is present, trace the foil pattern to the relay and inspect; replace the relay.
    - observe the output of Z106/206 at pin 6; if there is none, or it is badly distorted, turn unit off and check Q102/202, Q103/203, D101/201, D102/202. Replace as necessary. If these measure good, replace Z106/206.
  - c) Check for burned emitter resistors R144, R145, R244, R245; replace as necessary with ½ watt resistors of same value.

- 6-14.2. Insufficient output from headphone circuit.
- a) Verify +20 VDC at power supply output and at collectors of Q102/202 and Q103/203. There should be at least 117 VAC at the line plug for 120 V units and 215 VAC for 220 V units. Replace regulators Z6 and Z7 if necessary.
  - b) Replace Q102/202, Q103/203; verify proper resistance of R146/246, R161/261.

#### 6-15. MALFUNCTION OF OUTPUT RELAY

- 6-15.1. Relay K13-0 will not snap in after 5 to 10 second delay.
- a) Verify that R45 is 51K; if it is 100K, replace it with a 51K; C24 should be 470mf/16 V.
  - b) Check Q16, D39, D37 and replace as necessary.
  - c) Check for +20 VDC across the primary of K13-0. If none is present, refer to step c) below. If the proper voltage is present but the relay does not snap in, replace the relay.
- 6-15.2. Relay K13-0 snaps in but no output at A or B.
- a) Verify that the connector buss links are installed in the NR loop.
  - b) Check for presence of signal at pins 8 and 14 of Z9; if signal is present, trace foil pattern to relay K13-0, inspecting for breaks or cracked or cold solder connections, solder bridges. Replace K13-0 if necessary. If signal is not present at pins 8 or 14 of Z9, check for signal at pins 10 and 12; replace Z9 if signal is present. If signal is NOT present at the input of Z9 (pins 10 and 12), check the following:
    - inspect volume control R155/255, solder connections and signal at connections 9 and 6.
    - check for proper operation of the Tape 1 and 2 monitor relays--refer to 6-2.2.
  - c) If no output at A outputs only, troubleshoot the headphone switching circuit as outlined in 6-2.2.
- 6-15.3. Unit thumps due to output relay switching in immediately at turn-on.
- a) Check for shorted Q16 or open C24; replace as necessary.
  - b) Check for sticky relay K13-0; replace if necessary.

## 7.0 3000 Parts List

### TRANSISTORS:

GES 97.....126-0033-0  
GES 93.....129-0009-0  
3569.....126-0044-0  
4355.....126-0045-0  
2SC1844.....126-  
2SA991.....126-

### INTEGRATED CIRCUITS:

78MG.....126-0040-0  
79MG.....126-0041-0  
RC4156.....126-0062-0  
RC4739.....126-0029-0  
CD4013.....126-0056-0  
4042BC.....126-0058-0  
TDA1034/NE5534.....126-0060-0  
LM301.....126-0067-0  
LM394.....126-0061-0

### DIODES:

1N4148.....126-0002-0  
1N4004.....126-0003-0  
1N34.....126-0021-0  
1N752(5.6v).....126-0049-0  
1N755(7.5v).....126-0075-0  
1N758(10v).....126-0059-0  
1N4744(15v).....126-0064-0  
LED Amber.....126-0065-0  
LED Green.....126-0066-0

### CAPACITORS:

1000/25v elec.....127-0098-0  
470/50v elec.....127-0038-0  
470/16v elec.....127-0125-0  
47/35v elec.....127-0032-0  
22/16v elec.....127-0078-0  
.47 mylar.....127-0014-0  
.22 mylar.....127-0028-0  
.1 mylar.....127-0015-0  
.01 ceramic.....127-0063-0  
.0027 ceramic.....127-0049-0  
.01 poly.....127-0113-0  
.0027 poly.....127-0112-0  
100/3v tant.....127-0123-0

### POTENTIOMETERS:

Volume  
(100K dual).....129-0062-0  
Tone  
(100K dual L).....129-0067-0  
Balance  
(100K dual MN).....129-0068-0

### SWITCHES:

Power Sw.....129-0063-0  
3-Sta. Assy.....129-0081-0  
PCB Sw. Sm. Button....129-0070-0  
PCB Sw. Lg. Button....129-0071-0  
HB2/24v Relay.....129-0064-0

### FRONT PANEL ACCESSORIES:

Knob, 1.5" dia.....142-0038-0  
Knob, 1.1" dia.....142-0039-0  
Handle.....142-0036-0  
Handle Ferrule.....143-0018-0

### TRANSFORMER:

110-220v/42vCT.....125-0032-0

### METALWORK:

Front Panel.....220-0052-0  
Sub-Front Panel.....220-0053-0  
Chassis.....220-0054-0  
Top Cover.....220-0055-0  
Bottom Cover.....141-0085-0

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

USE ONLY REPLACEMENT PARTS ISSUED OR AUTHORIZED BY THE FACTORY SERVICE DEPARTMENT. A UNIT WILL NOT BE CONSIDERED UNDER THE FACTORY WARRANTY IF UNAUTHORIZED SUBSTITUTE REPLACEMENT PARTS HAVE BEEN INSTALLED.

8-0. Service Bulletins and Supplements.

This section of the 3000 Series Two Service Manual is reserved for the inclusion of any service bulletins, troubleshooting or other supplements which apply to the 3000.

SERVICE BULLETIN

SUBJECT: 3000 Series Two Control Potentiometer Shaft Size

When the model 3000II preamp was introduced in June of 1978 production runs were using metric sized threaded shafts on the front panel control potentiometers (8.75mm). Starting approximately January of 1979 (around serial number 3200) production runs utilized standard SAE sized shaft pots (3/8").

If it becomes necessary to replace a metric pot from an earlier model 3000II it will be necessary to enlarge the front panel pot shaft hole to 3/8" by either drilling or reaming. We currently stock only the SAE size pots and only front panels with SAE size pot shaft holes. Front panels with SAE size holes will fit onto earlier model 3000II's with metric pot shafts.

PHASE LINEAR SERVICE DEPARTMENT  
20121 48th Ave. West  
Lynnwood, WA 98036  
(206)774-8848  
(206)774-3571

SERVICE BULLETIN #122078

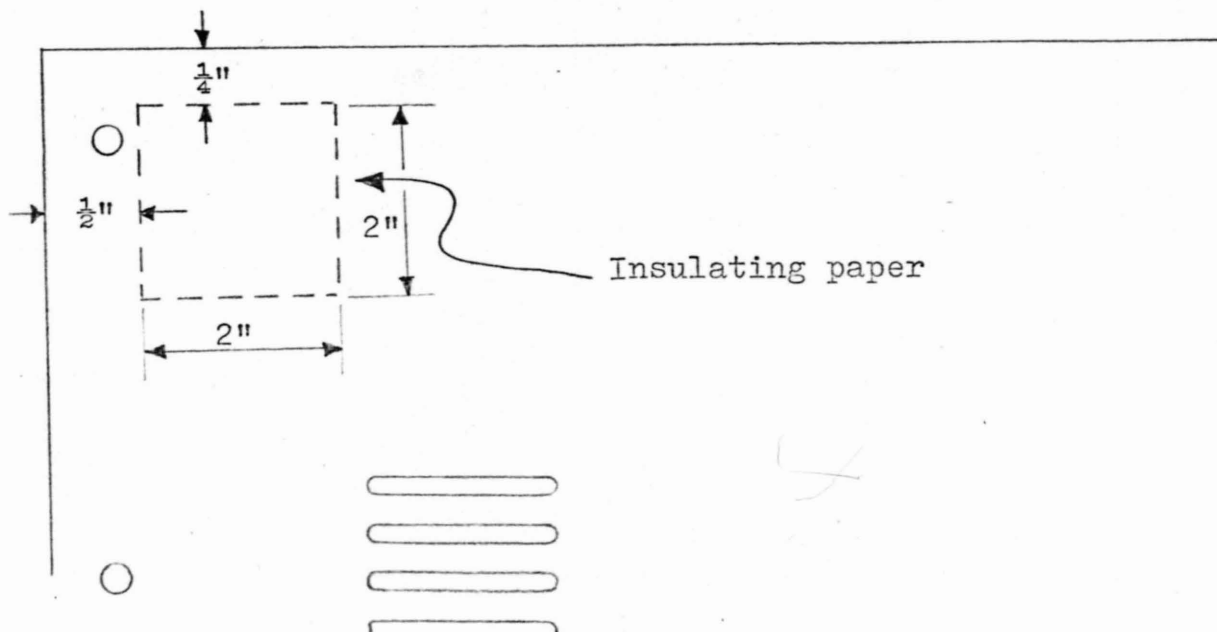
Subject: 3000 Power Switch

Upon completion of any test or service performed on the model 3000 preamplifier please inspect the bottom cover to verify that there is a piece of insulating paper (approximately 2" x 2" square) attached to the bottom cover. This paper MUST be positioned such that it is located between the bottom cover and the AC power switch terminals when the bottom cover is in place.

If the insulating paper is not located such that it is directly beneath the power switch terminals or is missing, please install a piece of insulating paper (rag-mylar-rag or equivalent) in this location as shown in the diagram below.

If you cannot locate proper insulating material or you have any questions feel free to contact the factory service department at the above address or phone number, or call (206) 774-8848.

Phase Linear Service Department





SERVICE BULLETIN

10 July 1980

Subject: Model 3000 Preamplifier Relays

After a very long period of deliberation with Aromat, the manufacturer of the relays used in the model 3000, we have received an updated version of the relay which we believe will be a working solution to the problems which have plagued the model 3000 in the past.

These new relays are a sealed unit which have gold-plated contacts and are filled with  $N_2$ , the culmination of which provides sufficient operation for the very low current application which is used in the model 3000. Being a sealed unit, they are also impervious to external or environmental elements which can aid in contact corrosion.

Our test results at the factory have proven extremely successful and we are very optimistic about these new relays offering a permanent cure to the intermittent problems of the 3000 we are so familiar with. They will have the same part number as the original relays, 129-0064, and the same price, \$4.30. Since we do not stock the original relays any more, it will not be necessary to specify the "new version" when ordering.

# Phase Linear CORPORATION

20121 - 48th Avenue West, LYNNWOOD, WASHINGTON 98036 U.S.A. Telephone: (206) 774-3571

## SERVICE BULLETIN

Subject: 3000II Line Amp S/N Mod

Beginning with 3000II ser.#3P5800 the following circuit changes were made to increase the line amp signal-to-noise ratio. R150/R250 were changed from 20K to 9.1K, and R156/R256 were changed from 1.1K to 1.8K. R values are 1/4-watt. Z8 and Z9 IC's have been changed from a Texas Instruments TL074 to either a Raytheon RC4156 or an NEC C4741 (Phase Linear part no. 126-0062), the NEC IC having slightly better specifications.

These combined changes will yield a 6dB increase in the high level signal-to-noise ratio.

