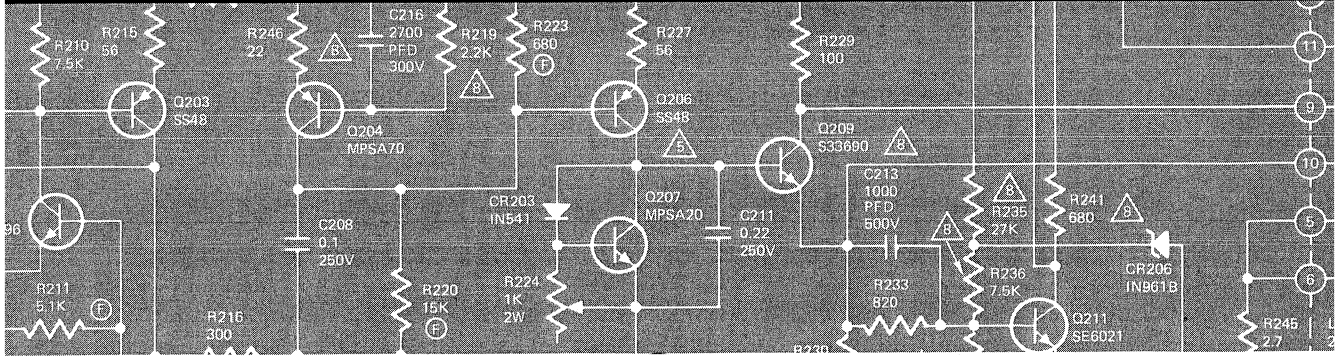


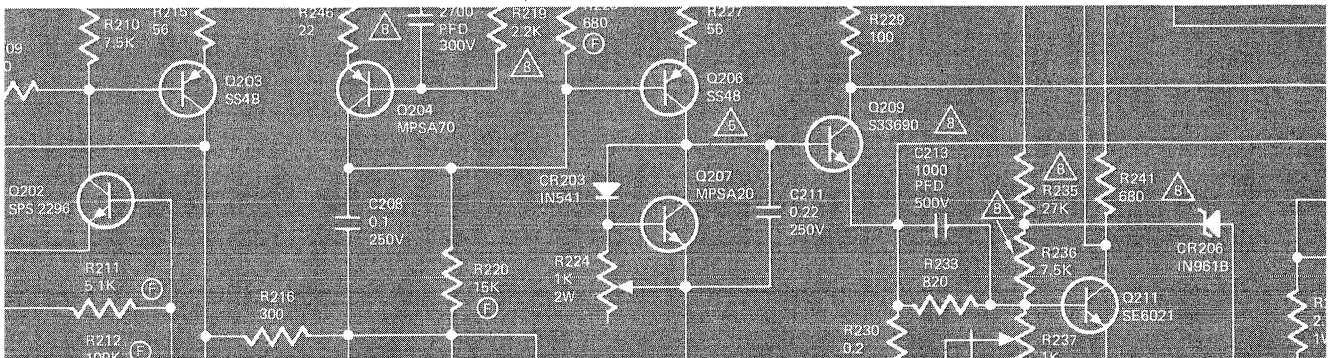
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MODEL 1200

SERVICE MANUAL

1200



Stereo Console Amplifier

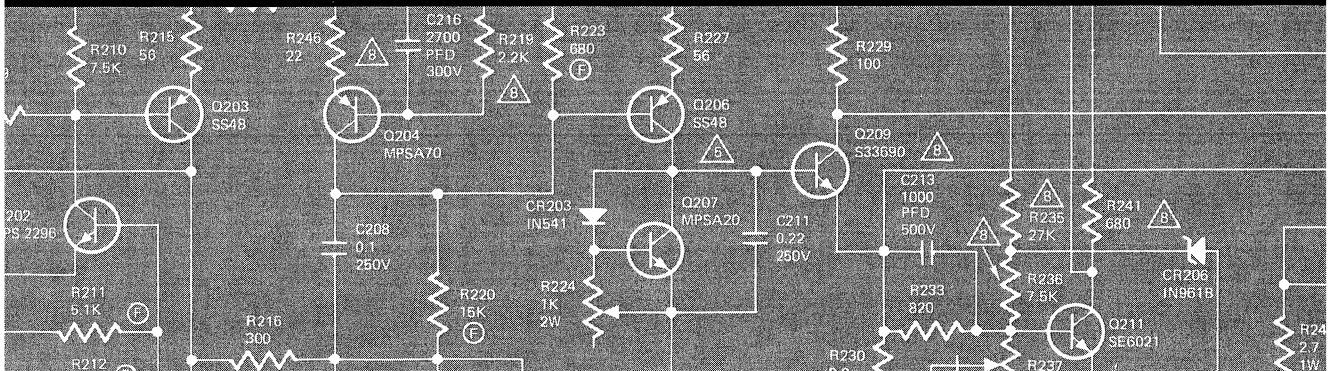


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INTRODUCTION

This service manual is intended for use by authorized warranty stations. The manual contains service information for the Marantz Model 1200 Stereo Console Amplifier, manufactured by The Marantz Company, a subsidiary of Superscope Incorporated, Sun Valley, California 91352.

Adjustment, maintenance, and troubleshooting information listed herein should be attempted only by the experienced technician, one knowledgeable in solid state amplifier operation and the use of test equipment. All instructions should be read carefully and understood fully before proceeding with any service.

Symptoms (and their remedies) listed in the troubleshooting section, are those which might occur in some units. As the Marantz Company becomes aware of other field problems, supplementary service bulletins will be issued to all stations. To improve this service, all problems (and their solutions) not covered in this service manual should be brought to the attention of the National Service Manager at our Sun Valley location.

CIRCUIT DESCRIPTION

The following circuit description will be based on Channel A only. Both channels of the BALANCE and VOLUME controls, TONE CONTROL switch, and DUBBING IN and DUBBING OUT jacks function simultaneously; thus, both channels will be shown in diagrams. HIGH and LOW filter switches are ganged for both channels, but only channel A will be shown.

PRE-AMPLIFIER

Program source signals from the 6 jacks (3 low level and 3 high level) on the rear panel are supplied to the SELECTOR switch, Figure 1. The

3 low-level inputs are applied to the low-level amplifier. A section of the SELECTOR switch selects the appropriate (Flat, RIAA) equalization network. The low-level amplifier comprises a single-ended differential amplifier (Q205, Q206), an inverter (Q207), and an emitter-follower (Q208). This amplifier provides a gain of 40dB. The output of the low-level amplifier is applied to another section of the SELECTOR switch.

This section of the SELECTOR switch applies either the output of the low-level amplifier or one of the high-level inputs to the TAPE MONITOR switch, the TAPE OUT jacks, and the DUBBING OUT jack.

The TAPE MONITOR switch applies either the TAPE IN or program source signals to the DUBBING IN jack. This jack contains a built-in switch which disconnects the TAPE IN signals when a plug is inserted into the jack. The signal from the DUBBING IN jack is applied to the MODE switch. This switch applies A, B, STEREO, STEREO REVERSE, or A + B signals to the BALANCE CONTROL.

The BALANCE control is a full range control that permits full attenuation of either channel without affecting the other channel. The output of this control is applied to the VOLUME control. This precision tracking control maintains the stereo balance dictated by the BALANCE control within 3dB from maximum to 50dB from maximum. The output of the VOLUME control is applied to the pre-amplifier (X10 amplifier).

The X10 amplifier, Figure 2, comprises a single-ended differential amplifier (Q404, Q405) and an inverter (Q406). The frequency response of the X10 amplifier is affected by the high and low filters. These filters are controlled by the three position HIGH and LOW filter switches. The filter outputs are applied as negative feedback to Q405. The filters' effect on the frequency response of the unit is shown in Figure 3. The X10 amplifier

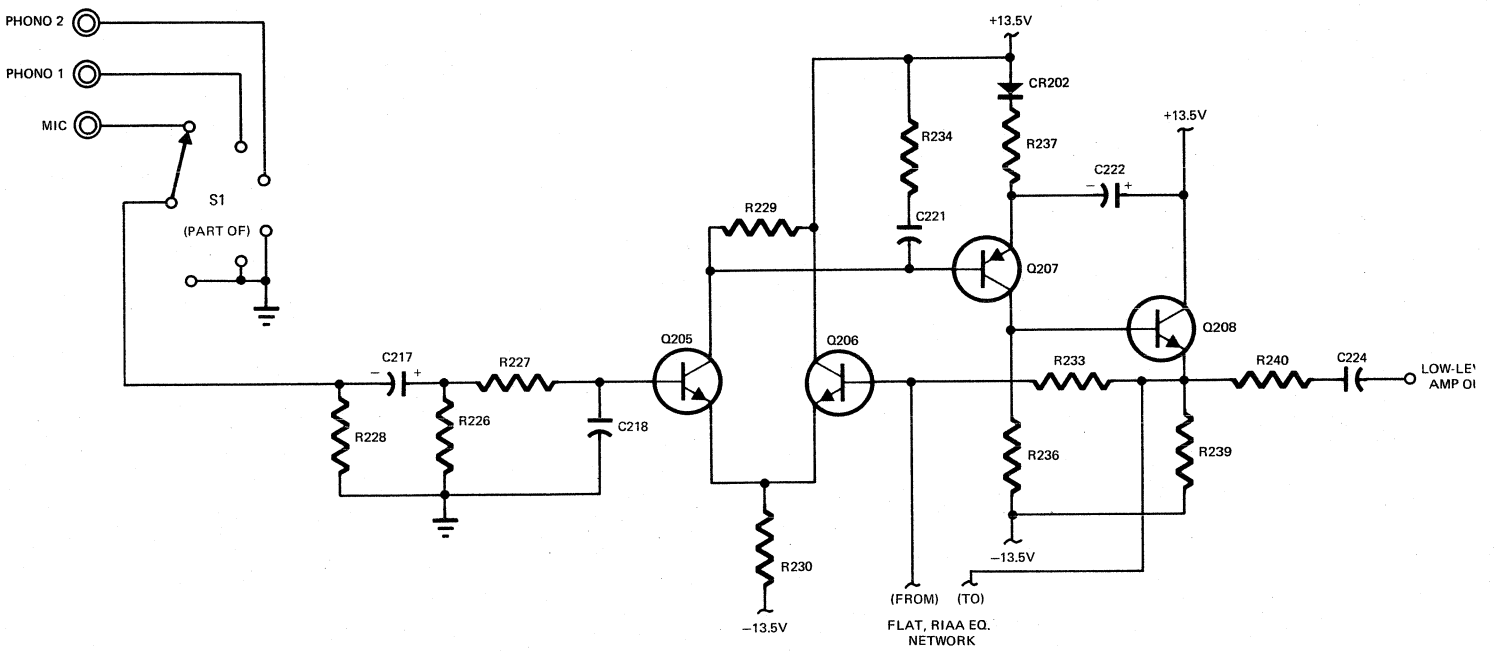


Figure 1. Low Level Amplifier Simplified Schematic.

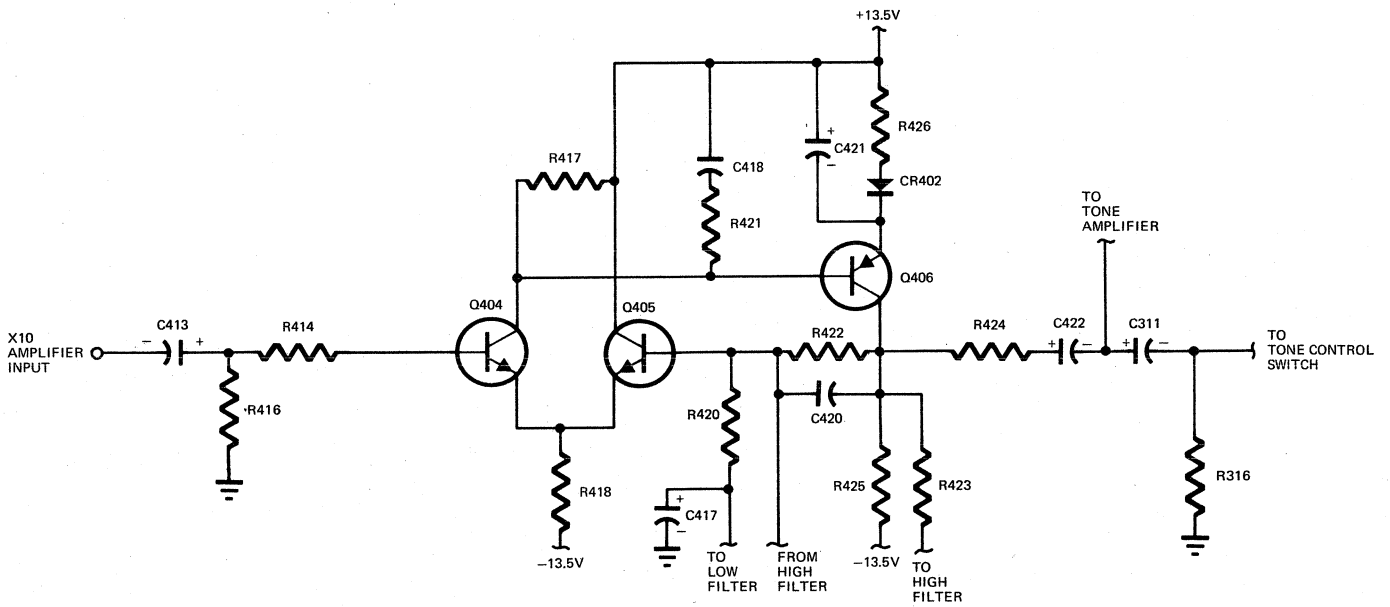


Figure 2. X10 Amplifier Simplified Schematic.

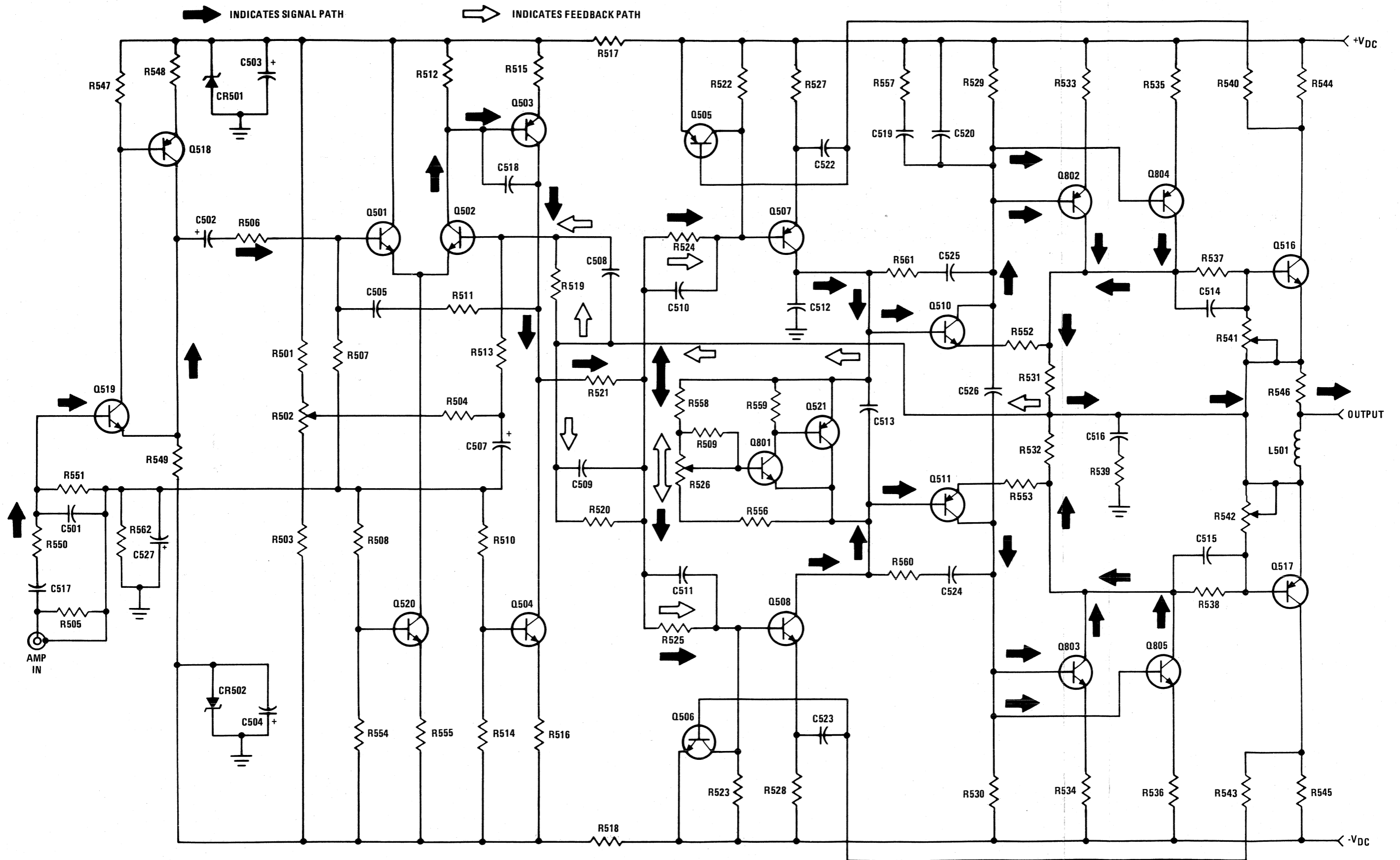


Figure 5. Amplifier Simplified Schematic

CIRCUIT DESCRIPTION (Continued)

RELAY BOARD AND POWER SUPPLY

The output of the power amplifier circuit is applied to the wipers of relay K301 of the relay board circuit, Figure 7. The relay energizes after a minimum delay of two seconds after AC power is applied to the unit. The duration of the delay is a factor of the time constant of R706, R707, and C702. This delay at turn-on is to prevent any transient surges from reaching the output terminals. Additionally, resistors R701 and R702 sample the audio output signals. Should a constant DC level greater than +4.5V, or a high amplitude signal below 10Hz be present, Q701 will turn on, shorting the base of Q703 to ground. C702 begins to discharge and K701 de-energizes. Should a constant DC level more negative than -4.5V be present, the voltage drop across R704 bucks the voltage present at the base of Q703 and K701 de-energizes. When the relay is energized, the audio output is applied to the speaker terminals.

The DC power supply voltage for the power amplifier circuit and the metering circuit is $\pm 58.5V$. 75VAC is developed across the secondary of T1, which is rectified by the full-wave bridge comprised of CR1 through CR4. The rectified positive and negative voltages are each filtered by a 20,000 μfd capacitor (C1 and C2). Resistors R1 and R2 are bleeder resistors.

The DC voltage for the relay circuit is +58V. The AC voltage from the transformer secondary is rectified by CR705 and CR706 (contained on the relay board) and filtered by C705.

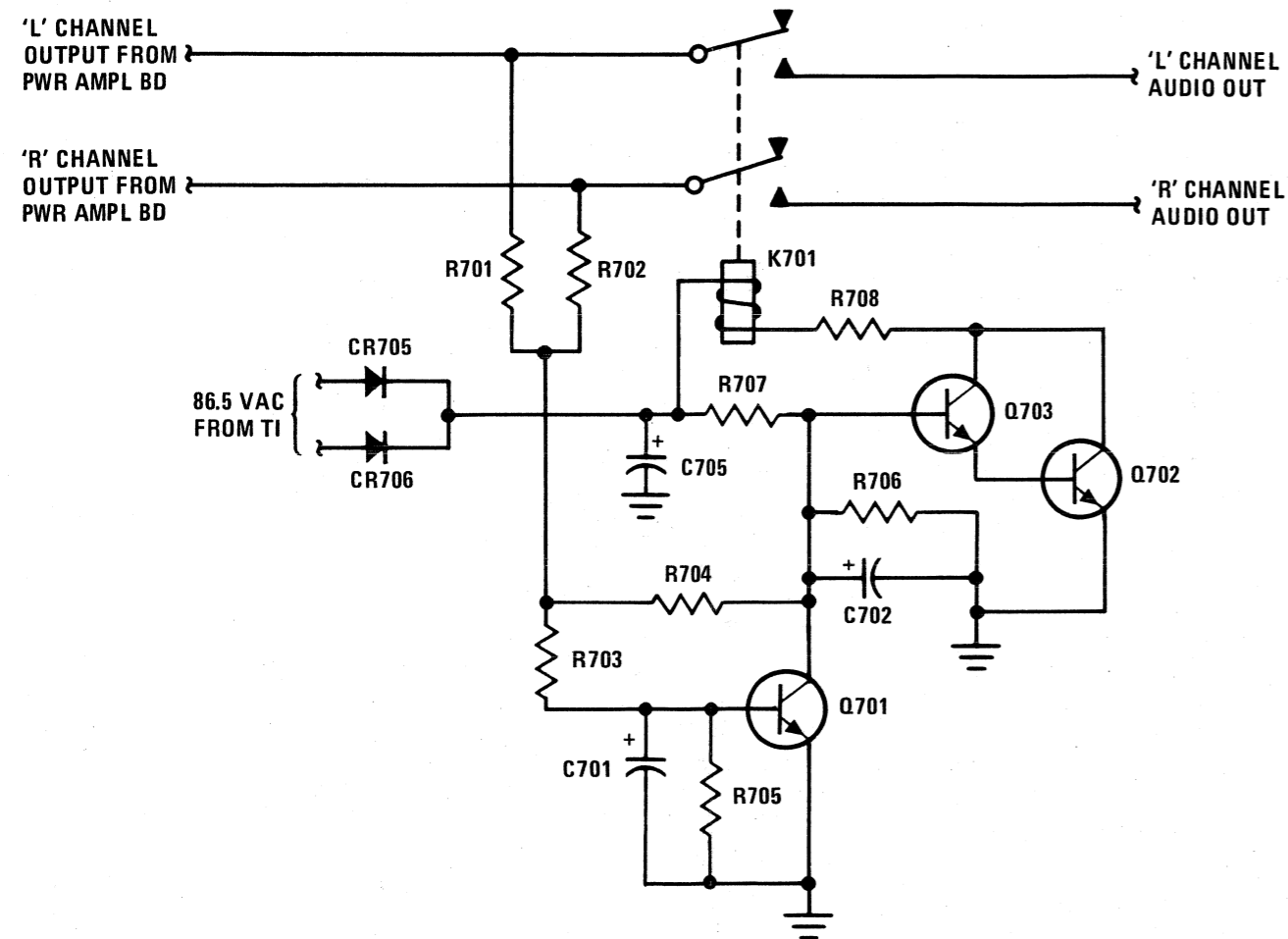


Figure 7. Relay Board Simplified Schematic

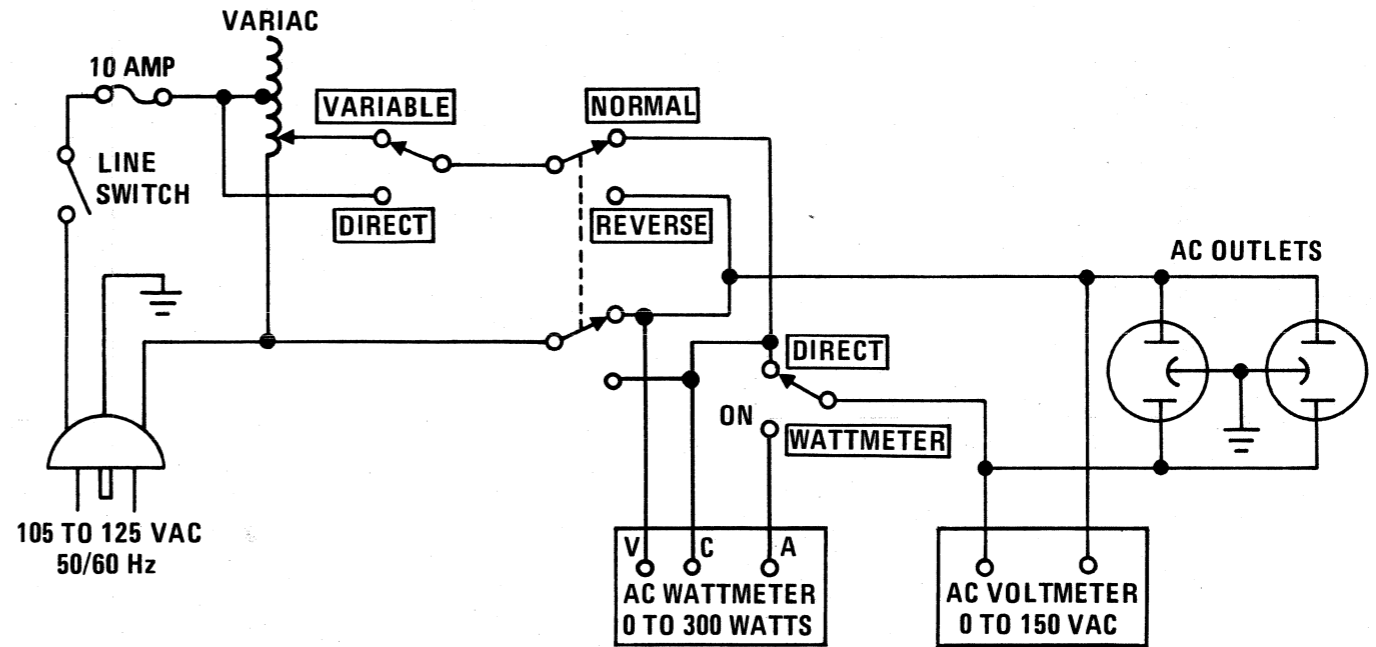


Figure 10. AC Power Control Box Simplified Schematic

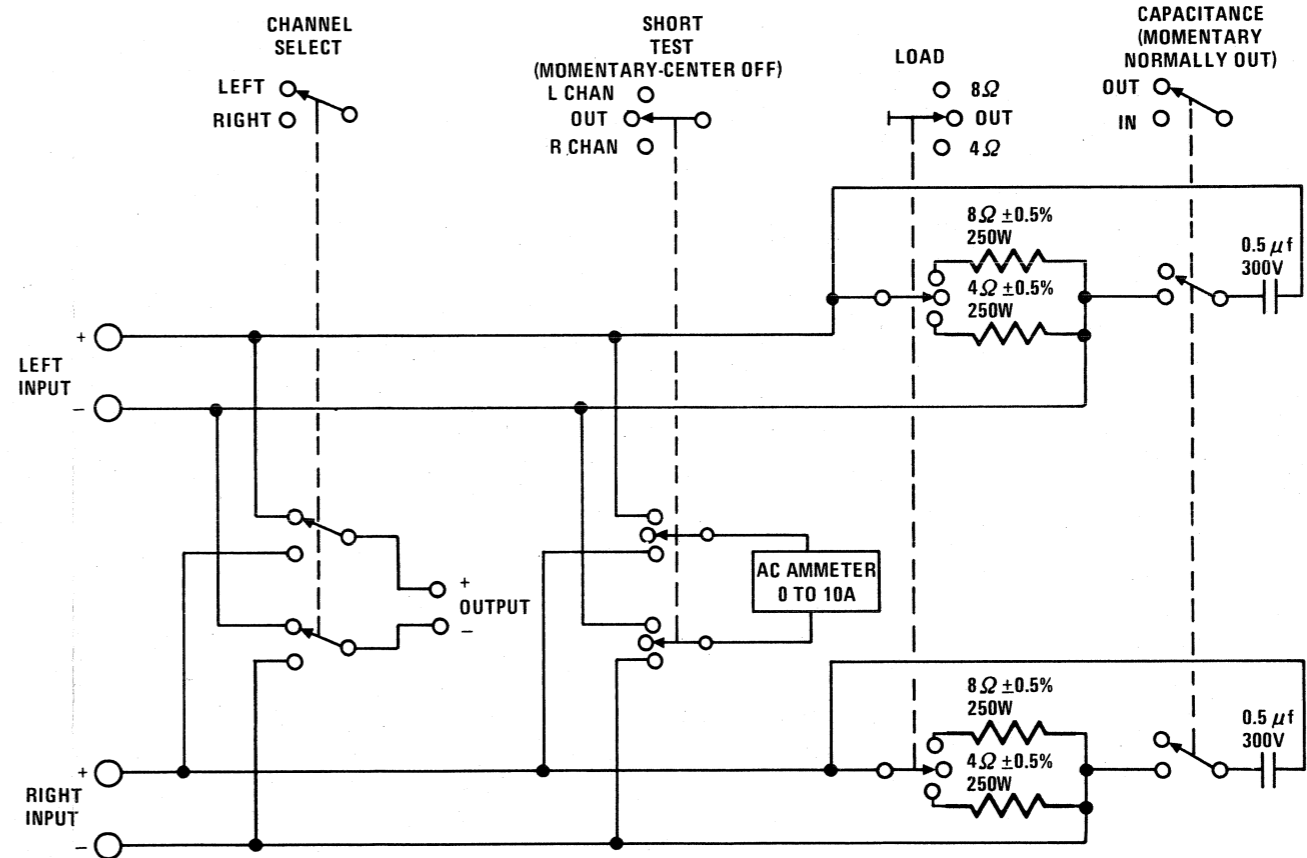


Figure 11. Amplifier Output Load Box Simplified Schematic

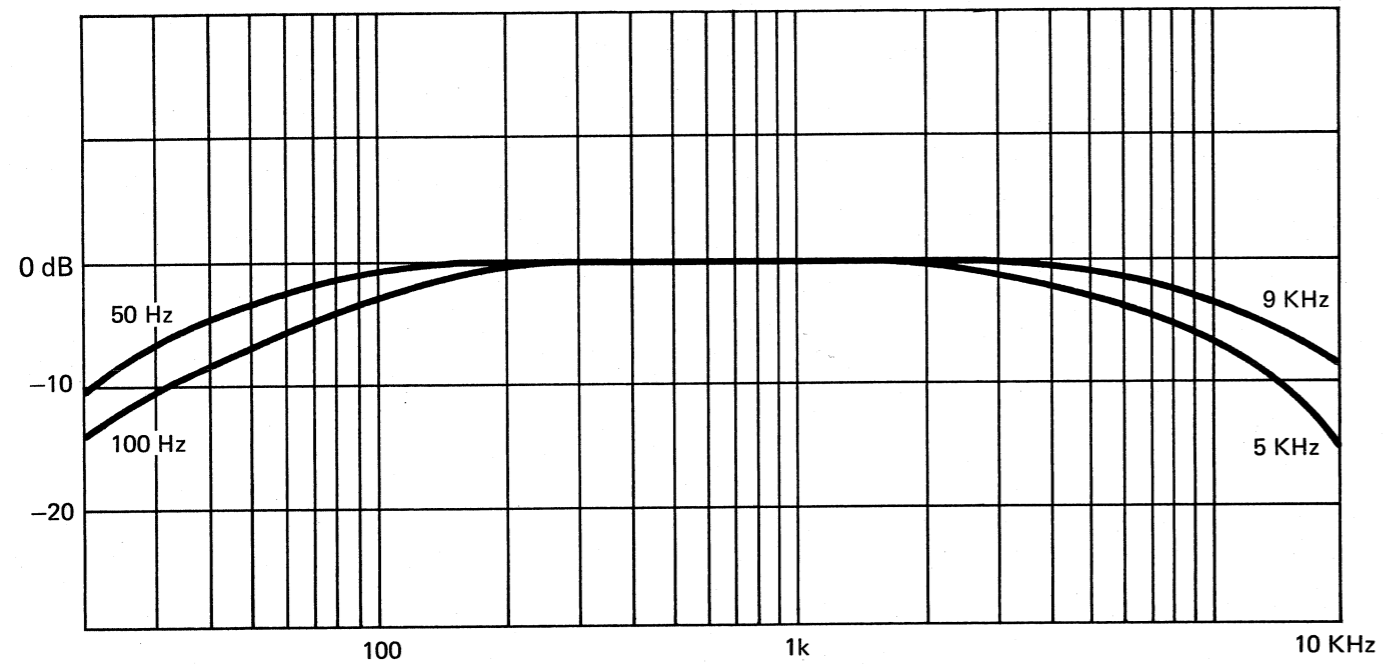


Figure 3. Filter Response Curve.

provides a gain of 20dB. The output of the X10 amplifier is applied to the TONE CONTROL switch and the tone amplifier.

With the TONE CONTROL switch set to IN, the output of the tone amplifier is applied to the GAIN switch on the rear panel, which selects

HIGH or LOW overall preamplifier gain. The output of the GAIN switch is applied to the PREAMP OUT jacks.

With the TONE CONTROL switch set to OUT the output of the X10 amplifier is applied directly to the GAIN switch, bypassing the tone amplifier.

The unity gain tone amplifier, Figure 4, comprises a single-ended differential amplifier (Q304, Q305) and an inverter (Q306). The frequency response of the tone amplifier is adjusted by the BASS and TREBLE controls. The frequency response curves for each 2dB of adjustment are shown in Figure 6.

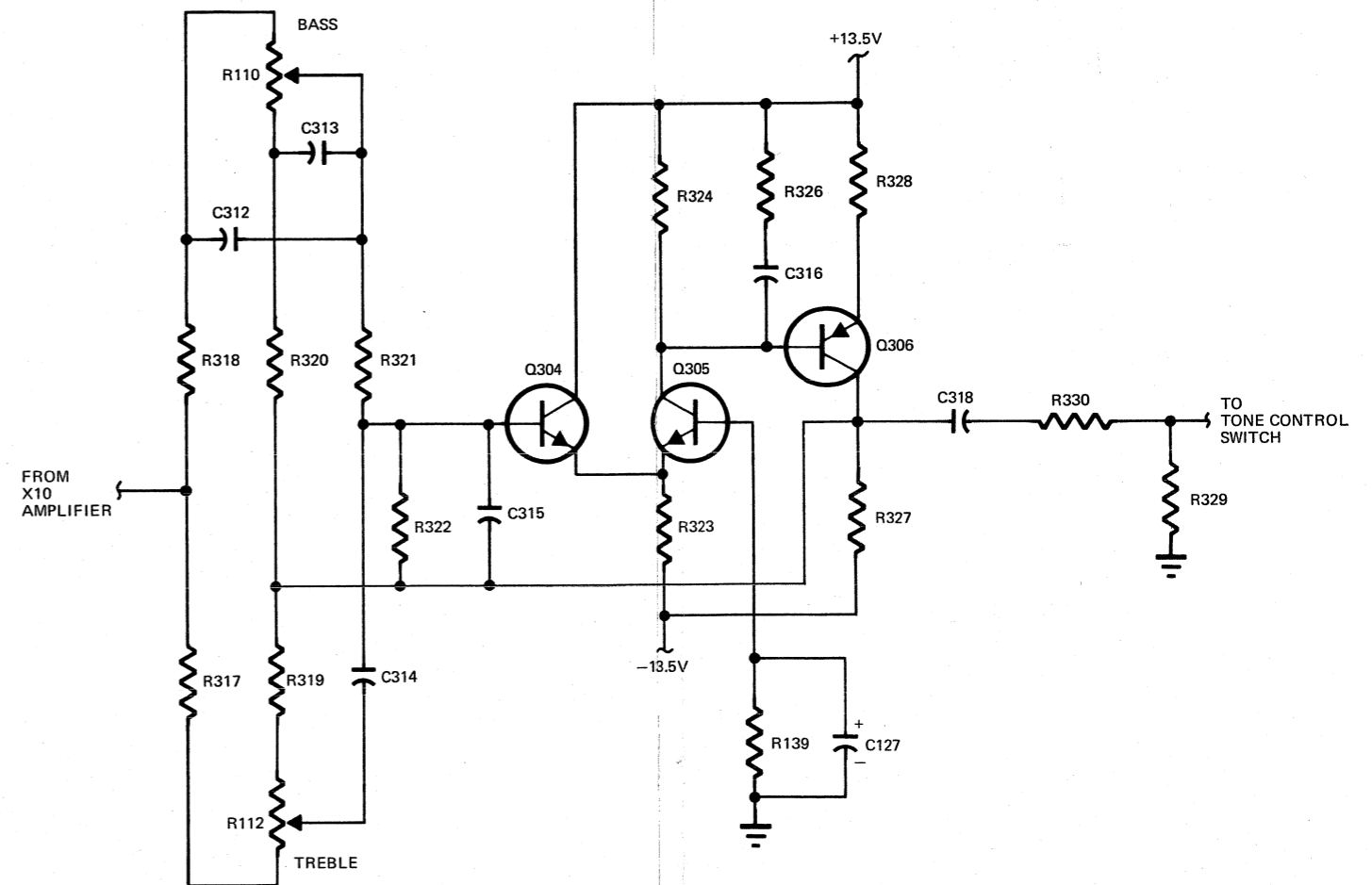


Figure 4. Tone Amplifier Simplified Schematic.

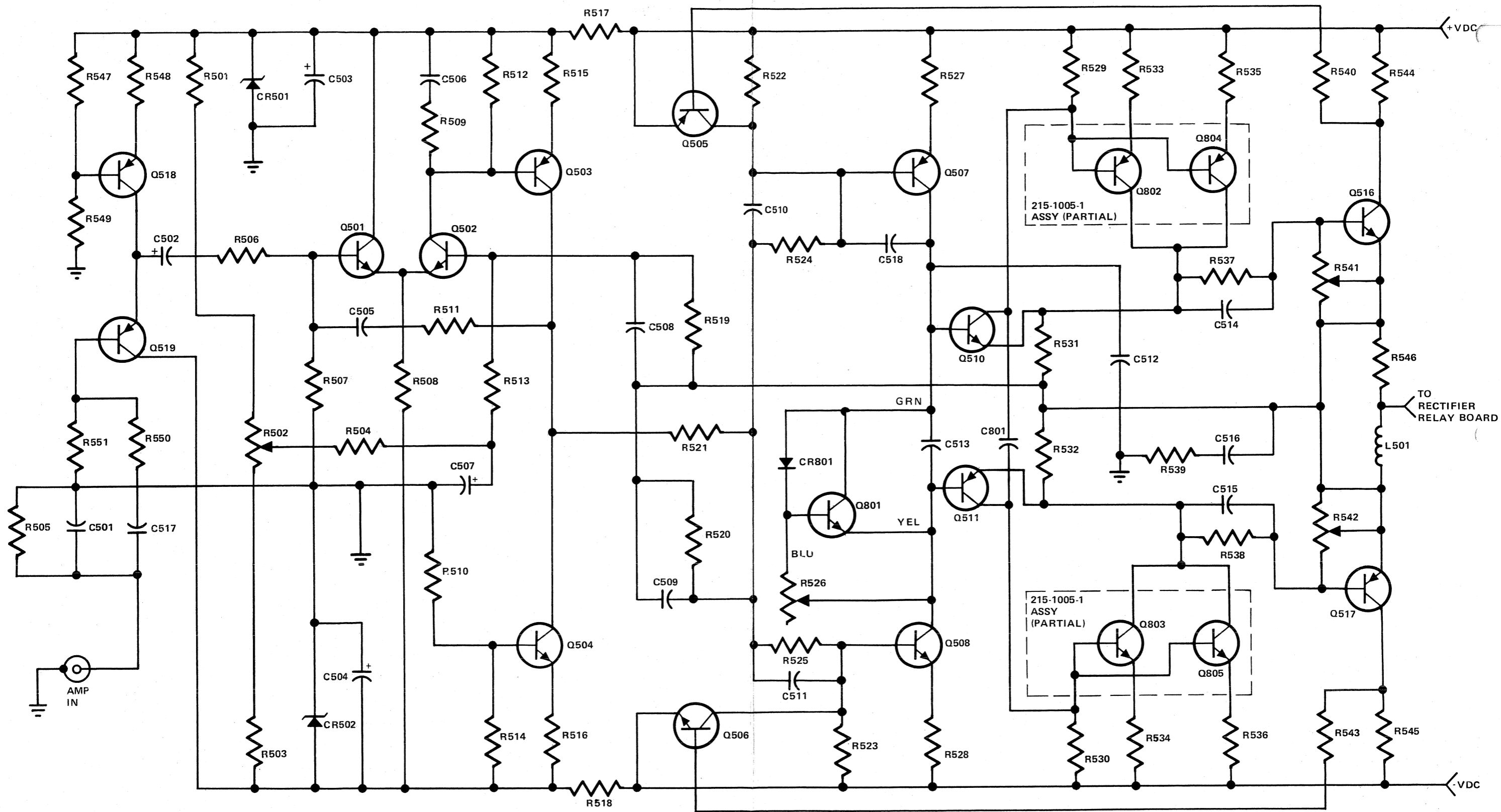


Figure 5. Amplifier Simplified Schematic.

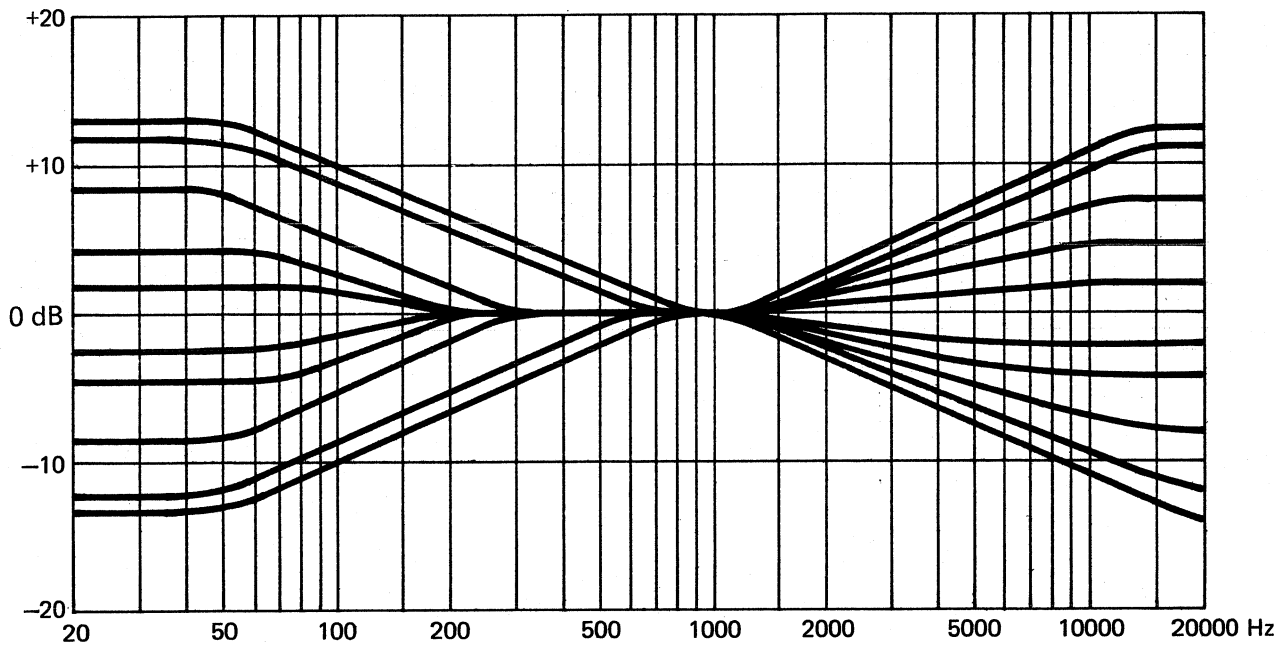


Figure 6. Tone Control Response Curves.

AMPLIFIER

The preamplifier outputs are connected to the power amplifier inputs by molded RCA pin plug bridging assemblies between the PREAMP OUT and AMP IN jacks on the rear panel. The input stage of the power amplifier, fig. 5, is comprised of an emitter-follower, Q519, and its current source, Q518. The output of this stage is coupled through C502 and R506 to the differential amplifier (Q501, Q502), which drives an inverter (Q503) whose collector current is developed through current source Q504. The inverter is coupled to complementary pre-drivers (Q507, Q508). The output of the pre-drivers is applied to their respective drivers (Q510, Q511) which are coupled to their respective power transistors (Q892, Q804-Q803, Q805).

Output current regulation is accomplished through

a current-sensing network. Excessive current levels are detected by resistors R531 and R532. Voltages developed across these resistors are applied to current sensors Q516 and Q517.

When excessive current levels are detected, Q516 and Q517 develop peak-limiting signals, which are applied to Q505 and Q506. These transistors disable the pre-drivers on excessive output current peaks, thus limiting peak output current to a safe level.

Feedback for the amplifier is developed at the junction of R531 and R532. The feedback is applied across two loops. Feedback applied across R520 and C509 completes the driver-power output loop. Feedback applied across R519 and C508 completes the loop for the entire power amplifier.

RECTIFIER-RELAY BOARD

The output of the power amplifier is applied to the wipers of relay K701 on the rectifier relay board, Figure 7. Relay K701 energizes after a minimum delay of two seconds after turn on. The length of the delay is a factor of the time constant of R706, R707, and C702. This delay at turn-on is to prevent any transient surges from reaching the output terminals. Additionally, resistors R701 and R702 sample the audio output signals. Should a constant DC level over +4.5 volts or a high amplitude signal below 10Hz be present, Q701 will turn on, shorting the base of Q703 to ground. C702 begins to discharge and K701 de-energizes. If a constant DC level over -4.5 volts is present, the voltage drop across R704 bucks the voltage present at the base of Q703 and K701 de-energizes. The output from K701 is applied to the SPEAKER select switch. Additionally, it is applied across resistor loads to the CENTER CHANNEL VOLUME CONTROL and to the HEADPHONE jack.

76 volts AC is applied to diodes CR701 through CR740 which develop the +52 and -52 volts for the power amplifier board. CR705 and CR706 develop the positive voltage to energize K701.

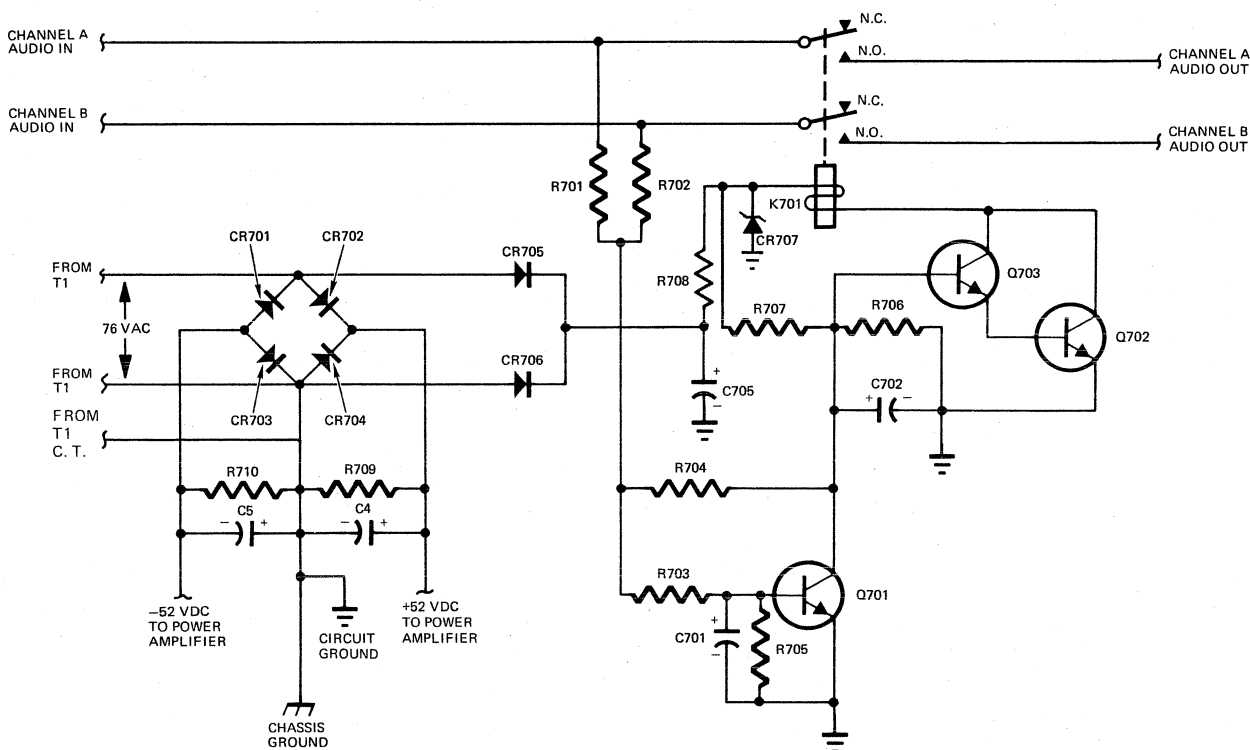
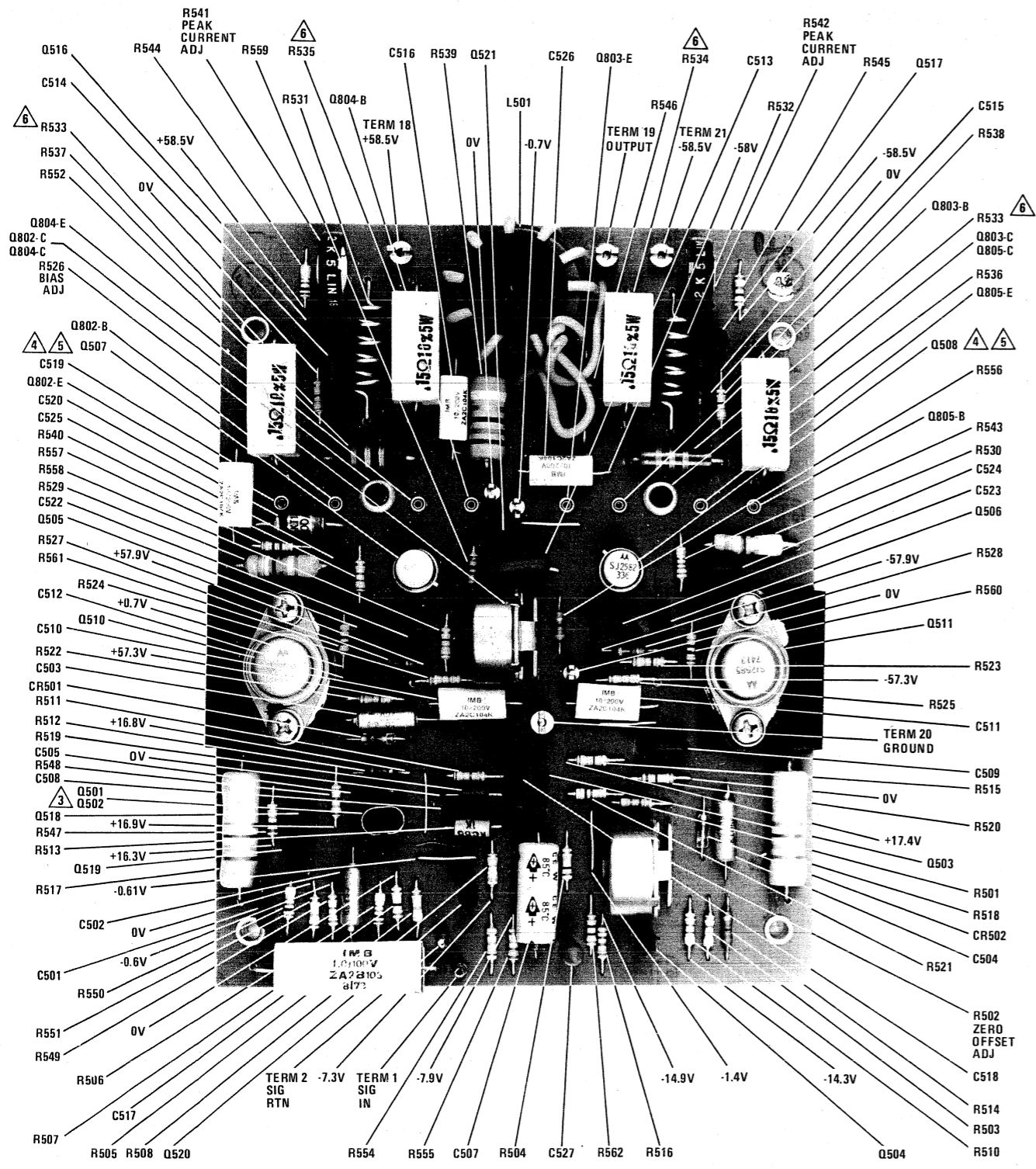
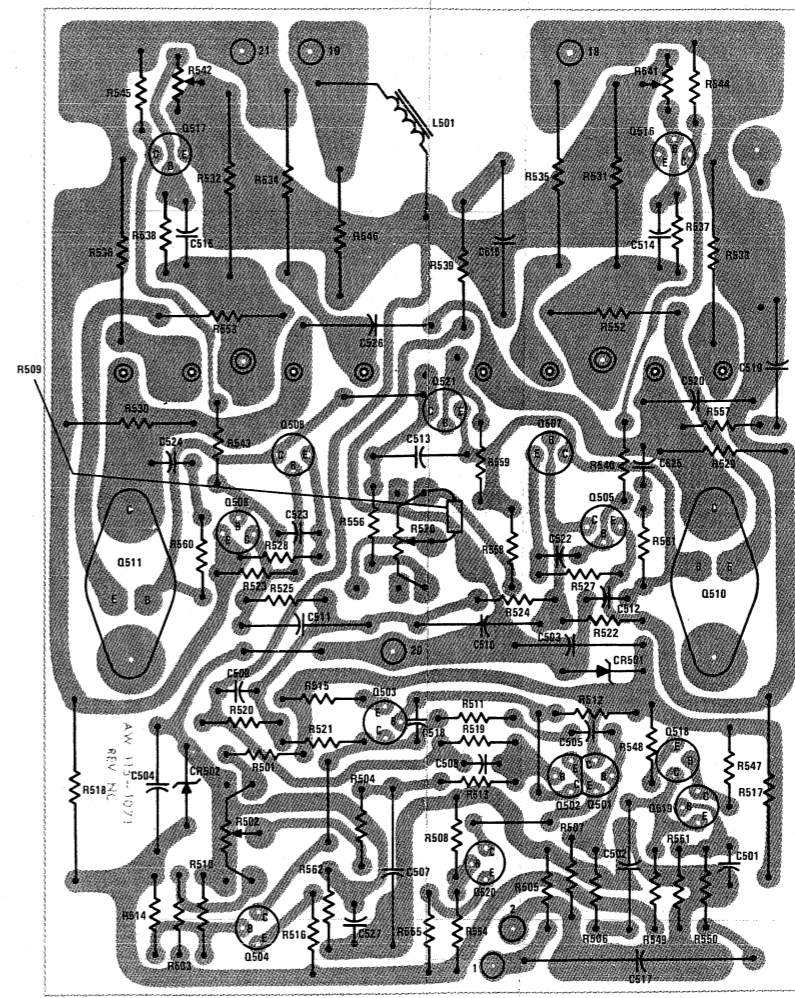


Figure 7. Rectifier/Relay Board Simplified Schematic.



- NOTES:
- VOLTAGES ARE DC VOLTS TO GROUND, MEASURED ON A TYPICAL UNIT.
 - CONFIGURATION SHOWN IS APPLICABLE TO CIRCUIT BOARDS FABRICATED FROM A/W 115-1071, REV N/C.
 - TRANSISTOR PAIR Q501-Q502 ARE TO BE EQUALLY SPACED OFF THE BOARD WITH THEIR ENTIRE FLAT SURFACES IN INTIMATE CONTACT. P/N 562-1005-000 THERMAL RETAINER TO BE INSTALLED ON THE PAIR.
 - P/N 562-1000-000 HEAT DISSIPATOR TO BE INSTALLED ON Q507 AND Q508.
 - P/N 372-1000-000 INSULATOR TO BE INSTALLED UNDER Q507 AND Q508.
 - RESISTORS R533, R534, R535 AND R536 TO BE INSTALLED 1/8" MINIMUM OFF BOARD.

COMPONENT SIDE



CIRCUIT SIDE

Figure 17. Power Amplifier Board – A5/A6 Component Assembly Diagram

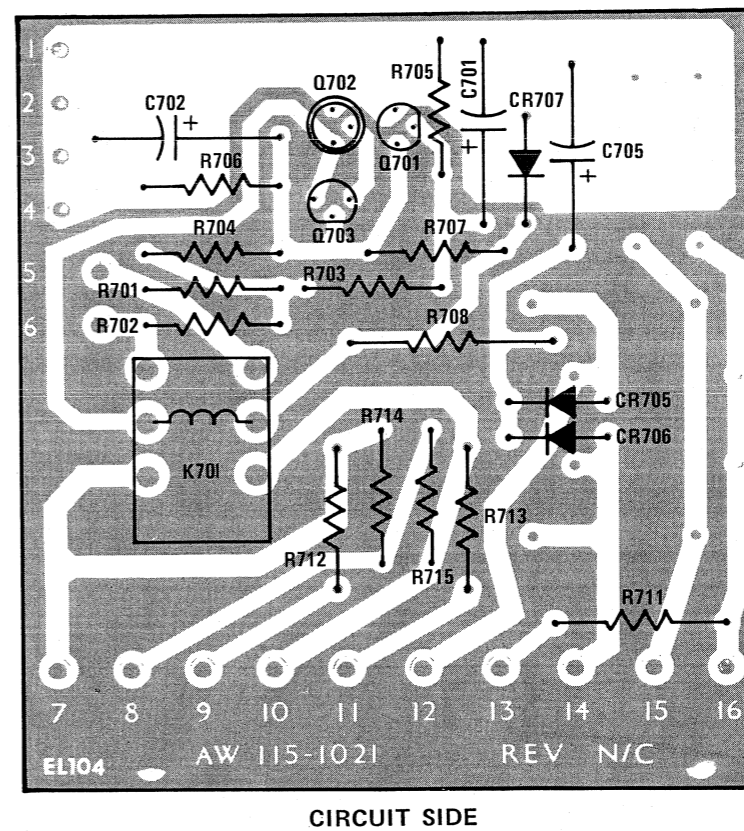
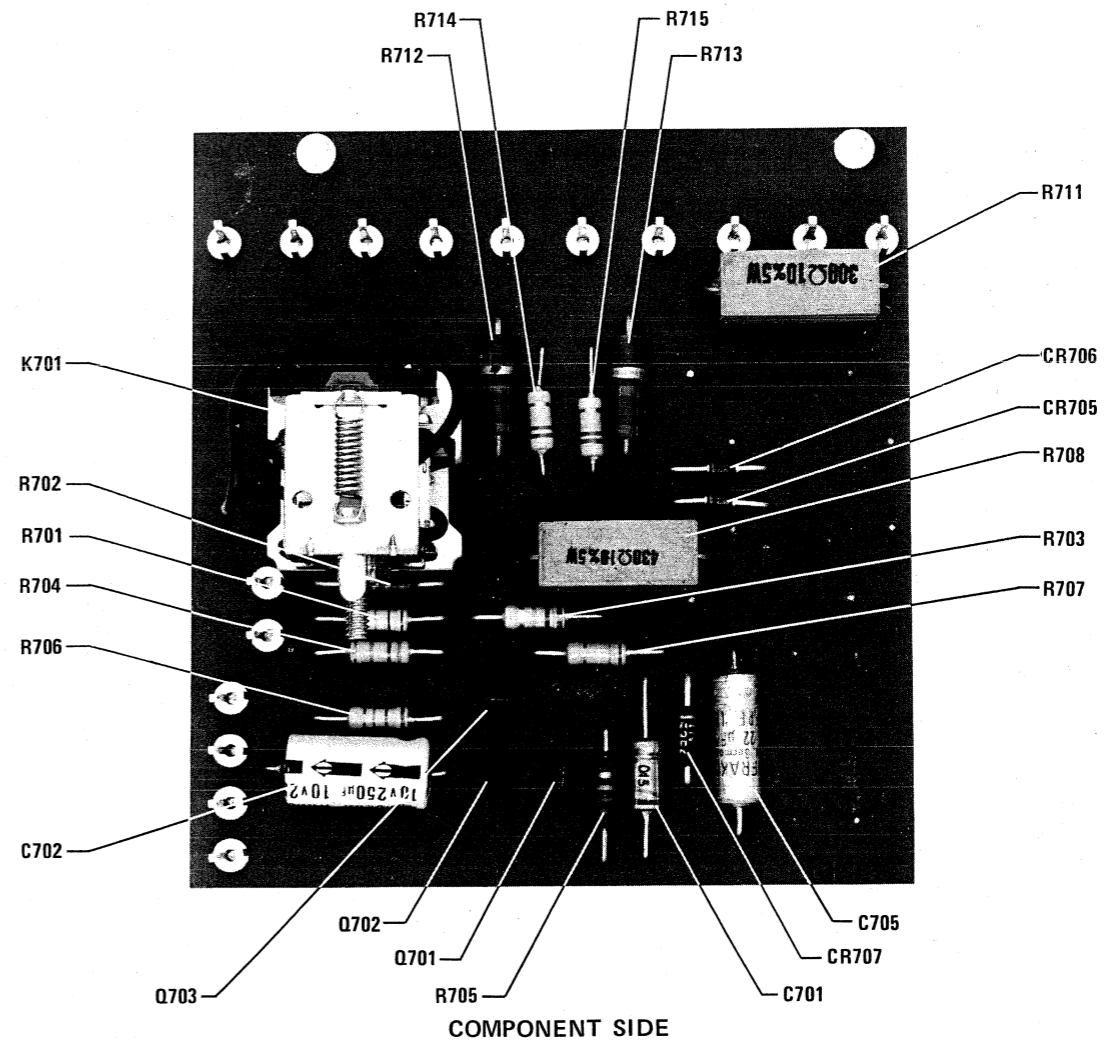
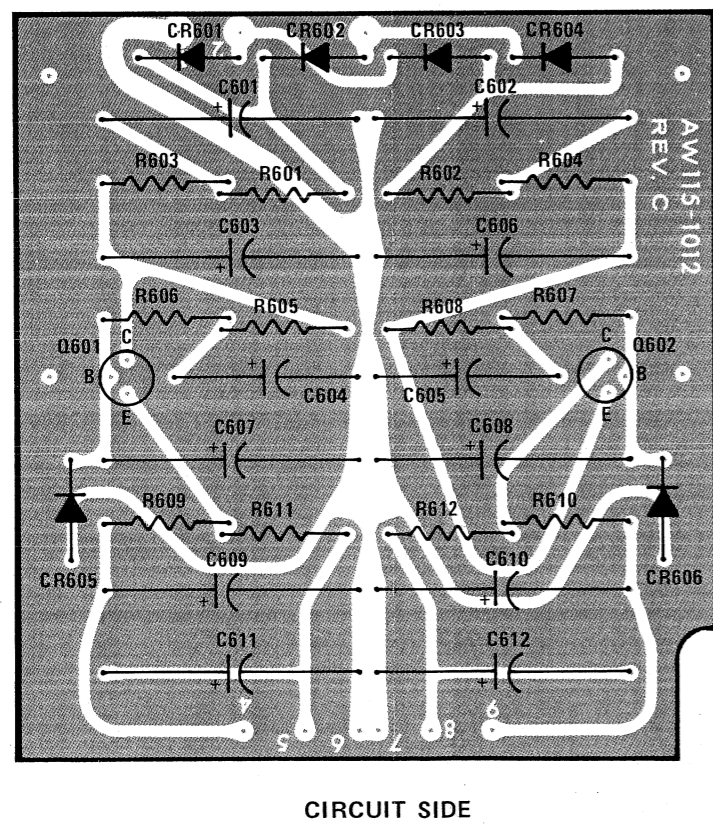
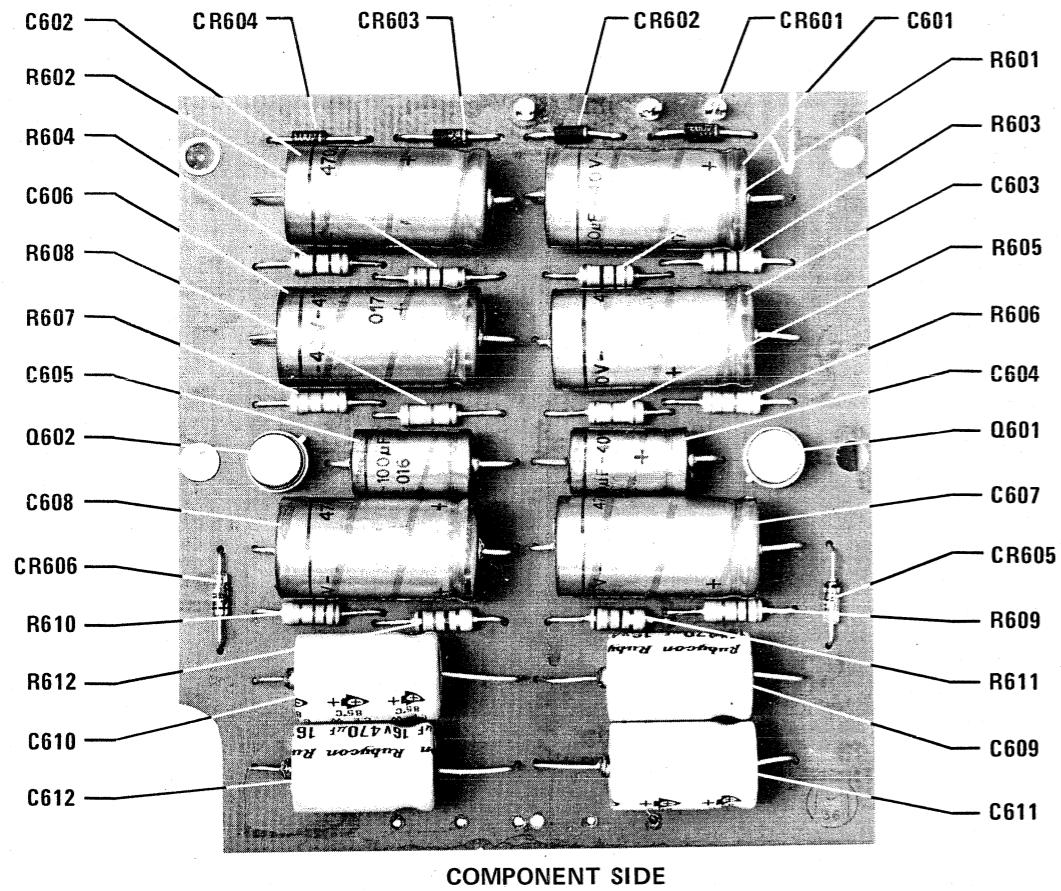


Figure 18. Power Supply Board – A7 Component Assembly Diagram

Figure 19. Relay Board – A8 Component Assembly Diagram

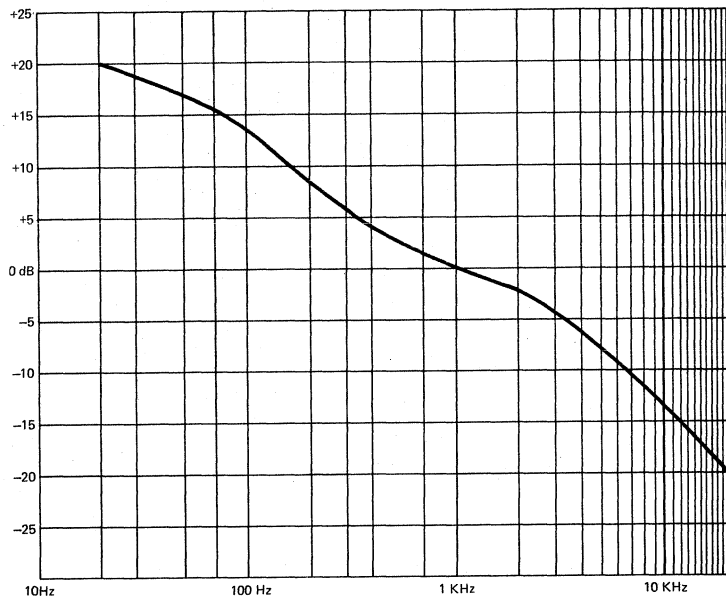


Figure 8. RIAA Equalization Curve

RIAA NAB DISK REPRODUCING STD.

20 KHz	-20 dB
15 KHz	-17.17 dB
14 KHz	-16.64 dB
13 KHz	-15.95 dB
12 KHz	-15.28 dB
11 KHz	-14.55 dB
10 KHz	-13.75 dB
9 KHz	-12.88 dB
8 KHz	-11.91 dB
7 KHz	-10.85 dB
6 KHz	-9.62 dB
5 KHz	-8.23 dB
4 KHz	-6.64 dB
3 KHz	-4.76 dB
2 KHz	-2.61 dB
1000	0
700	+ 1.23 dB
400	+ 3.81 dB
300	+ 5.53 dB
200	+ 8.22 dB
100	+13.11 dB
70	+15.31 dB
50	+16.96 dB
30	+18.61 dB
20 Hz	+ 20 dB

POWER SUPPLY BOARD

The power supply board, Figure 8, supplies nominal +13.5 and -13.5 volts to the low-level amplifier and pre-amplifier/tone amplifier section

of the pre-amplifier. Thirty-seven volts is applied to rectifiers CR601, 602, 603, and 604. Positive and negative regulation of the diode bridge output is accomplished by Q601 and Q602 respectively. The voltage reference for these two transistors is supplied by Zener diodes CR605 and CR606.

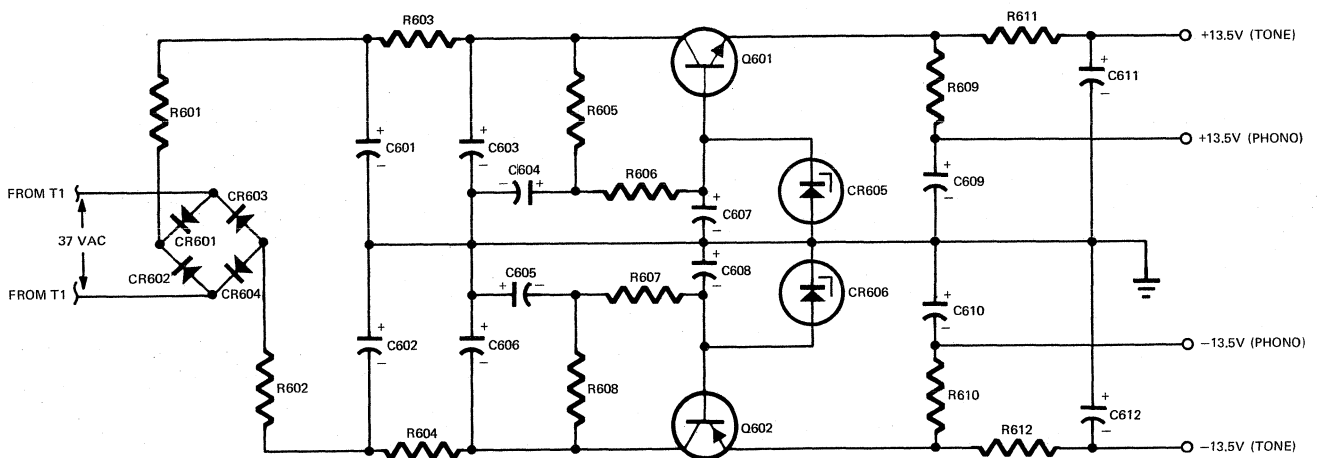


Figure 9. Power Supply Simplified Schematic

TECHNICAL SPECIFICATIONS

Power Output (each channel, both channels driven, at rated distortion, 20Hz to 20KHz)

Load	RMS
4 ohms	125W
8 ohms	100W
16 ohms	50W

Total Harmonic Distortion (including pre-amplifier)	.....	at or below rated power, 20HZ to 20 KHz. less than 0.15%
Intermodulation Distortion (including pre-amplifier)	.....	at or below rated power, SMPTE, any combination of two frequencies, 20Hz to 20KHz: less than 0.15%
Frequency Response	.....	+0 -3dB 6 Hz to 80 KHz, ±.25dB 20Hz to 20KHz
Input Sensitivity and Impedance	.....	Phono 1.35mV, 47K ohms
High Level	.....	135 mV, 100K ohms
Output Level and Impedance (volts RMS)		
Tape Recorder	.....	3V, 1000 ohms
Headphones	.....	3V, 8 ohms or greater
Center Channel	.....	3V, 1000 ohms
Tone Controls (Switch Defeatable)	.....	Treble ±10dB at 10KHz Bass ± 10dB at 100 Hz

Filters:

High Filters	.....	.5KHz and 9KHz
Low Filters	.....	50Hz and 100Hz

GENERAL

Total Noise	.....	Phono (input loaded & shielded) 2µV equiv. input
Power Requirements	.....	120V AC, 420W, 50/60 Hz
Dimensions	.....	15-3/8" w. x 5-3/4" h. x 14" deep
Unit Weight	.....	31 pounds
Shipping Weight	.....	37 pounds

220-Volt AC Conversion

Split primary windings permit easy conversion from 120-Volt to 220-Volt operation.

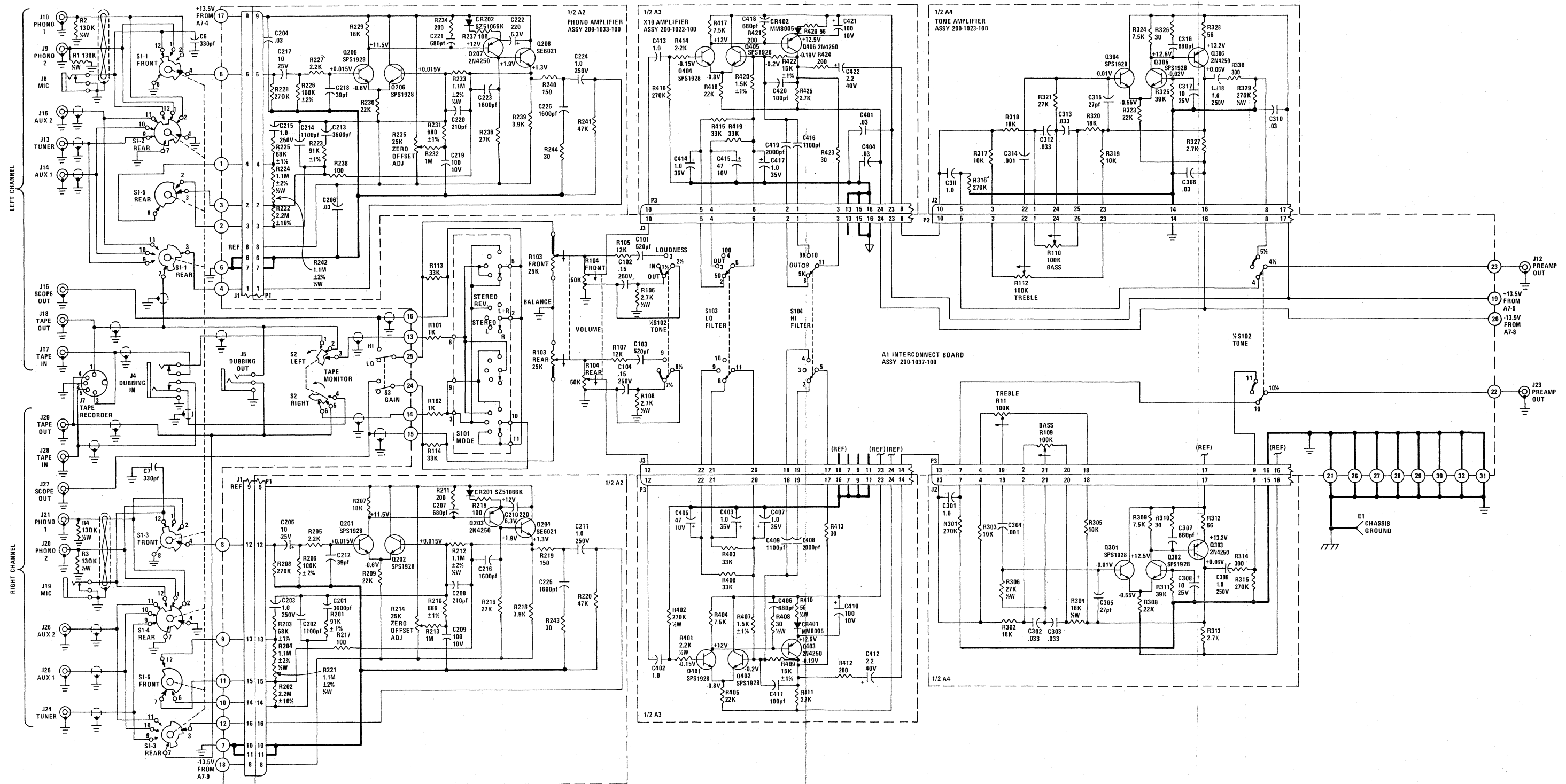
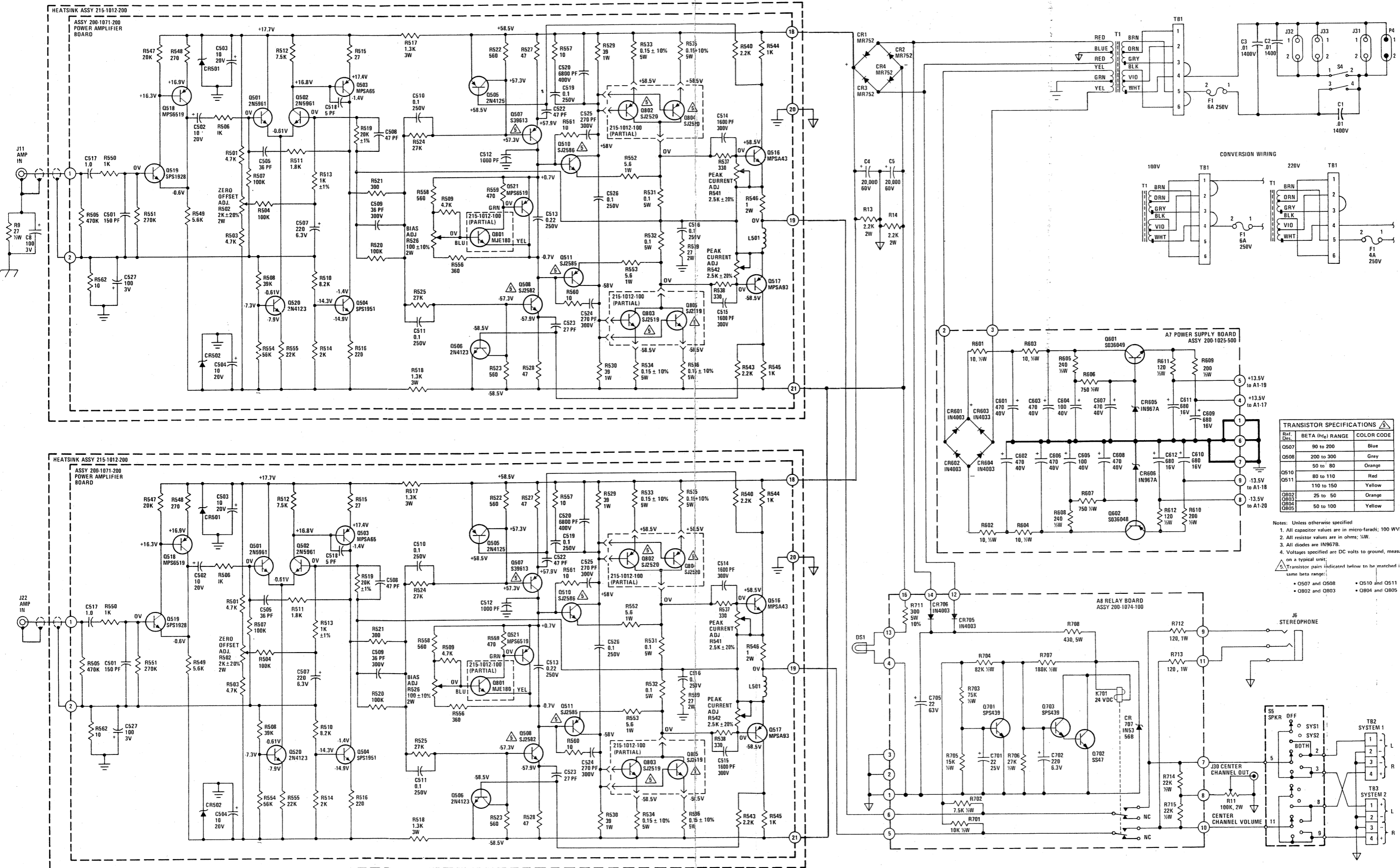


Figure 20. Model 1200B Schematic, A



Part No.	BETA (h _{FE}) RANGE	COLOR CODE
Q507	90 to 200	Blue
Q508	200 to 300	Grey
Q510	50 to 80	Orange
Q511	80 to 110	Red
Q802	110 to 150	Yellow
Q803	25 to 50	Orange
Q804	50 to 100	Yellow

Notes: Unless otherwise specified:
 1. All capacitor values are in micro-farads; 100 WVDC.
 2. All resistor values are in ohms; 1/2W.
 3. All diodes are IN967B.
 4. Voltages specified are DC volts to ground, measured on a typical unit.
 ⚠ Transistor pairs indicated below to be matched in the same beta range:
 • Q507 and Q508 • Q510 and Q511
 • Q802 and Q803 • Q804 and Q805

Figure 21. Model 1200B Schematic, B

TEST EQUIPMENT REQUIRED FOR SERVICING

Table 1 lists the test equipment required for servicing the Model 1200 Stereo Console Amplifier. The wattmeter, ac voltmeter, and variac may be assembled as a test fixture as shown schematically in Figure 9, and the load resistors and ac ammeter may be assembled into a second test fixture as shown in Figure 10.

Item	Manufacturer and Model No. (or equivalent)	Use
Distortion Analyzer	Hewlett Packard, Model 331A or 333A	Measures distortion and voltage of amplifier output.
Audio Oscillator	Weston Model CVO-100P (NOTE: Less than 0.02 percent residual distortion is required.)	Sinewave and squarewave signal source.
Oscilloscope	Tektronix, Model 503; Data, Model 555	Waveform analysis and troubleshooting
VTVM	RCA Senior Volt-Ohmyst, Model WV-98C	Voltage and resistance measurements.
AC Wattmeter	Simpson, Model 390	Monitors primary power consumption of amplifier.
AC Ammeter (0 to 10 amps)	Commercial Grade	Monitors amplifier output under short circuit condition.
Line Voltmeter (0 to 150 vac)	Commercial Grade	Monitors potential of primary power to amplifier.
Variable Autotransformer (0 to 140 vac, 10 amps)	Powerstat, Model 116B	Adjusts level of primary power to amplifier.
Shorting Plug	Use phono plug with 600 ohms across center pin and shell.	Shorts amplifier input to eliminate noise pickup.
Power Supply Bleeder Resistor (10 ohms at 1 W)	Commercial Grade	Discharges power supply filter capacitors prior to disassembly or resistance measurements.
Output Load Resistor (8 Ω \pm 0.5%, 250 W)	Commercial Grade	Provides 8-ohm load for amplifier output termination.
Output Load Resistor (4 Ω \pm 0.5%, 250 W)	Commercial Grade	Provides 4-ohm load for amplifier output termination.
Output Load Capacitor (0.5 mfd)	Mylar	Provides capacitive load for instability checks.
AC Power Control Box	Optional Item. Fabricate in accordance with Figure 3.	Monitors and controls primary power for amplifier.
Amplifier Output Load Box	Optional Item. Fabricate in accordance with Figure 4.	Provides various amplifier loads and can monitor shorted output.

220 and 100 VOLT AC CONVERSION

220-VOLT AC CONVERSION

To convert the Model 1200 to 220-volt operation, perform the following steps:

1. Remove the top cover.
2. Orient the Model 1200 so that the rear panel is facing toward the viewer.
3. Locate TB1, the strip located on the power transformer half shell facing the rear panel, which terminates the power transformer primary wires.
4. Unsolder the black and white power lead-in wires and all jumpers from TB1.
5. Solder a jumper to TB1 connecting the grey and violet transformer wires.
6. Solder the black and white power lead-in wires to the brown and white transformer wires, respectively, on TB1.
7. Re-attach the top cover.
8. Replace the 6-amp, 250V fuse in the unit with the 4 amp, 250V fuse, Part # 451-1003, supplied with the 220-volt conversion kit, Part # 105-1005-1.

100-VOLT AC CONVERSION

To convert the Model 1200 to 100-volt operation, follow the procedure outlined for 220-volt conversion, except for items 5, 6, and 8. Item 8 is eliminated. These items will read:

5. Solder two jumpers to TB1, one connecting the orange and violet transformer wires, and one connecting the grey and white transformer wires.
6. Solder the black and white power lead-in wires to the orange and white transformer wires, respectively, on TB1.

The Model 1200 is now ready for 100-volt operation.

PERFORMANCE VERIFICATION TEST PROCEDURE

A. Test equipment.

Refer to Table I for required test equipment.

B. Preliminary Procedures.

1. Make the test setup shown in Figure 11 with the instrument controls set in the following positions:

Line Switch	off
Variable — line switch	variable
Watt Meter Switch	on
Variac	0 (fully CCW)
Load	4 ohms (0.5 mfd — Off)
Audio Generator Output	Frequency 2 KHz 5V range
Gain Minimum	
AC Volt Meter	30V range
2. Make sure that connections between the resistive load and the system terminals of the Model 1200 have negligible resistance compared with the resistance of the load itself. Appreciable resistance in wiring adds to the total load, resulting in inaccurate measurement of output power.
3. Connect amplifier output to load and connect AC cord to line power. Connect a shorting plug (600 ohms) to the Phono 1 input jack of the model 1200.
4. Remove the top cover.

C. Bias Adjustment Tests

1. Remove the channel A and channel B power amplifier heat sinks from the chassis, leaving all wires connected.
2. With the component side of the amplifier board face up, rotate bias potentiometer R526 on each amplifier board fully CCW.
3. Turn the line switch on and slowly advance the variac while observing the voltmeter and wattmeter. When the line voltage reaches approximately 105 volts, the speaker relay should energize. The wattmeter should indicate less than 40 W. If the wattmeter indicates either 0 or greater than 40-watts, a defect exists. Turn off the variac and refer to the trouble analysis section of this manual.
4. Adjust left channel bias potentiometer R526 until the wattmeter indicates 10 watts above the initial reading.

- Adjust right channel bias potentiometer R526 until the wattmeter indicates 10 watts above the reading with the left channel properly biased.

D. Balance Tests

- With a VTVM connected to channel A SYSTEM 1 output terminals, set the VTVM in the DC mode. Select the greatest gain position (0.5V full scale or lower).
- Turn the amplifier on and set the SPEAKER switch to SYSTEM 1. Adjust channel A amplifier board potentiometer R504 for an indication of $0V \pm 50mV$ as indicated on the VTVM.
- Connect the VTVM to channel B SYSTEM 1 output terminals. Adjust channel B amplifier board potentiometer R504 for an indication of $0V \pm 50mV$ as indicated on the VTVM.

E. Total Hum and Noise Test

- With 600 ohms shorting plugs connected to the PHONO 1 input jacks and a 4-ohm resistive load connected across the SYSTEM 1 output terminals, connect a distortion analyzer across the load.

NOTE: In this test and tests that follow, if distortion analyzer used does not contain a built-in voltmeter, a VTVM may be substituted.

- Set the distortion analyzer controls for voltage measurements and apply power to the amplifier. Set the volume control fully CCW. Set the SELECTOR switch to PHONO 1.
- If the distortion analyzer indicates more than two millivolts, refer to trouble analysis section of this manual.
- Set the volume control fully CW. If the distortion analyzer indicates more than 36 millivolts refer to the trouble analysis section of this manual.

F. Maximum Power Output

- Connect the audio oscillator to the AUX 1 input. Set audio oscillator frequency to 2KHz. Set SELECTOR switch to AUX 1.
- With the distortion analyzer connected across the output load (4 ohms), set the analyzer on the 30V AC scale.
- Turn potentiometers R541 and R542 fully CCW.
- Turn the analyzer on and increase the audio oscillator output until the analyzer indicates 24.0 volts AC.

- Adjust potentiometer R541 CW until the positive peak of the wave form as observed on the oscilloscope just begins to clip.
- Adjust potentiometer R542 CW until the negative peak just begins to clip.
- Change output load to 8 ohms. Set analyzer sequentially to 20Hz, 2KHz, and 20KHz. Output voltage should be greater than 28.3 volts AC.
- Reduce audio oscillator output to minimum.

G. Relay Operation

- Set line switch to off. Wait approximately two minutes.
- Using a stop watch or the sweep second hand on a watch, time the relay delay from the time that the line switch is turned on.
- Turn the line switch on, time delay should be between two and ten seconds.
- Set audio oscillator for 10Hz. Slowly increase output of oscillator until relay de-energizes. Distortion analyzer should indicate between 15 and 22 volts just prior to relay cut off.

H. Harmonic Distortion Test

- Set the frequency of the audio oscillator and the distortion analyzer to 20KHz.
- Set the controls of the analyzer for voltage measurement on the 30-volt scale.
- Adjust the audio oscillator output level until the analyzer meter indicates 28.3 volts.
- Switch the distortion analyzer to SET LEVEL-MANUAL mode, and adjust SENSITIVITY for full scale reading on 0-1 scale.
- Measure the total harmonic distortion with the analyzer and verify it is less than 0.15 percent.

NOTE: Any parasitic oscillation in the amplifier will be displayed on the oscilloscope when capacitance is switched into the load.

- Switch 0.5 MFD across the load (Figure 10) and verify distortion is no greater than 0.3 percent. Switch 0.5 MFD out of the load.
- Switch the distortion analyzer back to SET LEVEL MANUAL. (Do not adjust SENSITIVITY of analyzer.)

8. Change the frequency of the audio oscillator and distortion analyzer to 2KHz. Adjust audio oscillator output as necessary to have a full scale reading on the 0-1 scale on the analyzer.
9. Measure the distortion, verifying it is no greater than 0.15 percent.
10. Repeat steps 8 and 9, changing frequency to 20 Hz. Distortion should be no more than 0.15 percent.
11. Switch 0.5 MFD across the load and verify distortion is no more than 0.3 percent.
12. Check for parasitic oscillations; there should be none.

I. Short Circuit Test

1. Switch back to a 4-ohm load and set the audio oscillator to 400Hz. Adjust output level of oscillator just below clipping of the output wave as displayed on the oscilloscope.

CAUTION: Do not perform short circuit test if amplifier shows any sign of parasitic oscillation.

2. Press the momentary switch (Figure 10) to a short circuit condition for no longer than three seconds. Verify the ac ammeter indicates no more than 9.5 amperes.

J. FREQUENCY RESPONSE

1. Set LOAD to 8 ohms.
2. Set audio oscillator to 20Hz.
3. Adjust oscillator output for an indication of 28.3 volts AC on distortion analyzer.
4. Sweep frequency up to 20KHz.
5. Output should remain within 27.4 volts to 29.2 volts AC.
6. Connect audio oscillator to PHONO 1 input jacks, set SELECTOR switch to Phono 1.

7. Set audio oscillator to 1KHz \pm 10Hz.
8. Adjust audio oscillator output for 1 millivolt. Distortion analyzer should indicate between .81 and 1.19 volts.
9. Adjust audio oscillator output for an indication of 0dB on analyzer.
10. Set audio oscillator to 20Hz.
11. Sweep frequency up to 20KHz.
12. Output should follow curve shown in figure 12 (\pm 2dB) as indicated on distortion analyzer.

PHONO PREAMPLIFIER DISTORTION TEST

1. Turn VOLUME control fully CCW (off). Connect audio oscillator to CHA Phono 1 input jacks, and set selector switch to PHONO 1. Connect distortion analyzer to CHANNEL A TAPE OUT jacks.
2. Set audio oscillator to 20Hz, 3mv out.
3. Switch the distortion analyzer to the 3 volt scale, and adjust the oscillator output for an output of 3.0 volts at the TAPE OUT jacks.
4. Switch the distortion analyzer to the SET LEVEL MANUAL mode, and adjust SENSITIVITY for a full-scale reading on the 0-1 scale. Set frequency vernier to 20Hz.
5. Measure the total harmonic distortion with the analyzer. If the distortion measures more than 0.1% slowly adjust dc balance potentiometer R235 for minimum distortion.
6. Connect oscillator and distortion analyzer to CHANNEL B PHONO 1 and TAPE OUT jacks, respectively.
7. Repeat steps 3, 4, and 5. Use d-c balance potentiometer R214 for channel B minimum distortion.

K. FUNCTIONAL TESTS

1. Perform functional tests on MODE, SELECTOR, HIGH and LOW filter, SPEAKER, TONE CONTROL, and TAPE MONITOR switches.
2. Perform functional tests on HEADPHONE and CENTER CHANNEL OUTPUT jacks and VOL. CONTROL CENTER CHANNEL.

L. FILTERS AND TONE CONTROLS

1. Set audio oscillator to 50 Hz and connect to Aux 1 inputs.

2. Set SELECTOR switch to AUX 1. Note output as displayed on distortion analyzer.
3. Set LOW filter switch to 50.
4. Distortion analyzer should indicate a drop of $-3 \pm 1.5\text{dB}$.
5. Set LOW filter switch to OUT.
6. Set audio oscillator to 100Hz. Note output as displayed on distortion analyzer.
7. Set LOW filter switch to 100.
8. Distortion analyzer should indicate $-3 \pm 1.5\text{dB}$.
9. Set LOW filter switch to OUT.
10. Set TONE CONTROL switch to IN. Set BASS controls to maximum and then to minimum. Distortion analyzer should indicate $+10 \pm 2\text{dB}$ and then $-10 \pm 2\text{dB}$. Set TONE CONTROL switch to OUT.
11. Set audio oscillator to 5KHz. Note output as displayed on distortion analyzer.
12. Set HIGH filter switch to 5K.
13. Distortion analyzer should indicate $-3 \pm 1.5\text{dB}$.
14. Set HIGH filter switch to OUT.
15. Set audio oscillator to 9KHz. Note output as indicated on distortion analyzer.
16. Set HIGH filter switch to 9K.
17. Distortion analyzer should indicate $-3 \pm 1.5\text{dB}$.
18. Set HIGH filter switch to OUT. Set TONE CONTROL switch to IN.
19. Set audio oscillator to 10KHz. Note output as indicated on distortion analyzer.
20. Set TREBLE controls to maximum and then to minimum.
21. Distortion analyzer should indicate $+10 \pm 2\text{dB}$ and then $-10 \pm 2\text{dB}$.

M. BALANCE

1. Set audio oscillator to 1KHz.
2. Set BALANCE control to mechanical center (line on knob pointing to dot on panel).
3. Difference between channel outputs as indicated on distortion analyzer should be $0 \pm 2\text{dB}$.

N. LOUDNESS

1. With audio oscillator at 1KHz note output as indicated on distortion analyzer.
2. Set TONE CONTROL switch to LOUDNESS.
3. Distortion analyzer should indicate $-7 \pm 2\text{dB}$.
4. Set TONE CONTROL switch to OUT.

O. CHANNEL SEPARATION

1. Set audio oscillator to 20KHz. Connect oscillator to channel A AUX1 input only, with shorting plug in channel B AUX 1 input. Connect distortion analyzer to PREAMP OUT channel A.
2. Adjust oscillator output until distortion analyzer indicates 0dB.
3. Measure channel B preamp out. Distortion analyzer should indicate -40dB or greater.
4. If indication is less than -40dB, adjust input wires to preamp board until reading is -40dB or greater.
5. Connect distortion analyzer to channel A SYSTEM 1 jacks.
6. Re-connect jumper between PREAMP OUT and AMP IN jacks.
7. Adjust oscillator output for an indication of +20dB on distortion analyzer.
8. Connect distortion analyzer to channel B SYSTEM 1 jacks.
9. Distortion analyzer should indicate -40dB or greater.
10. If indication is less than -40dB, adjust power supply wiring until reading is -40dB or greater.
11. Repeat steps 5, 7, 8, and 9 at 20Hz.
12. If indication is less than -48dB, check power supply filter capacitors.