

BROADCAST AUDIO EQUIPMENT

Type BA-6A

Limiting Amplifier



RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION CAMDEN, N. J.

EQUIPMENT LOST OR DAMAGED IN TRANSIT

When delivering the equipment to you, the truck driver or carrier's agent will present a receipt for your signature. Do not sign it until you have (a) inspected the containers for visible signs of damage and (b) counted the containers and compared with the amount shown on the shipping papers. If a shortage or if evidence of damage is noted, insist that notation to that effect be made on the shipping papers before you sign them.

Further, after receiving the equipment, unpack it and inspect thoroughly for concealed damage. This should be done within 15 days, if possible. If concealed damage is discovered immediately notify the carrier, confirmed in writing and insist upon an inspection and report.

In addition to the above, the shortages or damages should also be reported to RCA, but do not return any damaged equipment unless we have furnished complete return shipping instructions.

Transportation companies are required to adjust for damage resulting from their negligence and RCA will assist you, if necessary, in obtaining settlement. Accordingly, you should save all shipping papers, letters or invoices concerning the shipment until it is certain that the equipment was delivered in good condition or until any damage has been adjusted.

REPLACEMENT PARTS

When ordering replacement parts, please give symbol, description, and stock number of each item ordered.

The part which will be supplied against an order for a replacement item may not be an exact duplicate of the original part. However, it will be a satisfactory replacement differing only in minor mechanical or electrical characteristics. Such differences will in no way impair the operation of the equipment.

The following tabulations list service parts and electron tube ordering instructions according to your geographical location.

SERVICE PARTS

LOCATION	ORDER SERVICE PARTS FROM:
Continental United States, Alaska and Hawaii	Service Parts Order Service, Bldg. 60, 19th & Federal Sts., Camden 5, New Jersey or through your nearest RCA Regional Office. Emergency orders may be telephoned, telegraphed, or teletyped to RCA Emergency Service, Bldg. 60, Camden, N. J. (Telephone: WO 3-8000).
Dominion of Canada	RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec or through your local Sales Representative or his office.
Outside of Continental United States, Alaska, Hawaii and the Dominion of Canada	RCA International Division, Clark, N.J., U.S.A. or through your local Sales Representative.

ELECTRON TUBES

LOCATION	ORDER ELECTRON TUBES FROM:
Continental United States, Alaska and Hawaii	Local Tube Distributor
Dominion of Canada	RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec or through your local Sales Representative or his office.
Outside of Continental United States, Alaska, Hawaii and the Dominion of Canada	Local Tube Distributor or from: Tube Department RCA International Division 30 Rockefeller Plaza New York 20, New York, U.S.A.

If for any reason, it is desired to return tubes, please return them to the place of purchase.

PLEASE DO NOT RETURN TUBES DIRECTLY TO RCA WITHOUT AUTHORIZATION AND SHIPPING INSTRUCTIONS.

It is important that complete information regarding each tube (including type, serial number, hours of service and reason for its return) be given.

When tubes are returned, they should be shipped to the address specified on the Return Authorization form. A copy of the Return Authorization and also a Service Report for each tube should be packed with the tubes.

LIST OF RCA REGIONAL OFFICES

Atlanta 3, Georgia 522 Forsyth Bldg. Lamar 7703	Boston 16, Mass. Room 2301, John Hancock Bldg. 1186 200 Berkley St. Hubbard 2-1700	Chicago 54, Ill. Merchandise Mart Plaza Delaware 7-0700	Cleveland 15, Ohio 1600 Keith Bldg. Cherry 1-3450
Dallas 1, Texas 1907-11 McKinney Ave. Riverside 1371	Hollywood 28, Calif. RCA Bldg., 1560 N. Vine St. Hollywood 9-2154	Kansas City 6, Missouri 340 Dierks Bldg. Harrison 6480	New York 20, New York 36 W. 49th St. Judson 6-3800
Branch—San Francisco 2, Calif. 420 Taylor St. Ordway 3-3027			

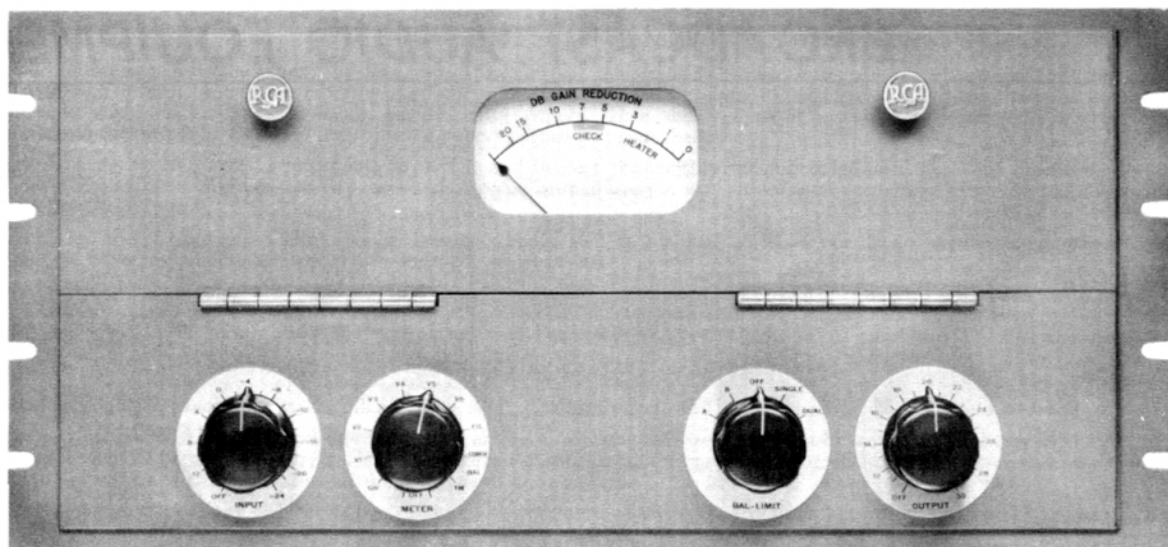
BROADCAST AUDIO EQUIPMENT

INSTRUCTIONS

Type BA-6A Limiting Amplifier

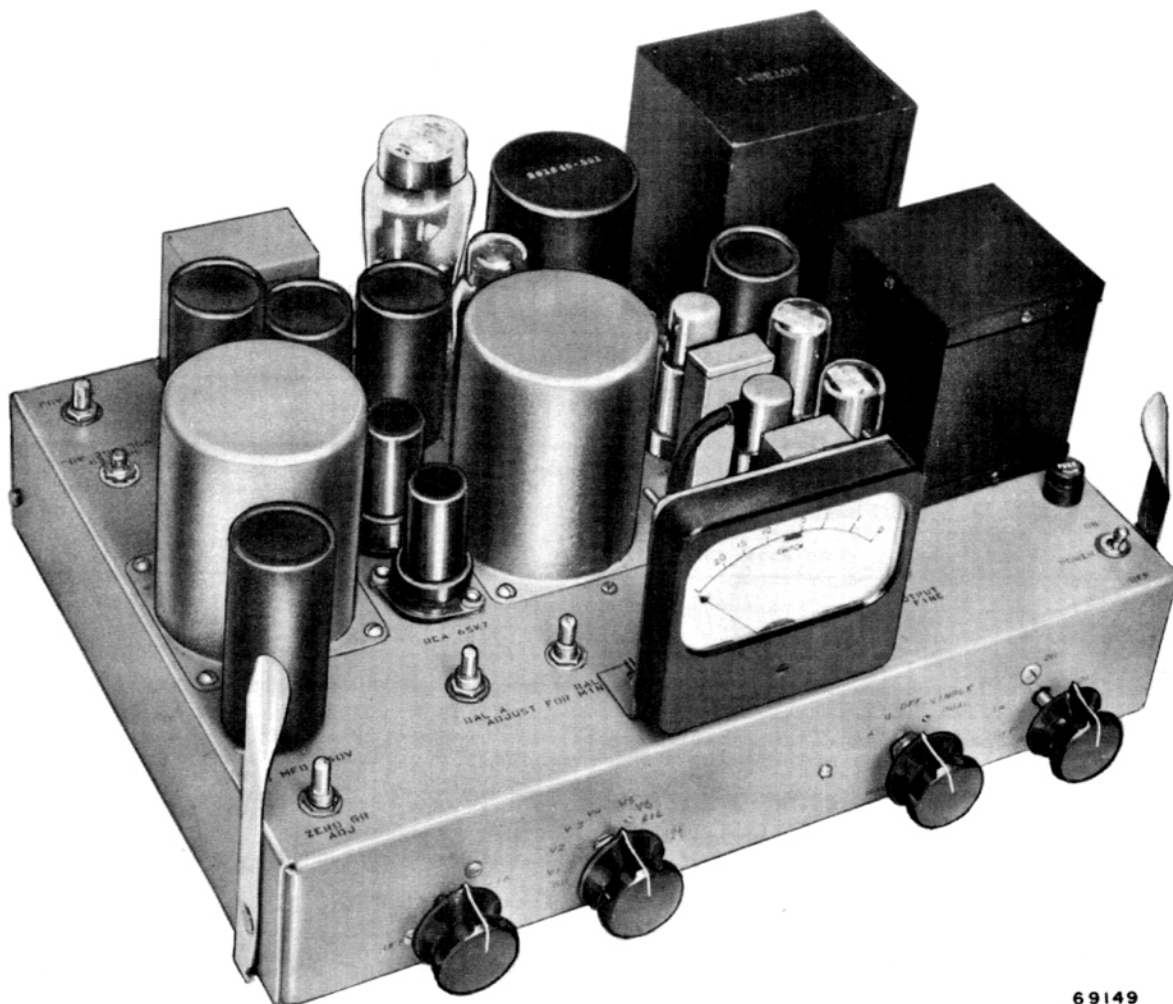
MI-11225

**RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION, CAMDEN, N. J.**



69616

Figure 1 - Type BA-6A Limiting Amplifier on MI-11599 Shelf



69149

Figure 2 - Type BA-6A Limiting Amplifier, with Front Panel Removed

TECHNICAL DATA

Power Required

100 to 130 volts, 50-60 cycles, 105 watts
Transformer taps provided for 105, 115,
and 125 v

Tube Complement (MI-11289)

2 RCA 6SK7
2 RCA 6J7
2 RCA 6V6GT
1 RCA 6H6
1 RCA OD3/VR150
1 RCA 5R4GY

Impedances

Source: 600/150 ohms
Input: 600/150 ohms, balanced or
unbalanced
Load: 600 ohms

Input Level

Minimum: -24 dbm at limiting verge
Maximum: +14 dbm

Output Level

Maximum (limiting off) at 1000 cps:
38.5 dbm
At verge of limiting with output controls
in minimum attenuation position:
29.5 dbm ± 1 db.

Gain

54 db ± 1 db at 1000 cps, 600-ohm source to
600-ohm load; input and output controls at
minimum attenuation (max. clockwise);
signal below verge of limiting.

Gain Controls

Input: 20 steps, 2 db per step
Output: 20 steps, 1 db per step

Frequency Response (1000 Cycle Reference)

Below verge of limiting: ± 1 db, 30-15,000 cps
Up to 20 db gain reduction: +1 db to
-2 db (see figure 5), 30-15,000 cps

Signal-to-Noise Ratio

83 db at verge of limiting. Maximum noise
level is -54 dbm with input and output
controls set at minimum attenuation (max.
clockwise), and input and output terminated
in 600 ohms resistance.

Harmonic Distortion (Total RMS)

Below limiting verge: Less than 0.6% from
50 to 15,000 cps. Less than 1.2% at 30 cps.
At 10 db gain reduction: Less than 0.75%
from 100 to 15,000 cps.
At 15 db gain reduction: Less than 1.0%
from 100 cps to 15,000 cps.

Limiting Characteristic

Output at verge of limiting: 29.5 dbm
 ± 0.5 dbm, output control in maximum gain
position.
Compression ratio above verge of limiting:
20 db into 2 db (see figure 4).

Time Constants

	Attack	Release
Single	600 microsec.	0.33 sec.
Dual, Fast Action	600 microsec.	0.33 sec.
Dual, Slow Action	0.9 sec.	2 sec.

Signal-to-Thump Ratio

21 db minimum, 26 db average, for a series
of tests made with different combinations
of non-selected tubes in variable gain
stage, and an increase in input level of
5 and 10 db above verge of limiting.

Dimensions and Weight

	Chassis	Overall
Length	16-3/16 inches	16-3/16 inches
Width	11-3/4 inches	14 inches
Height	3 inches	7-5/8 inches
Weight	37 pounds

Finish

Light umber gray.

Mounting

Plug-in mounting on MI-11599 Shelf.

DESCRIPTION

The Type BA-6A Limiting Amplifier (Figs. 1
and 2) is intended to prevent overmodulation
of a transmitter by limiting the high audio
peaks which occasionally occur. This limiting
action permits a substantial increase in the
average modulation level, and therefore a
greater transmitter range with the same

carrier power.

The action of the limiting amplifier is
similar to delayed automatic volume control
in a radio receiver. For input signals below a
specified level, the amplifier gain is not
affected. Above this level, however, the gain

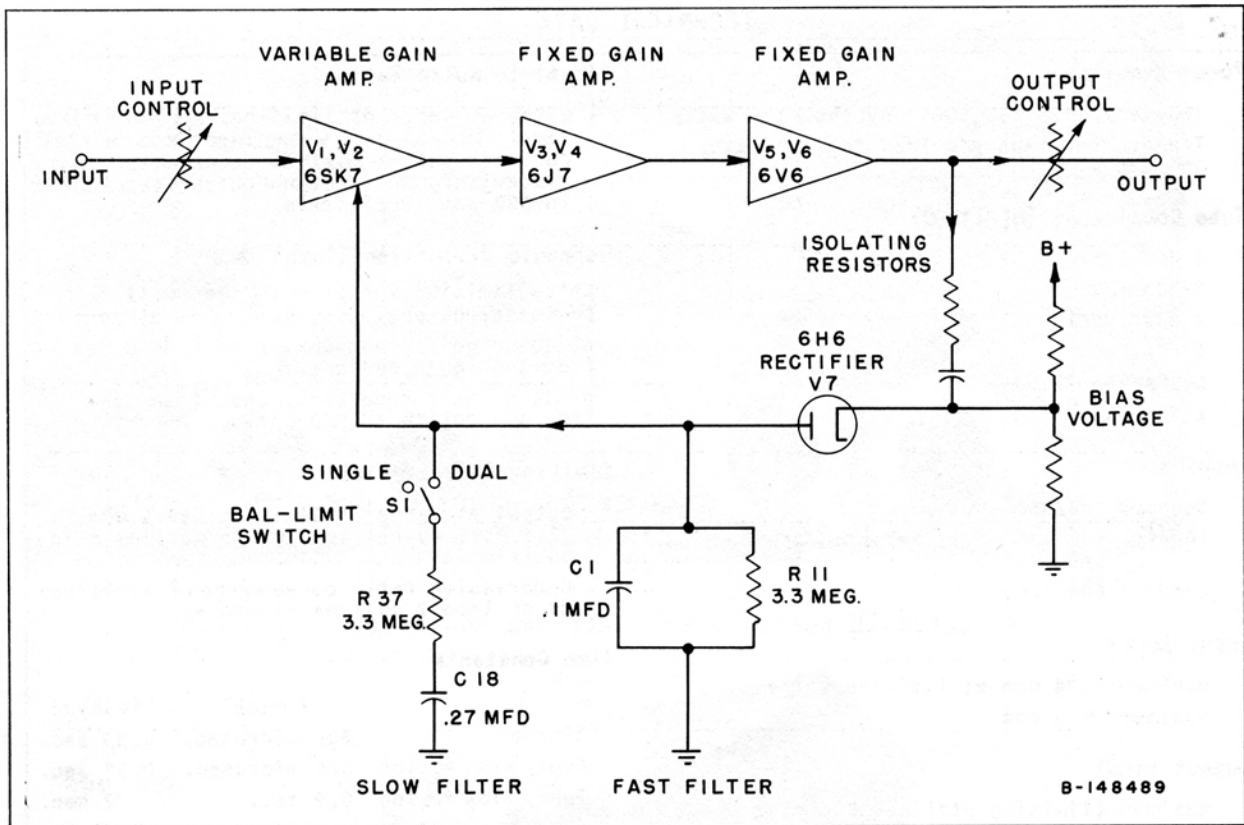


Figure 3 - Simplified Block Diagram

is sharply reduced by an amount that increases with input signal strength. As a result, above the pre-determined level the amplifier output changes only slightly for large changes in input level.

The amplifier is designed for plug-in mounting on an RCA MI-11599 shelf. Two plug-in receptacles and a hinged front panel are supplied with the amplifier for mounting on the shelf. The major operating controls are directly accessible from the front. All other controls, the tubes, and the plug-in capacitors are mounted on the top of the chassis and are accessible when the hinged front panel is opened.

Circuit

As shown in the block diagram, figure 3, and the schematic diagram, figure 8, the amplifier consists of three push-pull stages using commonly available tubes. The first stage which uses two RCA 6SK7 remote-cutoff pentodes, has a variable gain that is con-

trolled by automatic-gain-control voltage. The RCA 6J7 and RCA 6V6GT stages which follow have fixed gains. Negative feedback is applied over the two fixed-gain stages to improve frequency response, minimize distortion, and reduce instability caused by changes in tube characteristics and line voltage.

The heater voltage for the variable-gain stage is obtained from a selenium rectifier to reduce hum, and the screen voltage is held constant by an OD3/VR150 voltage-regulator tube to reduce sensitivity to line-voltage fluctuations. Potentiometers in the screen and cathode circuits of this stage make it possible to balance any pair of 6SK7 tubes over the entire range of grid voltages encountered, so that thumps produced by sudden shifts of the operating point will be cancelled. Switches on the front panel permit making the balancing adjustments quickly and without external equipment by applying an internal 60-cycle signal to the 6SK7 grids

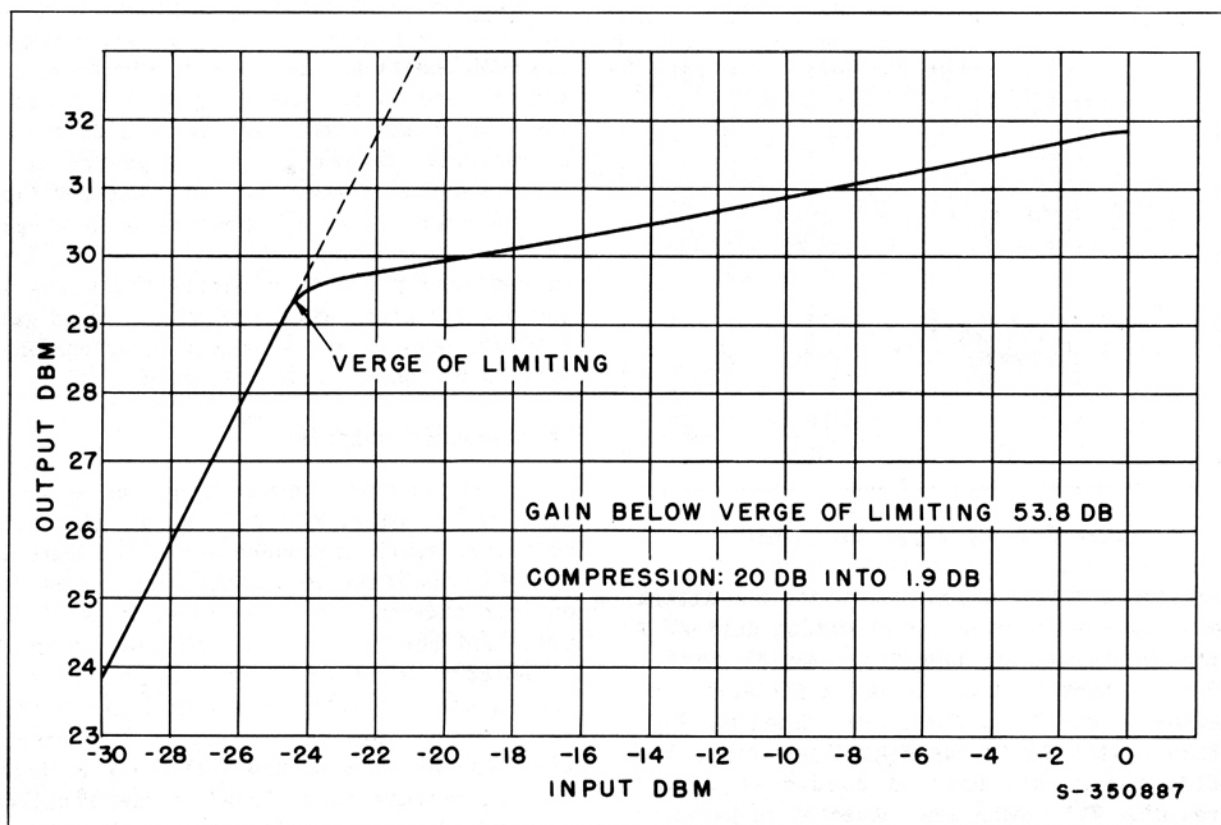


Figure 4 - Limiter Characteristics

and using the front-panel meter to indicate balance (See *Preliminary Adjustments*).

The variable grid bias which controls the gain of the 6SK7 stage is obtained by rectifying part of the output voltage of the last

stage with a 6H6 fullwave rectifier. Fixed positive bias on the rectifier cathodes prevents conduction until the output level exceeds the verge of limiting. The output voltage of the rectifier is fed to the grids of the 6SK7 tubes through a resistance ca-

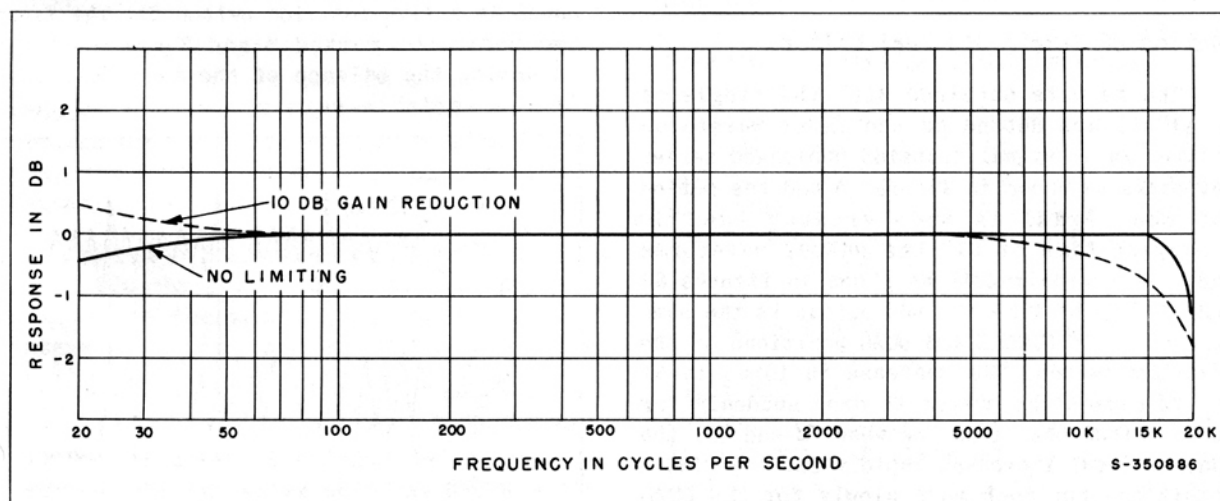


Figure 5 - Frequency Response

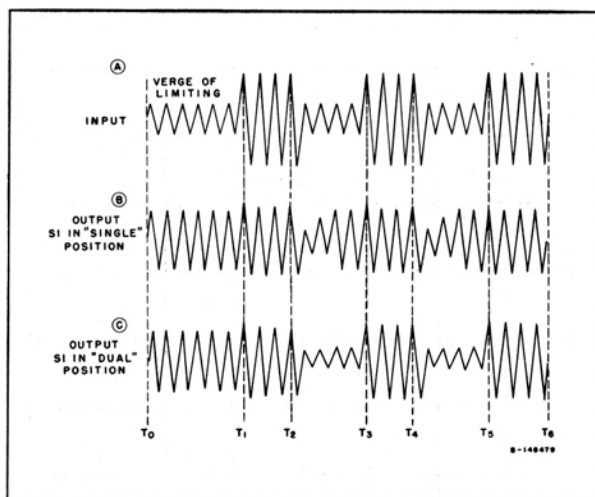


Figure 6 - Amplifier Waveforms

capacitance filter which determines the attack and release times of the limiting action. A rotary switch on the front panel marked BAL-LIM permits selection of a filter having either a single or dual time constant. When this switch is in the SINGLE position, the filter consists only of condenser C1 and resistor R11, which are connected in parallel between the rectifier plate and ground. This filter has a fast charging time, .0006 seconds, and a relatively slow discharge time, 0.33 seconds. When S1 is in the DUAL position, the additional series combination of R37 and C18 is shunted across C1 and R11, R37 and C18 have a slow charge time of .9 seconds and a slower discharge time of 2 seconds.

Action of Single and Dual Filters

The results obtained with the single or dual filters depend on the input waveform. If the input signal contains prolonged series of peaks as shown in figure 6A and the period of the signal is much greater than the charging time of C1, the output waveforms will be approximately as shown in figures 6B and 6C. Up to time T2, the output is the same for both the SINGLE and DUAL positions of the BAL-LIM switch. The decrease in input level at T2 causes the output to drop suddenly for both switch positions. Between T2 and T3, the output level increases rapidly for the SINGLE position, but much more slowly for the DUAL position, because the discharge time of C18 is longer than that of C1.

When the input contains short single peaks as shown in figure 7, and the switch is in the DUAL position, the circuit acts as if the switch were in the SINGLE position because there is insufficient time for C18 to charge appreciably. Comparison of the waveforms in figures 6 and 7 shows that the recovery time of the dual filter is short after a single peak and long after a series of peaks. This automatically prevents noticeable holes in the program after short peaks, and rapid gain fluctuations, known as breathing or pumping, between prolonged series of peaks.

Front-Panel Controls

Input Control: The knob at the extreme left of the panel controls a dual potentiometer R1 which is connected in the control grid circuit of the 6SK7 tubes. The resistance on each side of the potentiometer is 25,000 ohms and the control is calibrated in 20 steps of 2 db. This control is provided to compensate for differences in input signal level and to vary the amount of gain reduction. The markings on the dial plate indicate the approximate input level in dbm required to reach the verge of limiting.

Meter Switch: The second control on the panel is a switch (S2) for connecting the meter to various points in the circuit. The table given in the *Maintenance* section shows the metering function for each switch position.

Bal-Limit Switch: The third control on the panel is a five-position switch S1. The first two positions marked A and B are used for adjusting the balance of the two 6SK7 tubes in the variable gain stage. Use of these

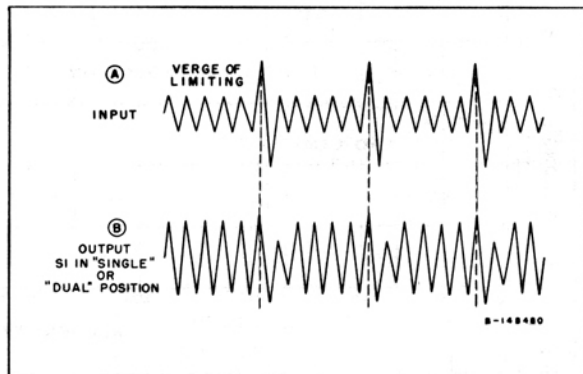


Figure 7 - Waveforms (Cont.)

positions of the switch is explained under *Balancing 6SK7 Tubes* under *Preliminary Adjustments*.

The last three positions of the switch determine the gain reduction action of the amplifier. In the OFF position, the gain control voltage is shorted to ground so that the gain of the amplifier is independent of the signal strength, and is approximately 54 db. In the SINGLE position, the output of the amplifier is limited and only the single timing circuit, consisting of C1 and R11, is connected across the rectifier output. In the DUAL position both timing circuits C1 and R11 and C18 and R37 are connected.

Output Control: The fourth knob on the panel controls a bridged T attenuator (R-36) in the output circuit. This control determines the output level of the amplifier. The control is calibrated in 20 steps of 1 db. The numbers on the dial plate indicate the approximate output level in dbm at the verge of limiting.

Chassis Controls

Seven controls are provided in the amplifier which do not usually require adjustment during normal operation of the amplifier. These controls are all on the top of the chassis, and are accessible when the hinged front panel is opened.

On-Off Switch: The toggle switch marked ON-OFF on the chassis turns the power on or off.

Balance A Potentiometer: The control marked BALANCE A, a 100-ohm screwdriver adjusted potentiometer in the cathode circuit of the push-pull 6SK7 stage, permits balancing the 6SK7 tubes by varying the cathode voltage.

Balance B Potentiometer: This control is a 10,000-ohm screwdriver adjusted potentiometer in the screen circuit of the 6SK7 stage which permits balancing the 6SK7 stage by varying the screen voltage.

Zero Adj.: The ZERO ADJ. control is a 100-ohm rheostat (R-47) that is connected in series with the meter when the METER switch is in the GR position. This control permits adjusting the meter to 0 gain reduction when no input signal is applied.

Fine Output Control: The FINE OUTPUT control (R-36), a 100-ohm rheostat in series with the output attenuator R-36, is a vernier adjustment for the OUTPUT control.

Hum Adj. Control: This control is a 100-ohm potentiometer (R-63) in the filament supply circuit that is provided for an external preamplifier. It is used to minimize the hum of the preamplifier.

Heater Voltage Adj.: The HEATER VOLTAGE control R-64, is a 2-ohm rheostat in the heater circuit of the 6SK7 stage. It is used to adjust the d-c heater voltage obtained from selenium rectifier SR1.

Tube Complement

The tubes required for the limiting amplifier are listed in the *Technical Data* table. These tubes are not supplied with the amplifier but may be obtained as a complete set by ordering MI-11289.

INSTALLATION

Installing Tubes and Plug-in Capacitors

Before mounting the amplifier seat the tubes and plug-in capacitors in the corresponding sockets which are identified by stencilling on the chassis. Place the grid leads on the two 6J7 tubes and fit the grid shield caps over them. To insure noise-free operation make certain that each shield makes a good electrical connection to the shell of the tube.

Mounting on MI-11599 Shelf Assembly

Attach each of the Jones plugs supplied with the amplifier to one of the U-shaped brackets supplied with the shelf assembly as directed in the instruction book for the shelf. Then attach one of the receptacles to the shelf at the extreme left and the other at the extreme right, using the appropriate holes in the rear of the shelf. Attach a guide strip to the shelf at its extreme right and left sides. All required mounting hardware for the brackets and guide strips is supplied with the shelf.

To install the amplifier, slide it back on the shelf until the plugs engage the receptacles and push back on the ejector handles to

insure a snug fit. To remove the amplifier, pull forward on the handles and slide it out.

Mount the front panel supplied with the amplifier as follows: Lift the latches at the rear of the lower panel section and place the panel flush against the shelf. Lower the latches to engage the side shelf supports between the latches and the panel. The panel is hinged at the center, and the upper section engages holes in the upper horizontal shelf support by means of two catches in the panel. The panel may be closed by snapping it shut, and opened by pulling the monogrammed knobs. After the panel is mounted, push the four knobs onto the amplifier control shafts.

To position the meter, open the panel, loosen the two binder-head screws that hold the meter bracket to the chassis, and adjust the bracket until the meter face is flush with the panel. Tighten the two screws and close the panel.

Connections

All audio leads should be shielded twisted pair insulated for 200 volts, but need not be larger than No. 19 A.W.G. All joints should be securely soldered and of low resistance. If the circuits run in conduit or duct which may be subject to moisture, a type of wire having a natural or synthetic rubber covering over the shield or lead should be used. To minimize noise pickup and cross-talk on long input circuits, the shielding of the input leads to the amplifier or rack should be covered with suitable insulation such as cotton braid and the shielding should be grounded only at the amplifier (point of lowest level). Make sure that the shields are electrically continuous and that the ground connections are perfect. Do not run the audio input leads adjacent to or laced in with a-c or high-level audio lines.

Solder all connections to the terminals on the two Jones receptacles J1 and J2 which mate with plugs P1 and P2 respectively, as directed in the following paragraphs:

Balanced Input Connections: For a 600-ohm balanced input connect the input leads to terminals 11 and 12 of input receptacle J1 and for a 150-ohm balanced input, to terminals 3 and 4 of J1.

Unbalanced Input Connections: For a 600-ohm unbalanced input unsolder the jumper from terminal 3 to 8 of input transformer T1 and interconnect terminals 1 and 8 of T1. Connect the high side of the input line to terminal 11 of input receptacle J1 and the low side to terminal 12 of J1.

For a 150-ohm unbalanced input unsolder the wire from terminal 3 to 8 of the input transformer and interconnect terminals 6 and 8 of the input transformer. Connect the high side of the input line to terminal 3 of input receptacle J1 and the low side to terminal 4 of J1.

INPUT RECEPTACLE J1

Terminal No.	Connection
3	150-ohm input
4	150-ohm input
7	External Meter (-)
8	External Meter (+)
9	Electrical ground
10	Chassis ground
11	600-ohm input
12	600-ohm input

Output Connections: For a 600-ohm balanced or unbalanced output, make the output connections to terminals 11 and 12 on receptacle J2.

External Meter: If use of an external gain reduction meter is desired, remove the 82-ohm resistor from terminals 7 and 8 of the input plug P1. Connect the + terminal of the meter to terminal 8 on the input receptacle J1, and the - terminal to terminal 7 on J1. A meter like that used on the amplifier may be obtained from the RCA Replacement Parts Department (see *List of Parts*).

OUTPUT RECEPTACLE J2

Terminal No.	Connection
3 and 4	Filament voltage supplied to external equipment, 6.3 v, 0.6 a
5 and 6	A-C line
9	B-
10	B+ voltage for external equipment, 270 v at 7 ma
11 and 12	600-ohm output

Power for External Preamplifier: Terminals are provided to supply sufficient plate and filament power for one MI-11231 preamplifier or a similar device. Make these connections to the proper terminals as listed in the table headed *Output Receptacle J2*.

A-C Power Connections: The power transformer T4 is connected for operation from a 110- to 120-volt, 50-60 cps power line. If the line voltage is normally 120 to 130 volts, disconnect the wire from terminal 3 on T4 and connect it to terminal 4 on T4. If the line voltage is normally 100 to 110 volts, disconnect this wire from terminal 3 on T4 and connect it to terminal 2 on T4.

Connect the leads from the a-c power supply to terminals 5 and 6 on output receptacle J2.

PRELIMINARY ADJUSTMENTS

To set up the equipment for operation, make the following adjustments:

Balancing 6SK7 Tubes

The 6SK7 tubes should be balanced before using the equipment for the first time, and whenever the tubes have been replaced or have aged unequally. To make the adjustment proceed as follows:

1. Open the front panel by pulling the monogrammed knobs, and turn the ON-OFF power switch on the chassis to ON. Allow the amplifier to warm up for at least 30 minutes.

2. Turn the METER switch to the FIL position and adjust the HEATER voltage control until the meter pointer is at the HEATER mark.

3. Turn the INPUT control to the OFF position.

4. Turn the METER switch to the COARSE BAL position.

5. Turn the BAL-LIM switch to position A. When the switch is in this position, a 60-cycle voltage is applied to the grids of the 6SK7 tubes in parallel and the amplifier output signal is disconnected from the outgoing line and switched to the meter. The output shown on the meter is due to unbalance of the 6SK7 tubes.

6. Turn the BAL A control on the chassis until the meter reading is minimum. This adjustment varies the cathode voltage of the two tubes.

7. Turn the BAL-LIM switch to position B and adjust the BAL B control on the chassis for minimum meter reading. Placing the BAL-LIM switch in the B position increases the 60-cycle voltage applied to the 6SK7 tubes, and increases the cathode bias voltage. Turning the BAL B control varies the screen voltage of the two tubes.

8. Turn the meter switch to the FINE BAL position and repeat the preceding adjustments until the meter shows no deflection in both the A and B positions of the BAL-LIM switch.

Meter Adjustment for Zero Gain Reduction

To adjust the meter to zero proceed as follows: Turn the BAL-LIM switch to OFF. Turn the METER switch to GR. Adjust the ZERO ADJ. control on top of the chassis until the meter reads 0 db (full scale).

Input and Output Adjustments

To adjust the amplifier for the desired amount of gain reduction on signal peaks, and the desired output level, proceed as follows:

1. Turn the BAL-LIM switch to the SINGLE position, and the meter switch to the GR position.

2. With a signal generator, apply a sine wave signal of approximately 1000 cycles to the amplifier input. Adjust the amplitude of this signal to the level expected on program signal peaks.

3. Adjust the INPUT control until the meter reads the amount of gain reduction that is desired on signal peaks. The maximum gain reduction used should be a compromise between the increase in average power output and loss of dynamic range. Listening tests indicate that as much as 15 to 20 db of gain reduction can be used on program material where the dynamic range is not of primary importance.

4. Adjust the OUTPUT control until the output is at the required level for 100 percent modulation of the transmitter. If this

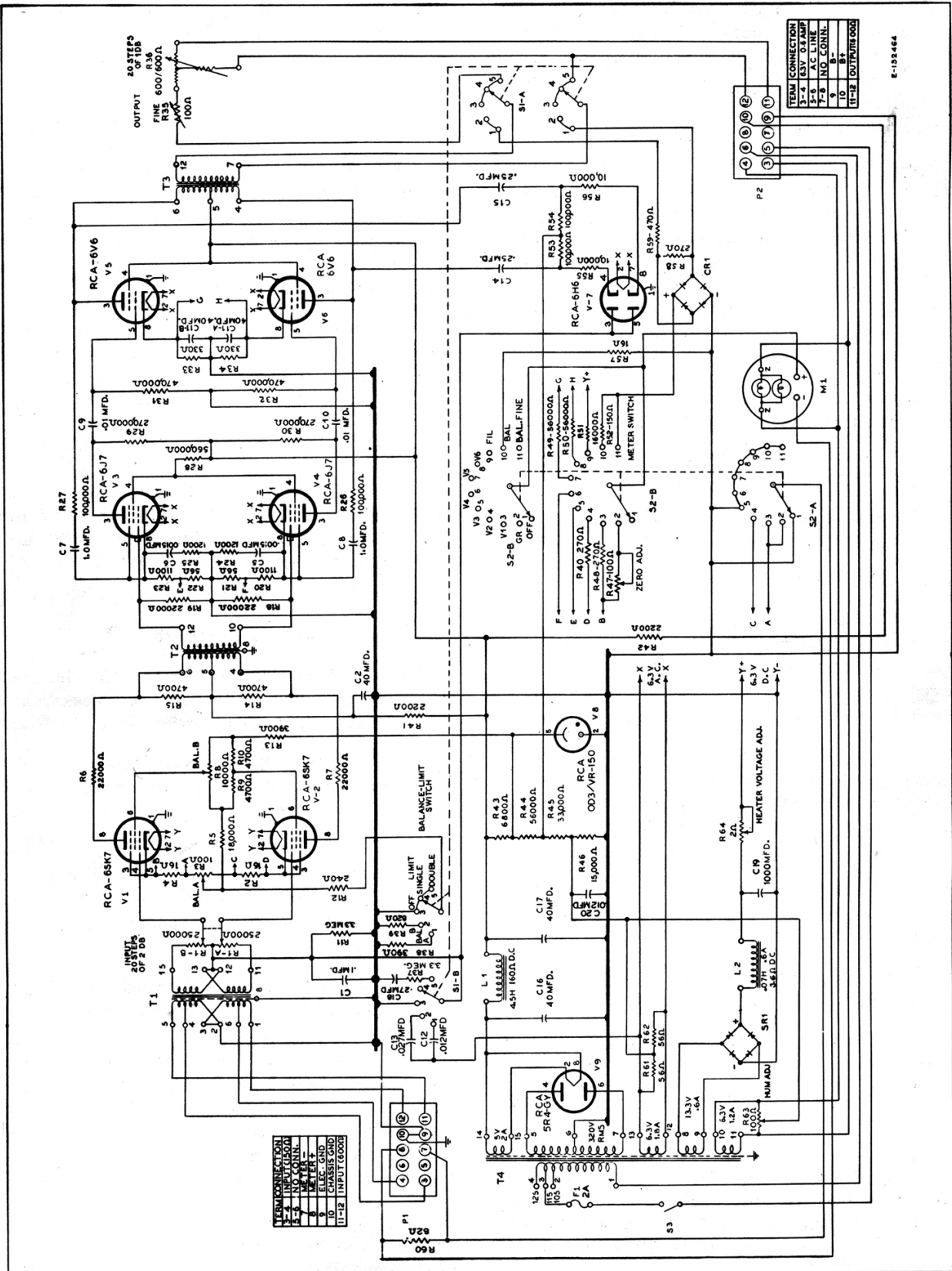


Figure 8 - Schematic Diagram

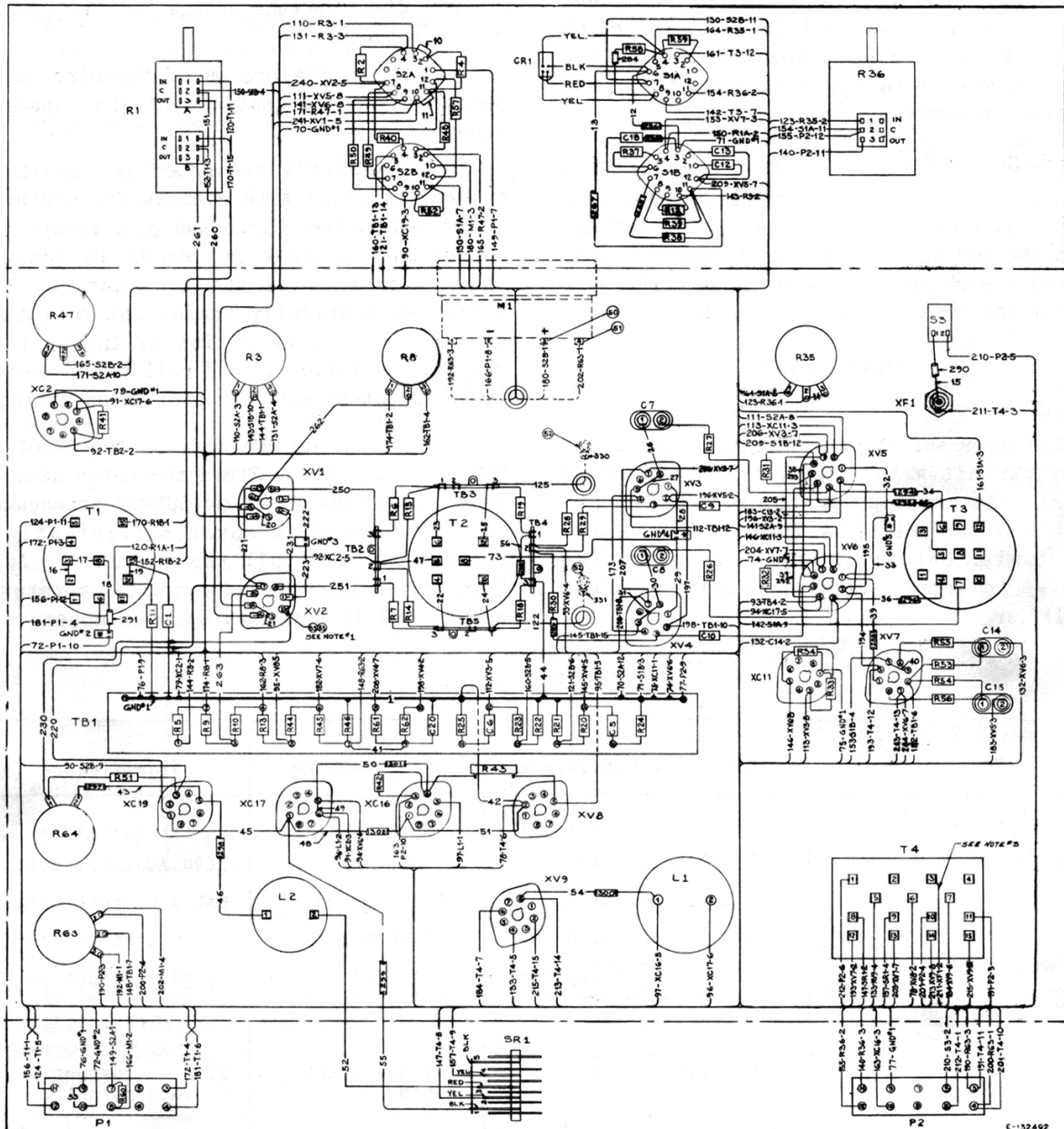


Figure 9 - Wiring Diagram

level cannot be set exactly with the OUTPUT control, adjust the FINE OUTPUT control on the chassis.

Use of Single or Dual Filters

After all adjustments are completed apply a program signal to the amplifier input and make listening tests with the BAL-LIM switch in the SINGLE and DUAL positions. Finally, set the switch in the position giving the desired results.

Hum Adjustment for External Preamplifier

If the limiting amplifier is used to supply power for an external preamplifier, turn the HUM adjustment potentiometer on the top of the chassis until the hum in the output of the preamplifier is minimum.

MAINTENANCE

Use of Meter

The METER switch permits testing the amplifier circuit with the meter on the front panel. The metering function for each position of the switch is shown in the following table. Unless otherwise noted in the table, no input signal is applied to the amplifier.

Cleaning

The Type BA-6A Limiting Amplifier should receive the care usually given to high-quality audio equipment, such as regular cleaning and inspection. Perform the following operations regularly:

1. Clean the tube prongs and the contacts of the sockets.
2. Clean the prongs of the plug-in capacitors and the contacts of the capacitor sockets.
3. Clean the prongs of the amplifier connection plugs with a clean dry cloth. Do not use abrasive. Clean the plug receptacles approximately every two months by removing the amplifier from the receptacles. This action automatically cleans the receptacle contacts by wiping action of the springs. Plug the amplifier in and pull it out several times to obtain sufficient cleaning action.
4. Clean the contacts of the INPUT and OUTPUT attenuators. Press the catch near the rear end of the INPUT or OUTPUT attenuator, turn the rear-end cover sufficiently to release it, and pull the cover off. Apply Davenoil to the exposed contacts, rotate the shaft, and if any dark streaks appear wipe

METER INDICATIONS

Meter Switch Position	Operating Conditions	Normal Meter Reading	Significance
OFF (two position)	No deflection
GR	BAL-LIM sw. OFF	Full scale	ZERO ADJ. correct
	BAL-LIM sw. at A	5 db approx.	BAL A circuit normal
	BAL-LIM sw. at B	10 db approx.	BAL B circuit normal
	Input signal applied and BAL-LIM sw. at SINGLE or DUAL	0 to full scale depending on signal strength	db gain reduction
V1 to V6	BAL-LIM sw. OFF	Within check band	Cathode current of tube normal
HEATER	At HEATER mark	DC heater voltage for 6SK7 stage is 6.5 ± 0.1 v
COARSE and FINE BAL	INPUT control OFF BAL-LIM sw. at A or B	No deflection	6SK7 stage balanced

off the contacts. Repeat this procedure until the contacts are clean, then apply a thin film of Davenoil. Press the catch nearest the front of the INPUT attenuator and remove the rear section of the attenuator exposing the front-section contacts. Clean these contacts in the same manner. Replace the rear section and back cover of the INPUT attenuator and the back cover of the OUTPUT attenuator and lock each in place.

Replacing Meter Lamps

The meter scale is illuminated by two series-connected 3.2-volt panel lamps (Type 42) mounted on the inside of a removable plate on the bottom of the meter. To replace the lamps, open the front panel and remove the two binder-head screws that hold the

meter bracket to the chassis. Remove the screw in the center of the bottom plate on the meter and take out the plate. After changing the lamps, replace the plate and the screw, position the bracket so that the meter is flush with the panel, and fasten the bracket in place with the two screws.

Typical Operating Voltages

Approximate operating voltages for an amplifier with no input signal applied are given in the following table. These voltages should be obtained when the a-c line voltage is 115 volts, and the d-c voltages are measured with a 20,000 ohms-per-volt meter. All voltages are measured to ground except the a-c filament voltages.

VOLTAGE TABLE

TUBE	PLATE		SCREEN		HEATER		CATHODE	
	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts	Pin No.	Volts
V1, V2 RCA 6SK7	8	135 dc	6	103 dc	2 & 7	6.5 dc	5	5.15 dc
V3, V4, RCA 6J7	3	71 dc	4	42 dc	2 & 7	6.3 dc	8	1.18 dc
V5, V6, RCA 6V6	3	275 dc	4	285 dc	2 & 7	6.3 dc	8	13.1 dc
V7, RCA 6H6	3 & 5	0 dc	-	-	2 & 7	6.3 dc	4 & 8	66 dc
V8, RCA OD3/VR150	5	155 dc	-	-	-	-	2	0 dc
V9, RCA 5R4GY	4 & 6	315 ac	-	-	2 & 8	5.0 ac	-	-

LIST OF PARTS

The following parts list is included to provide identification when ordering replacement parts. Order from *RCA Replacement Parts Department, Camden, New Jersey*, giving the *Stock Number* and *Description* of the parts

wanted. Replacement parts supplied may be slightly different in form or size from the original parts but will be completely interchangeable with them.

Symbol No.	Description	Stock No.
C1	Capacitor, molded paper, 0.1 mf, $\pm 10\%$, 200 v	73784
C2	Capacitor, dry electrolytic, 40 mf, -10% , $+50\%$, 450 v	56410
C5,6	Capacitor, molded paper, .0015 mf, $\pm 10\%$, 600 v	77123

Symbol No.	Description	Stock No.
C7,8	Capacitor, fixed, paper, 1 mf, -10% , $+20\%$, 600 v	56124
C9, 10	Capacitor, molded paper, 0.01 mf, $\pm 10\%$, 600 v	73565
C11A, B	Capacitor, dry electrolytic, 40-40 mf, -10% , $+250\%$, 25 v	93747

LIST OF PARTS (Cont'd.)

Symbol No.	Description	Stock No.
C12	Capacitor, molded paper, .012 mf, $\pm 10\%$, 200 v	59485
C13	Capacitor, molded, paper, .027 mf, $\pm 10\%$, 400 v	73554
C14,15	Capacitor, fixed, paper, .25 mf, -10% , $+20\%$, 600 v	57546
C16,17	Same as C2	
C18	Capacitor, molded paper, .27 mf, $\pm 10\%$, 200 v	73786
C19	Capacitor, dry electrolytic, 1000 mf, -10% , $+250\%$, 25 v	94179
C20	Same as C12	
CR1	Rectifier, meter, d-c reverse voltage, 2.25 v, d-c forward current 10 ma	59793
F1	Fuse, 2 amperes	3883
J1,2	Connector, input or output, 10 contacts, female	49032
L1	Reactor, plate supply, iron core	59791
L2	Reactor, heater supply, iron core	59792
M1	Meter, db gain reduction, scale 0 to 20	59790
P1,2	Plug, input or output, 10 contacts, male	48788
R1A,B	Resistor, variable, dual, 25,000 ohms per section	59779
R2	Resistor, fixed, comp. 16 ohms, $\pm 5\%$, 1 w	512016
R3	Resistor, variable, wire-wound, 100 ohms, $\pm 10\%$, 4 w	50937
R4	Same as R2	
R5	Resistor, fixed comp, 18,000 ohms, $\pm 5\%$, 1 w	512318
R6,7	Resistor, fixed comp, 22,000 ohms, $\pm 5\%$, 1 w	512322
R8	Resistor, variable, wire-wound, 10,000 ohms, 4 w	17885
R9,10	Resistor, fixed comp., 4700 ohms, $\pm 5\%$, 1 w	512247
R11	Resistor, fixed, comp, 3.3 megohms, $\pm 10\%$, 1 w	512533
R12	Resistor, fixed comp, 240 ohms, $\pm 5\%$, 1 w	512124
R13	Resistor, fixed comp, 3900 ohms, $\pm 5\%$, 1 w	512239
R14,15	Same as R9	
R18,19	Same as R6	
R20	Resistor, fixed carbon, film type, 1100 ohms, $\pm 1\%$, 1 w	59781
R21,22	Resistor, fixed comp, 56 ohms, $\pm 5\%$, 1 w	512056
R23	Same as R20	
R24,25	Resistor, fixed comp, 1200 ohms, $\pm 5\%$, 1 w	512212

Symbol No.	Description	Stock No.
R26,27	Resistor, fixed carbon, film type, 100,000 ohms, $\pm 1\%$, 1 w	207032
R28	Resistor, fixed, comp, 560,000 ohms, $\pm 10\%$, 1 w	512456
R29,30	Resistor, fixed, comp, 270,000 ohms, $\pm 10\%$, 1 w	512427
R31,32	Resistor, fixed comp, 470,000 ohms, $\pm 10\%$, 1 w	512447
R33,34	Resistor, fixed comp, 330 ohms, $\pm 5\%$, 2 w	522133
R35	Same as R3	
R36	Resistor, variable, attenuator pad, wire-wound, 600/600 ohms	59783
R37	Resistor, fixed comp, 3.3 megohms, $\pm 10\%$, 1 w	512533
R38	Resistor, fixed comp, 390 ohms, $\pm 5\%$, 1 w	512139
R39	Resistor, fixed comp, 820 ohms, $\pm 5\%$, 1 w	512182
R40	Resistor, fixed comp, 270 ohms, $\pm 5\%$, 1 w	512127
R41,42	Resistor, fixed comp, 2200 ohms, $\pm 10\%$, 1 w	512222
R43	Resistor, fixed, wire-wound, 6800 ohms, $\pm 10\%$, 10 w	93749
R44	Resistor, fixed comp, 56,000 ohms, $\pm 5\%$, 1 w	512356
R45	Resistor, fixed comp, 33,000 ohms, $\pm 5\%$, 1 w	512333
R46	Resistor, fixed comp, 15,000 ohms, $\pm 5\%$, 1 w	512315
R47	Same as R3	
R48	Same as R40	
R49,50	Same as R44	
R51	Resistor, fixed carbon, film type, 16,000 ohms, $\pm 1\%$, 1 w	211456
R52	Resistor, fixed comp, 150 ohms, $\pm 5\%$, 1 w	512115
R53,54	Resistor, fixed comp, 100,000 ohms, $\pm 10\%$, 1 w	512410
R55,56	Resistor, fixed comp, 10,000 ohms, $\pm 10\%$, 1 w	512310
R57	Resistor, fixed comp, 16 ohms, $\pm 5\%$, 1 w	512016
R58	Same as R40	
R59	Resistor, fixed comp, 470 ohms, $\pm 10\%$, 1 w	512147
R60	Resistor, fixed comp, 82 ohms, $\pm 5\%$, 1 w	31959
R61,62	Same as R21	
R63	Same as R3	
R64	Resistor, variable, wire-wound, 2 ohms, $\pm 10\%$, 4 w	59784

LIST OF PARTS (Cont'd.)

Symbol No.	Description	Stock No.
S1A,B	Switch, BAL-LIM, rotary 2 sections, 3 positions, 4 circuits	59785
S2A,B	Switch, METER, rotary, 2 sections, 12 positions, 4 circuits	59786
S3	Switch, power, toggle, S.P.S.T., 3 amperes, 250 v, a-c or d-c	48791
SR1	Rectifier, selenium, bridge, input 18 v ac, output 12.5 v dc at .780 amps	59504
T1	Transformer, input	59787
T2	Transformer, interstage	59788

Symbol No.	Description	Stock No.
T3	Transformer, output	43679
T4	Transformer, power, 125 v, 50/60 cycles	59789
XC2 to XC19	Socket, capacitor, 8 contacts	45368
XF1	Holder, fuse	48894
XV1,2	Socket, tube, 8 contacts	28413
XV3 to XV9	Socket, tube, 8 contacts	31319
	Knob	27990
	Handle, ejector, left	52403
	Handle, ejector, right	52404
	Lamp, meter	99931



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