



Type BA-3A
Program Amplifier

(MI-11224-A)

(MI-11224-B)

RADIO CORPORATION OF AMERICA
RCA VICTOR DIVISION CAMDEN, N. J.

BROADCAST EQUIPMENT

INSTRUCTIONS

Type BA-3A

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Figure 1—Front view of Type BA-3A Program Amplifier.
Inset: Adapter kit supplied with amplifier.

DESCRIPTION

General

1. The Type BA-3A (MI-11224-A and MI-11224-B) Program Amplifiers are three-stage, resistance-capacity-coupled units of the plug-in type, incorporating a self-contained power supply. By

suitable arrangement of the input connections these units can be used as line amplifiers, program amplifiers or high-level isolation amplifiers. A dual volume control is employed, which simultaneously controls the gain of the first and second stages.

TECHNICAL DATA

Power Supply

100 to 130 volts
50 to 60 cycles
55 watts

Fuse Rating

1 ampere (Type 3-AG)

Tubes

2 RCA 1620
1 RCA 1622
1 RCA 5Y3 GT/G

When increased hum, distortion and microphonics can be tolerated the following tube complement can be substituted.

2 RCA 6J7
1 RCA 6L6
1 RCA 5Y3 GT/G

Source Impedance

600-ohm or 250-ohm source

Input Impedance

Matching:
550 ohms
Bridging:
20,000 ohms (approximate)

Maximum Input Level

Matching:
0 dbm* with 0.5% total rms distortion from 30 cps to 15,000 cps (output +15 dbm*)
+11 dbm* with 1.0% total rms distortion from 30 cps to 15,000 cps (output +15 dbm*)

Bridging:
+40 dbm* with 1.0% total rms distortion from 30 cps to 15,000 cps (output +15 dbm*)

Output Load Impedance

600 ohms (refer to paragraph 20)

Rated Output Level and Distortion

+30 dbm* with 0.5% total rms distortion from 50 cps to 15,000 cps
+30 dbm* with 1.0% total rms distortion from 30 cps to 15,000 cps

Gain

With gain control at maximum:
65.5 db when operating from a 600-ohm source into a 600-ohm load.
27.5 db when operating from bridging input into a 600-ohm load.

Frequency Response

±1 db from 30 cps to 15,000 cps (600-ohm source or bridging input to 600-ohm load).

Noise Level

The total noise level of the amplifier measured with 600 ohms resistance across the input terminals is 82 db or more below the rated output level of the amplifier.
(Volume control in the maximum position.)

Isolation

90 db (with matching input)

Connections

2 10-prong plug-in connections mounted on the rear panel of the chassis.

Mounting

Shelf mounting in the Type BR-2A Shelf Assembly or the Type 36-B Panel-and-Shelf Assembly.

Finish

Light umber gray except for output and power transformers which are satin black.

Dimensions and Weight

Chassis dimensions:
Length 11¾ inches
Width 8 inches
Height 2 9/16 inches

Overall dimensions:
Length 13¾ inches
Width 8 inches
Height 7⅞ inches

Weight:
Complete 17½ pounds
Less tubes 17 pounds
Less tubes and plug-in capacitors 15¾ pounds

* dbm—decibel level referred to 1 milliwatt.

CIRCUIT

General

2. An input transformer, tapped for use with a 600-ohm or a 250-ohm source, supplies the signal to the grid of the first-stage tube. Resistance-capacity coupling is used between the first and second stages and between the second and third stages. A dual-potentiometer type gain control is a feature of the circuit. One section of this potentiometer is connected in the grid circuit of the first-stage tube while the other section is connected in the grid circuit of the second-stage tube.

3. An output transformer, with a tapped secondary winding, couples the third-stage tube to a balanced 600-ohm line or to a variety of other load impedances.

Degeneration

4. Inverse feedback from a tertiary winding on the output transformer to the cathode of the second-stage tube is included to reduce distortion, improve the frequency response, improve the output regulation and reduce instability caused by fluctuations in the a-c supply voltage and small variations in the characteristics of the tubes used.

Hum Adjustment

5. A hum-adjustment potentiometer marked HUM is located on the top of the chassis between the rectifier and the output tube. A screwdriver slot is provided in the potentiometer shaft for adjusting the hum and noise level in the amplifier output circuit to a minimum.

Metering Switch

6. A four-position rotary switch is mounted on the front panel of the amplifier chassis. This switch is designed to be used in conjunction with the Type 15-D (MI-4388) Metering Panel to indicate the cathode current of the individual tubes. When this metering panel is not available an external meter having an internal resistance of at least 20,000 ohms-per-volt may be used.

Power Supply

7. The self-contained power supply consists of a power transformer and a high-vacuum rectifier tube followed by a resistance-capacity type filter. The electrolytic capacitors in the filter circuit are of the plug-in type.

Line Fuse

8. A fuse holder is conveniently located on the

top of the amplifier chassis near the rectifier tube. A glass-type fuse (Type 3-AG) is used having a rating of 1 ampere.

INSTALLATION

Socket Connections

9. All connections to the amplifier enter the unit through the two 10-prong plugs mounted on the rear panel of the chassis. The input plug is to the left (as viewed from the front of the amplifier) and the output plug is to the right directly behind the power transformer. A view of these plugs is shown in figure 6. Two identical 10-prong sockets designed to mate with the amplifier connection plugs are included in the kit which is supplied with each amplifier. Connections to these sockets are shown in paragraph 25.

Mounting

10. The Type BA-3A (MI-11224-A and MI-11224-B) Program Amplifier is designed for mounting in the Type BR-2A (MI-11599) Shelf Assembly or (in conjunction with the adapter kit furnished with each amplifier) in the Type 36-B (MI-4682) Panel and Shelf Assembly. Two of these program amplifiers can be installed in each of the Type BR-2A or the Type 36-B shelf assemblies. Should it be desirable to install a Type BX-1A Preamplifier Power Supply on the same shelf with the program amplifier make sure that the amplifier is located to the left (as viewed from the front of the rack) of the power supply.

Procedure for Type 36-B Panel and Shelf Assembly

11. Remove the plugs from the holes in the panel through which the shafts of the amplifier-volume control and meter-selector switch will project when the amplifier has been installed. Mount the two dial plates from the adapter kit on the panel, securing them in place with the two bushings, washers and nuts supplied in the kit. Assemble the parts with the heads of the bushings on the outside of the panel. Place the washers under the heads of the bushings to avoid marring the dial plates.

Loosen the mounting nuts of the amplifier-volume control and the meter-selector switch. Adjust the height of these controls so that, with the amplifier in place on the shelf, the shafts line up with the holes in the dial-plate bushings in the front panel. Make sure that the locking nuts on the controls are securely tightened after these adjustments are made. Assemble the angle bracket to the rear panel of the amplifier chassis with the two 8-32 round-

head-machine screws, lockwashers and nuts provided. Secure the amplifier in place on the shelf by means of the four 8-32 round-head-machine screws furnished in the kit.

NOTE: The operating shafts of the amplifier-volume control and the meter-selector switch are longer than may be required for some applications. Both shafts are grooved for convenience in cutting to a shorter length when this is necessary.

12. Two socket covers are furnished in the adapter kit which act as shields for the socket-terminal connections. These covers are used with the connection sockets when the amplifier is mounted in the Type 36-B Panel and Shelf Assembly. Figure 3 shows a typical plug-in amplifier installation on this type shelf. The style of wiring as well as the methods used for securing the wire and anchoring the resulting cable are clearly indicated.

Procedure for Type BR-2A Shelf Assembly

13. Mount the two dial plates from the adapter kit on the panel (MI-11598), securing them in place with the two bushings, washers and nuts supplied in the kit. Assemble the parts with the heads of the bushings on the inside of the panel to insure clearance. Assemble the two connection sockets furnished in the adapter kit to two of the

"U" shaped brackets supplied with the shelf assembly by means of the fillister-head (6-32) screws furnished with the shelf assembly. Mount the sockets and brackets in the correct spaces on the shelf with six of the 8-32 round-head machine screws and lockwashers furnished with the shelf.

14. Assemble the two ejector handles to the amplifier chassis by means of the studs, spring washers and "C" washers supplied in the kit with the amplifier. The action of the ejector handles in assisting the insertion and removal of the amplifier will be obvious upon inspection.

Other Mounting Methods

15. When neither of the above shelf assemblies are available the sockets with the socket covers from the adapter kit can be attached to the amplifier and the connections wired directly to the terminals of the sockets while the amplifier is mounted in any convenient manner.

Input Shielding

16. All audio leads should be shielded twisted pair copper wire, insulated for 200 volts, and need not be larger than No. 19 A. W. G. All joints should be securely soldered. To prevent undesirable noise pickup and crosstalk, the shielding of the lines to the input terminals of the amplifier should be

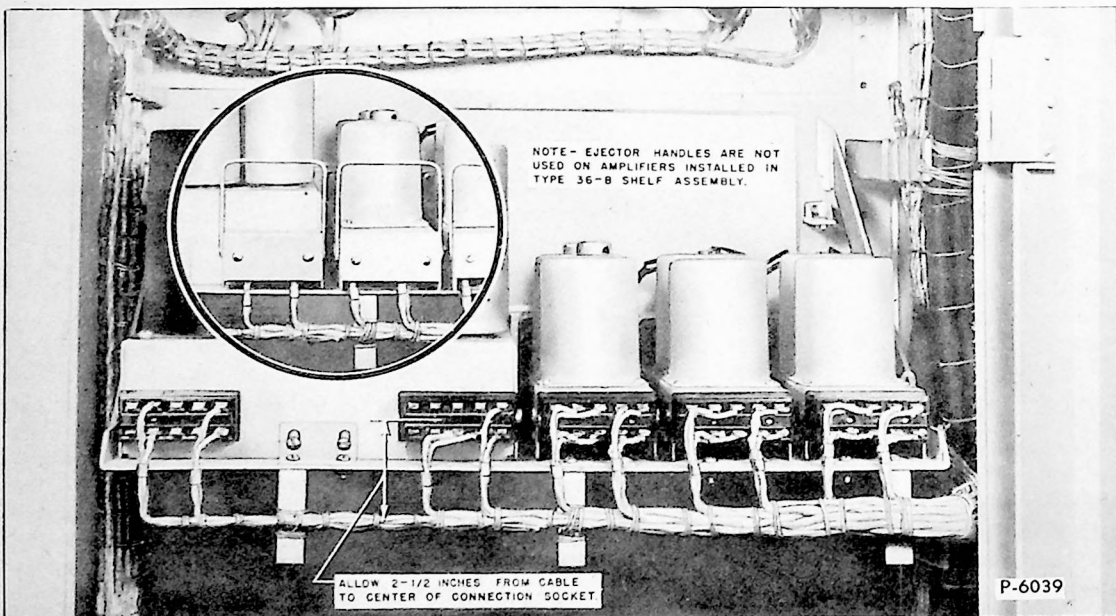


Figure 3—Mounting and wiring in Type 36-B Panel and Shelf assembly (covers removed).
Inset: Covers in place.

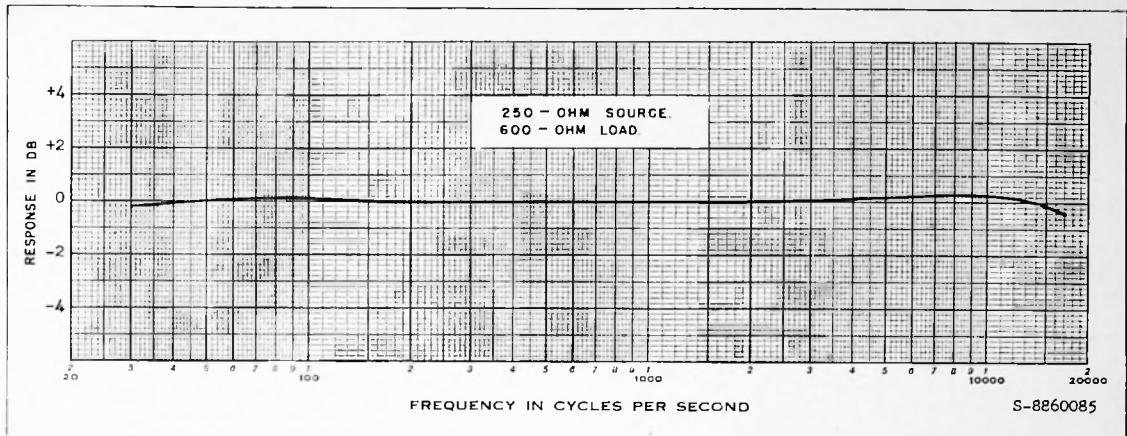


Figure 4—Normal frequency response of Type BA-3A Program Amplifier.

covered with a cotton braid or other suitable insulation and the shielding should be grounded only at the amplifier (point of lowest level). Make sure that the shields are electrically continuous. Do not run the audio-input leads adjacent to, or laced in with, a-c or high-level audio lines. If the input circuits run in conduit or duct which may be subject to moisture a type of wiring having a natural or synthetic rubber covering over the shield should be used.

Matching Input Connections

17. The amplifier is factory-wired for matching operation from a 600-ohm or a 250-ohm balanced source. Wire the incoming line to the terminals of the input-connection socket (furnished with the adapter kit) as follows:

a. For operation from a 600-ohm balanced source connect the line to socket terminals number 11 and number 12.

b. For operation from a 250-ohm balanced source connect the line to socket terminals number 3 and number 4.

18. When the input circuit operates from an unbalanced source (for example, series-parallel mixers) it will be necessary to disconnect the ground connection on the center-tap of the input-transformer-primary winding. To do this remove the jumper connecting terminals number 2 and number 4 on the input transformer (T-1). Refer to figure 11 and figure 12. Connect the incoming line as follows:

a. For operation from a 600-ohm unbalanced

source connect the line to terminals number 11 and number 12 of the input connection socket. Make sure that the grounded side of the line connects to terminal number 11.

b. For operation from a 250-ohm unbalanced source connect the line to terminals number 3 and number 4 of the input connection socket. Make sure that the grounded side of the line connects to terminal number 4.

Bridging Input Connections

19. A built-in pad is provided which is connected ahead of the input transformer when the amplifier is to be used with bridging input. To connect this pad into the circuit, install two jumpers on the input-connection socket: One across terminals number 9 and number 11, and one across terminals number 7 and number 12. Connect terminals number 5 and number 6 of the input connection socket across the line to be bridged.

Output Connections

20. The Type BA-3A Program Amplifier is wired for operation into a variety of load impedances. The secondary winding of the output transformer (T-2) is provided with a number of taps which are brought out to the terminals of the connection plug (J-2) mounted on the rear of the amplifier chassis (directly behind the power transformer). The center tap of the output-transformer-secondary winding (terminal number 8 on the output transformer) is connected to terminals number 4, 8 and 10 of the connection plug J-2. When the

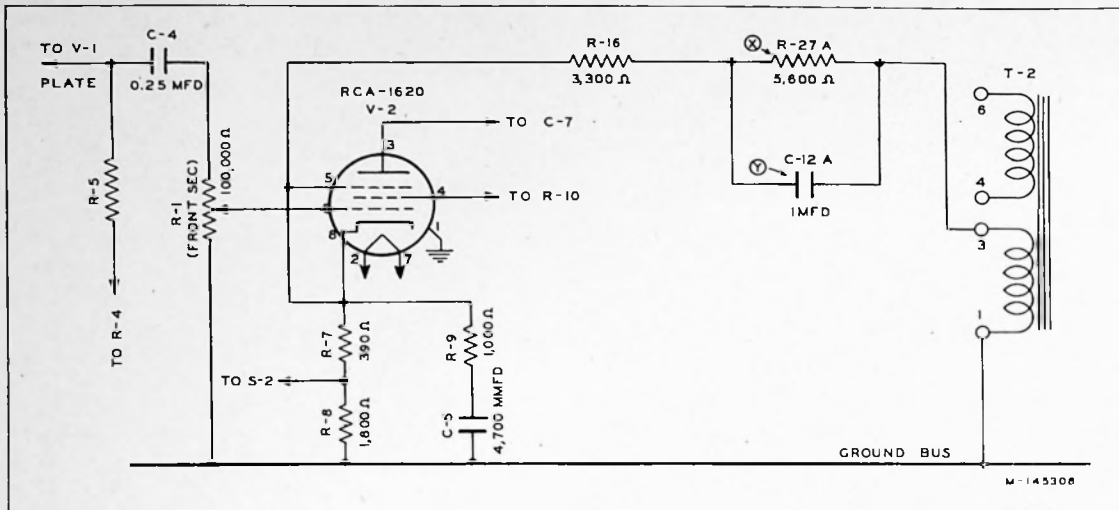


Figure 5—Partial schematic diagram showing changes for compensation.

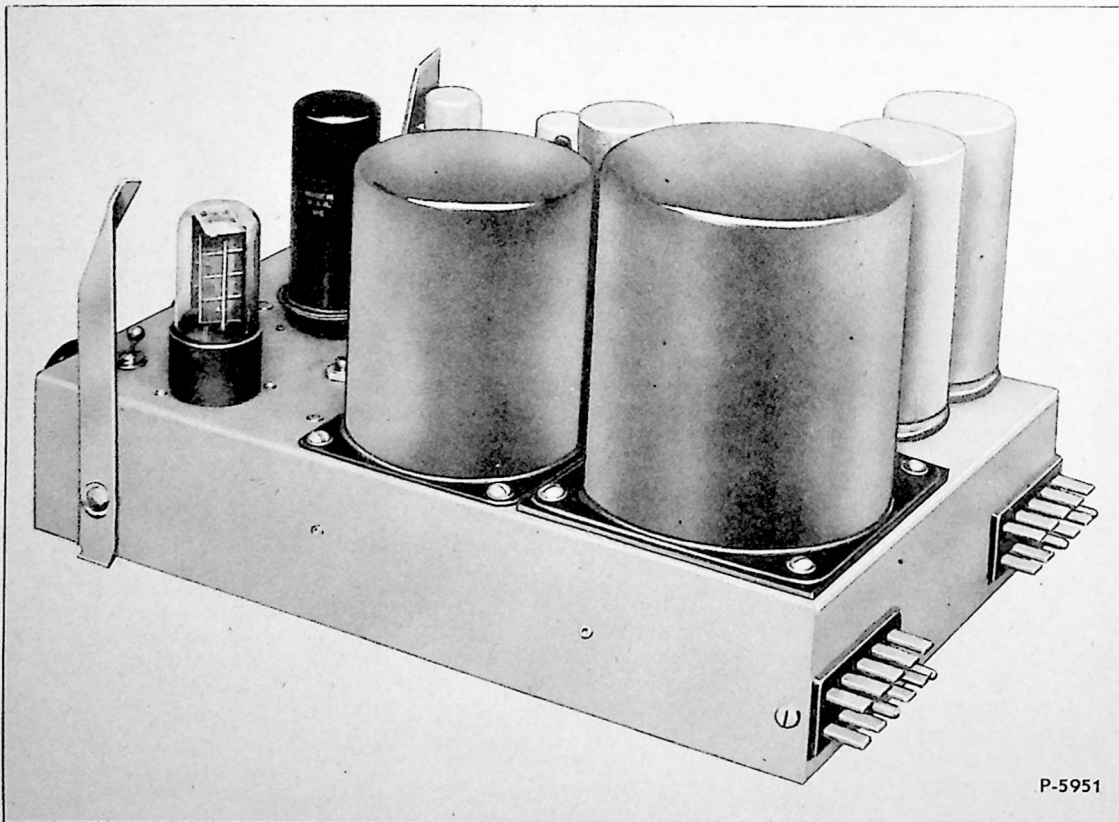


Figure 6—Rear view of Type BA-3A Program Amplifier.

amplifier is operating into a 600-ohm balanced load this tap should be grounded. Refer to figure 2.

21. Connection to the plug (J-2) is made by means of one of the mating sockets supplied with each amplifier. The following table shows line connections for loads of various impedance:

AMPLIFIER OUTPUT CONNECTIONS

Load Impedance	Socket Terminals
600 ohms (balanced)	12 and 11
250 ohms (unbalanced)	12 and 9
225 ohms	12 and 7
210 ohms	12 and 3
150 ohms	12 and 4
100 ohms	11 and 3
90 ohms	11 and 7
70 ohms	11 and 9
15 ohms	4 and 9
7.5 ohms	4 and 7
5 ohms	4 and 3
2.6 ohms	9 and 3
1.3 ohms	9 and 7

A-C Power Supply

22. Connect the a-c power supply for the amplifier to terminals number 5 and and number 6 of the output connection socket. Refer to J-2, figure 2. To insure a low hum level the a-c supply circuit should be shielded and the shield grounded. The amplifier is factory wired with the power transformer connected for operation from a 115-volt a-c power supply line. If the line voltage is normally 120 volts or higher, disconnect the red-and-black wire connected to terminal number 11 on the power transformer, T-3, and connect this wire to terminal number 12. If the line voltage is normally 110-volts or lower, disconnect the red-and-black wire and connect it to terminal number

INPUT SOCKET

Terminal No.	Connection
3	250-ohm input.
4	250-ohm input.
5	Bridging input.
6	Bridging input.
7	Output of bridging pad*.
8	Test meter (+)
9	Output of bridging pad*.
10	Amplifier ground.
11	600-ohm input.
12	600-ohm input.

* Refer to paragraph 19 for connections to these terminals.

10 on T-3. Refer to figure 2 and figures 10 and 11. Make sure that these connections are securely soldered.

Metering

23. The four-position rotary switch mounted on the front panel of the amplifier chassis is designed to be used in conjunction with the Type 15-D (MI-4388 or MI-4388-A) Metering Panel to conveniently check the operation of the individual tubes. Circuit arrangement is such that, with the tubes operating normally, the meter will read approximately 1 volt. When this panel is not available any suitable voltmeter can be used having an internal resistance of 20,000 ohms-per-volt or higher. Connect the positive terminal of the meter to terminal number 8 and the negative terminal of the meter to terminal number 10 on the input connection socket, J-1 in figure 2.

Capacitors

24. Four sockets are provided on the chassis for the plug-in type capacitors. Capacitor size and voltage rating are stenciled on the chassis adjacent to the sockets. Plug the capacitors into the correct sockets, making sure that the markings on the capacitor cans correspond to the stenciled ratings on the chassis.

Socket Connections

25. The connections to the two 10-prong sockets which mate with the amplifier plugs are shown in the tabulations at the bottom of the page.

CIRCUIT MODIFICATIONS

Gain Controls

26. In applications where extreme quietness or extended periods of operation without servicing are prime considerations the dual-potentiometer (carbon-type) volume control supplied in the

OUTPUT SOCKET

Terminal No.	Connection
3	Output transformer—5-ohm tap.
4	Output transformer—center tap.
5	A-C input to power transformer.
6	A-C input to power transformer.
7	Output transformer—7.5-ohm tap.
8	Output transformer—center tap.
9	Output transformer—15-ohm tap.
10	Output transformer—center tap.
11	Output transformer—600 ohms.
12	Output transformer—600 ohms.

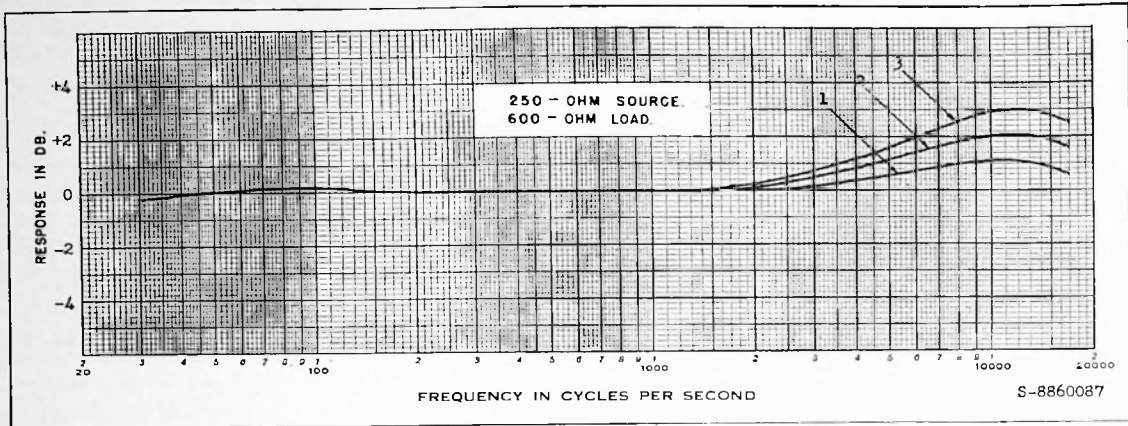


Figure 7—Frequency response with high-frequency compensation.

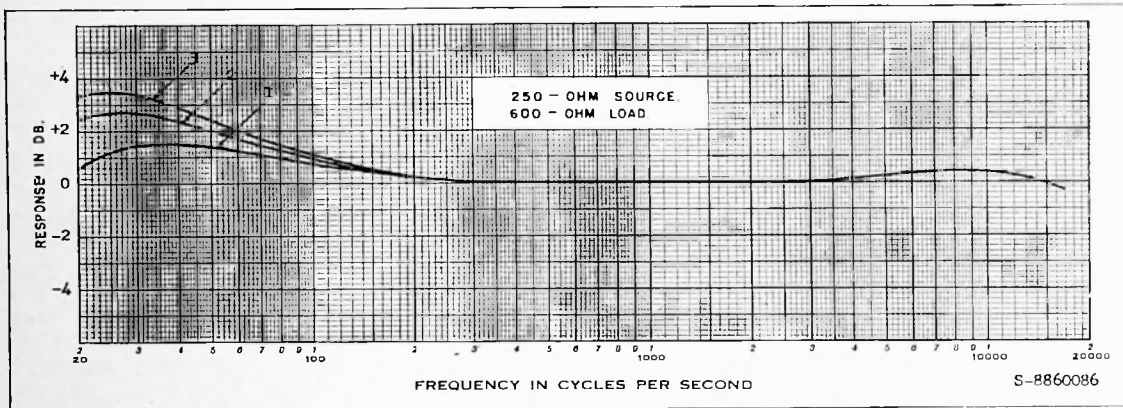


Figure 8—Frequency response with low-frequency compensation.

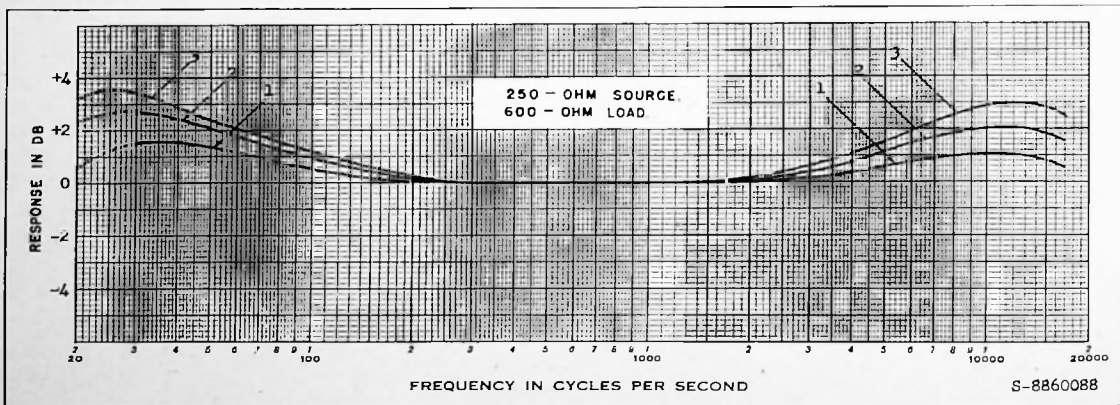


Figure 9—Frequency response with high- and low-frequency compensation.

MI-11224-A amplifier can be replaced with the two-section, step-type, gain-control attenuator furnished in the MI-11224-B amplifier. Order from *RCA Replacement Parts Department, Camden, New Jersey*, specifying stock number 52603. This attenuator is similar electrically to the carbon-type volume control and must be wired into the circuit in the same manner.

Frequency Compensation

27. Under certain conditions it may be desirable to provide additional gain at either the high-frequency or the low-frequency end of the audio range. Figure 7 and figure 8 show graphically the amount of increase that may be expected, while figure 9 illustrates the result of applying both high-frequency and low-frequency compensation in the same amplifier.

Increasing High-Frequency Gain

28. Three curves are shown in figure 7, numbered 1, 2 and 3. These curves illustrate the frequency characteristics of the amplifier after alterations are completed to increase the high-frequency response by approximately one, two and three decibels at 10,000 cps. To make these alterations proceed as follows:

- a. To obtain a frequency-response curve similar to number 1, replace the .0047 mfd capacitor marked C-5 in figure 2 with one having a value of .0065 mfd. Refer to figure 5.
- b. To obtain a frequency-response curve similar to number 2, replace the .0047 mfd capacitor marked C-5 in figure 2 with one having a value of .0086 mfd. Refer to figure 5.
- c. To obtain a frequency-response curve similar to number 3, replace the .0047 mfd capacitor marked C-5 in figure 2 with one having a value of .0112 mfd. Refer to figure 5.

Increasing Low-Frequency Gain

29. The frequency-response in the low-frequency region can be increased approximately $1\frac{1}{2}$, $2\frac{1}{2}$ and $3\frac{1}{2}$ decibels at 30 cps by making the alterations described below. The frequency-response curves resulting from these changes are illustrated in figure 8.

- a. To obtain a frequency-response curve similar to number 1, replace the 0.25 mfd capacitor marked C-4 in figure 2 with one having a value of 0.03 mfd and add the resistor and capacitor marked X and Y as shown in figure 5.

- b. To obtain a frequency-response curve similar to number 2, replace the 0.25 mfd capacitor marked C-4 in figure 2 with one having a value of 0.05 mfd and add the resistor and capacitor marked X and Y as shown in figure 5.

- c. To obtain a frequency-response curve similar to number 3, replace the 0.25 mfd capacitor marked C-4 in figure 2 with one having a value of 0.1 mfd and add the resistor and capacitor marked X and Y as shown in figure 5.

30. In applications where system losses or other deficiencies require an increase in the amount of amplification at both the high-frequency and the low-frequency ends of the audio spectrum, some suitable combination can be selected and applied as described in the two preceding paragraphs. This will assist in obtaining, in a simple and effective manner, an overall frequency-response curve for the entire system which closely approaches the ideal desired.

MAINTENANCE

General

31. The care of the Type BA-3A Program Amplifier should include the usual precautions observed in the maintenance of high quality speech-input components. Do not allow dust or dirt to accumulate on the equipment. Perform the following operations at regular intervals:

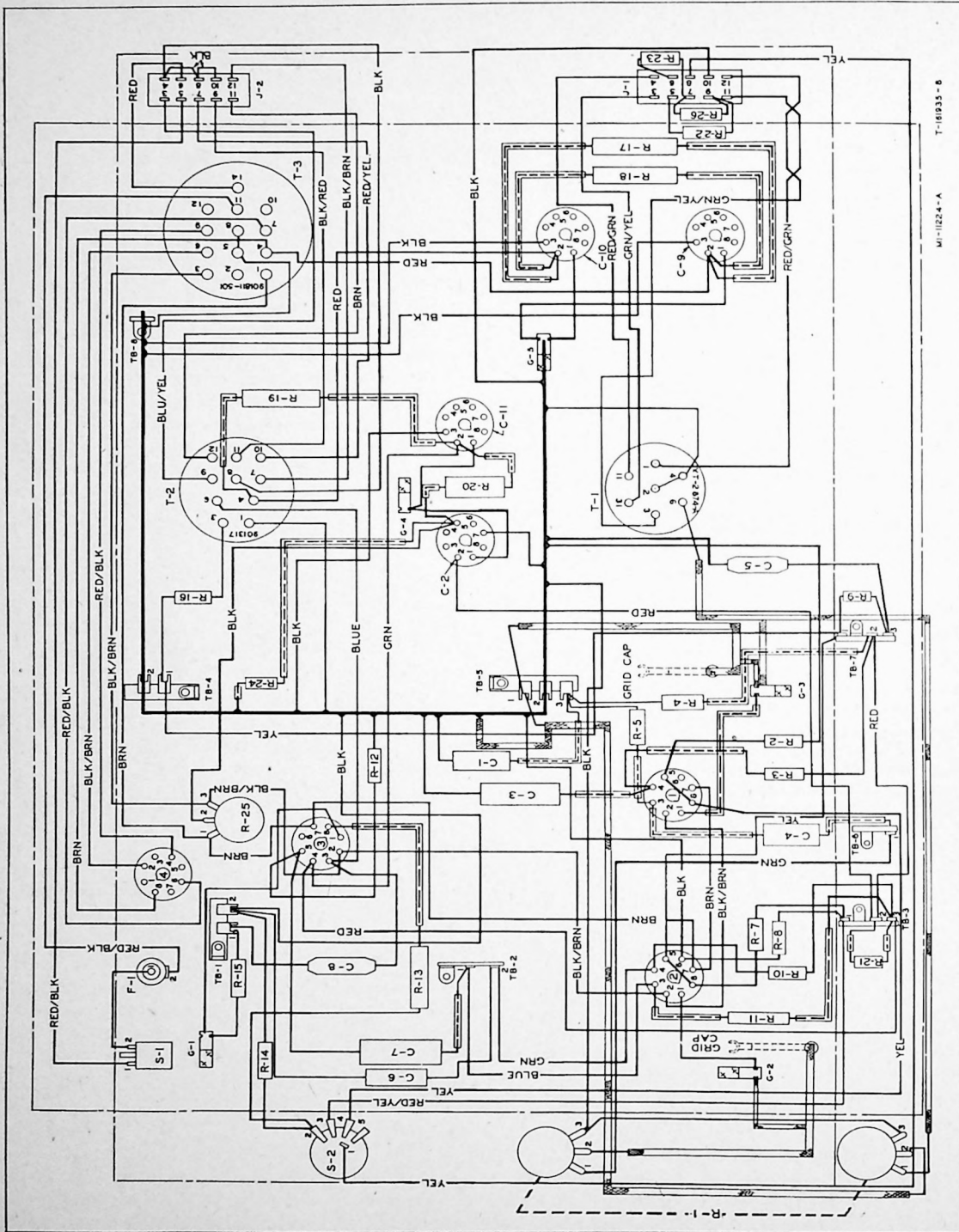
- a. Check the tubes for normal characteristics. Label each tube, indicating condition and length of service.
- b. Clean the tube prongs and tube sockets.
- c. Clean the contacts of the capacitor sockets and the prongs of the plug-in capacitors.
- d. Keep the prongs of the amplifier connection plugs clean.

Fuse Replacement

32. When replacing a blown fuse, make sure that the replacement fuse is of the same type and rating (1 ampere, Type 3-AG) as the one furnished with the amplifier. To use a fuse of higher rating for replacement purposes will needlessly endanger the windings of the power transformer.

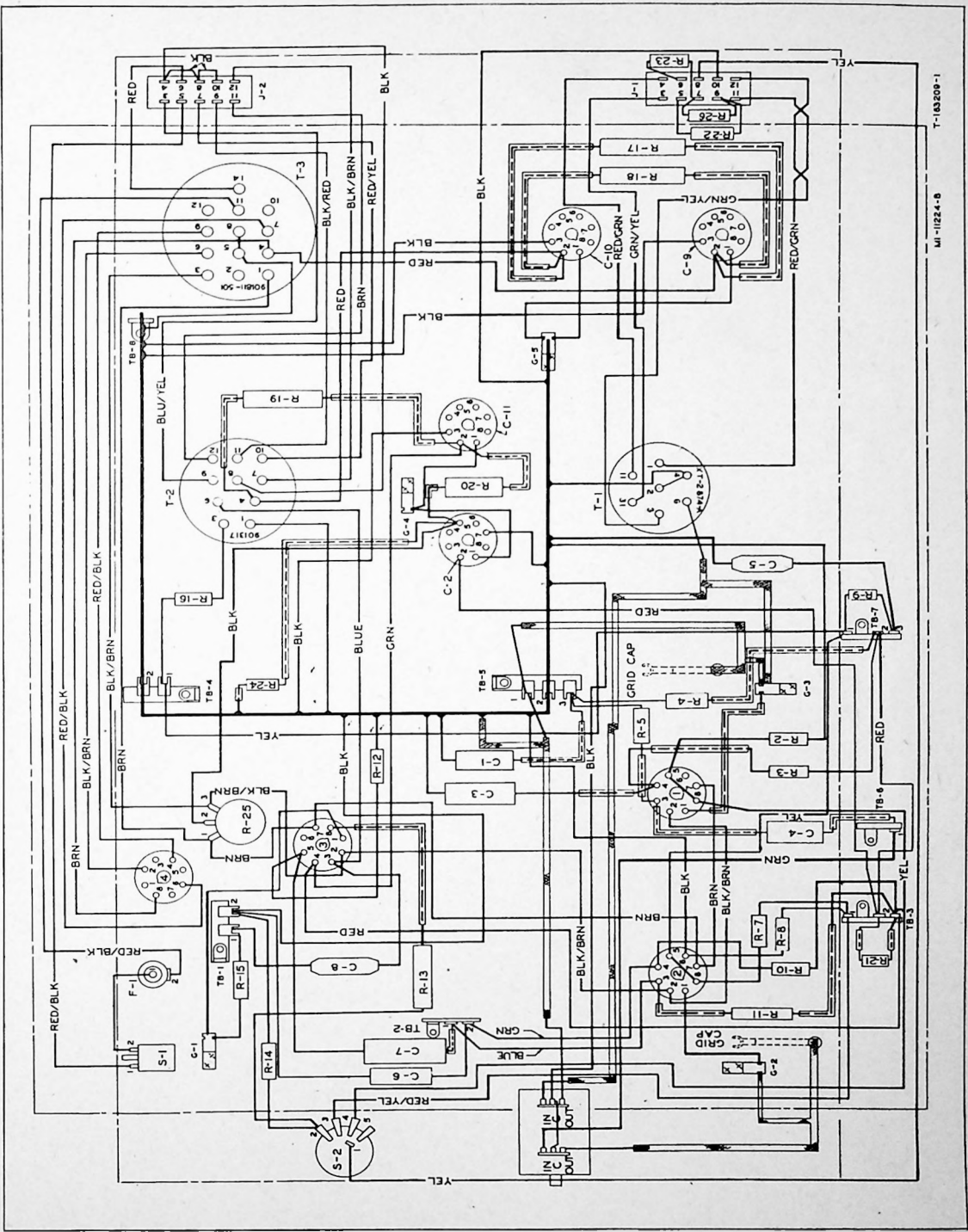
Voltage and Current Values

33. In the following table are shown the voltage and current values for a typical amplifier operating under normal conditions. Use a meter having an internal resistance of 20,000 ohms-per-volt or



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Figure 10—Wiring diagram for Type BA-3A (MI-11224-A) Program Amplifier.



MI-11224-B
T-11224-1

Figure 11—Wiring diagram for Type BA-3A (MI-11224-B) Program Amplifier.

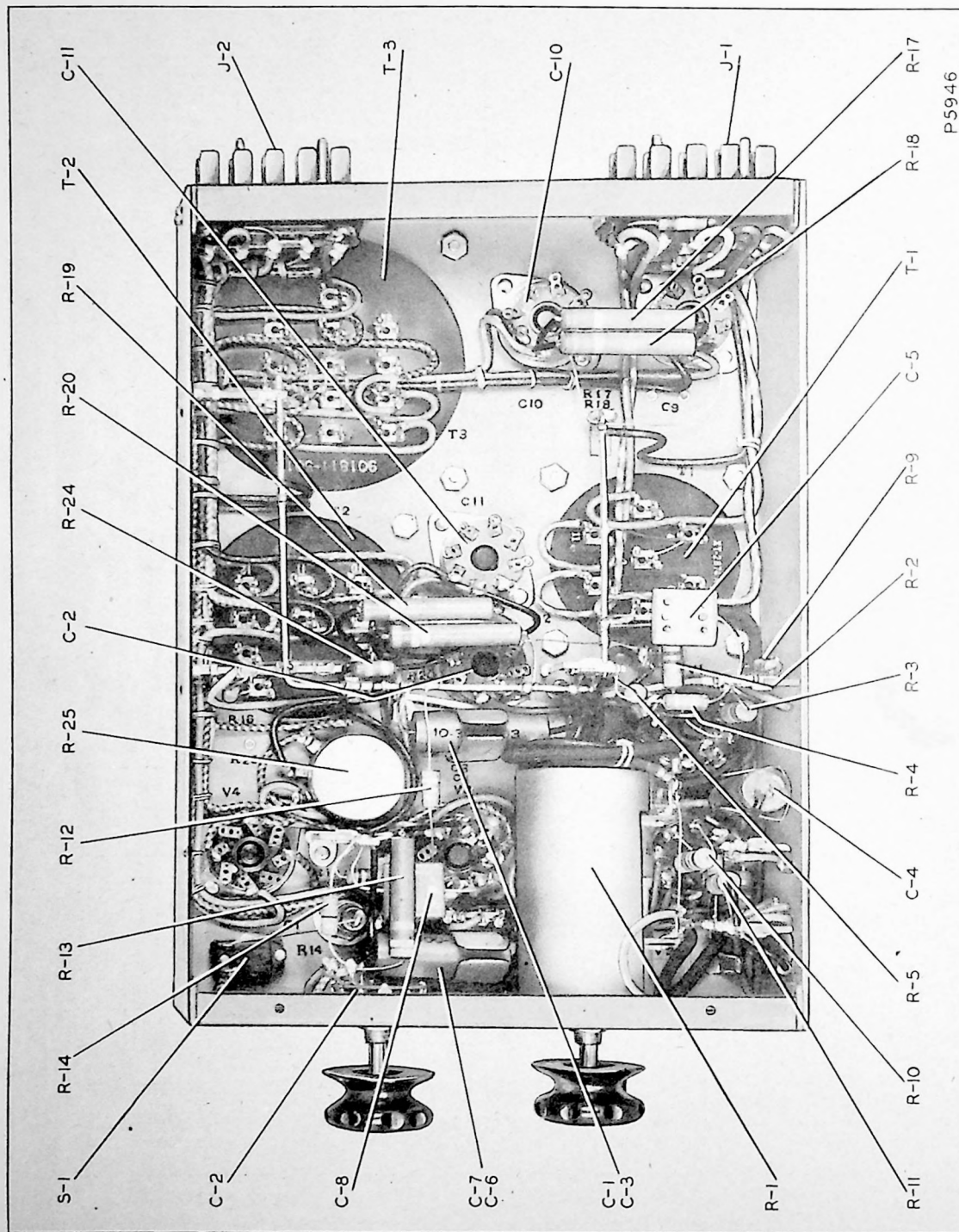


Figure 12—Subchassis view of Type BA-3A Program Amplifier.

higher when reading the values of d-c voltage shown.

VOLTAGE AND CURRENT VALUES

A-C supply to amplifier—117 volts, 60 cps.

(A-C supply connected to the 115-volt tap on the power transformer)

	First stage RCA 1620	Second stage RCA 1620	Third stage RCA 1622
Plate voltage	106 volts dc	93 volts dc	300 volts dc
Screen voltage	41 volts dc	34 volts dc	240 volts dc
Grid bias voltage	1 volt dc	1.2 volts dc	18 volts dc
Filament voltage	6.3 volts ac	6.3 volts ac	6.3 volts ac
Plate current	1.35 ma	0.73 ma	45.6 ma
Screen current	0.36 ma	0.18 ma	2.18 ma

Total "B" voltage—330 volts dc.

Total rectified current—55.2 milliamperes.

34. The arrangement of the component parts and the connecting wiring is shown in the wiring diagrams, figure 10 and figure 11 and in the sub-chassis view, figure 12.

CAUTION: Make sure that the grid-cap shields for the tubes of the first and second stages are in place whenever the amplifier is operating. The shield must make good electrical connection to the shell of the tube to insure noise-free operation.

Replacement Parts

35. The following parts list is included to provide identification when ordering replacement parts. Order from *RCA Replacement Parts Department, Camden, New Jersey*, giving *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.

LIST OF PARTS

Symbol No.	Description	Stock No.
C-1, -7	Capacitor, 0.1 mfd, 300 volt	30848
C-2	Capacitor, 10 mfd, 450 volt	39455
C-3, -4, -6	Capacitor, 0.25 mfd, 300 volt	30849
C-5	Capacitor, 4,700 mmfd	50812
C-8	Capacitor, 2,700 mmfd	39662
C-9, -10	Capacitor, electrolytic, 80 mfd, 450 volt	39458
C-11	Capacitor, electrolytic, 40 mfd, 450 volt	39457
F-1	Fuse, 1 ampere, type 3-AG	14133
J-1, -2	Plug, male, Amplifier connection	48788
R-1	Resistor, variable, Dual, 100,000 ohms (for MI-11224-A)	52602
R-1	Resistor, variable attenuator, step-type, Dual (for MI-11224-B)	52603
R-2	Resistor, 560 ohms, ½ watt	19783
R-3	Resistor, 560,000 ohms, 1 watt	90378
R-4	Resistor, 18,000 ohms, ½ watt	71025
R-5	Resistor, 100,000 ohms, 1 watt	19234
R-7	Resistor, 390 ohms, ½ watt	37138
R-8	Resistor, 1,800 ohms, ½ watt	19792
R-9, -15	Resistor, 1,000 ohms, ½ watt	19739
R-10	Resistor, 1,200,000 ohms, 1 watt	43017
R-11	Resistor, 220,000 ohms, 1 watt	43018
R-12	Resistor, 390,000 ohms, ½ watt	60215
R-13	Resistor, 390 ohms, 2 watt	51212
R-14	Resistor, 22 ohms, ½ watt	34209
R-16	Resistor, 3,300 ohms, ½ watt	61690
R-17, -18	Resistor, 1,200 ohms, 2 watt	28740

Symbol No.	Description	Stock No.
R-19	Resistor, 8,200 ohms, 2 watt	43493
R-20	Resistor, 82,000 ohms, 2 watt	43495
R-21, -22, -23	Resistor, 10,000 ohms, ½ watt	69714
R-24	Resistor, 1,800 ohms, ½ watt	19792
R-25	Resistor, variable, wire-wound, 100 ohms	43498
R-26	Resistor, 560 ohms, ½ watt	19783
....	Socket, female, Amplifier connection	49032
S-1	Switch, toggle, "OFF-ON"	48791
S-2	Switch, rotary, single pole, 4-position	50636
T-1	Transformer, Input (XT-2874-A)	28796
T-2	Transformer, Output (XT-3814)	46098
T-3	Transformer, Power (XT-3102-A)	50793
....	Holder, Fuse (for F-1)	48894
....	Knob, Volume control	17268
....	Knob, Meter-selector switch	17268
....	Socket, Vacuum tube	31319
....	Socket, Plug-in capacitor	45368
....	Handle, Ejector, with mounting stud—Left	52403
....	Handle, Ejector, with mounting stud—Right	52404
....	Washer, Spring (for ejector handle stud)	8078
....	Washer, "C" (for ejector handle stud)	2917
....	Plate, Dial (volume control)	52921
....	Plate, Dial (meter-selector switch)	52922

