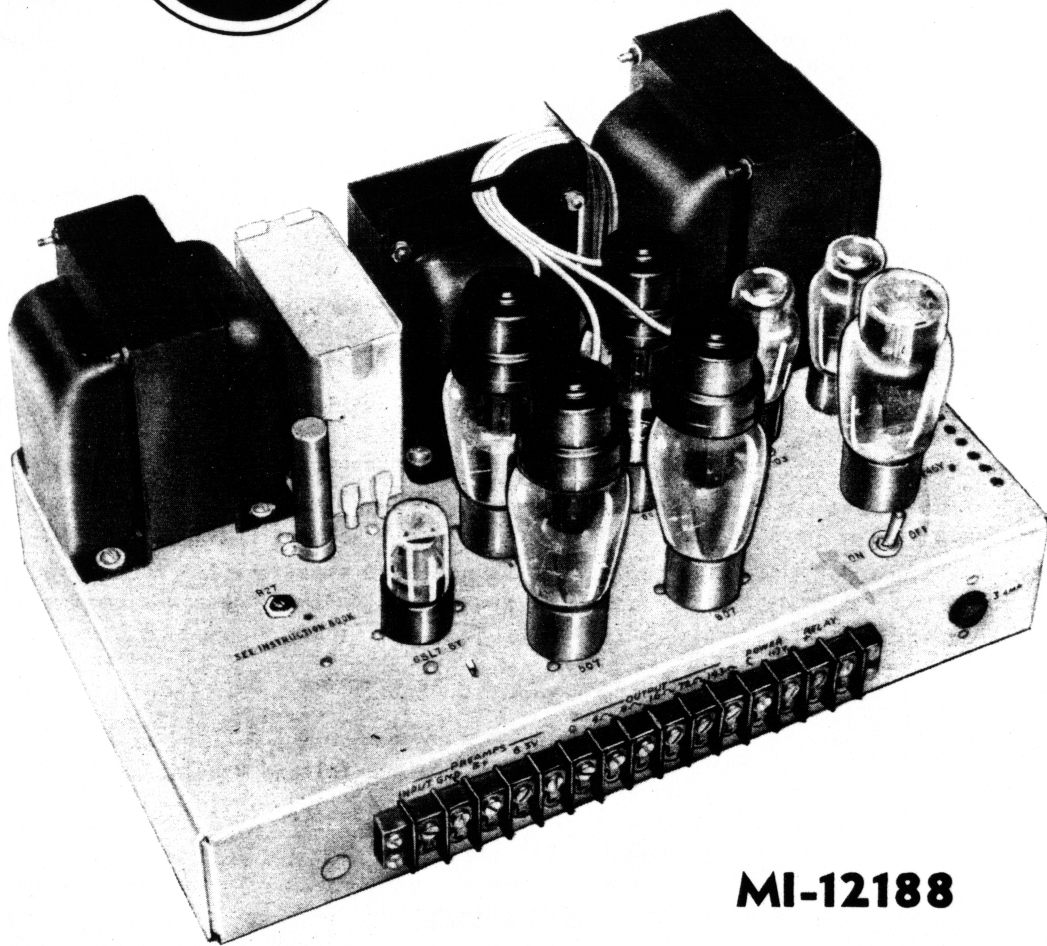

INSTRUCTIONS



70-Watt Power Amplifier



MI-12188

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

TECHNICAL DATA

Power Required	Rated Power Output and Distortion
240 watts	a. 70 watts with less than 5% total rms harmonic distortion, 100 to 7500 cps. with 117 volts on 117 volt tap.
105-125 volts	b. 70 watts with less than 5% total distortion, 50 to 7500 cycles, when plate currents of output tubes are balanced within 5 milliamperes (for a typical amplifier).
50-60 cycles	
Power Available for External Loads	Input Voltage for 70 Watts Output
1.5 amperes at 6.3 vac	3.3 volts
8 milliamperes at 300 vdc	
Fuse	Transmission Gain
3 amperes, type 3AG	41 db from an unterminated 600-ohm source to a 600-ohm load.
Tube Complement (Not furnished)	R.M.A. Gain
1 RCA 5R4GY	41 db from a 600-ohm source
2 RCA OD3	
4 RCA 807	Frequency Response
1 RCA 6SL7GT	Flat within 1.0 db from 30 to 15,000 cycles (600-ohm source)
Source Impedance	Flat within 4.0 db from 30 to 15,000 cycles (500,000-ohm source)
0 to 500,000 ohms	See figure 2
Input Impedance	Noise Level
470,000 ohms (1000 cps)	-30 dbm (0 db = .001 watt)
Load Impedance	Output Voltage Regulation
The output transformer is tapped to work into the following impedances:	3.6 db from full load to no load
4, 8, 16, 72, and 143 ohms	
70.7-volt line (72-ohm tap)	
100-volt line (143-ohm tap)	
Dimensions and Weight	
Length - 16-3/16 inches	
Depth - 10-3/8 inches	
Height - 8-1/4 inches	
Weight - 39 pounds	
Finish	
Cadmium and Clear Lacquer	

DESCRIPTION

The MI-12188 Amplifier, shown in figure 1, is a 70-watt unit with a self-contained power supply designed for operation at line voltages of 105 to 125 volts. The amplifier may be used in industrial plants or in other locations where a considerable amount of power is required. The only control is an ON-OFF switch, but, if desired, an MI-12106 Volume Control or the equivalent may be installed; and, for remote control, the amplifier may be equipped with an MI-13194 Plate Supply Relay. Complete details are given under *Installation*. The frequency response and low distortion characteristic of the unit make it excellent for amplification of wide range music as well as speech. The unit is

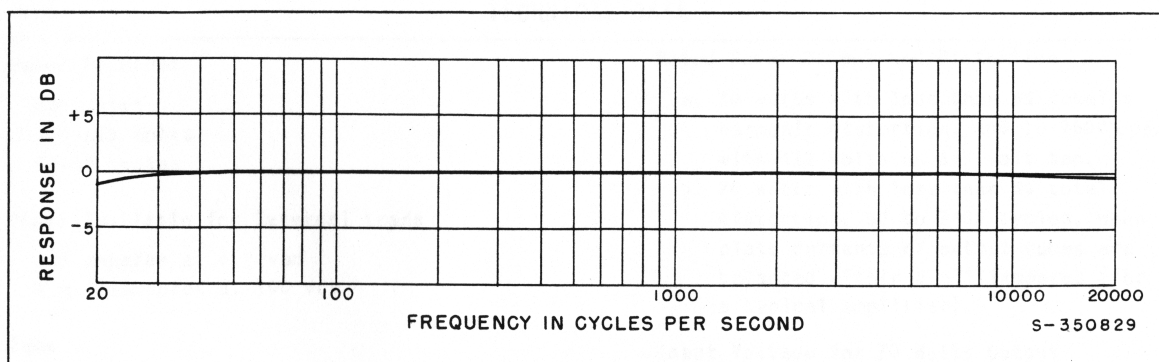


Figure 2 - Frequency Response

designed for shelf mounting. No tubes are furnished with the equipment.

CIRCUIT

Amplification Stages

The first stage consists of an RCA 6SL7GT tube, the two sections of which function as an input stage and a phase inverter stage, respectively. The output of the 6SL7GT tube drives four RCA 807 tubes which are connected in push-pull parallel and function as the output stage. The entire amplifier up to the output stage is resistance-capacitance coupled. The circuit is shown in figure 4.

Input

The amplifier has a high impedance input circuit consisting of a capacitor-resistor network.

Output

The output transformer T₁ is tapped for load impedances of 4, 8, 16, 72 and 143 ohms. As supplied the zero tap is connected to the ground terminal by a strap or jumper. However, the strap should be connected between ground and the 4-ohm tap when the amplifier is to be connected to a 0-16 ohm balanced line, or to the 16-ohm tap for working into a 0-72 ohm balanced line. Where necessary for a particular operation the low side of the taps used may be grounded without disturbing the proper functioning of the amplifier.

Inverse Feedback

An inverse feedback circuit including two resistors R₈ and R₉ is connected between the plate circuit of the output stage and the cathode of the input stage. The feedback has the effect of reducing harmonic and intermodulation distortion. In addition, it provides excellent output voltage regulation, thus making the amplifier most useful for individually or zone-controlled multiple-speaker installations, because speakers may be switched in or out of the system without appreciably changing the volume of the other speakers in the system. This feature also minimizes the effects of variation of loudspeaker impedance with frequency. Frequency response curves are shown in figure 2.

Power Supply

The self-contained power supply consists of a power transformer T₂, a high-vacuum rectifier tube (RCA 5R4GY) V₆, a choke-input type filter and two RCA OD3 voltage regulator tubes, V₇ and V₈.

The primary of the transformer T₂ is connected to the power input terminals through the fuse F₁ and the ON-OFF switch S₁. The primary is connected at the factory for operation at a nominal line voltage of 117 volts (110-125), but a tap has been provided for operation at 105 volts (100-110) where low line voltages are encountered. In addition to plate and filament windings for the rectifier tube, the transformer also has a 6.3 volt winding for supplying heater current to the 807 and 6SL7GT tubes plus a current of 1.5 amperes to a preamplifier or tubes external to the amplifier. A filtered and regulated voltage of 300 volts dc and current of up to eight milliamperes is available for external amplifiers. A plate supply relay may be installed if desired; terminals have been provided on the chassis for the relay operating coil connections.

Two type OD3 voltage regulator tubes keep the screen voltages of the tubes constant, regardless of variations in signal strength and line voltage changes, minimizing distortion and assuring the maintenance of high output level with high input levels. The regulator tubes also protect the 807 power output tubes when the amplifier is driven beyond normal input level. An internal jumper in each regulator-tube acts as an interlock to open the power-supply circuit to the screen grids of the output tubes when the voltage-regulator tube is removed from the circuit.

INSTALLATION

Mounting

The MI-12188 Amplifier is designed for installation on an RCA MI-12378 Cabinet Rack Shelf, but is easily adapted to other mounting facilities such as MI-13065-A Panel and Shelf Assembly. For mounting purposes the amplifier is provided with four #10-32 tapped holes, one at each corner of the chassis. To install the amplifier it is only necessary to drive four clearance holes in the shelf corresponding in position to the location of the holes in the amplifier, that is on 9" x 15-7/16" centers, and secure the amplifier in position with four #10-32 screws and lockwashers.

Tubes

With the power switch in the "OFF" position, install the tubes in the appropriate sockets. The tube type for each socket is marked on the chassis near the socket. Socket voltages are given in figure 7. To obtain maximum power output with minimum distortion the sum of the plate currents of the pairs of 807 tubes (V₂ + V₃ versus V₄ + V₅) should be balanced within five milliamperes or closer.

CAUTION: Always put the power switch in the OFF position before attempting to make any connection to the 807 plate circuit. The voltage on this circuit is high enough to be injurious to human life. Do not break the continuity of the plate supply circuit to any 807 tube while the amplifier power switch is in the ON position; to do so will cause the screen of the tube to draw excessive current and damage the tube.

For balancing purposes, the plate currents of the 807 tubes may be measured with a tube tester or in the following manner:

1. With the power switch in the OFF position and with no signal input, connect a 560-ohm resistor to the input terminals.
2. In turn, insert each of the tubes to be tested in the same socket with three tubes operating undisturbed in the other 807 sockets.
3. Remove the insulated plate circuit connector from the plate cap of the tube to be tested - if it is not already off - and connect a 0-100 milliamperere dc meter between the plate cap on the tube and the metal contact within the connector.
4. Put the power switch in the ON position, allow the tubes to heat for several minutes and then observe the plate current indication on the meter. Label the tube and record the plate current and the date on the label.
5. Put the power switch in the OFF position, disconnect the meter, and replace the plate circuit connector on the tube plate cap if testing has been completed, or install another tube and repeat the test.
6. Install the tested tubes in the appropriate sockets but arrange them in pairs so that the sum of the plate currents of tubes V₂ and V₃ does not differ from the sum of the plate currents of tubes V₄ and V₅ by more than five milli-amperes. To insure that this condition exists, again measure the plate currents, but test each tube in its assigned socket.

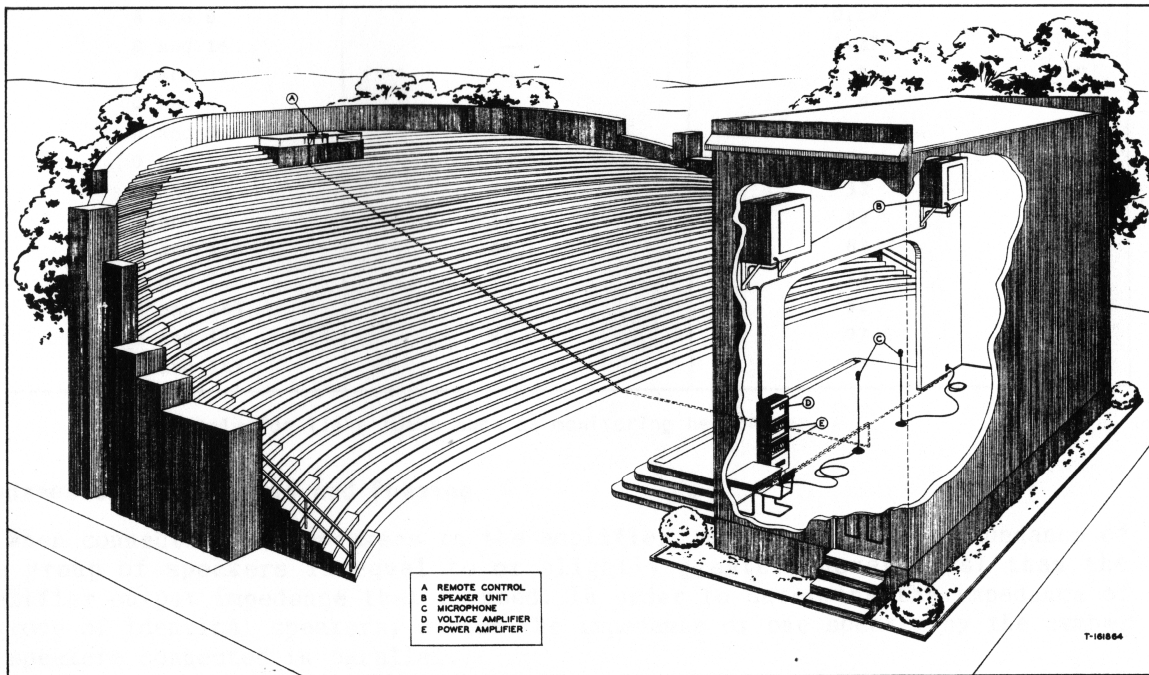


Figure 3 - Typical Sound System Installation

Terminal Strip

A terminal strip having ten terminals, sufficient for all connections, is mounted upon the front apron of the amplifier chassis. Output terminals are provided for connecting to 4-ohm, 8-ohm, 16-ohm, 72-ohm and 143-ohm loads or circuits. Refer to figure 1.

Audio Input Connections

The amplifier may be connected to any 500-ohm or 600-ohm line or high impedance source capable of supplying a 3.3 volt signal, such as an MI-4117-A, MI-4118-A, 4273-B or MI-4297-A Voltage Amplifier or by either an MI-12160 or an MI-12243 Line Amplifier.

Output Connections

Leads from the output transformer in the amplifier are connected to the terminal board. The output terminals on this board are marked 0, 4, 8, 16, 72, and 143 ohms. In the following table the first column gives the connections necessary for the load impedances shown in the third column. The combination of loudspeakers connected to the amplifier output must have an effective combined impedance equal to or slightly greater than the load impedance value chosen.

LOAD IMPEDANCE TABLE

Terminals	Volts Output (at 70 watts)	Load Impedance (ohms)
4 and 8	—	0.69*
8 and 16	—	1.37*
4 and 16	—	4
0 and 4	16.75	4
0 and 8	23.7	8
0 and 16	33.5	16
8 and 72	47.4	32
4 and 72	54.3	42
16 and 143	66.5	63
0 and 72	71	72
8 and 143	76	82
4 and 143	82.6	97.5
0 and 143	100	143

*Use only for light loads such as monitoring headphones.

Loudspeaker Connections and Phasing

When connecting loudspeakers to the amplifier, make certain the impedance of the group of speakers is equal to or slightly greater (never less) than the amplifier output impedance that is used. In order to determine the impedance of a group of identical speakers, divide the impedance of one speaker by the number of speakers connected in parallel.

When connecting two or more loudspeakers in the same vicinity, observe correct polarity in connections so that the speakers will operate in phase with each other. The cones of the various speakers must move simultaneously in the same direction. If they are not in phase, the sound output will be materially

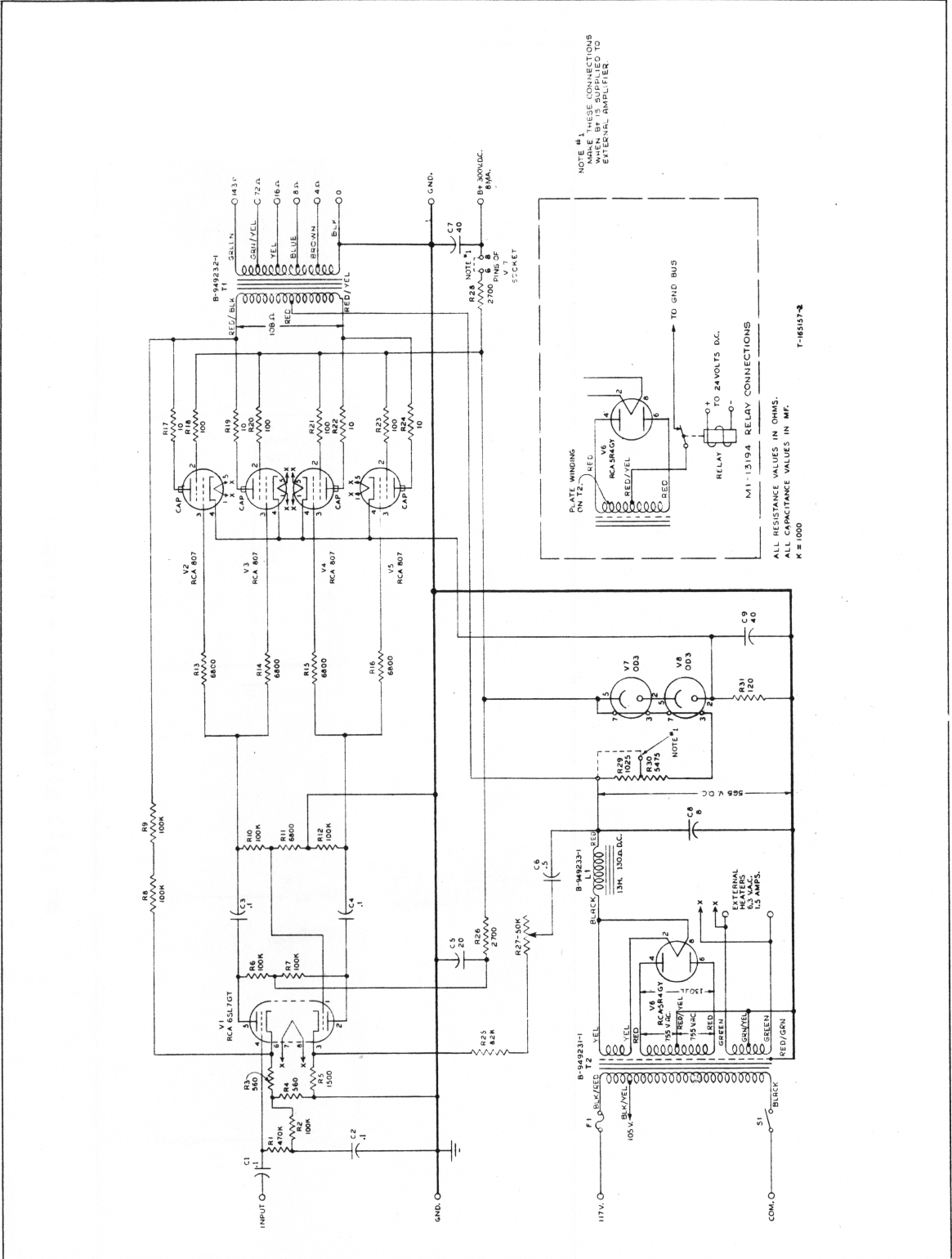


Figure 4 - Schematic Diagram

reduced because the sound from one unit will cancel that of the other. A simple method of checking the phase of speakers is to connect a 1-1/2 volt dry cell across the voice coil to determine polarity of winding. The cone will jump forward or backward, according to the battery polarity. Selecting the positive battery pole as a reference, all the voice-coil leads which are connected to this pole for the same direction of cone deflection should be connected together. This places the loudspeakers in parallel and in proper phase.

Installation of a Volume Control

A mounting hole is provided on the front of the amplifier for installation of a volume control. The use of an MI-12106 Volume Control or its equivalent is recommended.

The characteristics or taper of the MI-12106 volume control is such that when rotated (left to right) from zero to 50 percent of rotation the resistance increases from a minimum to 10 percent of the total resistance. At 60 degrees rotation the resistance is 20 percent of total and thereafter the resistance increases in a linear manner until maximum resistance is attained at the extreme clockwise position. This kind of taper is classified by Mallory and a number of manufacturers as Type I.

To install the volume control proceed as follows:

1. Invert the chassis, and with the terminal board toward the installer mount the volume control in the hole provided on the chassis, but with the terminals downward or adjacent to the top of the chassis.
2. Disconnect the resistor R₁ from terminal 4 of the 6SL7GT tube (V₁) socket and the center terminal on the nearby terminal board, see figure 6.
3. Disconnect the lead connecting capacitor C₁ to terminal 4 on the V₁ tube socket.
4. Connect a lead between the center terminal of the volume control and the number 4 terminal on the V₁ socket.
5. Connect the lead from C₁ to the terminal on the right side of the volume control, viewed from the front.
6. Connect a wire between the center terminal on the terminal board - from which R₁ was removed - and the remaining (unwired) terminal of the volume control.

Power Supply Taps

The amplifier is wired at the factory for 117 volt operation. To operate at 100-110 volts disconnect the transformer black-red lead from the fuse receptacle F₁ and connect the transformer black-yellow lead to the same terminal on the fuse receptacle. Cover the exposed end of the black-red lead with electrical tape, and coil and tie it.

Installing an MI-13194 Plate Supply Relay

The advantage of remote control of the amplifier may be obtained by installing an MI-13194 Plate Supply Relay. Twenty-four volts dc is required to operate the relay. This voltage may be secured from an MI-12501 or MI-12504

Relay Power Supply. When the relay is energized, the plate voltage is removed from the amplifier tubes, and the amplifier will not operate; when the relay is de-energized and the power switch is ON, the amplifier will operate. Figure 5 illustrates a method of connecting a double-pole double-throw switch to operate the relay and a microphone simultaneously. This type of switch is used on the MI-6427 Pushmike Stand and the MI-6425 Pushmike Adaptor.

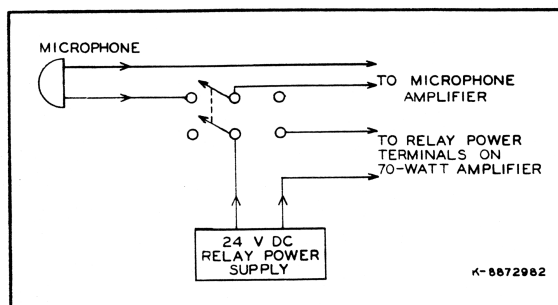


Figure 5 - Suggested Relay Power Control Connections

Install the relay by drilling sufficient holes in the side of the chassis to accommodate the base of the relay, and mounting the relay inside of the chassis.

Connect the relay by cutting and stripping the red-yellow lead from transformer T2 at a convenient place and connecting the lead ends thus formed to the relay contacts. Connect leads from the terminals of the relay operating coil to the terminals marked RELAY on the terminal board. Polarity does not have to be observed.

Connections for Supplying External Leads

Connections for 6.3 volt a-c heaters or similar external loads requiring a current of not more than 1.5 amperes are made directly to the terminals marked 6.3 v - under "PREAMPS" - see figure 1.

Connections for external amplifier plate current - not exceeding 8 milliamperes - are made to the terminals marked GND and B+. But also make the following alterations and connections within the amplifier (for B+ only).

1. Disconnect the red lead from R29 (lead to end of resistor nearest to the resistor tap) and connect it to the resistor tap (junction of R29 and R30).
2. Connect a jumper between terminals number 6 and 8 of the V7 tube socket.

OPERATION

Loudspeaker Placement and Operation

In some installations it may be desirable, because of unusual room conditions to operate a number of loudspeakers at various points in a room at a relatively low volume. If an installation of this type is made, the speakers should be close enough to each other (usually about 40 feet) for a listener at a point between two speakers to hear the sound from both at approximately the same time. Keep the volume low enough so that interference will not be caused by speakers which are not close together. A typical sound system installation is shown in figure 3. The relative placement of the loudspeakers and microphones for best results is indicated in the illustration.

NOTE: Howling is frequently caused by sound from the speakers reaching the microphone with sufficient intensity to cause audio-frequency oscillations within the power amplifier system. The following suggestions may be helpful if howling occurs:

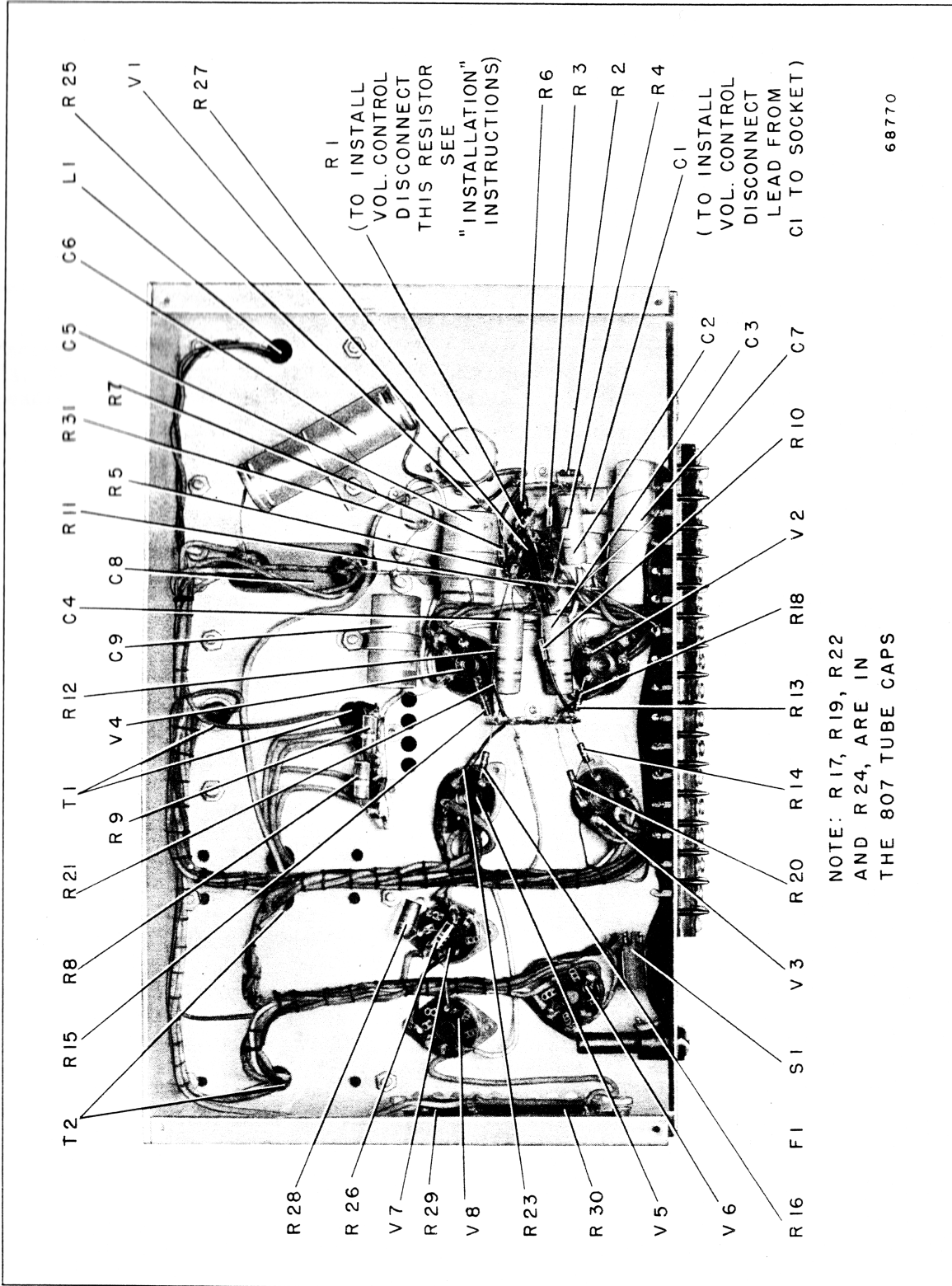


Figure 6 - Subchassis View of Amplifier

1. Reduce the system gain, if feasible.
2. Use the RCA MI-12018 Noise Cancelling Microphone or the MI-6203-C, MI-6204-C Varacoustic Microphone (unidirectional position).
3. Change the position of the microphone relative to the loudspeakers, or move the microphone farther from the loudspeakers.
4. Use directional baffles or projectors on the loudspeakers.
5. Use draperies or other soundproof materials on the walls, ceilings, etc., or use shielding baffles, where practicable, to lower the amount of reflected sound picked up by the microphone.

Noise Reduction

The noise-reducing potentiometer R27, shown in figure 1, is sealed at the factory, and should not be disturbed except when any or several of the resistors R3, R4, R5, R8, or R9 are replaced. In such a case, it will be necessary to readjust R27. To do so proceed as follows:

1. Disconnect any lines from the input and connect a 560-ohm resistor across the input terminals.
2. Connect a Vacuum Tube Voltmeter, capable of measuring down to .002 volts, to the 0-143 ohms output terminals.
3. Break the glyptol seal on R27.
4. Turn ON the amplifier and allow it to warm up for 20 minutes, at normal line voltage.

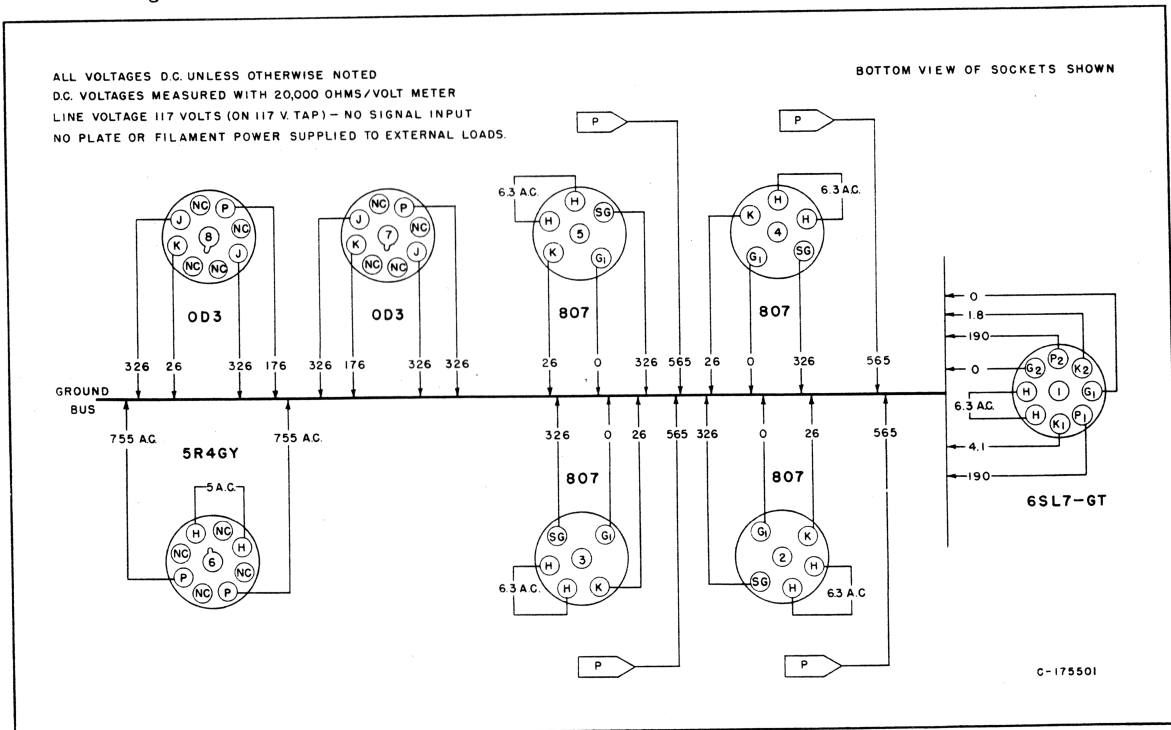


Figure 7 - Socket Voltages

5. Adjust R27 for a minimum voltage indication on the V.T. Voltmeter which in any case should be less than .009 volts, and may be as low as .006 volt.

6. Reseal R27 with glyptol or a similar cement without disturbing the setting of R27.

7. Recheck voltage after resealing.

Parallel Operation

Several MI-12188 Amplifiers may be operated in parallel. Installations of this type are frequently of advantage in larger systems. Correct phasing is necessary for this type of operation.

Connect the amplifiers in the following manner:

1. Wire together the corresponding input terminals.
2. Connect together similar output terminals, but only the terminals which will be connected to the line. The output impedance of the combination will then be equal to the value indicated in the *Load Impedance Table* (under *Output Connections*) divided by the number of amplifiers.

SERVICE

General

Procedures used in the servicing of resistance capacity-coupled amplifiers in general may be applied in making repairs on this amplifier. The location of the component parts is shown in figures 1 and 6. The values of the various components are shown in the schematic figure 4. The socket terminal voltages of a typical amplifier operating under normal conditions are given in figure 7.

Fuse Replacement

The fuse - 3 amperes, type 3AG --is located on the front apron of the amplifier chassis, see figure 1. It may be removed by turning the knurled extractor post. When replacing a fuse, install one of the same type and rating. To use a fuse of higher rating for replacement purposes will needlessly endanger the windings of the power transformer.

Replacement Parts

The following parts list is included to provide identification when ordering replacement parts. Order from your *RCA Sound Products Distributor* 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.

LIST OF PARTS

Symbol No.	Description	Stock No.
C1	Capacitor, molded paper, .1 mf, $\pm 10\%$, 400 v	73551
C2	Capacitor, molded paper, .1 mf, $\pm 10\%$, 200 v	73784
C3,4	Same as C1	
C5	Capacitor, dry electrolytic, 20 mf, -10% $+100\%$, 350 v	59416

LIST OF PARTS (Continued)

<i>Symbol No.</i>	<i>Description</i>	<i>Stock No.</i>
C6	Capacitor, paper, .5 mf, $\pm 10\%$, 1000 v	59418
C7	Capacitor, dry electrolytic, 40 mf, -10% $+50\%$, 400 v	74266
C8	Capacitor, paper, 8 mf, $\pm 20\%$, 1000 v	59261
C9	Capacitor, dry electrolytic, 40 mf, -10% $+100\%$, 150 v	59417
F1	Fuse, 3 amp, type 3AG	10907
L1	Reactor, filter choke, 13 henries, 100 v, 60 cycles .230 amp, dc	59415
R1	Resistor, fixed composition, 470,000 ohms, $\pm 5\%$, 1/2 w	30648
R2	Resistor, fixed composition, 100,000 ohms, $\pm 5\%$, 1/2 w	3252
R3,4	Resistor, fixed composition, 560 ohms, $\pm 5\%$, 1/2 w	5164
R5	Resistor, fixed composition, 1,500 ohms, $\pm 5\%$, 1/2 w	30654
R6,7	Same as R2	
R8,9	Resistor, fixed composition, 100,000 ohms, $\pm 5\%$, 2 w	28738
R10	Same as R2	
R11	Resistor, fixed composition, 6800 ohms, $\pm 5\%$, 1/2 w	14659
R12	Same as R2	
R13,14,15,16	Same as R11	
R17	Resistor, fixed composition, 10 ohms, $\pm 5\%$, 1/2 w	34761
R18	Resistor, fixed composition, 100 ohms, $\pm 5\%$, 1/2 w	34765
R19	Same as R17	
R20,21	Same as R18	
R22	Same as R17	
R23	Same as R18	
R24	Same as R17	
R25	Resistor, fixed composition, 82,000 ohms, $\pm 5\%$, 1/2 w	52609
R26	Resistor, fixed composition, 2700 ohms, $\pm 5\%$, 1 w	14421
R27	Resistor, variable, 50,000 ohms, $\pm 20\%$, 1/2 w	54203
R28	Resistor, fixed composition, 2700 ohms, $\pm 5\%$, 2 w	33855
R29,30	Resistor, wire wound, tapped, first section 5475 ohms $\pm 3\%$, 46 w; and second section 1025 ohms, $\pm 3\%$, 9 w	59419
R31	Resistor, ceramic, wire wound, insulated, 120 ohms, $\pm 3\%$, 25 w	59420
S1	Switch, toggle, spst, 6 amp, 125 v, 3 amp, 250 v	50751
T1	Transformer, audio, output	59414
T2	Transformer, power, 117 v, 50/60 cycles	59413