

TRANSISTORIZED VOICE FREQUENCY AMPLIFIERS 447A, 449A, 450, 453A, 455A, 457A (ALTEC)

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1. GENERAL

1.01 This section describes in detail the electrical and mechanical features of the Altec-Lansing Corporation transistorized voice frequency amplifiers.

1.02 Whenever this section is reissued, the reason for reissue will be noted in this paragraph.

1.03 These amplifiers are designed for use where central office 130 volt supplies are not available. They may be used at subscriber premises, cable terminals, or on poles.

1.04 The amplifiers are two-stage negative feedback types and are designed to operate on 24 or 48 volts, according to type. Direct current, required to power the amplifiers, can be simplexed on the line; permitting tandem repeater installations with no dependence on local power for circuit function. At subscriber premises locations the amplifiers can be energized from local 117 AC by using a power supply. Individual and multiple power supply units are available.

1.05 The amplifiers may be mounted in 105B Apparatus Boxes using adapters available.

1.06 The 447A, 449A, 453A (Fig. 1), 455A, and 450 are designed to operate on 24 volts DC. The 457A is designed to operate on 48 volts DC

1.07 The amplifiers weigh 14 ounces each. Dimensions are 1-11/16" x 1-5/8" x 6". The amplifiers have black front panels, engraved white. Metalwork is cadmium plated with dichromate finish.

2. ELECTRICAL CHARACTERISTICS

2.01 The nominal electrical characteristics of the amplifiers are shown in Table 1.

2.02 Impedance characteristics are shown in Figure 2.

2.03 Total Power consumption of an amplifier is 1/2 of 1 watt. Two power supplies are available. Type (533A) provides power for a single repeater. Two (533A) power supplies and two repeaters can be mounted in a standard 105 type apparatus box. A larger power supply (529A, Fig. 3) is available and is rack mounted. This larger type is capable of supplying power to 100 transistorized amplifiers.

2.04 Simplex power supplies can be used as in Fig. 4. This circuit arrangement shows the following:

- Center tapped chokes are used to simplex the DC voltage at the terminal stations and at the input/output of the amplifier.
- A bypass resistor is provided for proper voltage drop.
- A protective diode is provided to guard against inadvertent polarity reversal.
- A filter circuit is furnished to limit line noise and noise from degrading speech signals.

2.05 These transistorized amplifier types are similar in most respects, both electrically and mechanically. The 449A amplifier (Fig. 10) has optional input and output impedances of 150 ohms and 600 ohms respectively. The 447A amplifier (Fig. 11) is restricted to 600 ohms impedance. The 457A amplifier is similar to the 447A type but is designed for 48 volts DC. The 450 amplifier is also similar to the 447A type except it has resistor R-12 omitted for 20 ma. operation.

NOTICE

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Bell System except under written agreement.

TABLE 1

SPECIFICATIONS	(447A)	(449A)
Type:	Preamp or Line Amplifier	Preamp or Line Amplifier
Gain:	37 db	37 db
Power Output:	+ 18 dbm	+ 18 dbm
Harmonic Distortion:	At + 10 dbm is below 2%, 300-3000 Hz	At + 10 dbm is below 2%, 300-3000 Hz
Frequency Response:	± 1db at 200 and 6000 Hz	± 1db at 200 and 6000 Hz
Input Impedance:	600 ohms	150 or 600 ohms
Output Impedance:	600 ohms	150 or 600 ohms
Output Noise Level:	- 70 dbm	- 70 dbm
Controls:	Input volume control range: 2 db to maximum	Input gain control range: 0 db to maximum
Power Required:	50 ms at 20 volts, or 60 ma at 24 volts DC	22 ma at 24 volts DC
Transistors:	1-2N191, 1-2N188A	1-2N191, 1-2N188A

2.06 The 453A (Fig. 15) and 455A amplifiers have a DC simplex circuit which may be used to bypass the amplifier. A maximum current of 100 ma may be permitted provided out of balance current does not exceed 5 ma.

3. CIRCUIT FEATURES

OVERALL CIRCUIT

3.01 Equalizers are used in conjunction with repeaters to compensate for the frequency-amplitude characteristics in certain classifications of non-loaded or loaded cables and open wire lines. The 12912 equalizer case (Fig. 13, 14) is the same size as the amplifier and may be mounted in a similar manner as the amplifier. A rotary switch can be pre-set to suit the facility; e.g., non-loaded cable, H-44 or H-88 loaded cable, and open wire. Front panel controls are provided for the L.F. and H.F. adjustment respectively. Table 2 shows the parameters of cable facilities which may be aligned with the equipment.

TABLE 2

Facility Cables	Impedance	Attenuation per Mile at 1000 Hz		Cut-off Frequency
		16 ga.	19 ga.	
16 or 19 H-88	1160	.19	.35	4000 Hz
16 or 19 H-44	800	.25	.49	5600 Hz
16 non-loaded	330	.69	--	-----
19 non-loaded	468	--	1.06	-----
Open Wire (100% copper) (80 mils dia.)	766	.104		

Considerable equalization is needed as the line cut-off frequency is approached.

AMPLIFIERS

3.02 Negative feedback is employed to improve gain stability and is applied from the collector of the output stage to the emitter of the input stage. Approximately 9 db of feedback is used at the middle frequencies. The feedback path is frequency selective to improve the low frequency response of the amplifier. The gain control has an audio taper to permit ease of adjustment at low levels of gain. Resistor R1 sets the minimum gain of the unit while capacitors C3 and C5 maintain the low frequency response. Test sockets are provided at the front panel to monitor the output signal.

3.03 Gain characteristics, distortion characteristics, and the output transistor collector current characteristics over the temperature range of 80°F to 160°F are shown in Figure 5. At elevated temperatures the power rating of the transistor decreases appreciably; and, while the data of Figure 5 was obtained under 24 volt operation, it is necessary to decrease the supply to 12 volts for continuous operation of the unit at high temperature. Change of gain vs. output power characteristics for normal and reduced voltages are shown in Figure 6. Total current consumption at 12 volts is 12 ma.

3.04 Amplifier phase shift characteristics are shown in Figure 7. Envelope delay and delay distortion characteristics are shown in Figure 8. These items are important if facsimile and data circuits are involved.

3.05 Frequency characteristics are shown in Figure 9. The optional responses indicate how the low frequency characteristic may be modified by reducing the value of the capacitor in the feedback circuit.

EQUALIZER

3.06 The 12912 equalizer (Figures 13 and 14) is designed for use with either type of amplifier and permits correction of the frequency/amplitude characteristics of cable and open wire circuits. Non-loaded cables have a characteristic impedance of 150 ohms, and loaded cables 600 ohms or 1200 ohms, and open wire lines 600 ohms. In the equalizer all correction is made at an impedance of 600 ohms. Transformer T1 functions as the impedance matching device with its primary tapped to match the line connection. A center tap is provided to enable a DC control path to be operated over the cable facility.

3.07 Low frequency correction is made at the center of the secondary winding of the transformer with the introduction of resistance and capacity by the LF switch. High frequency correction is made by the variable resistor and the parallel circuit of inductance and capacity. The frequency of resonance is changed from 3600 Hz for H-88 loaded cables to 6500 Hz for other loaded and non-loaded cables. The amount of correction is dependent upon the setting of the potentiometer.

POWER SUPPLIES

3.08 Two power supply units are available. The 529A is capable of energizing up to a hundred amplifiers, while the 533A powers a single amplifier only. The 529A power supply delivers a total DC output of 2.5 amps. via ten busses, each fused at 250 ma. Figure 3 shows the circuit arrangement where the secondary of the power transformer is tapped to adjust the output voltage to 24 volts for any number of amplifiers. The rectifier is a bridge type and uses silicon rectifiers. A two-stage filter reduces the ripple to a level of a few millivolts. A distribution block is located on the rear of the panel. The front panel includes a power switch, pilot lamp, ten low voltage fuseholders, and a fuse designation strip. A flexible cord is provided to connect the unit to the 117 volt AC supply.

3.09 The 533A power supply is designed to fit in a 105B Apparatus Box. The supply can be mounted in the existing holes of the 105B Apparatus Box. The DC output terminals are at one end of the unit and a flexible cord is provided to connect to the AC supply. The unit delivers 24 volts at 25 ma.

4. INSTALLATION

4.01 Where amplifiers and equalizers are used in quantity, rack panels are used to mount the units on 19" relay racks. These panels are equipped with ten sockets, a distribution board, and a 24 volt terminal block. The amplifier panel and the equalizer panel are 1-23/32" in height.

4.02 Where a single amplifier is mounted in an apparatus box a 12962 bracket is provided. The bracket is drilled to occupy one 1-3/4" space in a 105B Apparatus Box; it is fitted with a single socket and a terminal strip to which can be connected the input and output cables and the 24 volt supply.

4.03 A typical installation consists of alternate rows of ten amplifiers and ten equalizers mounted on a relay rack of their respective mounting plates. Wired interconnections are made between adjacent panels with the incoming lines being terminated at the input pins of the equalizer sockets. The output pins of the equalizer sockets would connect directly to the input pins of the amplifier sockets. The output circuits of the amplifiers should be connected either to the outgoing lines, or to local equipment at the installation.

4.04 The amplifiers, being transistorized, are dependent upon the polarity of the amplifier station supply for their operation. Before the unit is inserted a check should be made to determine that the positive side of the supply is at pin 9 and the negative supply at pin 8.

4.05 To adjust the gain control, release the lock nut. The level at the monitor pins on the front panel, bridged by 600 ohms, is 11 db below the output level of the unit.

5. PARTS LIST

5.01 The various parts and accessories are listed in Table 3 and Table 4.

TABLE 3

ACCESSORIES

12910	Amplifier Mounting Panel 19" x 1-3/4" for standard rack mounting containing ten 11 pin sockets for mounting ten amplifiers.
529A	Power Supply, 24 volts, at 2.5 amperes, rack mounting and capable of energizing 100 amplifiers. Ten distribution outlets each fused at 250 ma.
12912	Equalizer. A switch permits selection of characteristics for H44, H88, and non-loaded cable.
12902	Equalizer. A switch permits selection of characteristics for H44, H88, and non-loaded cable.
12962	Assembly for mounting an amplifier in a 105B Apparatus Box.

SECTION 024-175-900PN

- 533A Power Supply, 20 volts at 30 ma. May be mounted in a 105B Apparatus Box.
- 13204 Extractor. For removing amplifiers from sockets.
- 13227 Assembly for mounting an amplifier in a 105B Apparatus Box.

**TABLE 4
(SEE NOTE BELOW)**

Parts List

- C1, C2 8 mfd 6V, Aerovox TNED 22
- C3 50 mfd 3V, Aerovox TNED 12
- C4 .2 mfd 200V, Hopkins P22D
- C5 200 mfd 3V, Aerovox TNED 14
- C6 20 mfd 50V, Aerovox TNED 94
- R1 24 ohms \pm 5%, 1/2 watt

- R2 100,000 ohms \pm 10 %, 1/2 watt
- R3, R9 10,000 ohms \pm 10%, 1/2 watt
- R4, R8 4,700 ohms \pm 10%, 1/2 watt
- R5 1,200 ohms \pm 10%, 1/2 watt
- R6 120 ohms \pm 10%, 1/2 watt
- R7 1,000 ohms \pm 10%, 1/2 watt
- R10 68 ohms \pm 10%, 1/2 watt
- R11 270 ohms \pm 10%, 1/2 watt
- R12 820 ohms, 3 watts, Sprague 151E
- T1 Peerless 4729
- T2 Peerless 16483
- P1 2,000 ohms, Z taper, Clarostat 48M-9-2000
- TR1 2N191 Transistor G. E.
- TR2 2N188A Transistor G. E.

Note: Table 4 shows parts for a typical amplifier. Check amplifier drawing for other types.

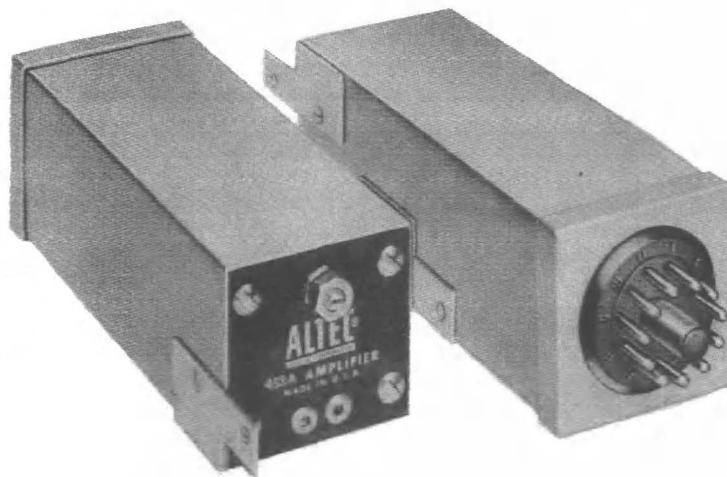


Fig. 1 — ALTEC 453 Amplifier

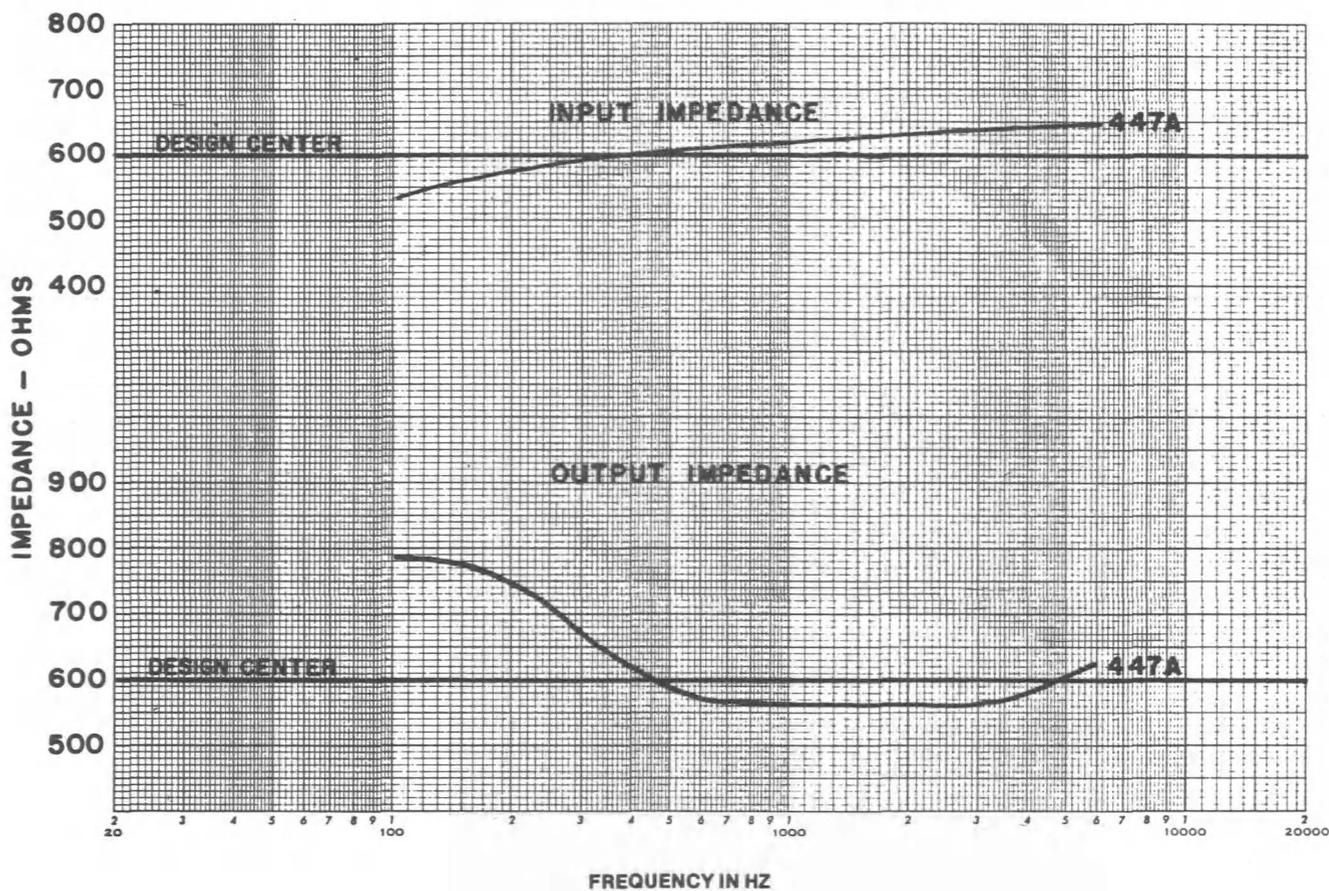


Fig. 2 — Magnitude - Impedance Characteristics

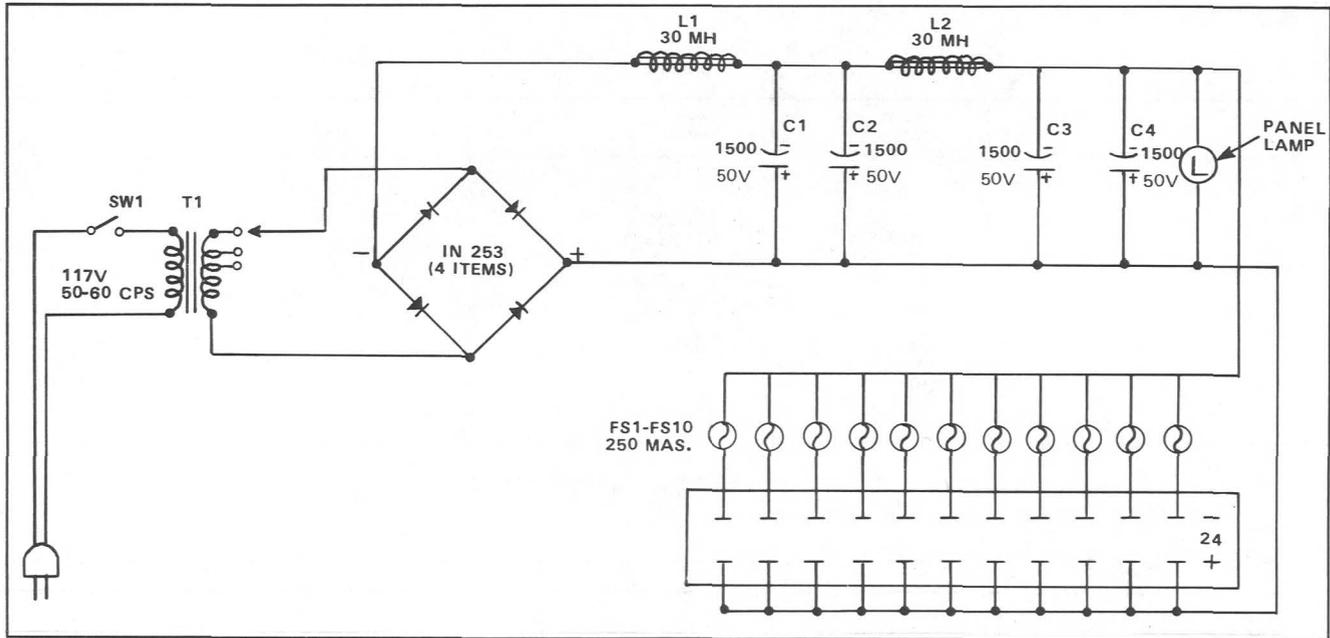


Fig. 3 — 529A Power Supply

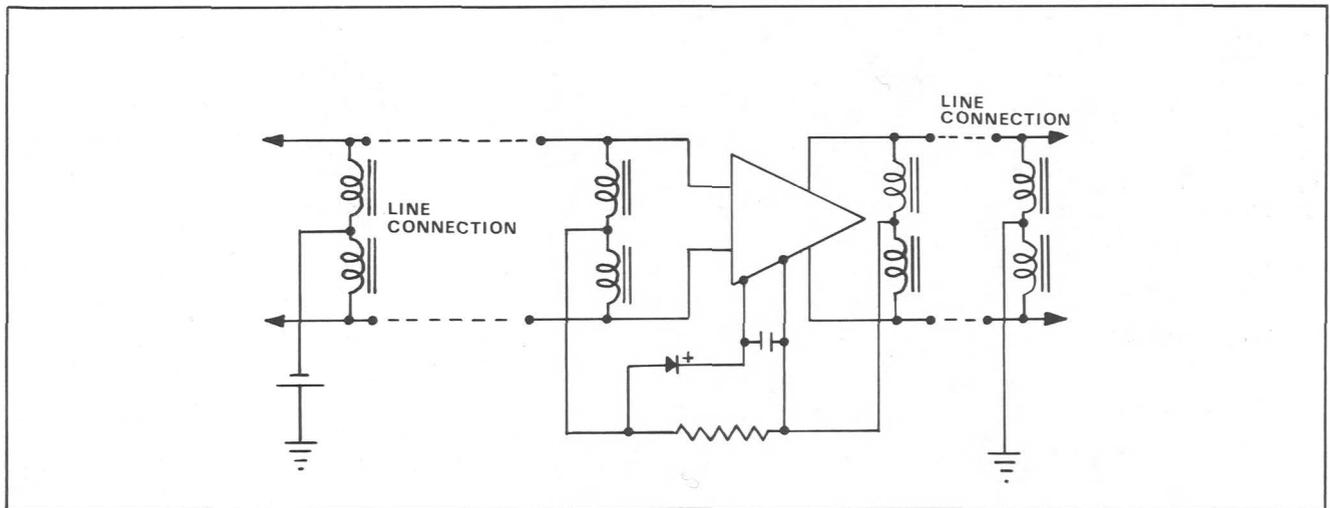


Fig. 4 — Repeater/Simplex D.C. System

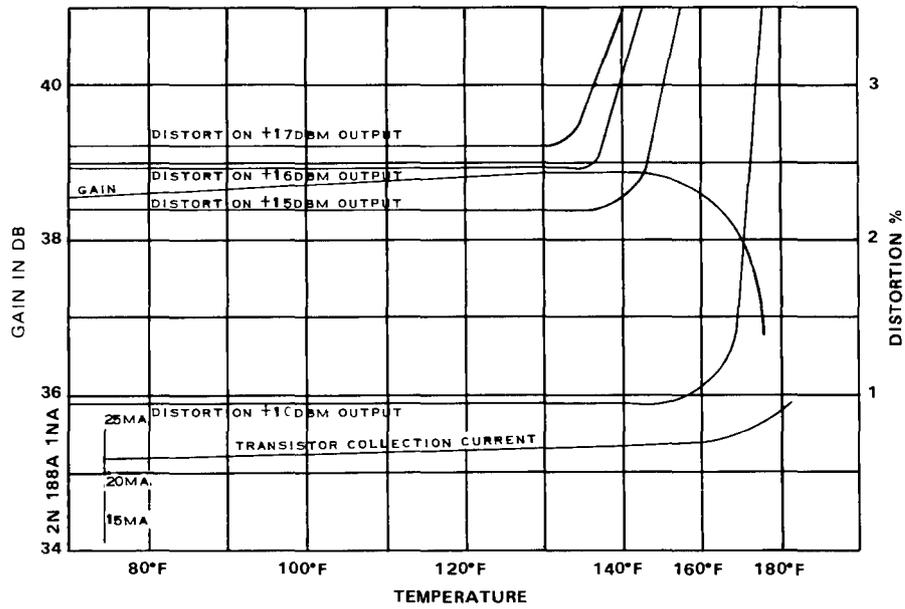


Fig. 5 — 447A Amplifier (24V Supply)

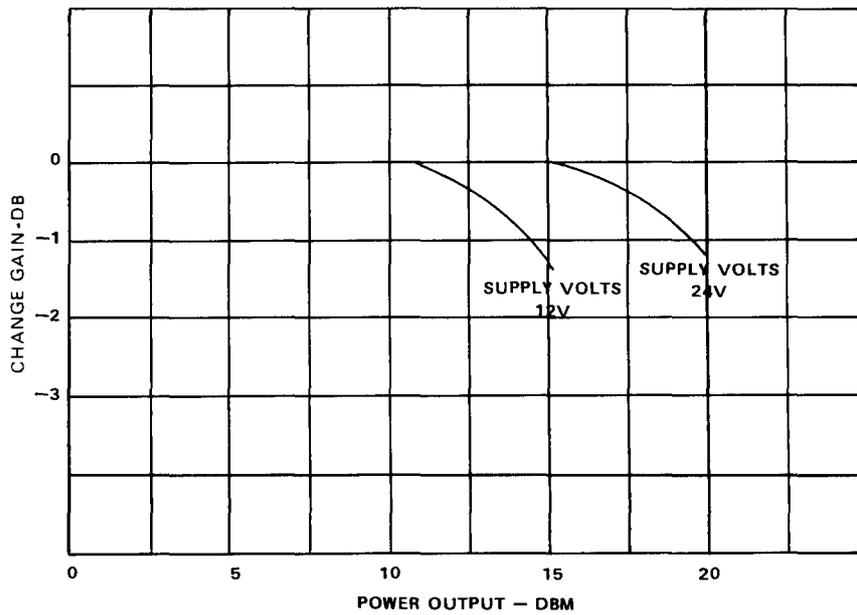


Fig. 6 — 447A Amplifier

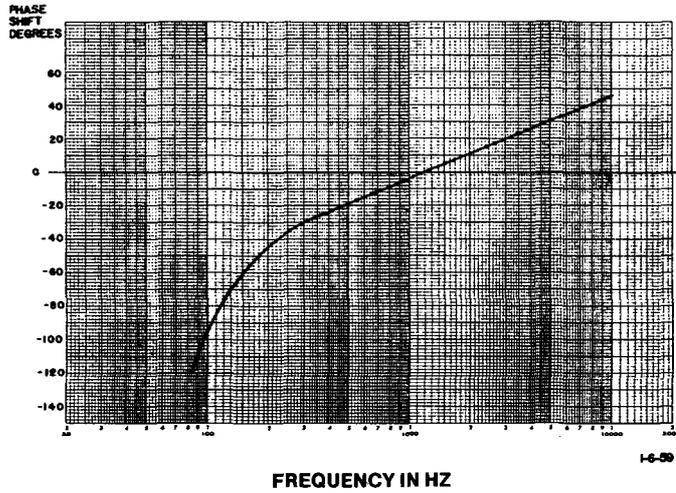


Fig. 7 — 447A & 449A Amplifier Phase Shift

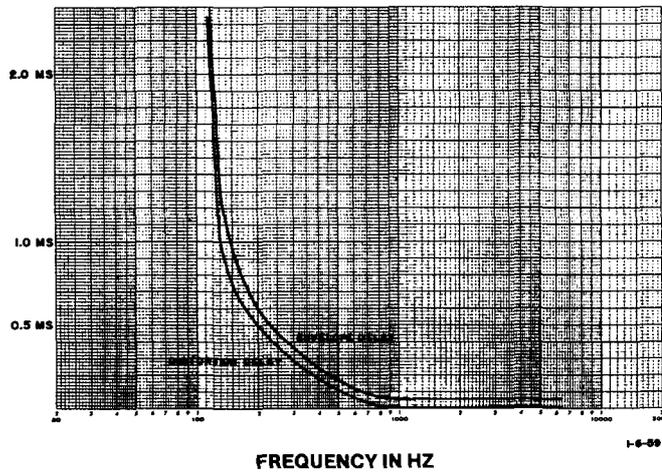


Fig. 8 — 447A & 449A Amplifier Envelope delay & Distortion Delay

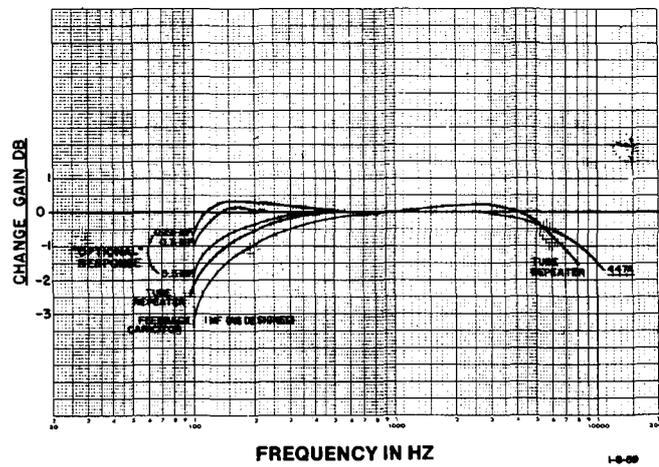


Fig. 9 — 447A Amplifier (24 V Supply)

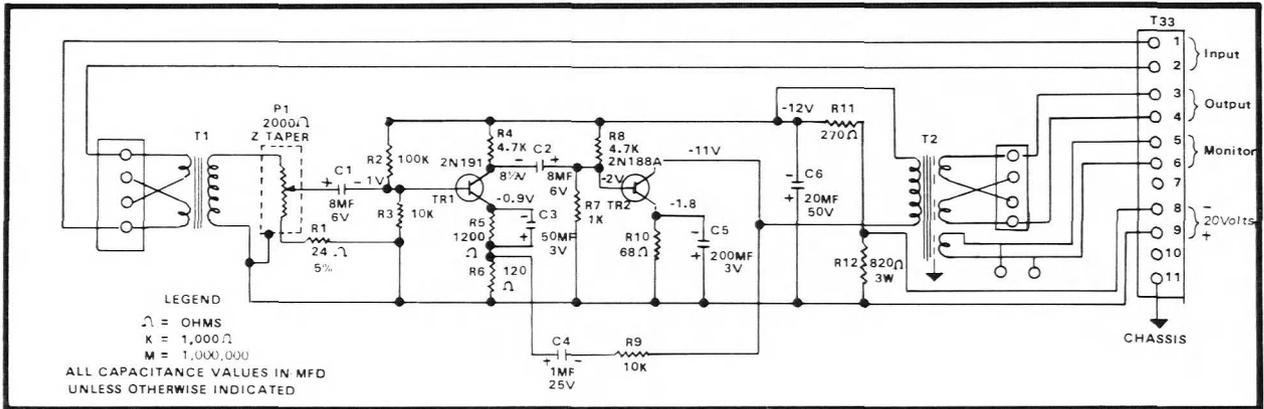


Fig. 10 — ALTEC Lansing 449A Amplifier

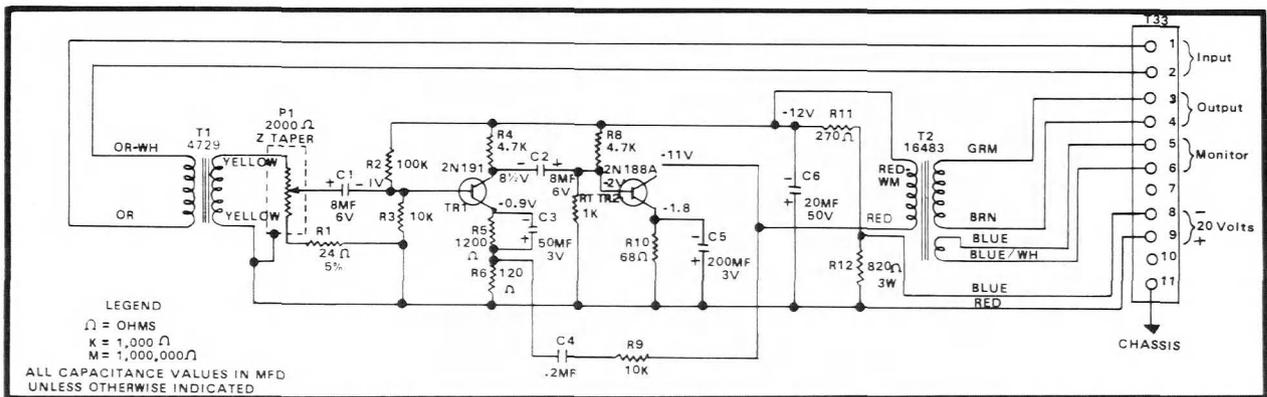


Fig. 11 — ALTEC Lansing 447A Amplifier

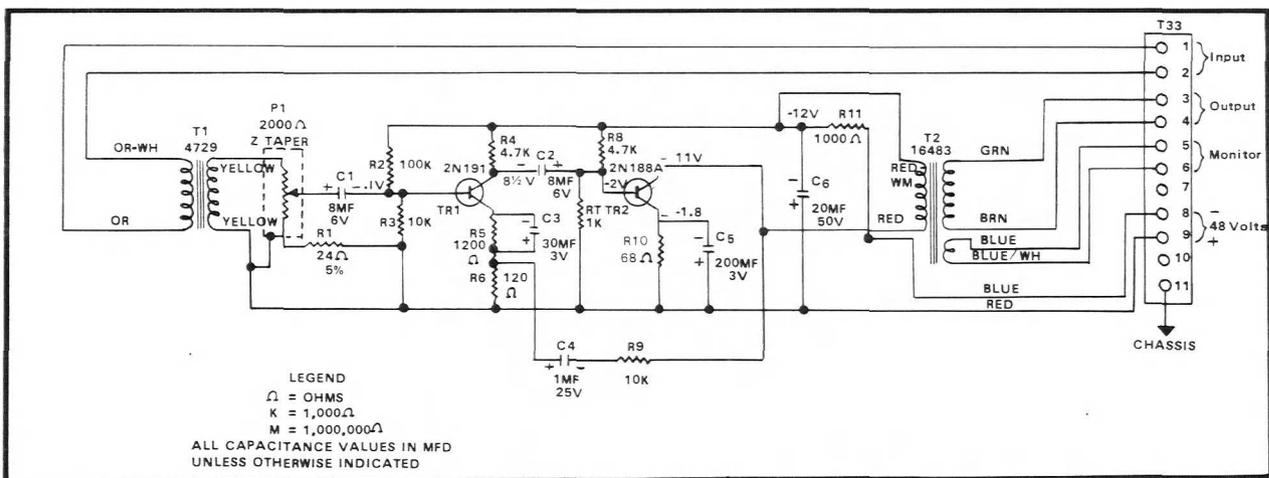


Fig. 12 — ALTEC Lansing 457A Amplifier

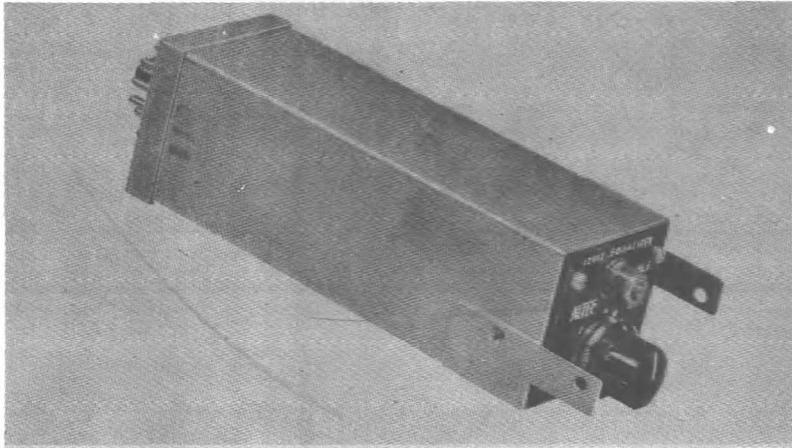


Fig. 13 — 12912 Equalizer

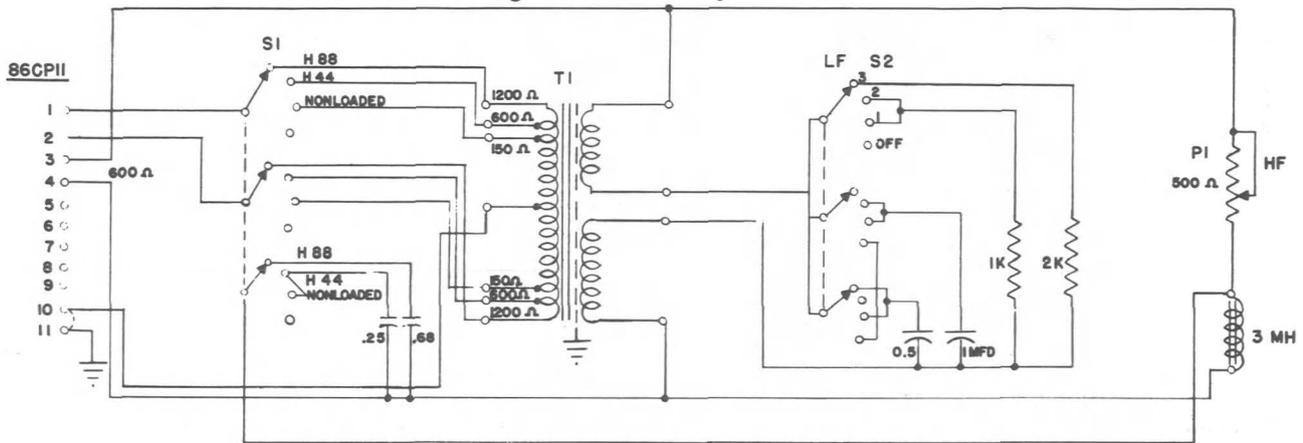


Fig. 14 — 12912 Equalizer For 447A Or 449A Amplifier

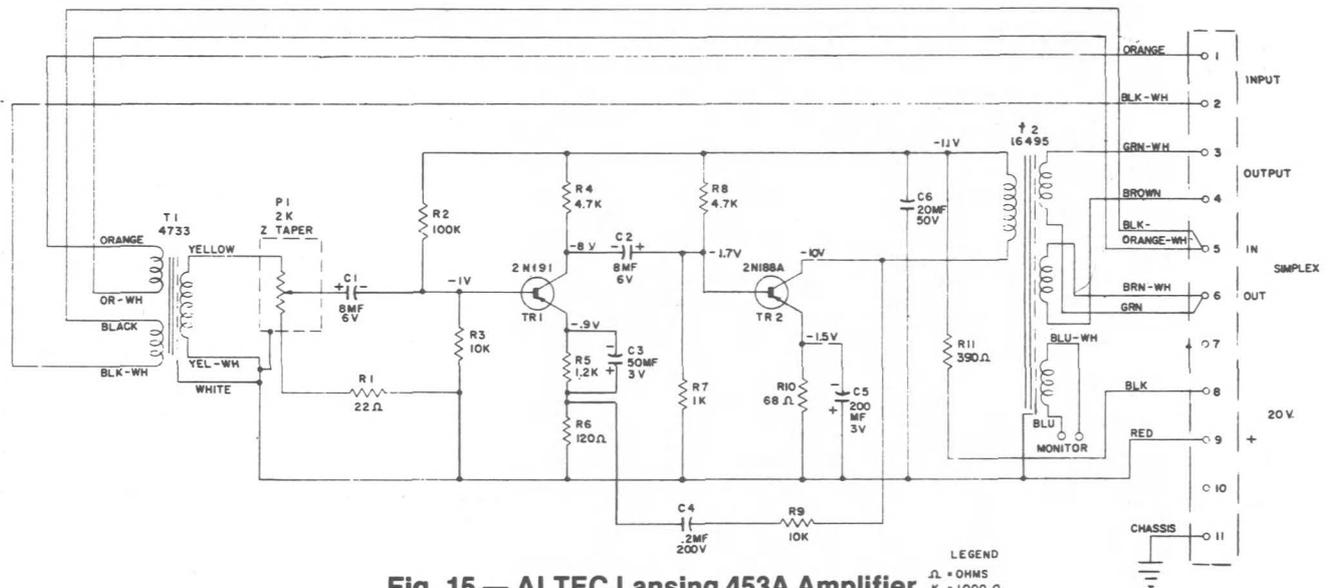


Fig. 15 — ALTEC Lansing 453A Amplifier