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

Contents Page

1. GENERAL 1
2. ELECTRICAL CHARACTERISTICS... 1
3. CIRCUIT FEATURES 2
4. INSTALLATION 3
5. PARTS LIST 4

1. GENERAL

1.01 This section describes in detail the electrical and mechanical features of the Altec-Lansing Corporation transistorized voice frequency amplifiers. The section is reissued to include new models. ←

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

1.03 The amplifiers are two-stage negative feedback type 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 volts AC by using a power supply. Individual and multiple power supply units are available.

1.04 The amplifiers may be mounted in 105B apparatus boxes using adapters available.

1.05 The 447A, 449A, 453A, 455A, and 450 are designed to operate on 24 volts DC. The 457A is designed to operate on 48 volts DC. ←

1.06 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. One type (533A) provides power for a single repeater, two repeaters and two such power supplies 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 shows an arrangement in which center tapped chokes are used to simplex the DC voltage at the terminal stations and at the input and the output of the amplifier, a bypass resistor provides proper voltage drop, a protective diode guards against inadvertent polarity reversal and a filter circuit limits line noise and hum from degrading the speech signals.

2.05 All types of transistorized amplifiers 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

© The Pacific Telephone and Telegraph Company, 1960

respectively. The 447A amplifier (Fig. 11) is restricted to 600 ohm impedance only. The 457A amplifier is identical to the 447A type except it is designed for 48 volts DC only. The 450 amplifier is also identical to the 447A type except it has resistor R-12 omitted for 20 ma. operation.

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 cps	At + 10 dbm is below 2%, 300-3000 cps
Frequency Response:	±1db at 200 and 6000 cps	±1db at 200 and 6000 cps
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 ma 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 and 455A amplifiers (see Fig. 15) have a DC simplex circuit which may be used to by-pass 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 often used in conjunction with repeaters to compensate for the frequency-amplitude characteristics encountered in certain classifications of non-loaded and loaded cables and open wire lines. The 12912 equalizer (Fig. 13, 14) is housed in a case which is of the same dimension 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 or 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 cps		Cut-off Frequency
		16 ga.	19 ga.	
16 or 19 H-88	1160	.19	.35	4000 cps
16 or 19 H-44	800	.25	.49	5600 cps
16 non-loaded	330	.69	--	------
19 non-loaded	468	--	1.06	------
Open Wire (100% copper) (80 mils dia.)	766	.104		

At frequencies approaching the cut-off frequency of the line considerable equalization is needed.

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. Some 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 characteristic at the normal and reduced voltages is shown in Figure 6. Total current consumption at 12 volts is 12 ma.

3.04 Amplifier phase shift characteristics are shown in Figure 7, and an 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, loaded cables 600 ohms and 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 cps for H-88 loaded cables to 6500 cps for other loaded and non-loaded cables with the amount of correction being 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 on 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 Mounting Panel equipped with sockets for 10 equalizers.
12962	Assembly for mounting an amplifier in a 105B Apparatus Box.
→ 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 ± 5%, ½ watt
R2	100,000 ohms ± 10%, ½ watt
R3, R9	10,000 ohms ± 10%, ½ watt
R4, R8	4,700 ohms ± 10%, ½ watt
R5	1,200 ohms ± 10%, ½ watt
R6	120 ohms ± 10%, ½ watt
R7	1000 ohms ± 10%, ½ watt
R10	68 ohms ± 10%, ½ watt
R11	270 ohms ± 10%, ½ watt
R12	820 ohms, 3 watts, Sprague 151E
T1	Peerless 4729
T2	Peerless 16483
P1	2000 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.

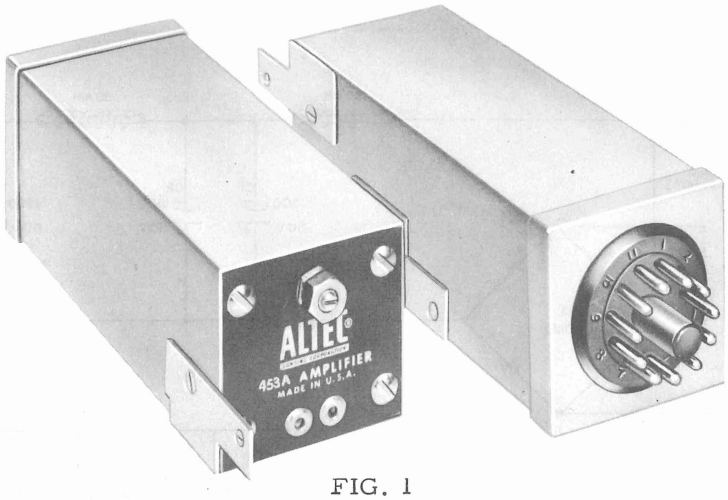

ALTEC
453A AMPLIFIER
MADE IN U.S.A.

FIG. 1

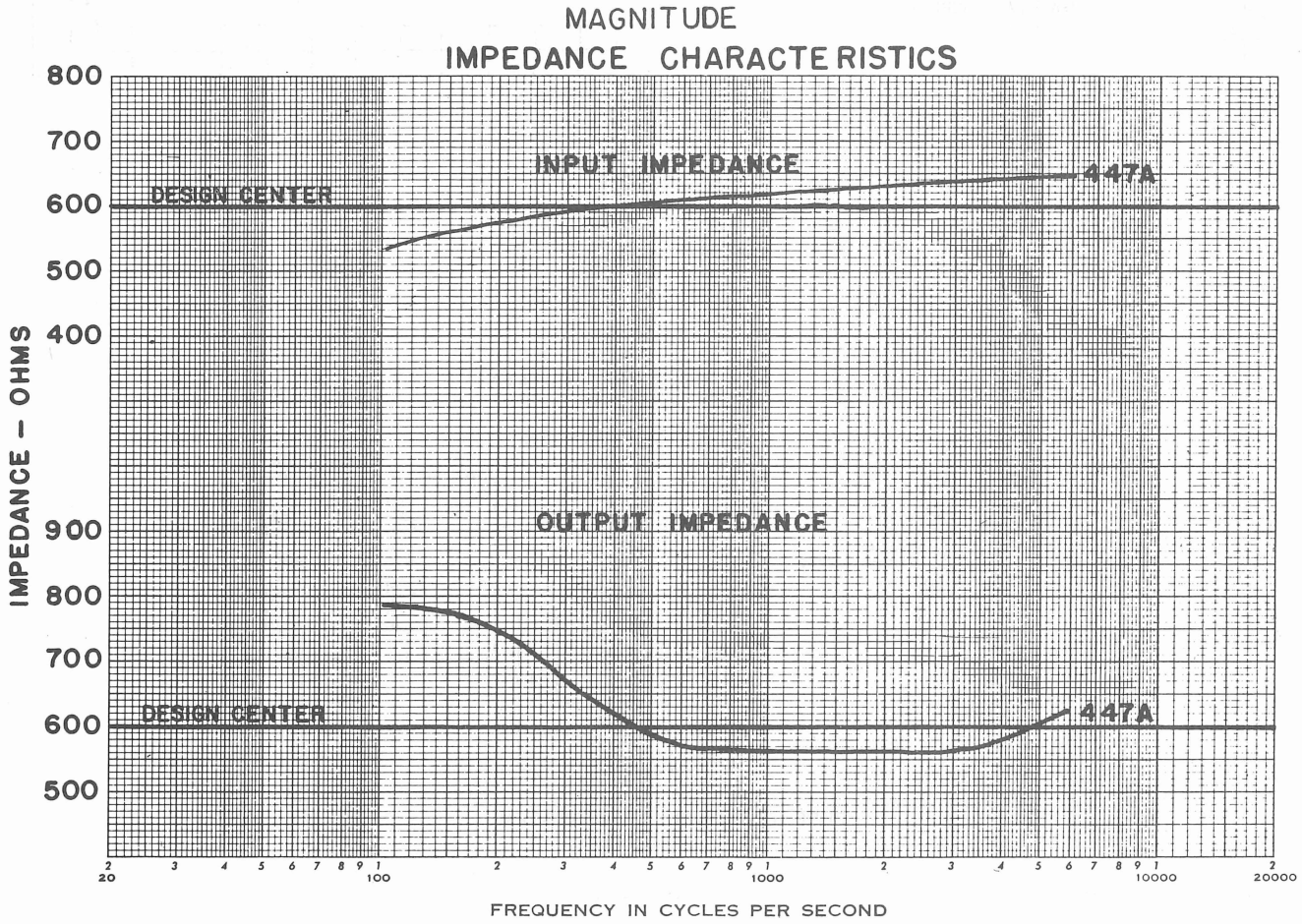

MAGNITUDE
IMPEDANCE CHARACTERISTICS
IMPEDANCE – OHMS
800
700
600
500
400
900
800
700
600
500
INPUT IMPEDANCE
447A
DESIGN CENTER
OUTPUT IMPEDANCE
447A
DESIGN CENTER
20
100
1000
10000
20000
FREQUENCY IN CYCLES PER SECOND

FIG. 2

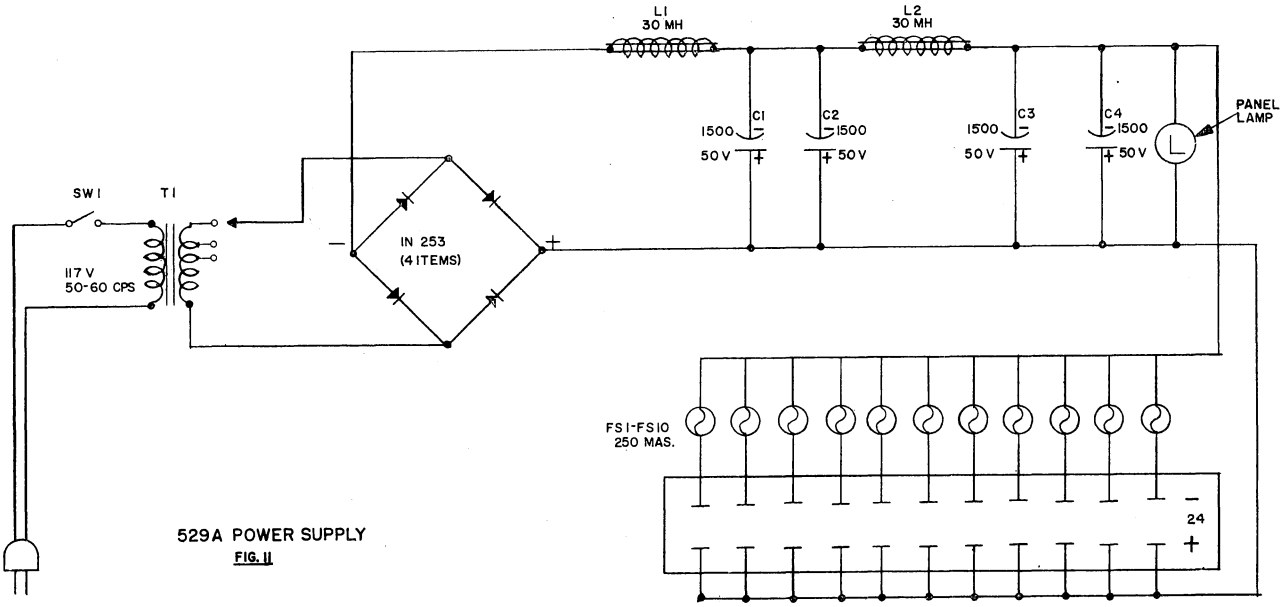

L1
30 MH
L2
30 MH
C1
1500
50 V
C2
1500
50 V
C3
1500
50 V
C4
1500
50 V
PANEL
LAMP
SW1
T1
117 V
50-60 CPS
IN 253
(4 ITEMS)
FS1-FS10
250 MAS.
24
529A POWER SUPPLY
FIG. II

FIG. 3

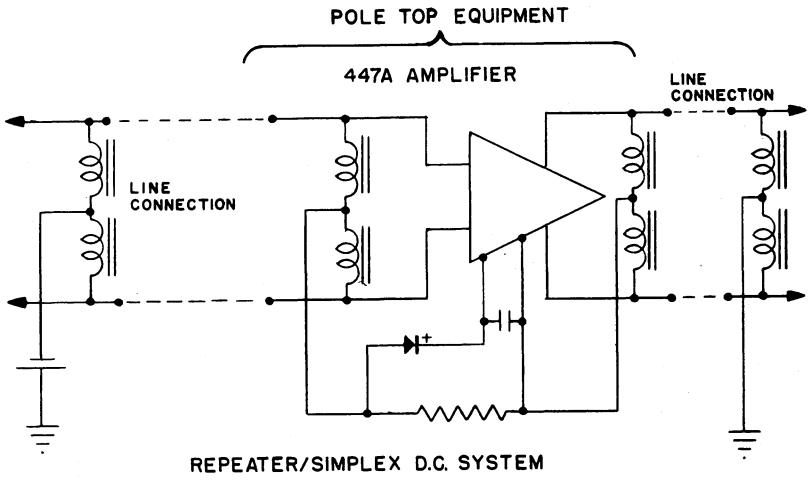

POLE TOP EQUIPMENT
447A AMPLIFIER
LINE
CONNECTION
LINE
CONNECTION
REPEATER/SIMPLEX D.C. SYSTEM

FIG. 4

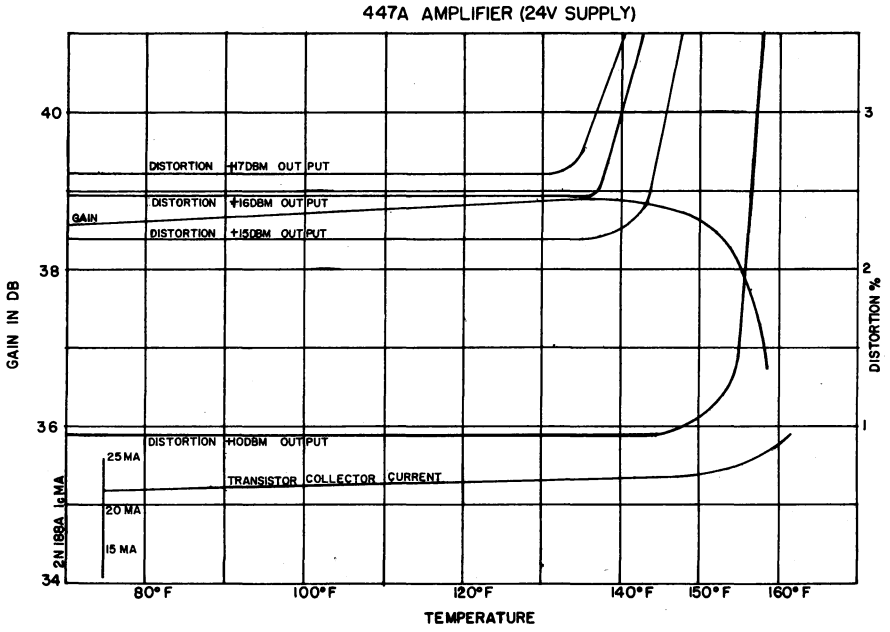

447A AMPLIFIER (24V SUPPLY)
GAIN IN DB
DISTORTION %
40
38
36
34
3
2
1
DISTORTION +17DBM OUTPUT
DISTORTION +16DBM OUTPUT
GAIN
DISTORTION +15DBM OUTPUT
DISTORTION +10DBM OUTPUT
TRANSISTOR COLLECTOR CURRENT
25 MA
20 MA
15 MA
2N 188A IcMA
80° F
100° F
120° F
140° F
150° F
160° F
TEMPERATURE

FIG. 5

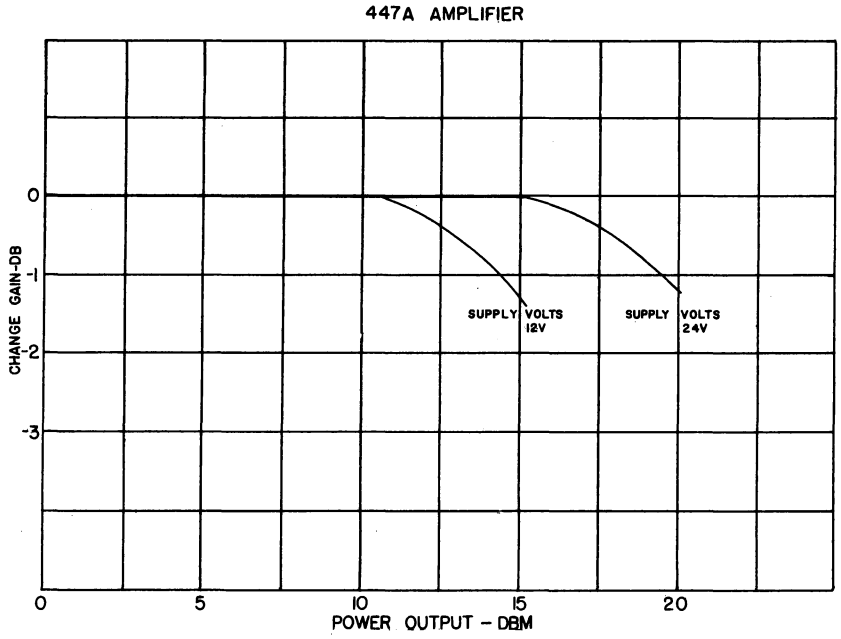

447A AMPLIFIER
CHANGE GAIN-DB
0
-1
-2
-3
SUPPLY VOLTS 12V
SUPPLY VOLTS 24V
0
5
10
15
20
POWER OUTPUT - DBM

FIG. 6

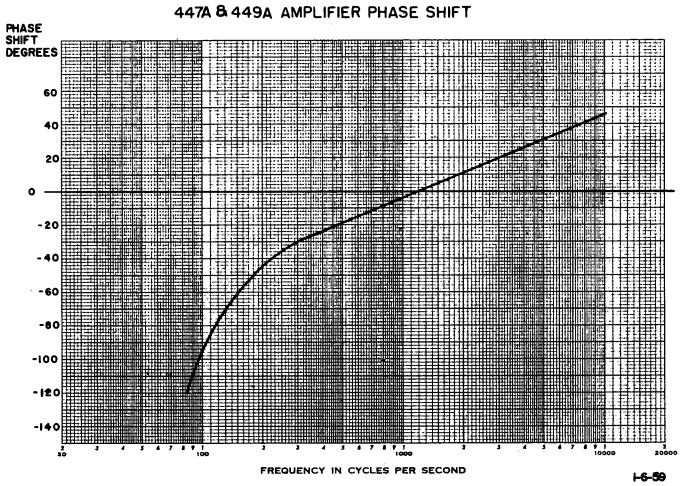


FIG. 7

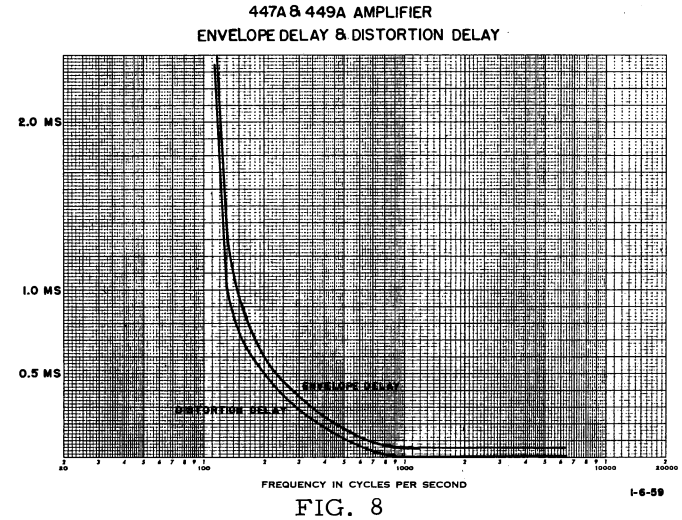


FIG. 8

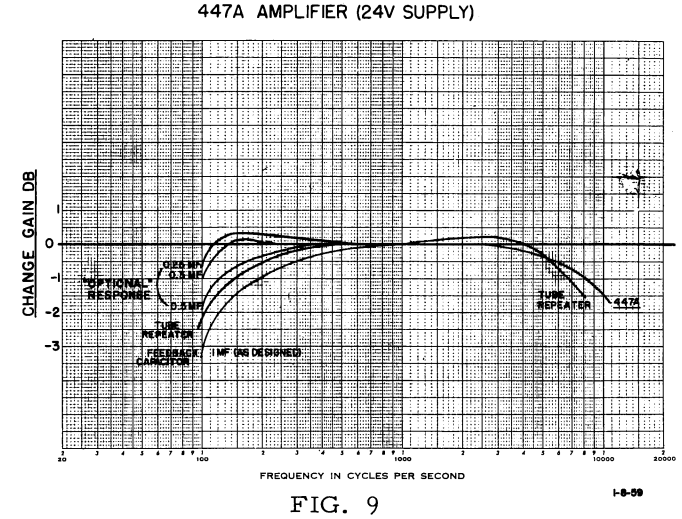
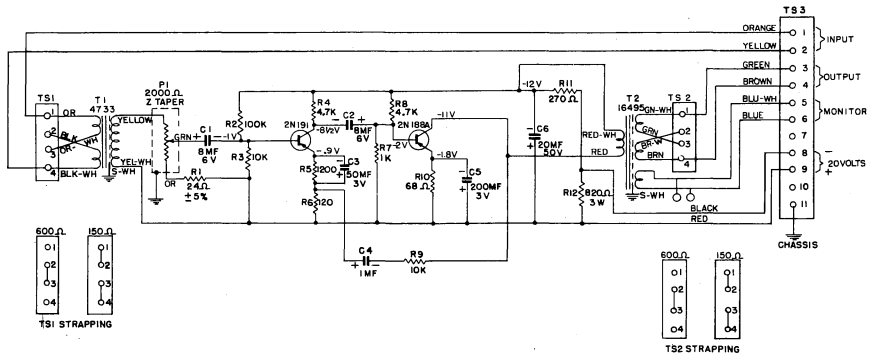
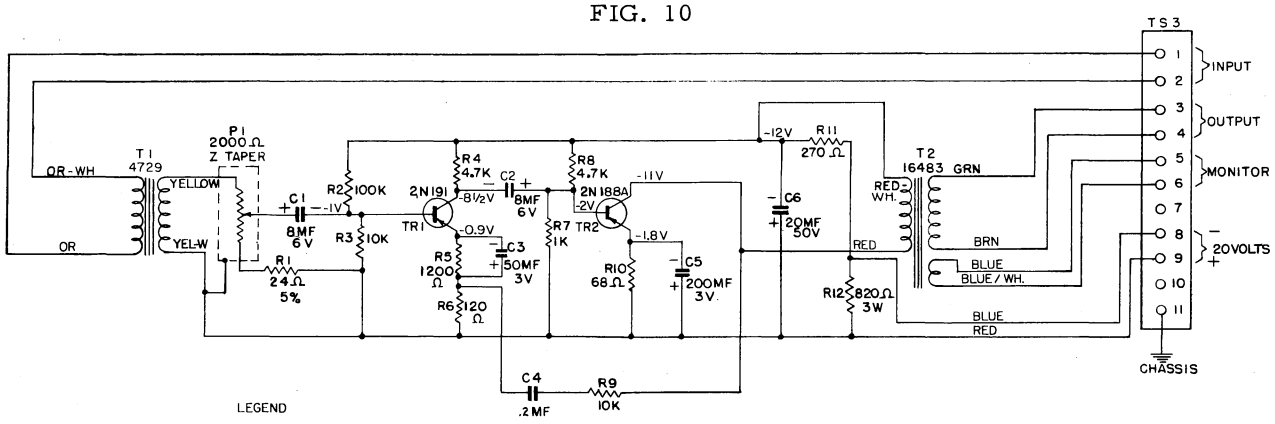


FIG. 9



ALTEC LANSING 449A AMPLIFIER

FIG. 10

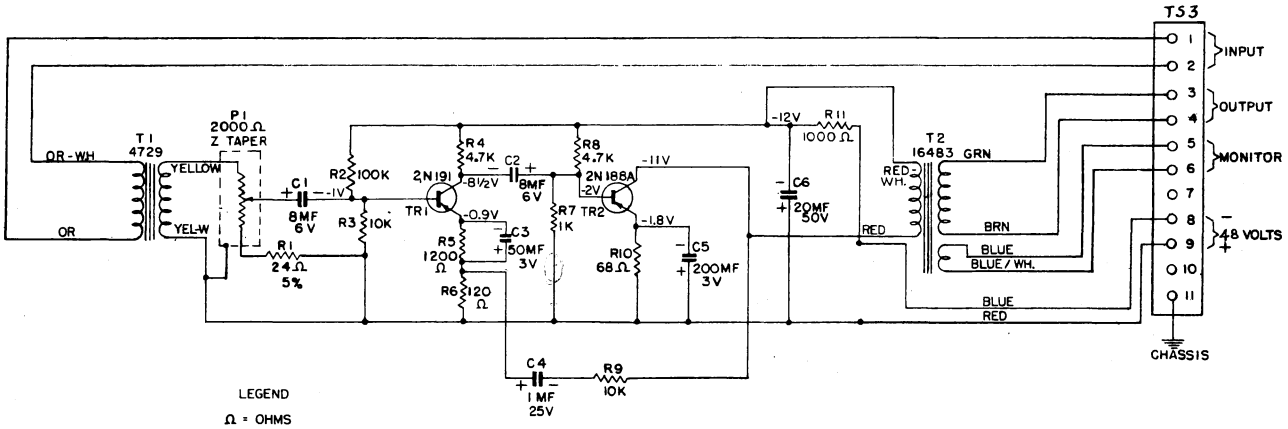


LEGEND

Ω = OHMS
K = 1,000 Ω
M = 1,000,000 Ω
ALL CAPACITANCE VALUES IN MFD
UNLESS OTHERWISE INDICATED

ALTEC LANSING 447A AMPLIFIER

FIG. 11



LEGEND

Ω = OHMS
K = 1,000 Ω
M = 1,000,000 Ω
ALL CAPACITANCE VALUES IN MFD
UNLESS OTHERWISE INDICATED

ALTEC LANSING 457A AMPLIFIER

FIG. 12

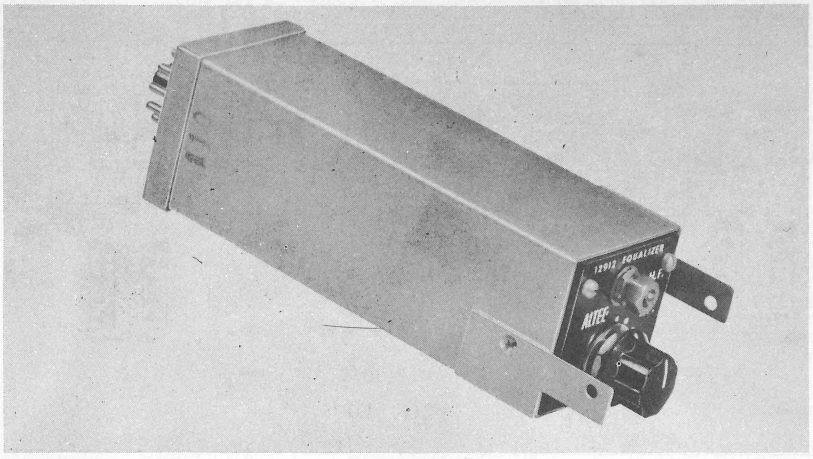
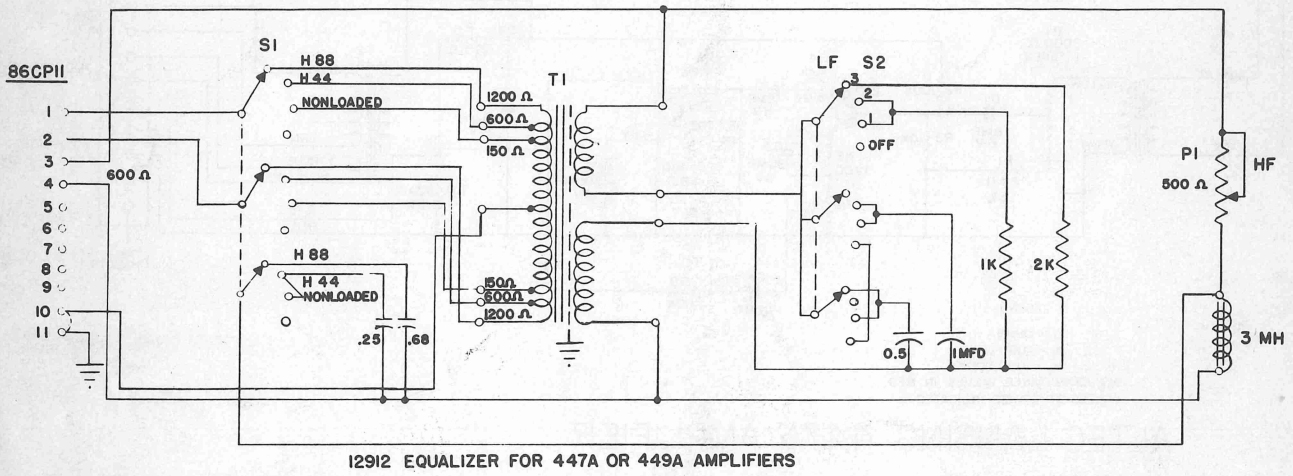
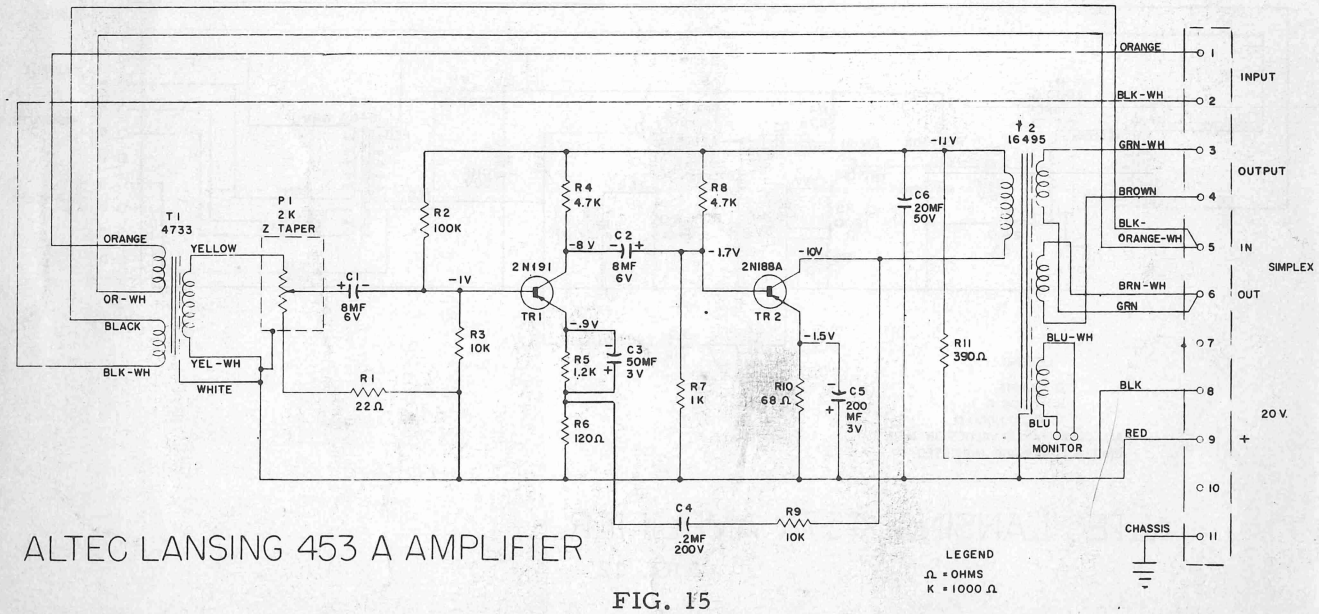


FIG. 13



12912 EQUALIZER FOR 447A OR 449A AMPLIFIERS

FIG. 14



ALTEC LANSING 453 A AMPLIFIER

FIG. 15