124-TYPE AMPLIFIERS — DESCRIPTION

CONTENTS

		PAGE
1.	GENERAL	1
2.	TRANSMISSION AND CIRCUIT FEATURES OF THE AMPLIFIERS	4
	(A) General Features Common to all Five Amplifiers	4
	Basic Amplifier Circuit	4
	First Stage Tube Connections and Interstage Circuit	5
	Second Stage Tube Connections	5
	Output Circuit	5
	Feedback Circuit	5
	Vacuum Tube Arrangements	5
	Grounding Arrangements	7
	Noise	7
	(B) Special Features Individual to Each of the Five Amplifiers	8
	124A Amplifier	8
	124B Amplifier	8
	124C Amplifier	9
	124D Amplifier	9
	124E Amplifier	10
3.	INSTALLATION	10
	(A) Mounting	10
	(B) Noise Pickup	10
	(C) Ventilation	11
	(D) Wiring	11
4.	AMPLIFIER OPERATING ADJUSTMENTS	11
	(A) Line Voltage	11
	(B) Vacuum Tubes	11
	(C) Power Output (Audio)	11
	(D) Input Arrangements	12
5.	ASSOCIATED DRAWING - NOT ATTACHED	12
6.	PARTS LIST	12

1. GENERAL

1.01 This Section describes a new series of amplifiers known as the 124-type, which includes five different models. The important electrical and mechanical features of each of these amplifiers are discussed in detail. Installation information is also included.

1.02 These amplifiers will be used in special services, such as program transmission, loud speaker paging and public address systems, one-way speech or music distribution systems, weather announcement systems, etc., where a compact a-c operated amplifier with built-in power supply is desired.

1.03 The 124A Amplifier is the basic amplifier, employing the simplest input arrangement of any of the amplifiers in this series. It may be used as a power amplifier where no gain control is required or where the gain control is furnished in circuits external to the amplifier.

1.04 The 124B Amplifier is designed primarily for use as a monitor amplifier in the Bell System program plant or as a part of a one-way speech or music transmission system. It may also be employed in "Time Announcement" and "Weather Announcement" systems and, in special applications, as a line amplifier in short regional program networks for medium quality service or as a temporary or emergency line amplifier on the major networks.

1.05 The 124C Amplifier is designed for use wherever it is desired to amplify the output of a carbon transmitter to loud speaker level, such as in loud speaker paging systems or test desk to main frame loud speaker systems. For paging system uses, the 124C Amplifier is mounted in a metal cabinet, the assembly being known as the 103C Amplifier.

1.06 The 124D Amplifier is intended for use where high gain is required, such as amplifying the output of a moving coil microphone or phonograph reproducer, to line or loud speaker level. It will be used as a component part of the 103D Amplifier, in which form it will find application in loud speaker paging systems.

1.07 The 124E Amplifier is intended for general use as a power amplifier where a self-contained gain control is desired.

1.08 Each of the five amplifiers is a-c operated, requires a 105-125 volt 50-60 cycle source of power, and is equipped with a 1.25 ampere "Fustat" mounted on the chassis (maximum amplifier power consumption with high level audio output and a 125-volt power supply is about 125 watts). With the exception of the 124D Amplifier, which includes an additional single tube, single stage amplifier, coded 116B, and connected ahead of the first main amplifier stage to give added gain, each amplifier employs two stages of amplification with negative feedback, the final stage being push-pull. All five amplifiers have substantially flat gain-frequency characteristics from 35-10,000 cycles, except the high gain

arrangement of the 124C Amplifier where the frequencies below 1000 cycles are purposely attenuated to improve articulation on loud speaker paging or announcing systems.

1.09 The input impedances of these amplifiers may be made either high or low, depending upon what input connections are used, except that the 124D is available with only a high impedance input. The impedance into which each amplifier is designed to operate may be adjusted over a considerable range, depending upon the strapping of the output transformer.

1.10 Each of these amplifiers may be arranged for a normal power output of 11.5 watts or a high level power output of 14 watts (for a total harmonic content of 1 per cent rms in either case), depending on the connection to the power transformer (see Paragraph 4.03). The corresponding amplifier outputs on a program basis are +33 vu and +34 vu for negligible distortion on a high quality reproducing system when transmitting a program band from 35-10,000 cycles. Higher power outputs are obtainable with increased harmonic distortion as indicated on Fig. 1, which shows the harmonic content as a function of the power output in watts for both normal and high level conditions.

1.11 There are gain control adjustments on all the 124-type amplifiers except the 124A. Each is mounted in the upper left-hand portion of the panel with its designation plate labeled GAIN CONTROL, and mounted in a corresponding position on the front mat. The designation plates on the 124B and E Amplifiers are marked with OFF at the extreme counter-clockwise position of the scale and "20" at the extreme clockwise position. A mark is engraved for each of the 19 steps between the two extreme positions with steps 5,

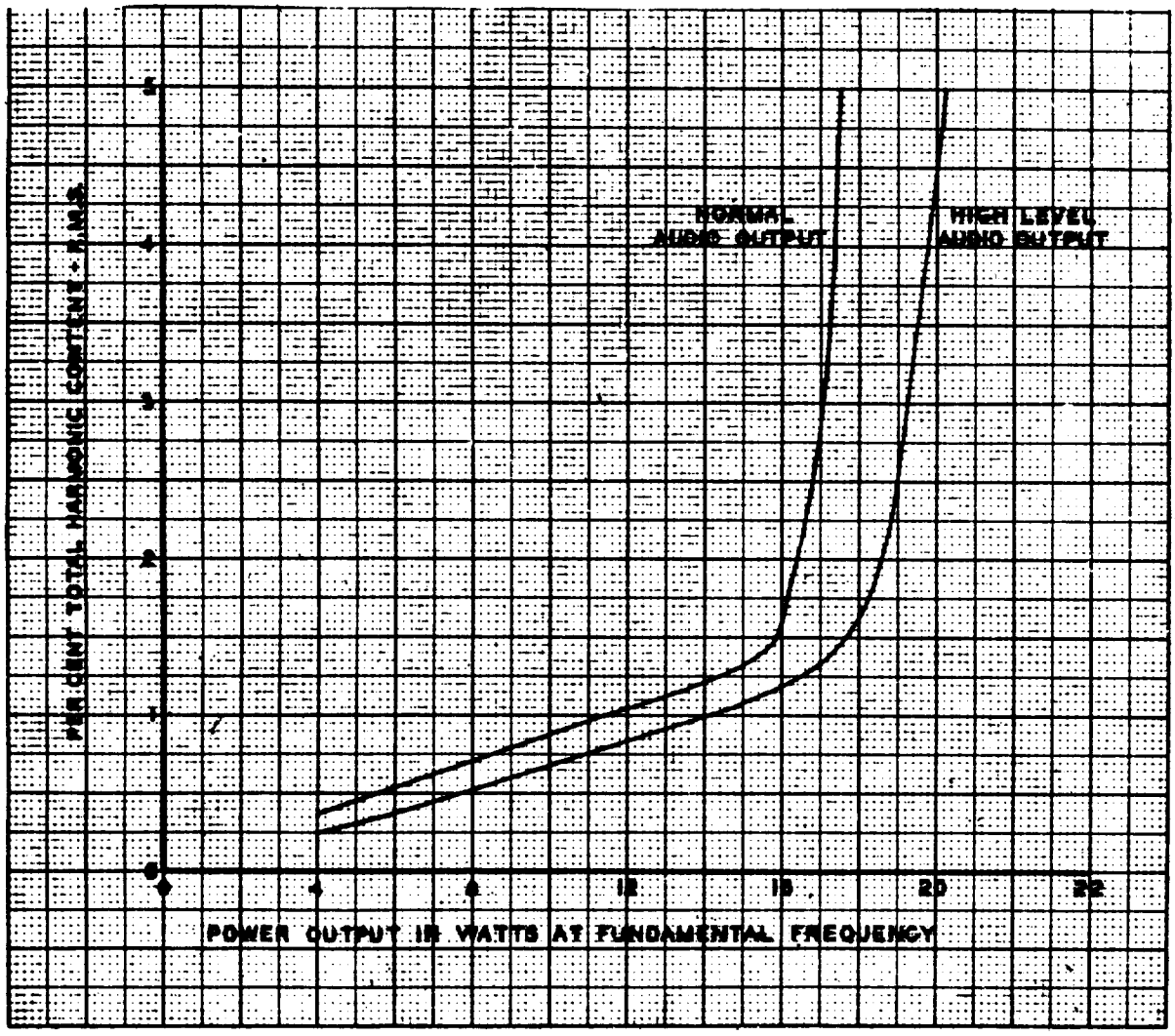


Fig. 1

TABLE I
124 TYPE AMPLIFIERS - TYPICAL OPERATING CHARACTERISTICS
THESE DATA ARE BASED ON THE USE OF WESTERN ELECTRIC TUBES IN EACH OF THE AMPLIFIERS

AMPLIFIER	MAXIMUM 1000 CYCLE GAIN WHEN OPERATING BETWEEN NOMINAL SOURCE AND LOAD IMPEDANCES	GAIN CONTROL	MAXIMUM INPUT PROGRAM LEVEL (SEE NOTE 1)	AMPLIFIER TERMINALS TO WHICH INPUT SHOULD BE CONNECTED	INPUT CIRCUIT - TERMINAL STRAPPING ARRANGEMENTS	SOURCE IMPEDANCE (IMPEDANCE OUT OF WHICH EACH AMPLIFIER IS DESIGNED TO OPERATE) NOMINAL	SOURCE IMPEDANCE (IMPEDANCE OUT OF WHICH EACH AMPLIFIER IS DESIGNED TO OPERATE) OPERATING RANGE	IMPEDANCE LOOKING INTO THE INPUT TERMINALS OF EACH AMPLIFIER (APPROXIMATE VALUES UNLESS LIMITS ARE GIVEN)	LOAD IMPEDANCE INTO WHICH EACH AMPLIFIER IS ARRANGED TO OPERATE (SEE NOTE 2)	IMPEDANCE LOOKING BACK INTO THE AMPLIFIER'S OUTPUT TERMINALS 13 & 14	IMPEDANCE LOOKING BACK INTO THE AMPLIFIER'S OUTPUT TERMINALS (THESE TERMINALS ARE WIRED IN THE CIRCUIT ONLY IN THE 124 B)	OUTPUT NOISE IN DB ABOVE REFERENCE NOISE LEVEL OF -36 DB (PROGRAM WEIGHTING)	OUTPUT NOISE IN DB ABOVE REFERENCE NOISE LEVEL OF -36 DB (UNWEIGHTED - LIMITING VALUES)	FREQUENCY CHARACTERISTIC WHEN OPERATING BETWEEN NOMINAL SOURCE AND LOAD IMPEDANCES. REFERRED TO 1000 CYCLES	POWER SUPPLY PROVIDED AS A PART OF THE AMPLIFIER ASSEMBLY
124A AMPLIFIER															
BRIDGING INPUT	30 DB	NONE. FIXED GAIN AMP.	*-8 VU	1 & 3		600 OHMS	0-25,000 OHMS	40,000 OHMS	75 OHMS			48 DB	80 DB	±1 DB 25-10,000 CYCLES -2 DB AT 14,000 CYCLES	NO
HIGH GAIN INPUT	63 DB		*-25 VU	1 & 2		600 OHMS	0-1000 OHMS	1000 OHMS							
124B AMPLIFIER															
INPUT ARRANGEMENT NO 1	67 DB	ADJUSTABLE IN 19 STEPS OF 2 DB PER STEP	*+2 VU	1 & 3	SEE FIG. 3 STRAP 5 & 11, STRAP 6 & 12 REMOVE, STRAP 5*	600 OHMS	500-700 OHMS	2500 OHMS	600 OHMS	600 OHMS WHEN OUTPUT TRANSFORMER IS STRAPPED FOR A 600 OHM LOAD		48 DB (INDEPENDENT OF GAIN CONTROL SETTING)	80 DB (INDEPENDENT OF GAIN CONTROL SETTING)	±1 DB 25-10,000 CYCLES -4 DB AT 14,000 CYCLES	YES
INPUT ARRANGEMENT NO 2	61 DB		*+2 VU	1 & 3	STRAP 5 & 11, STRAP 6 & 12 CONNECT, STRAP 5*	600 OHMS	400-1000 OHMS	600 ± 10% OHMS (50-8000 ~)							
INPUT ARRANGEMENT NO 3	45 DB		*+2 VU	1 & 3	STRAP 5 & 4, STRAP 6 & 7, STRAP 10 & 11 REMOVE, STRAP 5*	600 OHMS	500-700 OHMS	11,000 OHMS						±1 DB, 25-10,000 CYCLES -3 DB AT 14,000 CYCLES	
INPUT ARRANGEMENT NO 4	45 DB		*+26 VU	4 & 6	STRAP 10 & 11	600 OHMS	0-25,000 OHMS	11,000 OHMS							
INPUT ARRANGEMENT NO 5	41 DB		*+22 VU	8 & 9	STRAP 7 & 8, STRAP 5 & 11, STRAP 6 & 12 CONNECT, STRAP 5*	600 OHMS	0-1000 OHMS	600 ± 10% OHMS (50-8000 ~)							
124C AMPLIFIER															
BRIDGING INPUT	50 DB	NONE (CONTINUOUSLY ADJUSTABLE OVER A RANGE OF 45 DB)	*-7 VU	1 & 3		600 OHMS	0-25,000 OHMS	27000 OHMS	600 OHMS	3/4 OF NOMINAL LOAD IMPEDANCE FOR ANY STRAPPING OF THE OUTPUT TRANSFORMER		43 DB (INDEPENDENT OF GAIN CONTROL SETTING)	80 DB (INDEPENDENT OF GAIN CONTROL SETTING)	±1 DB 25-5000 CYCLES +3.3 DB AT 14,000 CYCLES -2.5 DB AT 25 CYCLES -1 DB AT 100 CYCLES -4.5 DB AT 200 CYCLES -1 DB AT 500 CYCLES +1 DB AT 3000 CYCLES +2 DB AT 14,000 CYCLES	YES — SEE NOTE 3
HIGH GAIN INPUT	58 DB		*+12 VU	1 & 2		50 OHMS	0-1000 OHMS	150 OHMS							
124D AMPLIFIER															
ARRANGED TO WORK OUT OF A NOMINAL IMPEDANCE OF 30 OHMS	107 DB	CONTINUOUSLY ADJUSTABLE OVER A RANGE OF 35 DB	-67 VU WITH MAX GAIN, -32 VU WITH MIN GAIN	1 & 2		30 OHMS	15-60 OHMS	HIGH - NO TERMINATION ON SECONDARY OF INPUT TRANSFORMER	600 OHMS			78 DB WITH MAXIMUM AMPLIFIER GAIN	85 DB WITH MAXIMUM AMPLIFIER GAIN	-2 DB AT 25 CYCLES ±1 DB 30-10,000 CYCLES -2 DB AT 14,000 CYCLES	YES
ARRANGED TO WORK OUT OF A NOMINAL IMPEDANCE OF 120 OHMS	107 DB			1 & 3		120 OHMS	60-250 OHMS								
124E AMPLIFIER															
INPUT ARRANGEMENT NO 1 BRIDGING INPUT	50 DB	ADJUSTABLE IN 19 STEPS OF 2 DB PER STEP	*+23 VU	1 & 3	SEE FIG. 7	600 OHMS	0-25,000 OHMS	40,000 OHMS	75 OHMS			43 DB (INDEPENDENT OF GAIN CONTROL SETTING)	80 DB (INDEPENDENT OF GAIN CONTROL SETTING)	±1 DB, 25-10,000 CYCLES -2 DB AT 14,000 CYCLES	YES
INPUT ARRANGEMENT NO 1 HIGH GAIN INPUT	63 DB		*+5 VU	1 & 2		600 OHMS	0-1000 OHMS	1,000 OHMS							
INPUT ARRANGEMENT NO 2	30 DB		*+42 VU	5 & 6	STRAP 7 & 1, STRAP 9 & 3	600 OHMS	0-25,000 OHMS	40,000 OHMS							
INPUT ARRANGEMENT NO 3	43 DB		+22 VU	11 & 12	STRAP 7 & 1, STRAP 8 & 2	600 OHMS	0-1000 OHMS	600 OHMS							

NOTES

1 MAXIMUM INPUT LEVEL AS DETERMINED BY A VOLUME INDICATOR CONNECTED ACROSS THE INPUT TERMINALS, AND THE READING CORRECTED IN THOSE CASES WHERE THE SOURCE IMPEDANCE OR LOAD IMPEDANCE IS OTHER THAN 600 OHMS.

2 AS WIRED AT THE FACTORY. BY RESTRAPPING THE OUTPUT TRANSFORMER AS INDICATED ON FIG 3 OR ON 30-95104, THE AMPLIFIERS CAN BE ARRANGED TO GIVE SATISFACTORY OPERATION INTO A CONSIDERABLE NUMBER OF NOMINAL LOAD IMPEDANCES BETWEEN 175 AND 600 OHMS.

3 THE FREQUENCIES BELOW 1000 CYCLES ARE PURPOSELY ATTENUATED IN ORDER TO REDUCE CHEST AND BREATHING NOISES WHEN THE AMPLIFIER WORKS OUT OF AN OPERATOR'S TRANSMITTER.

\# THIS DESIGNATION "3" DOES NOT APPEAR ON THE AMPLIFIER. THE STRAP REFERRED TO IS THE ONE BETWEEN THE TWO UNNUMBERED TERMINALS ON THE RESISTANCE MOUNTING STRIP WITH A RED PAINT MARK BETWEEN THEM.

* THE INPUT PROGRAM LEVEL TO EACH OF THE AMPLIFIERS SHOULD IN ANY CASE BE LIMITED TO SUCH A VALUE THAT THAT LEVEL INCREASED BY THE GAIN OF THE AMPLIFIER FOR A GIVEN SETTING OF THE GAIN CONTROL (IF THERE IS ONE) WILL NOT EXCEED +33 VU WHEN THE AMPLIFIER IS ARRANGED FOR NORMAL OUTPUT LEVEL, OR +34 VU WHEN IT IS ARRANGED FOR HIGH OUTPUT LEVEL.

10, and 15 so designated. Each step down from the "20" position represents 2 db of attenuation. The plates on the 124C and D Amplifiers are marked with OFF at the extreme counterclockwise position and MAX at the extreme clockwise position. A mark is engraved for 19 intermediate positions with the second, fourth, sixth, etc., marks designated as 1, 2, 3, etc., up to the designation 9 which is opposite the second marked position below the MAX position.

1.12 The maximum gains of these amplifiers vary over wide limits, depending upon whether they are connected as bridging or terminating amplifiers, and upon what maximum input levels they are arranged to handle. Typical values of gains obtainable with each of the five amplifiers are given in Table 1.

1.13 The apparatus units comprising each of the five amplifiers are assembled on a depressed panel 7" high and are arranged for mounting on a standard 19" relay rack or in an apparatus cabinet. The front of the depressed panel is covered with a metal mat. The overall depth of each of the amplifiers from the rear of the mat is about 7". The mat furnished with each of the amplifiers may be obtained in any of the finishes indicated in Table 2. The number placed after the letter in the amplifier code designates the particular finish.

TABLE 2

Amplifier Code	Finish on Mat
124A-3	Rubber finish black japan
124B-3	" " " "
124C-3	" " " "
124D-3	" " " "
124E-3	" " " "
124A-15	Aluminum gray
124B-15	" "
124C-15	" "
124D-15	" "
124E-15	" "
124B-24	Aluminum lacquer
124C-24	" "

1.14 A perforated rear cover coded as the 102A Cover is available in cases where it is desirable to provide mechanical protection of the vacuum tubes and amplifier components It also acts as a protection for the plant personnel against the possibility of burns resulting from accidental contact with the tubes while the amplifier is operating. Although the 102A Cover will fit any one of the five 124-type amplifiers, it is furnished only when specified in the order.

1.15 Each amplifier alone weighs approximately 20 pounds. Equipped with a 102A Cover, this weight is increased to 23 pounds.

1.16 Either Western Electric or commercial types of vacuum tubes suitable for use in these amplifiers are available.

1.17 Detailed performance data for each of the five amplifiers operating under various conditions are shown in Table 1.

1.18 Front and rear views of the 124B Amplifier are shown in Fig. 2. The other four amplifiers are similar in appearance to the 124B except in such details as the power switch, the gain control unit and the input unit.

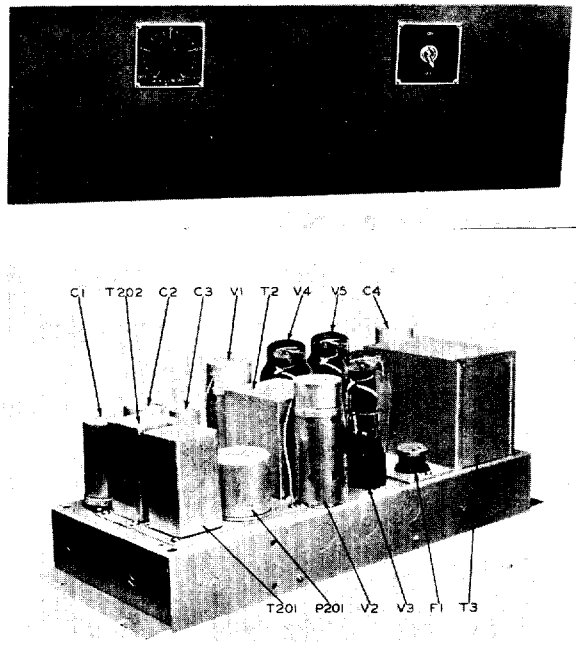


Fig. 2 - 124B Amplifier - Front and Rear Views

2. TRANSMISSION AND CIRCUIT FEATURES OF THE AMPLIFIERS

2.01 The schematic circuit diagram of the 124B Amplifier is shown in Fig. 3. The portion of the schematic to the right of the dashed "box" forms the basic circuit for all five amplifiers. The portion in the box shows the five input arrangements individual to the 124B Amplifier. Input arrangements for each of the five amplifiers will be discussed in Part 2 (B).

(A) General Features Common to All Five Amplifiers

Basic Amplifier Circuit

2.02 The amplifying part of the circuit is basically a 2-stage amplifier employing a push-pull arrangement in the final stage.

2.03 The audio frequency output from the unit that forms the input circuit of each amplifier is fed into the grid of V1 and through the condenser C1.1 to the junction of the cathodes of V1 and V2. Grid bias voltage for the amplifying tube V1 is obtained by connection of the lower end of the input circuit output to the grounded end of the cathode resistance R2. V2 is a phase inverter tube whose sole function is to provide, in conjunction with V1, a balanced arrangement for driving the push-pull second stage (V3 and V4). To its grid is applied the voltage drop across R9 through which flows the difference between the output currents of V1 and V2. This feedback arrangement results in automatically adjusting the output voltage of V2 so as to be approximately equal to, and 180° out of phase with, the output voltage of V1.

First Stage Tube Connections and Interstage Circuit

2.04 The suppressor grid of each of the first stage tubes is connected to its cathode. The screen grid of V1 is connected to one end of the resistance R4 and the screen grid of V2 connected to the other end of R4.

2.05 The interstage circuit consists essentially of resistance coupling through the plate resistances R5 and R6 which feed plate battery to V1 and V2, the coupling condensers C5 and C6, and the grid resistances R7 and R8.

Second Stage Tube Connections

2.06 The control grid of each tube obtains its bias voltage by connection to the grounded side of the resistance R10.1. Each of the deflector plates is connected to its own cathode. Each screen grid is kept to a potential of about 250 volts above ground by its connection to the junction of R11 and R15.2 in the power supply section of the amplifier.

Output Circuit

2.07 The plate voltage to the second stage tubes is supplied through the midpoint of the primary of the output transformer T2. The ends of this primary winding are connected directly to the plates of V3, V4. Condensers C7, C11 and resistance R12 form a protective network to guard against high frequency surges with an attendant possible breakdown of the final stage tubes. As this network tends to reduce somewhat the amplifier gain at the higher frequencies, the capacitance C10 has been provided in the feedback circuit to compensate for this and thus bring the overall gain at the various frequencies to within the required limits. The values of plate voltage for both normal and high level amplifier outputs (see Paragraph 4.03) depend upon the type of rectifier tube that is employed. If a Western Electric 274B Vacuum Tube is used, the plate to ground voltage for the standard output will be about 375 volts and for the high level output will be about 410 volts. If a 5T4 or 5U4G rectifier tube is substituted the corresponding plate voltages will be 400 and 430 volts.

2.08 There are four secondary windings on the output transformer which may be connected in a number of ways so that each of the amplifiers can be arranged for operation into a considerable number of nominal load impedances between 1.75 and 600 ohms. A table appearing on the schematic Fig. 3 shows the output transformer strapping for each load impedance. The output impedance of the amplifier, as seen looking back into it from the output terminals 13 and 14, is about 3/4 of the nominal load impedance for any particular transformer strapping. The 124B Amplifier makes use of an additional pair of terminals 16 and 17 (which appear on all the 124-type amplifier chassis but are wired in the output circuit only in the 124B), each of which has connected between it and the output transformer a 75-ohm resistance so that when the transformer is connected for a 600-ohm load the impedance looking back into those terminals will also be 600 ohms.

Feedback Circuit

2.09 Referring to the schematic, Fig. 3, the main feedback circuit has two paths. One path is from the plate of V3 through the resistance R13, the capacitance C9 and the resistance R3. The other path is from the plate of V4 through the resistance R14, the capacitance C8 and the resistance R4. Capacitances C8 and C9 also provide low frequency equalization permitting a less expensive input transformer to be employed. The equalization amounts to about 1.5 db at 35 cycles. The first feedback path connects to the cathode of V1 and the second to the screen of V1 in order to obtain the proper phase relation and also to neutralize any power ripple that might be fed back. The feedback amounts to between 6 and 8 db and results in a lower output impedance over the audio frequency range as seen looking back into the output terminals of the amplifier, as well as a stabilized and improved amplifier characteristic. In addition, V1 has local feedback by virtue of R3 and R4, and V2 has local feedback by virtue of R9. The local feedback circuit as affecting V1 exists automatically due to the resistances R3 and R4 being a part of the main feedback circuit. The local feedback circuit as affecting V2 exists automatically due to the resistance R9 being a part of the main feedback circuit.

Vacuum Tube Arrangements

2.10 The tubes used in the amplifying circuits of the 124-type amplifiers are of the 6.3 volt heater type. The heaters of the

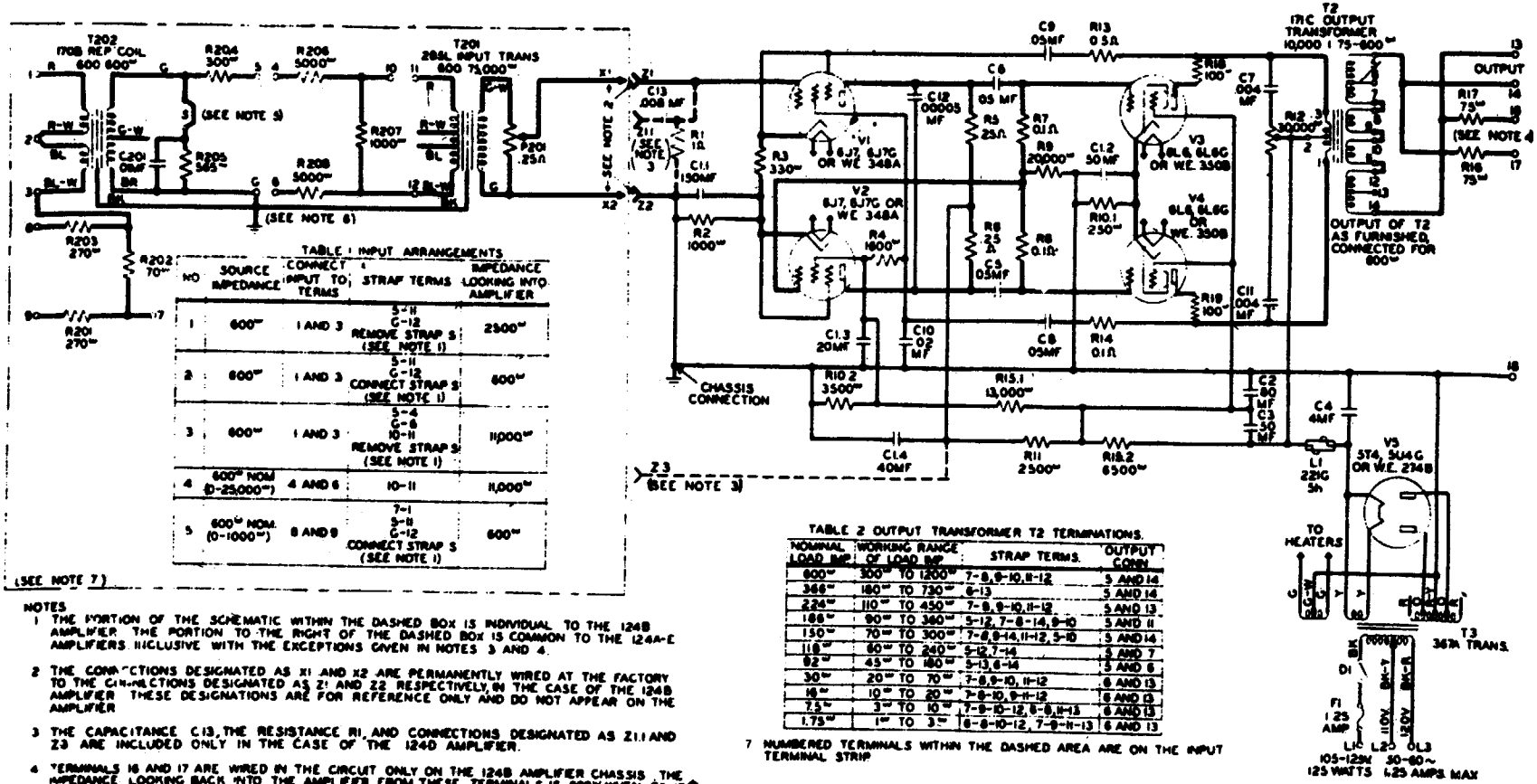


TABLE 1 INPUT ARRANGEMENTS

NO	SOURCE IMPEDANCE	CONNECT INPUT TO TERMS	STRAP TERMS	IMPEDANCE LOOKING INTO AMPLIFIER
1	600W	1 AND 3	5-11 C-12 REMOVE STRAP S (SEE NOTE 1)	2500W
2	600W	1 AND 3	5-11 C-12 CONNECT STRAP S (SEE NOTE 1)	600W
3	600W	1 AND 3	5-4 C-8 10-11 REMOVE STRAP S (SEE NOTE 1)	11,000W
4	600W NOM (0-25,000W)	4 AND 6	10-11	11,000W
5	600W NOM. (0-1000W)	8 AND 9	7-11 5-11 C-12 CONNECT STRAP S (SEE NOTE 1)	600W

TABLE 2 OUTPUT TRANSFORMER T2 TERMINATIONS

NOMINAL LOAD IMP.	WORKING RANGE OF LOAD IMP.	STRAP TERMS.	OUTPUT CONN.
600W	300W TO 1200W	7-8,9-10,11-12	5 AND 14
366W	180W TO 730W	8-13	5 AND 14
224W	110W TO 450W	7-8,9-10,11-12	5 AND 13
186W	90W TO 360W	5-12, 7-8-14, 9-10	5 AND 11
150W	70W TO 300W	7-8,9-14,11-12, 5-10	5 AND 14
118W	60W TO 240W	5-12,7-14	5 AND 7
82W	45W TO 180W	5-13,8-14	5 AND 6
30W	20W TO 70W	7-8,9-10, 11-12	6 AND 13
18W	10W TO 20W	7-8-10, 9-11-12	6 AND 13
7.5W	3W TO 10W	7-9-10-12, 8-8,11-13	6 AND 13
1.75W	1W TO 3W	8-8-10-12, 7-9-11-13	6 AND 13

NOTES

1 THE PORTION OF THE SCHEMATIC WITHIN THE DASHED BOX IS INDIVIDUAL TO THE 124B AMPLIFIER. THE PORTION TO THE RIGHT OF THE DASHED BOX IS COMMON TO THE 124A-E AMPLIFIERS INCLUSIVE WITH THE EXCEPTIONS GIVEN IN NOTES 3 AND 4.

2 THE CONNECTIONS DESIGNATED AS X1 AND X2 ARE PERMANENTLY WIRED AT THE FACTORY TO THE CONNECTIONS DESIGNATED AS Z1 AND Z2 RESPECTIVELY, IN THE CASE OF THE 124B AMPLIFIER. THESE DESIGNATIONS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON THE AMPLIFIER.

3 THE CAPACITANCE C13, THE RESISTANCE R1, AND CONNECTIONS DESIGNATED AS Z1.1 AND Z3 ARE INCLUDED ONLY IN THE CASE OF THE 124D AMPLIFIER.

4 TERMINALS 16 AND 17 ARE WIRED IN THE CIRCUIT ONLY ON THE 124B AMPLIFIER CHASSIS. THE IMPEDANCE LOOKING BACK INTO THE AMPLIFIER FROM THESE TERMINALS IS 600W WHEN T2 IS CONNECTED FOR A 600W LOAD.

5 A STRAP IS WIRED BETWEEN THESE TWO TERMINALS AT THE FACTORY AND MUST BE REMOVED WHEN INPUT ARRANGEMENT 1 OR 3 IS EMPLOYED. THESE TERMINALS ARE NOT NUMBERED BUT APPEAR ON THE RESISTANCE MOUNTING STRIP WITH A RED PAINT MARK BETWEEN THEM.

6 TERMINAL G IS PERMANENTLY WIRED TO THE CHASSIS AT THE FACTORY. THIS TERMINAL SHOULD BE CONNECTED TO AN EXTERNAL GROUND WHEN THE AMPLIFIER IS INSTALLED.

7 NUMBERED TERMINALS WITHIN THE DASHED AREA ARE ON THE INPUT TERMINAL STRIP.

Fig. 3 - 124B Amplifier - Schematic Circuit Diagram

four amplifier tubes (5 in the case of the 124D) are wired in parallel and are connected to the 6.3 volt winding, (green leads) of the power transformer T3. Either commercial or Western Electric types of tubes suitable for use in the amplifier are available. The commercial tubes may be had in either the glass or metal variety (with the exception of the 1612 tube used in the 124D Amplifier which is available only as a metal tube). The Western Electric tubes are of the glass type.

2.11 The expected life of the Western Electric tubes is about four times that of their commercial counterparts when the normal audio power output is employed. When the high level output is used, decreased service life of the commercial power tubes may be experienced as discussed in Paragraph 4.03.

2.12 A filamentary type of rectifier tube is specified and it too is available as a glass or metal tube in the commercial variety and as a glass envelope Western Electric tube. It is preferable to employ a glass type tube for the rectifier whether a commercial or Western Electric tube is chosen.

2.13 The code numbers, quantity and designation are given in Table 3 for the amplifier and rectifier tubes required.

TABLE 3

Type	Quantity	Designation
6J7 or 6J7-G or WE 348A	2	V1, V2
6L6 or 6L6-G or WE 350B	2	V3, V4
5T4 or 5U4-G or WE 274B	1	V5
*1612 (no WE counterpart)	1	V1 (in the 116B Amplifier)

* Used only in the 124D Amplifier.

Caution: The operating personnel should be warned against handling the vacuum tubes while the amplifier is in operation, due to the danger of burns, particularly in the case of the rectifier and final stage amplifier tubes. While the glass tubes do not become as hot as the metal tubes either type may become a hazard if touched after the amplifier has been operating for some time.

2.14 None of the amplifiers should be operated with a mixed complement of Western Electric and non-Western Electric amplifier tubes (with the exception of the 1612 tube which is employed in the first stage of the 124D Amplifier and must be used regardless of the type of tubes employed elsewhere in this amplifier). However, Western Electric amplifier tubes may be used in an amplifier employing a non-Western Electric rectifier tube or vice versa.

2.15 The first stage tubes in the 124-type amplifiers are equipped with individual shields so that either glass or metal tubes may be employed with the assurance of stable operation and freedom from high frequency oscillation. When metal tubes are used these shields are not required unless the amplifier is exposed to high external electric fields.

Grounding Arrangements

2.16 The following points of the amplifier are connected to the terminal marked "G" for external grounding: The lower side of the secondary winding of the input transformer in the 124A, B, C and E Amplifiers; the lower side of the secondary winding of the repeating coil in the 124B Amplifier, and the cathode (through a 40 mf condenser C2.1) of the tube in the preliminary 116B Amplifier that forms a part of the 124D Amplifier. The chassis of the amplifier is also connected to the "G" terminal. In addition, the mid-point of the primary winding of the repeating coil in the 124B Amplifier is brought out to terminal 2 so that it may be connected to ground if desirable from a noise standpoint.

Caution: If the 124B Amplifier is employed in a reversible program circuit and it is desirable to ground the mid-point of the primary winding of the repeating coil, an external 2 mf condenser should be connected between that mid-point (amplifier terminal 2) and the actual ground connection.

Noise

2.17 With any of the five 124-type amplifiers adjusted for maximum gain, the input terminated in the nominal impedance out of which that amplifier is designed to operate, and the output terminals connected to the load impedance for which the output transformer is strapped, the noise at the output terminals should not be higher than the figures given in Table 4.

TABLE 4

Amplifier	Noise in db Above Reference Noise With Program Weighting (Using 2 Type Noise Measuring Set or 4B Weighting Network)	Unweighted
124A, B C and E	45	60
124D	76	85

2.18 The noise at the output terminals of the 124B, C and E Amplifiers is independent of the gain control settings. The noise at the output of the 124D Amplifier becomes about equal to that at the output of any of the other 124-type amplifiers when its gain is decreased to a value about equal to the maximum gain of the other four amplifiers.

2.19 When any of the 124-type amplifiers is used as a line amplifier operating at or near zero vu level, the gain and output capacity will be in excess of that normally required and the ratio of signal-to-amplifier noise may be improved by the use of a pad between the amplifier output terminals and its load (with the pad located near the amplifier).

(B) Special Features Individual to Each of the Five Amplifiers

124A Amplifier

2.20 This amplifier is a fixed gain amplifier. Its input circuit is shown in Fig. 4 and consists essentially of the input transformer T101, series resistances R102 and

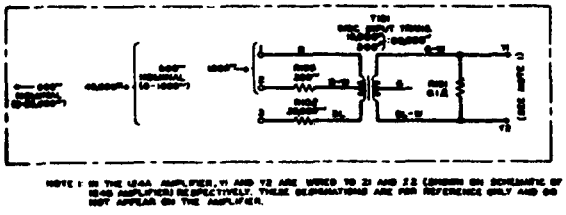


Fig. 4 - 124A Amplifier - Input Arrangement

R103 in the primary circuit and a shunt resistance R101 across the secondary. The two series resistances are included to permit the amplifier to operate out of a wide variety of source impedances with little or no effect on the frequency characteristic. The shunt resistance was chosen to have a value such as to give the most uniform high frequency amplifier characteristic commensurate with the amplifier gain requirements. This amplifier may be connected for use either as a bridging or a high gain terminating amplifier with characteristics as indicated in Table 1.

124B Amplifier

2.21 This amplifier is equipped with a gain control adjustable in 19 steps of 2 db attenuation per step from the maximum gain. Referring to the schematic shown on Fig. 3 the input circuit consists essentially of a repeating coil T202; an input transformer T201; a gain control potentiometer P201; a low impedance 20 db U-type pad composed of the resistances R201, R202, R203; a high impedance 20 db U-type pad composed of the resistances R206, R207, R208; a series building-out resistance R204; and a resistance R205 and a capacitance C201 bridged across the secondary of the repeating coil T202. (This resistance-capacitance combination is wired across T202 at the factory so that the amplifier as received will have a 600-ohm input impedance.) The capacitance C201 is provided in order that the impedance looking into the amplifier with input arrangement No. 2 will be 600 ohms + 10 per cent. over the range of 50-8000 cycles. There are five different input arrangements provided for this amplifier, the one to be chosen depending upon the type of service in which the amplifier will be employed and the maximum input levels which may be encountered. Each input arrangement is shown on the schematic Fig. 3 and each will be discussed in some detail below.

Input Arrangement No. 1

2.22 Intended for use in applications such as loud speaker monitoring where high input levels will not be encountered (the 124B operating, for example, out of the monitoring winding of a line amplifier), where high gain is desired and where it is not essential that the impedance looking into the amplifier shall match the source impedance. Makes use of the repeating coil T202 in order to meet longitudinal balance requirements but has the termination across the secondary of the repeating coil removed in order to realize maximum gain.

Input Arrangement No. 2

2.23 Intended for use as a loud speaker monitoring amplifier in applications where it operates out of a low level bridge or, in special applications, as a line amplifier in short regional networks for medium quality service or as a temporary or emergency amplifier in major network service, where high input levels will not be encountered, where a moderately high gain is desired, and where it is required that the impedance looking into the amplifier shall match the source impedance. Makes use of repeating coil T202 with the resistance R205 and capacitance C201 connected across the secondary winding in order to meet longitudinal balance requirements and provide an impedance of 600 ohms looking into the amplifier input terminals.

Input Arrangement No. 3

2.24 Intended for use as a bridging amplifier (11,000 ohms input) in applications such as the one in which it is connected across an incoming 600-ohm program circuit where high input levels will not be encountered. Makes use of the repeating coil T202 to meet longitudinal balance requirements but has the termination across the secondary of this coil removed in order that the amplifier may present a high impedance to the source.

Input Arrangement No. 4

2.25 Intended for use as a bridging amplifier (11,000 ohms input) in applications such as the one in which it is connected across an outgoing program circuit or program bus where high input levels may be encountered. The repeating coil T202 is not employed in this arrangement and consequently the input circuit does not have the same degree of balance from the longitudinal standpoint as in the first three arrangements. It does, however, make use of a high impedance 20 db pad in order that high levels may be connected to the amplifier input and at the same time the amplifier may present a high impedance to the source.

Input Arrangement No. 5

2.26 Intended for use as a loud speaker monitoring amplifier in applications where it is required that the impedance looking into the amplifier shall be 600 ohms and where high input levels may be encountered, such as the application in which it operates out of a high level bridge associated with the 14C program amplifier. Makes use of the repeating coil T202, and the terminating resistance R205 and capacitance C201 in order to meet longitudinal balance and input impedance requirements. This arrangement also employs the low impedance 20 db U-type pad between the input terminals of the amplifier and the input to the repeating coil so that the maximum level across the input of the coil will be no higher than in arrangements 1, 2 and 3 above.

124C Amplifier

2.27 This amplifier may be employed either as a terminating or a bridging amplifier in applications where a carbon transmitter source is required. Referring to Fig. 5, its input circuit consists essentially of the input transformer T301, the series resistance R302,

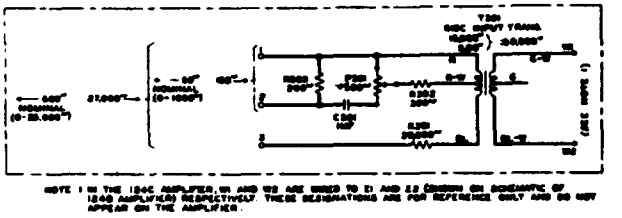


Fig. 5 - 124C Amplifier - Input Arrangement

a shunt resistance R303, a series capacitance C301, the gain control potentiometer P301 and the building-out resistance R301. The network composed of R303, C301 and P301 attenuates the frequencies below 1000 cycles (see Table 1 for details) in order to reduce chest and breathing noises when the amplifier with its high gain input works out of an operator's transmitter.

124D Amplifier

2.28 This amplifier is a high gain amplifier presenting a very high impedance to the source and equipped with a gain control continuously adjustable over a range of 35 db.

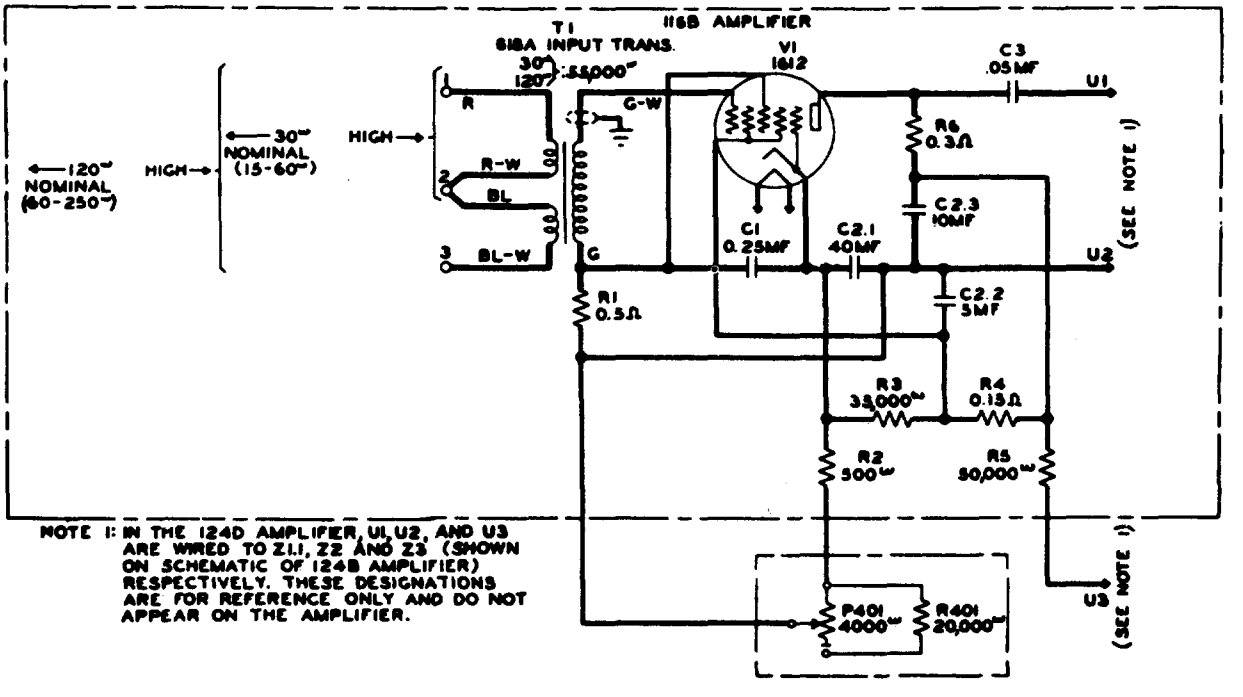
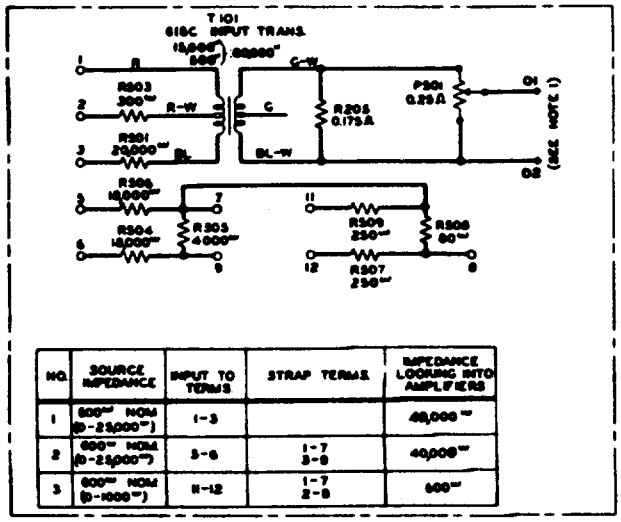


Fig. 6 - 124D Amplifier - Input Arrangement

Referring to Fig. 6, the input circuit consists essentially of a coded 116B Amplifier which forms an integral part of the 124D Amplifier and is mounted on its chassis. A shunt resistance R1, a gain control potentiometer P401 with its associated resistance R401 and capacitance C13, are also included. This condenser is provided in order to prevent a surge of current, due to the rapid operation of the gain control on the 116B Amplifier, from affecting the grid bias of V1 in the main amplifier to such an extent as to block it. The 116B Amplifier is a single tube, single stage amplifier having a 1000-cycle maximum gain of approximately 40 db.

124E Amplifier

2.29 This amplifier is equipped with the same kind of gain control (adjustable in 19 steps of 2 db attenuation per step from the maximum gain) as in the 124B Amplifier but does not include a repeating coil as this amplifier (124E) is not intended to work out of a telephone circuit, either message or program. Referring to Fig. 7, the input circuit consists essentially of: a low impedance 20 db U-type pad composed of resistances R507, R508, R509; a high impedance 20 db U-type pad composed of resistances R504, R505, R506; the series resistances R501 and R503; the input



NO.	SOURCE IMPEDANCE	INPUT TO TERMS	STRAP TERMS	IMPEDANCE LOOKING INTO AMPLIFIERS
1	600W NOM (0-25000W)	1-3		40,000W
2	600W NOM (0-25000W)	5-6	1-7 5-8	40,000W
3	600W NOM (0-1000W)	11-12	1-7 2-8	600W

NOTE 1: IN THE 124C AMPLIFIER, 01 AND 02 ARE WIRED TO Z1 AND Z2 (SHOWN ON SCHEMATIC OF 124B AMPLIFIER) RESPECTIVELY. THESE DESIGNATIONS ARE FOR REFERENCE ONLY AND DO NOT APPEAR ON THE AMPLIFIER.

Fig. 7 - 124E Amplifier - Input Arrangement

transformer T501; the gain control potentiometer P501; and the resistance R502 bridged across the secondary of the transformer. There are three different input arrangements provided for this amplifier, the one chosen depending upon the type of service in which the amplifier will be employed and the maximum input levels which may be encountered.

Input Arrangement No. 1

2.30 Intended for use in applications such as public address systems, music distribution systems or as a loud speaker amplifier for broadcast studio control rooms or audition rooms where high input levels will not be encountered, where high gain is desired (the amplifier input connected, for example, to the monitoring circuit of a preliminary amplifier) and where it is not essential that the impedance looking into the amplifier shall match the source impedance.

Input Arrangement No. 2

2.31 Intended for use in applications such as public address systems, music distribution systems, or as a loud speaker amplifier for broadcast studio control rooms or audition rooms where a bridging amplifier is required and where high input levels may be encountered (the amplifier input connected, for example, across a high level 8 or 600-ohm program bus). This arrangement is similar to the No. 1 input arrangement just described except that the high impedance U-type pad is connected between the amplifier input and the primary of the input transformer.

Input Arrangement No. 3

2.32 Intended for use in applications such as public address systems, music distribution systems or as a loud speaker amplifier for broadcast studio control rooms or audition rooms, where it is required that the impedance looking into the amplifier shall be 600 ohms and where high input levels may be encountered (the amplifier input connected, for example, to one of the high level outputs of a 600-ohm program bridge). Makes use of the low impedance 20 db U-type pad between the input to the amplifier and the primary of the transformer T501.

3. INSTALLATION

(A) Mounting

3.01 These amplifiers may be mounted either vertically or horizontally in a relay rack or on a shelf or in an apparatus cabinet.

(B) Noise Pickup

3.02 The noise pickup in one 124-type amplifier due to another 124-type amplifier operating close to it will be negligible if the nearest sides of the amplifiers are separated by at least 7 inches. No particular vertical separation is required other than that necessary for ventilation (see Paragraph 3.05).

3.03 Due to the use of a shielded power transformer in each of the 124-type amplifiers, the noise pickup from any one into a

12 or 14-type program amplifier mounted in the same or adjacent bay will be negligible. A separation of at least 18 inches in any direction between a 124-type amplifier and a 44A1 or D91220 Repeater is required.

3.04 The input transformer in each of the 124-type amplifiers is shielded against electromagnetic pickup by a case of high permeability magnetic material. Due to the presence of this shield, no appreciable magnetic pickup will ordinarily be encountered in any of the amplifiers if it is mounted so that its input transformer is more than about 3 inches distant from disturbing sources of power equipment of the type likely to be found in program or message bays. In special cases where such exposure can not be avoided, it may be possible to obtain some reduction in noise by rotating the input transformer (except in the case of the 124B Amplifier where both the repeating coil and input transformer are permanently fastened to the chassis) until the point of minimum pickup is reached as determined by a noise measuring set connected across the amplifier output terminals.

(C) Ventilation

3.05 When one of these amplifiers is mounted on a relay rack, one space (1-3/4") should be left between the top of the amplifier and the nearest piece of equipment above for ventilation. When mounted on a partially closed shelf or in a perforated metal cabinet, however, 50 square inches of opening to free air near the bottom of the amplifier and a similar area provided above the amplifier is usually required and at least one space (1-3/4") provided between the top of the housing and the nearest part of the amplifier.

3.06 If additional 124-type amplifiers are mounted on the same bay or in the same apparatus cabinet, proportionally increased ventilation will be required, and amplifiers or other apparatus units should be separated at least 3-1/2 inches from the top of any one of the 124-type amplifiers.

3.07 In any case, a test of sufficient ventilation will be that the air temperature 1 inch above the center of the power transformer surface (which is in the upper left-hand corner as one faces the rear of the amplifier) is not greater than 30° F. above the room temperature after the amplifier has been operated four hours.

(D) Wiring

3.08 In order to avoid noise pickup in the input leads, 500 CL Cable (using one pair only of the two quads that make up the cable) is employed for the input wiring to the 124-type amplifiers. The unused pairs and the metal tape surrounding the quads are left floating at both ends of the cable.

3.09 500 CL Cable (using one pair only of the two quads that make up this cable) is also employed for the output wiring from the 124-type amplifiers, the unused pairs and the metal tape surrounding the quads being left floating at both ends of the cable.

4. AMPLIFIER OPERATING ADJUSTMENTS

(A) Line Voltage

4.01 If the a-c power supply at a given amplifier location is within the range of 105-115 volts, the supply is connected to terminals L1 and L2 on the terminal strip associated with the power transformer T3; if it is within the range of 115-125 volts, the supply is connected to terminals L1 and L3.

(B) Vacuum Tubes

4.02 With the a-c supply connected to the proper terminals of the power transformer T3 as explained in Paragraph 4.01, the heater currents for the amplifier tubes should be satisfactory and with those currents within the correct operating limits the grid potentials and plate currents should in general be correct. Therefore, no other power supply adjustments are provided. The amplifier performance as detailed in Table 1 assumes that the tubes are satisfactory as regards cathode activity.

(C) Power Output (Audio)

4.03 The power output is adjusted in accordance with circuit order or other instructions which may, when necessary, be issued to the field. If the normal audio frequency output of 11.5 watts with 1 per cent. total harmonic content is specified, the orange leads from T3 are connected to the plate terminals of vacuum tube socket VS5 and the red leads taped and pushed out of the way (the amplifiers are wired this way at the factory). If the higher audio output of 14 watts with 1 per cent. total harmonic content is specified, the orange leads are removed from the plate terminals of VS5, their ends taped and moved out of the way and the red leads substituted. The red leads are connected to the ends of the high voltage secondary winding of T3 so that the maximum potential difference exists between them. The orange leads are connected to taps, part way in from either end of the high voltage winding, and consequently have a lower potential across them. Use of an increased plate voltage to obtain higher audio frequency outputs from the amplifiers may result in decreased life of the final stage 616 or 616-G tubes for they will then be operated somewhat in excess of their rated maximum power. If Western Electric tubes are employed, satisfactory life should be obtained under both high power and normal audio frequency output conditions.

(D) Input Arrangements

4.04 Connect as called for on circuit order or other instructions which may be issued to the field.

5. ASSOCIATED DRAWING - NOT ATTACHED

Title	Drawing No.
Common Systems 124B Amplifier Circuit for Program Transmission and Other Uses	SD-95104-01

6. PARTS LIST

6.01 The item designations shown on Table 6 are those indicated on the input arrangement drawings, Paragraphs 2.20, 2.27, 2.28 and 2.29, for the 124A, C, D (only the gain control arrangement) and E Amplifiers, respectively, and those indicated for the 124B Amplifier on the schematic Fig. 3.

TABLE 6

Item	Description
C1	Mallory Type FP 4 Sec. Condenser (40 mf 450 Vᴐ) (50 mf 150 Vᴐ) (20 mf 150 Vᐃ) (150 mf 25 V)
C2	80 mf Mallory Type FP Cond. 450V
C3	50 mf Mallory Type FP Cond. 350V
C4	4 mf Cornell-Dubilier Cond. Cat. No. TLA-6040, 600V
C5) C6)	0.05 mf Cornell-Dubilier Cond. Cat. No. TVC 6S5-6
C7	0.004 mf Cornell-Dubilier Cond. Cat. No. 4-6D4
C8) C9)	0.05 mf Cornell-Dubilier Cond. Cat. No. TVC-6S5-4
C10	0.02 mf Cornell-Dubilier Cond. Cat. No. TVC-6S2-4
C11	0.004 mf Cornell-Dubilier Cond. Cat. No. 4-6D4
C12	0.00005 mf Cornell-Dubilier Cond. Cat. No. 5W-5Q5
C13	0.008 mf Cornell-Dubilier Cond. Cat. No. 1W-5D8
C201	0.01 mf Cornell-Dubilier Cond. Cat. No. 1W-5S1
C301	1 mf 141A Cond.
D1	No. 20992 H & H Switch
F1	D-106 Fuse Receptacle 1.25 Amp. Fustat
P201	IRC Type A21 Attenuator Pot. Ckt. 0.25Ω 19 Steps, 2 db per step
P301	500 IRC Pot. Type CS, Curve C
P401	4000 IRC Pot. Type CS, Curve A
P501	IRC Type A21 Attenuator Pot. Ckt. 0.25Ω 19 Steps, 2 db per step
R1	1Ω)
R2	1000ω)
R3	330ω)
R4	1600ω)
R5	0.25Ω) IRC BT-1/2 Resistors
R6	0.25Ω)
R7	0.1Ω)
R8	0.1Ω)
R9	20,000ω)
R10	3750ω IRC MW4 Resistor with tap at 250ω
R11	2500ω IRC BT-1/2 Resistor
R12	30,000ω IRC EM Resistor with center tap
R13	0.5Ω) IRC BT-1 Resistors
R14	0.1Ω)
R15	19,500ω IRC MW Resistor with tap at 6500ω
R16) R17)	75ω IRC BW2 Resistors
R18) R19)	100ω IRC BW-1/2 Resistors
R101	0.1Ω)
R102	20,000ω) IRC BT-1/2 Resistors
R103	300ω)
R201	270ω 1 pair of IRC BW-1/2 Resistors matched in series to equal 270ω + 1%
R202	60ω 1 pair of IRC BW-1/2 Resistors matched in parallel to equal 60ω + 1%
R203	270ω 1 pair of IRC BW-1/2 Resistors matched in series to equal 270ω + 1%
R204	300ω IRC BT-1/2 Resistor
R205	565ω 1 pair of IRC BW-1/2 Resistors matched in series to equal 565ω + 1%
R206	5000ω)
R207	1000ω)
R208	5000ω) IRC BT-1/2 Resistors
R301	20,000ω)
R302	300ω)
R303	200ω IRC BT1 Resistor
R401	20,000ω)
R501	20,000ω)
R502	0.175Ω)
R503	300ω)
R504	18,000ω) IRC BT-1/2 Resistors
R505	4000ω)
R506	18,000ω)
R507	250ω)
R508	80ω)
R509	250ω)

TABLE 7

116B Amplifier

Item	Description
C1	0.25 mf Cornell-Dubilier Cond. Type ZB 400V
C2	Mallory Type FP Cond. (10 mf 400 V□) (5 mf 300 V△) (40 mf 25 V-)
C3	0.05 mf Cornell-Dubilier Cond. Type TVC-4S5-4
R1	0.5Ω
R2	500ω
R3	35,000ω
R4	0.15Ω
R5	50,000ω
R6	0.3Ω

R1–R6: IRC BT-1/2 Resistors

6.02 The item designations shown on Table 7 are those indicated on the 116B Amplifier schematic on the input arrangement drawing for the 124D Amplifier shown in Paragraph 2.28.

6.03 When an amplifier part as shown on the standard drawing differs from the corresponding part as indicated in Table 6 or 7, the part shown on the standard drawing shall be considered to be the correct one.