

992606-0002

DATATAPE<sup>®</sup>

**13-542**

***DIRECT RECORD AMPLIFIER***

**OPERATION AND MAINTENANCE MANUAL**

INSTRUMENTS DIVISION

360 Sierra Madre Villa, Pasadena, California 91109



**BELL & HOWELL**

This manual describes the operation and maintenance procedures for the Type 13-542 Direct Record Amplifier, with serial numbers 2001 through 2999.

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SECTION I

GENERAL DESCRIPTION

1-1. GENERAL.

1-2. This manual describes the Bell & Howell 13-542 Direct Record Amplifier and its application as a component of a Bell & Howell record/reproduce system. It requires no modification for use over the entire range of bandwidths from 50 Hz to 2.0 MHz. Bandwidth limiting, as desired, is accomplished at the channel's reproduce amplifier.

1-3. FUNCTION AND USE.

1-4. In direct recording, the amplitude/time relationship of the data input signal is recorded directly on magnetic tape after being added to a high frequency bias signal. The 13-542 Direct Record Amplifier scales the data signal to the required amplitude and then feeds that signal to the Type 13-540A Record Head Driver Amplifier which is located near the record heads. The record head driver amplifier amplifies the bias signal and combines it with the data signal.

1-5. GENERAL EQUIPMENT DESCRIPTION.

1-6. The 13-542 Direct Record Amplifier, although composed of relatively few parts, is constructed on the same size of printed wiring board as other types of record and reproduce amplifiers for this record/reproduce system. It is installed in card guides in the Type 13-505 Amplifier Mounting Assembly. As explained in Section II of the record/reproduce system manual, various combinations of direct record and FM record channels can be implemented by a simple change of plug-in amplifiers. The bias signal for a given channel is automatically suppressed when an FM record amplifier is plugged into a record position.

1-7. PERFORMANCE CHARACTERISTICS.

1-8. Typical performance characteristics for the 13-542 Direct Record Amplifier are given in table 1-1.

ITEM	CHARACTERISTIC
Input Level	0.15 to 15.0 volts p-p to produce normal record level via input potentiometer control. Input power not to exceed 0.5 watt.
Input Impedance	75 ohms standard. May be easily converted to any value between 50 and 10K ohms. Shunt capacity 20 picofarads maximum.
Bias Frequency	8 MHz.
Bandwidth	50 Hz to 2.0 MHz.
Input Power	25 ma at +15 vdc and 25 ma at -15 vdc from power supplies in the tape transport.

Table 1-1. Typical Performance Characteristics of the 13-542 Direct Record Amplifier



## SECTION II

### INSTALLATION

#### 2-1. GENERAL.

2-2. The 13-542 Direct Record Amplifiers are positioned vertically in card guides within the 13-505 Amplifier Mounting Assembly. Card guide positions, numbered left to right, correspond to record/reproduce channel numbers. See Section II of the record/reproduce system manual for channel installation and system structuring information.

#### 2-3. AMPLIFIER CARD INSTALLATION.

**CAUTION**

Turn system power OFF before installing or removing amplifier cards from mounting assembly.

2-4. All electrical connections to the amplifier are complete when the card is placed, pin end first, into the card guides and the connector pins on the amplifier card are mated with the connector socket in the mounting assembly. When the card is installed, the controls needed for calibration are accessible on the front of the card. A printed wiring board extractor is mounted near the upper edge of the card to facilitate its removal from the mounting assembly. An extender card is needed only for troubleshooting.

#### 2-5. AMPLIFIER CARD PREPARATION.

2-6. Prior to installation, the amplifier cards should be inspected visually for impact damage, loose parts, moisture, corrosion, dust particles, and for any other condition which may impair the life of the amplifier or otherwise degrade its performance. In the event an undesirable condition is found, see paragraph 5-22 of this manual before proceeding with repairs.





SECTION III  
OPERATION

3-1. GENERAL.

3-2. Once the 13-542 Direct Record Amplifier is installed and set up as part of a system, it operates as part of the system; there are no operating procedures for the record amplifier alone.

3-3. Calibration procedures for the record amplifier are given in Section V of this manual.



SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

4-2. Most of the energy required to do wide band recording in the direct mode must come from the bias signal source, leaving a relatively simple task to be performed by the direct record amplifier. Figure 4-1 illustrates the manner by which the data signal and the bias signal are added to one another at a point which is in close proximity to the record head.

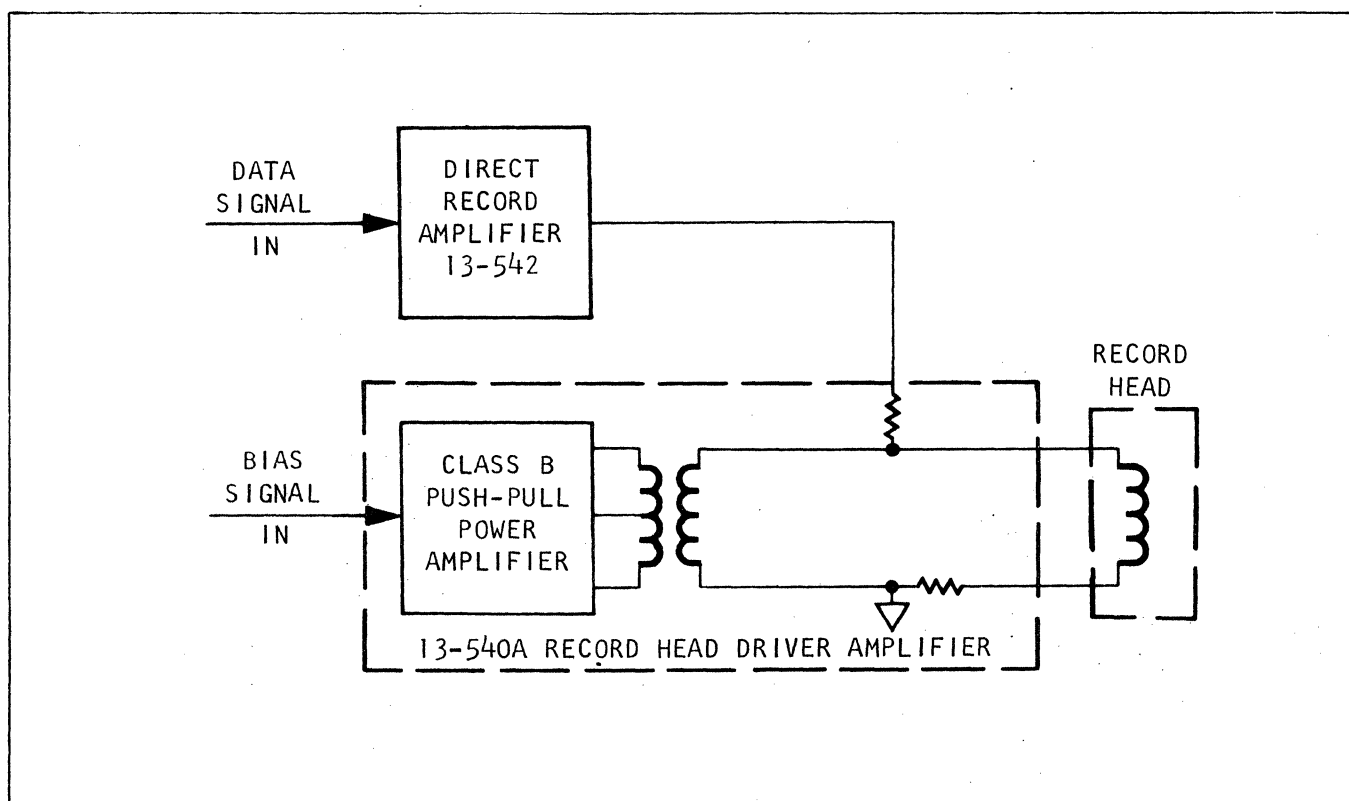


Figure 4-1. Block Diagram, Direct Record System

4-3. The complete schematic of the 13-542 Direct Record Amplifier appears in figure 7-1. Its circuit contains only four transistors, two of which are used in the output stage as a complementary emitter follower. In the absence of a RECORD command from the transport control panel, contacts of relay K1 shunt the output of the emitter follower to ground.

4-4. Variable resistor R2 serves as the data signal input attenuator, or RECORD LEVEL control. From resistor R2, the data signal is fed directly to the base of transistor amplifier Q1. The inverted output from the collector of Q1 is sent to the base of Q2. Transistor Q2 again inverts the data signal and drives complementary emitter follower Q3-Q4. The output of the complementary emitter follower is ac coupled through C8, C9, and normally open contacts of relay K1 to the amplifier output pin. Degenerative feedback is provided from the complementary emitter follower to transistor amplifier Q1 through R10 and C3.

4-5. Preemphasis is provided to compensate for high frequency record head losses. This preemphasis is accomplished by series-parallel circuit R5, C11, and R15, which reduces the degenerative feedback at high frequencies.

4-6. Variable resistor R9 is used to control the gain of the bias amplifier for this channel, in the 13-540A Record Head Driver Amplifier. In the adjustment procedures, this adjustment is referred to as the BIAS LEVEL control.

4-7. Inductors L1 and L2, in conjunction with capacitors C6 and C7, are connected in the +15 vdc and -15 vdc power circuits, respectively, to decouple the data signal from the power supply.

## SECTION V

## CALIBRATION AND MAINTENANCE

## 5-1. GENERAL.

5-2. The maintenance section for the direct record amplifier is presented in three parts: preventive maintenance, calibration, and troubleshooting and corrective maintenance.

## 5-3. PREVENTIVE MAINTENANCE.

5-4. Preventive maintenance consists of general cleaning and periodic inspection. Accumulation of dust, dirt, grit, and/or grease on the circuit boards is harmful and should be guarded against by periodic inspection and cleaning. Every six months, under normal laboratory conditions, inspect the units for signs of deterioration, loose connections, insecurity of mounting, and foreign matter. The period of cleaning depends on the particular operating environment and should be determined by inspection. As necessary, clean the circuit board with a soft brush, low air pressure, or suitable solvent, being careful not to damage the printed circuitry.

## 5-5. CALIBRATION.

5-6. The function of each control for the direct record amplifier is summarized in table 5-1. The locations of the controls are shown in figure 5-1.

CONTROL	FUNCTION
Record Level Control, R2	Adjusts the amplitude of the input data signal.
Bias Level Control, R9	Adjusts the amplitude of the 8 MHz bias signal applied to this channel in the record head driver amplifier.

Table 5-1. Direct Record Amplifier Controls

5-7. BANDWIDTH SELECTION. The usable bandwidth of the 13-542 Direct Record Amplifier extends from 50 Hz to 2.0 MHz and is not adjustable. System bandwidth may be either the intermediate or wideband category, determined by the choice of reproduce heads and amplifiers.

5-8. CALIBRATION ADJUSTMENT PROCEDURES. Readjustment of the record and bias levels is necessary whenever record amplifiers are interchanged, a different tape type is used, or when the system is converted to another bandwidth category. Readjustment of the record level control is also necessary if a new Normal Record Level is established. (Normal Record Level is that input data voltage level which produces 1% third harmonic distortion.) The test equipment listed in table 5-2 should be utilized while performing the following calibration adjustment procedures.

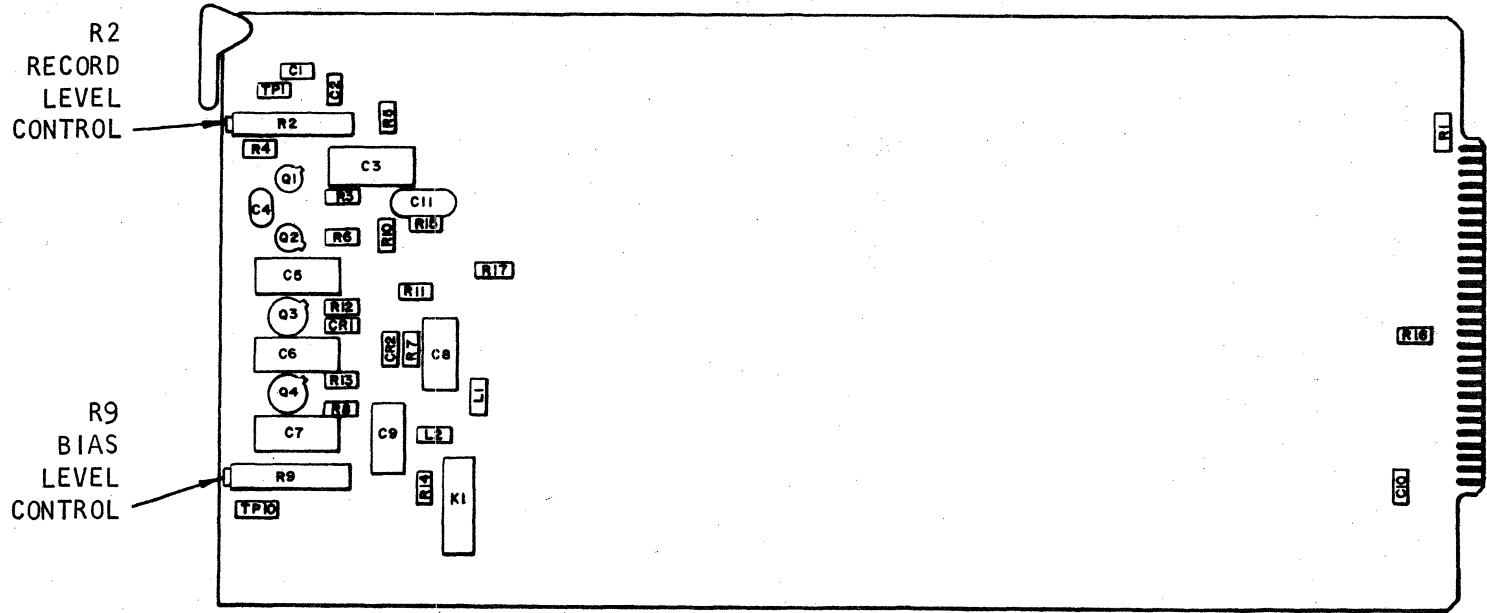


Figure 5-1. 13-542 Direct Record Amplifier Controls

EQUIPMENT	USE
Sine Wave Generator: Hewlett-Packard 651B, or equivalent	Bias Level Adjustment. Record Level Adjustment.
AC Voltmeter: Hewlett-Packard 400FL, or equivalent	Bias Level Adjustment. Record Level Adjustment.
Wave Analyzer: Hewlett-Packard 310A, or equivalent	Record Level Adjustment.
Oscilloscope: Tektronix 545B/1A1, or equivalent	Observation of input and output signals.

Table 5-2. List of Test Equipment Required for Calibration Adjustment Procedures

5-9. Ensure that the proper reproduce heads and reproduce amplifiers are installed for the desired intermediate or wide bandwidth.

5-10. Apply power to the record/reproduce system. Do not run tape. The amplifier may be energized without moving the tape by placing the NORM/TEST switch on the tape transport front panel in the TEST position. Allow 15 minutes for temperature stabilization.

5-11. Temporarily disconnect the system input and output coaxial cables from the BNC connectors at the rear of the cabinet. Connect the test equipment to the record/reproduce system at the test points on the front of the amplifiers, as shown in figure 5-2.

5-12. Since a uniform amplitude-versus-frequency response of the entire direct system is necessary in order to set the record level properly, the direct reproduce amplifier should be equalized before attempting to set either the bias level or the normal record level. If the amplifiers are completely out of alignment, the record amplifier should be preset as described in the following steps, then the reproduce amplifier equalized according to the procedure in the reproduce amplifier manual. Following this, the bias and normal record levels can be set per paragraph 5-13. The procedure for presetting the direct record amplifier is as follows:

- a. Rotate the record level control (R2) fully counterclockwise, then clockwise 3 1/2 turns.
- b. Rotate the bias level control (R9) fully clockwise, then counterclockwise 4 turns.
- c. Proceed with the equalization of the direct reproduce amplifier as described in Section V of the reproduce amplifier manual.

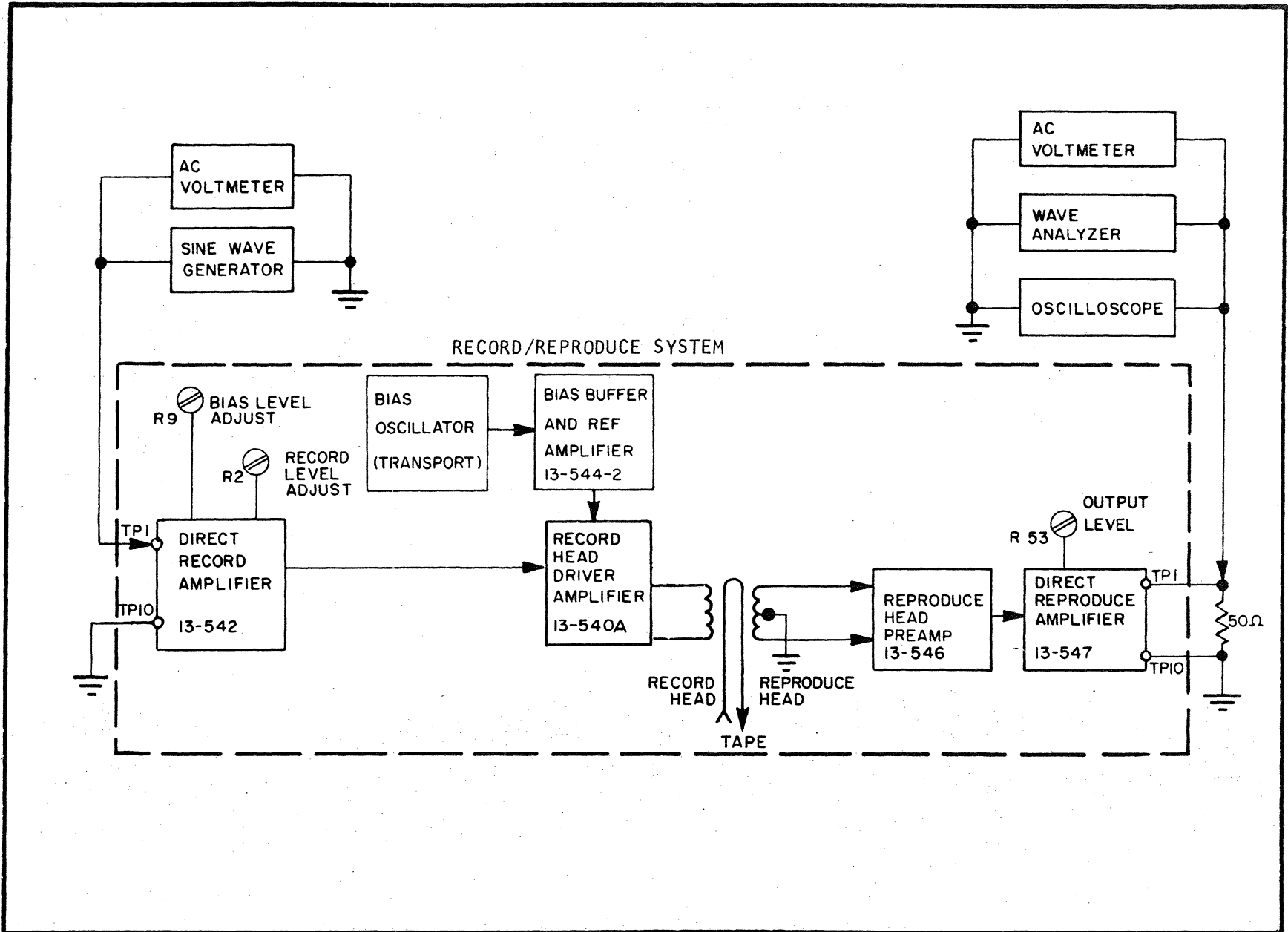


Figure 5-2. Setup for Direct Record Amplifier Calibration Adjustments



5-13. Once the reproduce amplifier has been equalized as previously described, the bias and normal record levels can be set as follows:

a. Select a tape speed of 120 ips, or the highest speed for which reproduce amplifier equalizers are installed, and adjust the sine wave generator for a normal record input level at the appropriate upper band edge frequency (see table 5-3). Normal record input level is the maximum data signal level expected at the input to the record amplifier during actual operation.

TAPE SPEED (ips)	INTERMEDIATE BANDWIDTH		WIDEBAND OPTION A		WIDEBAND OPTION B	
	UBE (kHz)	RLSF (Hz)	UBE (kHz)	RLSF 1/10 UBE (kHz)	UBE (kHz)	RLSF 1/10 UBE (kHz)
120	600	1000	1500	150	2000	200
60	300	1000	750	75	1000	100
30	150	1000	375	37.5	500	50
15	75	500	187	18.7	250	25
7 1/2	38	500	93	9.3	125	12.5
3 3/4	19	500	46	4.6	62	6.2
1 7/8	10	500	23	2.3	31	3.1
15/16	5	500	12	1.2	15	1.5

UBE = Upper Band Edge Frequency  
RLSF = Record Level Set Frequency

Table 5-3. Frequencies Used for Calibration Adjustments

b. Check that the reproduce amplifier output is 1 vrms.

c. Adjust the bias level control (R9) for 3 db overbias (on 600 kHz or 1.5 MHz systems) or 2 db overbias (on 2.0 MHz systems); that is, rotate R9 clockwise until the reproduce amplifier output reaches its peak as indicated on the ac voltmeter, then continue rotating R9 clockwise until the output decreases by 3 db or 2 db, as appropriate.

d. Adjust the sine wave generator for normal record input level at the appropriate record level set frequency. On intermediate bandwidth (600 kHz) systems, record level is set at 1000 Hz for tape speeds of 120 ips through 30 ips; at 500 Hz, for speeds of 15 ips through 15/16 ips. On wideband systems (1.5 MHz or 2.0 MHz), the record level is set at 1/10 upper band edge frequency for all tape speeds (see table 5-3).

e. Tune the wave analyzer to the third harmonic of the test frequency set in step d.

f. Adjust the record level control (R2) for 1%  $\pm$ 0.1% distortion as indicated on the wave analyzer.

g. Repeat steps a through f.

5-14. If the reproduce amplifier has been mounted on a circuit extender card during the equalization procedure, the bias and normal record levels should be checked once more when the reproduce amplifier is reinstalled in the amplifier mounting assembly.

5-15. The record amplifier adjustments are summarized in table 5-4. This summary assumes that the system is capable of recording and reproducing at 120 ips. If 120 ips is not available on the subject machine, use the highest tape speed possible and vary the adjustment test frequencies accordingly. Table 5-3 lists the upper band edge and record level set frequencies for all tape speeds of the intermediate bandwidth and wideband systems. Using the appropriate test frequencies, the adjustments are identical for all tape speeds within a given system.

#### 5-16. TROUBLESHOOTING AND CORRECTIVE MAINTENANCE.

5-17. Before attempting repair of a unit suspected of malfunctioning, verify that the symptom is not caused by malfunction of associated equipment such as the power supply, the mounting assembly, intercabling errors, etc. This can be done by substituting a known good unit for the suspected unit, or making continuity checks from unit to unit. If such a check eliminates the associated equipment as a source of trouble, check the adjustments which are detailed in previous portions of this section.

5-18. Once the existence of a defective unit has been established, check it for obviously damaged components, such as burned resistors, or incorrect seating of components. The next step is to verify that the proper supply voltage is reaching the unit. If the supply voltage is correct, the faulty stage within the unit can be located by tracing signals from stage to stage.

5-19. TRACING SIGNALS. Since there are only three stages and four transistors in the 13-542 Direct Record Amplifier, signal tracing is very simple. An extender board, a signal generator, and an oscilloscope are all that should be needed. The amplifier may be energized without moving tape by placing the NORM/TEST switch on the transport control panel in the TEST position. If a satisfactory signal can be traced all the way through to card pin 28, but the reproduced signal is absent or otherwise incorrect, then the record driver, reproduce head preamplifier, and reproduce amplifier should be checked. Consult manuals for the record driver, reproduce head preamplifier, reproduce amplifier, and for the record/reproduce system.

5-20. Once the defective stage has been located, the defective component in that stage can be determined by reference to the schematic diagram, and by making continuity, voltage, and/or resistance measurements about the suspected components. The prime exception to this is open coupling capacitors, which should be checked by substitution, or by adding a test capacitor in parallel.

5-21. VOLTAGE MEASUREMENTS. Typical dc voltage measurements for the 13-542 Direct Record Amplifier are listed in table 5-5. The voltages may vary somewhat from unit to unit but will approximate the values indicated.

ADJUSTMENT	RECORD/ REPRODUCE UPPER BAND EDGE FREQUENCY	TAPE SPEED (ips)	DATA SIGNAL FREQUENCY	REPRODUCE AMPLIFIER OUTPUT LEVEL	WAVE ANALYZER SETTING FOR 3RD HARMONIC	OPERATION
Bias Level	1.5 MHz or 2.0 MHz (Wideband)	120	1.5 MHz or 2.0 MHz	1.0 vrms	N/A	While observing ac volt- meter at reproduce am- plifier output, turn R9 clockwise through peak response, until volt- meter reading is 3.0 db below peak value (1.5 MHz) or 2.0 db below peak value (2.0 MHz).
	600 kHz (Intermediate Band)	120	600 kHz	1.0 vrms	N/A	Same, adjust R9 clock- wise through peak response, until volt- meter reading is 3.0 db below peak value.
Record Level	1.5 MHz or 2.0 MHz (Wideband)	120	150 kHz or 200 kHz	1.0 vrms	450 kHz or 600 kHz	While observing wave analyzer, turn R2 clock- wise until the 3rd har- monic amplitude is 1.0 $\pm 0.1\%$ of the fundamental.
	600 kHz (Intermediate Band)	120	1 kHz	1.0 vrms	3 kHz	Same.

Table 5-4. Summary: Adjustment Parameters, 13-542 Direct Record Amplifier

TRANSISTOR	EMITTER	BASE	COLLECTOR
Q1	(R4/C3) -0.68 v	(R22) -0.014 v	(R3/C4) +10.0 v
Q2	(R6/C5) +10.5 v	(R3/C4) +10.0 v	(C4/CR1) -1.9 v
Q3	(R12) -2.5 v	(C4/CR1) -1.9 v	(L1/C6) +15.0 v
Q4	(R13) -2.6 v	(R7/R8) -3.2 v	(L2/C7) -15.0 v

CONDITIONS OF MEASUREMENT:

1. Amplifier installed on extender card in 13-505 or 13-505A Amplifier Mounting Mounting Assembly.
2. Transport RECORD/TEST SELECTOR in TEST position (all record circuits energized).
3. Control Settings: Amplifier set up for normal record level with 1 volt input.
4. Input open, no signal.
5. Output connected to record head via 13-540A Record Head Driver Amplifier.
6. Reference Schematic: Figure 7-1 (C-471615).
7. Measurements were taken using a Hewlett-Packard Type 3439A Digital Voltmeter with a Type 3442A Plug-in.

Table 5-5. Typical DC Voltage Measurements, 13-542 Direct Record Amplifier

## 5-22. REPAIR.

5-23. Repair of the unit should be attempted only by personnel experienced in printed wiring techniques. Recommended repair is limited to the replacement of defective parts and adjustments of controls. When removing and replacing defective parts, care should be exercised so as not to damage surrounding components or the circuit board. Replacement parts must be of the correct type and value, as listed in the parts list in Section VI. When installing a new part, place it in the exact position of the replaced part. After replacement, carefully inspect the circuit board for evidence of cold solder joints, solder splashes, and insecurity of mounting. If the equipment is repaired, the amplifiers should be checked and, if necessary, adjusted as described in the Calibration Adjustment Procedures which are detailed in previous portions of this section.

5-24. PARTS IDENTIFICATION. Components of the 13-542 Direct Record Amplifier are illustrated in Section VI of the manual, showing locations and part designations. The parts list of Section VI itemizes the component parts in each assembly and provides a Bell & Howell part number for each.

5-25. FIELD REPAIR SERVICE.

5-26. Regular scheduled maintenance service is available from the Bell & Howell Instruments Division Sales and Service Office on a contract basis. If immediate service is required, it may be obtained on an emergency basis. Every effort is made to furnish the needed repair as soon as possible. For a complete description of Bell & Howell's maintenance service plans and their costs, contact the Instruments Division Sales and Service Office.

5-27. FACTORY REPAIR SERVICE.

5-28. If desired, instruments (or major assemblies) may be returned to the factory for repair. When an instrument or assembly is returned:

a. Indicate the symptom of defect. State as completely as possible, both on an instrument tag and on the order form, the nature of the problem encountered. Too much information is far better than too little. If the trouble is intermittent, please be specific in describing the instrument's performance history.

b. Give special instructions. If any changes in the instrument or assembly have been made, and it is desired to retain the modified form, please indicate this specifically.

c. State the desired invoicing procedure. In the first correspondence, indicate whether repair work may begin immediately with billing in accordance with the standard pricing system or whether Bell & Howell should secure prior approval of the price before proceeding with the repair. The price will be the same in both cases, but any delay will be minimized by permission to start work immediately. The order acknowledgment copy will, of course, always show the price.

d. Pack securely and label. Proper packaging saves money. The small amount of extra care and time it takes to cushion a part or instrument properly may prevent costly damage while in transit. Make certain that the address is both legible and complete; failure to do so often results in needless delay. Address all shipments and correspondence to:

Bell & Howell  
Instruments Division  
360 Sierra Madre Villa  
Pasadena, California 91109  
Attention: Repair Department

e. Show return address on repair correspondence. Please indicate clearly the exact address to which the equipment should be returned after repair is completed. All shipping costs will be borne by the owner of the equipment, not by Bell & Howell.



SECTION VI  
PARTS LISTS

6-1. GENERAL.

6-2. Appropriate parts lists and illustrations for the 13-542 Direct Record Amplifier follow the instructions given below. The parts lists include the Bell & Howell Instruments Division part number, description, figure and index and/or schematic reference symbol, and where applicable, the manufacturer's or military part number for each component. Manufacturers are identified in the parts lists by code number in accordance with the Federal Supply Code for Manufacturers, Cataloging Handbook H4-2, and as listed in table 6-1. The components are illustrated in figure 6-1.

6-3. ORDERING REPLACEMENT PARTS.

6-4. Parts should be ordered through the nearest Bell & Howell Instruments Division Sales and Service Office. Price and delivery information on parts or complete instruments may be obtained there also. To assist in making this contact, a list of Sales and Service Offices is included in the front of this manual. Bell & Howell recommends that whenever possible, and particularly when an instrument is used in a critical application, the user maintain a minimum stock of spare parts. Instruments Division has specialized personnel ready to assist the user in making a selection of spares at any time. The same personnel are also ready and able to prepare or quote on the preparation of illustrated parts breakdowns (IPB's), provisioning parts breakdowns (PPB's), and other parts documentation that might be required.

6-5. When ordering parts, the following information should always be supplied to the field office engineers:

- a. A description of the part or assembly, obtained from the parts list.
- b. The Bell & Howell part or assembly number, also on the parts list, or on the component itself.
- c. The figure and index, and/or reference symbol, given on the applicable diagram and on the parts list.
- d. The part or type number of the major assembly, shown on the instrument nameplate.
- e. The production serial number, also on the nameplate.
- f. The Bell & Howell register number applying to the complete system or order.

CODE	MANUFACTURER
01121	Allen-Bradley Company Milwaukee, Wisconsin
03508	General Electric Company Semiconductor Products Department Syracuse, New York
04713	Motorola Semiconductor Products, Incorporated Phoenix, Arizona
06540	Anatom Electronic Hardware Division Mite Corporation New Rochelle, New York
07088	Kelvin Electric Company Van Nuys, California
24546	Corning Glass Works Bradford, Pennsylvania
42451	Union Carbide Corporation Carbon Products Division New York, New York
56289	Sprague Electric Company North Adams, Massachusetts
72136	Electro Motive Manufacturing Company, Incorporated Willimantic, Connecticut
74970	E. J. Johnson Company Waseca, Minnesota
76493	J. W. Miller Company Compton, California
81349	Military Specifications
96906	Military Standards

Table 6-1. List of Manufacturers



Table 6-2. Parts List for the 13-542 Direct Record Amplifier (Sheet 1 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION					QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
		0	1	2	3	4				
1	471612-1	13-542 Direct Record Amplifier					1	6-1		
2	471612	Printed Wiring Board					1	6-1/1		
3	197998	Extractor, card					1	6-1/2		
4	70131-16	Pin, spring					1	6-1/3	96906	MS171493
5	475560	Shield and Insulator Assembly					1	6-1/4		
6	471349	Shield, printed wiring board					1			
7	249641-16	Post, elec-mech					5		06540	95058-8-0256-14
8	475559	Insulator, shield					1			
9	7138-7505	Res, 75Ω ±5%, 1/2 w					1	R1	81349	RC20GF750J
10	471922-1822	Res, 1.8K ±2%, 1/4 w					1	R3	24546	C4-182G
11	471922-5122	Res, 5.1K ±2%, 1/4 w					1	R4	24546	C4-512G
12	471922-1012	Res, 100Ω ±2%, 1/4 w					2	R5,14	24546	C4-101G
13	471922-1022	Res, 1K ±2%, 1/4 w					1	R6	24546	C4-120G
14	471922-2002	Res, 20Ω ±2%, 1/4 w					1	R7	24546	C4-200G
15	471922-2722	Res, 2.7K ±2%, 1/4 w					1	R8	24546	C4-272G
16	471922-2022	Res, 2K ±2%, 1/4 w					1	R10	24546	C4-202G
17	7138-2415	Res, 240Ω ±5%, 1/2 w					1	R11	81349	RC20GF241J
18	471922-1002	Res, 10Ω ±2%, 1/4 w					3	R12,13,16	24546	C4-100G
19	471922-5102	Res, 51Ω ±2%, 1/4 w					2	R15,17	24546	C4-510G
20	471573-0920	Res, var, 10K ±20%, 1/3 w					2	R2,9	01121	NP103M
21	471863-6	Cap, 2.2 μf ±20%, 25 v					3	C1,2,10	42451	T320A225-M025AS
22	471930-0003	Cap, 100 μf +75 -10%, 16 v					4	C3,5,6,7	56289	500D107G016DC7
23	199985-4	Cap, 5 pf ±5%, 500 v					1	C4	72136	DM10C050D0500 WV-4CR

Table 6-2. Parts List for the 13-542 Direct Record Amplifier (Sheet 2 of 2)

ITEM NO.	B&H PART NO.	DESCRIPTION							QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
		0	1	2	3	4	5					
1	471930-2							Cap, 50 $\mu$ f +75 -10%, 16 v	2	C8,9	56289	500D506G016CB7
2	70094-62							Cap, 1000 pf $\pm$ 5%, 500 v	1	C11	72136	DM19F102J0500 WV-4CR
3	471788-23							Coil, RF, 120 $\mu$ h $\pm$ 5%	2	L1,2	76493	9210-80
4	246954							Diode	2	CR1,2	03508	1N4154
5	471472							Transistor, NPN	1	Q1	04713	2N3947
6	471931							Transistor, PNP	1	Q2	04713	2N3251
7	471927							Transistor, NPN	1	Q3	04713	2N2219
8	471925							Transistor, PNP	1	Q4	04713	2N2905
9	246626-1							Relay, sub-miniature	1	K1	07088	CIC-15
10	204749-8							Jack, tip, brown	1	TP1	74970	105-758
11	204749-3							Jack, tip, black	1	TP10	74970	105-753

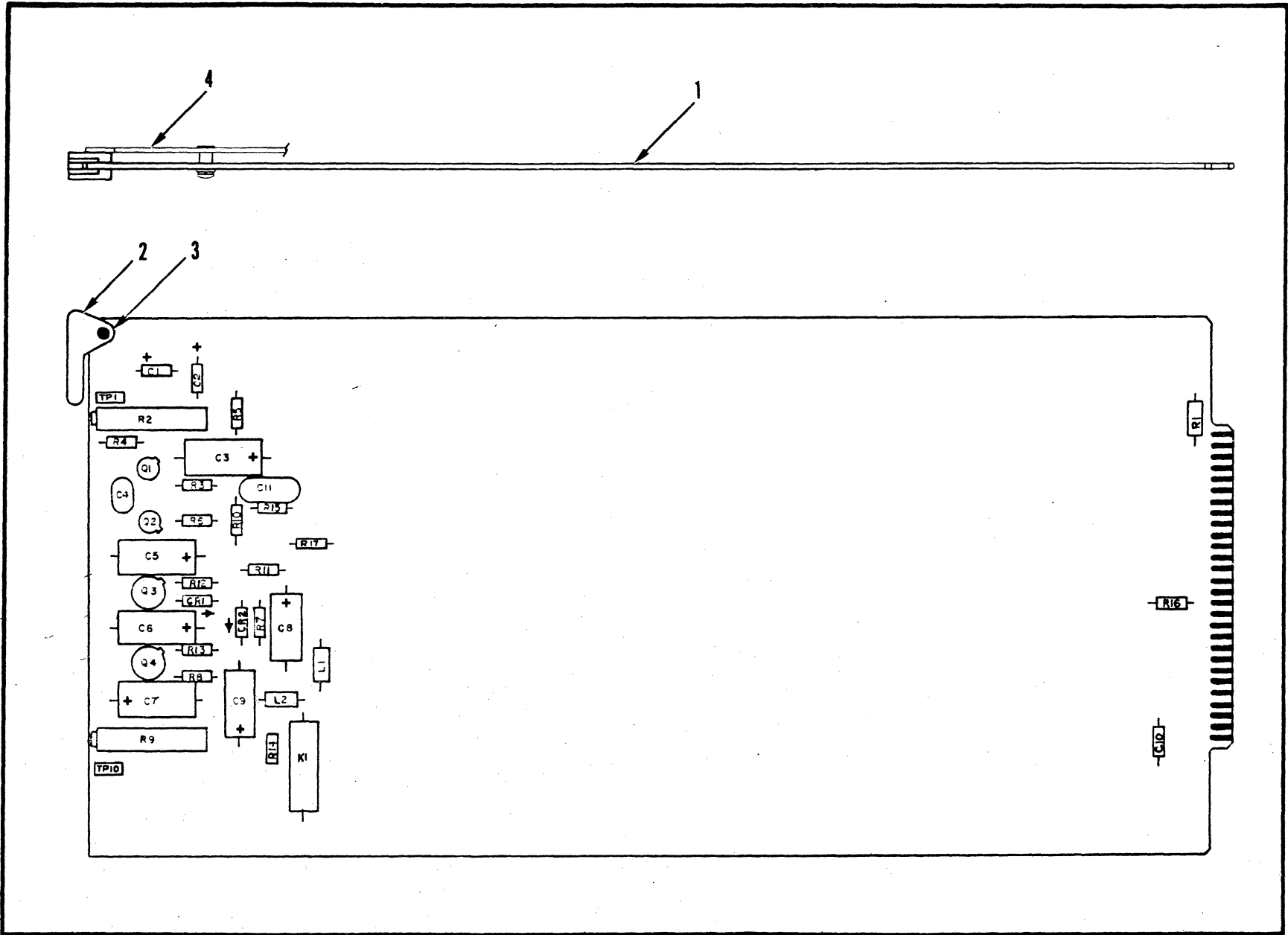


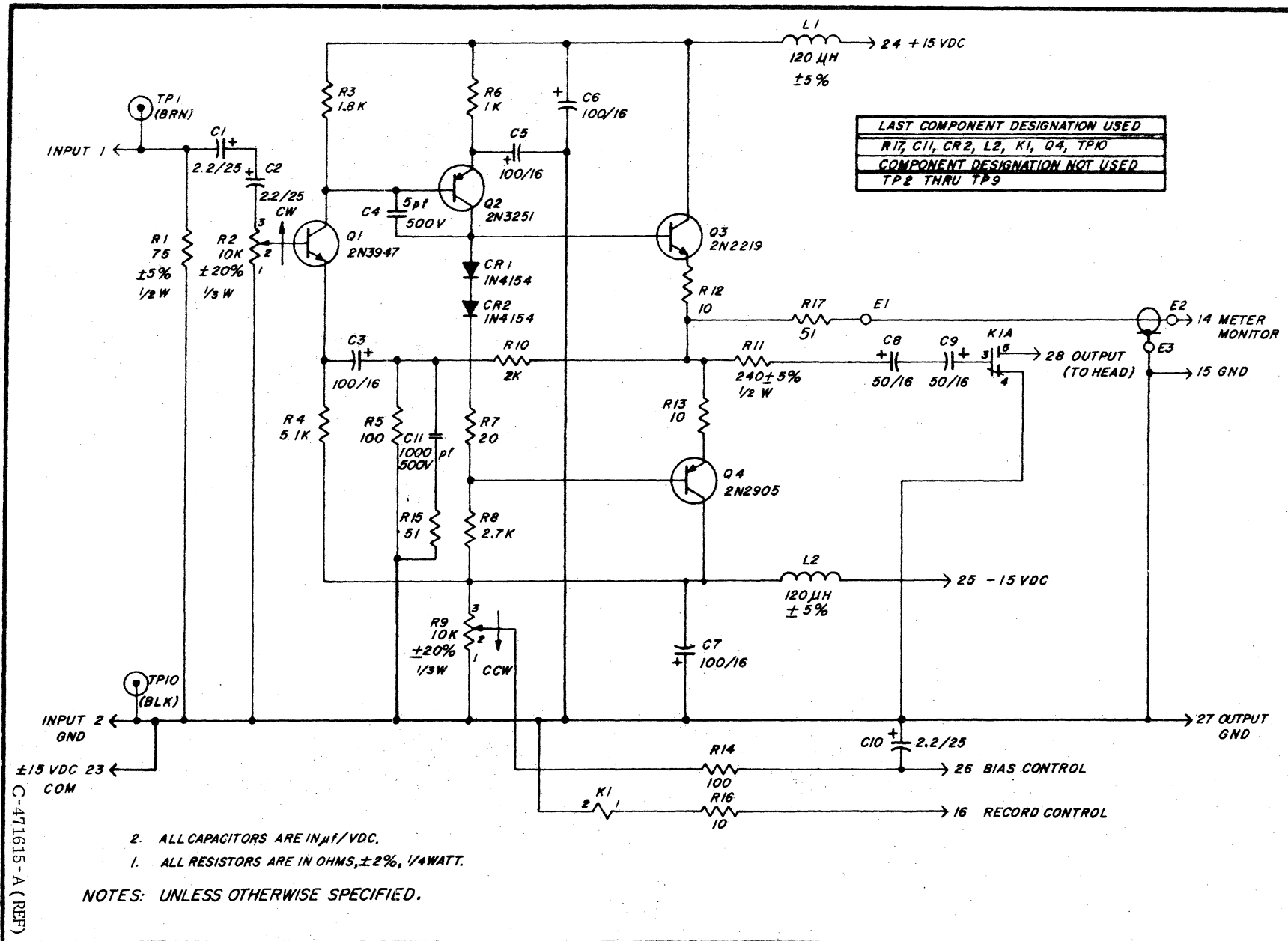
Figure 6-1. 13-542 Direct Record Amplifier



SECTION VII  
DRAWINGS AND SCHEMATICS

7-1. GENERAL.

7-2. Figure 7-1 is a schematic of the 13-542 Direct Record Amplifier.



C-471615-A (REF)

Figure 7-1. Schematic, 13-542 Direct Record Amplifier