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DATATAPE® | VR-3700B MAGNETIC TAPE RECORD/REPRODUCE SYSTEM

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 VR-3700B Magnetic Tape Record/ Reproduce System, using the Type 13-501 Tape Transport, with serial numbers 3001 through 3999.

LIST OF EFFECTIVE PAGES

CONTENT AND ORGANIZATION

This book is a set of operation and maintenance manuals for the DataTape® VR-3700B Magnetic Tape Record/Reproduce System. The first of this set of manuals is for the overall magnetic tape system and provides a general system description, a summary of system specifications, and installation and operating instructions for the system as a whole. This is followed by a complete operation and maintenance manual for each of the major components of the system. The tabbed dividers indicate the subject matter of each manual.

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INTRODUCTION

This manual contains the operation and maintenance procedures for the DataTape® VR-3700B Magnetic Tape Record/Reproduce System. It is divided into seven sections.

Section I describes the system as a whole, lists the system specifications and performance characteristics, and contains a table of the standard components available for the system.

Section II deals with system installation. Included are the system location requirements, power and system cabling data, and unpacking and installation procedures.

Section III describes the system operation. In this section are a list of all system controls and indicators and their location and function, a list of recommended tape and tape threading procedures, and operating procedures necessary for the proper operation of the system.

Section IV explains the theory of system operation. Included are a block diagram and signal flow chart of the system and a brief description of the function and use of system components.

Section V contains the maintenance procedures for the system. Included are the system level preventive maintenance and troubleshooting procedures and system calibration procedures. Component maintenance is described in the component manuals.

Section VI covers the necessary parts lists. In this section are lists only for the system cabinet, cabinet accessories, interconnecting cables, and magnetic heads. Parts lists for all other system components are contained in the applicable component manuals.

Section VII contains a system cabling diagram and drawings of the cables used to interconnect the various components of the system.

All descriptions, drawings, and operation and maintenance procedures in this manual pertain to the system as a unit. Component-level operation, maintenance, theory of operation, parts lists, and schematics are covered in separate operation and maintenance manuals for each major component of the system. All pertinent component manuals are supplied as companion items to this system manual.

TABLE OF CONTENTS

SECTION V. MAINTENANCE AND CALIBRATION

SECTION VI. PARTS LISTS

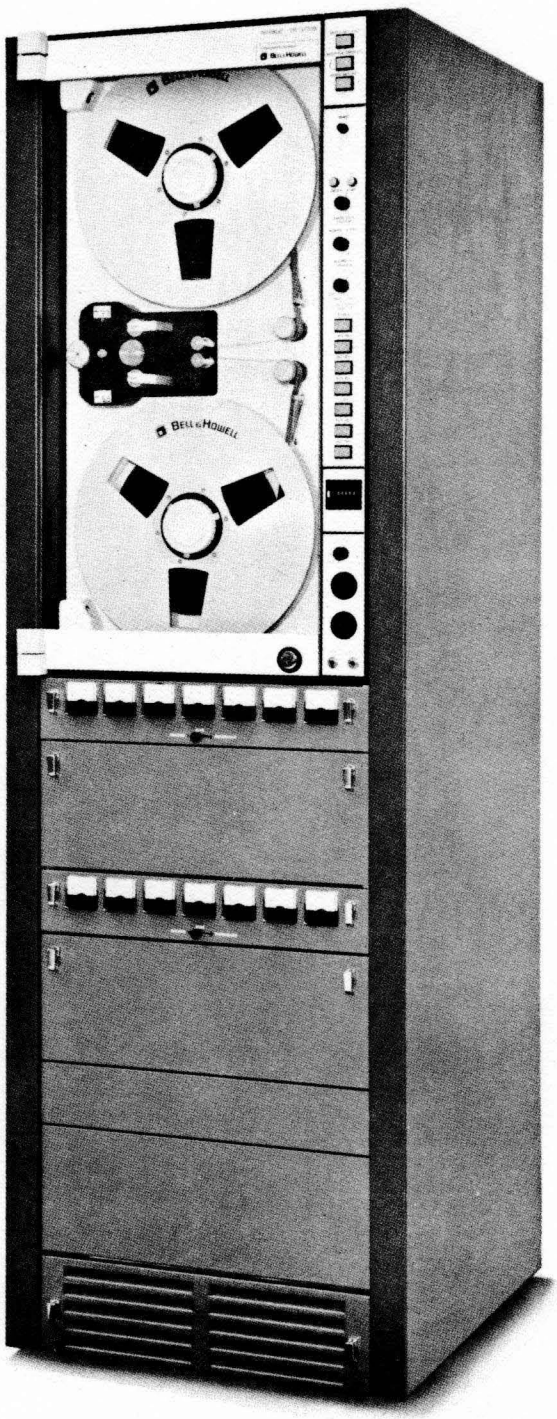
SECTION VII. DRAWINGS AND SCHEMATICS

LIST OF ILLUSTRATIONS

LIST OF TABLES

VR-3700B Magnetic Tape Recorder/Reproducer

General Specifications



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General Specifications

TAPE TRANSPORT

Tape Speeds: 9, bi-directional, rotary switch selectable, 240, 120, 60, 30, 15, 7½, 3¾, 1⅞, 15/16 ips.

Reels: Standard EIA to 15 inch diameter can be accommodated. Precision reels are recommended.

Tape: ½″ or 1″ width standard, 1 or 1½ mil mylar base tape. All specifications are based on Bell & Howell-recommended tape.

Start Time: 6 seconds maximum at 120 ips and 3 seconds at 60 ips to phase lock.

Stop Time: 4 seconds maximum at 120 ips and 2 seconds maximum at 60 ips and lower speeds.

Wind/Rewind: 7200 feet in less than 5 minutes.

Tape Speed Accuracy: ±0.10% at all tape speeds when in tach mode
±0.01% at all tape speeds when in tape mode

Flutter (Cumulative P-P):

Tape Speed (ips)	Flutter Bandwidth	% Flutter P-P
120	0.2 to 10,000 Hz	0.11
60	0.2 to 10,000 Hz	0.13
30	0.2 to 5,000 Hz	0.13
15	0.2 to 2,500 Hz	0.18
7½	0.2 to 1,250 Hz	0.25
3¾	0.2 to 625 Hz	0.32
1⅞	0.2 to 312 Hz	0.38
15/16	0.2 to 156 Hz	0.50

Controls: Illuminated pushbuttons for RUN FORWARD, RUN REVERSE, RECORD, FAST FORWARD, FAST REVERSE, and POWER (push-ON, push-OFF). Rotary speed selector, phase lock selector (Tape/Tach), and record test selector are front panel located. Remote control of all operating modes via connection at the transport by use of accessory Bell & Howell Remote Control Unit, or equivalent.

Dynamic Skew:

Tape Speed (ips)	Microseconds (1) 0 to Peak	(2) 0 to Peak	(3) 0 to Peak
120	.10	.35	.65
60	.20	.70	1.30
30	.50	1.4	2.60
15	1.20	2.8	5.20
7½	2.40	5.6	10.5
3¾	4.80	11.2	21.0
1⅞	9.60	24.0	42.0
15/16	19.20	48.0	90.0

(1) Track to adjacent track in same headstack.
(2) Between outside tracks in same headstack—½″ tape.
(3) Between outside tracks in same headstack—1″ tape.

MAGNETIC HEADS

The record and reproduce head stacks are precision mounted on plug-in subplates for easy replacement. Plug-in connector can facilitate heads with up to 42 channels.

Head and Head Stack Configuration: Per IRIG 106-71

Head Polarity: Per IRIG 106-71

Head Azimuth: Record Head, factory set to better than ±1 minute of arc. Reproduce Head adjustable.

PHASE LOCK SERVO DRIVE

The Phase Lock Capstan Motor Control unit provides a closed loop servo operation for the d-c capstan motor. This unit provides two modes of operation, tachometer and tape. When in the tachometer mode the control servo uses the signal from the optical tachometer on the capstan drive assembly. The tachometer mode is used for initial recording. The tape control servo mode uses the prerecorded signal from the tape to establish highly accurate speeds and low time base error when reproducing tapes.

Time Base Error:

Speed (ips)	Control Reference	TBE
120	200 kHz	±0.5 microseconds
60	100 kHz	±0.5 microseconds
30	50 kHz	±0.5 microseconds
15	25 kHz	±1.00 microseconds
7½	12.5 kHz	±1.5 microseconds
3¾	6.25 kHz	±3.0 microseconds
1⅞	3.125 kHz	±6.0 microseconds
15/16	1.5625 kHz	±16.0 microseconds

Fail Safe: Capstan control is automatically returned to tach mode whenever tape signal is lost or when system is placed in record mode, regardless of position of mode selector switch. Respective tach and tape lamps light only when transport is up to speed and in servo locked operation.

External Signal: External reference frequencies may be inserted for variable speed control with inclusion of optional External Reference Kit.

Data Channel: The servo control track may be used as a data channel when the optional bandpass filter card is included and provided none of the data is within one octave above or below the servo control frequency.

Power: 115 VAC ±10% from 47-63 Hz. Approximately 1500 watts for 14 track system.
230 VAC option available.

Environment: Temperature
Operating: 0°C to 50°C
Storage: −20°C to +65°C

Altitude: Operating: to 10,000 ft.
Storage: to 50,000 ft.

Relative Humidity: 5% to 95% without condensation. (Tape limited)

Physical Data: Size
Single Cabinet: 72¾ inches high, 23⅛ inches wide, 25¾ inches deep.
Weight: Approx. 800 pounds.

DIRECT RECORD/REPRODUCE SYSTEM

Operating Speeds: 8, electrically switched.

Input Level: 0.15 to 15 volts P-P to produce normal record level via input potentiometer.

Input Impedance: Normally 75 ohms shunted by 100 Pf max. Convertible by resistor change from 50 to 10K ohms.

Output Level: 0-4 volts P-P into 50 ohms single ended.

Output Impedance: 50 ohms convertible by resistor change up to 600 ohms.

INTERMEDIATE BAND

Tape Speed (ips)	Response ±3 db Over Indicated Bandwidth	SNR*
120	300 Hz to 600 kHz	37 db
60	300 Hz to 300 kHz	37 db
30	200 Hz to 150 kHz	37 db
15	100 Hz to 75 kHz	36 db
7½	100 Hz to 38 kHz	36 db
3¾	100 Hz to 19 kHz	36 db
1⅞	100 Hz to 10 kHz	34 db
15/16	100 Hz to 5 kHz	31 db

*measured at the output of an 18db/octave bandpass filter.

Normal Record Level: 1% third harmonic distortion of 50 kHz signal recorded and reproduced at 120 ips.

WIDEBAND

Tape Speed (ips)	Option A (1.5 MHz) Bandwidth (±3 db) (kHz)	*SNR (db)	Option B (2.0 MHz) Bandwidth (±3 db) (kHz)	*SNR (db)
120	0.4-1,500	28	0.4-2,000	22
60	0.4-750	28	0.4-1,000	22
30	0.4-375	28	0.4-500	22
15	0.4-187	26	0.4-250	22
7½	0.4-93	26	0.4-125	21
3¾	0.4-46	26	0.4-62	19
1⅞	0.4-23	24	0.4-31	19
15/16	0.4-12	22	0.4-15	17

*measured at the output of an 18db/octave bandpass filter.

	Option A	Option B
Normal Record Level	1% 3RD H.D. of a 150 kHz signal at 120 ips.	1% 3RD H.D. of a 200 kHz signal at 120 ips.
Phase Response: (envelope delay)	Less than ±0.25 microsecond from 100 kHz to 1.2 MHz at 120 ips.	Less than ±0.3 microsecond from 100 kHz to 2 MHz at 120 ips.

DOUBLE BANDWIDTH PERFORMANCE (OPTION B ONLY)

Tape Speed (ips)	Double Band Mode Response ±3 db (kHz)	SNR*	Normal Mode Response ±3 db (kHz)	SNR*
120			0.4-2,000	31 db
60	0.4-2,000	20 db	0.4-1,000	31 db
30	0.4-1,000	20 db	0.4-500	31 db
15	0.4-500	20 db	0.4-250	31 db
7½	0.4-250	20 db	0.4-125	31 db
3¾	0.5-125	19 db	0.4-62	31 db
1⅞	0.5-62	17 db	0.4-31	28 db
15/16	0.5-31	16 db	0.4-15	28 db

*measured at the output of an 18db/octave filter.

Switch Conversion from Double Band to Normal Mode

FM SYSTEM SPECIFICATIONS

Input Level: 0.2 to 10 V RMS for ±30% or ±40% deviation. Single FM record amplifier supplies all center frequencies and deviation capability.

Input Impedance: 20 K ohms minimum, single-ended and shunted by 100 Pf maximum. Provision for termination at any value from 50 ohms to 20 K ohms. WB II and WB III delivered as 75 ohm ±5%.

Center Frequency Offset: Capable of ±30% or ±40% carrier offset.

DC Linearity: ±0.5% of full deviation from best straight line through zero.

System Drift: After 10-minute warm-up, ±0.5% of full deviation over 8 hours, with temperature variation of 20°F, within the operating range and line voltage variation from 105 to 125 V. RMS.

Output Impedance: 10 ohms maximum, may be set to 50 or 75 ohms.

Output Level: 4 V peak-to-peak into 75 ohms, single ended.

Speed Switching: Eight speeds electrically switchable for WBI, seven speeds for WBII and WBIII. Reproduce board houses nine filters. Filter movable to create special bandwidths.

Transient Response: **Wideband Group I and Lower:** Rise time 6 microseconds for 80 kHz filter and proportionally greater for lower frequency filters.

Wideband Group II and III: Rise time 1.2 microseconds for 500 kHz and 600 kHz filters and proportionally greater for lower frequency filters.

40% DEVIATION SYSTEM

Tape Speed	LOW BAND Center Frequency (kHz)	LOW BAND Bandwidth (±½ db)	LOW BAND SNR (db)	INTERMEDIATE BAND Center Frequency (kHz)	INTERMEDIATE BAND Bandwidth (±½ db)	INTERMEDIATE BAND SNR (db)	WIDEBAND GROUP I Center Frequency (kHz)	WIDEBAND GROUP I Bandwidth (±½ db)	WIDEBAND GROUP I SNR (db)
120	108	DC to 20 kHz	55	216	DC to 40 kHz	51	432	DC to 80 kHz	50
60	54	DC to 10 kHz	55	108	DC to 20 kHz	51	216	DC to 40 kHz	50
30	27	DC to 5 kHz	54	54	DC to 10 kHz	50	108	DC to 20 kHz	50
15	13.5	DC to 2.5 kHz	53	27	DC to 5 kHz	48	54	DC to 10 kHz	48
7½	6.75	DC to 1.25 kHz	50	13.5	DC to 2.5 kHz	48	27	DC to 5 kHz	46
3¾	3.375	DC to 625 Hz	48	6.75	DC to 1.25 kHz	46	13.5	DC to 2.5 kHz	45
1⅞	1.6875	DC to 312 Hz	47	3.375	DC to 625 Hz	45	6.75	DC to 1.25 kHz	43
15/16				1.6875	DC to 312 Hz	43	3.375	DC to 625 Hz	41

HARMONIC DISTORTION LESS THAN 0.5% FOR MODULATION INDICES GREATER THAN 21.6

30% DEVIATION SYSTEM

Tape Speed	WIDEBAND GROUP II Center Frequency (kHz)	WIDEBAND GROUP II Bandwidth +1 −3 db	WIDEBAND GROUP II SNR (db)	WIDEBAND GROUP III Center Frequency (kHz)	WIDEBAND GROUP III Bandwidth +1 −3 db	WIDEBAND GROUP III SNR (db)
120	900	DC–500 kHz	35	1500	DC–600 kHz	33
60	450	DC–250 kHz	35	750	DC–300 kHz	33
30	225	DC–125 kHz	34	325	DC–150 kHz	33
15	112.5	DC– 63 kHz	33	187.5	DC– 75 kHz	29
7½	56.25	DC– 31 kHz	30	93.75	DC– 37.5 kHz	27
3¾	28.125	DC– 16 kHz	30	46.875	DC– 18.75 kHz	27
1⅞	14.06	DC– 8 kHz	27	23.44	DC– 9.375 kHz	25

ACCESSORIES

- Tape Control Servo
- External Speed Reference
- Voice Logging & Annotation
- Transport Shuttle
- Remote Control
- Footage Counter
- Monitor Meters
- Monitor Oscilloscopes
- Tape Tension Gage
- Tape Degausser
- Portable F.M. Calibrator
- Bin Loop Adapter
- Transport Dolly
- Patch & Switch Panels
- Attenuator Panel

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NOTE: All specifications shown in this folder are subject to change without notice. All specifications based on using standard Bell & Howell test procedures.

3700B—S/372

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SECTION I

GENERAL DESCRIPTION

1-1. GENERAL.

1-2. The VR-3700B Magnetic Tape Record/Reproduce System (figure 1-1) provides multi-channel data recording and reproducing facilities with a selection of nine tape speeds in the range of 15/16 ips to 240 ips. It records and reproduces 7 or 14 tracks of data on 1/2 inch or 1 inch magnetic tape, respectively.

1-3. The tape transport used in the VR-3700B System has manual controls on the front panel for local operation, and facilities for remote operation.

1-4. The electronics are all solid-state, mounted on plug-in circuit boards. Packaging of all major system components is modular, to facilitate substitution of different components to perform different functions.

1-5. ENVIRONMENT.

1-6. The system is designed for use in a laboratory environment where shock, vibration, salt atmosphere, and excessive sand or dust are not encountered. The equipment is suitable for use in a trailer installation while stationary, or on shipboard where laboratory conditions are maintained. An environmental temperature range of 0° to 50° C, with 10% to 95% relative humidity without condensation is considered laboratory operating conditions.

1-7. PRIMARY POWER REQUIREMENTS.

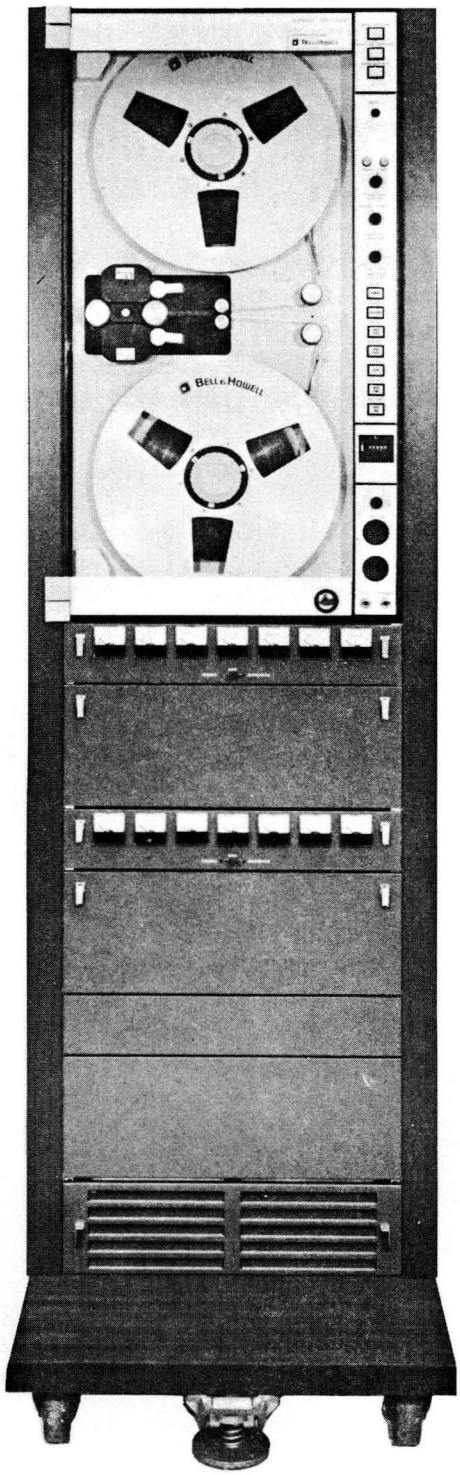
1-8. The VR-3700B System requires the following Primary Power.

VOLTAGE	105-125 volts ac rms
FREQUENCY	47-63 Hz
PHASE	Single
POWER	1200 VA (7-channel system) 1500 VA (14-channel system)

Table 1-1. Primary Power Requirements, VR-3700B

1-9. GENERAL SYSTEM SPECIFICATIONS.

1-10. The general specifications for the VR-3700B Magnetic Tape Record/Reproduce System are listed on the specifications sheet at the end of this section. The specifications are predicated on the use of Bell & Howell recommended magnetic tape and testing in accordance with Bell & Howell test procedures. The use of other than Bell & Howell test procedures or the recommended magnetic tape may result in degradation of optimum performance.



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1-2 Figure 1-1. Typical VR-3700B Magnetic Tape Record/Reproduce System

1-11. SYSTEM COMPONENTS.

1-12. Table 1-2 lists the system components and provides a brief description of each.

COMPONENT	DESCRIPTION
13-501 Tape Transport The tape transport electronics panel can accommodate the following plug-in board assemblies: Sine wave reference generator Reproduce servo control Low pass or band pass filters Square wave reference generator Capstan servo amplifier Tape control logic Tape/tach servo equalizer Speed switching and dc regulator Footage counter Shuttle control Voice logger	The tape transport is powered from a single source of 115 volts ac at 60 Hz, and operates at any one of nine tape speeds: 240, 120, 60, 30, 15, 7 1/2, 3 3/4, 1 7/8, and 15/16 ips. Operating modes are: FAST FORWARD, RUN FORWARD, RECORD, FAST REVERSE, RUN REVERSE, and STOP. Backlighted pushbutton controls are used for mode control. Speed selection is made by a rotary selection switch. A search position (which allows selection of variable tape speeds) and a remote position are also provided with the rotary switch. The transport uses all-metal-surface record and reproduce head stacks and can handle either 1/2 inch tape for 7-channel operation, or 1 inch tape for 14-channel operation. The head stacks are compatible with the mechanical requirements of IRIG Document 106-69. The tape transport uses a closed loop capstan drive. Fail-safe mechanical brakes are actuated after tape stops or in the event power source fails.
Reference Generator	The reference generator has three outputs; bias reference, capstan reference, and record servo reference. The circuit board plugs into J418 on the Electronics and Relay Chassis. a. The bias reference circuit in the reference generator contains a crystal controlled oscillator. By means of appropriate jumpers, 4 MHz, 8 MHz, or 16 MHz can be used as bias reference. The 8 MHz signal is normally used in the VR-3700B System.

Table 1-2. Components Available for VR-3700B System (Sheet 1 of 7)

COMPONENT	DESCRIPTION
Reference Generator (Cont'd)	b. The 16 MHz crystal controlled oscillator is the frequency source for the record servo reference signal. This signal is put on the tape for use in servo control of the capstan speed in the reproduce mode. A specific record servo reference signal frequency is divided down for each tape speed. In the TAPE mode, the signal from the tape is compared with a tachometer signal to control tape speed. The record servo reference signal is a square wave signal. It can be recorded as a sine wave by use of the optional 13-544-1 sine wave generator assembly. c. The 16 MHz crystal controlled oscillator is the frequency source for the capstan servo reference signal. This is a square wave signal used in the phase lock servo to control the capstan speed. A specific capstan servo reference signal frequency is designated for each tape speed. The frequency source is divided down for the particular tape speed.
13-414-2 1/2 Inch Tape Width Kit; or 13-414-5 1 Inch Tape Width Kit	Each kit consists of parts which must be changed to adapt the transport for use with the specified tape width.
Magnetic Heads	
13-523-5 7-Channel Record Head, 2 MHz 13-524-5 7-Channel Reproduce Head, 2 MHz 13-525-5 14-Channel Record Head, 2 MHz 13-526-5 14-Channel Reproduce Head, 2 MHz 13-524-25 7-Channel Reproduce Head, 600 kHz 13-526-25 14-Channel Reproduce Head, 600 kHz	Seven-channel heads are provided for use with 1/2 inch tape, and 14-channel heads for 1 inch tape. Electrically, all the tracks of any one head are identical and suitable for use in direct, or FM, recording and reproducing of data within the limits given in the system specifications. Voice logging edge track is part of each magnetic head assembly.

Table 1-2. Components Available for VR-3700B System (Sheet 2 of 7)

COMPONENT	DESCRIPTION
80782-X Head Cable	Used from the record head driver to the record head and from the reproduce head to the reproduce preamplifier. One cable is required for each record channel and one cable is required for each reproduce channel.
DIRECT ELECTRONICS	
13-542 Direct Record Amplifier	In direct recording, the amplitude/time relationships of the analog input signals are recorded directly on magnetic tape, superimposed on a high-frequency bias signal. The direct record amplifier amplifies the input signal to the required record level and feeds it to the record head driver. One amplifier is required per channel.
13-547 Direct Reproduce Amplifier	This unit amplifies the reproduced data signal to the required output level and equalizes the phase and frequency response of the overall record/reproduce system. Equalization components are wired as part of the reproduce amplifier. One amplifier is required per channel.
FM ELECTRONICS	
13-554 FM Record Amplifier	The FM record amplifier receives analog input data signals and converts them to frequency modulation of a carrier center frequency. The 13-554 FM Record Amplifier can be adapted to record analog input signals in three bandwidth ranges.
13-557 FM Reproduce Amplifier	The FM reproduce amplifier is used for the reproduction of data signals that are recorded on magnetic tape using the FM recording technique. The FM reproduce amplifier receives the FM carrier from the reproduce preamplifier and presents at its output a close facsimile of the original data signal used to modulate the carrier. The 13-557 FM Reproduce Amplifier is available in three bandwidth ranges.

Table 1-2. Components Available for VR-3700B System (Sheet 3 of 7)

COMPONENT	DESCRIPTION
COMPONENTS USED WITH ALL VR-3700B SYSTEMS	
13-505 Amplifier Mounting Assembly	This mounting assembly houses and provides all signal and power distribution facilities for up to 16 direct or FM, record and/or reproduce amplifiers. It contains +15 vdc and -15 vdc regulators which furnish power to the amplifiers. It also routes all the signals between the transport and the amplifiers: the record or reproduce signal, record control, FM squelch, and nine speed control lines (for switching amplifier components that must change as a function of tape speed), as well as one bias control line for each amplifier. In a seven-track tape system, one mounting assembly houses all of the record and reproduce amplifiers. The record amplifiers are usually on the left and the reproduce amplifiers on the right (as viewed from the front of the assembly). With a 14-channel system, two mounting assemblies are required.
13-546 Reproduce Head Preamplifier Assembly	This assembly contains four preamplifier channels per card assembly. The preamplifiers amplify the low-level signal from the reproduce head to reduce the effects of noise pickup, and high frequency loss in signal cables.
13-568 Regulator Assembly	This unit provides ±15 volts dc to the reproduce head preamplifiers. It is mounted on a card assembly that is inserted in the right-hand slot of the 13-505-3 Mounting Assembly.

Table 1-2. Components Available for VR-3700B System (Sheet 4 of 7)

COMPONENT	DESCRIPTION
13-505-3 Preamplifier Mounting Assembly	This assembly houses the 13-546 Reproduce Head Preamplifier Assemblies close to the reproduce heads at the back of the transport baseplate. Four 13-546 Reproduce Head Preamplifier Assemblies and a 13-568 Regulator Assembly can be housed within a 13-505-3 Preamplifier Mounting Assembly. The housing provides signal and power distribution facilities for the reproduce head preamplifiers.
13-540A Record Head Driver Amplifier	Each module consists of four channels. A channel combines the bias signal and the data signal by superimposing the data signal on the high frequency bias. This combined signal drives the record head. Two channels can be used for voice logging. They are called voice track A and voice track B.
13-544-2 Bias Buffer and Reference Amplifier	This module is housed in the right hand slot (as viewed from the front of the housing) of the 13-505-4 Record Head Driver Amplifier Housing. The bias signal originates in the reference generator of the transport. The 13-544-2 amplifies the bias and routes the signal to the record head driver amplifiers. The servo reference frequency can be mixed with data and recorded on any desired channel. The mixed signal is cabled to the applicable record head driver amplifier.
13-505-4 Record Head Driver Amplifier Housing	This assembly houses the 13-540A Record Head Driver Amplifiers and the 13-544-2 Bias Buffer and Reference Amplifier. Four driver amplifier circuit cards are housed in the first four mounting slots (left to right as viewed from the back of the transport) and the bias buffer and reference amplifier is housed in the right-hand slot. The bias signal and operating voltages are distributed to each channel through housing connectors.

Table 1-2. Components Available for VR-3700B System (Sheet 5 of 7)

COMPONENT	DESCRIPTION
AUXILIARY FUNCTIONS AND MISCELLANEOUS EQUIPMENT	
13-502 Basic Cabinet	This is the cabinet for a single-cabinet system; two identical cabinets are used for a dual-cabinet system. The rear door assembly is part of the basic cabinet assembly.
13-503A-1 Cabinet Accessories	Includes an air filter grill assembly for each cabinet, an ac power input connector, and a multiple outlet box. Some of the system interconnecting cables are included with the cabinet accessories and some are furnished with individual components.
13-544-1 Sine Wave Generator Assembly	Optional board that plugs into J415 of the 13-501 Tape Transport. This assembly converts the square wave signal from the reference generator to a sine wave. This allows recording of the servo reference frequency as a sine wave instead of a square wave thereby increasing the usable bandwidth for that channel since all odd harmonics present in the square wave are eliminated. This allows data to be recorded above the servo control bandwidth without interference from the control signal.
13-545-1 Band Pass Filter Assembly	Optional board that plugs into J417 of the 13-501 Tape Transport. This assembly provides the band pass filters required to isolate the data signal when multiplexing on the channel used for servo reference frequency recording.
13-545-2 Low Pass Filter Assembly	Optional board that plugs into J417 on the 13-501 Tape Transport. This assembly is furnished when a 13-571 Reproduce Servo Control Assembly is ordered without a 13-545-1 Band Pass Filter Assembly. This assembly eliminates the high frequency noise (inherent in wide band record/reproduce tape systems) that interferes with the servo control circuits.

Table 1-2. Components Available for VR-3700B System (Sheet 6 of 7)

COMPONENT	DESCRIPTION
13-571 Reproduce Servo Control Assembly	Optional board that plugs into J416 of the 13-501 Tape Transport. This assembly allows the capstan motor to be servo-controlled from a recorded reference frequency rather than the tachometer. This assures that the record and reproduce speeds are precisely the same.
13-578 Voice Logging Unit	This unit provides the electronics for recording and reproducing voice data on a special channel along the edge of the tape. A microphone and an auxiliary jack are provided to allow input of voice data.
13-587 Remote Control Unit	The tape transport is adapted for use with an optional remote control unit. This unit is a standard option of the system, and can be provided on special order.
13-580 Shuttle Control Assembly	This unit provides a means for automatic cyclical or repetitive playback of pre-selected portions of recorded tape. The selection of tape to be shuttled is manually selected at a control panel which is mounted in the upper end of the transport control panel. The printed circuit board is installed into J423 of the electronics and relay chassis.
13-599 Footage Counter	This unit is used to count footage of tape passing the capstan from any starting point, and to keep a record of the tape position with reference to that starting point. The counter and driver printed circuit board are mounted at the bottom of the transport control panel. The footage counter printed circuit card is inserted into J422 of the electronics and relay chassis.

Table 1-2. Components Available for VR-3700B System (Sheet 7 of 7)

SECTION II

INSTALLATION

2-1. GENERAL.

2-2. When the equipment is received and installation is to be accomplished, contact the Bell & Howell representative who will assist with installation and checkout.

WARNING

This tape system is unstable when standing upright on its wooden shipping base. The cabinet will tip over if the tape transport is opened before the cabinet is secure in its permanent location.

2-3. LOCATION.

2-4. When choosing the permanent installation site, make sure that the primary power intended for the equipment is of the correct voltage and frequency, and that sufficient current is available at all times. The area should be relatively free from strong electrical or magnetic fields, as these fields may adversely affect the quality of the magnetic recordings. The location should allow sufficient clearance for opening the front dust cover and back access door, as well as clearance on top for the air outlet. Figure 2-1 shows the floor space requirements for installation of a one-cabinet system.

2-5. SYSTEM SHIPPING TIE-DOWN BLOCKS.

2-6. The system is shipped on its back in a shipping crate. Styrofoam sheets are packed over and around the electronics panel circuit board connectors, and the electronics panel power supply heat sinks, before the rear door of the system cabinet is secured with tape.

2-7. PRIMARY POWER CONNECTIONS.

2-8. Operating power requirements for the system are 15 to 20 amps of 105 to 125 volts ac at 47 to 63 Hz, single phase with external ground. Power is applied via the receptacle on the cabinet rear. This receptacle, Bell & Howell part number 129247, mates with the power input connector, Bell & Howell part number 129247-2. Because the length of the power cable is determined by the particular installation site, the cable is not furnished with the system. Cable fabrication data is given in figure 2-2. The power input circuit is shown in a diagram enclosed in Section VII of this manual.

2-9. REMOTE CONTROL.

2-10. By using a Bell & Howell Type 13-587 Remote Control Unit, the tape transport can be operated from remote locations. This unit is often modified because of varying customer requirements. For a remote control installation to fit your specific requirements, contact the local Bell & Howell representative. For systems supplied with a 13-587 Remote Control Unit, a 13-587 Remote Control Unit operation and maintenance manual will be supplied. If

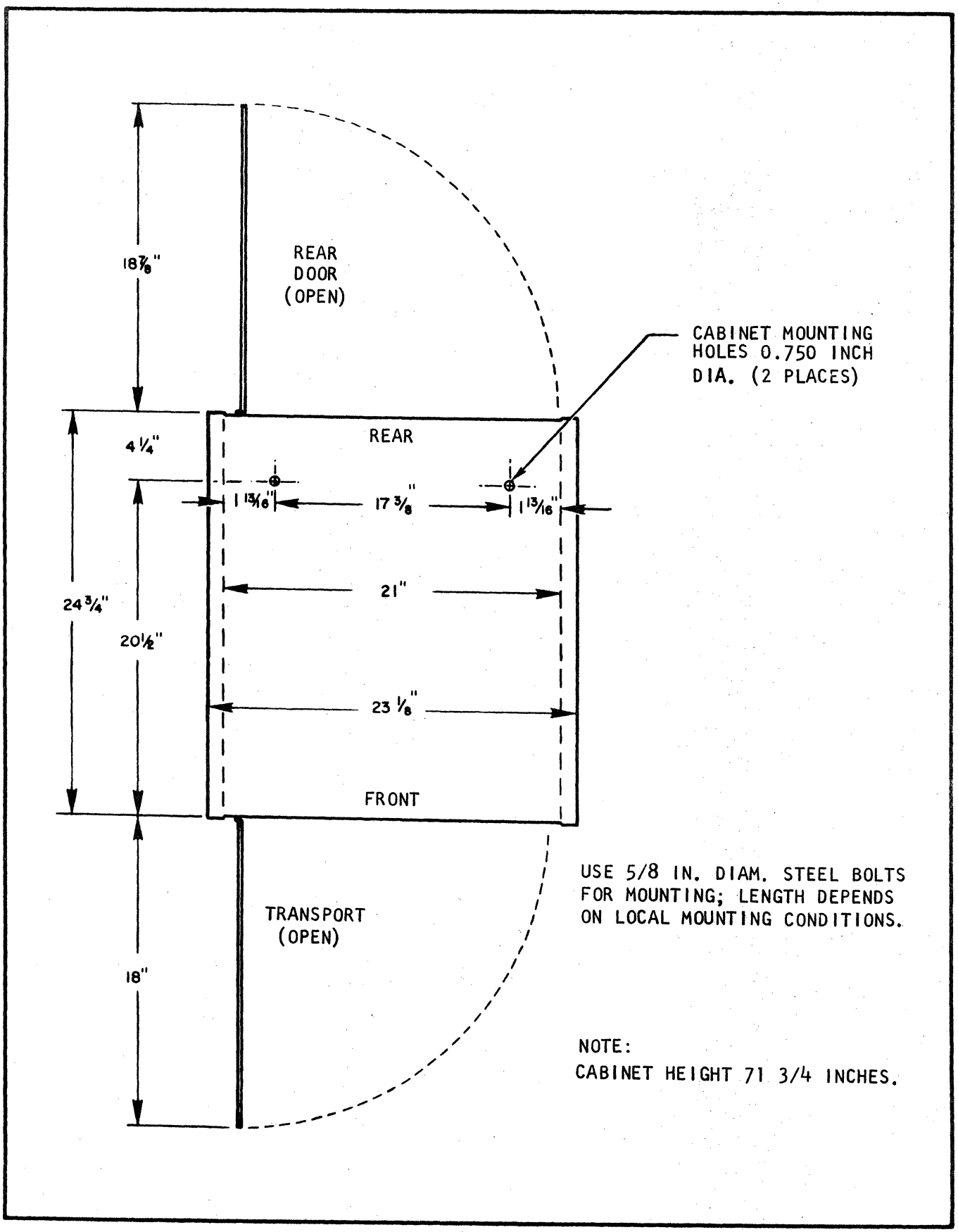


Figure 2-1. Space Requirements for Installation

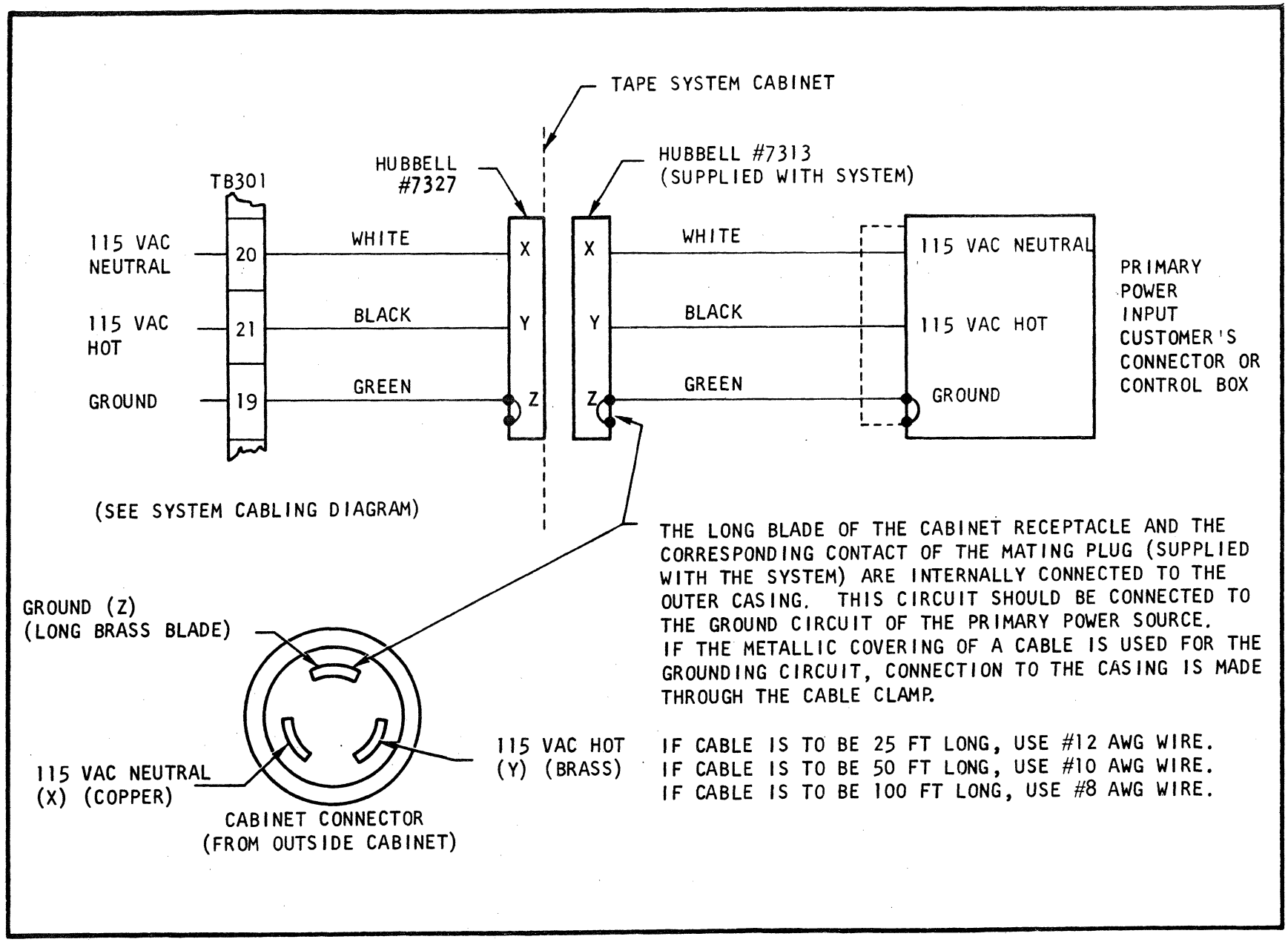


Figure 2-2. Power Cable Construction Data

the VR-3700B System does not have a companion remote control unit, or if the remote control unit is removed, a jumper connector P402 (Bell & Howell part number 472164) must be installed in J402 on the tape transport.

2-11. ENERGIZING THE SYSTEM.

2-12. The primary power is controlled by the circuit breaker on the transport power supply panel and the POWER switch on the transport control panel. An indicator lamp adjacent to the circuit breaker indicates when the power is on. Access to the circuit breaker is available when the transport baseplate assembly is open.

Note

With the circuit breaker CB301 OFF and the main power connector applied to the system cabinet, check the following terminal board points (TB301, inside rear door of system cabinet on rear of transport power supply) for proper phase connection of the ac line cord.

1. Pin 21 to ground 115 vac.
2. Pin 20 to ground zero volts (neutral).
3. Pin 19 to ground zero volts (ground).

2-13. Turn on CB301 and press the tape transport POWER switch. Verify that power light indicators remain on. Using a multimeter, measure the tape transport power supply voltages listed in table 2-1. Terminal strips TB501, TB502, and TB503 are located adjacent to the upper reel motor.

TERMINAL BOARD	FROM PIN (HOT)	TO PIN (COMMON)	VOLTAGE MEASUREMENTS	TOLERANCE
TB501	14	12	-12 vdc	±10%
TB501	11	12	+12 vdc	±10%
TB501	2	3	+5 vdc	±10%
TB503	14	13	-20 vdc	±10%
TB503	12	13	+20 vdc	±10%
TB503	10	13	-28 vdc	See Note
TB502	9	TB503 13	+28 vdc	See Note

NOTE: The +28 vdc and the -28 vdc are unregulated and are therefore affected by ac line voltage and dc load current variations. These voltages, at no load conditions, can be as high as 33 vdc. Under load conditions (such as capstan motor coming up to speed or reversing direction), these voltages can be as low as 22 vdc.

Table 2-1. Transport Power Supply Voltage Measurements at Terminal Boards

2-14. If the voltages in the preceding table are not available, check the fuses in the fuse strip on the power supply plate assembly. Remove power and replace any blown fuses. The output of the power supply can be measured at the fuse mounting assembly. The fuses are clearly tabulated on the transport power supply. A table of circuit breaker and fuse circuits is located in Section V, Maintenance and Calibration.

2-15. SIGNAL INPUT/OUTPUT CONNECTIONS.

2-16. BNC receptacles on the rear of each amplifier mounting assembly provide the input/output signal connections to the system. The cables are not normally furnished and must be fabricated by the user (Type RG-62 cable, or equivalent).

SECTION III

OPERATION

3-1. GENERAL.

3-2. Before leaving the factory, the performance of the magnetic tape record/reproduce system is carefully checked. When received, it can be placed in service immediately after being installed as described in Section II of this manual.

3-3. Before attempting operation of the system or any part of it, personnel unfamiliar with this equipment should read the individual operation and maintenance manuals devoted to the instruments which make up the overall tape system. Even personnel familiar with systems of the same general type should read at least the transport manual. The operator should be familiar with the most frequently used controls and the system interlocks.

3-4. ACCESS. All controls necessary to operate the system are accessible from the front of the cabinet. The transport assembly swings on heavy-duty pivot hinges and locks open for safety and convenience of operating personnel. The amplifier mounting assemblies are mounted below the transport in the lower section of the cabinet. The front covers of the amplifier mounting assemblies swing down exposing the amplifier adjustment controls. All operational controls and test connections for the setup and calibration of the record/reproduce circuits are accessible at the front of the individual amplifiers.

3-5. The amplifier mounting assembly has screw latches on the front of the panel. To release a screw latch, first lift the latch, then turn the latch toward the outside edge of the cabinet.

3-6. To open the transport assembly, first ensure that the dust cover is fully open, then turn the two latch screws (the black knobs at the top and bottom of the baseplate) counterclockwise until they are loose. Grasp the control panel and swing the transport out on its pivots. To close the transport, release the elbow latch, which is attached to the lower left inside corner of the transport, by pressing downward on the button in the center of the latch, then swing the transport closed and tighten the latch screws in the clockwise direction.

3-7. TEST CONNECTIONS AND CONTROLS. Test connections and operator's controls for the components which make up the tape system are described in the individual manuals for the system components. For persons unfamiliar with this equipment, refer to the system description given in Section IV of this manual and/or to the individual manuals for the system components for detailed descriptions, operation and maintenance instructions, illustrations, parts lists, and schematic diagrams.

3-8. SIGNAL CONNECTIONS.

3-9. The internal system cabling (outputs from record amplifiers and inputs to reproduce amplifiers) is connected to receptacles J33 through J48, the lower row of BNC connectors. The user's signal lines (inputs to record amplifiers and outputs from reproduce amplifiers) are connected to receptacles J17 through J32, the upper row of BNC connectors, as indicated by the placarding on the mounting assembly.

Note

The amplifier mounting assembly can accommodate 16 amplifier cards and thus has 16 amplifier slots and 16 sets of input and output connectors. The amplifier slots for channels 15 and 16 are located in the center of the mounting assembly; thus, in the usual 7- or 14-channel system, the two center slots, and the corresponding input and output connectors (J31 and J32, and J47 and J48) on the rear panels, are not used.

3-10. In the typical system configuration, the record and reproduce amplifiers for seven channels are housed in one amplifier mounting assembly. This is true for both 7- and 14-channel systems. (In a 14-channel system, the record and reproduce amplifiers for channels 1 through 7 are housed in one mounting assembly, the record and reproduce amplifiers for channels 8 through 14 are housed in a second mounting assembly.) The record amplifiers are mounted on the left side of the assembly, the reproduce amplifiers on the right. Thus, the record amplifier input cables must be connected to receptacles J24 through J30 and the reproduce output cables to receptacles J17 through J23.

3-11. The amplifiers are numbered from left to right as viewed from the front of the mounting assembly. The connectors on the rear panel are numbered from right to left, with the exception of channels 15 and 16 (connectors J31-J32 and J47-J48) which are in the center.

3-12. CONTROLS AND INDICATORS.

3-13. Table 3-1 lists the transport controls and indicators, their locations, and their functions.

NAME OF CONTROL	LOCATION	FUNCTION
Cabinet Power CB301	Electronics Control Panel	Toggle action circuit breaker, double-pole, single throw, protects primary ac power to entire cabinet. Associated indicator (DS301) lights when power is on.
FAST	Electronics Control Panel	Resistor, variable: Sets the operating speed of the capstan motor in the FAST FWD or FAST REV modes of operation.

Table 3-1. Tape Transport Controls (Sheet 1 of 4)

NAME OF CONTROL	LOCATION	FUNCTION
SEARCH	Electronics Control Panel	Resistor, variable: Sets the capstan motor operating speed in the SRCH mode of operation when the RUN FWD or RUN REV buttons are pushed. Tentatively set at 180 ips, but variable by the operator.
PEOT	Electronics Control Panel	Switch, toggle: Defeats, in the OFF position, the photo end-of-tape control and allows the tape to be completely used or rewound.
TRANSFER REV OFF FWD	Electronics Control Panel	Switch, toggle: Selects the direction the tape transport will run if the TRANS switch is in any position other than OFF, and is connected as a slave tape system, on receiving the transfer command.
POWER	Front Control Panel	Double action, push-on, push-off, backlighted switch: Operates a relay which controls power to the tape transport. Indicator lights when POWER is on.
RECORD	Front Control Panel	Momentary action, pushbutton, backlighted switch: Must be held in while appropriate run button is pushed to overcome interlock which protects against accidentally placed transport in RECORD mode of operation.
FAST REV	Front Control Panel	Momentary action, pushbutton, backlighted switch: Pressed to wind tape at high speed from lower reel to upper reel. Indicator lights when transport is in Fast Reverse.
RUN REV	Front Control Panel	Momentary action, pushbutton, backlighted switch: When pushed, tape motion at selected speed from lower reel to upper reel is established. Indicator lights when transport is in Run Reverse.

Table 3-1. Tape Transport Controls (Sheet 2 of 4)

NAME OF CONTROL	LOCATION	FUNCTION
STOP	Front Control Panel	Momentary action, pushbutton, backlighted switch: When pressed, tape motion in any mode stops and indicator lights. Indicator lights any time transport power is on and the tape is not moving.
RUN FWD	Front Control Panel	Momentary action, pushbutton, backlighted switch: When pushed, tape motion at selected speed from upper reel to lower reel is established. Indicator lights when transport is in Run Forward.
FAST FWD	Front Control Panel	Momentary action, pushbutton, backlighted switch: Pressed to wind tape at high speed from upper reel to lower reel. Indicator lights when button is pushed.
READY	Front Control Panel	Indicator: Lights when tape is properly loaded on the transport, POWER switch is on, and RECORD TEST SELECTOR switch is in NORM position.
TACH/TAPE PHASE LOCK	Front Control Panel	Rotary toggle switch: Selects either servo control of the capstan motor controlled by TACHometer output, or by recorded frequency on TAPE. Appropriate indicator lights only when capstan has reached selected speed. If recorded frequency signal should be lost while operating in the TAPE mode, system will automatically switch to the TACH mode and the appropriate indicator will light.

Table 3-1. Tape Transport Controls (Sheet 3 of 4)

NAME OF CONTROL	LOCATION	FUNCTION
NORM/TEST RECORD TEST SELECTOR	Front Control Panel	Rotary toggle switch: TEST position is used to turn on the record amplifiers for testing purposes without moving the tape. In the TEST position, the transport is interlocked so that it will not operate in any mode. The READY indicator will not light, and since the capstan will not run, neither TACH nor TAPE indicator will light.
RMTE, SRCH, 15/16, 1 7/8, 3 3/4, 7 1/2, 15, 30, 60, 120, 240, TAPE SPEED SELECTOR	Front Control Panel	Rotary selector, 11 position switch: Selects 15/16 to 240 ips speed, search (SRCH), or remote (RMTE) mode of operation of the tape transport. A transport when purchased has facilities for selecting any one of nine speeds.

Table 3-1. Tape Transport Controls (Sheet 4 of 4)

3-14. SUMMARY OF OPERATING PROCEDURES.

3-15. This summary assumes that the system has been previously set up and calibrated and that the only further changes would be the changing of tape reels. Refer to Section V for the system calibration procedures.

3-16. TAPE TRANSPORT OPERATION.

3-17. The following paragraphs provide general instructions for operation of the tape transport. For further details, refer to the tape transport manual.

3-18. OPERATING PRECAUTIONS. The following apply not only to this tape transport, but to any instrumentation tape recorder from which high accuracy and optimum operation are expected.

a. Magnetic tape. Dirty tape or any which appears worn should be discarded as unreliable. Dust or dirt on the tape will lift it away from the heads and cause excessive tape dropouts. Excessively worn tape or tape with jagged or uneven edges may cause mistracking and loss of signal.

b. Tape reels. The quality and condition of the tape reels used on any tape transport have a significant effect on the quality of tape recordings and reproductions. Excessive unbalance or misalignment of the reels may cause mistracking of the tape or flutter, or both, resulting in degradation of the accuracy of recorded signals.

c. Dust and dirt accumulation. To avoid dust contamination to the magnetic tape and to the tape transport, leave the dust cover closed whenever possible. As periodic inspection indicates, the head stacks, the pinch rollers, and the capstan shaft should be cleaned. See the preventive maintenance procedures in the tape transport manual.

Note

Cleaning the tape transport components is important. Most tape manufacturers coat their tapes with a lubricant which gradually forms a coating on components with which it comes in contact. Dirty pinch rollers or a dirty capstan shaft may cause loss of positive capstan control of the tape speed. Excessive tape deposits on the head stacks are detrimental to close tape-to-head contact and may cause excessive tape dropouts as well as deterioration in the system high frequency response. See Section V, paragraph 5-7, for detailed procedures on cleaning the tape handling components.

d. Demagnetization. It is extremely important that tape transport components which come in contact with the tape, particularly the record and reproduce heads, do not become magnetized. Magnetized components degrade the system signal-to-noise, cause excessive second harmonic distortion in recorded signals, and act to induce spurious flux fields into the magnetic tape. See Section V, paragraph 5-24, for detailed procedures on degaussing magnetized components. If the following precautions are observed, little difficulty should be encountered in this respect.

1. Do not remove record amplifiers from their mounting assemblies while recording.

2. Do not saturate the record heads with abnormally high input signals or unbalanced pulses.

3. Do not connect an ohmmeter or any other dc measuring device or dc source across the head windings, for the presence of dc current will magnetize the heads, and the dc current may be sufficient to damage the head windings.

4. Do not allow magnetized components to come in contact with the tape transport components.

5. Do not locate the equipment in strong electrical or magnetic fields.

6. As performance checks indicate, demagnetize the magnetic heads and any other applicable tape handling components.

3-19. MAGNETIC TAPE.

3-20. The type of recording tape used with a magnetic tape system is a very important factor in determining the overall performance of that system as well as the life of the magnetic heads. Frequency response, signal-to-noise ratio, and distortion, all of which are interdependent factors, are determined to a great extent by the type of magnetic tape used. Once a system is adjusted for one type of tape, changing to another manufacturer or type will probably require readjustment of the system.

3-21. For wide band recording, use Minnesota Mining and Manufacturing Company Type 888 tape, or equivalent. For intermediate band recording, use Minnesota Mining and Manufacturing Company Type 871 tape, or equivalent.

3-22. To find recording time in minutes, divide the length of tape in feet by 5 times the tape speed in inches per second.

3-23. All system specifications are based on the use of precision reels.

3-24. INSTALLING TAPE REELS.

3-25. To install a tape reel onto the hub assembly, turn the knurled knob of the hub assembly fully counterclockwise; this will withdraw the three finger actuators into the hub assembly. Place the reel over the hub assembly and press firmly. Lock the reel onto the hub assembly by turning the knurled knob fully clockwise. Inspect the three finger actuators to make certain that they are holding the reel firmly in place. To remove the reel, turn the knob assembly counterclockwise and lift off the reel by pulling evenly away from the hub assembly.

3-26. TAPE THREADING.

3-27. Thread the magnetic tape onto the tape transport as follows:

a. Place the supply reel (upper reel) of tape on the upper reel hub and lock in place so that the tape will feed from the top of the reel, from left to right.

b. Place the takeup reel (lower reel) on the lower reel hub and lock in place.

c. Pull approximately three feet of tape leader off the upper reel.

d. Thread the tape through the tape path as shown in figure 3-1.

e. Wrap the tape around the takeup reel (lower reel) in a clockwise direction, and back off the leader until all slack is taken up.

f. Holding the tape end with an index finger, rotate the lower reel clockwise until the tape locks itself onto the reel with the overlap.

CAUTION

Do not let the tape double up under the first wraparound. That is, the leader should be flush against the inner hub of the lower reel so that there is no bump or bulge where the tape starts to wrap onto the lower reel.

3-28. TAPE TRANSPORT SAFETY INTERLOCKS AND EQUALIZATION CONTROL.

3-29. RECORD CIRCUITS AND CAPSTAN MOTOR INTERLOCKS. The record circuits are interlocked so that they receive power only when the transport is switched to the RECORD mode of operation. The reproduce circuits are energized in all operating modes. If desired, during the RECORD/RUN FWD mode, the data recorded on the tape may be monitored at the reproduce amplifier outputs.

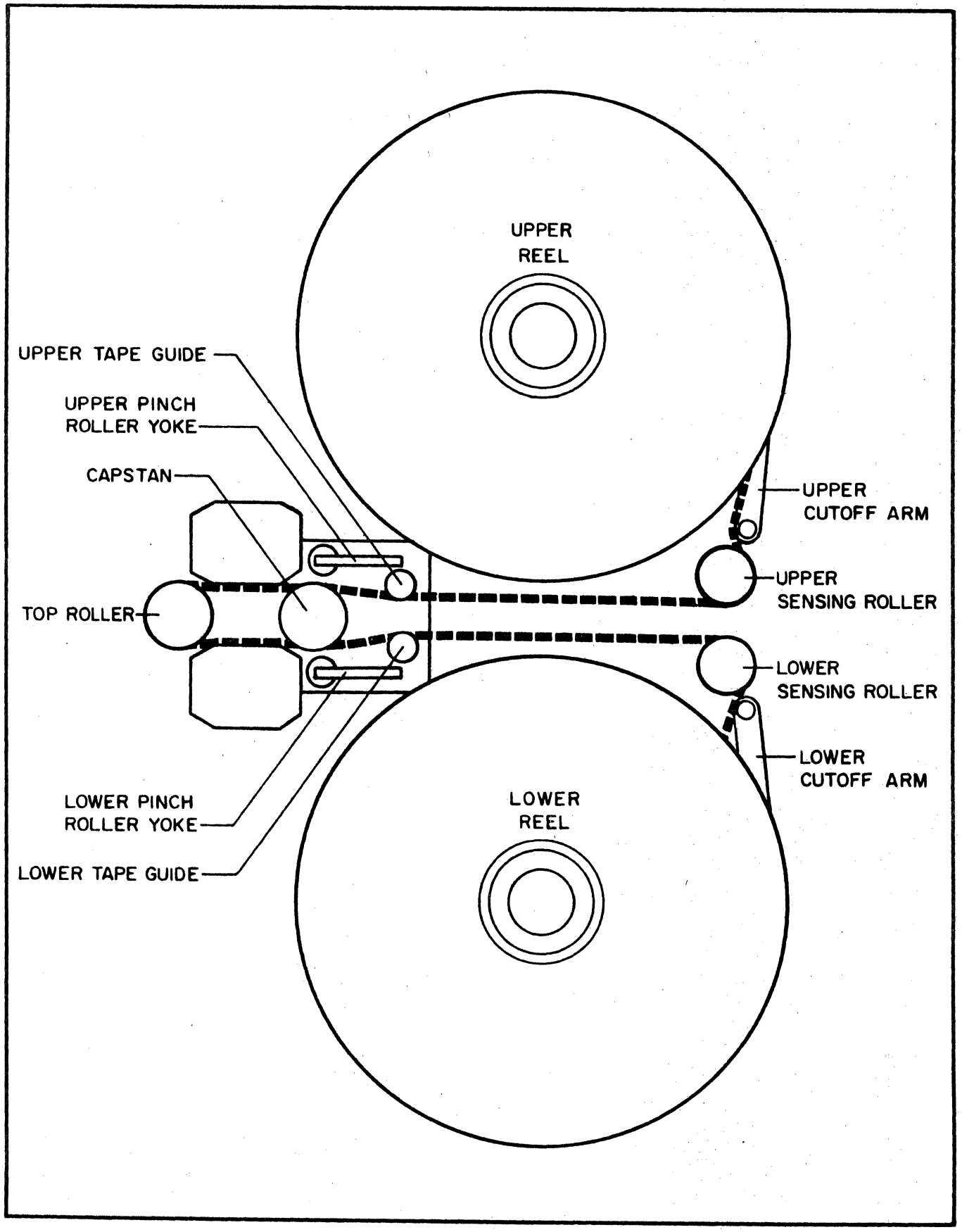


Figure 3-1. Tape Installation Threading Path

3-30. For the operator's convenience when initially setting up and calibrating the record amplifiers, a test-normal switch is provided on the transport control panel. To turn on the record amplifiers for testing or calibration without running tape in the record mode, set the test-normal switch in the TEST position.

Note

Before operating the transport, make sure that the test-normal switch is in the NORMal position. When the test-normal switch is in the TEST position, the RECORD indicator on the transport lights, and the transport will not operate in any mode.

3-31. NO-TENSION/END-TAPE. The transport will not operate in any mode until tape is threaded. If tape goes slack while operating in any mode, the mechanical brakes will be automatically applied and all tape motion will stop. When tape has completely run off either of the reels, the mechanical brakes will automatically operate to stop the reels.

3-32. PHOTO END-OF-TAPE. The tape transport automatically stops when the tape stack on either the upper or the lower reel diminishes to a radial stack of 1/16 to 1/8 inch. Once stopped by the end-of-tape sensors, the transport can be operated in any mode until all tape has been removed from the reel.

3-33. FAIL-SAFE MECHANICAL BRAKES. Power must be available to release the mechanical brakes. Therefore, if a power failure occurs during any of the operating modes, the brakes will be applied and automatically stop tape motion.

3-34. ELECTRONIC EQUALIZATION. The record electronics are turned on only in the record mode. The reproduce electronics are turned on in all modes. The transport speed selection circuits automatically switch the appropriate speed-selective elements into the electronics to correspond to the selected tape speed.

3-35. SPEED SELECTION.

3-36. Any of the tape transport speeds may be selected by rotating the TAPE SPEED SELECTOR switch. Tape speeds may be changed during tape travel, allowing approximately a four-second delay for the tape to obtain the selected speed when switching between the lowest and highest tape speeds. When the FAST FWD speed is suddenly changed to FAST REV speed, approximately a twelve-second delay is required for the tape to obtain the selected speed.

3-37. MODE SELECTION.

3-38. Operating modes, except the record mode, are selected by pressing the appropriate button on the control panel. (Refer to table 3-1 for control functions.) The record mode is selected by holding down the RECORD pushbutton and, while it is depressed, actuating and releasing the RUN button, then releasing the RECORD button. The purpose of this required double action is to prevent any accidental recording which might occur during the playback of previously made recordings. (Such a double recording would destroy the original.)

3-39. When the tape transport is switched to different modes with or without passing through the stop mode, no tape damage will take place because of the interlocks and delays incorporated. The READY indicator light (green) remains on throughout tape transport operation.

3-40. STOP. At any time that it is desired to stop all tape motion, press the STOP button and the tape will rapidly and smoothly stop. Once stopped, the transport will remain in the standby condition, ready for the next command. Pressing the STOP switch when tape is traveling at the highest tape speed will require approximately five seconds for tape travel to stop. During this delay period, the tape transport will not start in the run or record modes. However, any of the other operating modes may be initiated in the normal way.

3-41. TRANSPORT ADJUSTMENTS.

3-42. If the action of the transport in operation indicates a possible need for adjustments, see the transport manual for the proper procedures.

3-43. OPTIONAL CONTROL EQUIPMENT.

3-44. The 13-501 Tape Transport has the capability of including the following control equipment.

3-45. REMOTE CONTROL. In the RMTE position of the tape speed selector switch, control of the tape transport is transferred to a remote control station. The remote control unit is built to customer order and parallels the five operating mode controls so that the transport can be operated from a remote location.

3-46. PHASE LOCK SELECTOR. In the TAPE position of the phase lock selector switch, servo control of the capstan motor is referenced to a prerecorded signal on one data channel. Should the recorded signal fail, the transport will automatically reference the capstan servo to the sine wave generator, this condition being indicated by the light above the TACH position of the switch.

3-47. PHOTO END-OF-TAPE AND TRANSFER SWITCHES.

3-48. PHOTO END-OF-TAPE DEFEAT SWITCH. The photo end-of-tape has a defeat switch (S401) which, in the ON position, will allow the PEOT sensors to stop the transport prior to running out of tape. In the OFF position, the switch will override the PEOT sensors and allow the transport to run completely out of tape.

3-49. TRANSFER FUNCTION.

3-50. TRANSMITTING SYSTEM. When in the record mode of operation and the PEOT is activated, a contact closure is provided at TB403 between pins 2 and 3, and is applied to TB403-1 and -4 of the receiving system for record/transfer operation.

3-51. RECEIVING SYSTEM. Switch S402 on the receiving system determines whether, and in what direction (Record Forward or Record Reverse), the receiving system will move tape.

3-52. When S402 is in the OFF position, the receiving system will not accept the command from the transmitting system. When the transmitting system provides a contact closure, the receiving system will enter the record reverse mode when S402 is in the REV position, and the record forward mode when S402 is in the FWD position.

Note

Systems may be interconnected such that they will transfer back and forth between each other.

3-53. RECORDING DATA.

3-54. GENERAL. The following procedures assume that the tape transport is properly aligned and that the record and reproduce amplifiers have been previously aligned and adjusted for a predetermined maximum signal input level as required by the user. Upon completion of initial alignment, all readings should be recorded as a guide for failure equipment checks. Do not attempt any adjustment of the controls during the following procedure. If readings are out of tolerance, refer to the system calibration procedures in Section V.

Note

The record/reproduce system must be calibrated whenever amplifiers are interchanged, a different type of tape is used, or when the system is converted to another bandwidth category. If the tape system is supplied with FM recording and reproducing capability, the center frequency at the record amplifier should be checked daily.

a. Open the transport from the rack and set the power circuit breaker CB301 to ON. Close the transport.

b. Thread tape on the transport in normal manner (see paragraph 3-26).

c. For recording data, set the TAPE/TACH switch to TACH.

d. Check that the signal lines (inputs to the record amplifiers and outputs from the reproduce amplifiers) are connected. Refer to paragraph 3-8.

e. Press the POWER pushbutton indicator, transport control panel. The STOP, POWER, and READY indicators will illuminate. Allow 15 minutes warmup time for system components to stabilize.

f. Set the TAPE SPEED SELECTOR, transport control panel, to the desired tape speed. In general, the tape transport should be operated at the lowest tape speed consistent with the frequency range of the signals to be recorded and the recording technique used. The system specifications in Section I of this manual indicate the frequency range of signals which can be recorded by each method. The recording time available at each tape speed can be computed by dividing the length of the tape in feet by five times the tape speed in inches per second.

g. Apply the data input signal to the record amplifiers at the BNC receptacles on the rear of the amplifier mounting assembly.

h. If necessary, adjust the signal amplitude to the normal record level, as described in the calibration procedures, Section V. Set the RECORD TEST SELECTOR switch to NORMal.

i. Simultaneously press the RECORD and RUN FWD pushbuttons on the transport control panel. The tape will move smoothly from the supply to the bottom reel under precise control; the record circuits will turn on; the data signals applied to the record amplifiers will record on magnetic tape. The RECORD and RUN FWD pushbutton indicators will illuminate. When the end-reel condition is reached, the tape transport will automatically stop, turning off the record electronics and the RECORD and RUN FWD indicators. If the TRANSFER switch on a standby transport is set to REC REV or REC FWD, operation will automatically transfer to the standby transport when the master transport senses photo end-of-tape (PEOT).

j. To stop the recording operation at any time, press the STOP switch on the transport (or on the remote control unit if one is used).

3-55. RECORDING THE SERVO CONTROL TAPE SIGNAL.

3-56. To reproduce data under control of a tape servo signal, it is necessary to record a servo control tape signal. The servo control tape signal can be directly recorded on tape or multiplexed with the data signal. Servo signal recording is always done with the PHASE LOCK SELECTOR switch set to TACH and the system in the RUN FWD (record) mode. Refer to maintenance and calibration procedures in Section V for the proper setup and calibration for either direct recording or multiplexing the servo signal.

3-57. REPRODUCING DATA.

3-58. To reproduce data recorded on magnetic tape using a VR-3700B System, proceed as follows:

a. Check that the equipment has been calibrated as described in Section V.

b. Open the transport from the rack and set the power circuit breaker CB301 to ON. Close the transport.

c. Thread tape on the transport in normal manner (see paragraph 3-26).

d. For reproducing data under tape servo control, set the TAPE/TACH switch to TAPE. For reproducing data under tachometer control, set the TAPE/TACH switch to TACH.

e. Set the RECORD TEST SELECTOR to the NORMal position.

f. Set the TAPE SPEED SELECTOR, transport control panel, to the desired tape speed required by the tape to be reproduced.

g. Check that the reproduce signal lines are connected to the desired external equipment, using the BNC receptacles on the back of the amplifier mounting assembly. Be sure that the outputs of the reproduce amplifiers are properly loaded as described in the system specifications.

h. Press POWER pushbutton indicator, transport control panel. The STOP, POWER, and READY indicators will illuminate. Allow 15 minutes warmup time for system components to stabilize.

i. Press the RUN FWD pushbutton switch. The tape will move smoothly from the top reel to the bottom reel under precise capstan control, and the data recorded on the magnetic tape will be reproduced through the reproduce heads and amplifiers. The POWER and RUN FWD indicators will illuminate during the RUN FWD (reproduce) mode. When the end-reel condition is reached, the transport will automatically stop.

j. If necessary, adjust the signal output to the desired level for the type of amplifiers being used (see Section V, system maintenance and calibration procedures).

k. To stop the transport before end-reel, press the STOP pushbutton.

SECTION IV

SYSTEM DESCRIPTION

4-1. GENERAL.

4-2. This section of the manual briefly describes each major component of the system. For further details pertaining to the components of the system, refer to the separate operation and maintenance manuals for the components, supplied as companion manuals to this system manual.

4-3. Figure 4-1 shows the signal flow through the system. All input/output signal connections are made with BNC connectors at the rear of the amplifier mounting assemblies.

4-4. The amplitude/time relationships of analog input signals to be recorded on tape are amplified by the direct record amplifier. The output of the direct record amplifier is connected to the magnetic recording heads, via the record head driver amplifier.

4-5. As the transport moves tape past the head, the record head induces magnetic fields into the oxide coating on the tape. These fields are proportional in intensity (amplitude) and correspond in polarity to the signals applied to the record head winding.

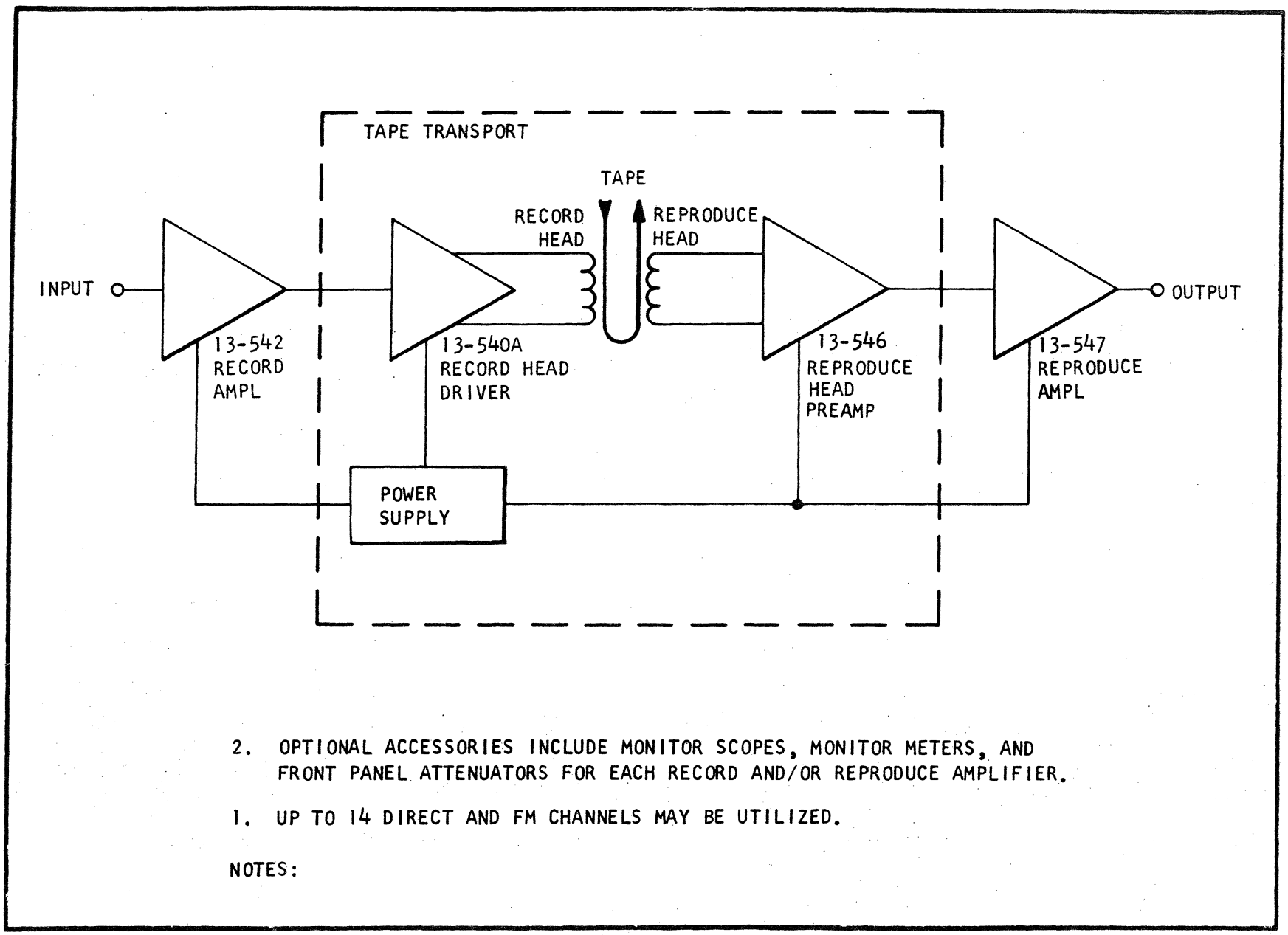
4-6. When the recorded tape moves past the reproduce head, the magnetic fields in the tape induce a voltage into the reproduce head winding. Output signals from the reproduce heads are applied to reproduce head preamplifiers, which are mounted close to the reproduce heads to prevent loss of high frequency components due to cable capacitance. From the preamplifiers, the reproduced signals are applied to the reproduce amplifiers. The direct reproduce amplifiers equalize the head response and provide additional signal amplification. Speed selective elements used in the reproduce amplifiers, are controlled automatically by the tape transport speed selection circuit.

4-7. The frequency range of the system is 0 (dc) to 600 kHz using frequency modulation (FM) techniques, or 100 Hz to 2 MHz with direct recording techniques.

4-8. TAPE TRANSPORT.

4-9. The 13-501 Tape Transport is a precision mechanism used to move 1/2 inch or 1 inch wide magnetic tape at precisely controlled record and reproduce tape speeds of 240, 120, 60, 30, 15, 7 1/2, 3 3/4, 1 7/8, and 15/16 inches per second. These tape speeds are electrically selected by front panel controls. The tape is held on reels of either 10 1/2, 14, or 15 inch diameter, with NAB hub dimensions.

4-10. On the 13-501 Tape Transport the bias frequency, capstan reference frequency, and the record servo reference frequency are obtained from the reference generator circuit board that plugs into J418 of the electronics and relay chassis. A complete description of this board assembly and the tape control servo loop is in Section IV of the tape transport manual. The following paragraphs summarize these circuits. The record servo reference frequency and bias paths are illustrated in figure 4-2.



2. OPTIONAL ACCESSORIES INCLUDE MONITOR SCOPES, MONITOR METERS, AND FRONT PANEL ATTENUATORS FOR EACH RECORD AND/OR REPRODUCE AMPLIFIER.

1. UP TO 14 DIRECT AND FM CHANNELS MAY BE UTILIZED.

NOTES:

Figure 4-1. System Signal Flow Chart

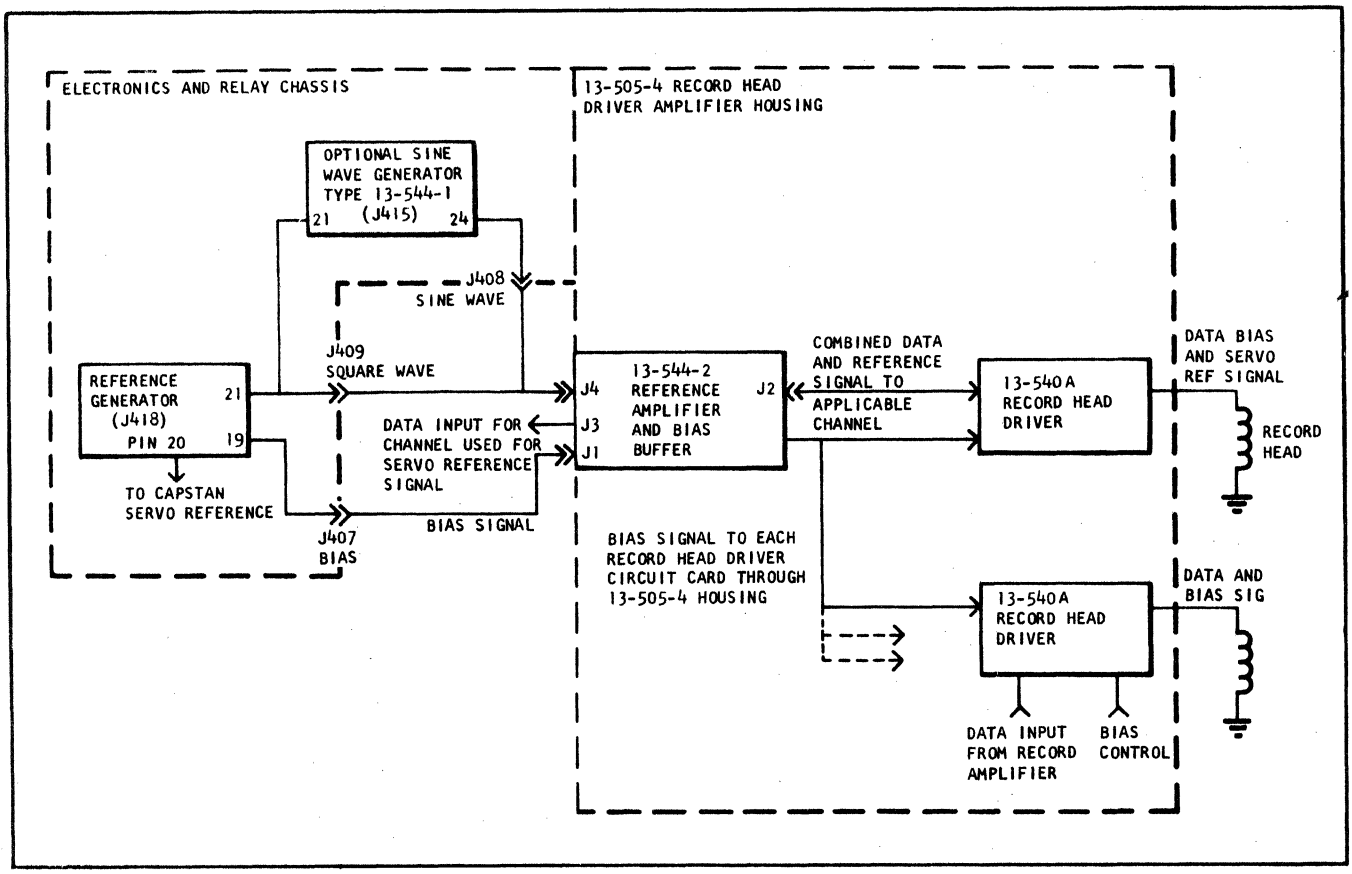


Figure 4-2. Record Servo Reference and Bias Signal Flow Chart

4-11. The capstan controls both the supply and the takeup of tape past the record and reproduce heads during all modes of operation.

4-12. The capstan motor drive is servo controlled to provide stable operation at all selected speeds from 15/16 ips to 240 ips. A dc feedback phase lock system detects and corrects for any phase shift and/or speed variations. A servo reference frequency generator signal is compared with the tachometer or tape signal at 180 degree phase shift. A dc voltage representing any variations between the two signals is fed back to the capstan power amplifier, thereby controlling the speed of the capstan motor and phase locking it at the selected speed.

4-13. Closed loop servo systems drive the reel motors and maintain uniform tape tension in all transport modes of operation. Search forward and search reverse modes are provided to rapidly scan data recorded on the tape. The search speed is adjustable, and controlled by variable resistor R403 on the electronics and relay panel.

4-14. The bias reference circuit is part of the reference generator board assembly. The unit contains a crystal controlled bias oscillator. By means of appropriate jumpers, 4 MHz, 8 MHz, or 16 MHz can be used. The 8 MHz signal is normally used in the VR-3700B system. The bias signal is fed to the 13-544-2 Reference Amplifier and Bias Buffer and then to each 13-540A Record Head Driver. When the system is in direct record mode of operation, a bias control voltage enables the bias circuit of the record head driver. In all other modes of operation the bias signal is inhibited. When the FM record amplifier is installed, it disables the bias circuit.

4-15. End-of-tape sensing circuits are incorporated in the transport to automatically stop the transport when the supply of tape on either reel ends, or if control of tape tension is lost. Photo end-of-tape (PEOT) sensors are also incorporated to automatically stop the transport before the end-of-tape condition is reached.

4-16. The transport power supply provides all operating power for the system electronic components. The primary power is wired through a master circuit breaker on the electronics and relay chassis. With the circuit breaker closed, power is applied to the system by pressing the power switch on the control panel. The power supply provides three separate stabilized dc supply circuits: ±28 vdc, ±20 vdc and +5 vdc. The power supply also provides 28 vac. The ±28 vdc circuits are employed in the relay logic of the electronics and relay chassis. The ±20 vdc is supplied to the amplifier mounting assembly where it is further regulated to ±15 vdc for the amplifier boards. The +5 vdc is used in the tachometer lamp circuit and the circuit cards in the electronics and relay chassis. The 28 vac supply provides power to illuminate the upper and lower PEOT lamps in the transport. The power supply is also the junction point for the tape equalization circuits.

4-17. REPRODUCE HEAD PREAMPLIFIER.

4-18. The 13-546 Reproduce Head Preamplifier contains four preamplifier circuits per card assembly. The preamplifiers amplify the low-level signal from the reproduce head to reduce the effects of noise pickup, and high frequency loss in signal cables. A preamplifier circuit is used with each channel. Four 13-546 Reproduce Head Preamplifier circuit cards can be housed within the 13-505-3 Preamplifier Mounting Assembly. The housing provides all signal and power distribution facilities for the reproduce head preamplifiers. By mounting the preamplifiers close to the reproduce heads, high frequency loss due to cabling capacitance is minimized.

4-19. AMPLIFIER MOUNTING ASSEMBLY.

4-20. The Type 13-505 Amplifier Mounting Assembly houses all end-connected amplifiers used in the VR-3700B System. The mounting assembly can house up to 16 direct or FM record and/or reproduce amplifiers. The mounting assembly contains dc voltage regulators which furnish power to the amplifiers. The mounting assembly routes all signals between the transport and the amplifiers: record control, FM squelch, and nine speed control lines (for switching amplifier components that must change as a function of tape speed), as well as one bias control line for each amplifier.

4-21. In a seven-track tape system, one mounting assembly houses all of the record and reproduce amplifiers. The record amplifiers are usually on the left and the reproduce amplifiers on the right (as viewed from the front of the assembly). With a 14-channel system, two mounting assemblies are required. The record amplifiers are usually housed in the upper assembly and the reproduce amplifiers in the lower assembly.

4-22. Channel positions (seen from the front of the mounting assembly) are numbered from left to right: 1 through 7, then two spare channels (15 and 16), then either 8 through 14 or 1 through 7 again, depending on system configuration. All amplifier connectors are wired identically. Corresponding electrical connectors on the rear panel are numbered from right to left.

4-23. Data signal input and output connectors are made via two rows of BNC connectors on the rear panel of the mounting assembly. Power and control connectors from the transport are made via one 42-pin connector in the center of the rear panel. An additional 20-pin coaxial connector is used only on the 13-505A assembly for monitor connections. Immediately

forward of the rear panel is the printed circuit board which contains the voltage regulator circuits and the control, squelch, and speed control relays.

4-24. DIRECT RECORD/REPRODUCE CIRCUITS.

4-25. Each direct record/reproduce channel consists of a direct record amplifier, a record head driver, a reproduce head preamplifier, and a direct reproduce amplifier (see figure 4-1). The bias oscillator provides an 8 MHz bias signal to the record head driver. The head preamplifier provides the input signal to the direct reproduce amplifier.

4-26. In direct recording, the amplitude/time relationship of the input signals are recorded directly on magnetic tape linearly mixed with the bias signal. The direct record amplifier amplifies the data input signal to the required level, and drives the record head with a current directly porportional to the input signal. The bias is mixed in the record head driver stage. High frequency bias is used because the flux density induced into a magnetic medium does not vary linearly with the magnetizing force. The bias signal overcomes this hysteresis nonlinearity characteristic of the magnetic tape.

4-27. Signals recovered from the tape by the reproduce heads are amplified by a low level preamplifier. The output of the preamplifier is applied to the input of the direct reproduce amplifier. The direct reproduce amplifier equalizes, for both frequency and phase, and amplifies the signal to a level of one volt rms.

4-28. FM RECORD/REPRODUCE CIRCUITS.

4-29. In frequency modulation recording, the amplitude/time relationship of the data input signal is first converted to a frequency/time relationship and then recorded on magnetic tape; thus the FM record amplifier changes amplitude modulated data to FM modulated data. The amount of frequency deviation from center frequency is determined by the amplitude of the source data signal. The rate at which the frequency to be recorded varies about the center frequency is determined by the frequency of the data signal.

4-30. FM recording has dynamic range capabilities resulting from the fact that a record amplitude excursion is not restricted by the level at which magnetic saturation of the tape occurs. Side benefits of this principle are improved linearity and relative freedom from dropouts. Low frequency response extends to dc. The frequency modulated signal is recovered by the preamplifier before being applied to the FM reproduce amplifiers for restoration of the data signal.

SECTION V

MAINTENANCE AND CALIBRATION

5-1. GENERAL.

5-2. Maintenance on the magnetic tape record/reproduce system should be performed only by qualified technicians and personnel familiar with this type of equipment. Maintenance consists of both preventive maintenance, which should be regularly scheduled, and corrective maintenance, which includes troubleshooting and repair, replacement or adjustment of any assembly or component found to be inoperative during preventive maintenance checks, performance checks, or troubleshooting.

5-3. COMPONENT IDENTIFICATION.

5-4. Figure 1-1 in Section I of this manual is an illustration of the complete magnetic tape record/reproduce system. Detail parts of the components are identified in the individual assembly manuals. The individual assembly manuals also contain complete parts lists and schematic diagrams of each unit and its submodules. A parts list of the cabinet and its accessories is listed in Section VI of this manual and cable diagrams and schematic diagrams of the system are included in Section VII.

5-5. PREVENTIVE MAINTENANCE.

5-6. GENERAL. To ensure trouble-free operation of the system, perform the preventive maintenance procedures detailed in the individual manuals for the components which make up the system. After the relevant parts of the individual manuals have been read at least once, the following paragraphs can be used as a brief summary for ready reference.

Note

No details are given here regarding the overall maintenance of the tape transport. The transport requires maintenance procedures different from those applicable to the other system components, and some of these procedures must be performed frequently. For details, refer to the tape transport manual.

5-7. CLEANING THE HEADS AND TAPE HANDLING COMPONENTS. Schedule daily or every eight hours of operation. Clean all surfaces contacted by the magnetic tape. Use a soft, lint-free cloth, moistened, not saturated, with DuPont Freon TF. Be careful not to scratch or mar the surface of the components, and be sure to remove all excess fluid after cleaning.

Note

Freon TF, a DuPont product, is available from Freon Solvent Sales Agencies. Freon TF is nontoxic and nonflammable. Do not use carbon tetrachloride, alcohol, trichloroethylene, or any cleaning agent which might be detrimental to the tape or tape handling surfaces. Dirty tape may also be cleaned with Freon TF.

5-8. SYSTEM MAINTENANCE. The normal period for preventive maintenance of the system components other than the transport is three months, but this time may be increased or decreased as experience indicates may be advisable to suit the environment and operating requirements of each individual installation.

5-9. To begin the actual preventive maintenance, remove power from the system.

Note

As printed wiring boards are extracted, tag them or put them down in the same order as they were installed in the equipment, so that they can be replaced in their original positions. Interchanging printed wiring boards may require readjustment of the system.

CAUTION

When handling any of the long printed circuit boards, use extreme care not to bend the board as this could cause permanent damage to the circuit by cracking or separating the etched circuit. Be careful when handling any printed wiring board, and especially when cleaning it, not to scratch the printed wiring. Scratching the wiring can cut through a connection.

5-10. Remove dust, dirt, grease, and other foreign material from the system. Clean delicate parts with a soft brush and larger harder surfaces with a cloth. If necessary, use a suitable cleaning solvent. Blow away the loosened particles using low-pressure air.

5-11. Inspect all parts for signs of damage or deterioration, insecurity of mounting, or loose connection, and repair or replace as required.

5-12. Inspect all electrical contacts and clean as required using a standard contact cleaning fluid.

5-13. Clean air filter in bottom front of cabinet, monthly.

5-14. TROUBLESHOOTING.

5-15. The discussion of system troubleshooting is restricted to suggestions of techniques for pinpointing trouble to a particular assembly. Once the faulty component is located, normal troubleshooting procedures can be found in the individual manual for that assembly. The following paragraphs suggest a few possible locations for causes of various symptoms.

5-16. Troubles in a magnetic tape recording/reproducing system are of four types:

a. Troubles affecting tape movement.

b. Troubles affecting the data recorded or reproduced.

c. Troubles affecting auxiliary functions of the system.

d. Troubles which are not apparent during normal operation but are indicated by failure of the equipment to respond properly to adjustment.

5-17. TAPE MOVEMENT FAULTS. Table 5-1 lists common tape movement faults and possible causes.

SYMPTOMS	POSSIBLE CAUSES
No tape movement	1. Tape not properly threaded (especially, not threaded through end-of-tape cutoff assembly). 2. If remote control unit is not used, jumpers not properly installed in its place. 3. If remote control unit is used, jumpers not removed. 4. RECORD TEST SELECTOR switch not set to NORM. 5. Faulty reeling motor. 6. Faulty brake, brake solenoid, or solenoid energizing circuit. 7. Faulty end-of-tape circuit.
Sluggish tape movement	1. Faulty motor or motor control circuit. 2. Faulty brake.
Tape movement at wrong speed (in any RUN mode)	1. Faulty speed selection circuit.
Excessive speed in any RUN mode	1. Faulty capstan motor or associated power or control circuit.
Tape slack between supply reel capstan	1. Faulty supply reeling motor or associated power or control circuit.
Tape not winding properly onto takeup reel	1. Faulty takeup reeling motor or associated power or control circuit.
Inaccurate speed or varying speed in RUN mode	1. Faulty speed control servo.

Table 5-1. Tape Movement Faults and Possible Causes (Sheet 1 of 2)

SYMPTOMS	POSSIBLE CAUSES
Tape breaking, any mode	1. Faulty relay logic. 2. Faulty braking.
Loop throwing on starting any RUN or FAST mode	1. Reel servo control misadjusted.
Loop throwing on stopping, any mode	1. Brakes misadjusted.
Faulty tape stacking, any mode	1. Faulty reel or reels. 2. Faulty tape. 3. Rollers not properly aligned.
Mistracking, any mode	1. Faulty reel or reels. 2. Pinch roller not properly aligned. 3. Other rollers not properly aligned.

Table 5-1. Tape Movement Faults and Possible Causes (Sheet 2 of 2)

5-18. SIGNAL FAULTS. Table 5-2 lists common signal faults and possible causes (see also paragraph 5-20).

SYMPTOMS	POSSIBLE CAUSES
No signal or weak signal	1. Dirty head. 2. Faulty head (open winding, shorted gap). 3. Faulty preamplifier or amplifier. 4. Faulty signal wiring. 5. Faulty power supply. 6. Faulty power wiring. 7. Faulty monitor equipment (giving indication of no signal or weak signal when signal actually is normal).

Table 5-2. Signal Faults and Possible Causes (Sheet 1 of 2)

SYMPTOMS	POSSIBLE CAUSES
Dropouts of portions of signal	1. Dirty tape. 2. Dirty head.
Distorted signal (even harmonic distortion)	1. Magnetized head.
Periodic distortion or interference (synchronized with rotation of roller)	1. Magnetized roller.
Noise (on FM data)	1. Flutter in tape transport.
Noise (on direct data)	1. Faulty preamplifier, amplifier, or signal wiring. 2. Spurious signal originating in tape transport or elsewhere, because of arcing, loose connection, cold solder joint, faulty switch or relay, open capacitor or diode, or oscillating amplifier.

Table 5-2. Signal Faults and Possible Causes (Sheet 2 of 2)

5-19. FAULTS IN AUXILIARY FUNCTIONS. For information regarding the location of faults in monitor, voice logging, or shuttle control equipment, see the corresponding technical manual.

5-20. FAULTS REVEALED DURING ADJUSTMENT. Table 5-3 lists common adjustment faults and possible causes.

SYMPTOMS	POSSIBLE CAUSES
Adjustment of equalization has no effect at one or more speeds	1. Speed selector equalizer switching faulty.
Adjustment of equalization for one or more tracks cannot produce adequate high frequency response	1. Dirty heads. 2. Head gaps have opened (head must be replaced).

Table 5-3. Adjustment Faults and Possible Causes

5-21. TROUBLESHOOTING RECORD/REPRODUCE CIRCUITS. Trouble in these circuits frequently may be located by tracing signals and checking power supply voltages. Signal flow through the system can be traced by applying an input signal and measuring the output signal from each amplifier while simultaneously recording and reproducing data (in the record mode). Amplitude of signal output from an amplifier can be observed on the monitor meter, if provided as part of the system. The record signal waveform can be observed with an oscilloscope at the optional record head driver test jack J7 (see paragraph 5-22). Outputs of reproduce amplifiers can be observed with an oscilloscope at the output test point (TP1, direct reproduce; TP3, FM reproduce). For the proper amplitudes and waveforms in the various types of record and reproduce amplifiers, see the calibration procedures in this section, or the individual manuals for the amplifier. The following list (a through e) explains possible symptoms and solutions for this system.

a. If the record or reproduce signal is absent in a particular channel, try substituting another amplifier from a channel which is working properly.

b. If the second amplifier fails to produce a signal, check the connector on the mounting assembly, its wiring, the head cabling, head connector, and the head itself.

Note

Do not interchange amplifiers indiscriminately. This applies especially to the direct reproduce amplifiers. If amplifiers are interchanged as a troubleshooting check, always return the amplifiers to the original channels from which they were removed. The amplifiers are adjusted at the factory for optimum operation with the magnetic head in the channel into which the amplifiers are installed. Interchanging or mixing of amplifiers may necessitate complete readjustment of the channels involved.

c. If the fault is in one channel only, first check to see that the operational voltages are present within the amplifiers tried in that channel.

d. If the operational voltages are present and normal, check the signal path circuitry.

CAUTION

Do not connect an ohmmeter directly across the windings of a magnetic head or any circuit with a dc connection to the head. Even if the current from the meter is not sufficient to harm the winding, the presence of the dc will magnetize the head. If dc has been accidentally introduced into the winding of a head, be sure to degauss the head carefully before further use.

e. If all the amplifiers in a mounting assembly fail to work, look first for failure of the power supply or of the cabling between the tape transport, and amplifier mounting assembly.

5-22. OPTIONAL RECORD HEAD MONITORING CAPABILITY.

5-23. An optional accessory to the tape transport is a record head test cable assembly (Bell & Howell part number 475158) and companion jack assembly J7. Jack J7 is located beneath the 13-505-4 Record Head Driver Housing. The test cable is eight feet long allowing placement of monitoring equipment adjacent to the tape system. This optional cable assembly allows monitoring the input data and bias signal to each record head channel.

5-24. DEGAUSSING THE TAPE HANDLING COMPONENTS.

5-25. MAGNETIZED HEADS. Magnetized heads have adverse effects on direct recording. The presence of a dc element in the record signal degrades the signal-to-noise ratio by production of excessive noise. The dc element also works to shift the operating center of the magnetic recording process so that recordings are made on a nonlinear part of the magnetization curve, and excessive even harmonic distortion of recorded signals may be produced.

5-26. MAGNETIZED ROLLERS OR CAPSTAN SHAFT. Magnetized rollers can cause serious deterioration of the signal-to-noise ratio of the direct record/reproduce system. If a magnetic field from a magnetized roller is turned (by passage of tape) so that the lines of force of its field cut across the gap of the reproduce head, noise signal is created.

5-27. It is possible for the non-magnetic stainless steel capstan to become magnetized during demagnetization of the heads. This is due to the capstan rotating in synchronization with the strong 60 Hz flux field from the head degausser. With a magnetized capstan, the sensitivity of the reproduce heads is such that unwanted signals may be induced into them originating from the magnetized capstan.

5-28. DEGAUSSING PROCEDURE. Magnetized components may be degaussed as follows:

a. System power should be turned off and capstan rotation stopped.

b. Degauss the capstan, the turn around roller, and both pairs of heads.

c. With a circular motion, slowly pull the degausser away from the transport.

Note

Do not turn the degausser off until it is at least three feet away from heads. Another method of making sure that the collapsing field of the degausser does not remagnetize the heads is to also turn the degausser 90° away from the transport before turning the power off.

d. If checks show that some of the tape handling components are still magnetized, repeat the above procedures.

5-29. HARD-TO-TRACE TROUBLES. Occasionally, an equipment defect will not produce any noticeable direct effects, but will produce an indirect effect which is hard to trace logically back to the original fault. If the trouble is unfamiliar, and if logical analysis provides no useful leads, check to see whether or not there is anything abnormal in any of the other sections, even those which have no apparent logical connection with the trouble. Sometimes, in such a case, the explanation for a trouble becomes apparent only after the cause has been found. The checking should be as direct and conclusive as possible. Use signal tracing, voltage and resistance measurement, and other functional and component tests in electrical and electronic circuits. For mechanical parts and, where appropriate, for electrical ones, use sight, hearing, and other senses to obtain indications of how the parts actually are functioning. Stroboscopes, sound amplifiers, and other supplements to the senses sometimes can be used profitably.

5-30. FUSES AND CIRCUIT BREAKERS. A blown fuse or a tripped circuit breaker can be a symptom of trouble elsewhere; replace the fuse or reset the circuit breaker once; if the circuit opens a second time, look for the primary cause of the trouble. Table 5-4 lists the circuit breaker and all of the fuses in standard components of the VR-3700B System.

5-31. REPAIR AND REPLACEMENT.

5-32. Repair of this magnetic tape record/reproduce equipment should be undertaken only by technicians experienced in the maintenance of instrumentation grade tape equipment. The printed circuit boards should be repaired only by personnel experienced in printed wiring techniques. It is recommended that repair be limited to replacement of defective components and adjustment of controls.

5-33. Be sure that replacement parts are of the correct type and value, and that they are known to be good. Identification of the system components and parts is described in paragraph 5-3. When removing and replacing defective components, be careful not to burn or damage the surrounding circuit parts, particularly on printed circuit boards. When installing a new part, place it in the exact position of the replaced part and, after replacement, inspect the circuit board for evidence of cold solder joints, solder splashes, and insecurity of mounting.

5-34. REPRODUCE HEAD AZIMUTH ALIGNMENT. Use the following procedure to align the reproduce heads:

a. Connect to the record amplifier input a sine wave generator capable of generating the upper band edge frequency of the system under test (1.5 MHz or 2 MHz, depending on the direct components employed).

b. Set the transport for 120 ips and record a sine wave signal at the upper band edge frequency. Signal level is not critical but should not be higher than the normal record input level.

c. While operating at 120 ips, adjust the head azimuth for maximum output at the reproduce head. Odd number channels are controlled by adjustment at left-hand side of the head assembly, even number channels by adjustment at right-hand side of head assembly.

REFERENCE DESIGNATION	CAPACITY AND TYPE	CIRCUIT PROTECTED
CB301	25 amp Circuit Breaker	System Power
F301	Spare	
F302	8 amp, 125 v, 3 AG, QA	115 vac Reeling Servos
F303	20 amp, 32 v, 3 AG, MA	Input to the +5 vdc Series Regulator
F304	7.5 amp, 32 v, 3 AG, MA	+28 vdc Supply
F305	7.5 amp, 32 v, 3 AG, MA	-28 vdc Supply
F306	3 amp, 250 v, 3 AG, QA	+20 vdc Transport
F307	3 amp, 250 v, 3 AG, QA	+20 vdc Ampl Mtg Up
F308	3 amp, 250 v, 3 AG, QA	+20 vdc Ampl Mtg Lwr
F309	3 amp, 250 v, 3 AG, QA	-20 vdc Transport
F310	3 amp, 250 v, 3 AG, QA	-20 vdc Ampl Mtg Up
F311	3 amp, 250 v, 3 AG, QA	-20 vdc Ampl Mtg Lwr
F312	7.5 amp, 32 v, 3 AG, MA	+5 vdc Transport
F313	7.5 amp, 32 v, 3 AG, MA	+5 vdc Supply
F314	7.5 amp, 32 v, 3 AG, MA	+5 vdc Supply
F315	2 amp, 250 v, 3 AG, QA	28 vac Supply
F316 thru F322	Spares	

MA = Medium Action (1 - 10 seconds). QA = Quick Action (less than 1 second).

Table 5-4. Table of Current Overload Protective Devices

5-35. DIRECT RECORD/REPRODUCE SYSTEM CALIBRATION PROCEDURES.

5-36. In any direct recording process, the characteristics of wide-frequency response, low distortion, and high signal-to-noise ratio are dependent one on the other, so that the best of any one characteristic can be achieved only at the expense of the others. Peak system adjustment represents a balance between these factors rather than the optimum of any one. The procedures given below are for peak operational adjustment of the direct system circuits. For maintenance adjustments, refer to the individual manuals for the components which make up the system. The equipment is completely adjusted at the factory, and under normal operating conditions, further adjustment may not be required. The operational adjustment procedures given below should be performed following installation to assure peak system performance. Also, operational adjustments are required whenever amplifiers are interchanged, a different type of tape is used, or when the system is converted to another bandwidth category.

5-37. Each procedure given below assumes that the previous procedure has been completed. Therefore, under actual operating conditions, these procedures may be modified for the particular application. The procedures assume that the exact normal record level has not been established. By definition, normal record level is that input data voltage level which produces 1% third harmonic distortion. The input signal data can be between 0.15 and 15 volts peak-to-peak. The amplifiers are adjusted for normal record level.

5-38. Perform the procedures for one channel at a time. Before beginning, verify that the test equipment (or equivalent) listed in table 5-5 is available and ready for use.

Note

Before performing the system operational adjustments, the tape transport must be properly aligned. Check the mechanical and electrical alignment procedures in Section V of the tape transport operation and maintenance manual.

EQUIPMENT	USE
Sine Wave Generator: Hewlett-Packard 651B, or equivalent.	Test frequency source.
Square Wave Generator: Hewlett-Packard 211B, or equivalent.	Test frequency source.
AC Voltmeter: Hewlett-Packard 400FL, or equivalent.	Input and output level setting.
Wave Analyzer: Hewlett-Packard 310A, or equivalent.	Establishing normal record level.
Oscilloscope: Tektronix 545B/1A1, or equivalent.	Output waveform monitoring.
Multimeter: Triplett 630, or equivalent.	Making resistance checks.

Table 5-5. List of Test Equipment

5-39. DIRECT RECORD AMPLIFIER CONTROLS. The function of each control for the direct record amplifier is summarized in table 5-6. 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 5-6. Direct Record Amplifier Controls

5-40. DIRECT REPRODUCE AMPLIFIER CONTROLS. The function of each control for the direct reproduce amplifier is summarized in table 5-7. Adjustments are provided for input and output levels and for amplitude and phase equalization. Figure 5-2 shows the relative physical locations of the controls and test points.

CONTROL	FUNCTION
R12	Adjusts level at 120 ips.
R53	Adjusts output signal level, up to 4 v p-p into 50 ohms.
R78	120 ips
R79	60 ips
R80	30 ips
R81	15 ips
R82	7 1/2 ips
R83	3 3/4 ips
R84	1 7/8 ips
R85	15/16 ips
R78, R79, R80, R81, R82, R83, R84, R85	High Frequency Gain Adjustments.
R133	Adjusts mid-band gain at all tape speeds.
R134	Adjusts mid-band gain at 15/16, 1 7/8, 3 3/4, and 7 1/2 ips.
R137	Adjusts input level.
R67	Adjusts phase at all tape speeds.

Table 5-7. Direct Reproduce Amplifier Controls

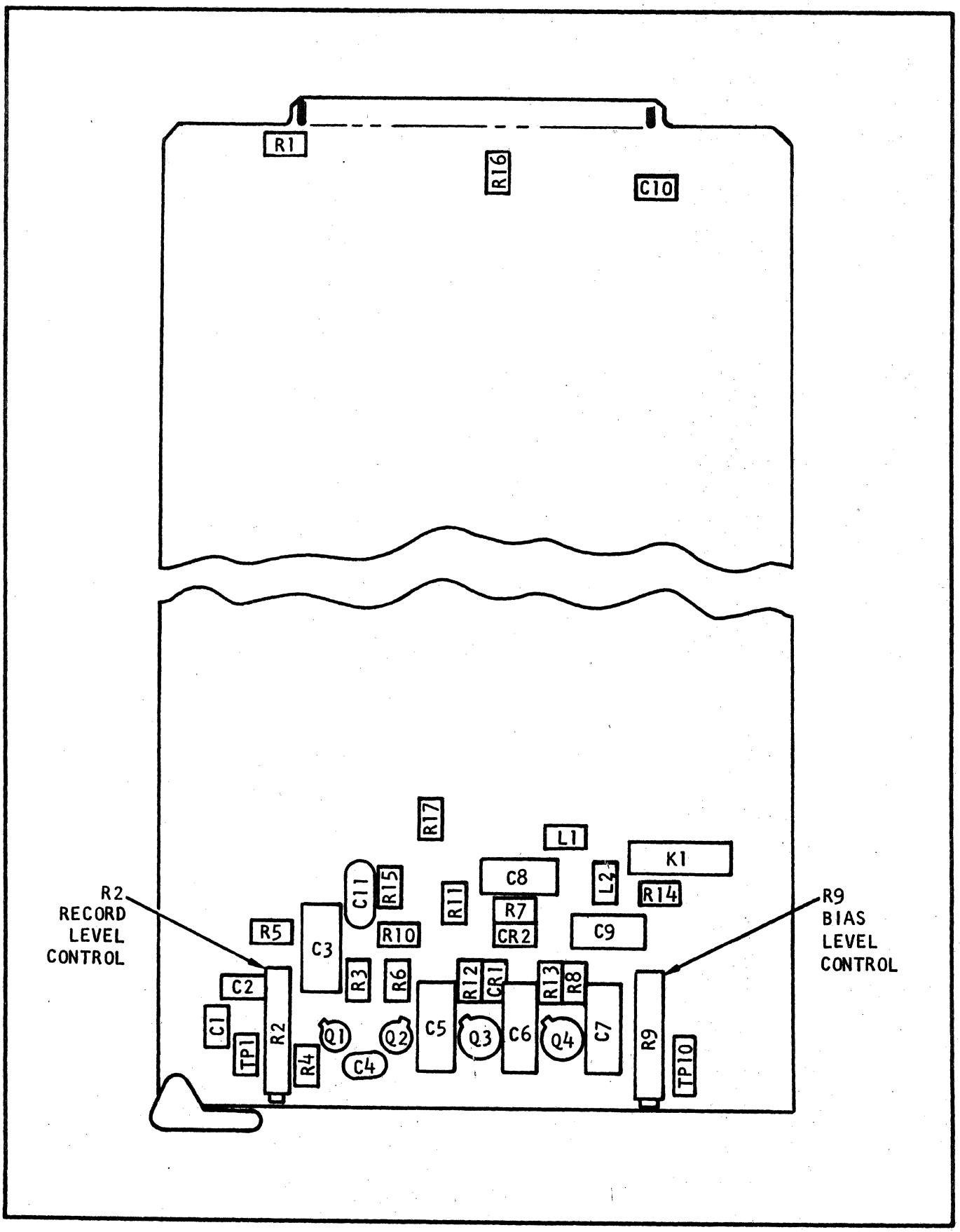


Figure 5-1. Type 13-542 Direct Record Amplifier Control and Test Point Locations

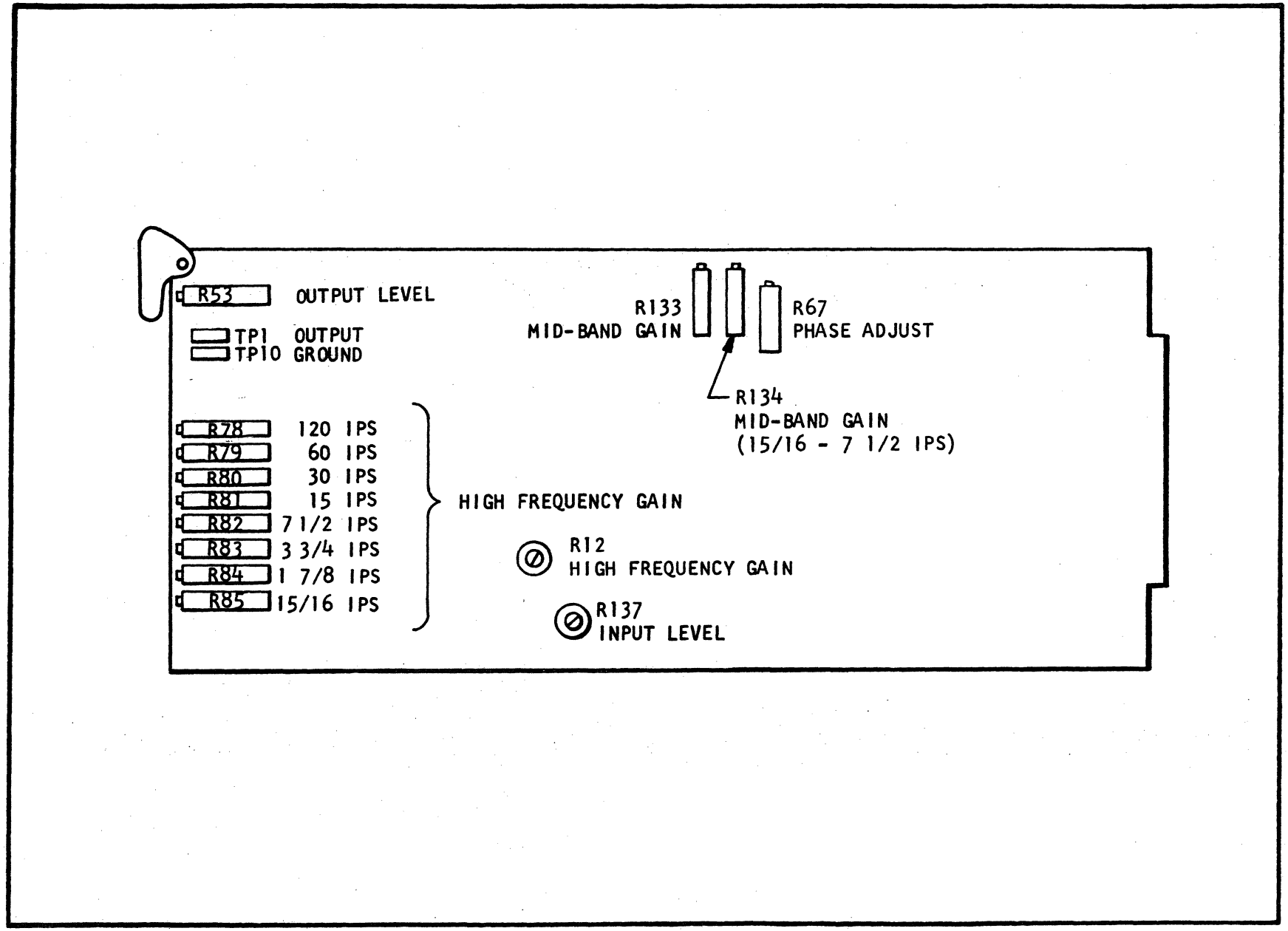


Figure 5-2. Type 13-547 Direct Reproduce Amplifier Control and Test Point Locations

5-41. PRELIMINARY PROCEDURES. Determine the bandwidth category of the reproduce heads and amplifiers installed in the system. The intermediate band (600 kHz) reproduce head assemblies are Type 13-524-25 (7-channel) and Type 13-526-25 (14-channel). The intermediate band reproduce amplifier is the Type 13-547-1. The wide band (1.5 MHz and 2.0 MHz) reproduce head assemblies are Type 13-524-5 (7-channel) and Type 13-526-5 (14-channel). The 1.5 MHz bandwidth reproduce amplifier is the Type 13-547-3 and the 2.0 MHz amplifier is the Type 13-547-2.

5-42. Set up the test equipment as shown in figure 5-3, turn on the system power and allow a 15 minute warmup period. Be sure to terminate the reproduce amplifier in 50 ohms.

5-43. Rotate the record level control (R2) on the record amplifier fully counterclockwise, then clockwise 3 1/2 turns. Rotate the bias level control (R9) on the record amplifier fully clockwise, then counterclockwise 4 turns.

5-44. If the controls on the 13-547 Direct Reproduce Amplifier are suspected of being far out of alignment or if components in the amplifier have been changed, the controls should be preset using an ohmmeter for the values shown in table 5-8.

CONTROL	SETTING
R12	1.9K ohms
R53	2.7K ohms
R67	700 ohms
R133	450 ohms
R134	30 ohms
R137	Fully clockwise

Table 5-8. Resistance Settings for Controls, Reproduce Amplifier

5-45. The adjustment procedures are based on a top tape speed of 120 ips. If 120 ips is not available on the subject machine, use the highest speed available and modify the procedures accordingly. Refer to table 5-9 for the appropriate test frequencies for each tape speed.

5-46. Mount the reproduce amplifier to be adjusted on a circuit extender card (Bell & Howell part number 471755-1) to permit access to all controls.

5-47. ADJUSTMENT PROCEDURE. To adjust the amplifiers, proceed as follows:

a. Rotate the reproduce amplifier input level control (R137) fully clockwise.

b. Place the system in the record mode at 60 ips and simultaneously record and reproduce a square wave of 20 kHz (600 kHz), 50 kHz (1.5 MHz), or 75 kHz (2.0 MHz)

c. Adjust the oscilloscope for observation of two square wave cycles and adjust the reproduce amplifier output level control (R53) for approximately 2.8 volts peak-to-peak.

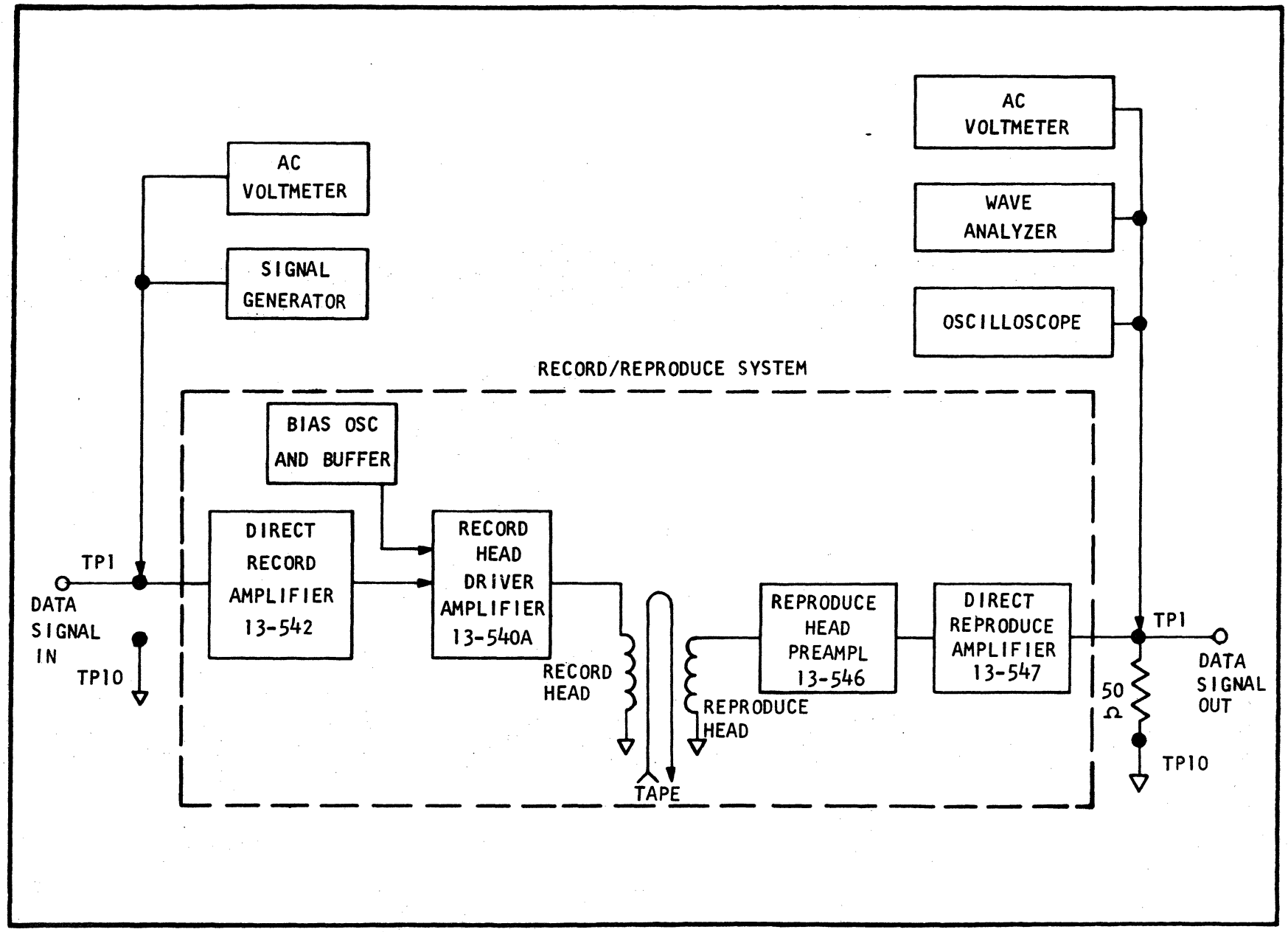


Figure 5-3. Setup for Direct System Calibration Adjustments

TAPE SPEED (ips)	INTERMEDIATE BANDWIDTH		WIDEBAND OPTION A		WIDEBAND OPTION B	
	UBE (kHz)	1/4 UBE (kHz)	UBE (kHz)	1/10 UBE (kHz)	UBE (kHz)	1/10 UBE (kHz)
120	600	150	1500	150	2000	200
60	300	75	750	75	1000	100
30	150	37.5	375	37.5	500	50
15	75	18.75	187	18.7	250	25
7 1/2	38	9.5	93	9.3	125	12.5
3 3/4	19	4.75	46	4.6	62	6.2
1 7/8	10	2.5	23	2.3	31	3.1
15/16	5	1.25	12	1.2	15	1.5
UBE = UPPER BAND EDGE FREQUENCY						

Table 5-9. Frequencies for Operational Adjustments

d. Refer to figure 5-4 and adjust R67, the phase adjustment control on the reproduce amplifier, for approximately 10% pre-ring at the trailing edge of the square wave. Avoid a setting of R67 which affects the leading edge of the square wave.

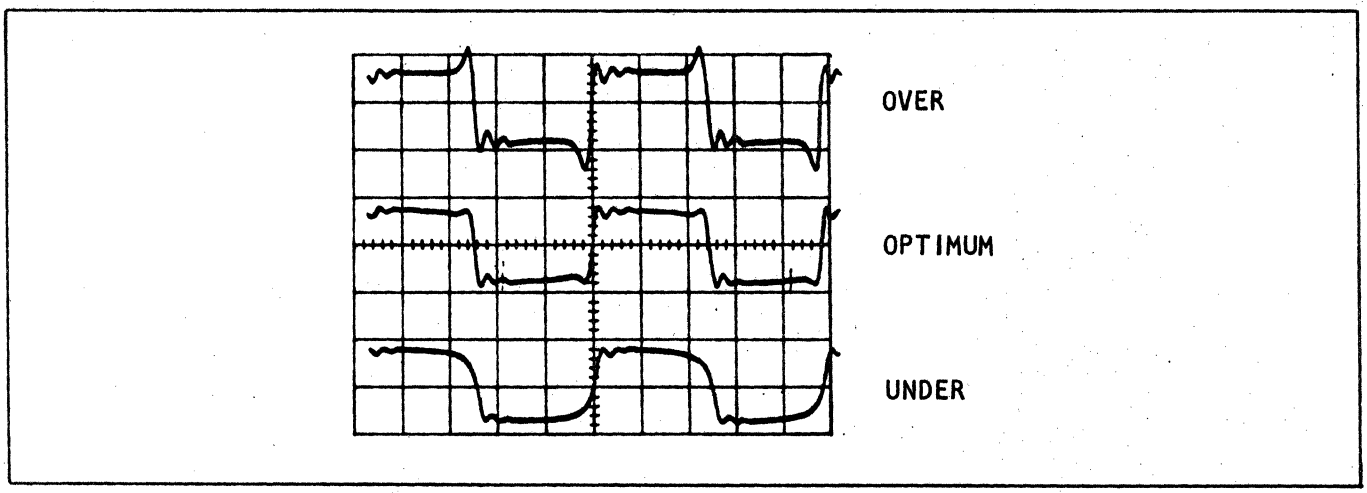


Figure 5-4. Phase Adjustment

e. Place the system in the record mode at 120 ips or the highest tape speed available on the machine, and adjust the sine wave generator for normal record level at 1/100 upper band edge frequency.

Note

The normal record level is the data voltage level at the input of the direct record amplifier which produces 1% third harmonic distortion.

f. Adjust the reproduce output level (R53) for 1 vrms as indicated on the AC voltmeter.

g. Adjust the sine wave generator for normal record input level at 1/4 upper band edge frequency (600 kHz), or 1/10 upper band edge frequency (1.5 MHz or 2.0 MHz).

h. Adjust the reproduce amplifier mid-band gain control (R133) for 1.0 vrms output as indicated on the AC voltmeter.

i. At the sine wave generator, increase the record input +3 db. If signal breakup occurs, turn the reproduce amplifier input level control (R137) counterclockwise until a normal waveform is restored.

j. At the sine wave generator, reset the record input to normal level and readjust the reproduce amplifier output level control (R53) for 1.0 vrms output.

k. Adjust the sine wave generator for upper band edge frequency at the normal record input level. Adjust the 120 ips high frequency gain control (R12) for 0 db (600 kHz) output or -2 db (1.5 MHz or 2.0 MHz) referenced to 1.0 vrms output as indicated on the AC voltmeter.

l. Adjust the 120 ips high frequency gain control (R78) for -1 db (600 kHz) or 0 db (1.5 MHz or 2.0 MHz) at 2/3 upper band edge.

m. Adjust the sine wave generator for upper band edge frequency at the normal record level. Set the exact value of bias with the bias level control (R9) on the record amplifier for 3 db overbias (600 kHz or 1.5 MHz) or 2 db overbias (2.0 MHz) by rotating R9 clockwise until the 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.

n. Adjust the sine wave generator for normal record level at 1 kHz (600 kHz) or 1/10 upper band edge frequency (1.5 MHz or 2.0 MHz). Set the exact record level by adjusting the record level control (R2) on the record amplifier for 1% ±0.1% third harmonic distortion as indicated on the wave analyzer.

o. Recheck steps b through k and readjust as necessary.

p. Stop the transport and adjust the sine wave generator for normal record input level at 1 kHz.

q. Select a tape speed of 7 1/2 ips and place the system in the record mode.

r. Adjust the reproduce amplifier output level control (R53) for 1.0 vrms output.

s. Adjust the sine wave generator for normal record level at 1/4 upper band edge frequency (600 kHz), or 1/10 upper band edge frequency (1.5 MHz or 2.0 MHz). Adjust the low speed mid-band gain control (R134) for 0 db.

t. Adjust the sine wave generator for normal record input level at upper band edge frequency. Adjust the 7 1/2 ips high frequency gain control for 0 db (600 kHz), or -3 db (1.5 MHz or 2.0 MHz) as referenced to 1.0 vrms.

u. Repeat step r and check for proper output level.

v. Stop the transport, then turn off system power. Remove the reproduce amplifier from the circuit extender card and remove the extender card from the amplifier mounting assembly. Replace the amplifier in the mounting assembly and turn on power.

w. Adjust all other high frequency gain controls (R79 through R85) at the appropriate tape speed and upper band edge frequency for normal output level as indicated on the AC voltmeter. Normal output level is 0 db (600 kHz), or -2 db (1.5 MHz or 2.0 MHz) as referenced to 1.0 vrms for speeds of 120 ips through 15 ips. For speeds of 7 1/2 ips through 15/16 ips, normal output level is 0 db (600 kHz), or -3 db (1.5 MHz or 2.0 MHz).

Note

After accomplishing steps q through u, it will be necessary to readjust the output level as described in steps e and f before tape speeds of 120 ips through 15 ips can be selected for step w.

5-48. Proper adjustment of the 13-547-1, 13-547-2, or 13-547-3 controls will be evidenced by a uniform amplitude-versus-frequency response (±3 db) over the system bandwidth for each tape speed.

5-49. FM RECORD/REPRODUCE SYSTEM CALIBRATION PROCEDURES.

5-50. If the tape system is supplied with FM recording and reproducing capability, certain adjustments must be made on the FM components after initial receipt, or following replacement of parts. The center frequency of the FM record amplifier should be checked daily.

5-51. The following FM record/reproduce amplifier adjustment procedures presuppose that all other components of the tape system using the FM amplifiers are correctly set up and adjusted. These procedures also assume that the adjustments requiring tape movement will be made with the transport in phase lock and that the test equipment listed in table 5-10 is available.

5-52. The FM record amplifier can be used for various FM bandwidths listed in the system specifications. The selection of bandwidths is explained in the FM record amplifier component manual. The FM reproduce amplifiers are available in three bandwidth groups thus:

Type 13-557-1 is configured for IRIG Wide Band Group I, 80 kHz.

Type 13-557-2 is configured for IRIG Wide Band Group II, 500 kHz.

Type 13-557-3 is configured for Bell & Howell Wide Band Group III, 600 kHz.

As there are three wide band frequency groups, much of the information is given in tabular form. Tables 5-11, 5-12, and 5-13 tabulate the deviation limits for Wide Band Group I, Group II, and Group III, respectively. Table 5-14 contains the FM operational adjustments for the three wide band groups. Check the type number stenciled on the amplifier card to determine which amplifier is in the system. Those bandwidths specified for IRIG Intermediate Band and IRIG Low Band may be obtained by altering the patch arrangement on the FM reproduce amplifier. This is explained in the FM reproduce amplifier component manual.

EQUIPMENT	USE
Oscilloscope: Tektronix 531 with X10 Probe, or equivalent.	Waveform monitoring
AC Voltmeter: Hewlett-Packard 400FL, or equivalent.	System gain adjustment
DC Voltmeter: Digital, Hewlett-Packard 3439A with appropriate plug-in unit, or equivalent.	Frequency deviation adjustment Dc offset adjustment Record level adjustment
Counter: Hewlett-Packard 5245L with X10 Probe, or equivalent.	Center frequency adjustment Frequency deviation adjustment Dc offset adjustment
DC Power Supply: Hewlett-Packard 6220B with output floating, or equivalent.	Frequency deviation adjustment Dc offset adjustment
Wave Analyzer: Hewlett-Packard 310A, or equivalent.	Balance adjustment
Sine Wave Generator: Hewlett-Packard 651B, or equivalent.	System gain adjustment

Table 5-10. List of Test Equipment Required for Operational Adjustment Procedures

IRIG LOW BAND	IRIG INTER-MEDIATE BAND	IRIG WIDE BAND GROUP I	CARRIER CENTER FREQ (kHz)	CARRIER PLUS 40% DEVIATION (kHz)	CARRIER MINUS 40% DEVIATION (kHz)
TAPE SPEED (ips)	TAPE SPEED (ips)	TAPE SPEED (ips)			
--	--	120	432	608.8	259.2
--	120	60	216	302.4	129.6
120	60	30	108	151.2	64.5
60	30	15	54	75.6	32.4
30	15	7 1/2	27	37.8	16.2
15	7 1/2	3 3/4	13.5	18.9	8.1
7 1/2	3 3/4	1 7/8	6.75	9.45	4.05
3 3/4	1 7/8	--	3.375	4.725	2.025
1 7/8	--	--	1.688	2.363	1.012

Table 5-11. Deviation Limits, IRIG Low Band, Intermediate Band, and Wide Band Group I

IRIG WIDE BAND GROUP II			
TAPE SPEED (ips)	CARRIER CENTER FREQ (kHz)	CARRIER PLUS 30% DEVIATION (kHz)	CARRIER MINUS 30% DEVIATION (kHz)
120	900	1170	630
60	450	585	315
30	225	292.5	157.5
15	112.5	146.25	78.75
7 1/2	56.25	73.125	39.375
3 3/4	28.125	36.563	19.688
1 7/8	14.063	18.281	9.844

Table 5-12. Deviation Limits, IRIG Wide Band Group II

BELL & HOWELL WIDE BAND GROUP III			
TAPE SPEED (ips)	CARRIER CENTER FREQ (kHz)	CARRIER PLUS 30% DEVIATION (kHz)	CARRIER MINUS 30% DEVIATION (kHz)
120	1500	1950	1050
60	750	975	525
30	375	487.5	262.5
15	187.5	243.75	131.25
7 1/2	93.75	121.875	65.625
3 3/4	46.875	60.938	32.813
1 7/8	23.438	30.469	16.406

Table 5-13. Deviation Limits, Bell & Howell Wide Band Group III

TYPE 13-557-1 IRIG LOW: 108 kHz CF at 120 ips; 20 kHz BANDWIDTH IRIG INT: 216 kHz CF at 120 ips; 40 kHz BANDWIDTH IRIG GP I: 432 kHz CF at 120 ips; 80 kHz BANDWIDTH	TYPE 13-557-2 IRIG WIDE BAND GP II 900 kHz CF at 120 ips 500 kHz BANDWIDTH	TYPE 13-557-3 B&H WIDE BAND GP III 1.5 MHz CF at 120 ips 600 kHz BANDWIDTH
1. Choose the highest tape speed which has an FM center frequency equal to or less than one-fourth the maximum wave analyzer frequency. (With an HP310A Wave Analyzer these speeds are as follows: Low BW, 120 ips; Intermediate BW, 120 ips; Group I, 60 ips; Group II, 30 ips; Group III, 30 ips.) Record and reproduce with no input signal to the FM record amplifier.	1. (Same as for 13-557-1 except use table 5-18.)	1. (Same as for 13-557-1, except use table 5-19.)
2. Monitor TP1 of the FM reproduce amplifier with the oscilloscope and adjust RECORD LEVEL, R70, on the FM record amplifier for maximum carrier amplitude.	2. (Same as for 13-557-1.)	2. (Same as for 13-557-1.)
3. Connect the wave analyzer to TP2 of the FM reproduce amplifier and tune to the CF defined in tables 5-15 through 5-17, adjust BALANCE, R44, FM reproduce amplifier, for minimum indication.	3. (Same as for 13-557-1, except use table 5-18.)	3. (Same as for 13-557-1, except use table 5-19.)
4. Tune the wave analyzer to the fourth harmonic of the CF and adjust the proper CENTER FREQUENCY VERNIER CONTROL, R98-R106, on the FM reproduce amplifier (see tables 5-15 through 5-17) for minimum indication. Do not disturb other CENTER FREQUENCY VERNIER CONTROLS at this time.	4. (Same as for 13-557-1, except use table 5-18.)	4. (Same as for 13-557-1, except use table 5-19.)
5. Connect the dc voltmeter to TP3 of the FM reproduce amplifier and adjust OFFSET, R46, for 0 ±50 millivolts. Then disconnect the voltmeter.	5. (Same as for 13-557-1.)	5. (Same as for 13-557-1.)

Table 5-14. FM Operational Adjustment Procedures (Sheet 1 of 5)

TYPE 13-557-1 IRIG LOW: 108 kHz CF at 120 ips; 20 kHz BANDWIDTH IRIG INT: 216 kHz CF at 120 ips; 40 kHz BANDWIDTH IRIG GP I: 432 kHz CF at 120 ips; 80 kHz BANDWIDTH	TYPE 13-557-2 IRIG WIDE BAND GP II 900 kHz CF at 120 ips 500 kHz BANDWIDTH	TYPE 13-557-3 B&H WIDE BAND GP III 1.5 MHz CF at 120 ips 600 kHz BANDWIDTH
6. Connect the sine wave generator to the input of the FM record amplifier. Apply a calibration signal* at a frequency that is 10% of band edge for the particular tape speed. Connect the ac voltmeter to TP3 of the FM reproduce amplifier and adjust GAIN, R72 for the desired full scale output (1.0 vrms nominal). Disconnect the sine wave generator and ac voltmeter.	6. (Same as for 13-557-1.)	6. (Same as for 13-557-1.)
7. Reconnect the dc voltmeter to TP3 on the FM reproduce amplifier; then readjust OFFSET, R46, for a reading of 0 ±3.5 millivolts.	7. (Same as for 13-557-1.)	7. (Same as for 13-557-1.)
8. Adjust CENTER FREQUENCY VERNIER CONTROLS, R98-R106, for 0 ±3.5 mv at all other tape speeds for which low pass filters are installed. Use tables 5-15, 5-16, or 5-17 to ascertain the correct R-Number for each CENTER FREQUENCY CONTROL.	8. (Same as for 13-557-1, except use table 5-18.)	8. (Same as for 13-557-1, except use table 5-19.)
*The calibration signal is defined as the normal, maximum, signal level that will be applied to a given FM record/reproduce channel in the system during actual operation. This level can range between 0.25 and 15 volts peak.		

Table 5-14. FM Operational Adjustment Procedures (Sheet 2 of 5)

TYPE 13-557-1 IRIG LOW: 108 kHz CF at 120 ips; 20 kHz BANDWIDTH IRIG INT: 216 kHz CF at 120 ips; 40 kHz BANDWIDTH IRIG GP I: 432 kHz CF at 120 ips; 80 kHz BANDWIDTH	TYPE 13-557-2 IRIG WIDE BAND GP II 900 kHz CF at 120 ips 500 kHz BANDWIDTH	TYPE 13-557-3 B&H WIDE BAND GP III 1.5 MHz CF at 120 ips 600 kHz BANDWIDTH
9. This completes the adjustment procedures for the 13-557-1 FM Reproduce Amplifier.	9. Connect the wave analyzer and ac voltmeter to TP3 of the FM reproduce amplifier and connect the sine wave generator to the input of the FM record amplifier. Apply a calibration signal at one-half the band edge frequency of the highest tape speed for which low pass filters are installed. Record and reproduce at this tape speed. Adjust the AMPLITUDE EQUALIZATION CONTROLS, R76-R82, FM reproduce amplifier (see table 5-18) for minimum second harmonic distortion of the calibration signal.	9. (Same as for 13-557-2, except use table 5-19.)
10. Not applicable.	10. Adjust the sine wave generator for the band edge frequency (see table 5-18). Adjust PHASE EQUALIZATION CONTROL, R12, FM reproduce amplifier for -1.0 to 1.5 db.	10. (Same as for 13-557-2 except use table 5-19.)

Table 5-14. FM Operational Adjustment Procedures (Sheet 3 of 5)

TYPE 13-557-1 IRIG LOW: 108 kHz CF at 120 ips; 20 kHz BANDWIDTH IRIG INT: 216 kHz CF at 120 ips; 40 kHz BANDWIDTH IRIG GP I: 432 kHz CF at 120 ips; 80 kHz BANDWIDTH	TYPE 13-557-2 IRIG WIDE BAND GP II 900 kHz CF at 120 ips 500 kHz BANDWIDTH	TYPE 13-557-3 B&H WIDE BAND GP III 1.5 MHz CF at 120 ips 600 kHz BANDWIDTH
11. Not applicable.	11. Readjust the sine wave generator frequency to one-half band edge. Readjust the AMPLITUDE EQUALIZATION CONTROLS, R76-R82, (see step 9). Turn R76-R82 counterclockwise until distortion is -36 db below 1.0 vrms. Interaction is to be expected as steps 10 and 11 are carried out. The results of the two adjustments compromise the distortion level at one-half band edge with the distortion level at lower modulating frequencies.	11. (Same as for 13-557-2.)
12. Not applicable.	12. Repeat steps 10 and 11 until adjustment of the PHASE EQUALIZATION CONTROL, R12, is no longer necessary. R12 should not be adjusted for any of the remaining speeds.	12. (Same as for 13-557-2.)

Table 5-14. FM Operational Adjustment Procedures (Sheet 4 of 5)

TYPE 13-557-1 IRIG LOW: 108 kHz CF at 120 ips; 20 kHz BANDWIDTH IRIG INT: 216 kHz CF at 120 ips; 40 kHz BANDWIDTH IRIG GP I: 432 kHz CF at 120 ips; 80 kHz BANDWIDTH	TYPE 13-557-2 IRIG WIDE BAND GP II 900 kHz CF at 120 ips 500 kHz BANDWIDTH	TYPE 13-557-3 B&H WIDE BAND GP III 1.5 MHz CF at 120 ips 600 kHz BANDWIDTH
13. Not applicable.	13. For each remaining speed, adjust the amplitude equalization controls as in step 11 and table 5-18. Since a double minimum can occur at some tape speeds, it is best to turn each potentiometer fully counterclockwise before seeking the minimum. If the incorrect minimum has been selected, band edge response will be down by 3 db or more.	13. (Same as for 13-557-2, except use table 5-19.)

Table 5-14. FM Operational Adjustment Procedures (Sheet 5 of 5)

IRIG LOW BAND							
TAPE SPEED (ips)	PATCH TERMINALS FROM	PATCH TERMINALS TO	LOW PASS FILTER TYPE NO.	CF VERN	AMPL EQUAL.	CENTER FREQ (kHz)	BAND-WIDTH (kHz)
120	E2	E12	13-560-13	R100	N/A	108	20
60	E3	E13	13-560-14	R101	N/A	54	10
30	E4	E14	13-560-15	R102	N/A	27	5
15	E5	E15	13-560-16	R103	N/A	13.5	2.5
7 1/2	E6	E16	13-560-17	R104	N/A	6.75	1.25
3 3/4	E7	E17	13-560-18	R105	N/A	3.375	0.625
1 7/8	E8	E18	13-560-19	R106	N/A	1.6875	0.3125

Table 5-15. Operational Parameters, IRIG Low Band

IRIG INTERMEDIATE BAND							
TAPE SPEED (ips)	PATCH TERMINALS FROM	PATCH TERMINALS TO	LOW PASS FILTER TYPE NO.	CF VERN	AMPL EQUAL.	CENTER FREQ (kHz)	BAND-WIDTH (kHz)
120	E2	E11	13-560-12	R99	N/A	216	40
60	E3	E12	13-560-13	R100	N/A	108	20
30	E4	E13	13-560-14	R101	N/A	54	10
15	E5	E14	13-560-15	R102	N/A	27	5
7 1/2	E6	E15	13-560-16	R103	N/A	13.5	2.5
3 3/4	E7	E16	13-560-17	R104	N/A	6.75	1.25
1 7/8	E8	E17	13-560-18	R105	N/A	3.375	0.625

Table 5-16. Operational Parameters, IRIG Intermediate Band

IRIG WIDE BAND GROUP I							
TAPE SPEED (ips)	PATCH TERMINALS FROM	PATCH TERMINALS TO	LOW PASS FILTER TYPE NO.	CF VERN	AMPL EQUAL.	CENTER FREQ (kHz)	BAND-WIDTH (kHz)
120	E2	E10	13-560-11	R98	N/A	432	80
60	E3	E11	13-560-12	R99	N/A	216	40
30	E4	E12	13-560-13	R100	N/A	108	20
15	E5	E13	13-560-14	R101	N/A	54	10
7 1/2	E6	E14	13-560-15	R102	N/A	27	5
3 3/4	E7	E15	13-560-16	R103	N/A	13.5	2.5
1 7/8	E8	E16	13-560-17	R104	N/A	6.75	1.25

Table 5-17. Operational Parameters, IRIG Wide Band Group I

IRIG WIDE BAND GROUP II								
TAPE SPEED (ips)	PATCH TERMINALS FROM	PATCH TERMINALS TO	LOW PASS FILTER TYPE NO.	CF VERN	AMPL EQUAL.	CENTER FREQ (kHz)	BAND-WIDTH (kHz)	1/2 BAND EDGE (kHz)
120	E2	E10	13-560-31	R98	R76	900	500	250
60	E3	E11	13-560-32	R99	R77	450	250	125
30	E4	E12	13-560-33	R100	R78	225	125	62.5
15	E5	E13	13-560-34	R101	R79	112.5	62.5	31.25
7 1/2	E6	E14	13-560-35	R102	R80	56.25	31.25	15.625
3 3/4	E7	E15	13-560-36	R103	R81	28.125	15.625	7.8125
1 7/8	E8	E16	13-560-37	R104	R82	14.0625	7.8125	3.9063

Table 5-18. Operational Parameters, IRIG Wide Band Group II

BELL & HOWELL WIDE BAND GROUP III								
TAPE SPEED (ips)	PATCH TERMINALS FROM	PATCH TERMINALS TO	LOW PASS FILTER TYPE NO.	CF VERN	AMPL EQUAL.	CENTER FREQ (kHz)	BAND-WIDTH (kHz)	1/2 BAND EDGE (kHz)
120	E2	E10	13-560-51	R98	R76	1500	600	300
60	E3	E11	13-560-52	R99	R77	750	300	150
30	E4	E12	13-560-53	R100	R78	375	150	75
15	E5	E13	13-560-54	R101	R79	187.5	75	37.5
7 1/2	E6	E14	13-560-55	R102	R80	93.75	37.5	18.75
3 3/4	E7	E15	13-560-56	R103	R81	46.875	18.75	9.375
1 7/8	E8	E16	13-560-57	R104	R82	23.483	9.375	4.688

Table 5-19. Operational Parameters, Bell & Howell Wide Band Group III

5-53. Verify that the bandwidths of the FM record and FM reproduce amplifiers are compatible with the reproduce head stacks.

Type 13-524-25 7-channel Reproduce Head, Wide Band Group I

Type 13-526-25 14-channel Reproduce Head, Wide Band Group I

Type 13-524-5 7-channel Reproduce Head, Wide Band Groups I, II, and III

Type 13-526-5 14-channel Reproduce Head, Wide Band Groups I, II, and III

5-54. Verify that the amplifier cards in the Type 13-505-3 Preamplifier Housing and the Type 13-505-4 Record Head Driver Amplifier Housing are fully seated.

5-55. Install a reel of tape and thread tape on transport.

5-56. Set up the equipment as shown in figure 5-5.

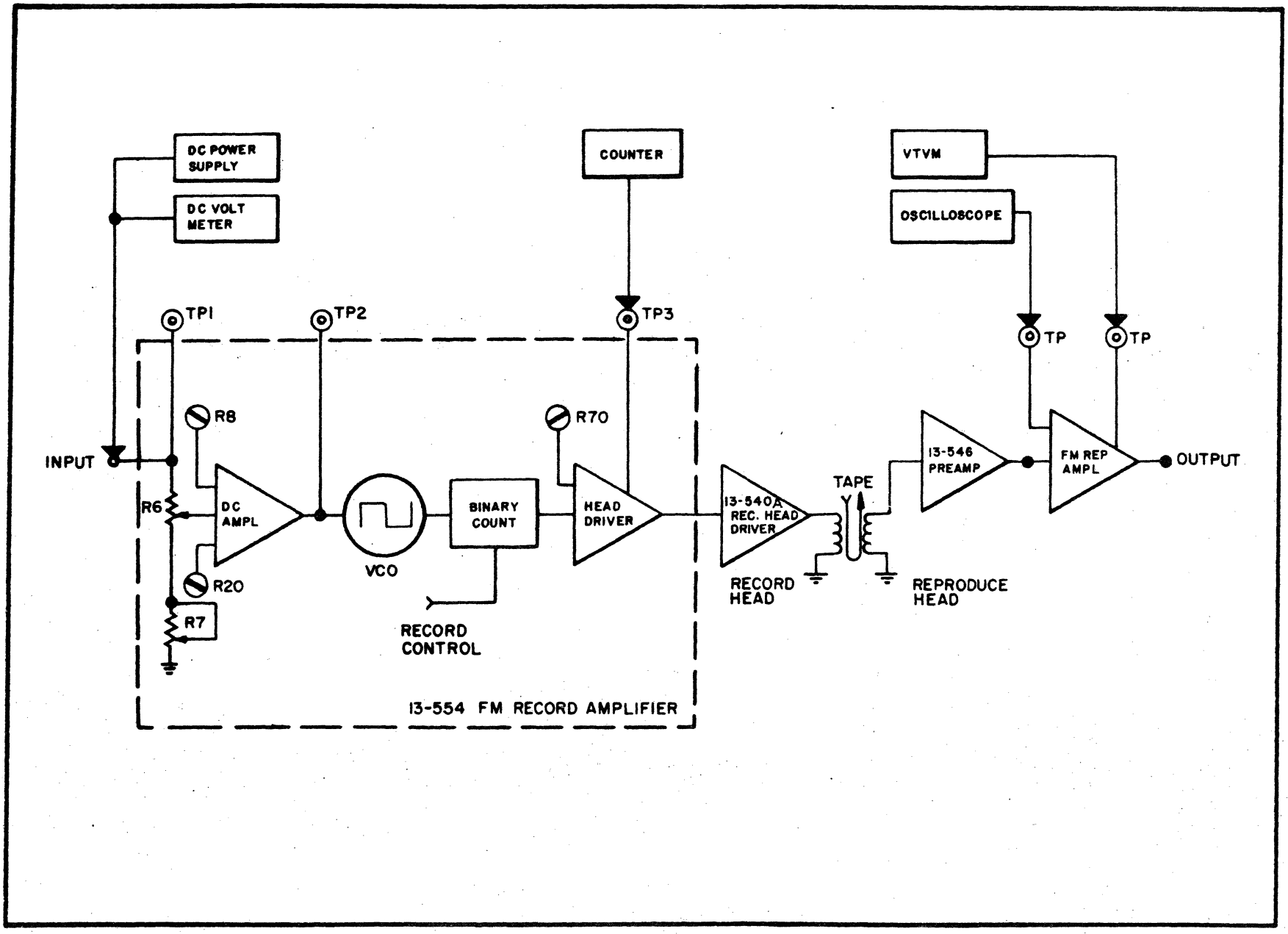


Figure 5-5. Setup for FM Record Amplifier Operational Adjustments

5-57. Apply power to the record/reproduce system. Turn TEST-NORMAL switch on transport control panel to TEST position. Allow fifteen minutes for test equipment and record/reproduce system to stabilize.

5-58. CENTER FREQUENCY ADJUSTMENT. The center frequency may be adjusted using the procedure below:

a. Remove input signals from the FM record amplifier.

b. Connect the counter to TP3 (orange) on the FM record amplifier.

c. Set tape speed switch on transport control panel to 120 ips.

d. Adjust the CENTER FREQ controls, R8 (COARSE) and/or R20 (VERNIER), to the center frequency ±100 Hz for 120 ips. See tables 5-11, 5-12, and 5-13 for the center frequency of each tape speed in each band. Example: Wide Band Group I, 120 ips; adjust R8 and/or R20 for 432 kHz ±100 Hz at TP3.

e. Change tape speeds and verify that the correct center frequency as stated in table 5-11, 5-12, or 5-13 is observed at TP3.

5-59. DEVIATION ADJUSTMENT. Adjustment of the frequency deviation for a given input signal may be accomplished using the following procedure:

a. Center frequency adjustment must be accomplished before attempting deviation adjustment.

b. Connect the dc power supply and the dc voltmeter to the input of the FM record amplifier.

c. Set the output voltage of the power supply to the peak positive voltage of the calibration signal. Set tape speed to 120 ips.

Note

The calibration signal is defined as the normal, or maximum, signal level that will be applied to a given channel in the system. This level can range between 0.25 and 15 volts peak. The level of the calibration signal should equal the maximum level of the signal which will be used subsequently in actual operation.

d. Adjust the deviation controls, R6 (ATTEN) and/or R7 (VERNIER), to the plus deviation frequency for 120 ips. See tables 5-11, 5-12, and 5-13 for the plus deviation frequency of each tape speed in each band. Example: Wide Band Group I, 120 ips; adjust R6 and/or R7 for 604.8 kHz ±0.1%.

e. Reverse the polarity of the calibration signal, keeping the voltage level the same as in step c, and check the minus deviation. Deviation should be within ±0.5% of the figures listed in tables 5-11, 5-12, and 5-13.

f. Disconnect the dc power supply.

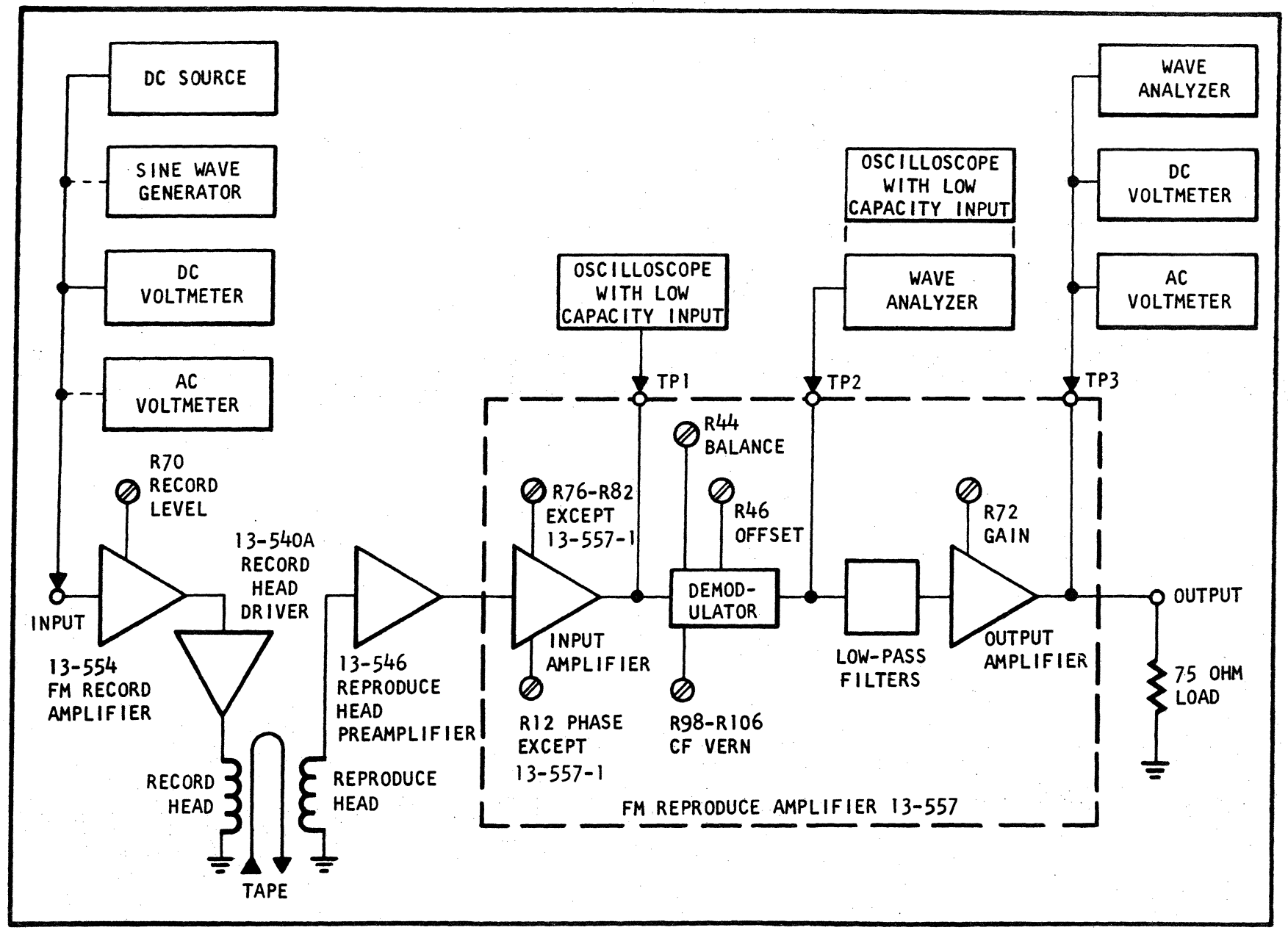


Figure 5-6. Setup for FM Reproduce Amplifier Operational Adjustments

5-60. DC OFFSET ADJUSTMENT. If the data signal to be recorded contains a dc component which is not desired on the recording, it is possible to offset the carrier center frequency to compensate for this dc component as follows:

a. Center frequency and deviation adjustments must be accomplished before attempting dc offset adjustment.

b. Connect the dc power supply and the dc voltmeter to the input of the FM record amplifier.

c. Set the output voltage of the dc power supply to the offset voltage, but opposite polarity to that expected in the data signal.

d. Adjust the CENTER FREQ controls, R8 (COARSE) and/or R20 (VERNIER), to the center frequency ±100 Hz for a tape speed of 120 ips. See tables 5-11, 5-12, and 5-13 for the center frequency of each tape speed in each band.

5-61. FM REPRODUCE AMPLIFIER ADJUSTMENT. Set up the test equipment as shown in figure 5-6. Unless otherwise specified, reference to the highest tape speed means the highest tape speed for which the amplifier is wired and for which filters are installed. Refer to the FM reproduce manual for information on altering the patch arrangement.

5-62. FILTER RESPONSE SWITCH (13-557-1 ONLY). The output response can be altered by means of a switch on each low pass filter. The filters can be changed from a flat amplitude response to an optimized transient response by the switch. Figure 5-7 contrasts the effect upon the voltage waveforms at the filter input terminal (TP2) for the output response conditions.

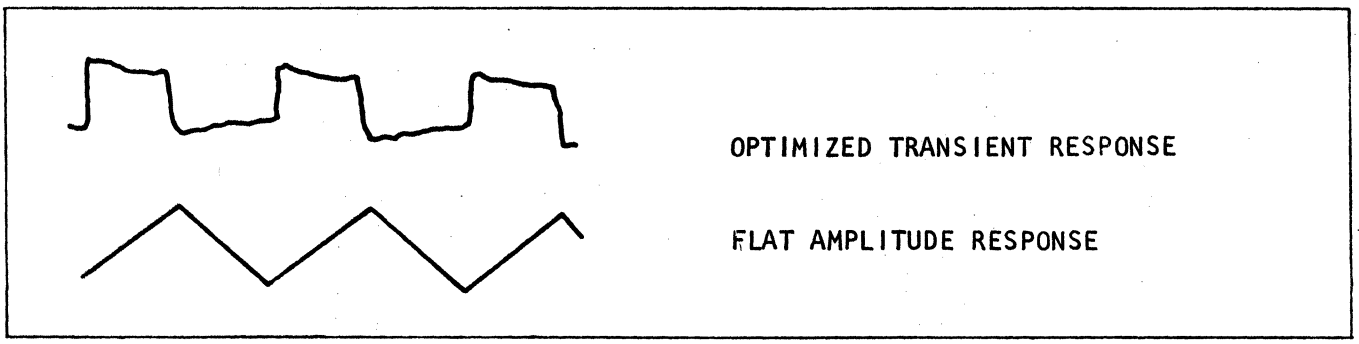


Figure 5-7. Filter Input Voltage Waveforms

5-63. SQUELCH THRESHOLD ADJUSTMENT. The squelch threshold control, R19, controls the point at which the output of the FM reproduce amplifier is squelched in the run and run/record modes.

a. Connect an ac voltmeter to the FM reproduce amplifier output (TP3).

b. Record and reproduce a 1/10 band edge signal.

c. Adjust R19 fully clockwise and then counterclockwise until the signal appears at the reproduce amplifier output.

d. Adjust R19 two additional turns in the counterclockwise direction.

5-64. SETUP PROCEDURES FOR DIRECT RECORDING OF THE TAPE SPEED SERVO REFERENCE SIGNAL.

5-65. There are two methods of recording a servo reference signal. In the first method, a reference square wave signal replaces the data signal on the selected channel. The second method has the data signal mixed with the reference signal and requires a low pass filter (Type 13-544-1 Sine Wave Generator) to be used to furnish the reference signal (see paragraph 5-69).

5-66. To record the servo square wave signal, proceed as follows:

a. Disconnect the data signal cable from the input to the record head driver amplifier for the channel to be used for recording the reference signal.

b. Connect a BNC cable to J409 on the transport electronics and relay chassis to J4 (or J3) of the reference amplifier and bias buffer. Do not connect data line to the other jack (unused J3 or J4).

c. With a BNC cable, jumper between J2 (reference amplifier and bias buffer) and the record head driver amplifier to be used in recording the servo signal (see step a).

d. Switch the transport phase lock switch to the TACH position. Select the tape speed required and place the transport in the RECORD mode.

e. Adjust the output of the reference generator R1834 (mounted on the reference generator assembly) to provide a 1.4 volt peak signal at TP1803.

5-67. SERVO CONTROL MULTIPLEX.

5-68. To use the control channel as a data channel for frequencies above the constant amplitude control frequency, it is necessary to multiplex the data and the servo control signals.

Note

The frequency of the data signal must be not less than one octave above or below the record reference frequency as given in table 5-20.

5-69. MULTIPLEX RECORD.

5-70. Multiplex recording requires the use of a low pass filter (Bell & Howell Type 13-544-1 Sine Wave Generator) in series with the output of the reference generator (see figure 5-8). The low pass filter is inserted into J415 on the transport electronics and relay chassis.

5-71. The output of the filter is connected by a BNC cable from J408 on the transport electronics and relay chassis to J4 on the reference amplifier and bias buffer. Connect data signal to J3.

5-72. Switch the transport phase lock switch to the TACH position. Select the tape speed required and place the transport in the RECORD mode.

5-73. Adjust the output of the reference generator R1834 (mounted on the reference generator assembly) to provide an output of 10 db below normal record level.

TAPE SPEED SELECTOR SWITCH POSITION	OUTPUT AT J405 (kHz)	FREQUENCY BAND TWO OCTAVES (kHz)
240	400	200 - 800
120	200	100 - 400
60	100	50 - 200
30	50	25 - 100
15	25	12.5 - 50
7 1/2	12.5	6.250 - 25
3 3/4	6.250	3.125 - 12.5
1 7/8	3.125	1.562 - 6.250
15/16	1.562	0.781 - 3.125

Table 5-20. Tape Speed Versus Servo Reference Frequency Generator Output

5-74. Set the data record level by adjusting R2, in the direct record amplifier, to 1 db below normal record level.

5-75. MULTIPLEX REPRODUCE.

5-76. Servo control from a multiplex signal requires the use of a band pass or low pass filter (Bell & Howell Type 13-545-1 Band Pass Filter Assembly or 13-545-2 Low Pass Filter Assembly) in series with the input to the reproduce servo control amplifier (see figure 5-9).

Note

The band pass filter is used in place of the Low Pass Filter, Type 13-545-2, and plugs into J417 on the transport electronics and relay chassis.

5-77. Connect a BNC cable (Bell & Howell part number 199240-5) between J405 on the transport electronics and relay chassis and the applicable channel on the reproduce amplifier mounting case.

5-78. Switch the transport phase lock switch to the TAPE position, and reproduce the recordings made in paragraphs 5-69 to 5-74. Adjust the input to the reproduce servo control (R1) to give 1 volt peak-to-peak (0.3 volt rms) measured at test point TP2 on the reproduce servo control assembly.

5-79. FIELD REPAIR SERVICE.

5-80. 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 service 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.

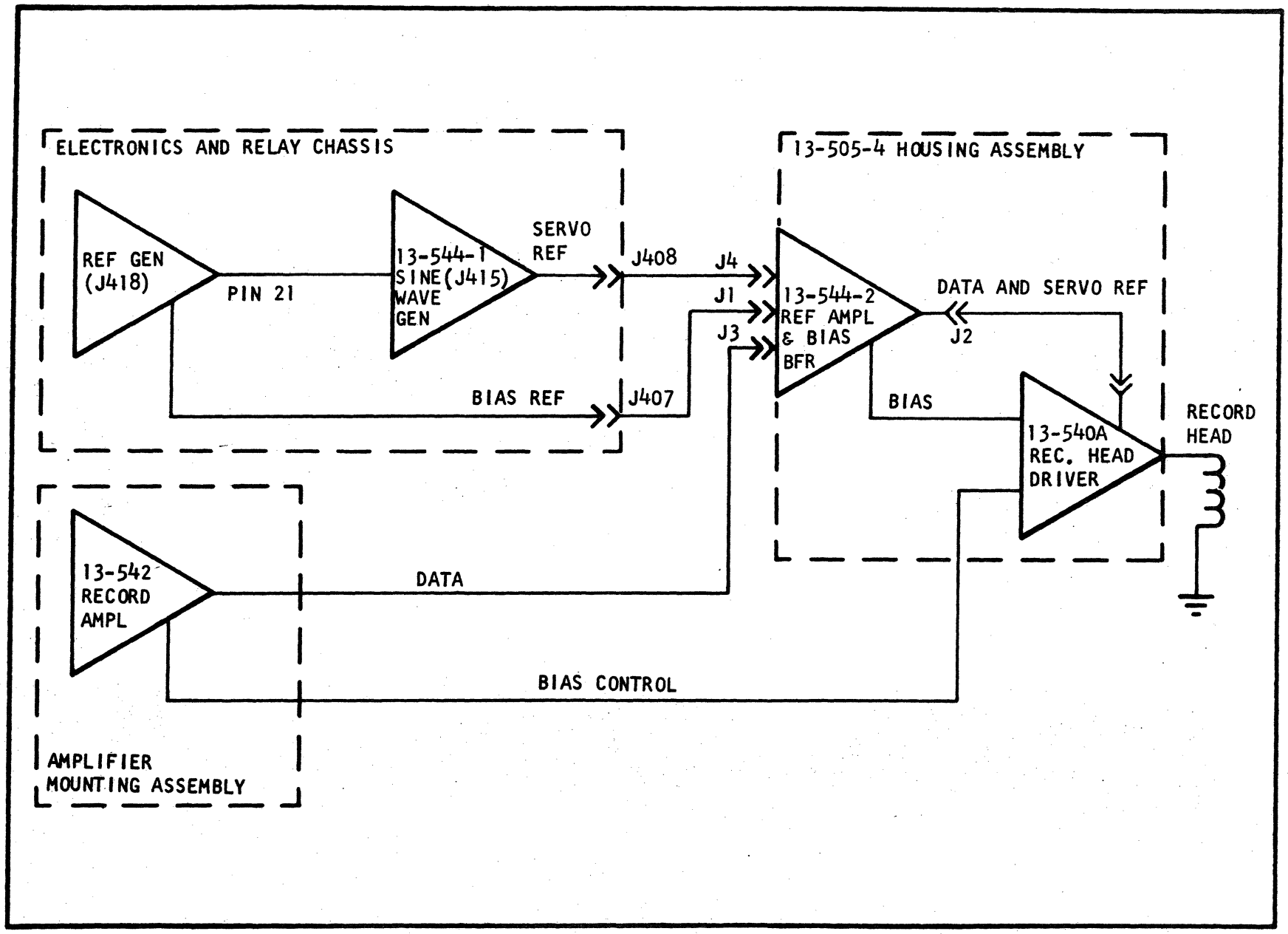


Figure 5-8. Multiplex Record Signal Path

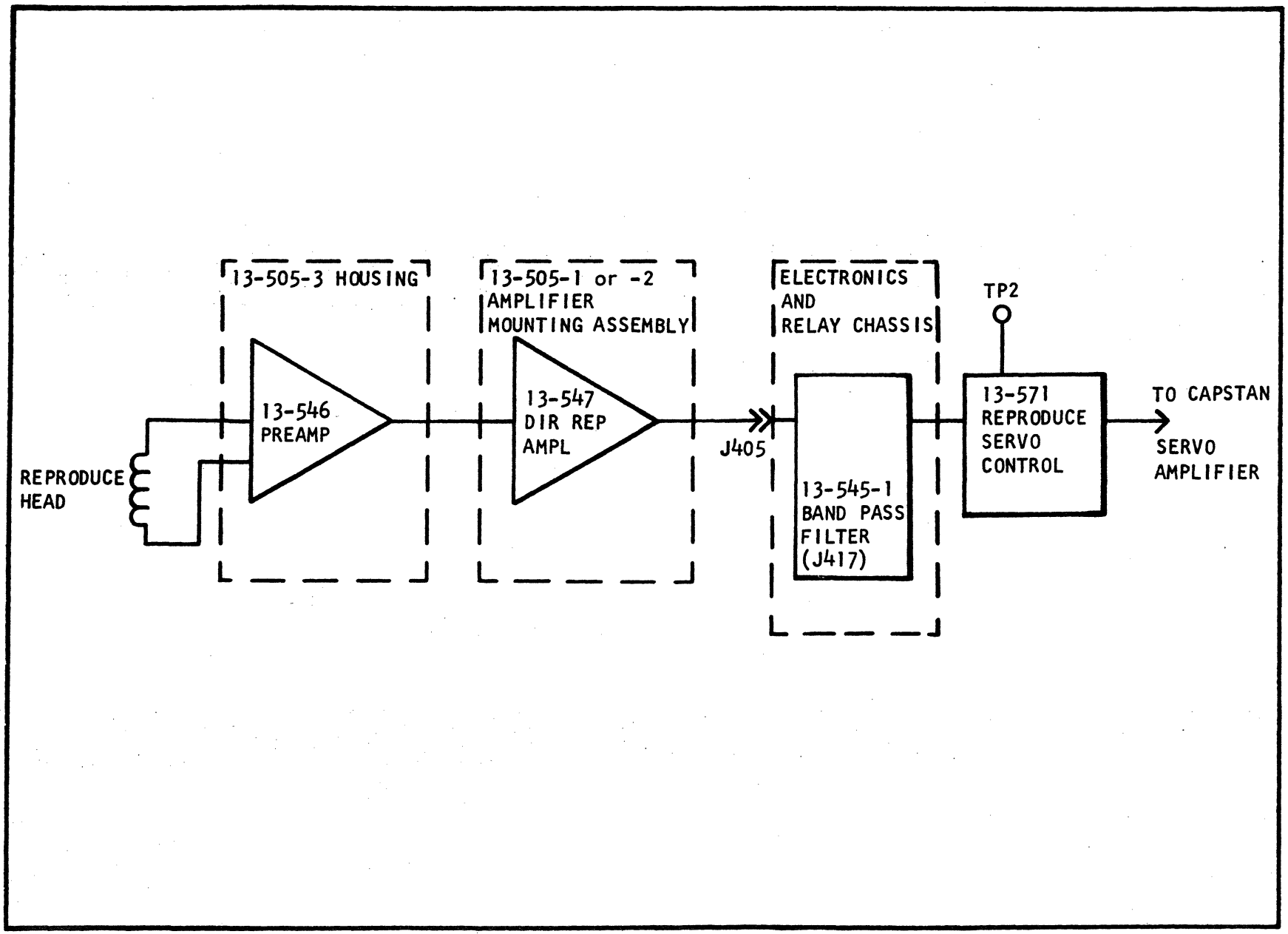


Figure 5-9. Multiplex Reproduce Signal Path

5-81. FACTORY REPAIR SERVICE.

5-82. 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. REPLACEMENT PARTS LIST.

6-2. Parts lists for the basic cabinet and the cabinet accessories are included in this section of the manual. Parts lists for the other components which may make up a VR-3700B System are included in the individual component manuals. Tables 6-1 through 6-6 give the Bell & Howell part numbers and descriptions of replaceable parts, and where applicable, the manufacturer and manufacturer's part number, or the military part number. The manufacturers are identified by the Federal Supply Code for Manufacturers, Cataloging Handbook H4-2.

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. When ordering parts, the following information should be supplied to our 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 in the parts list, or on the component proper.

c. The schematic symbol, given on the cabling diagram and on the parts list.

d. The part or assembly type number, 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.

Table 6-1. Parts List for the 13-502 Basic Cabinet Assembly. Note: If dual cabinets are used, the quantities given for the basic cabinet assembly should be doubled.

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	474651	Basic Cabinet Assembly (VR-3700B)	1			
2	373975	Base, pan	1			
3	474655	Door, rear	1			
4	247216	Panel, perforated	1			
5	472447	Latch, recessed, cup	2			
6	201656	Receptacle, latch	2			
7	211658	Cam	1			
8	211620-4	Hinge, take apart	3			
9	129858-2	Foam Edge Molding (13'5")	A/R			
10	212498-11	Washer, nylon	3			
11	474656	Rack, electrical equipment	1			
12	197701-4	Nut, unistrut #5/16-18	16			
13	19543-12	Screw, cap. hex hd #5/16-18 x 3/4	16			
14	211620-3	Hinge, take apart	3			
15	19784-56	Tape, foam, vinyl, 1/4 x 3/8	A/R			

Table 6-2. Parts List for the 13-503A-1 Single Cabinet Accessories

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	478366	13-503A-1 Single Cabinet Accessories (VR-3700B)	1			
2	Ref	System Cabling Diagram	Ref			
3	478363	Schematic Diagram, outlet strip supply	Ref			
4	167001-0062	Plug, button	1			
5	6887-0051	Grommet	1			
6	478365	Connector Assy, electrical	1			
7	472449-0001	Connector, electrical	1			
8	156071-0002	Terminal, lug, insul	3			
9	478364	Cable K	1			
10	129206-0001	Connector	1			
11	472169-4	Cable, ground (6")	1			
12	472169-3	Cable, ground (25")	1			
13	472169-2	Cable, ground (19")	2			
14	472169-1	Cable, ground (6")	2			
15	471757	Label, "Caution"	2			
16	474822-1	Panel, blank (1 3/4")	A/R			
17	474822-2	Panel, blank (3 1/2")	A/R			
18	474822-3	Panel, blank (5 1/4")	A/R			
19	474822-4	Panel, blank (7")	A/R			
20	474822-5	Panel, blank (8 3/4")	A/R			
21	474822-6	Panel, blank (10 1/2")	A/R			
22	474822-7	Panel, blank (12 1/4")	A/R			

Table 6-3. Parts List for the 13-506-1 Blower Assembly (5 1/4")

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	472042	Blower Assembly	1			
2	377685	Tab, locating	2			
3	248363-1	Fastener, pawl	2			
4	377374-1	Grill, blower	1			
5	249290	Retainer, filter	2			
6	248793	Blower, packaged, twin	1			

Table 6-4. Parts List for the 13-506-2 Blower Assembly (8 3/4")

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	476445	Blower Assembly	1			
2	377685	Tab, locating	2			
3	248363-1	Fastener, pawl	2			
4	476444	Grill, blower	1			
5	249290	Retainer, filter	2			
6	248793	Blower, packaged, twin	1			

Table 6-5. Parts List for the 13-506-3 Blower Assembly (10 1/2")

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	472041	Blower Assembly	One			
2	374598	Bracket, mounting blower	1			
3	374606	Clip, filter holding	2			
4	374607-1	Grill, blower	1			
5	371713-15	Stud, weld	4			
6	213183-103	Fan, cooling	2	B1,2		
7		Capacitor, 2.0 μf	Ref			
8	213183-001	Clamp	6			
9	27025-4	Terminal Board	1	TB1		
10	248363-1	Fastener, pawl	2			
11	374623	Filter, air (washable)	1			
12	16656-27	Fuse, 3/8 amp., 125 V SB	2	F1,2		
13	245026-1	Cable Assembly	1			
14	245027	Plug, fused	1			
15	37560-4	Cable, pwr, elec 18 GA	A/R			

Table 6-6. Parts List for the VR-3700B Magnetic Head Assemblies

ITEM NO.	B&H PART NO.	DESCRIPTION 0 1 2 3 4 5	QTY	FIG./INDEX OR REF SYM	MFR CODE	MFR OR MIL PART NO.
1	209682-81	7 Channel Record, 2.0 MHz	1			
2	209682-151	14 Channel Record, 2.0 MHz	1			
3	209683-82	7 Channel Reproduce, 600 kHz	1			
4	209683-152	14 Channel Reproduce, 600 kHz	1			
5	209682-82	7 Channel Reproduce, 2.0 MHz	1			
6	209682-152	14 Channel Reproduce, 2.0 MHz	1			

SECTION VII

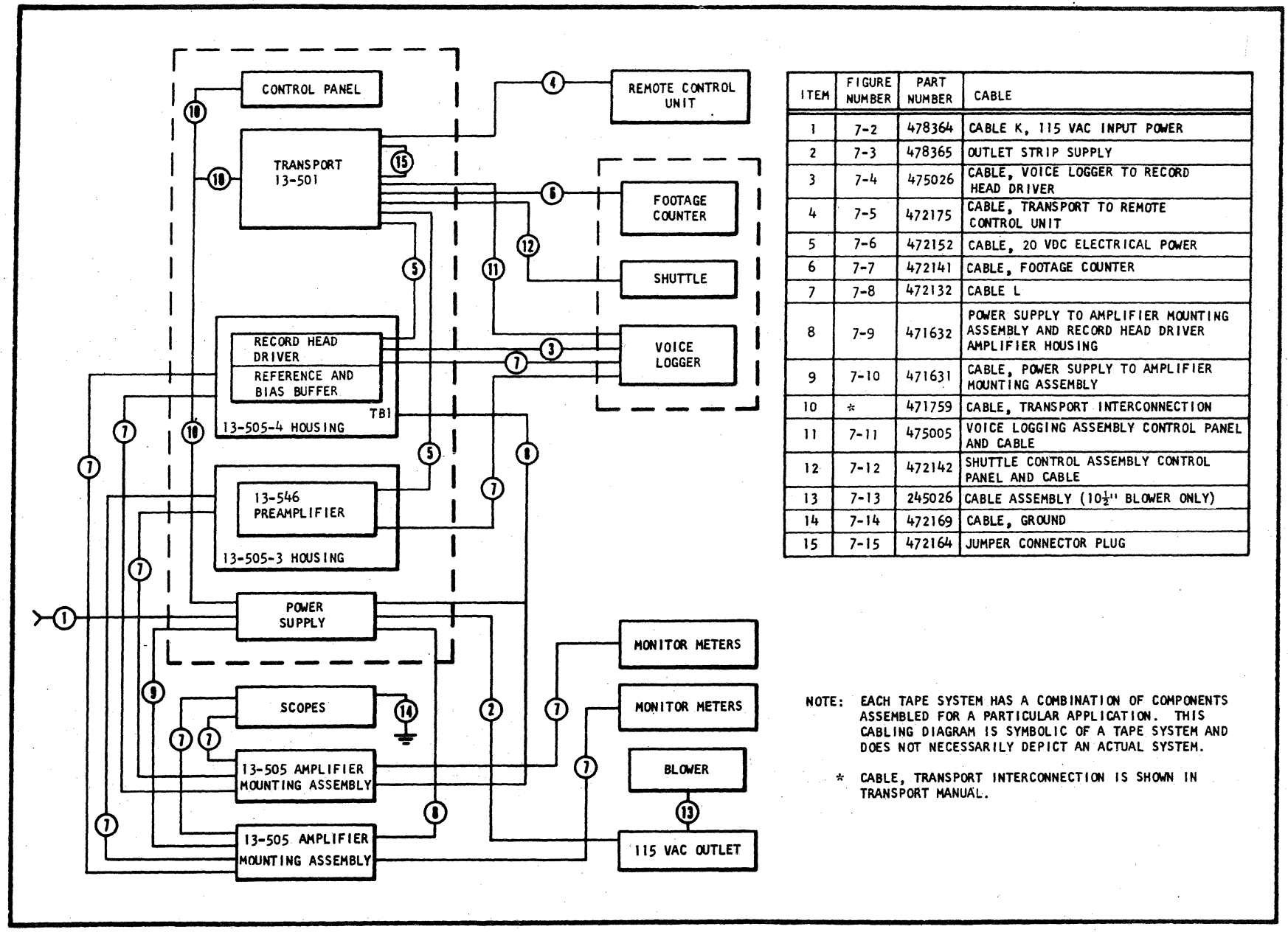
DRAWINGS AND SCHEMATICS

7-1. GENERAL.

7-2. This section contains the cabling diagrams of the VR-3700B Magnetic Tape Record/ Reproduce System. All cables furnished as part of the system cabinet, as well as any cables required for interface between subassemblies of the system, are included in this section.

7-3. Detailed schematics, block diagrams, and cabling diagrams for each subassembly are located in the subassembly operation and maintenance manuals furnished with this system.

7-4. A list of the cabling diagrams included in this section can be found in the List of Illustrations at the front of this manual.



ITEM	FIGURE NUMBER	PART NUMBER	CABLE
1	7-2	478364	CABLE K, 115 VAC INPUT POWER
2	7-3	478365	OUTLET STRIP SUPPLY
3	7-4	475026	CABLE, VOICE LOGGER TO RECORD HEAD DRIVER
4	7-5	472175	CABLE, TRANSPORT TO REMOTE CONTROL UNIT
5	7-6	472152	CABLE, 20 VDC ELECTRICAL POWER
6	7-7	472141	CABLE, FOOTAGE COUNTER
7	7-8	472132	CABLE L
8	7-9	471632	POWER SUPPLY TO AMPLIFIER MOUNTING ASSEMBLY AND RECORD HEAD DRIVER AMPLIFIER HOUSING
9	7-10	471631	CABLE, POWER SUPPLY TO AMPLIFIER MOUNTING ASSEMBLY
10	*	471759	CABLE, TRANSPORT INTERCONNECTION
11	7-11	475005	VOICE LOGGING ASSEMBLY CONTROL PANEL AND CABLE
12	7-12	472142	SHUTTLE CONTROL ASSEMBLY CONTROL PANEL AND CABLE
13	7-13	245026	CABLE ASSEMBLY (10½" BLOWER ONLY)
14	7-14	472169	CABLE, GROUND
15	7-15	472164	JUMPER CONNECTOR PLUG

NOTE: EACH TAPE SYSTEM HAS A COMBINATION OF COMPONENTS ASSEMBLED FOR A PARTICULAR APPLICATION. THIS CABLING DIAGRAM IS SYMBOLIC OF A TAPE SYSTEM AND DOES NOT NECESSARILY DEPICT AN ACTUAL SYSTEM.

* CABLE, TRANSPORT INTERCONNECTION IS SHOWN IN TRANSPORT MANUAL.

Figure 7-1. System Cabling Diagram

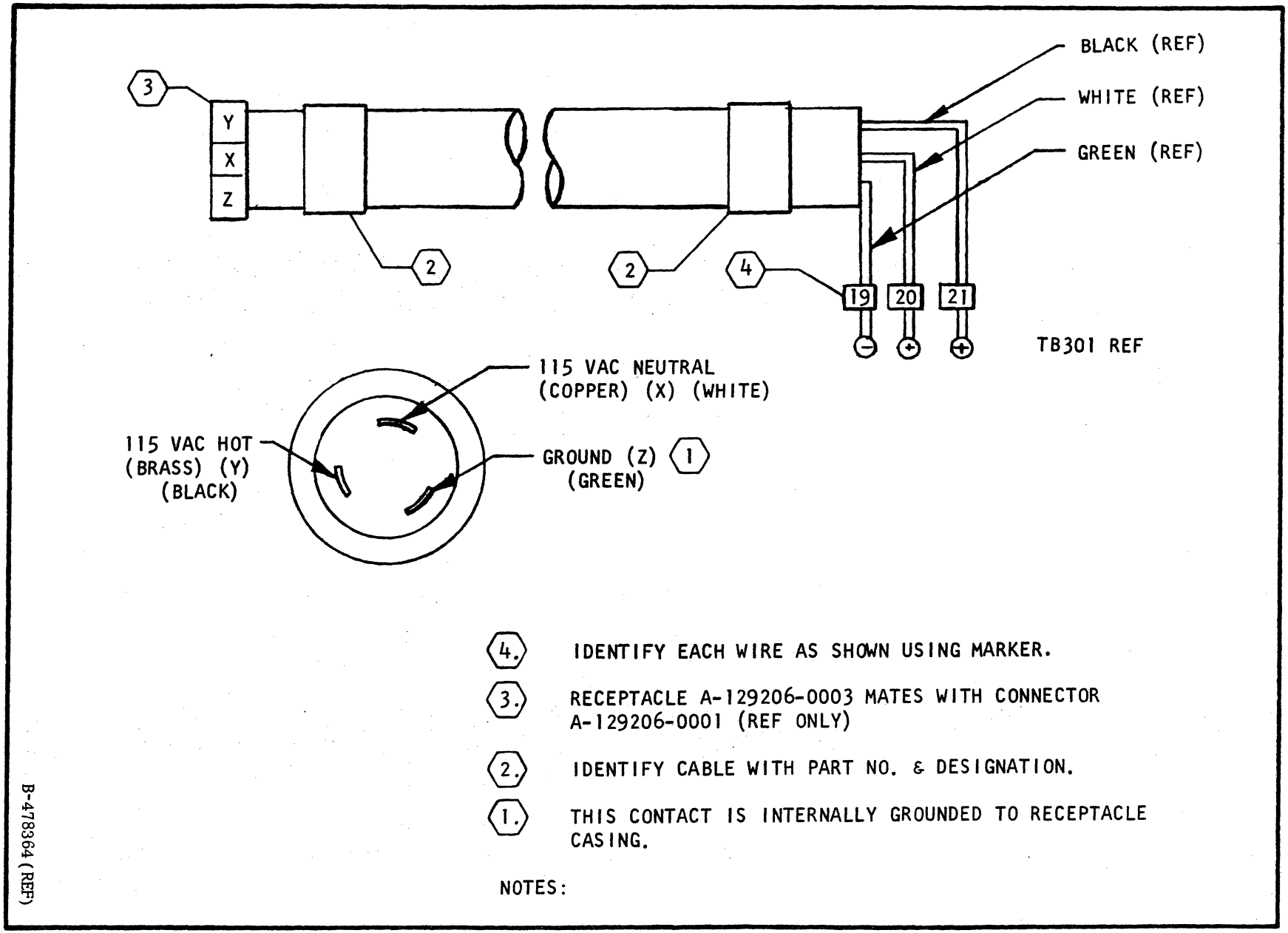


Figure 7-2. Cable K, 115 VAC Input Power

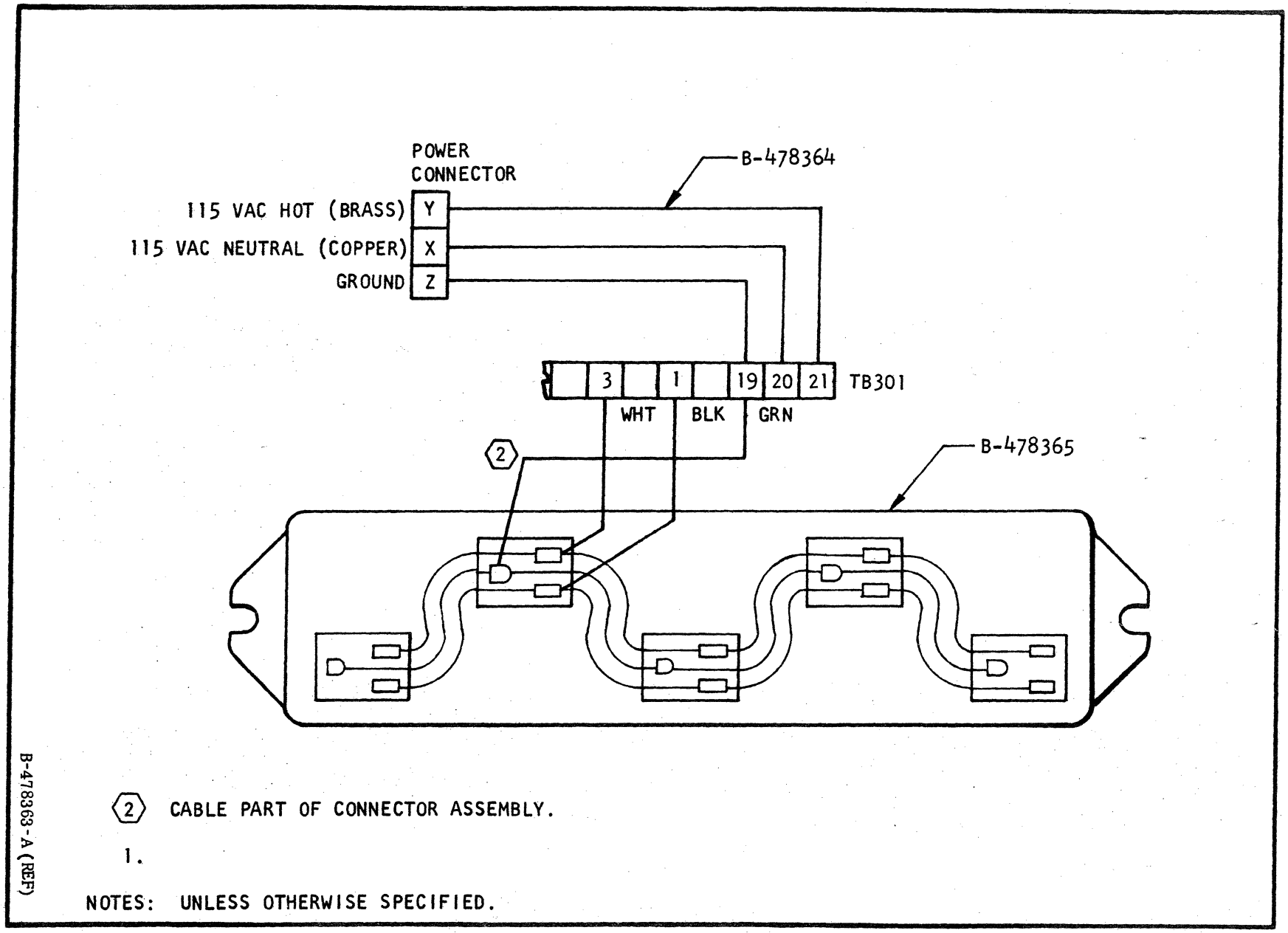
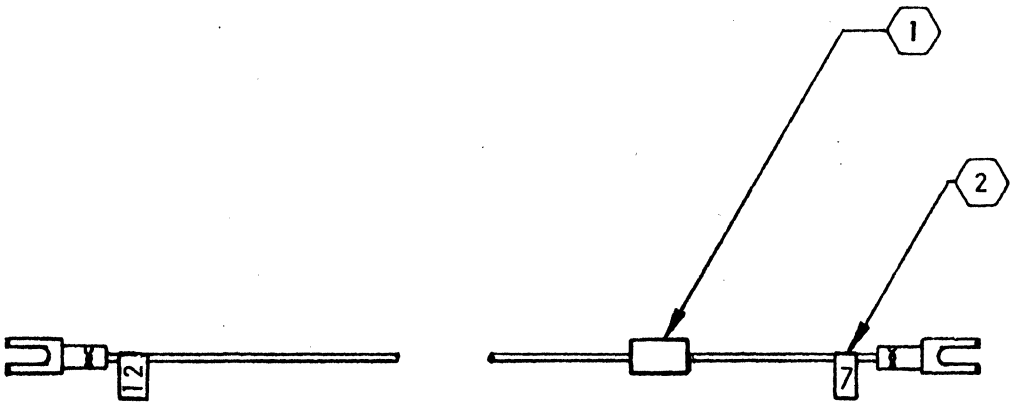


Figure 7-3. Outlet Strip Supply



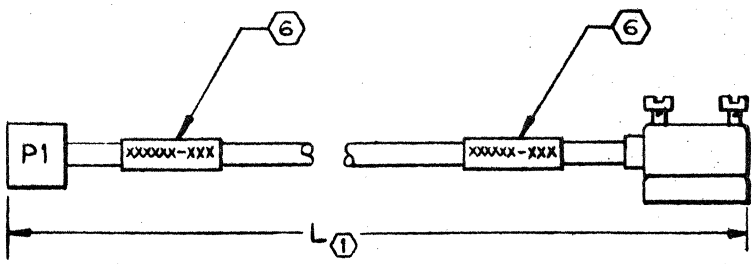
(2) IDENTIFY WIRE AS SHOWN.

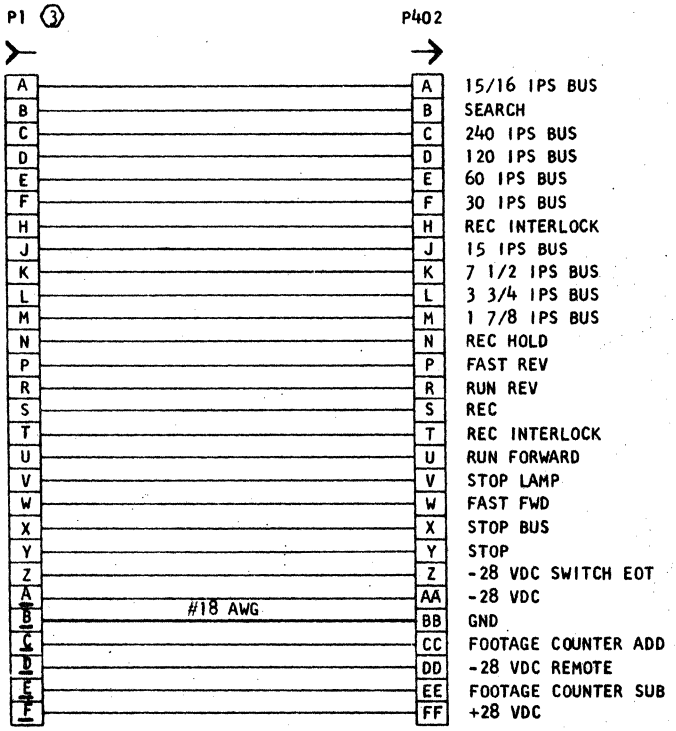
(1) IDENTIFY CABLE WITH PART NO.

NOTES:

B-475026 (REF)

Figure 7-4. Cable, Voice Logging Assembly to Record Head Driver Amplifier Housing





⟨6⟩ IDENTIFY CABLE WITH B&H PART NO.

5. FUNCTION: TRANSPORT TO REMOTE SWITCHING CONTROL.

4.

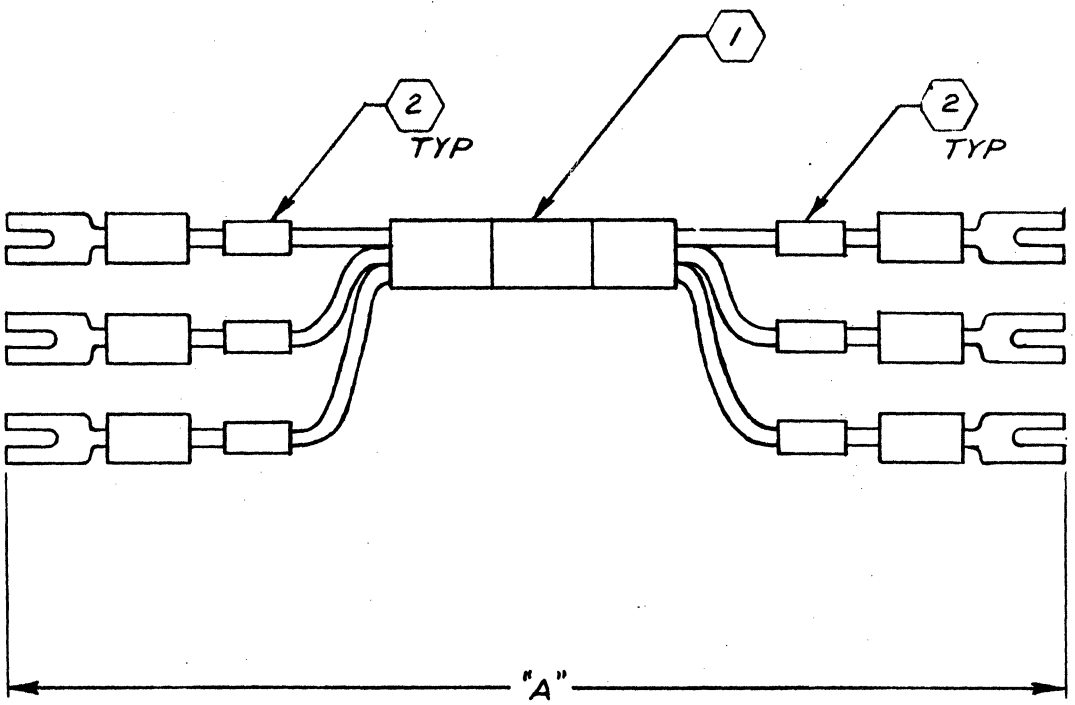
⟨3⟩ CONTACT DESIGNATIONS INDICATED THUS "A" DENOTE LOWER CASE "a".

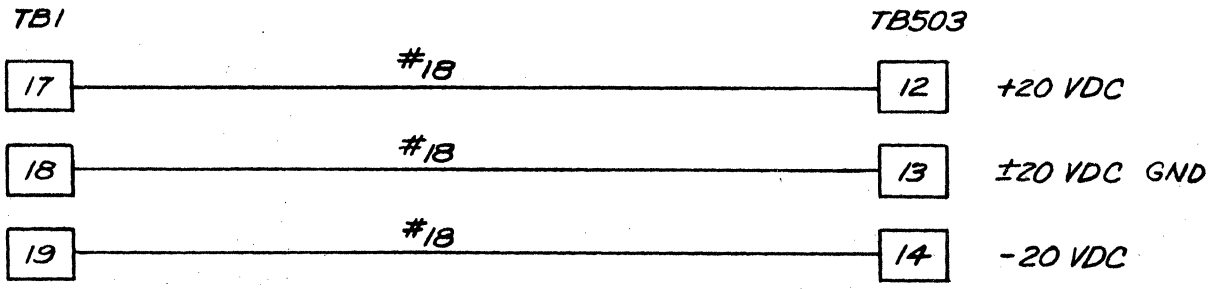
⟨1⟩ A. DASH NO. INDICATES LENGTH OF CABLE IN INCHES, 100 FT. MAXIMUM LENGTH. (FOR LENGTH OF CABLE, SEE CUSTOMER'S ORDER.)
EXAMPLE: B&H P/N 472175-150 = CABLE 150 INCHES LONG.

NOTES: UNLESS OTHERWISE SPECIFIED.

D-472175-B(REF)

Figure 7-5. Cable, Transport to Remote Control Unit





(2) USE MARKER TO IDENTIFY EACH WIRE TO TB1 & TB503.

(1) IDENTIFY CABLE WITH B&H PART NO. TABULATED.

NOTES:

(1) B & H PART NO.	USED ON	DIM "A"
C-472152-1	13-505-3	60.00± .50
C-472152-2	13-505-4	36.00± .50

C-472152 (REF)

Figure 7-6. Cable, 20 VDC Electrical Power

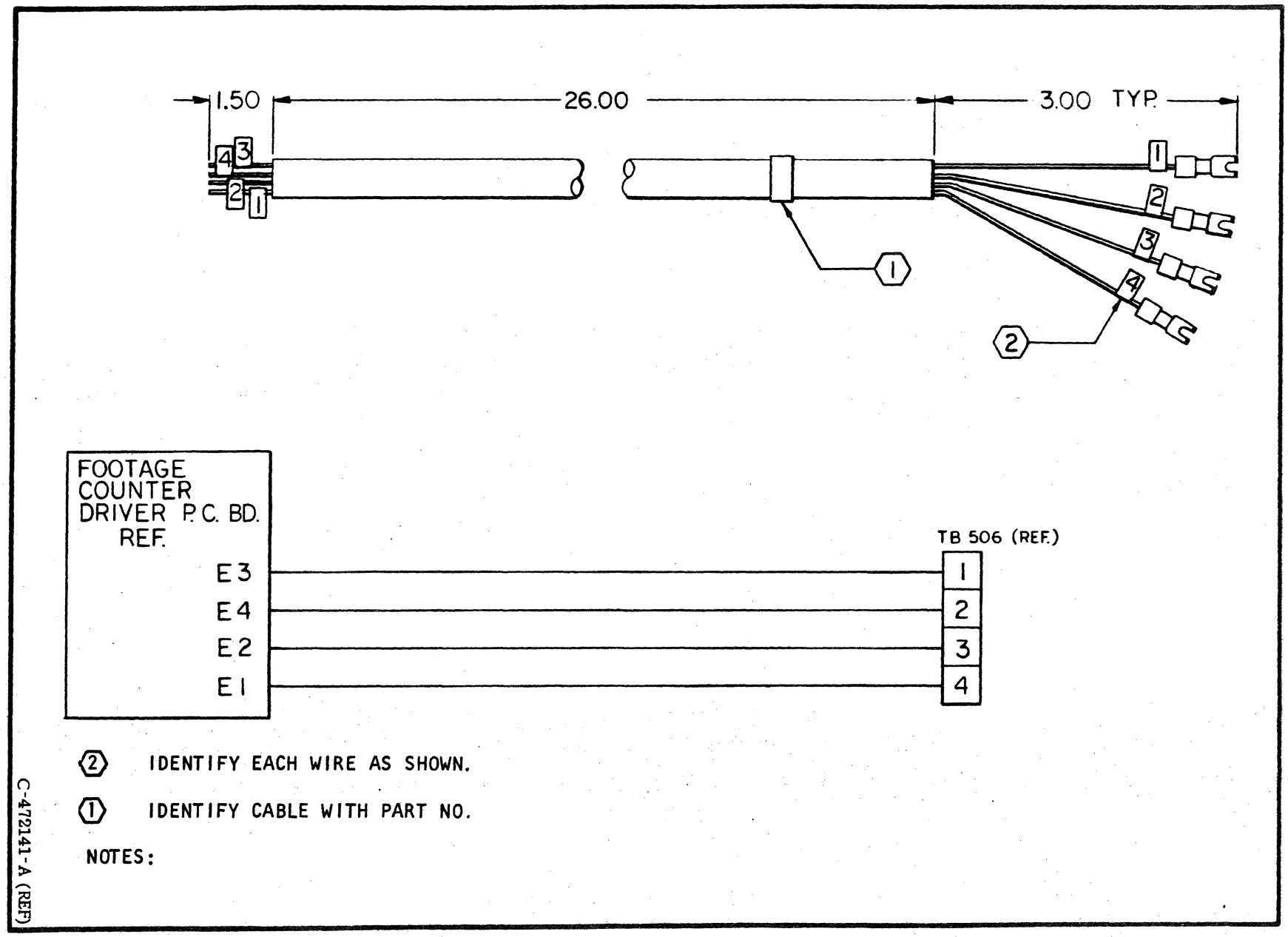
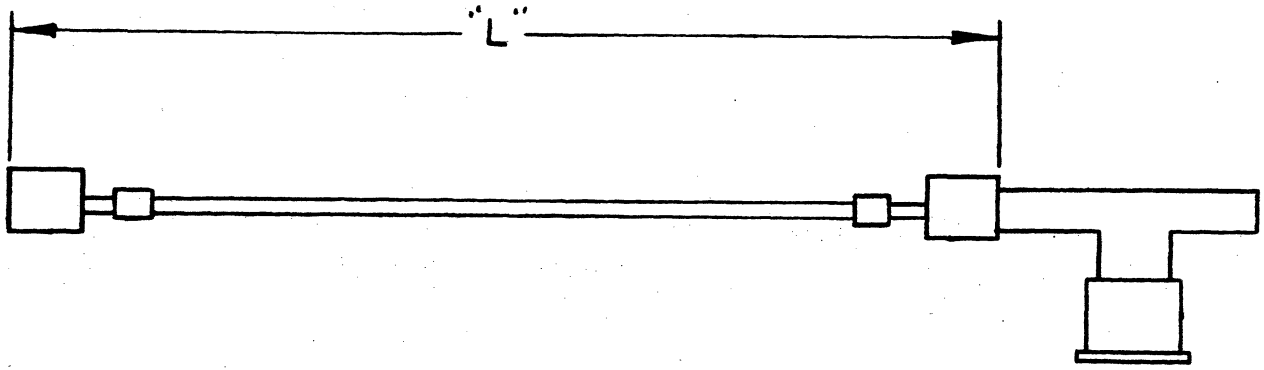


Figure 7-7. Cable, Footage Counter



B&H DASH NO.	CABLE DES	"L" ±1"	FUNCTION
-0001	L1	98"	AMPL CHASSIS TO REC HD DRIVER AMPL
-0002	L2	60"	REPRODUCE TO SERVO
-0003	L3	48"	BIAS TO BIAS BUFFER OR REC REF TO REF AMPL OR VOICE CABLE
-0005	L5	30"	OSCILLOSCOPE TO AMPL CHASSIS
-0006	L6	10"	REF AMPL TO REC HD DRIVER AMPL
-0007	L9	88"	AMPL CHASSIS TO PREAMP
-0009	L10	32"	MONITOR METER TO AMPL

B-472132-H (REF)

Figure 7-8. Cable L

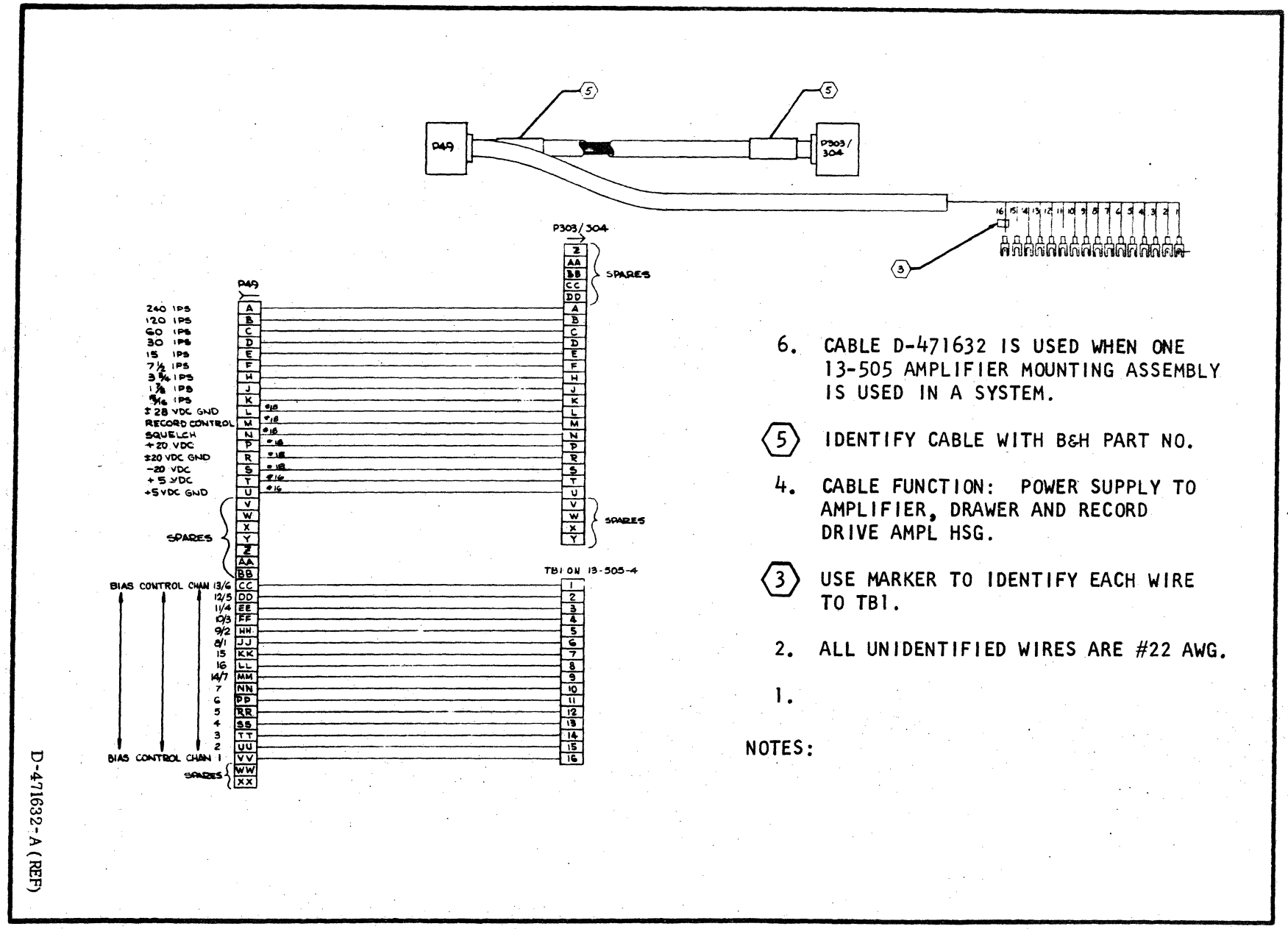


Figure 7-9. Cable, Power Supply to Amplifier Mounting Assembly and Record Head Driver Amplifier Housing

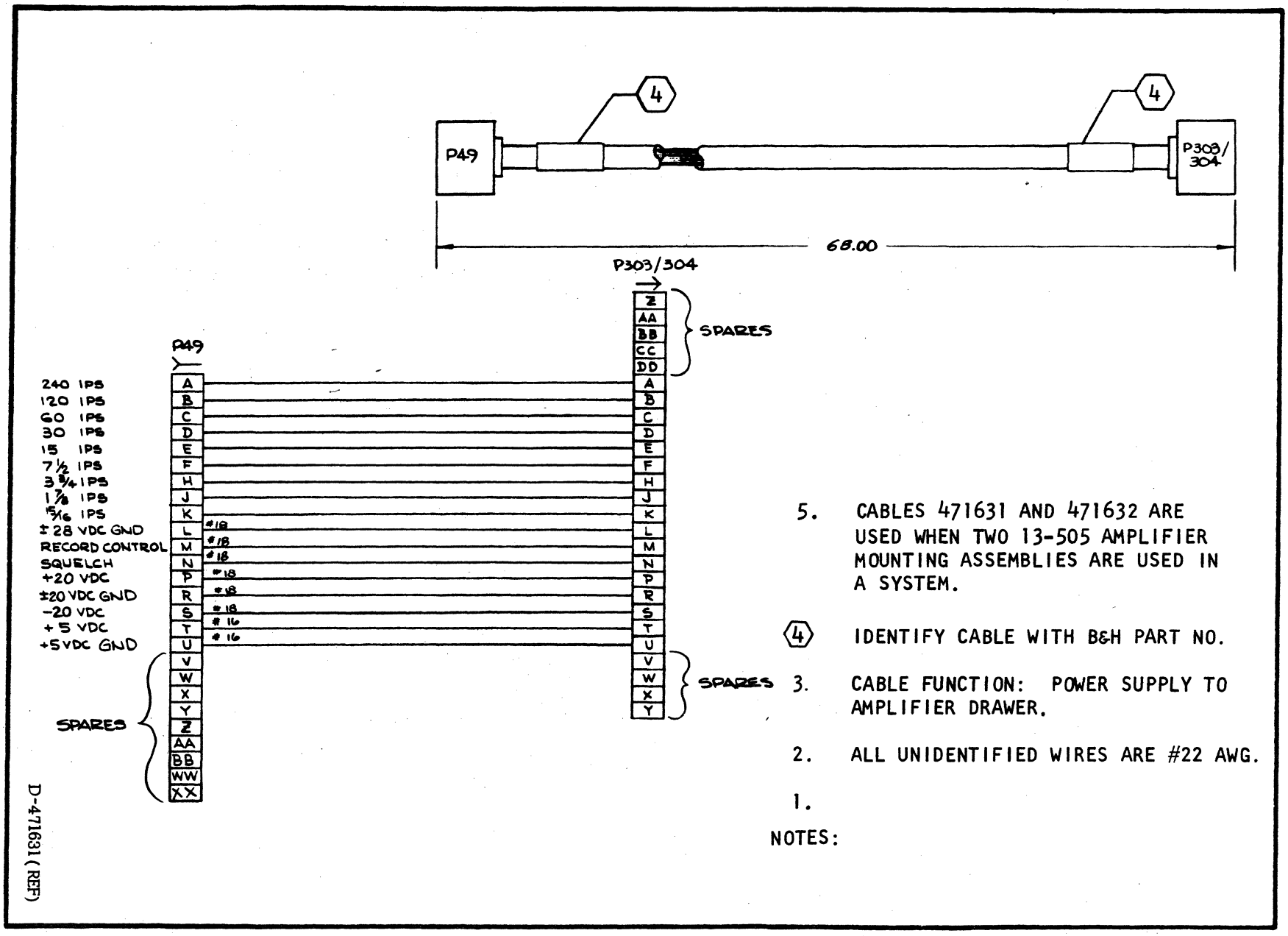


Figure 7-10. Cable, Power Supply to Amplifier Mounting Assembly

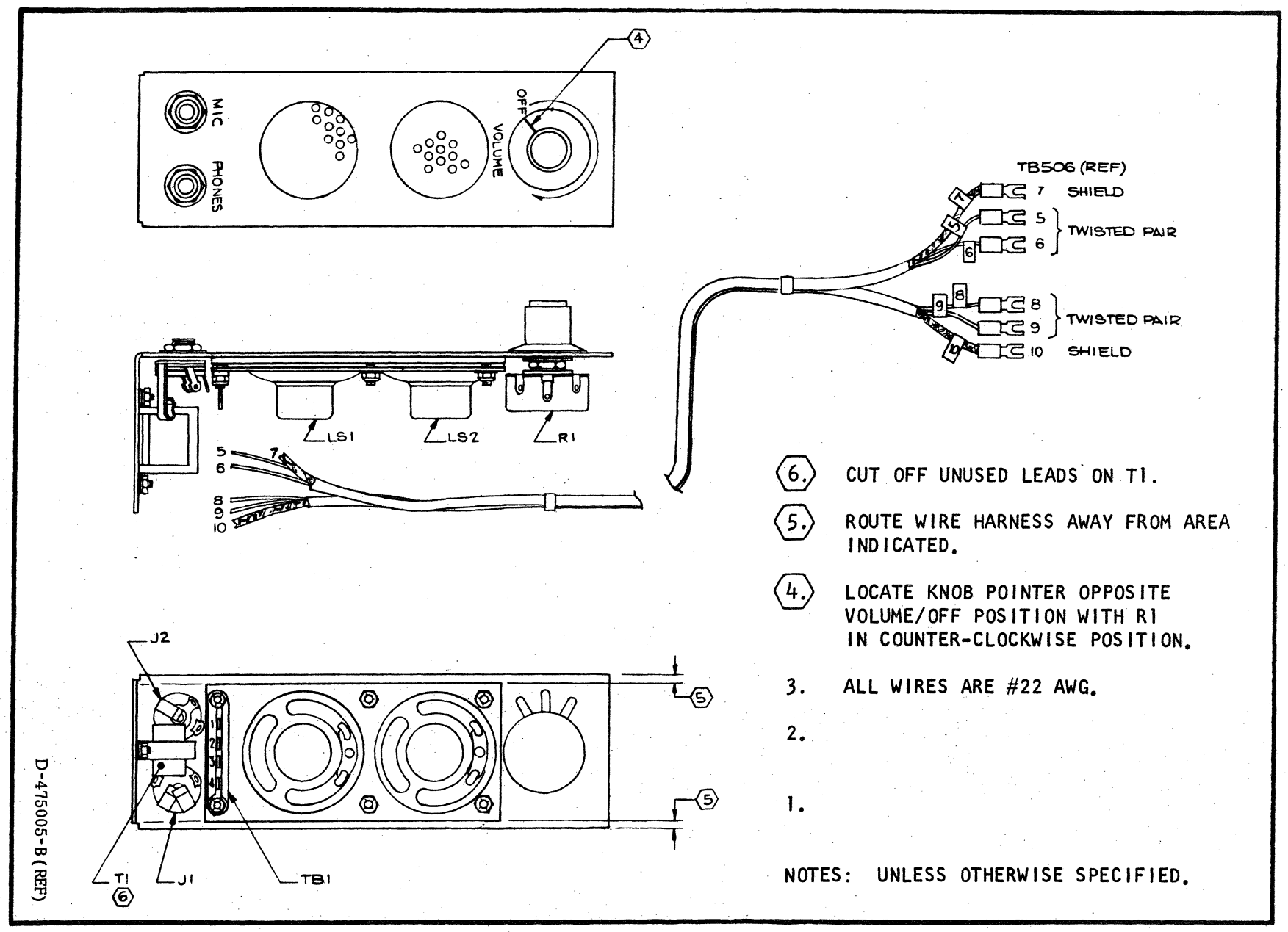


Figure 7-11. Voice Logging Assembly Panel and Cable

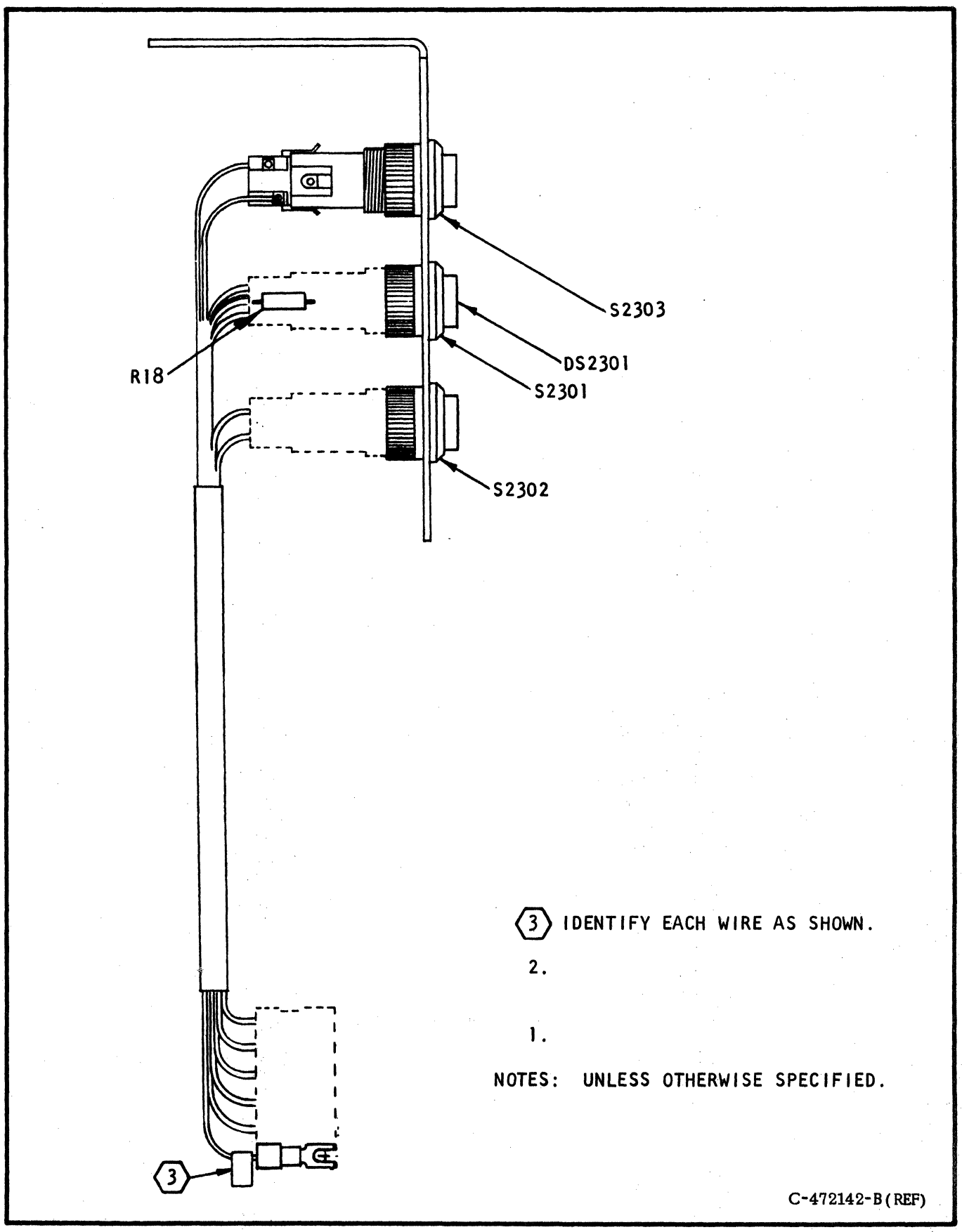
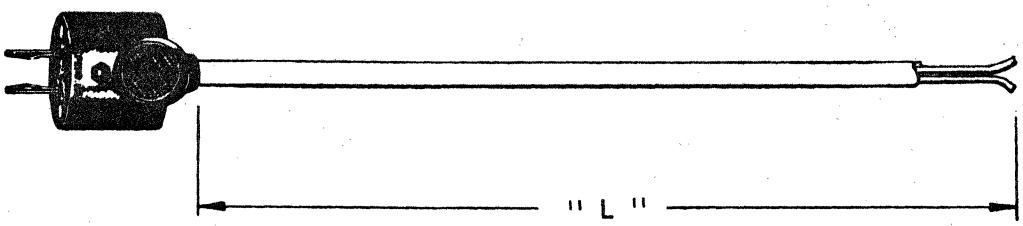


Figure 7-12. Shuttle Control Assembly Control Panel and Cable



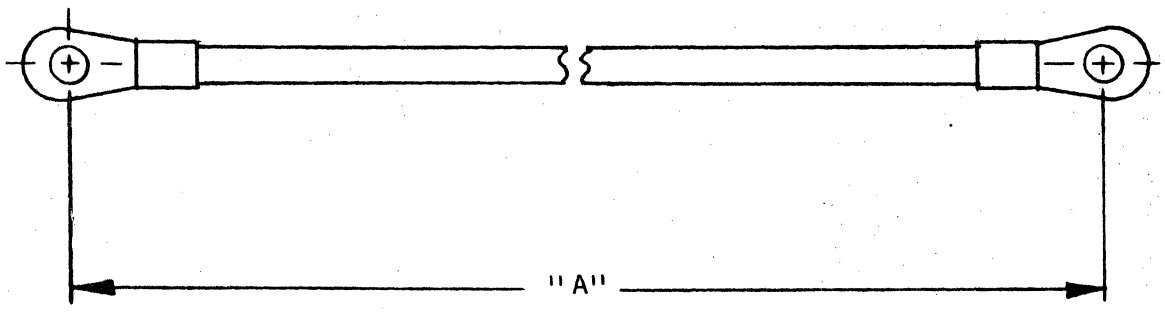
⟨1⟩ DIMENSIONS TO BE DETERMINED AT ASSEMBLY.

NOTES: UNLESS OTHERWISE SPECIFIED.

DASH NO.	"L"
BASIC	⟨1⟩
-1	48"

B-245026-A (REF)

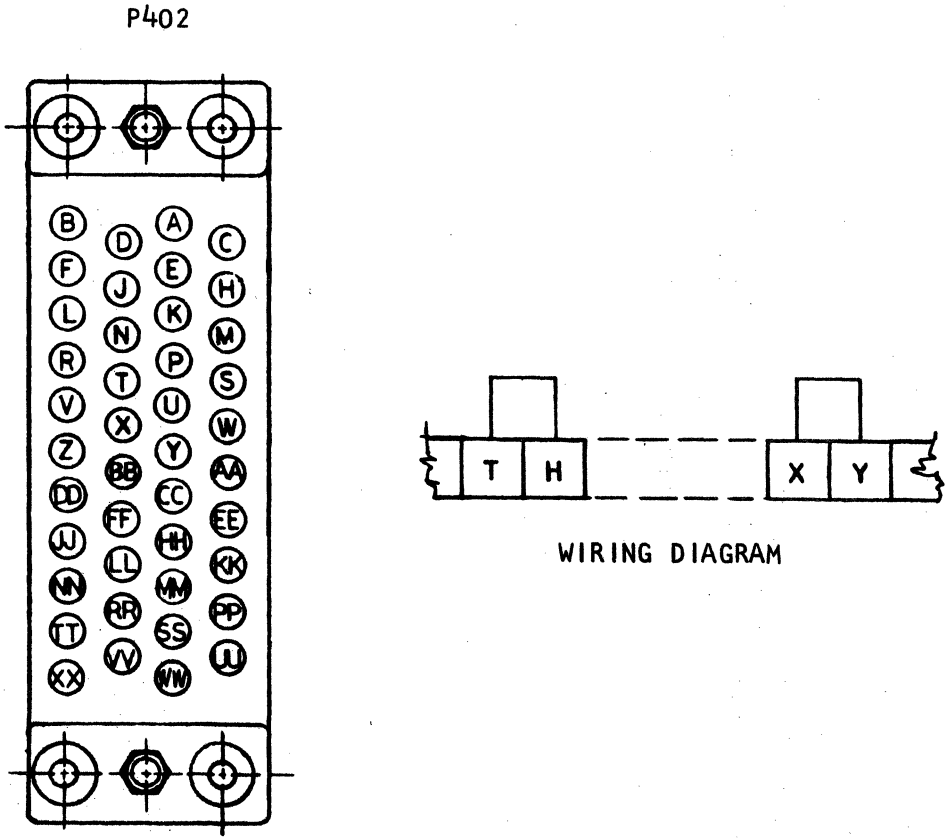
Figure 7-13. Cable Assembly



DASH NO.	"A"
-1	6.00
-2	19.00
-3	25.00
-4	6.00

B-472169-A (REF)

Figure 7-14. Cable, Ground



1. INSTALLED IN J402 WHEN REMOTE CONTROL NOT USED.

NOTE: UNLESS OTHERWISE SPECIFIED.

B-472164 (REF)

Figure 7-15. Jumper Connector Plug

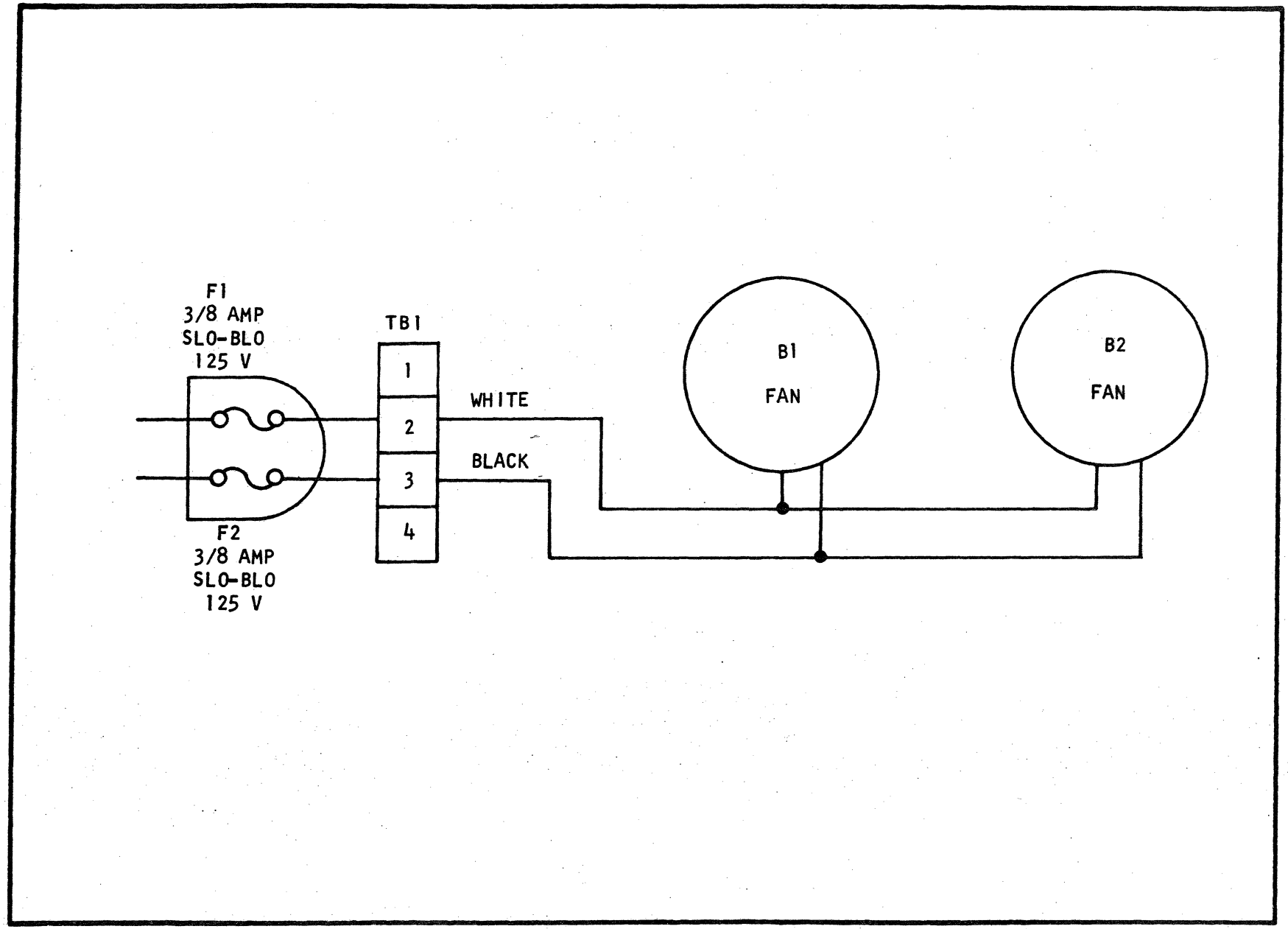


Figure 7-16. Blower Assembly, 10 1/2 Inch