AMPRO

BROADCAST EQUIPMENT

OPERATION
and
MAINTENANCE MANUAL

for

CT 2500B, CT 3500B, CT 4500B
TAPE CARTRIDGE REPRODUCE
and
RECORD-REPRODUCE SYSTEMS

EQUIPMENT LOST OR DAMAGED IN TRANSIT

When delivering the equipment to you, the truck driver or carrier's agent will present a receipt for your signature. Do not sign it until you have (a) inspected the containers for visible signs of damage and (b) counted the containers and compared with the amount shown on the shipping papers. If a shortage or if evidence of damage is noted, insist that notation to that effect be made on the shipping papers before you sign them.

Further, after receiving the equipment, unpack it and inspect thoroughly for concealed damage. If concealed damage is discovered, immediately notify the carrier, confirming the notification in writing, and secure an inspection report. This item should be unpacked and inspected for damage WITHIN 15 DAYS after receipt. Claims for loss of damage will not be honored without proper notification of inspection by the carrier.

Ampro will file all claims for loss and damage on this equipment so long as the carriers original copy of the inspection report is forwarded to Ampro Corporation within 30 days along with your letter stating in detail the extent of damages and whether equipment is to be repaired at your location or replacement is required.

WARRANTY ITEMS

Particular parts and/or equipment covered by warranty are specifically stated as such in the warranty or contract given to the customer at the time of sale. The warranty or contract also stipulates the conditions under which the warranty may be exercised.

To obtain a new replacement for such warranty items, contact Ampro Corporation and please supply full product identification information including the original invoice number, Model, type & serial numbers. The replacement part identification number (including stock number and description) must be supplied for the particular part for which warranty replacement is requested.

Request for warranty replacements may be unduly delayed if all this information is not supplied.

REPLACEMENT PARTS

When ordering replacement parts, please supply unit type, description & reference symbol number of each item ordered.

The part which will be supplied against an order for a replacement item may not be an exact duplicate of the original part. However it will be a satisfactory replacement differing only in minor mechanical or electrical characteristics. Such differences will in no way impair the operation of the equipment.

ORDERING INFORMATION

Replacement parts & Warranty items may be ordered from:

AMPRO CORPORATION
PARTS & ACCESSORIES DEPT.
850 Pennsylvania Boulevard
Feasterville, Pa. 19047

Telephone: 215-322-5100

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AMPRO WARRANTY

Ampro Corporation warrants each product of its manufacture to be free of defects of workmanship or material and conforms to the specifications referred to or set out herein. This warranty extending only to the original user is for a period of one year from date of shipment and no claim shall be maintained hereunder unless written notice is received by Seller within 30 (thirty) days after discovery of the facts giving rise to the claim. The sole or exclusive liability of seller for breach of warranty shall be to refund the purchase price of the item sold, or at its option to replace or repair the item or part concerned which our examination shall disclose to our satisfaction to have been defective, FOB factory or such other place as it may designate. This warranty shall not be effective if the alleged defect is due to maltreatment, exposure, excessive moisture or any other use of the equipment other than the use for which the manufacturer prescribed.

No other warranties expressed or implied, shall be applicable to any equipment sold hereunder, and the foregoing shall constitute the Buyer's sole right and remedy under the agreements in the above paragraph contained. In no event shall Ampro Corp. have any liability for consequential damages, or for loss, damage, or expense directly arising from the use of the products, or any inability to use them either separate or in combination with other equipment or materials, or from any other cause.

This Seller's Warranty is given solely to the original user and only to the extent above described. No dealer or agent is authorized to make any other or additional guaranty or warranty.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

EQUIPMENT LIST

	OPTIONAL FEATURES (NOTES 1,2 & 3) END CUE	TRIP CUE	FAST FWD.	MONAURAL MODEL	STEREO MODEL
SERIES 2500	–	–	–	CT2501B	CT2511B
REPRODUCER	X	X	–	CT2505B	CT2515B
NAB TYPE A CARTS	X	X	X	CT2507B	CT2517B
SERIES 3500	–	–	–	CT3521B	CT3531B
REPRODUCER	X	X	–	CT3525B	CT3535B
NAB TYPE A & B CARTS	X	X	X	CT 3527B	CT3537B
SERIES 3500	–	–	–	CT3541B	CT3551B
RECORDER-REPRODUCER	X	X	–	CT3545B	CT3555B
NAB TYPE A & B CARTS	X	X	X	CT3547B	CT3557B
SERIES 4500	–	–	–	CT4561B	CT4571B
REPRODUCER	X	X	–	CT4565B	CT4575B
NAB TYPE A, B & C CARTS	X	X	X	CT4567B	CT4577B
SERIES 4500	–	–	–	CT4581B	CT4591B
RECORDER-REPRODUCER	X	X	–	CT4585B	CT4595B
NAB TYPE A, B & C CARTS	X	X	X	CT4587B	CT4597B

NOTES:
1. ALL UNITS INCLUDE 1K Hz STOP CUE AND AUDIO SWITCHER AS STANDARD FEATURES.
2. Units are available for 50 Hz operation. To order, suffix model number with "50", thus, CT3541-50.
3. Electronic splice finder (installed) is available on Models CT3547, CT3557, CT4587 & CT4597. To order, suffix model number with "ESF".

CARTRIDGE TAPE EQUIPMENT ACCESSORIES

	PART NO.
RACK SHELF - mounts three CT2500, two CT3500, or one CT4500	9135-501
with one CT2500	9135-501
FILL PANEL - 1/3 rack width	9521-1
FILL PANEL - 1/2 rack width	9522-1
REMOTE CONTROL PANEL (4 Start Switches)	9519-501
REMOTE CONTROL PANEL (Full Function Record)	9520-501
CARD EXTENDER	9216-501
ALIGNMENT TOOL KIT - includes head insertion gage, height gage, allen head wrenches, adjustment screw driver	9217-501
HIGH LEVEL INPUT TRANSFORMER - one (1) required for mono two (2) required for stereo	9230-501
SPARE SEMICONDUCTOR KIT - Reproducer	9283-501
SPARE SEMICONDUCTOR KIT - Recorder/Reproducer	9282-501
HEAD CLEANER CARTRIDGE	9241-1
SPEED TEST CARTRIDGE	9243-1
TORQUE TEST CARTRIDGE	9242-1
AZIMUTH AND RESPONSE CARTRIDGE	9240-1

TECHNICAL DATA

SPECIFICATIONS

Record/playback Equalization	NAB Standard
Tape Velocity	7.5 in/s (190.5 mm/s)
Timing Accuracy (7.5 in/s)	0.1%
Frequency Response (400 Hz ref)	
50—15,000 Hz	± 2 db
30—18,000 Hz	+ 2, -4 db
Distortion:	
Playback only (20-20,000 Hz) (1)	0.5% THD max.
Record/Play 8db above NAB Reference Level, 400 Hz, 3M156 Tape)	3% max.
Signal/Noise Radio (2)	58 dB
Wow and Flutter (3)	0.15% rms max.
Crosstalk (Magnetic head limited):	
Cue channel to program channel:	
150 Hz	— 50 db max.
1000 Hz	—50 db max.
8000 Hz	—50 db max.
Recorder Input Impedance:	
High Level, balanced differentail amplifier	18,000 ohms
Recorder Input Level	—20 to + 18 dBm
Reproducer Output Impedance (Balanced)	600/150 ohms (5)
Reproducer Output Level (4) (400 Hz NAB Standard Reference Level)	+ 8 dBm nominal
Bias Oscillator Frequency	100 kHz
Fast-Forward Tape Velocity	22.5 in/s (1171 mm/s)
Ambient Operating Temperature	0 to 55°C
Tape Start Time	0.1s max.
Tape Stop Time	40m sec.
Tape Pull Force	1.5 lbs min.
Power Requirements	105-125/210-230V, 50 or 60 Hz (6), 60W max.
Dimensions:	
CT2500B	5-1/4" H; 5-7/8" W; 17" D (133, 149, 432 mm)
CT3500B	5-1/4" H; 8-3/4" W; 17" D (133, 222, 432 mm)
CT4500B	5-1/4" H; 11-3/4" W; 17" D (133, 298, 432 mm)

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1 Using loop-injection measurement techniques at playback output level of + 18 dBm.

2 Below 400 Hz at 3% THD level, 3M156 Tape, 20—20,000 Hz. 58 db S/n ratio, tape standing still; 50 dB, tape still with 5 machines in parallel.

3 Measured per ANSI S4.3

4 Adjustable 0 to + 10 dBm, Clipping Level + 20 dBm

5 Restrapping required for 150 ohms.

6 Motor speed synchronous to line frequency. Use 60 Hz units on 60 Hz power only; 50 Hz units on 50 Hz only.

FIG. 1. CT 2500B, CT3500B, & CT 4500B Tape Cartridge System

SECTION I
INTRODUCTION

GENERAL

The CT2500B, CT3500B and CT4500B Cartridge Tape Recorders and Reproducers are second generation professional units designed for full compliance with the newest NAB specifications for cartridge type equipment.

The CT2500B series units are compact Reproducers for NAB type "A" and "AA" cartridges and are available in mono or stereo in three versions which include a variety of extra facilities such as end cue, trip cue and fast forward recueing (See Ordering Information). The dimensions of the individual unit allow three units to fit in only 5-1/4 inches (133 mm) of rack space.

The CT3500B series units are available as Recorder-Reproducers and Reproducers for the NAB type A, AA, B & BB cartridges. They are available in monaural and stereo in four versions which include end cue, trip cue, fast forward recueing and built in electronic splice finder options. The CT3500B occupies one half of a rack width to allow two units to fit in only 5 1/4 inches of vertical rack space.

The CT4500B is essentially a CT3500B unit with the ability to play or record all three cartridge sizes. The CT4500B occupies two thirds of a rack width. The third section can be used for a CT2500B reproducer, if desired. See Fig. 2.

The CT2500B, CT3500B and CT4500B offer the ultimate in flexibility, thirty four individual models allow the user a full choice of performance features, from the simplest basic reproducer to the most complete cartridge recording system available.

CT2500B, CT3500B, CT4500B REPRODUCERS

The CT2500B, CT3500B and CT4500B Reproducers are identical in all respects other than the necessary mechanical modifications to accommodate the different cartridge sizes (See Fig. 1).

A CT2500B Stereo Reproducer with all options is shown in Fig. 3. and is typical of all reproducers in the series. The Reproduce Unit consists of a Transport Assembly, a card cage containing a Playback Logic/Power Supply circuit card, a Playback Amplifier circuit card and a Cue Detector circuit card. The right hand side panel mounts the power transformer, audio output transformers and +24 VDC Regulator. The left side panel mounts the Motor Control Circuit with fast forward relay K1 and the circuit card cage.

The tape transport assembly mounts a single playback head with a dummy head in the position normally occupied by the record head. This dummy head serves to maintain proper tape tension. The head shown in Fig. 3 is a three track unit which provides two program tracks for stereo and a third track for control tones. The monaural unit utilizes a two track head, one track for program and the other for control tones.

The control tone track is for prerecorded cue signals which are detected by the Cue Detector Circuit card as the tape is playing and used to perform the following functions:

a) A 1kHz tone recorded at the beginning of a message is detected during playback as a Stop Cue. After a message has played and the tape has reached its starting point this tone stops the tape in cued up position ready to be replayed.

b) A 150Hz "End-Cue" tone recorded at the end of a message on the tape can activate an audio switching system, serve as an automatic start command to another interconnected unit, and switch the unit into high speed fast forward for rapid recueing.

c) A 8kHz "Trip-Cue" may be recorded at any time during a message using a record unit. The Trip-Cue, through the external switching output, automatically will operate such auxillary equipment as slide & film projectors, lighting controls, etc.

The program tracks of the Reproduce head feed the Program Amplifier circuit card. This card contains an Equalized Preamplifier and Line Driver circuit for each track along with a FET Audio Switcher section.

The Playback Logic/Power Supply circuit card contains integrated circuit logic and power switching circuits for all basic transport control and indicating functions. A second section on this circuit board is designated for control of the audio switchers while the third section controls the high speed recueing (fast forward) operation.

REPRODUCER EXPANSION

The basic CT2500B, CT3500B & CT4500B Reproducers can be upgraded in the field to include all available reproducer options. Chassis wiring is included for all available option items. This feature makes the addition of most option items a simple matter of interchanging printed circuit boards. Consult factory for detailed instructions.

CT3500B, CT4500B RECORDER-REPRODUCERS

The CT3500B, CT4500B Recorder-Reproducers are identical to each other in all respects other than the necessary mechanical modifications to accommodate the different cartridge sizes. (See Fig. 4). The Recorder-Reproducers include all the features and options described In the Reproduce section and in addition provide a professional quality high level input record facility. As shown in Figure 5 the CT3500B & CT4500B Recorder-Reproducer consists of all the elements described under Reproducers and in addition contains a Record Amplifier Circuit Assembly, a Record Logic and Cue Tone Generator Circuit Assembly and a Bias Oscillator/Meter Amplifier Circuit Assembly.

RECORDER-REPRODUCER EXPANSION

The following options are available factory installed or as field change kits, 150 Hz End Cue Generator, 8kHz Trip Cue Generator and High Level transformer inputs. All the parts necessary for conversion of any particular unit are available from stock. Consult factory for detailed information.

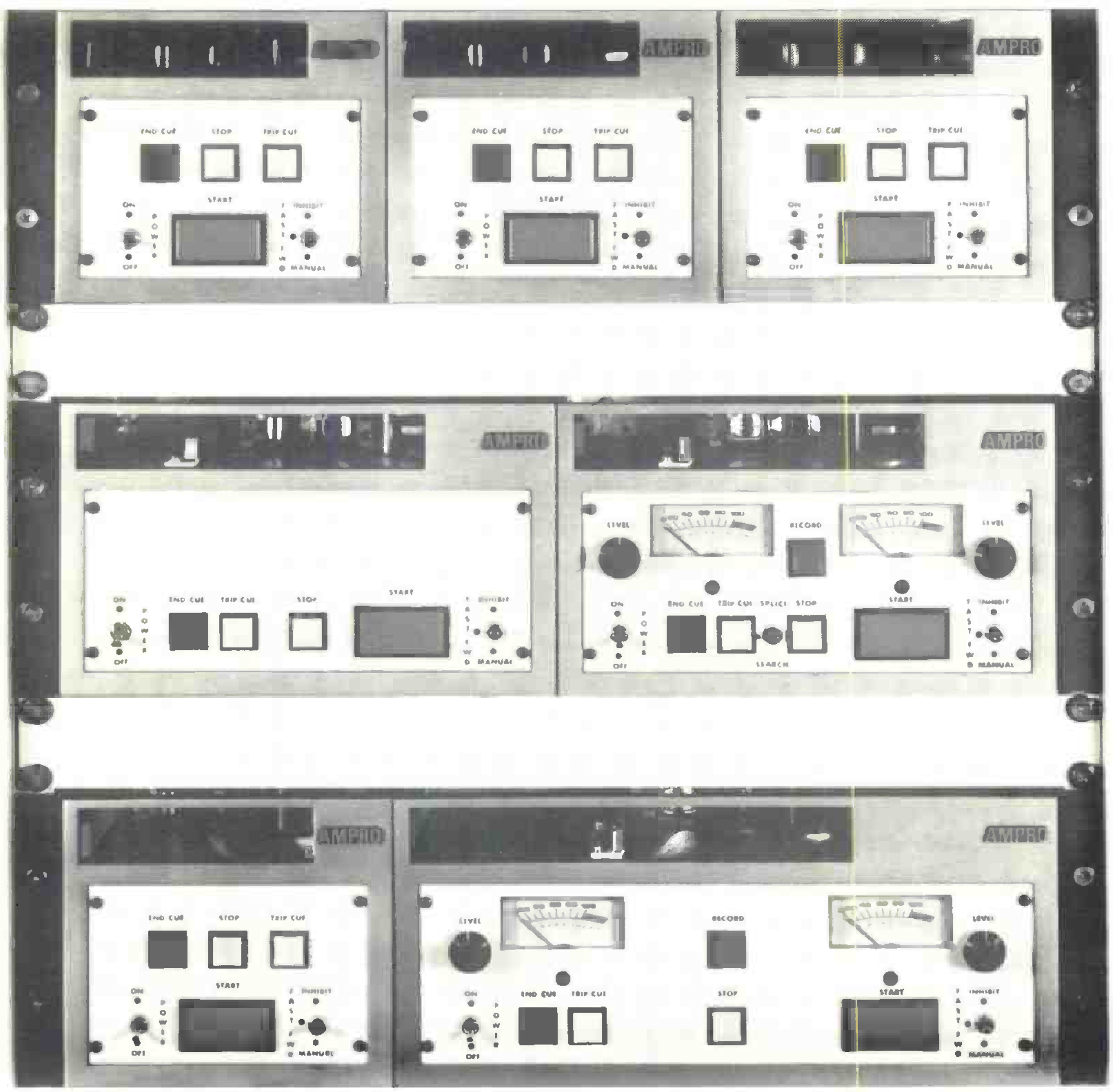


FIG. 2. CT 2500B, CT3500B, & CT 4500B Rack Mounted Units

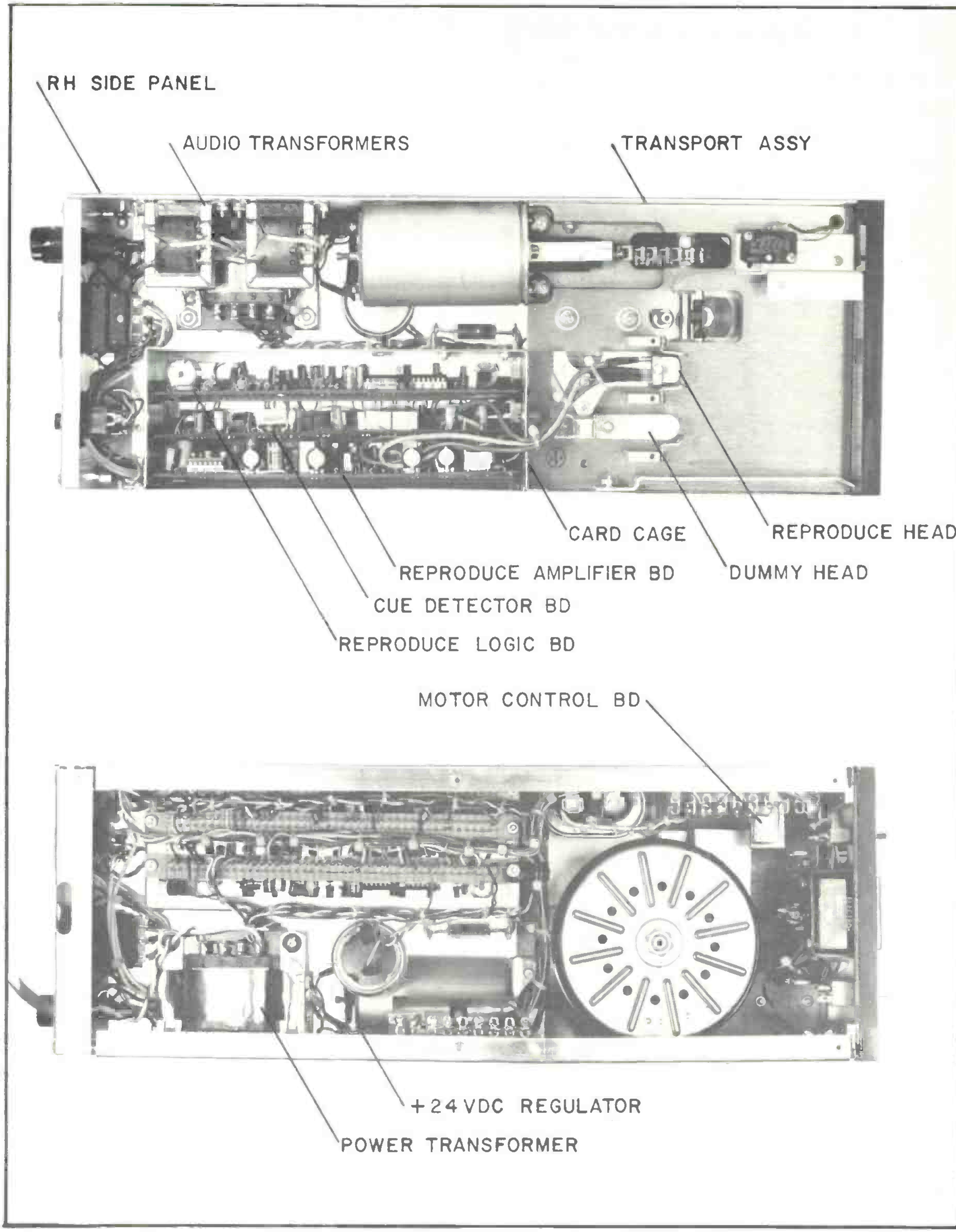


FIG. 3. CT 2517B Reproducer

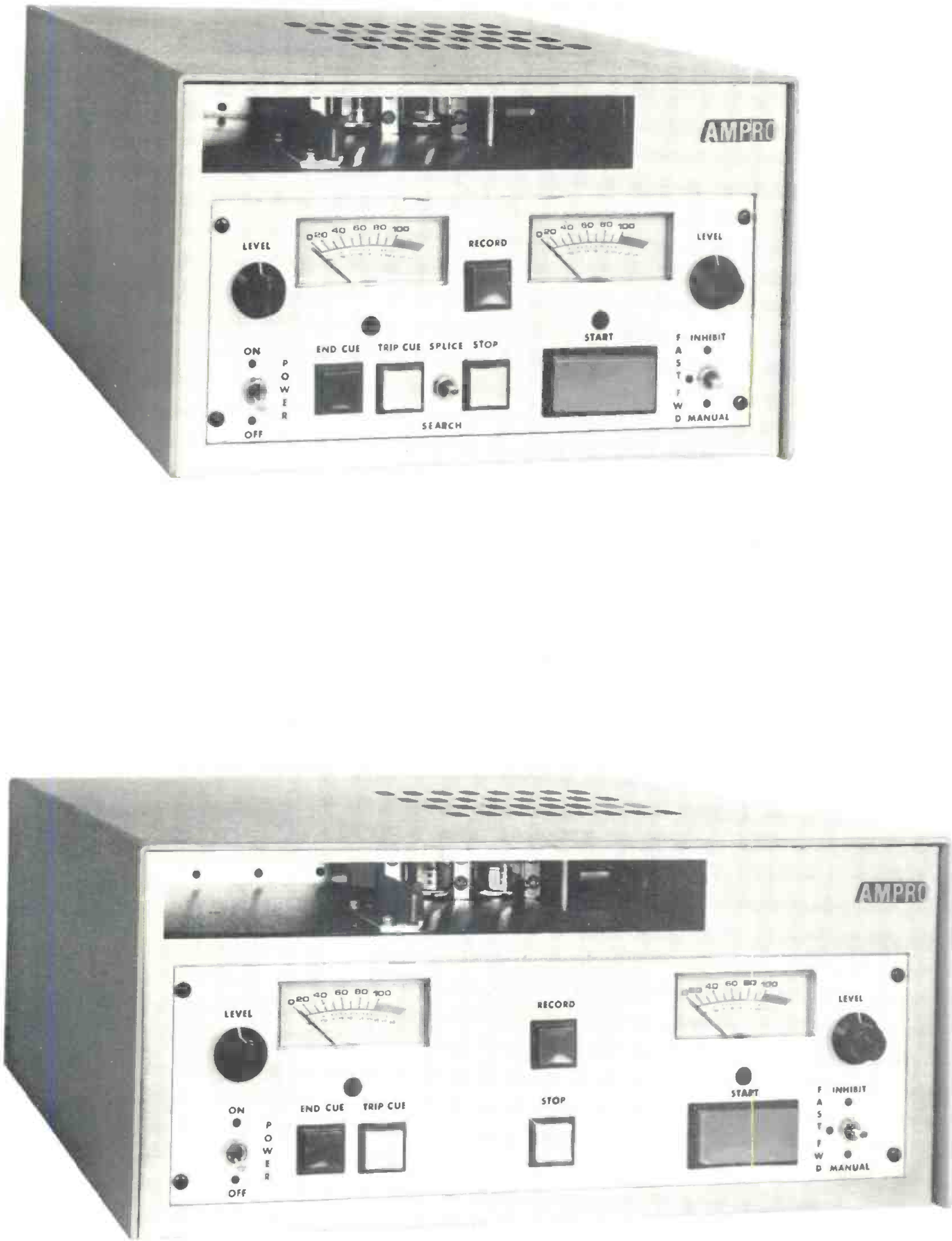


FIG. 4. CT 3500B & CT 4500B Record-Reproducers

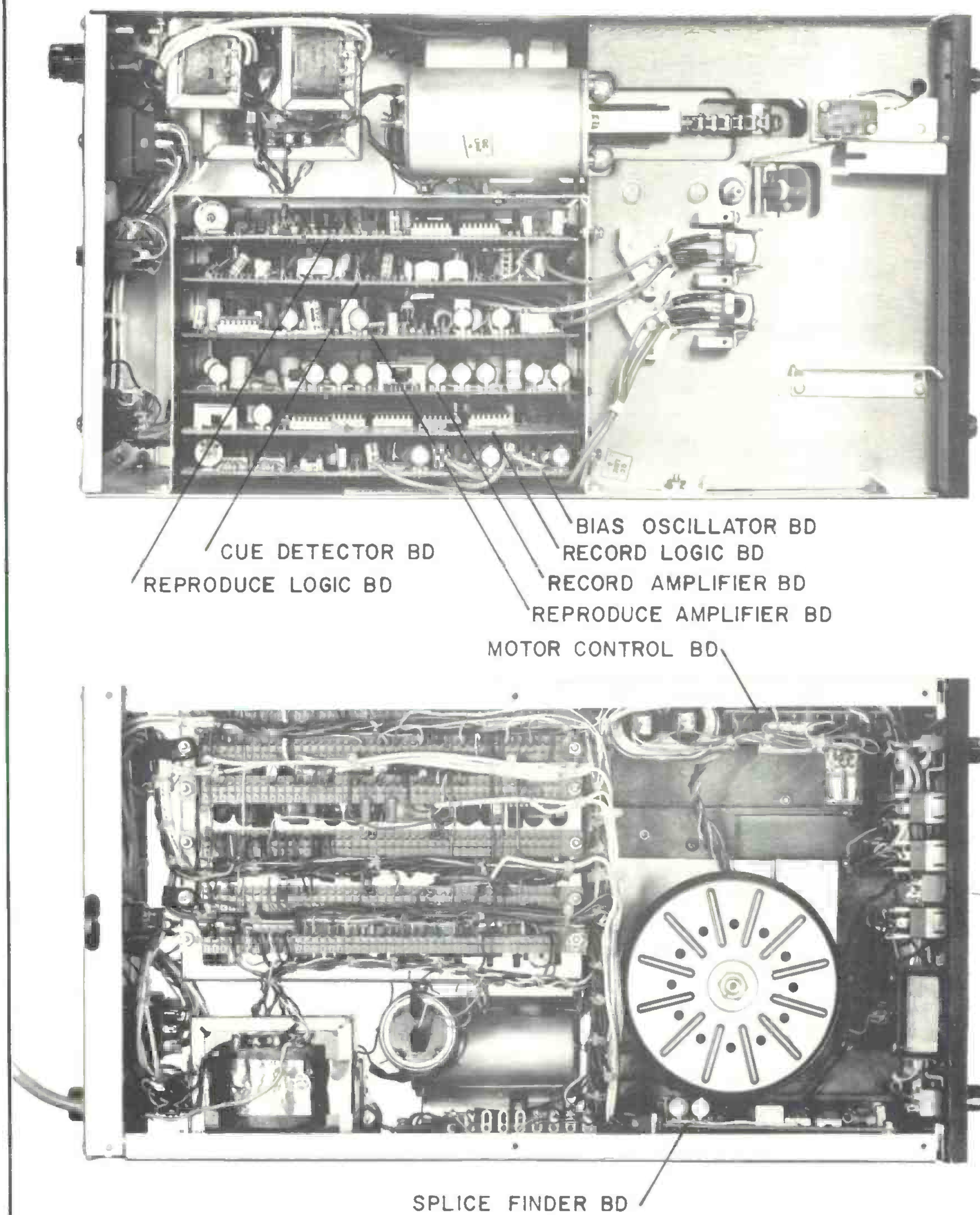


FIG. 5. CT 3557B ESF Record-Reproducer

SECTION II

DESCRIPTION

GENERAL

This section contains circuit descriptions for the CT2500B, CT3500B & CT4500B Reproduce and Record-Reproduce units. The method used for describing circuit operation employs the functional block diagrams of the Reproduce and the Record sections. See Figures 6 & 7. The functional block diagrams provide the user with a basic understanding of the over all operation of a Record/Playback system by showing the major control circuits in simplified form along with the associated controls, indicators and adjustments. This enables the user to obtain good comprehensive understanding of all control circuitry without being hindered by the detailed circuits of the electronic sub assemblies. The detailed schematic diagrams show the individual circuits of each electronic sub assembly with associated circuit descriptions which describe in detail the theory of operation of each circuit.

FUNCTIONAL BLOCK DIAGRAM DESCRIPTION

GENERAL

The functional block diagrams are split into the Reproduce Section, Figure 6 and the Record Section, Figure 7. CT2500B, CT3500B & CT4500B Reproducers will have only those circuit elements described in Figure 6. Recorder-Reproducers will include all of those circuit elements described in both block diagrams, Figures 6 & 7. The block diagrams show a stereo system incorporating all commonly used option items.

MODES OF OPERATION

READY MODE

There are three basic modes of operation for the reproduce system: The Ready mode, the Playback mode and the Recue (Fast Forward) mode. When the power switch on the front panel is operated power is applied to the motor and power supply circuits. Upon energization all circuits are set to a STOP condition. Transport assembly microswitch S4 generates a CART signal when a cartridge is fully inserted and seated in position to be played. The READY indicator, part of the front panel STOP switch is illuminated by insertion of the cartridge. When the READY indicator is illuminated the system is ready to be placed into the Playback mode.

PLAYBACK MODE

The playback mode is selected by simply pressing the Start pushbutton/Play indicator. The momentary START signal sets the Run flip-flop which energizes the play solenoid L1. When the Play solenoid is energized it rotates the Pinch roller from the down relaxed position up into the tape cartridge and presses the pinch roller against the capstan thus driving the tape. The capstan is directly driven by the hysteresis-synchronous capstan motor and in turn the tape is pulled across the heads. The Play flip-flop is also set by the START command thus turning on the Play indicator (part of START switch S2) and turning on the FET audio switchers in the playback amplifiers. With the tape running, prerecorded audio is amplified by the Playback Amplifier and applied to the Audio Output Jack J2 on the rear of the Reproducer unit. When a prerecorded STOP cue (1kHz) is picked up on the cue track of the playback head the system is automatically stopped, the audio switchers are turned off and the system reverts to the READY mode. The 1kHz STOP CUE signal is applied to the Cue Detector Circuit Assembly which preamplifies, shapes, counts and detects all signals on the cue track. The output of the 1kHz due detector is an electronic switch closure to ground which duplicates the action of the front panel Stop switch. The STOP signal resets the RUN and PLAY flip-flops, deenergizes the PLAY solenoid, stops the tape and extinguishes the RUN indicator, thus leaving the system in a READY state.

An End Cue tone (150Hz) may be recorded on the Cue track at the end of the audio message. This End Cue tone is detected by the cue detector circuit assembly and is used to reset the audio switcher control (PLAY) flip-flop which turns off the audio switchers on the Playback Amplifier Assembly. The front panel End Cue indicator is a visual indication of the presence of an End Cue tone on the tape.

When a prerecorded Trip-Cue tone (8kHz) is picked up on the cue track of the playback head, an electronic switch closure is provided on output Jack J1 for control of external devices. The trip cue indicator is illuminated to denote the presence of a Trip-Cue tone.

FAST FORWARD MODE

In systems which include the Fast Forward option, the End Cue signal sets the Fast Forward control flip-flop energizing the Fast Forward relay and placing the motor in the high speed mode. The motor drives the tape at high speed forward to the beginning of the recorded message at which time the system is stopped by the Stop Cue tone and reverts to the Ready state.

Playback audio muting and Fast Forward operation are triggered at the trailing edge of the End Cue tone thus permitting automatic audio overlap of multiple interconnected reproducers.

RECORD MODE

The CT3500B & CT4500B Recorder-Reproducers incorporate additional logic and audio circuits for record functions. The record mode is selected by pressing the Record push button on the front panel of the unit. If the system is in a READY state, the Record flip-flop is set, the Record indicator on the front panel is illuminated and the front panel VU meters are switched to the Record amplifier to allow preadjustment of signal levels. The Record state cannot be selected unless the tape is stopped and a cartridge inserted. After operating the Record push button the Start push button will place the tape in motion and begin recording. At the instant the tape is started a 1kHz Stop Cue tone is generated in the Record Logic Circuit assembly and recorded on the cue track of the cartridge. Audio input to be recorded is applied to the record amplifier via the input Jack J4.

The Record Amplifier provides a 18,000 ohm balanced bridging, differential preamplifier input capable of accepting levels from -20 to +18dBm. The Record Level is set by individual controls on the front panel for each channel and individual VU meters are provided for monitoring and level setting purposes. The VU meters monitor the Record Amplifier signal during recording and are automatically switched to the Playback Amplifier output when the system is not in the record mode. The output of the front panel level controls are fed into the record equalizer stage found on the Record Amplifier Circuit Assembly. The audio record output from the record amplifier is combined with a 100 kHz bias signal on the Bias Oscillator/Meter Amplifier Circuit Assembly, amplified and then fed to the low impedance record head on the transport Asssembly.

If so equipped, a 150Hz End Cue tone may be applied to the cue track at the end of the recorded message on the cartridge. This tone is used during the playback process to control playback audio switching, fast forward recueing and external start control of other interconnected cartridge machines. To apply an End Cue to the tape simply operate the End Cue push button on the front panel. When an End Cue is applied the End Cue indicator will be activated after a short delay while the tape travels from the record head to the playback head. It is not necessary to be in the record mode in order to record cue tones. Cue tones may be applied to the tape during recording or during a subsequent playback of the tape. IT SHOULD BE NOTED: although multiple End Cues may be recorded onto the cue track, the reproduce logic is so designed as to recognize only the first End Cue during any START-STOP cycle of the tape and to supress all subsequent End Cue outputs.

The Trip-cue push button switch is provided to permit the operator to insert an 8kHz Trip-Cue tone. When the pushbutton is operated internal logic gates the 8kHz output of the tone generator onto the cue track. The duration of the End & Trip cue tones is controlled by the length of time that the push button is held by the operator.

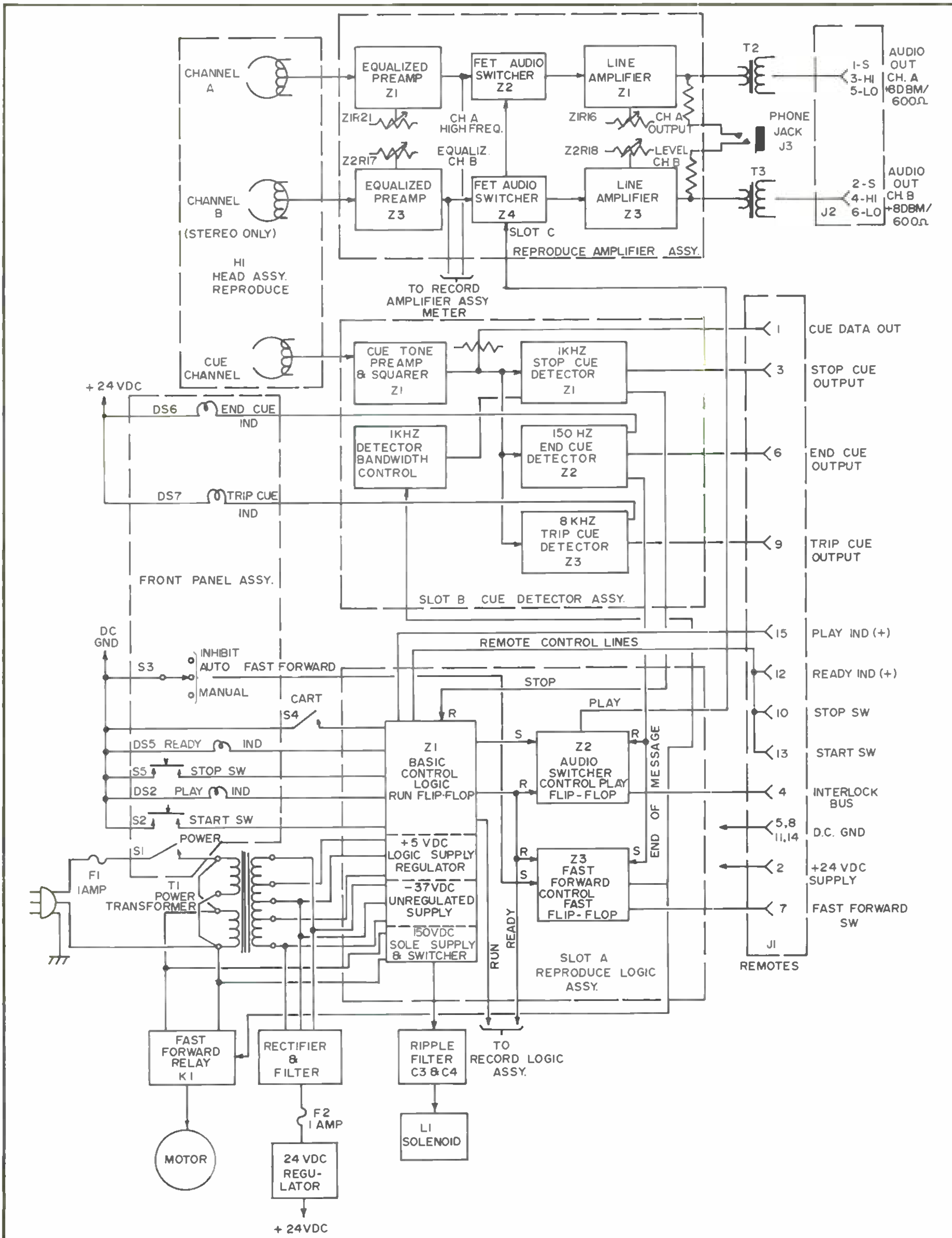


FIG. 6. Block Diagram Reproduce Electronics

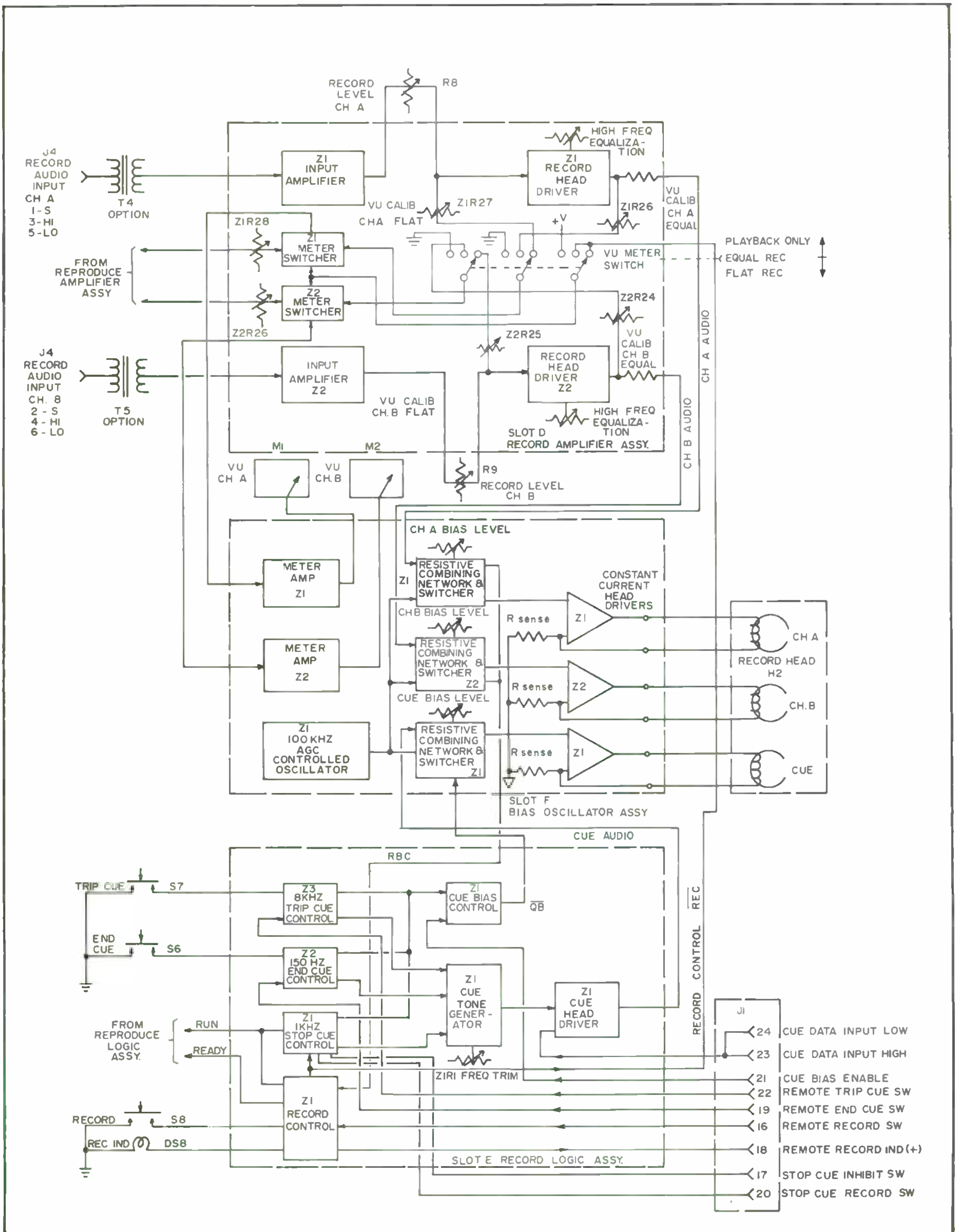


FIG. 7. Block Diagram Record Electronics

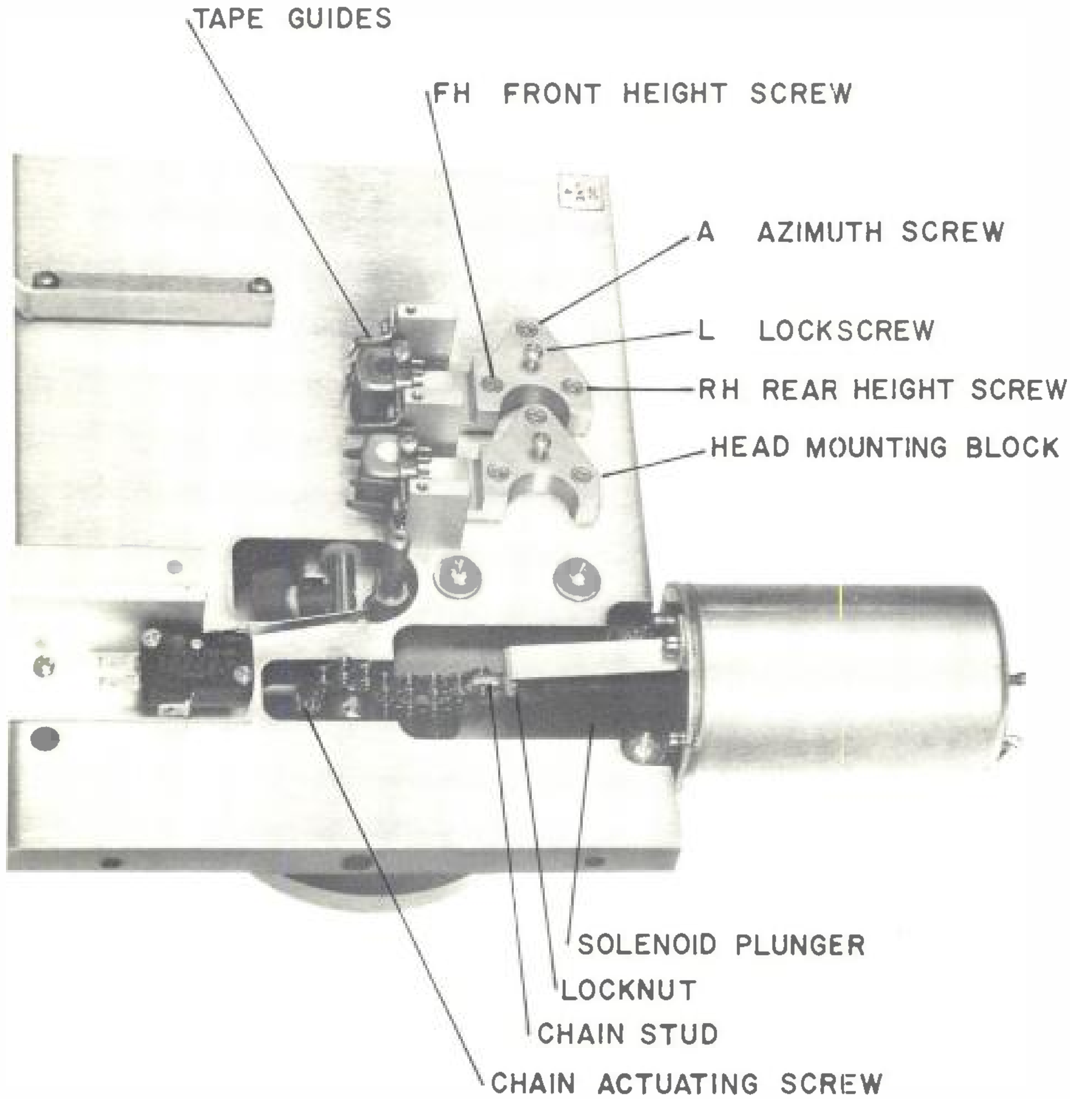


FIG. 8. Transport Assembly

PRINCIPLES OF OPERATION

MECHANICAL OPERATION

HEAD ASSEMBLY

The CT2500B, CT3500B & CT4500B cartridge-tape machines all utilize a highly reliable and extremely sturdy head mount for both record and playback heads.

The micro-adjust feature of this head mount permits azimuth adjustment of heads without disturbing the height adjustments. After tightening the centrally located locking screw the entire head mount is securely positioned. See Figure 8.

Three non-magnetic tape guides are provided, mounted separately from the head mounts, and are preset at the factory. Field adjustment, while not normally required, is possible.

CAPSTAN DRIVE

The tape drive in the CT2500B, CT3500B and CT4500B cartridge tape machines is accomplished by direct drive from a hysteresis-synchronous motor which has an electrolized drive shaft.

The electrolizing process is a finish achieved by blasting a highly polished capstan shaft with aluminum oxide particles then hardening the resultant random-rough pattern resulting in an extremely durable capstan surface with a high coefficient of friction. A larger diameter capstan shaft is provided on units specified for 50 Hz operation.

PRESSURE ROLLER ASSY.

Pressure roller contact is achieved by converting a linear solenoid action into a rotary action to bring the pressure roller into the correct position for contact with the capstan shaft. More than adequate pressure is available thru the use of a powerful solenoid. Pressure is adjusted by setting the chain stud engagement in the solenoid plunger thus varying the depth of penetration of the plunger into the solenoid.

The air damping action of the solenoid assures extremely quiet mechanical operation by controlling the speed of the action. This air damping adjustment is controlled by the needle valve at the rear of the solenoid.

The self-aligning feature of the ball bearing pressure roller assures even pressure across the width of the tape and compensates for any slight misalignments in parallelism between the Pinch Roller and Capstan shafts.

ELECTRONIC CIRCUIT DESCRIPTIONS

+24V REGULATED SUPPLY - FIG. 51, 52. The 117-volt ac line voltage is stepped down by power transformer T1 and rectified by the transformer mounted diodes CR1 and CR2 (See Fig. 9). The output of the rectifiers (approximately +38 VDC with .6V ripple) is fed through fuse F2 (1 Amp) to pin 10 of the playback Logic board. An interlock circuit ensures that the Logic board is in place before voltage is applied to the regulator circuit. The interlock output (pin 9) is fed to the filter capacitor C1 (2000/50V), the regulator input capacitor C2 (.33), and the regulator input. The regulator is a Three-Terminal Positive Voltage Regulator integrated circuit employing internal current limiting, thermal overload protection and output transistor safe-area compensation making it essentially blow-out proof. The output of the regulator is applied to the +24V power bus.

PLAYBACK LOGIC BOARD ASSY. Fig. 37.

+5VDC REGULATED SUPPLY. The output of power transformer T1 (6.6VRMS windings) is applied to the full-wave rectifier comprised of diodes CR14 and CR15 on the Reproduce Logic printed circuit board. The DC output is applied to filter capacitor C4 and to F1 which is a board mounted 1/2 amp fuse. The output of the fuse is fed to the series pass transistor, Q10. The base of Q10 is held at 5.6V by Zener Diode CR16 which receives its zener current from the +24V supply thru limiting resistor R26. The 5 volt regulated output of Q10 is fed to the various 5 volt circuits throughout the unit. CR17 is applied across the output of Q10 to limit voltage to 5.6 volts in the event of a Q10 failure (short circuit).

-37VDC SUPPLY. This is an unregulated supply and its output voltage may vary from a negative 32 volts to a negative 45 volts. Power is obtained from the 28VAC windings of T1 and rectified and filtered by CR11, CR12 and filter capacitor C3. (See Fig. 9).

SOLENOID SUPPLY AND CONTROL CIRCUIT

See simplified schematic- (Fig. 10). 115 volts AC is supplied to a bridge rectifier consisting of diodes CR7 through CR10. The output of the bridge is applied to the RC filter network consisting of R1-C3 and R2-C4. DC voltage supplied to the solenoid in the stop (deenergized) position is approximately 150V. The voltage divider consisting of R3 and R25 supply operating voltage of approximately 25 volts to the Optically Coupled Isolator (U4) and transistor Q9. When the run logic calls upon the solenoid to be energized, the photo-transistor starts conducting, turning on Q8 and energizing the solenoid. Voltage across the solenoid is approximately 100 Volts when energized. When a stop condition is called for the light emitting diode is de-energized, the phototransistor stops conducting and the solenoid is deenergized.

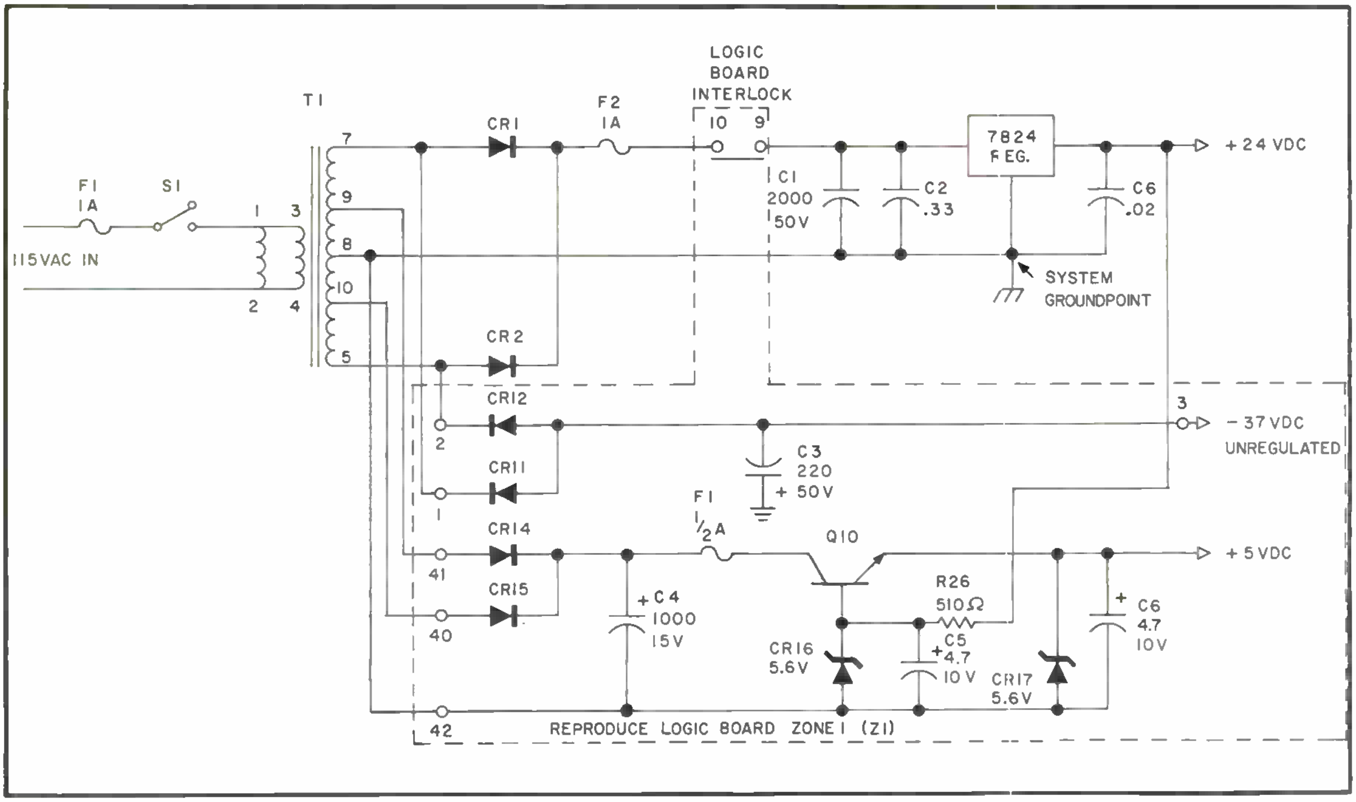


FIG. 9. Simplified Schematic Power Supply Circuit

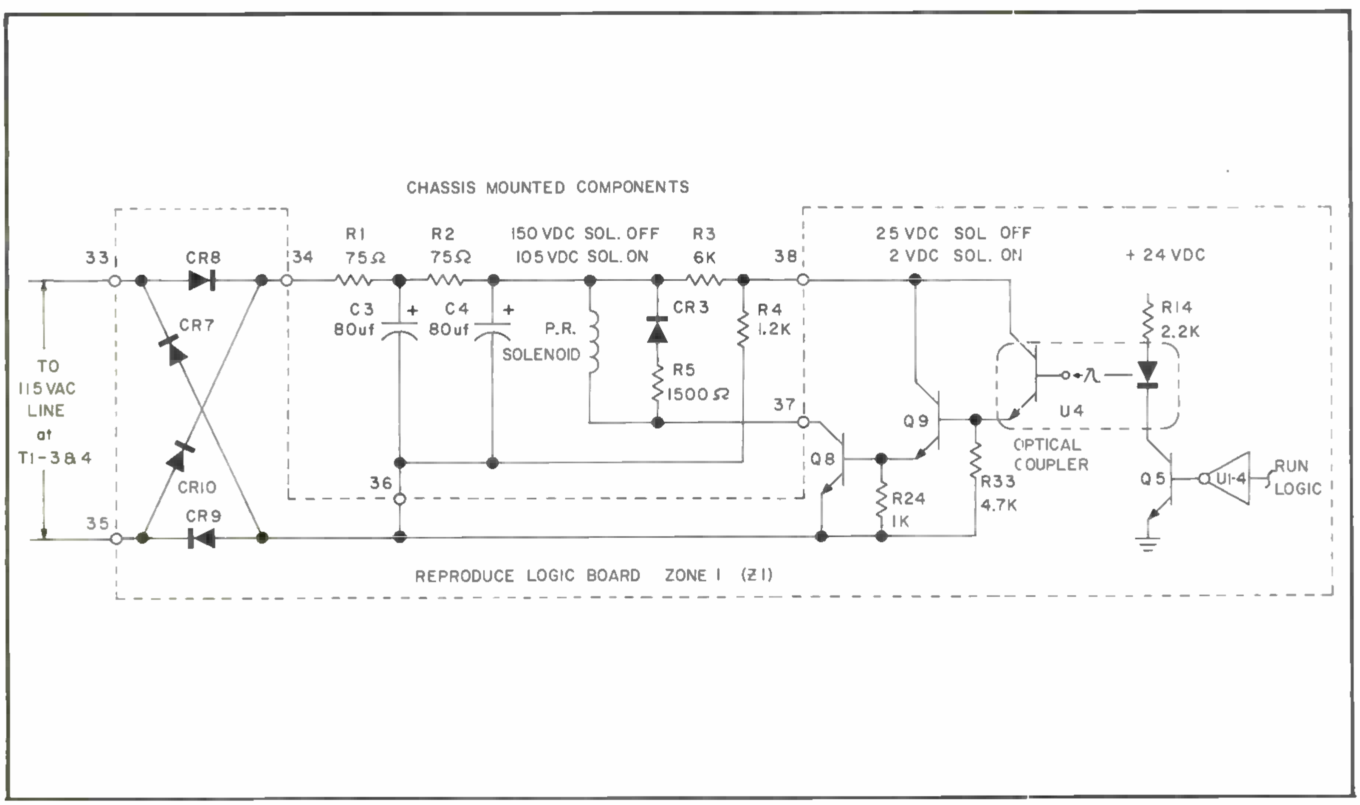


FIG. 10. Simplified Schematic-Solenoid Supply & Control Circuit

BASIC LOGIC SECTION

See Figure 37. The basic control logic is contained in Section Z1 of the Playback Logic Board. the Circuitry supplies the ready, start, stop and cue block functions. In the following descriptions and explanations the high level will be +5 volts, low level will be ground potential.

The output of pin 12 of U1 is low whenever a cartridge is not in place. With CR2 pulled to ground, Q3 and Q4 are turned off and no indicator lights are lit. When a cartridge is fully inserted, cart switch S4 closes pulling pin 13 to ground allowing the ready signal to go high. This will back bias CR2 (CR4 is back biased when in the NOT RUN condition) allowing Q3 and Q4 to turn on, lighting the ready light on the front panel and the external ready light if used. In the ready mode Q12 is held on, holding pin 1 of U3 low. Pin 13 is high (READY) and pin 2 ($\overline{\text{FF}}$) is high along with output pin 12. In this condition, pins 2 (RUN) and 3 ($\overline{\text{GO}}$) of U2 are high thus holding its output low. The RUN condition keeps CR4 back biased allowing the stop light to light (if a cart is in place), and also is inverted at pin 8 of U1 to hold Q5 and U4 (optical-coupler) off (solenoid deenergized).

When either a local or an external start signal is applied Q12 is turned off pulling pin 1 of U3 high, satisfying the gate condition, allowing pin 12 to go low (for the duration of time the switch is held). Gates 1 and 2 of U2 are wired as a flip-flop. When pin 3 of gate 1 goes low the high output (pin 1) feeds back to pin 5 causing its output to go low. When the start switch is released pin 3 returns high but the output at pin 1 remains high because of the low signal now present at pin 2. When pin 2 went low, CR4 became forward biased turning off Q3, Q4, and the stop light. Prior to this line going low, CR1 was back-biased, allowing Q1 to turn on and C1 to charge. With Q1 on Q2, (Cue Block) is held off. When pin 2 of the flip-flop went low, this negative transition was coupled through C1 to turn off Q1, turning on Q2, causing the CUE BLOCK output. The time constant of R4 and C1 determine the duration of the CUE BLOCK signal during start (approximately 1 1/4 seconds) which allows the STOP CUE tone to move out from the playback head without stopping the tape. Pin 2 going low also causes pin 8 of U1 to go high turning on Q5 and U4 (LED) causing the solenoid to energize and the tape to start moving.

Q11 in the stop circuit is normally turned on holding the output at pin 10 of U1 high (ready line). When either the local or remote stop switches are closed or a STOP CUE grounds connector pin 20, Q11 will turn off, pulling pin 10 of U1 to ground. This momentary low at pin 6 will reset the RUN FF which will:

1) Cause pin 8 of U1 to go low de-energizing the solenoid.
2) Cause CR4 to be back biased allowing Q3 and Q4 to turn on the READY light.

AUDIO SWITCHING LOGIC [Z2]

When the audio switching is used the on-board jumper is shifted from J1 to J2. (See Fig. 37, circuit group Z2). Gate 1 of U3, and 4 of U2, make up the audio switcher flip-flop. With the cartridge in but not running pins 3 & 4 of U3 are high, pin 5 is low and the output at pin 6 is high. Both pins 11 and 12 of U2 are high, causing pin 13 to be low holding off Q6, Q7 and the PLAY light (part of Start Switch).

When the start pushbutton is pushed the $\overline{\text{GO}}$ line drops to ground for the length of time the button is held. This grounding of pin 11 of U2 causes its output to go high, (flip-flop switches state) which causes pin 6 of U3 to go low latching the flip-flop in this state after the $\overline{\text{GO}}$ line returns high. When the $\overline{\text{GO}}$ line dropped low C1 coupled this transition to turn off Q3 and turn on Q4 for the RC time constant. This 50 ms interlock pulse is fed out on remote connector J1 pin 4 to an interlock bus for Multiple System Audio Switching. In normal operation with audio switching and fast forward an interlock pulse from a unit starting on the bus would cause the previously playing units audio switcher to drop out and go into fast forward. Since the interlock pulse feeds back into the unit being started, it must be inhibited from going into fast forward. This is accomplished when Q12 goes high and feeds pins 11 and 12 of U5 causing its output to go low and inhibiting the fast forward function till after the start button is released. The audio switching flip-flop need not be gated since the starting pulse is considerably longer than the 50 ms interlock pulse.

When the unit was started pin 12 of U2 was pulled to ground. This caused pin 6 of U1 to go high, turning on Q2 which turns on the audio switchers in the playback amplifiers. The audio switcher flip-flop remains in this state until one of the following events occur:

1) a STOP CUE or a manual stop causes the ready line to go low, (Pin 3 of U3),
2) an interlock pulse causes pin 5 of U3 to go low,
3) the trailing edge of an END CUE is sensed by C3 & Q6 causing pin 5 of U3 to go low.

If any of these events occur the flip-flop will shift state dropping out the PLAY light and the audio switchers. After an END CUE is received both pins 8 and 9 of U2 are high and output pin 10 is low. This signal is used to disable the END CUE detector so that no end cues, after the first one received can be transmitted out to any external equipment such as an automation system.

FAST FORWARD LOGIC [Z3]

A unit with the fast forward option will go into fast forward when one of the following events turn off transistor Z2Q5. (See Fig. 37, circuit group Z3).

1) Remote fast forward switch is pushed (momentary switch closure between pin 7 of J1 and ground).
2) Front panel fast forward switch is pushed
3) Interlock pulse from another unit is received
4) The trailing edge of an END CUE signal triggers Z2Q6.

During normal running, U5 pin 10 is high, pin 4 is low, pin 1 is high, (gates 1 and 2 of U5 make up the fast forward flip-flop) pin 4 of U1 is low and the fast forward relay is de-energized. When the collector of Z2Q5 goes high, pin 2 of U1 will turn off the audio switcher and pin 9 of U5 will cause the fast forward flip-flop to pick up the FF relay, shifting the motor to high speed (1800 RPM). When pin 1 of U5 went low it latched the flip-flop (pin 6) in this mode after the collector of Q5 is returned low. The unit will remain in fast forward until either a manual stop or a STOP CUE cause the ready line to go low, grounding pin 3 of U5 which will reset the flip-flop and de-energize the relay. At the end of a fast forward cycle a 1 1/4 sec. pulse is generated by Z3C1 & Z3R5 which prevents the audio switchers from turning on until the motor has slowed down to normal speed.

If the fast forward switch S3 is in the inhibit position, pin 2 of U5 is held low which disables the flip-flop and prevents the unit from going into fast forward.

RECORD LOGIC BOARD ASSY.

BASIC CONTROL LOGIC (Fig. 39, circuit group Z1) Gate 2 of U4 is a three input and gate which feeds the record flip-flop (gates 2 of U3, and 3 of U4). When not in the record mode pin 6 of U3-2 is low which holds the output of U1-6 high. This high keeps Q2 and the record lights turned off.

When a cartridge is inserted the READY line (pin 4 of U4) goes high. If the unit is running, pin 3 will be low and the unit cannot be switched into the RECORD mode. If the unit is not running U4 pin 3 will be high. When either the front panel or the remote RECORD pushbuttons are pushed Q3 will turn off causing pin 5 to go high. When all three conditions are met the output at U4 pin 6 will go low trigering the flip-flop. This high signal at pin 13 of U1 is inverted and will turn on Q2 which will turn on the RECORD light and the external RECORD light if used. The output of the RECORD flip-flop is also fed to pin 12 (U3-4) to trigger the STOP CUE when the START button is pushed and the unit goes into a RUN mode. The low level at U3 pin 11 is inverted at U3 pin 8 and turns on Q4 which in turn switches on the recording high frequency bias as the tape starts running in the Record Mode. The RECORD flip-flop remains set until a manual STOP or a STOP $\overline{\text{CUE}}$ causes the READY line to go low (Pin 11 of U4) or the $\overline{\text{FF}}$ line goes low which means the unit was shifted into the fast forward mode.

CUE TONE GENERATOR (Z1U2). All cue tones used are derived from a single Precision Waveform Generator integrated circuit. The frequency of this highly accurate oscillator is selected externally by the amount of timing capacitance tied to pin 10. C4A and B are permanently attached to pin 10 and set the 8kHz frequency (if TRIP CUE option is used). Capacitors C3 or C2 are paralleled with C4 (for the STOP and END CUE tones). Whe the generator is not called on to produce a cue tone pin 4 of U1 will be low. With pin 4 low the R8-R9 divider will bias CR3 at slightly less than half the supply voltage. As the internal oscillator tries to go positive to charge C4 the current will sink into CR3 preventing oscillation. Trimmer pot R1 is used as a fine adjust to trim the generator to precisely 1kHz when the STOP CUE one shot is activated.

When the RECORD button is pushed pin 12 (U3-4) goes high. When the START button is pushed the RUN line feeding pin 13 goes high and pulls the output down which triggers the STOP CUE one shot (U5). The STOP CUE one-shot is triggered at the beginning of each recording process. C13 and R3 set the timing (.5 sec) of the one-shot which determines the time the oscillator is on (time of recorded cue tone). The Q output (pin 6) is inverted by U1-4 grounding C3 in parallel with C4. When the $\overline{Q}$ output of U5 dropped low, pin 12 (U4-1) went high, pin 2 (U1-1) went low and pin 4 (U1-2) went high allowing the oscillator to turn on. With C3 and C4 in parallel the generator will produce a .5 sec. 1000 Hz pulse. When pin 2 (U1-1) went low it turned off Q1 which causes pin 10 (U1-5) to go low gating the 100 kHz bias oscillator to the cue record head for recording of the cue tone. At the end of .5 seconds pin 10 wil return high gating off the bias oscillator.

The STOP CUE INHIBIT slide switch (accessible through the card cage cover) will, when placed in the INHIBIT position, block the automatic recording of the Stop Cue to allow the production of continuously running loops for sound effects etc. Once operated, this switch must remain in the INHIBIT position until the recording is complete and the tape has been manually stopped otherwise a Stop Cue will be recorded as the switch is returned to the normal position. The internal INHIBIT switch is paralleled with a remote control line available at J1-17. A remote STOP CUE INSERT line is available at J1-20. Both remote lines require grounding contacts. Grounding the STOP CUE INSERT line will record a STOP CUE on the cue track in either the record or playback operating modes.

Output of the Cue Tone Generator is fed to an operational amplifier (U6) then to the bias oscillator board and out to the record head (cue track). If it is desired to record other than the normal cueing tones such as teletype code logging data the CUE BIAS ENABLE line may be grounded, which will turn off Q1 and allow the bias oscillator to feed the cue track. The external tones to be recorded may then be tied into the input of the operational amplifier via J1. (See Section III).

END CUE GENERATOR, Z2

When it is desired that an END CUE signal is to be recorded, either the front panel or the remote END CUE pushbutton switch is pushed which will turn off Q1. If the unit is in the RUN mode, but not in FAST FORWARD pin 8 of Z2U1 will go low and pin 6 will go high. The high output at pin 6 is inverted and parallels C2A and B with C4 to give the 150Hz output. The low output will cause pin 4 (U1-2) to go high turning on the generator for the time that the end cue pushbutton switch is held.

TRIP CUE GENERATOR, Z3

The TRIP CUE circuitry functions the same as the END CUE circuit explained above except that there is no requirement to switch the timing capacitor since C4A and B (sets frequency at 8 kHz) are permanently tied to pin 10 of U2.

REPRODUCE AMPLIFIER BOARD ASSEMBLY

EQUALIZED PREAMPLIFIER. The playback preamplifier is a two stage, low noise, equalized amplifier consisting of Q2 and Q3. (See Fig. 41). The playback head is connected between input terminals E1 and E2 with the head cable shield grounded at E3. The RC network sets the fixed low frequency equalization while the variable resistor R21 allows for adjustment of the high frequency equalization (clock-wise rotation of R21 will reduce the high frequency output.)

AUDIO SWITCHER (Z2). Two Field Effect Transistors (FET's) are connected in both arms of a L-pad to form a voltage controlled attenuator. The resistance of a FET (Rds-drain to source resistance) can be controlled by applying voltage to the gate and keeping the drain to source voltage at zero.

Q1 (upper arm) is a P-channel FET while Q2 (lower arm) is a N-channel FET. When the audio switcher is off the voltage at the cathode of CR3 (10V Zener) is +24 volts. The drop across CR3 is 10 volts which applies +14V at the junction of the anode of CR1 and the cathode of CR2. Since CR1 is forward biased this positive potential is applied to the gate of the P-channel FET causing its Rds to be in the meg-ohm region. CR2 is back biased at this time so its gate is at ground potential and its Rds is approximately 200 ohms. This configuration produces a maximum attenuation of approximately 90 db.

When the unit is in the PLAY mode the $\overline{\text{AS}}$ line is pulled low, grounding the cathode of CR3. This sets the voltage at the anode of CR3 at a negative 10 volts (CR3 and R2 form a voltage divider across the -37V supply). This fixes the voltage at the junction of CR1 and CR2 at approximately -9 volts which will back-bias CR1 and forward bias CR2. with CR1 back-biased the Rds will drop to approximately 600 ohms. CR2 is forward-biased and the voltage at the gate of Q2 is approximately a negative 8 volts. This produces an Rds in the meg ohm region. Under this condition the attenuation is essentially zero.

C16 and C5 are used as DC blocking capacitors.

If the audio switcher is not used a jumper (J1) is added on the board to bypass the audio switcher circuitry.

LINE AMPLIFIER. The line amplifier consists of an operational amplifier (U1) along with a class AB, push-pull, complementary, output stage. R6, R26, R15 along with C13 form a voltage divider to provide +12 VDC to set the operating point of the op-amp. R17, C10 and C8 are frequency compensating components. Variable resistor R16 along with R10, R1 and C1 set the amplifier feedback for a gain of from +20 db to +30 db depending on the setting of R16. The output of the push-pull stage feeds out through a 150 ohm resistor to the headphone output jack J3 and also to the audio output transformer. The output transformer provides for an additional 6 db of gain.

CUE DETECTOR BOARD ASSEMBLY - Fig. 43

EQUALIZED PREAMPLIFIER AND STOP CUE DETECTOR. The cue preamplifier circuit is used for preamplification of the cue signals from the cue track of the playback head (1kHz stop cue, 8kHz trip cue, and 150 Hz end cue). The head is connected between terminals E2 and E3 with the shield tied to E1. The preamplifier consists of a three stage (Q8, Q6, Q1) direct coupled amplifier with both AC and DC feedback. The AC feedback path is from the emitter of Q1 to the emitter of Q8 (through resistors R18, R19 and capacitor C7). The DC feedback path is from the emitter of Q6 to the base of Q1. This is a negative feedback for stabilization of Q6 emitter current. Capacitor C1 is a decoupling capacitor used for isolation of external variations on the +24V power supply. The output from the emitter of Q1 is applied to a noise discriminator network consisting of capacitor C4 resistors R14 and R20, and diode CR1. Since the diode is connected across the emitter-base circuit of Q7, the resulting rectified pulses control the switching of Q7. These pulses must be at least .5 volts in amplitude in order to turn on Q7 and, correspondingly, the input signal at that point must be at least 1 volt peak-to-peak. Any signal less than 1 volt peak-to-peak is not sufficient to turn on Q7. In this manner, the cue signals are used to control switching of Q7 and, in effect, noise signals 20 db below nominal signal levels are discriminated from controlling the switching.

When transistor Q7 is turned on by the pulse developed during the positive half-cycle of the input signal, the resulting negative going pulse at its collector turns on Q2 also. Transistors Q4 and Q9 are connected as a class B amplifier. When Q2 is turned on it will turn on Q4 which will provide the positive feedback through R11 to drive Q7 into saturation, which will drive Q2 and Q4 into saturation. The emitter of Q4 will remain at +24 volts until diode CR1 is forward biased on the negative half-cycle at which time Q7, Q2 and Q4 will turn off and Q9 will turn on to pull down the output to ground. The output remains at 0 volts until Q7 is turned on again during the positive half-cycle of the input signal. The resulting output at the emitter of Q4 is a square wave with a frequency the same as the frequency of the input signal.

The +24V square wave available at the emitter of Q4 is fed to the input of the STOP CUE detector (also feeds the END CUE and TRIP CUE detectors if used). The output also feeds a divider consisting of R33 and R34 to feed the CUE OUT line at J1 pin 1 (0 to +4VDC square wave).

CUE DETECTOR CIRCUITS. The trip cue, stop cue, and end cue detector circuits are used for detection of the various cue signal outputs from the cue preamplifier. Detection is accomplished by band-pass filters at the input of each detector circuit which pass only the desired input signal. Upon detection, a switching and timing circuit is energized to provide a switched-ground output.

All three detector circuits are identical with the exception that the component values for the filter circuits for each are different. For ease of explanation only the STOP Q detector circuit will be described. The filter circuit consists of resistors R5 and R12 and capacitors C2, C3 and C12. At the desired frequency the square wave signal through the filter is of sufficient amplitude to operate transistor Q5. The resulting pulses at the collector of Q5 are stored by integrating capacitor C11 and after a delay of approximately .007 sec, the charge on the capacitor is sufficient to turn on transistor Q10. When Q10 is turned on, transistors Q3 and Q11 are turned on also and the collector of Q11 is switched to ground potential to provide the switched-ground output. Positive feedback from the collector of Q3 to the base of Q2 (through capacitor C5) is used to assure positive switching.

When the input signal is removed capacitor C11 discharges and in turn, transistors Q10 and Q3 are switched off. However, a timing circuit is used to maintain the switched-ground output for approximately .1 second. This timing circuit is controlled by the action of capacitor C8. When transistors Q10 and Q3 are initially turned on, the collector of Q3 goes positive and capacitor C8 remains charged until transistors Q10 and Q3 are switched off, at which time it discharges through diode CR3 and R25. The discharge time is such that transistor Q11 stays switched on for approximately .1 sec.

To allow use of digital and FSK logging tones at the NAB standard frequencies of 3.3 to 3.5 Khz along with normal fast forward operation a bandwidth control circuit is included. Fast forward operation requires detection of Stop Cues anywhere within the range of 975 hz to 3075 hz as the tape varies in speed from 7 1/2 ips to 22 1/2 ips.

The bandwidth controller consists of a timer circuit Q12, R38 & C14 driving a DC Switching Stage Q13 which controls a FET audio Switch Q14. During normal speed playback the $\overline{\text{FF}}$ line is high, Q12 is saturated, Q13 is off and Q14 shorts capacitor C2 in the Stop Cue detector filter circuit resulting in a low speed bandwidth of 700 to 2000 hz. R38 & C14 are selected to provide a .5 second time delay after the start of fast forward which corresponds to the motor accelleration time to 1.5 times normal speed. At this speed the Stop Cue is at 1500 hz and the logging tones have shifted up to approximately 5 Khz. Afterthe .5 second delay Q13 saturates and Q14 is cut off inserting C2 into the Stop Cue detector filter and widening the detector bandwidth to 700 - 4000 hz.

The End & Trip Cue detectors are also wide band circuits to eliminate frequency sensitivity and guarantee compatability with tapes made on any other recorder. The End Cue detector will respond to signals within the range of 75 to 300 hz and the Trip Cue detector operates over the range of 7000 to 12000 hz. Since the filter sections are fed constant amplitude square waves regardless of input signal amplitude (above -20db noise threshold) the cue detectors are completely insensitive to level variations and have infinitely steep cut off slopes above and below the stated bandwidths.

A $\overline{\text{CUE BLOCK}}$ line grounds the base of Q10 in the Stop Cue detector for 1.5 seconds after a START command. This prevents a newly recorded or existing Stop Cue from generating a Stop Command as it moves past the playback head just after the tape is started.

An $\overline{\text{EQG}}$ (End Cue Gate) line is connected to the base of Z2Q3 in the End Cue Detector. After the first End Cue is detected during one START-STOP cycle this line is held low preventing the circuit from responding to any additional spurious End Cues which might be recorded on the tape. This feature is of particular value in automation system applications where extra recorded end cues (or missing Stop Cue tones) might result in unpredictable operation of the Program Sequence Controller .

Operation of the Trip Cue detector is allowed at all times and consequently the Trip Cue will indicate presence of frequencies on the cue track between 7 and 12 Khz when running at fast forward. Digital logging information will shift to 10 Khz in fast forward and will operate theTrip Cue indicator.

RECORD AMPLIFIER BOARD ASSY. - Fig. 45

HIGH LEVEL DIFFERENTIAL INPUT PREAMP. The differential input preamps accept input signals of from -20 to +18 dBm. With the differential input, any noise common to both lines will be cancelled by the operational amplifier (U1). The RC network consisting of R3-C3 and R4-C4 provide a high frequency (RF) rolloff. Diodes CR1 through CR4 form a clipper circuit for both positive and negative peaks to limit the input level from ground to +24 volts. The resistor divider network consisting of R8, R9 and R10 set the +12 volt operating point of U1. Capacitors C6 and C7 along with R11 provide for two pole compensation while R7 is the feed-back resistor. The input resistance of 15K (R3 + R5) along with the feedback resistance of 15K (R7) set U1 at unity gain.

The front panel INPUT LEVEL pot is set for the various input levels to give a nominal -20db at the wiper of the pot.

EQUALIZED RECORD HEAD DRIVER. The output of the level pot feeds the record driver stage which consists of an equalized operational amplifier (U2). Resistors R16, R19 and R20 provide the +12V operating point. Resistor R23 along with capacitors C10 and C11 provide for amplifier compensation.

A series resonant network in the negative feedback loop around U2 is formed by L1 and C12. This network generates a response peak at 19kHz. The magnitude of the peak is adjustable with the Record Equalization Control R18 to precisely compensate for high frequency losses in the record-reproduce process.

METER SWITCHING CIRCUIT. The meter switching circuits select either the output of the record preamp (FLAT), the equalized output of the record head driver (EQUAL), or the output of the playback preamp for display on the VU meter. The output of the record preamp feeds one METER ADJUST pot (R27) while the equalized output of the record head driver stage feeds METER ADJUST pot (R26). The wiper of each pot feeds a board mounted switch. The selected output (Flat or Equalized) is fed to Field Effect transistor Q3 (P channel FET). The output of the playback preamp is fed through METER ADJUST pot (R28) to the Field Effect Transistor Q4 (N channel FET). The level that is selected for display depends upon which FET (Q3 or Q4) is biased on, which in turn is determined by the voltage present at the junction of CR8 and CR9. This voltage is determined by the status of the record logic. When not in the RECORD mode +14 volts is present at the diode junction which will gate Q4 on and select the output of the playback preamp for display. When in the RECORD mode minus 10 volts is present at the diode junction which will bias Q3 on and Q4 off. Depending on the position of the slide switch either the record preamp or the record head driver stage will be selected for display, allowing either conventional VU monitoring in the FLAT position or equalized VU monitoring for lowest distortion recording of program material having unusually high energy content at either the high or low end of the frequency spectrum. A third position of the slide switch (PLAY ONLY) applies a continuous +14V bias to the junction of CR8 & CR9 holding the FET switcher in the playback metering mode regardless of the state of the Record Logic.

BIAS OSCILLATOR AND METER AMPLIFIER BOARD ASSEMBLY - Fig. 47

GENERAL

The unique bias oscillator circuit is a prime contributor to the excellent recorded noise characteristics achieved by Ampro recorders. Distortion of the bias wave form is a major cause of recorded noise and most recorders in the past have used a simple resonant transformer oscillator capable of producing a relatively clean voltage output (1% distortion). It is, however, not the voltage applied but rather the current flowing through the record head which produces the resultant flux on the tape. The record head, being a ferromagnetic device, is a producer of odd harmonic distortion products due to magnetic core nonlinearities and saturation at the high currents of the bias signal. The current distortion resulting from these effects is often as high as 5% with a typical resonant transformer drive through a 20K ohm isolation resistance. The result is a high recorded noise level on the tape.

The Bias Oscillator used in Ampro recorders is a complete departure from previous technology. A master AGC controlled 100k hz oscillator feeds a stable, extremely high purity waveform into individual constant current feedback sensing record head drive amplifiers. The actual current through the record head is sensed in sampling resistors and compared with the input signal from the master oscillator in a high loop gain drive amplifier. Feedback correction for magnetic nonlinearities of the record head results in actual current waveform distortion under .5%. Additional benefits of the improved circuitry include the elimination of bias traps since audio is resistively mixed with bias prior to the drive amplifiers, shaped and timed on-off switching of the bias for complete elimination of pops and clicks; and complete stability of bias level adjustments through AGC control of master oscillator level.

MASTER OSCILLATOR

The master oscillator is comprised of LC oscillator stage A1, amplifier A2 and AGC feedback stage A3. The frequency determining elements are L1 & C1 in the negative feedback loop of A1. Clipper diodes CR1 & CR2 along with controlled positive feedback maintain this oscillator at a stable amplitude just below the self-limiting point where distortion is at a minimum. Amplifier A2 provides 13db of gain and an output level of 22Vp-p. AGC control stage A3 senses the peaks of the output waveform, compares them with the 9.5V zener voltage of CR4, integrates and filters the difference voltage and applies that to the control gate of FET Q1. Q1 operates as a variable resistance in the positive feedback loop of oscillator A1. The absence of signal output drives the gate of Q1 positive, cutting off Q1 (maximum resistance) resulting in maximum positive feedback for reliable self starting. Increasing output amplitude above the CR4 threshold drives the gate toward ground and the FET to minimum resistance thus reducing the positive feedback and reducing oscillator amplitude.

HEAD DRIVERS

The Master Oscillator output feeds resistive combining networks for each channel in which the bias level is set using pots Z1R10 (ChA), Z1R25 (Cue) and Z2R7 (ChB). The bias is resistively added to the audio input from the record amplifier and the combined signal is switched into the head driver for each channel using a LED driven photo conductive switch. The combined bias and audio is applied to one base of a differential input stage Q4 and Q5, (ChA) the other base is driven from a 200 ohm current sensing resistor placed in series with the record head between the low side and ground. Additional DC feedback from the head driver output stage is also fed to the base of Q5 to stabilize the DC operating point. The differential stage output is amplified by Q6 and drives the complimentary symmetry class B emitter follower output stage Q7 & Q8. C10 is a boot strap drive capacitor, C9 provides feed forward compensation around the output stage and C11 tunes out the load reactance for maximum loop gain. The drivers for Cue and ChB are identical to ChA as described.

BIAS SWITCHING

The combined bias and audio waveform is gated into the record head driver using a LED driven photo - conductive cell. When the LED (Light Emitting Diode) is driven the photo conductive cell has a low resistance. When the LED is off, the cell has a resistance in the 10 meg ohm range. The LEDs for both program channels are controlled by the $\overline{\text{RBC}}$ line (Record Bias Control) which goes to ground as the tape is started in the record mode. A miller integrator stage Q2, timing capacitor C26 and Zener CR5 provide a short delay to allow the tape to start moving and then a shaped turn on of bias. The combination of the delay and shaping eliminates all pops and clicks from bias build up. At stop the bias is turned off with a shaped decay.

The cue bias is controlled by the Cue Bias line ($\overline{\text{QB}}$) through R28.

METER AMPLIFIER CIRCUIT. The selected output of the Meter Switching circuit on the Record Amplifier board is fed to the input of an operational amplifier, A4. Zener diode CR15 along with resistor R44 provide the +15 volts operating voltage, while Zener diode CR16 and resistor R45 provide the negative fifteen volts needed. Capacitor C20 along with resistor R42 and capacitor C21 provide the frequency compensation of the op amp. Feedback resistors R40 and R41 determine the gain of A4 (approximately 40db). The output of A4 is fed to the bridge consisting of diodes CR11 through CR14. The output of the bridge is used to drive the VU meter.

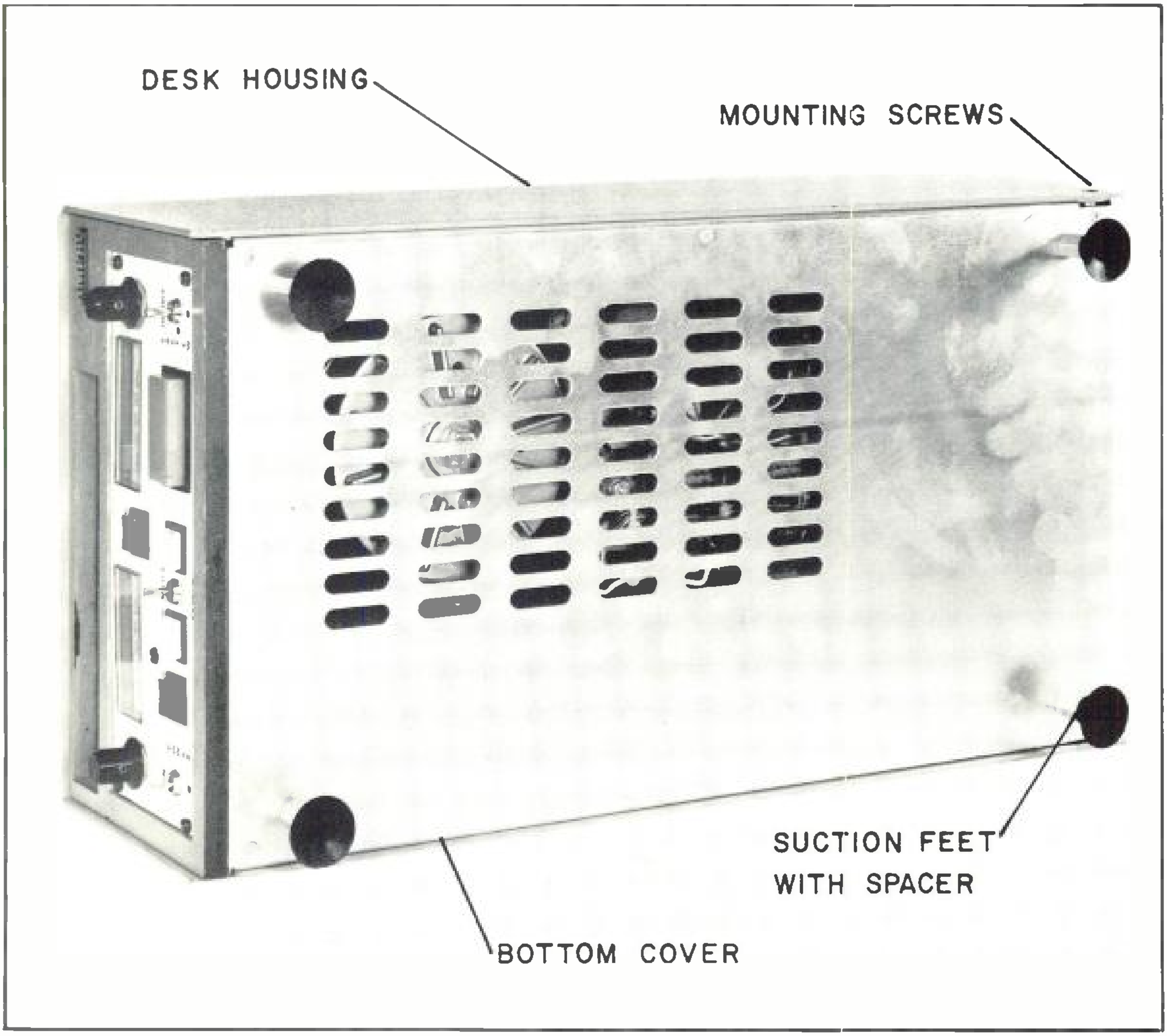


FIG. 11. Desk Mount

SECTION III

INSTALLATION

DESK MOUNTING THE CT2500B, CT3500B and CT4500B

For desk use, four rubber suction cup feet, spacers and a flip top housing are available, easily assembled by mounting the feet or spacers into holes provided in the bottom cover and snapping the cover into holes provided in the sides of the chasses. These items are not used when rack mounting. See Fig. 11 for assembly details.

RACK MOUNTING THE CT2500B, CT3500B, and CT4500B

Standard Rack mounting is available for all models and mixing of sizes is also accommodated. See Fig. 2.

Provision for locking units in place is provided by captive screws which are to be assembled to the rack chassis and held in place with O-rings. (See Fig. 12). Mount enclosure into the rack allowing a minimum of 1.75 inches ventilation space above and below. Stacked enclosures should be provided with forced air cooling. Feed captive screw through appropriate clearance hole in rear flange of enclosure to center cartridge unit in desired slot & secure with O ring. Slide cartridge unit (minus mounting feet and cover) into slot & tighten captive screw into floating nut on rear of cartridge unit.

The floating spring nut should be assembled into the hole located in the lower center of the cartridge machine prior to inserting in rack.

VENTILATION

Each cartridge tape unit dissipates approximately 50 watts under continuous tape drive conditions and must be adequately ventilated to prevent excessive internal temperature rise. Normal convection cooling is adequate in most studio environments if adequate space above and below each unit is allowed for free air flow.

It is normally possible to stack two units high using the desk top enclosures & spacer feet without excessive temperature rise so long as free air flow is not impeded by laying papers etc. on top of and in between stacked units.

Rack mounted units must not be installed in unventilated enclosures or mounted above high power equipment. Rack shelves must be mounted with 1.75 inches clearance above and below for free air flow.

A good rule of thumb is that under maximum duty conditions the deck plate in front of the heads should remain comfortable to the touch (115°F maximum).

Dummy panels are available in 1/3 & 1/2 enclosure sizes. See Accessory List.

Mounting is accomplished simply by sliding the Dummy Panel into place in the rack chassis and securing in place from below with the screws supplied.

POWER CONNECTIONS

The CT2500B, CT3500B & CT4500B cartridge-tape units are shipped completely adjusted and wired for operation on 115-volt 60 Hz ac power. For operation from a 230 volt line the jumpers from terminals 1-3 and 2-4 of power transformer T1 should be removed and a jumper installed between terminals 2 and 3. Refer to Fig. 14 and schematic diagrams (Fig. 51 & 52) for additional information.

50 Hz OPERATION

Tape velocity is a function of motor speed which is synchronous to line frequency. This precludes the operation of a 60 Hz unit on 50 Hz power or the operation of a 50 Hz unit on a 60 Hz supply. 50 Hz units are available directly from the factory (See Ordering Information). Operation on either 115 volts or 230 volts is accomplished the same as with the 60 Hz power connections.

AUDIO OUTPUT CONNECTIONS

As shipped, the playback is wired for operation with 600 ohm program lines. For 600 ohm program line operation, proceed as directed in step a; for 150 ohm program line operation, proceed as directed in step b. The nominal output level of the playback is + 8 dbm. P2 is provided for easy access to the audio. See Fig. 15.

a) Operation on 600 ohm program line.

1. For monaural playback connect the channel A program line to terminals 3 and 5 of output jack J2. For stereo operation connect the channel B program line to terminals 4 and 6 of J2.

If it is desired to ground the shields of the output cables at the cartridge unit the external shields can be tied to pins 1 and 2 of output jack J2. If the output shields are to be grounded at the console, no connection should be made to pins 1 or 2.

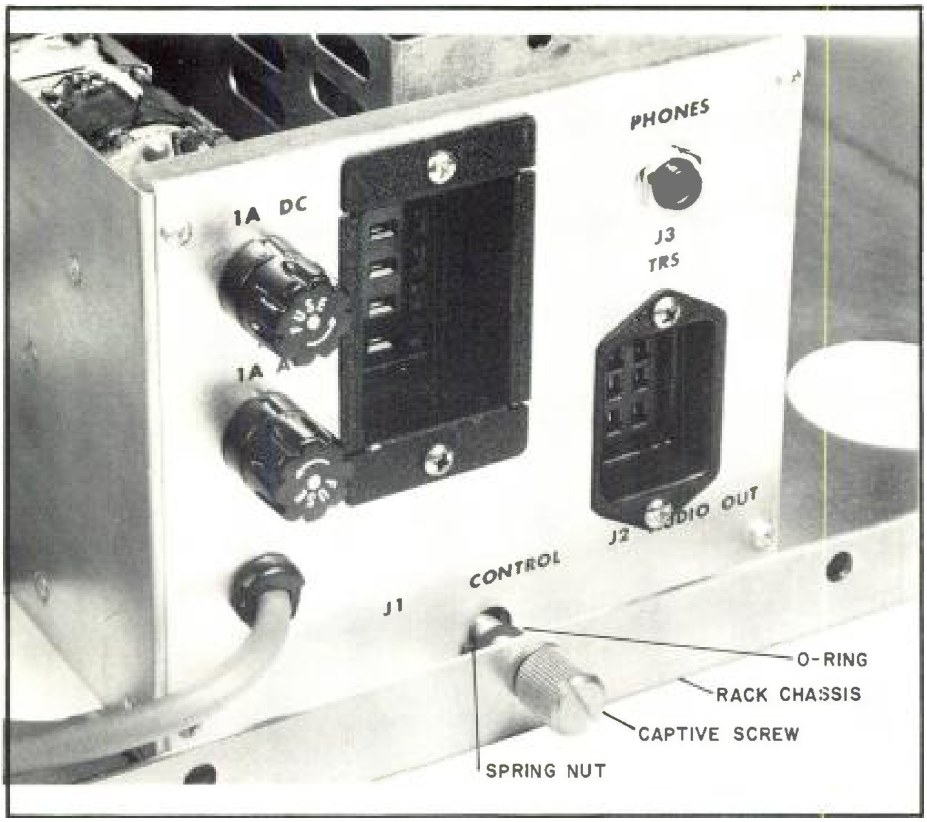


FIG. 12. Rack Mount Detail, Rear View

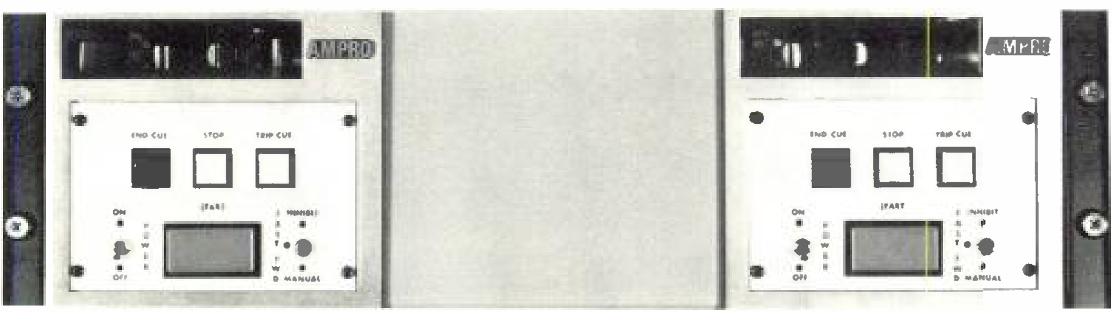


FIG. 13. Rack Mount with Fill Panel

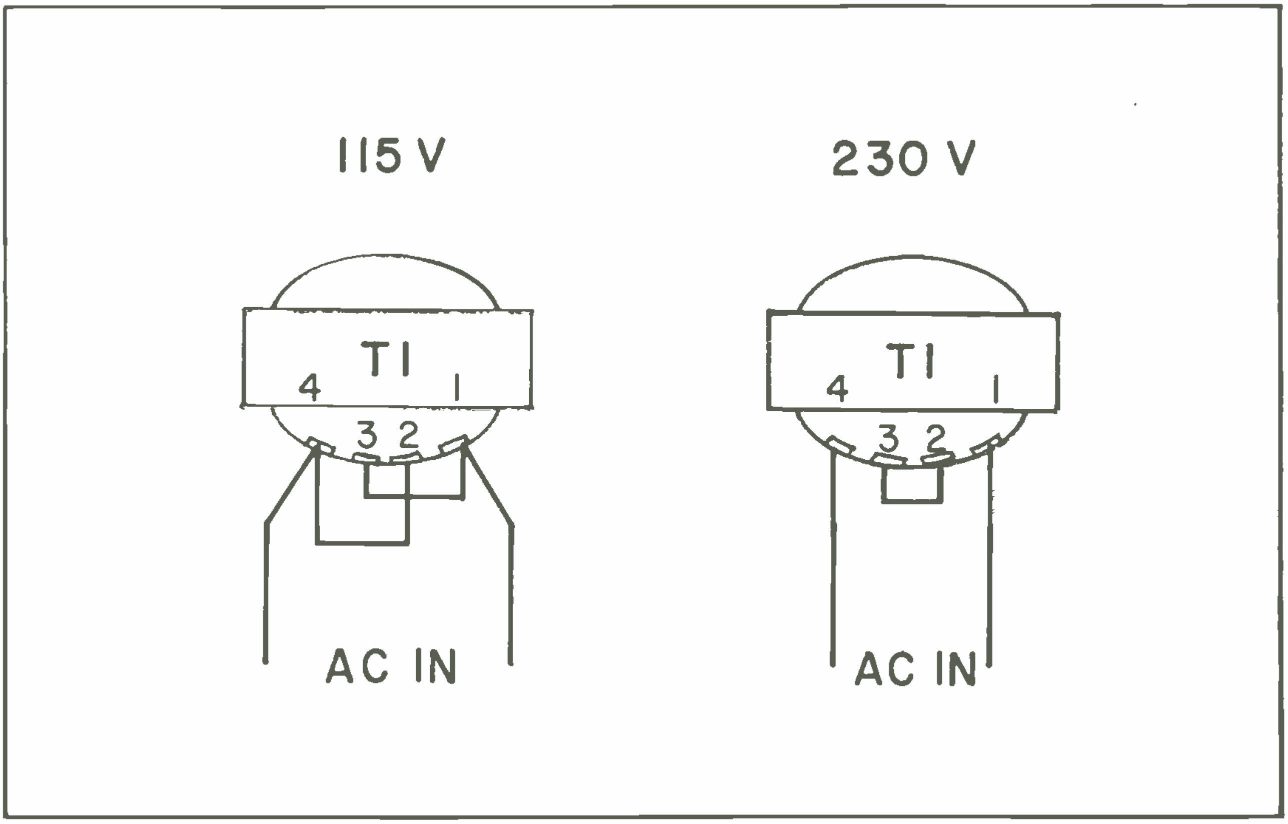


FIG. 14. Power Transformer 115/230 VAC Connections

Pin	Function
1	Shield CHA (Mono)
2	Shield CHB
3	CH. A Output High (Mono)
4	CH. B Output High
5	CH. A Output Low (Mono)
6	CH. B Output Low

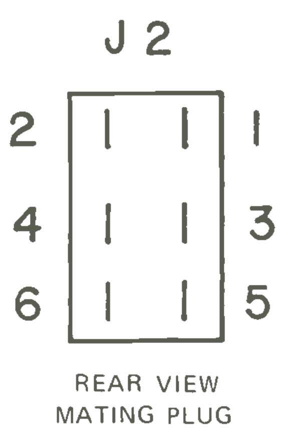


FIG. 15 Audio Output Connection Table J2

Pin	Function
1	Shield CHA (Mono)
2	Shield CHB
3	CH. A Input High (Mono)
4	CH. B Input High
5	CH. A Input Low (Mono)
6	CH. B Input Low

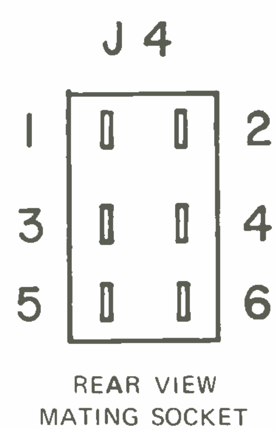


FIG. 16. Audio Input Connection Table J4

Pin	Function
*1	Cue Data Out
2	+24V Supply
3	Stop Cue (Output)
4	Interlock Bus
5	GND
6	End Cue (Output)
7	Fast Forward Switch
8	GND
9	Trip Cue Output
10	Stop Switch
11	GND
12	Ready Indicator (+)
13	Start Switch
14	GND
15	Play Indicator (+)
16	Record Switch
17	Stop Cue Inhibit Switch
18	Record Indicator (+)
19	End Cue Switch
20	Stop Cue Record Switch
21	Cue Bias Enable
22	Trip Cue Switch
23	Cue Data Input High
24	Cue Data Input Low

*Pins 1 - 15 Playback Units
Pins 1 - 24 Record Play Units Only

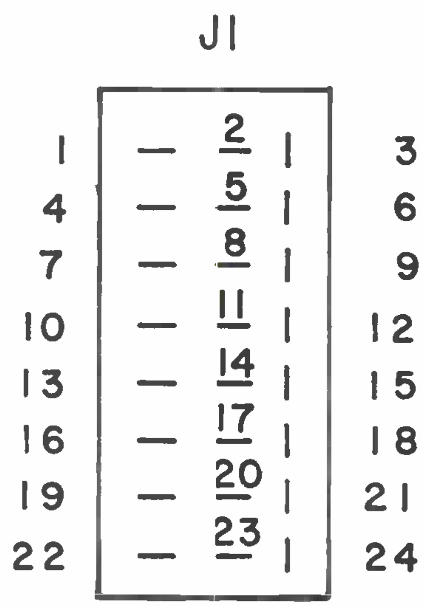
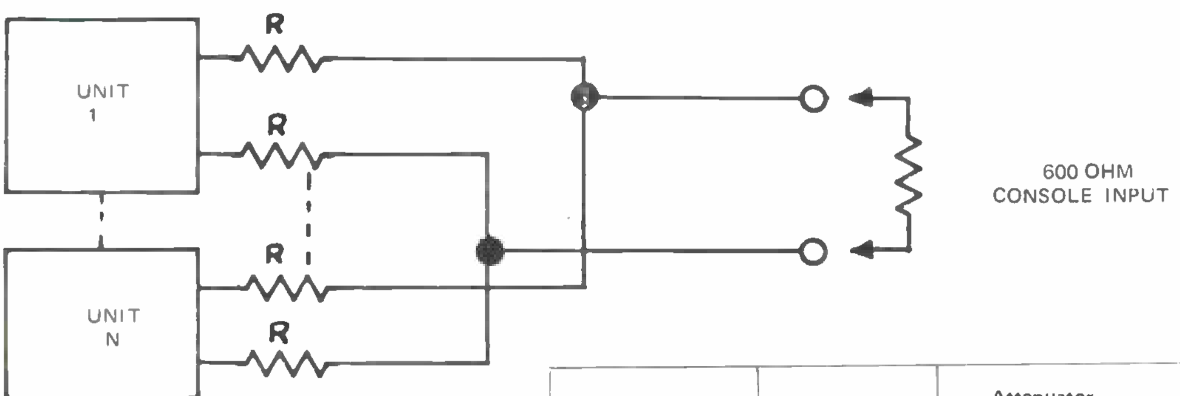


FIG. 17. Remote Control Connection Table J1



Number of Units	R (Ohms)	Attenuator Loss (db)
2	180	8
3	220	11
4	220	13
5	240	15
6	240	16
7	270	17
8	270	18
9	270	19
10	270	20

FIG. 18. Constant Impedance Combining Network Table

b) Operation with 150 ohm program line.

1. Remove the jumper strap between terminals 4 and 5 of T2 (For stereo operation, also remove the jumper strap on T3).

2. Install jumpers from 3 to 4 and from 5 to 6 on T2. (For stereo operation connect jumpers on T3).

3. Connect the 150 ohm program line as in step a-1 above.

AUDIO INPUT CONNECTIONS

Audio input to the Record Amplifiers is by means of Input Jack J4. See Fig. 16. High-level inputs ranging from -20 to +18 dBm can be applied into the differential 18,000 ohm bridging input. Channel A input is by means of contacts 3 (high), and 5 (low) of J4. For stereo, use contacts 4 (high) and 6 (low) for channel B input. Space has been left in the unit for the mounting of high level input transformers. (See Accessories) for applications where the audio input lines have exceptionally high common mode noise, hum or transients present.

REMOTE CONTROL FUNCTIONS

GENERAL

Complete remote control functions are accessible from control jack J1 on all units (See Fig. 17). The following sections describe the functions available with Reproduce units and the additional functions associated with Record-Reproduce systems. Two Remote Control Panels are available (See Accessories) for ease of interfacing. The four button unit contains start switches and run indicators for the remote starting of up to four separate units. The five button unit has Start, Stop, Record, Trip-cue, and End-cue pushbuttons, along with their respective indicator lamps. This unit allows for the remote operation of either a Reproduce or a Record-Reproduce System. All Remote switching may be either mechanical switch contacts or a NPN transistor switch capable of pulling down 5 ma. at less than .6VDC drop. External indicators should be 28 VDC Lamps which do not draw in excess of 40 ma.

REPRODUCER REMOTE CONTROLS

REMOTE START AND STOP SWITCHES. Connect a SPST (normally open) momentary pushbutton switch from pin 13 to 14 (Gnd) for remote start. Connect a momentary switch between pins 10 and 11 (Gnd) for remote stop. The PLAY and READY indicators should be connected from pins 15 and 12 respectively to ground at pin 14.

REMOTE FAST FORWARD. Connect a momentary SPST switch between pins 7 and 8 (Gnd) of J1.

REMOTE END CUE AND TRIP CUE LIGHTS. Connect 28V, 40ma lamps from pins 6 and 9 respectively to pin 2 (+24V). Cue outputs will switch up to .5A from up to a 40 volt external supply.

REMOTE STOP CUE. The remote Stop Cue Output is available from pin 3 of J1.

CUE DATA OUT. The Cue Data Out signal is available from pins 1 and ground for Data Logging. Output is a +4 Volt square wave from a 10,000 ohm source resistance.

INTERLOCK BUS. The Interlock Bus allows for multiple system audio switching and guarantees that only one unit will feed audio to the system at a time.

Pin 4 of all units to be interlocked should be tied together and the audio outputs of all units combined in a constant impedance mixing network. Start of any unit will switch the audio output from the previously running unit to the unit which was just started. (See Fig. 18).

AUTOMATIC SEQUENCING. The order of operation for Automatic Sequencing is governed by installed external connections. The end cue output from each unit at pin 6 is connected to the remote start input pin 13 of the next unit to play. The audio outputs may be combined (Fig. 18) for a common audio output and the interlock bus connected to guarantee only one audio feed to the system at a time.

AUDIO OVERLAP. In an automatic sequencing system, an automatic audio overlap controlled by the duration of recorded end cues can be provided by combining the audio outputs and not connecting the interlock bus. While sequencing, the next unit will start at the leading edge of the end cue and the audio of the previous unit will be muted at the trailing edge of its end cue. For the duration of the end cue both units will feed audio for a smooth overlap.

RECORDER-REPRODUCER REMOTE CONTROL. The Record-Reproduce units contain the same remote functions as the Reproduce units plus the following additional features.

RECORD SWITCH AND LIGHT. Connect a momentary SPST switch between pins 16 & 14 (Gnd). Connect the Record Indicator from pin 18 to pin 14 (Gnd).

REMOTE END CUE AND TRIP CUE RECORDING. Ground pins 19 (End Cue) or 22 (Trip Cue) through external momentary SPST Switches for remote cue recording.

STOP CUE INHIBIT. A maintained ground applied to J1 pin 17 will block the automatic recording of Stop cues. This feature facilitiates the production of continuously running loops for sound effects. This line must remain grounded for the entire record cycle until the tape has been manually stopped.

STOP CUE RECORD. A momentary ground applied to J1 pin 20 will cause the recording of a 1 Khz Stop cue onto the cue track. NOTE: The Stop cue is normally automatically recorded at the beginning of a recording. It is only necessary to use this feature to add additional Stop Cues to previously recorded material.

CUE DATA RECORDING. To record cue data connect a SPST switch from pin 21 (Cue Bias Enable) to Gnd. Connect the signal input to pins 23 (Cue Input High) and 24 (Cue Input Low). When the switch grounds the Cue Bias Enable with tape running the signal input will be recorded on the cue track. Input level required is .78 Vrms into an input impedance of 8000 ohms. The data signal should be 3.5 Khz for pulse tone recording or 3.3 to 3.5 Khz for FSK recording.

SECTION IV

OPERATION

Fig. 19

Front Panel Controls and Indicators

Control/Indicator	Symbol No.	Function
REPRODUCER		
POWER – SPST SW.	S1	Controls the application of AC power.
STOP – Pushbutton/Indicator		
Switch	S5	Stops tape and reverts system to Ready mode.
Ready Indicator	DS5	Lights to indicate that system is in Ready mode of operation & cartridge is fully inserted.
START – Pushbutton/Indicator		
Switch	S2	Starts the tape running.
Play Indicator	DS2	Lights to indicate that tape is playing on line.
TRIP-CUE – Indicator	DS7	When the tape is running, a momentary lighting indicates the playback of a Trip-Cue Tone.
END CUE – Indicator	DS6	When the tape is running, a momentary lighting indicates the playback of a End-Cue Tone.
FAST FWD. SW. FAST FORWARD	S3	Normal run position.
INHIBIT		Inhibits Fast Forward operation when an End-Cue is received.
MANUAL		Switches unit from a Run mode to Fast Forward mode.
RECORDER		
RECORD – Pushbutton/Indicator Switch Switch	S8	Sets up system for Record mode. Lights to indicate that system is in the Record mode. Switches VU meters from Playback output to Record Amplifier Input.
LEVEL – Potentiometers	R1 R2 (Stereo)	Controls output levels of channel A (channel B, stereo) record amplifiers. Amplifier output level is indicated on adjacent VU meter.
TRIP CUE – Pushbutton Switch	S7	Inserts an 8kHz cue on the cue track of the tape either during playback or record mode.
END CUE – Pushbutton Switch	S6	Inserts a 150 Hz cue on the cue track of the tape either during playback or record mode. End cue is used to start external equipment, or to indicate the end of a program.

TO PLAYBACK

a. Operate the ON-OFF switch to ON.

b. Align the prerecorded cartridge with the right side of the tape slot and push the cartridge straight in. Press the cartridge in firmly. When the cartridge is properly inserted, the READY indicator will light.

c. To start playback, press the START switch: The PLAY indicator lights and the READY indicator goes out. The tape runs until it is stopped by the prerecorded stop cue signal. The TRIP CUE indicator will momentarily light when a Trip Cue Signal passes the playback head and the END CUE indicator will light momentarily when the first End Cue signal passes the playback head (all subsequent End Cues are blocked). External equipment may be controlled with the prerecorded cue signals (refer to the INSTALLATION section).

NOTE: The playback may be stopped by pressing the STOP switch but the tape will not be properly cued for later playback.

d. Once the unit is stopped the cartridge may be removed simply by pulling out.

TO RECORD

a. Operate the POWER switch to ON.

b. Align the erased tape cartridge with the right side of the tape slot and push the cartridge straight in. Press the cartridge in firmly. When the cartridge is properly inserted, the READY indicator lights (indicator section of the STOP pushbutton/indicator).

c. To initiate the recording process, press the RECORD switch: The RECORD indicator lights.

d. Adjust the LEVEL controls so that only an occassional peak will reach O VU.

e. Press the START switch: The tape runs, the READY indicator goes out, the PLAY indicator comes on and a STOP cue signal is automatically recorded on the cue track of the tape.

f. At the end of the recording the tape will stop at the STOP CUE which was automatically put onto the cue track when the START button was operated in Record. The message length must be carefully timed in relation to the length of tape on the cartridge used in order to avoid overlap.

g. If the playback and record units are equipped for additional cue functions, End cues or Trip cues may be recorded either during playback or recording by pressing the TRIP CUE or END CUE button at the appropriate point in the recording. The TRIP CUE indicator momentarily lights when a trip cue passes the playback head and the END CUE indicator momentarily lights when the First End Cue passes the playback head. An End Cue should be recorded only at the end of the recorded message to activate the audio switching, external sequencing & fast forward control circuits during playback.

NOTE: Trip cues and end cues play back during the recording process. Disable external program equipment if it is not desirable that equipment operation should be affected by the operation of the cue circuits during recording.

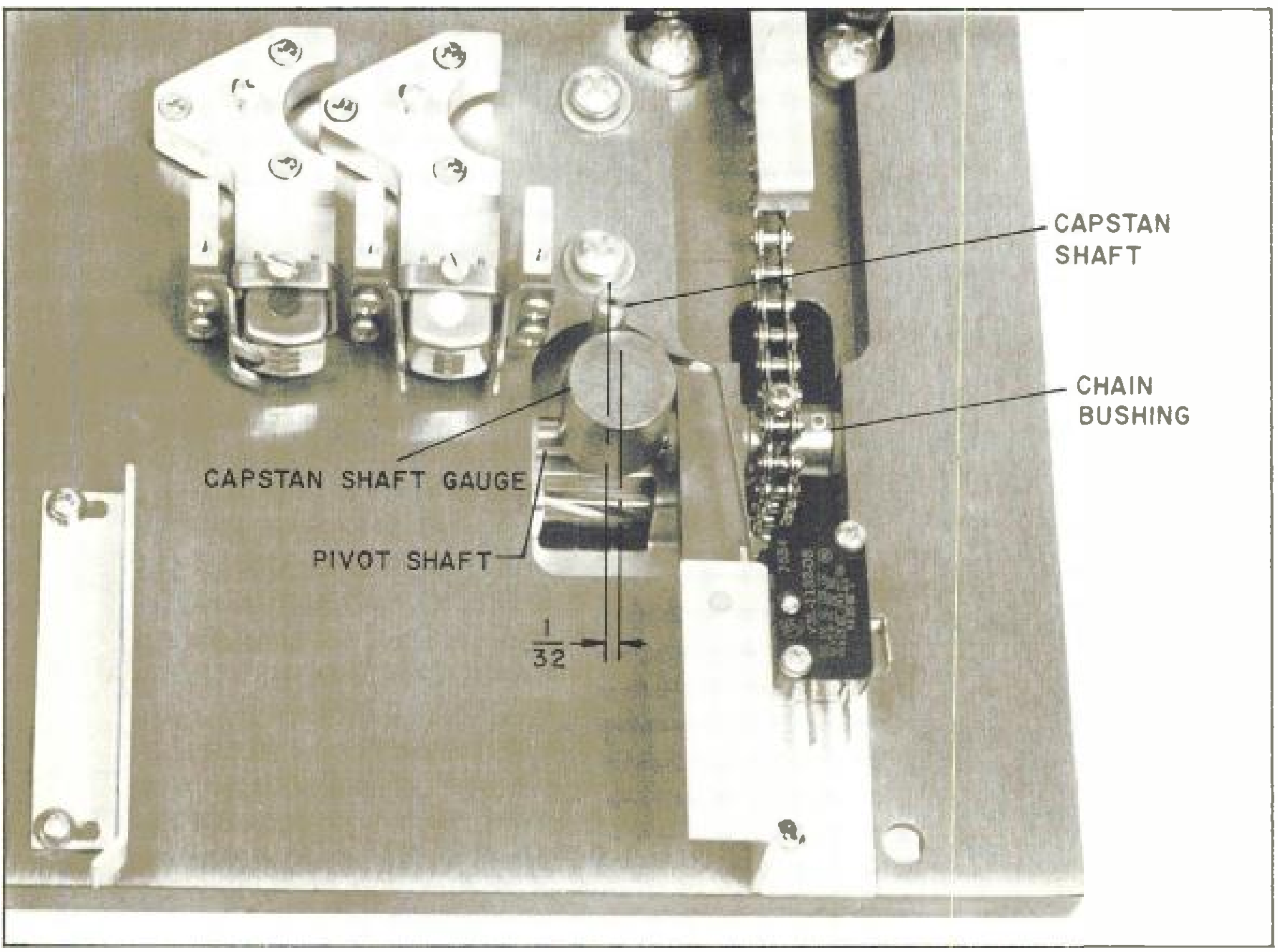


FIG. 20. Capstan to Pressure Roller Alignment

SECTION V

MAINTENANCE

PERIODIC MAINTENANCE

Heads, tape guides and the capstan should be cleaned using cotton swabs & alcohol (or other solvents specifically recommended for tape head cleaning) on a daily basis. These parts should be demagnetized on a regular basis and particularly after any mechanical maintenance work.

Dust and dirt accumulations should be removed from all moving parts regularly. The solenoid plunger should be fully extended and wiped clean of any loose particles monthly. Sluggish solenoid operation is often due to dirt accumulations inside the solenoid bore which can readily be removed with a cotton swab.

MECHANICAL ADJUSTMENTS

CT2500B, CT3500B and CT4500B cartridge tape units under normal operation require only a minimum of simplified adjustments.

The sequence of adjustment is important and the procedure outlined in this section should be followed.

Alignment gauges used in the following procedures are available. (See Accessories.)

CAPSTAN SHAFT POSITION

This adjustment (preset at the factory) will normally be required only when the motor or pivot shaft has been removed; however, a check for proper positioning should be included as a step in proper alignment of the cartridge tape units. The purpose of the following five steps is to assure that the Capstan and Pressure Roller surfaces are nominally parallel with allowance for the deflection of the Pressure Roller under load.

1. Unscrew and remove the pressure roller assy. and replace with capstan shaft gauge. (See Fig. 20.)

2. Check position of capstan shaft gauge in relation to clearance hole in the deck plate, gauge should be centered with approximately .150 clearance on each side. If adjustment is required, loosen chain bushing-adjust pivot shaft sideways to center gauge then retighten screws.

3. Loosen the motor mounting screws and position the motor so that the entire surface of the capstan shaft is in contact with the entire height of the gauge with the center of the capstan shaft offset 1/32'' toward the heads. This offset allows the tape to slightly ''wrap'' around the capstan shaft for better pull and results in minimum wow and flutter.

4. Tighten the motor mounting screws and recheck alignment.

5. Remove gauge and replace pressure roller Assy.

SOLENOID PRESSURE

The solenoid pressure should be checked occasionally to compensate for pressure roller wear and at anytime mechanical parts replacements are made. The following procedure will set the Solenoid Pressure sufficiently close for most applications.

1. Check to see that the chain stud is engaged approximately half way in the solenoid plunger (5/8 inch extending out) and that the chain actuating screw is between the eighth and ninth chain link pins.

2. Unscrew and remove the pressure roller assy. and replace with capstan shaft gauge.

3. Loosen the screws in the chain bushing, adjusting the tension so that the bushing is snug on the pressure roller shaft but can be moved with a small amount of force.

4. Apply pressure to the solenoid plunger until the plunger bottoms inside solenoid and the capstan shaft gauge is touching the capstan shaft. Adjust the chain bushing by rotating until the chain is taut. (Do not move chain bushing horizontally on pivot shaft). Tighten screws to secure chain bushing to Pivot Shaft.

5. Loosen Locknut on Chain Stud, rotate solenoid plunger CCW one full turn (1/32'') retighten Locknut.

6. Remove capstan shaft gauge and replace pressure roller assembly. This adjustment will be adequate for most situations.

7. If a cartridge torque tape is available the adjustment can be further refined. To increase torque, loosen lock nut on chain stud and rotate solenoid plunger clockwise. To decrease torque, rotate counter clockwise. After achieving specified torque (1.5 pounds) retighten lock nut.

8. A good rule of thumb is that there should be approximately a 1/32 inch dimple in the pressure roller when running.

SOLENOID DAMPING

The speed of actuation of the solenoid is controlled by the adjustment valve on the rear of the solenoid. (See Fig. 22.)

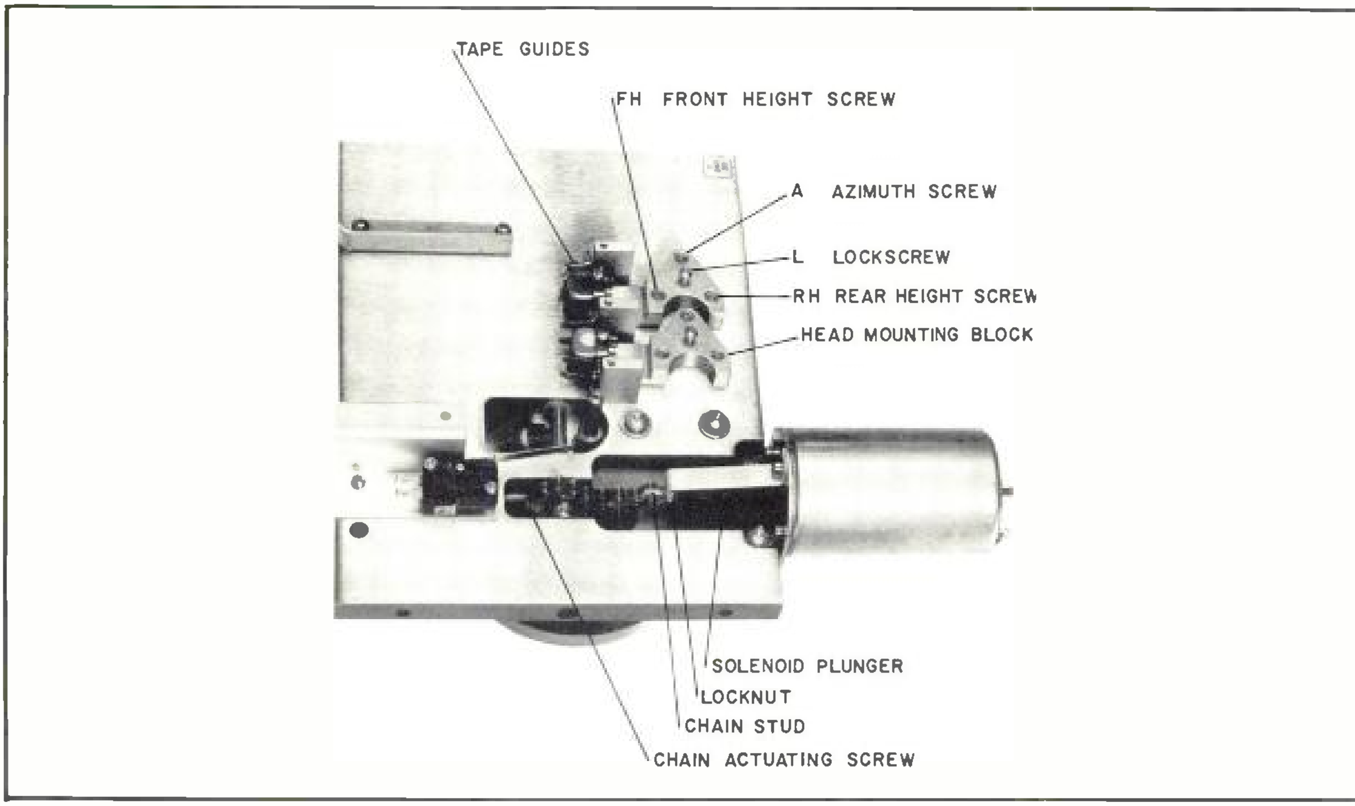


FIG. 21. Solenoid Pressure Adjustment

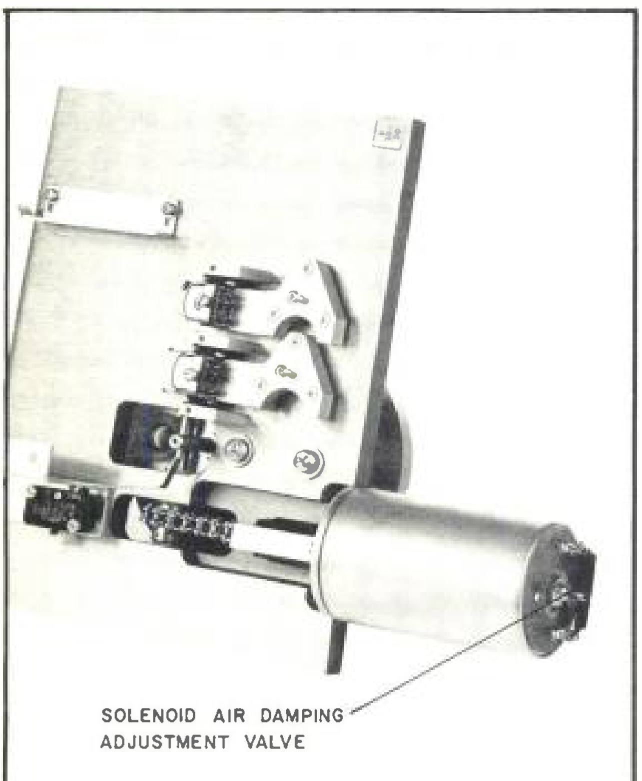


FIG. 22. Solenoid Damping Adjustment

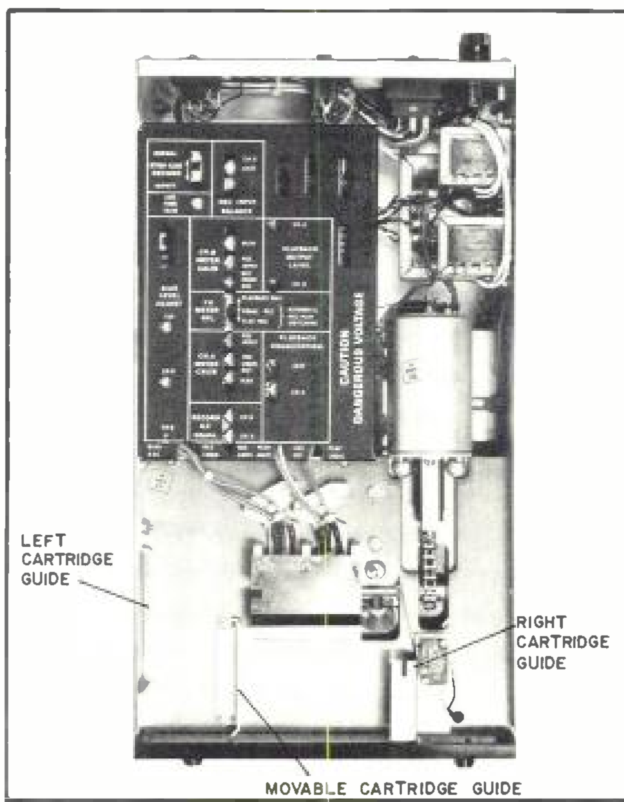


FIG. 23. Cartridge Guides

The noise and actuation speed of the pressure roller is proportional to the speed at which the air is allowed to bleed through the needle valve.

The needle valve adjustment in no way affects the solenoid pressure setting.

1. Loosen the locknut on the needle valve cap screw.

2. Turn the cap screw into the needle valve to decrease the speed of the solenoid operation and reduce noise.

3. Check adjustment by inserting a cartridge and actuating the unit. Refine the adjustment until the optimum balance between noise and actuation speed is achieved.

4. Tighten the locknut.

RIGHT CARTRIDGE GUIDE

The right cartridge guide mounts the cartridge sensing microswitch and controls the cartridge position in relation to the capstan shaft, pressure roller and heads. (See Fig. 23.)

The right cartridge guide is factory preset and should not normally need adjustment.

If removed for any reason the following replacement procedure should be followed.

1. Loosen the three mounting screws (two are located on microswitch).

2. Position cartridge so that the keyhole in the cartridge is centered on the cutout in the mounting plate and the face of the cartridge is against both cartridge stops mounted on the tape guides.

3. Position the cartridge guide 1/64 of an inch from the cartridge for its entire length.

4. Tighten the three mounting screws.

LEFT CARTRIDGE GUIDE

The left mounting guide is factory present and needs no adjustment.

MOVABLE CARTRIDGE GUIDE

The movable cartridge guide should be used with cartridges of less than the maximum size capability of the machine to provide proper insertion guidance. The guide must be removed to use the maximum cartridge size capability of the machine. (See Fig. 23.)

To adjust the movable guide

1. Place guide in desired position and screw down loosely. Insert cartridge and position the guide so that the end of the guide closest to the heads is 1/64 inch away from the cartridge. Allow the other end of the guide to angle away from the cartridge thereby creating a guide path to the proper position of the cartridge.

2. Tighten Mounting Screws.

CARTRIDGE HOLD DOWN SPRING

To assure proper position of cartridge and tape the cartridge hold down spring should always be in place while operating the unit. The spring helps to maintain the correct cartridge corner post height above the deck by exerting a downward pressure of approximately 600 grams. Without the holddown spring there is a possibility that warped cartridges would not seat properly, thus causing gross azimuth problems in mono and severe stereo phasing errors.

HEAD REPLACEMENT

Replacing heads in the cartridge tape machines is a quick and easy operation.

1. Remove Cartridge Hold Down Spring.

2. Loosen the head mounting strap.

3. Remove the head cables noting color code and position of cables.

4. Remove the old head and insert the new one positioning the head so that the head penetration is set by the machined step in the head mounting block.

5. Tighten the head mounting strap clamping the head in place.

6. Reconnect the head cables in proper position observing phasing (Fig. 24).

7. Replace Cartridge Hold Down Spring & Shield.

8. Check azimuth adjustment. Height and perpendicularity adjustments will not usually be affected by changing heads.

TAPE GUIDE ADJUSTMENT

CT2500B, CT3500B, and CT4500B cartridge tape units have three independently mounted tape guides to provide the maximum in tape guidance outside the cartridge.

Proper tape guide alignment is mandatory for optimum performance of cartridge tape units. The principal guide surface is the underside of the upper guide prong, because the tape is normally urged toward the upper guide by internal cartridge geometry.

To check and adjust tape guide alignment the following procedure should be carefully adhered to:

1. Using the tape guide height gauge (See Accessories) check the height of the underside of the uppermost prong of the tape guides. This surface should be .562 $\pm$ .001 from the mounting deck surface. (See Fig. 25.)

2. If necessary, loosen mounting screws slightly and adjust tape guides to this dimension.

NOTE: Some cartridge designs call for removal of tape guides. The guides can be removed at the discretion of the owner if it is desired to follow the cartridge manufacturers recommendations, however such removal is not recommended. If guides are removed the equipment may not perform to warranteed level of quality.

CARTRIDGE CORNER POST ADJUSTMENT

The head assembly includes three tape guides - the maximum number of tape guides which can be used with NAB type A cartridges. Even with carefully adjusted tape guides, the tracking of the tape as it passes across the recording and reproducing heads can be adversely affected by improper positioning of the corner post in most cartridges.

After the tape has been pulled up out of the center of the endless loop, the cartridge corner post must bring the tape down to the proper height to pass across the heads. If the corner post is too high, the tape will be traveling "downhill" as it encounters the first tape guide and recording head. By the time the tape reaches the reproducing head, it will normally be brought into the proper position; but, in the worse case, tracking across the reproducing head can also be adversely affected by an improperly positioned cartridge corner post.

For optimum results, the tape must travel in a perfect horizontal path through the tape guides and across the heads. When the tape travels "downhill", as in the example cited above, the azimuth positioning of the recording head would be different from that of the reproducing head.

Several cartridge manufacturers now offer cartridges with vernier adjustments for vertical positioning of the corner post. In older cartridges, proper position can be achieved by using a Tape Height Gauge available from cartridge manufacturers as shown in Figure 26.

1. Place the cartridge and the Tape Height Gauge on a flat surface and advance the gauge between the upper and lower edge of the cartridge corner tape guide. The gauge should advance between the flanges without friction while resting flat on the surface, but there should be no room for noticeable vertical movement of the gauge between the flanges.

2. If adjustment is required, remove the top from the cartridge and raise the upper portion of the corner post from the cartridge base.

3. Sparingly apply a small amount of a general purpose cement to the inside of the corner post mounting hole in the cartridge base.

4. Keeping the Tape Height Gauge flat on the surface, press the corner post into the base until the gauge fits snugly between the two flanges as shown in Figure 26.

5. Remove the excess cement and re-check the corner post positioning before replacing the top cover.

HEAD HEIGHT ADJUSTMENT

The magnetic tape head nearest the capstan shaft is head A, the reproducing head. Head B is the record head. On a Playback only unit, Head B is a "dummy" which is installed to maintain constant tension on the tape and minimize wow and flutter.

The adjustment procedure outlined below should be followed in positioning both the reproducing and recording heads. See Figure 21 for the location of the adjustment screws.

1. Loosen the Lock Screw L by turning it counter-clockwise approximately four complete turns.

2. Coarse Height: Adjust the Front Height Screw FH until the top of the upper head track (pole piece) is 9/16 of an inch above the deck surface.

3. Coarse Zenith: Adjust the Rear Height Screw RH until the face of the head is perpendicular with the surface of the deck. Position the Tape Height Gauge (or any gauge known to be square) on the deck surface and move it against the face of the head. The gauge used should be demagnetized before using for adjustment. Be careful to avoid scratching the face of the head. When the head is perpendicular, the face of the head and the "square" will be flush.

4. Fine Height and Zenith. This adjustment is made by using a strip of white "leader" tape or a piece of recording tape from which the oxide has been removed. (Shellac thinner, flux remover or a similar solvent will loosen the oxide which can then be wiped off the transparent base.) A test cartridge may also be used for this adjustment.

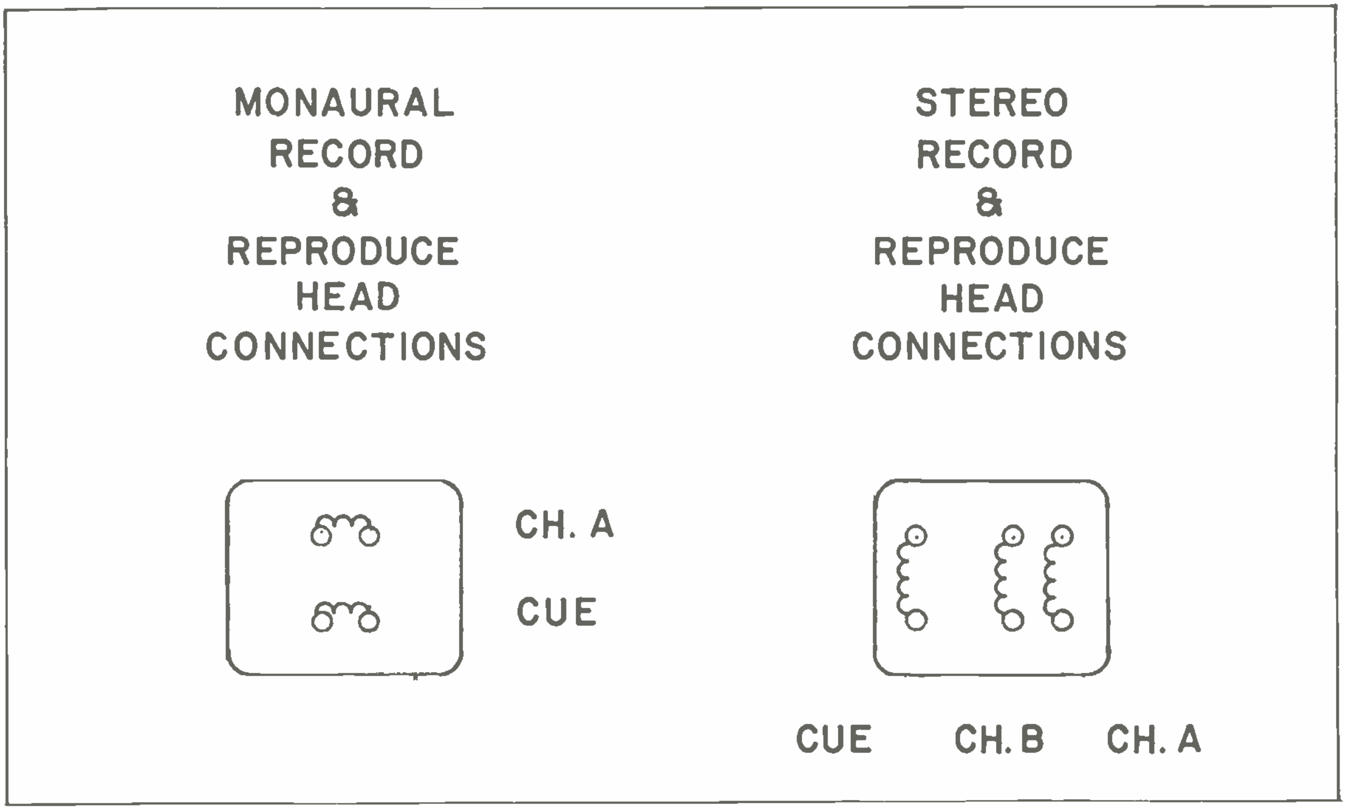


FIG. 24. Head Connections

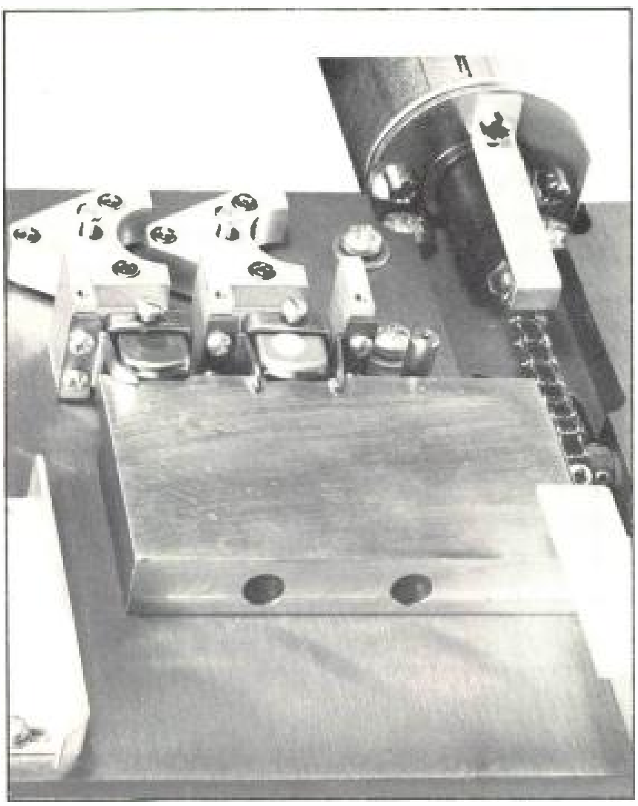


FIG. 25. Tape Guides

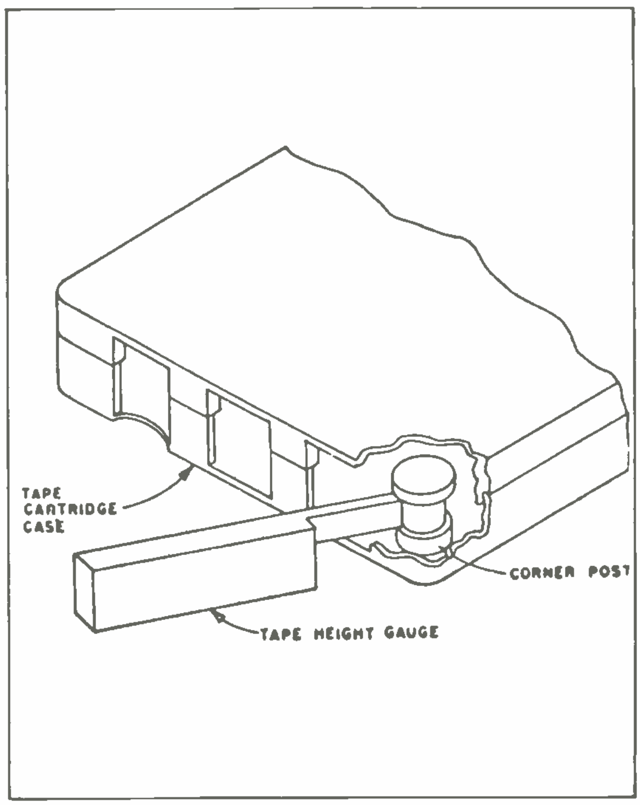


FIG. 26. Corner Post Adjustment

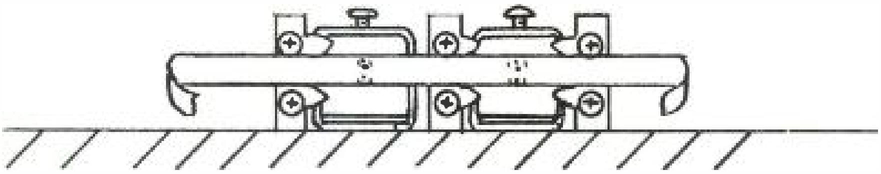


FIG. 27. Head Adjustments

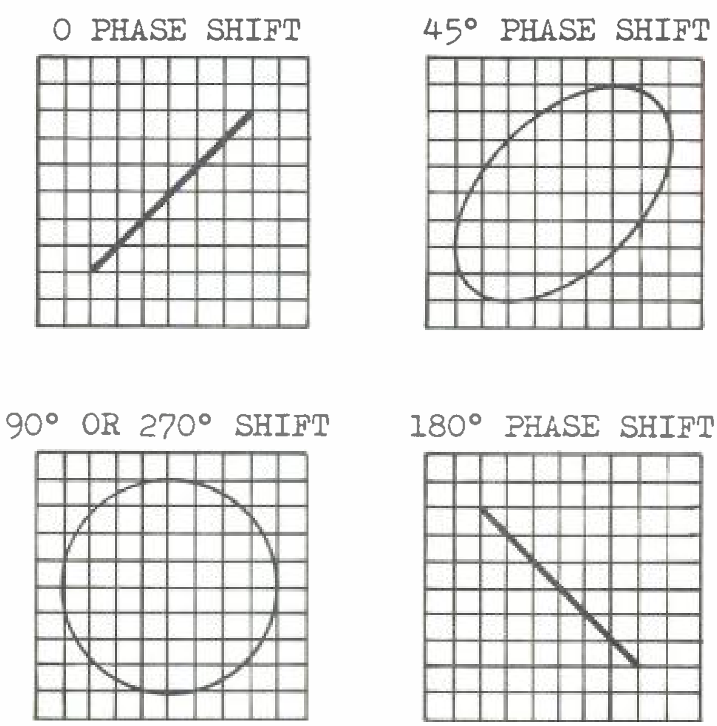


FIG. 28. Phase Shift Patterns

a. Position the transparent tape across the face of the heads as the tape would be positioned if a cartridge was being played. See Figure 27. Check to see that the tape is not being distorted (wrinkled) where it makes contact with the tape guides and attach it to one of the tape guide support blocks with adhesive tape to free one hand for adjustments.

b. Alternately adjust Height Screws FH and RH to position the top of the upper head track (pole piece) so that it is even with the upper edge of the tape, and to position the bottom of the lower head track (pole piece) so that it is even with the lower edge of the tape. Screws FH and RH should be adjusted by equal amounts in the same direction.

c. Re-check the zenith of the head as instructed in Step 3 above.

d. Remove the transparent tape.

MONOPHONIC HEAD AZIMUTH ADJUSTMENT

Before attempting these adjustments, insure that the mechanical adjustments of the tape guides and the adjustment of height and zenith of both the Record and Reproduce heads are correct.

1. Reproduce Head Azimuth Adjustment:

a. Connect a 600 ohm load to the output terminals. Connect a VTVM across this load.

b. Insert a 15 kHz Standard Azimuth Alignment Tape (See Accessories) and start the machine.

c. Adjust the azimuth screw A (refer to Figure 21 for location) of reproduce head to produce maximum output level.

d. Carefully tighten lock screw L, observing the VTVM to insure that no change in output level occurs.

2. Record Head Azimuth Adjustment: It is reminded that changes in azimuth to the Master Record head can result in azimuth errors in all the Reproduce machines within a system unless the resultant azimuth is carefully checked against each of these Reproducers. Any change of azimuth of the record head should be attempted ONLY AFTER all mechanical adjustments are carefully checked and the Master Reproduce head is aligned to the 15 kHz Standard Azimuth Alignment Tape as above.

a. Select an erased 3 1/2 minute cartridge which has had the corner post properly adjusted and is known to have consistently good operating characteristics.

b. Connect a 600 ohm load to the reproducer output terminals. Connect a VTVM across this load.

c. Connect an audio generator to the Recorder input terminals. Set the input and Record Level to -10 dBm and 15 kHz.

d. Start the Recorder and adjust the azimuth screw A on the record head to produce maximum output level.

e. Carefully tighten lock screw L, observing the VTVM to insure that no change in output level occurs.

STEREO SYSTEM HEAD AZIMUTH ADJUSTMENT

Two track stereo recording-reproducing results are subject to several contributing mechanical inaccuracies which can cause phase shift in simultaneously monitored reproducer outputs. In stereo systems these phase shifts are generally not perceptable in the final reproduction; however, in cases where monophonic "dubbing" or channel summing is desired, phase shifts can result in serious amplitude variations or drop-out at the higher frequencies. Most common of these problems are improper azimuth of the heads with respect to each other (record head to play head on any reproducer in a system) and improper tape guidance (skew) within either the cartridge or through the tape guide system

1. Master Reproduce Head Azimuth:

a. Connect 600 ohm loads to both left and right channel outputs. Connect a VTVM to the left channel output. Insert a FULL TRACK 400 Hz reference "O" level tape and start the machine. Set left playback gain control for a reference level output. Connect VTVM to right channel output and adjust Right Playback gain Control to the reference output.

b. Insert a 15kHz FULL TRACK azimuth alignment tape and carefully adjust playhead azimuth screw A for maximum reading on the VTVM. Observe the mechanical position of the azimuth screw.

c. Move the VTVM to the left channel output. Now move azimuth screw A a small amount in either direction and observe the VTVM reading as an increasing or decreasing output. Continue moving the screw in the direction that produces increasing output until a maximum reading is obtained.

d. Observe direction and amount that the screw was turned to obtain maximum reading on the left output with respect to the previous setting for maximum on the other channel. Set screw A to the mid-point between these settings to obtain AVERAGE azimuth for the two channels.

e. Connect the horizontal input of any scope so equipped to the right channel output. Insert a FULL TRACK FREQUENCY ALIGNMENT TAPE and start the machine. Adjust the horizontal gain, if provided on the scope to a suitable amplitude. Remove the horizontal input.

f. Connect the vertical input to the same right channel output and adjust the vertical gain to provide a deflection equal to that of the horizontal above.

g. Now connect the horizontal input to the left channel output. Run the tape to the 400 Hz section. A pattern such as Figure 28A should now appear. If not, reverse the two leads of the horizontal input. This pattern represents the "O" or near "O" phase shift pattern of the system.

h. Allow the tape to run to the 5kHz section and observe if phase shift has occurred. (Refer to figures 28B through 28D). If phase shift has occurred, adjust the azimuth screw A to correct this phase shift in the exact reverse rotation to which it has occurred. (This means that if the pattern was increasing clockwise from 0 shift as frequency increased, screw A should be turned in such a way to cause scope display to rotate CCW back to the "O" position)

i. Now allow the tape to continue through the various frequencies observing the scope display to insure that no 180° reversals occur. At 15kHz final adjustment of screw A can be made to provide best average phase shift. It is normal for shift "jitters" of several degrees to occur at the highest frequencies, so setting should be based on best results. It is desirable to run the tape several times, observing that phase reversals do not occur at any frequency. Tighten lock screw L and observe that no change occurs.

2. Master Record Head Azimuth:

a. Select a 3 1/2 minute cartridge that is known to have consistently good operating characteristics and proper adjustment of the corner post.

b. Connect a 15 kHz tone to both channel inputs on the recorder. (Observe phase relationship of these inputs.) Set the input and Record levels to -10 dBm.

c. Start the recorder and adjust the azimuth screw A on the record head for max mum amplitude of the display on the scope. (The scope gains may be adjusted in equal amounts to increase amplitude of the display if necessary).

d. Sweep the dial on the tone source slowly to 400 Hz and observe phase rotation on the scope display. If 180° reversals occur, adjust screw A (of the record head only) at 5 kHz to produce "O" phase shift. Repeat the 400 Hz to 15 kHz sweep and adjust as necessary to remove phase reversals and provide best average phase shifts at 15 kHz. Tighten lock screw L and observe that no change occurs.

3. Other Reproduce Head Azimuth: It is important to realize that all reproducers within a system must be azimuth aligned to the master recorder. To implement this it is necessary to prepare a test cartridge recorded on the master recorder each time any adjustment to this recorder is performed. This cartridge is in turn used to align EACH reproducer in the system, using the technique outlined in paragraph 1 above.

A useful test cartridge for this purpose can be made by recording white noise or FM interstation hiss in phase onto both tracks using the properly aligned master recorder. The resultant lissajous (XY Scope) display should be a narrow 45° line on a properly aligned reproducer. The advantage of the use of white noise is the simultaneous display of the entire audio frequency spectrum which prevents missing a midfrequency phase reversal and eliminating the visual jitter averaging required when using single frequency tones.

The white noise recording is also an efficient and effective technique for checking the phase tracking of cartridges prior to recording and for setting adjustable corner post cartridges.

ELECTRICAL ADJUSTMENTS

All electrical adjustments are accessable through the card cage dust cover. An insulated adjustment tool should be used to avoid accidental short circuits. Location of all adjustments is detailed in Figure 29.

REPRODUCE LEVEL ADJUSTMENT

To set the reproduce level, playback a 400 Hz test tape recorded at standard program level (See Accessories). Adjust the Ch. A Reproduce Level Control for the desired level output measured with an audio voltmeter across a 600 ohm load applied to J2 terminals 3 & 5 (Ch.B is J2-4 & 6). The adjustment range is 0 to +10 dBm at reference level and is factory set to +8 dBm.

On Recorder-Reproducers also calibrate the front panel VU meter for OVU at reference level playback by trimming the Ch.A Play Meter Calibrate pot. On stereo units Ch.A is the left hand meter. Repeat the adjustment procedure for Ch.B on stereo machines.

REPRODUCE EQUALIZATION ADJUSTMENT

The reproduce equalization must be standardized by adjustment to a standard frequency response test tape (See Accessories). Reproduce equalization must be adjusted prior to any Record equalization or bias adjustments and should not be attempted until the reproduce head has been properly aligned.

To adjust the reproduce equalization, connect a 600 ohm load to the reproducer Audio output terminals (Channel A J2-3 & 5, Channel B J2-4 & 6). Monitor the output with an external audio voltmeter or the panel VU meter. (Do not take measurements from the headphone jack when the headphones are connected as false response readings will result.) Note the meter reading when playing the lkHz reference level and adjust the channel A equalization pot to match this level exactly for the 15 kHz tone. Continue playing the test tape to make sure no readings deviate from the lkHz reference level by more than 2 db. Minor peaks and valleys in the response curve below lkHz are normal and are due to contour effects in the reproduce head. In addition a boost of as much as 2.5 db at 100 Hz may be noted when reproducing full track test tape on a mono or stereo machine or a half track tape on a stereo machine. This boost is normal and is due to fringing effects which are not present when reproducing the correct track width for the head in use. Repeat adjustment procedure for Ch.B of stereo units.

CUE DETECTOR ADJUSTMENT

There are no adjustments necessary for operation of the Cue Detector Circuits. The cue preamplifier accepts input signals having a 12 db range above and below the nominal level and converts all tones to constant amplitude square waves which are applied to the wide band tone detector circuits.

If a malfunction is suspected, the tone levels applied to the cue detector from the head may be easily checked by interchanging leads at the head to apply the cue track signals to a program channel input. The NAB cue tone output levels when reproduced through a NAB equalized playback channel, although not critical, should be approximately as follows:

400 Hz std reference level	=	Odb ref. = OVU
1000 Hz Stop Cue Tone	=	+ .4db
150 Hz End Cue Tone	=	+ 6.1db
8000 Hz Trip Cue Tone	=	-9.4db

External switched loads controlled by the cue detector outputs must be limited to .5 AMP maximum with an applied voltage between 0 and + 40 VDC. External lamp loads should utilize 28 VDC, 40 ma lamps.

BIAS LEVEL ADJUSTMENT

When setting the bias levels there exist conflicting requirements. A high bias level is desirable for lowest distortion recording while a lower bias reduces self erasure of high frequencies and thereby improves frequency response. The method of adjustment which follows provides an optimum balance between these requirements.

In order to avoid erroneous results due to tape saturation, all high frequency recording tests should be run with a record level approximately 10db below zero VU reference level. In the following test the panel VU meter may be used to select this level if the Record VU meter calibration pot has not been misadjusted. If the calibration of the Record VU meter is in doubt a rough setting of "O" VU prior to bias adjustment can be achieved by setting the meter switch to "PLAY ONLY", and applying a 1kHz input from an. audio generator to the Record Amplifier input (ChA-J4 terminals 3 & 5, ChB-J4 terminals 4 & 6). Set the front panel Record level controls to the 12 o'clock position and apply sufficient 1kHz input from the generator such that a tape recorded at this level will play back at -10 VU.

To set the bias levels, connect an audio generator to the Record Amplifier inputs and a loaded audio voltmeter to the Reproducer output. Insert an erased 3 1/2 minute cartridge, operate the Record panel switch and set the generator input for 10 kHz at a record level of -10 VU indicated on the panel VU meter. Press the START switch and slowly adjust the CHANNEL A BIAS LEVEL potentiometer until a peak is noted on the output meter. Note the meter reading and advance the bias level control clockwise until the level drops by 4db from the peak.

Repeat this procedure for Channel B on stereo units.

The cue bias level adjustment is not critical and may be made usually by adjusting the Cue Bias Potentiometer to the same position as the channel A bias control. For a more precise adjustment interchange playback head leads to apply cue signals to a properly adjusted program channel input, adjust cue bias to match cue playback levels to those called out on Page 43 (Cue Detector Adjustment).

RECORD LEVEL

Adjust the reproduce level as previously described. Connect an audio generator to the Record Amplifier input (Ch.A J4 terminals 3 & 5, Ch.B J4 terminals 4 & 6). Adjust generator frequency and record level such that a recorded cartridge will play back at the same level & frequency as the standard reference level band on the test tape. Adjust the flat and equalized Ch.A & B Record VU meter calibration controls for O VU on the panel meter when in Record mode.

When this method is used to set the level indicated by O VU, the level will match that used for O VU by all major U.S. manufacturers of professional tape equipment. However, on the CT3500B & CT4500B this level will typically measure in excess of 10 db below the 3% distortion level, therefore, the user may drop the level indicated by the VU meter by 2 to 4 db yielding an equivalent increase in signal to noise ratio.

RECORD EQUALIZATION ADJUSTMENT

Before attempting to adjust the Record equalization the reproduce equalization, bias level & record level adjustments must be properly set.

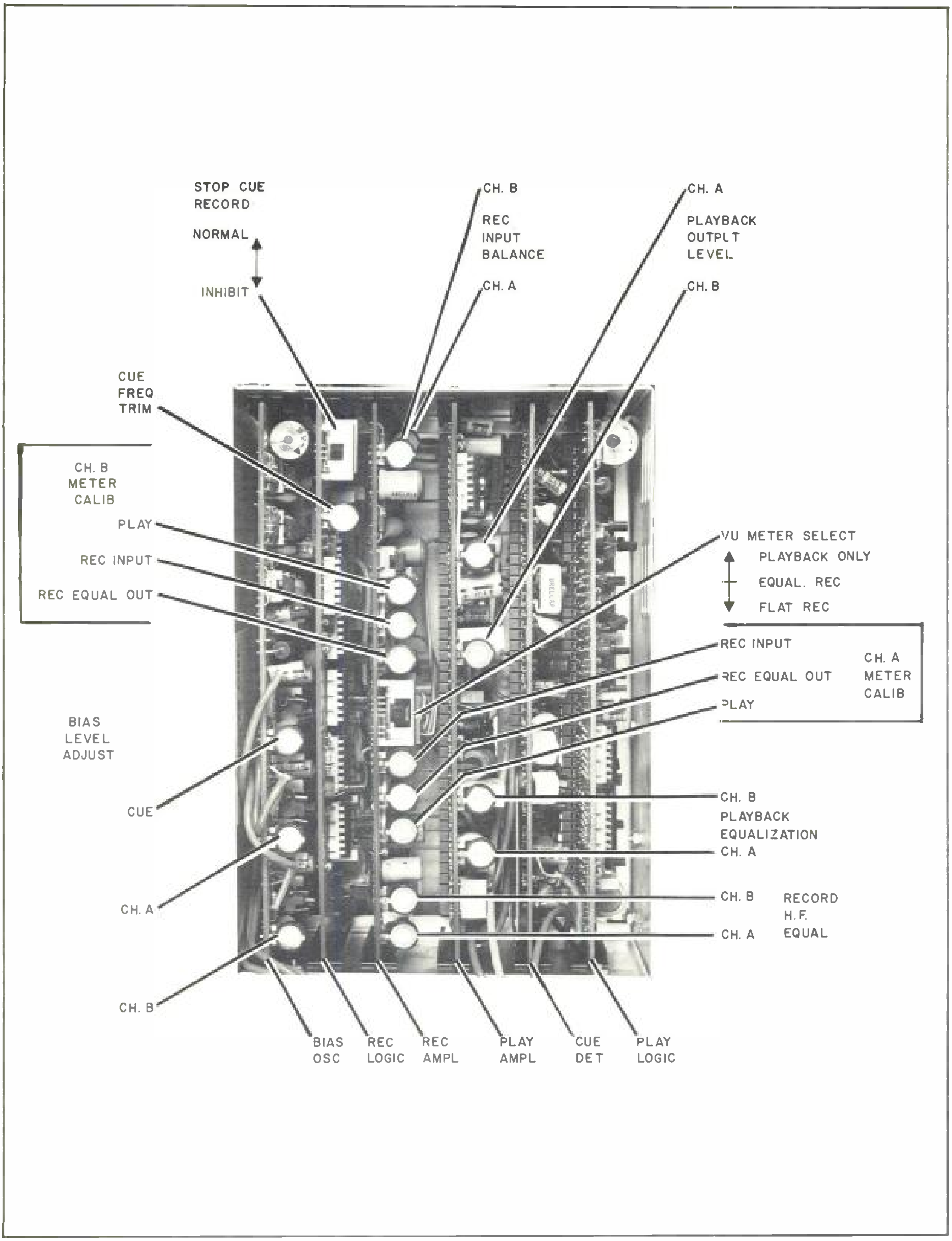


FIG. 29. Electrical Adjustments

To adjust the record equalization connect an output voltmeter and rated load to the reproducer output terminals (Channel A J2-3 & 5, Channel B J2-4 & 6). Connect an audio generator to the Record Amplifier input terminals (Ch.A J4-3 & 5, Ch.B J4-4 & 6). Record onto Channel A of a blank tape a 700 Hz sine wave at an indicated -10VU on the front panel VU meter. Note the 700 Hz Reproducer output level on the external meter. Increase the oscillator frequency to 15 kHz while maintaining input level constant. Adjust the Channel A Record Equalization control to match the 15 kHz Reproduced output to the 700 Hz output. Sweep the oscillator slowly from 30 Hz to 20 kHz to verify that the Record-Reproduce frequency response is within specification limits. Repeat equalization adjustments for Channel B on Stereo units.

CUE GENERATOR FREQUENCY

Adjustment of the cue generator frequency need not be performed as part of regular maintenance. Adjustment will be required only if the cue generator integrated circuit (Z1U2 on the Record Logic Board) or its associated timing capacitors (Z1C2, Z1C3, or Z1C4) are replaced. The equalized cue generator output is available on pin 43 of the Record Logic Circuit Board. The cue frequency can be measured visually using a calibrated scope time base, forming a Lissajous pattern display utilizing a scope with an external generator feeding the horizontal sweep input or more simply with a frequency counter. If it is necessary to increase the pulse duration of the Stop Cue burst for measurement purposes, temporarily clip a large electrolytic capacitor across the 39 mfd. timing capacitor observing polarity. Parallel Z1C13 when measuring and adjusting the 1kHz Stop Cue. A parallel 150 mfd/10VDC capacitor will produce a 2.5 second pulse which should be adequate for measurement.

The relationship of the End Cue and Trip Cue frequencies to the Stop Cue frequency is determined by fixed capacitor values. If the frequency of the End Cue or Trip Cue is found to be out of NAB specifications after adjusting the Stop Cue to 1kHz it is an indication of an out of tolerance component either Z1-C2A, C2B, C3 or C4.

Frequency limits are 1kHz $\pm$ 50 Hz, 150 Hz $\pm$ 8 Hz and 8kHz $\pm$ 400 Hz.

TEST CARTRIDGE MAINTENANCE

Preventative maintenance should be performed on a regular schedule. A primary standard test cartridge is required and is available from NAB.

Under regular usage the high frequency response of the test tape will be gradually degraded. Proper handling & storing of tape, avoidance of magnetic fields, cleaning and demagnetization of heads & tape guides before use will all help to reduce signal loss. The best method of preserving a Standard Test Cartridge is to record a number of secondary Standard Test Cartridges from a machine properly aligned using the Primary Standard Cartridge and use these secondary standards for normal maintenance. They should be compared with the Primary Standard Test Cartridge on a regular schedule and replaced when significant high frequency losses are noted.

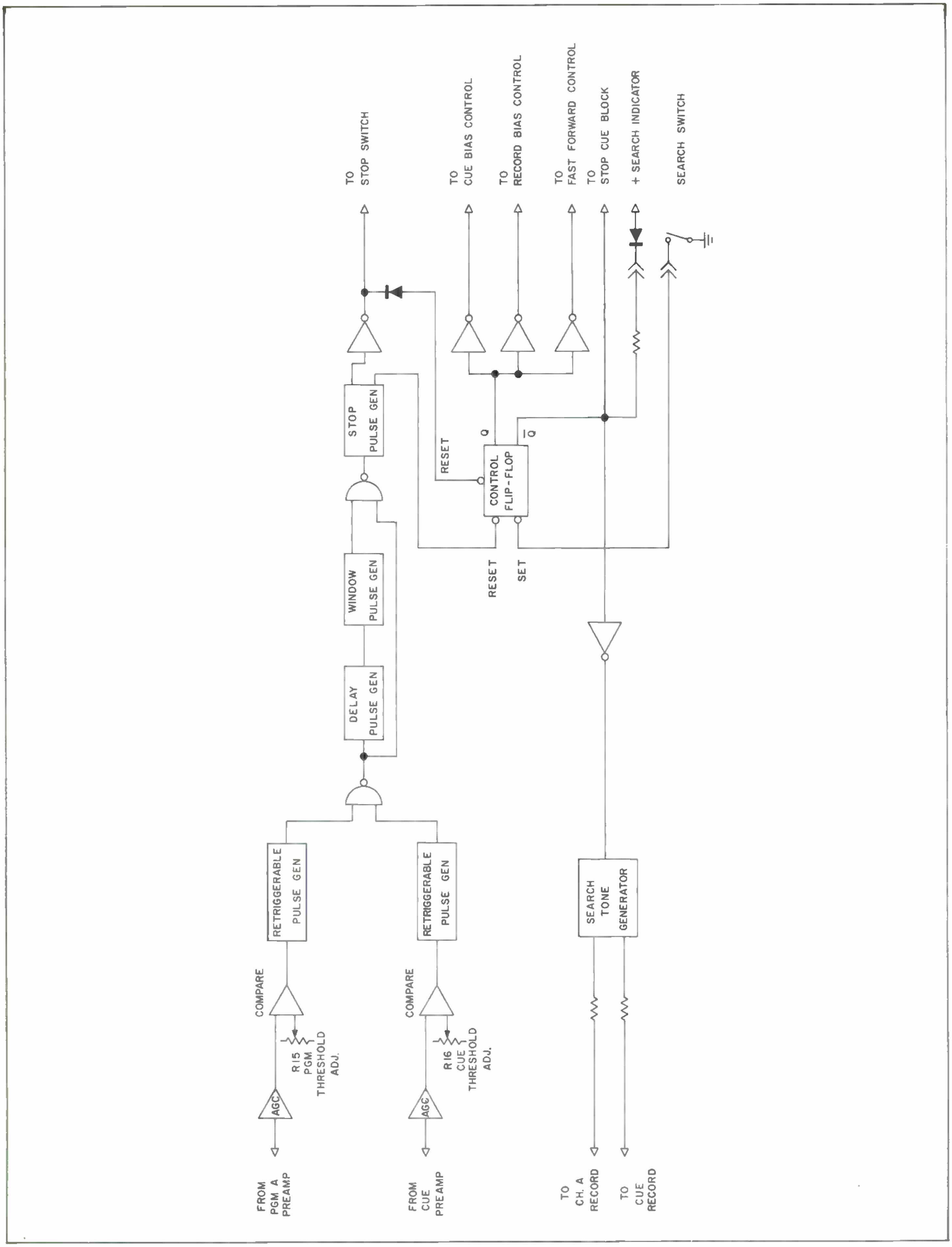


FIG. 30. Splice Finder Block Diagram

SECTION VI

ESF-2 SPLICE FINDER

GENERAL

The ESF-2 SPLICE FINDER is an optional, factory installed, all electronic system for locating and properly positioning the tape splice prior to recording new information on a cartridge. The ESF-2 is a valuable production tool for upgrading and maintaining high quality cartridges by automatically positioning the tape splice just past the playback head where it is least likely to be heard later in the recorded program.

The ESF-2 consists of a printed circuit assembly and connector mounted on the inside right hand side plate of the cartridge machine just behind the front panel. Test points and adjustments are accessible by removing the bottom cover plate of the cartridge machine.

OPERATION

1. Insert cartridge to be searched into machine. Cartridge need not be pre-erased.

2. Press down and hold the momentary splice search toggle switch, the SEARCH indicator will light.

3. While holding splice switch also press and release green start push button. Tape will start and accelerate to high speed.

4. Continue holding search switch until tape has reached maximum speed and then release (5 - 6 seconds).

5. When tape stops, look for splice positioned between the playback head and pinch roller cutouts of the cartridge. If not visible repeat search.

6. When splice is located, bulk erase cartridge and proceed with the recording of new program material.

7. The Splice Search operation can be reset at any time by operating the STOP switch.

NOTE: Simultaneous recorder audio inputs during Splice Search will interfere with proper operation of the splice detector. Remove record audio input feed or turn Record Level controls to minimum.

Theory of Operation

The reliable detection of splices is a difficult engineering problem. A well-made, new splice will be completely inaudible and practically undetectable electrically. Only with age, usage, heat, etc. does the splice deteriorate and become audible. It is very necessary, however, to detect this new, perfect splice and position it just ahead of the beginning of the recorded program where it is least likely to be heard during playback several months in the future when the splice has spread apart, curled up, frayed, etc., becoming a distinctly audible ''plop''.

The all electronic technique used in the Ampro ESF-2 splice finder is capable of detecting approximately 90% of a random sampling of new splices with a minimum of false stops. The all electronic system is inherently stable and will not require readjustment except to compensate for gross head wear.

The ESF-2 records a 16 Khz search tone onto both the channel A and cue tracks (see Fig. 30) while the tape is running in the fast forward mode at three times normal speed. These search tones can be recorded directly over old program material, therefore it is not necessary to erase the cartridge prior to splice search. Immediately after recording, the playback circuits pick up the two search tones, amplify them in slow release AGC amplifiers and apply them to the splice finder logic. The splice finder compares the incoming 16 Khz signals from the two tracks with individual pre-set reference levels. If the 16 Khz tone in either track drops below the set reference, a dropout is noted. The reference level is normally set approximately 3 to 6 db below the normal input level, since a good splice may only produce a 10 db reduction in level.

The detection of the first dropout on either of the two tracks starts a logic timing cycle which opens a timing window at a subsequent time corresponding to the expected dropout on the other track as the trailing edge of the 45° splice passes the second gap. If a dropout occurs on the other track during the window, a splice is registered and a stop command given to the control logic of the cartridge machine. If a second dropout does not occur during the timing window, the logic is reset, no stop command is given and the tape continues to run.

The use of automatic gain control amplifiers in each playback signal path compensates for all normal variations in playback level due to high or low output tape oxides, bias adjustments, playback head condition, azimuth settings, etc. and allows the dropout detection thresholds to be set very close to the nominal playback level for reliable splice detection.

The time discrimination provided by the logic eliminates the majority of false stops due to random dropouts, however well used cartridges having badly worn tape or pressure pads will product excessive dropout detection which statistically will sometimes occur in a time relationship which will trigger the splice detector stop command.

Cartridges which cause multiple false stops should be replaced or reloaded.

ADJUSTMENTS

The ESF-2 is factory adjusted empirically to provide optimum performance on a wide range of new, average and well used cartridges. This adjustment requires a compromise between missed splices on new carts and excessive dropout detection on badly worn tape and is generally set to detect a level decrease of between 3 to 6 db. If your station is afflicted with large quantities of cartridges in poor condition a reduction in false dropout stops can be achieved by resetting the threshold to 12 db below nominal level (1/4 voltage) with a resulting slight increase in the number of missed splices. If you generally maintain your cartridges in good condition and replace tape at regular intervals, a decrease in the number of missed splices can be achieved by adjusting the thresholds up to approximately 3 db below nominal level (.7 Voltage). A slight increase in the number of false stops due to oxide dropouts may result.

To readjust the thresholds, connect a D.C. coupled oscillosocope to Test Point 1 (TP1) which is the output of the PGM A AGC preamp. Start tape in the search mode (if tape stops erratically hold down Search Switch to force continuous operation wh le making adjustments). The waveform at TP1 should be approximately a 14V p-p, 16 khz unclipped sine wave signal swinging around a +12 VDC reference voltage. To determine the desired comparator set point measure the actual peak positive swing above the reference voltage at TP1, multiply this value by .7 for -3db set point, .5 for -6 db, or .25 for -12b, and add the resultant number to the actual reference voltage measured at TP1 under no signal conditions.

To illustrate, suppose we measure at TP1 a reference voltage of +12.5 VDC with no tape running. Operating the Search and Start switches we measure a 16 Khz signal swinging from +18.5V to +5.5V, (+6, -7V around reference, slight assymetry is normal). If we wish a -3db threshold setting we multiply the +6V positive peak by .7 = +4.2 Volts and add this number to the reference voltage of +12.5 resulting in a desired setting of R15 measured at TP2 of 4.2 + 12.5 = 16.7 Volts DC. Transfer scope to TP2 and adjust R15 for a measurement of +16.7V.

Repeat this procedure for the cue channel measured at TP3 & TP4 respectively.

It is necessary that the 16 Khz signals applied to the comparators be unclipped. Clipped signals measured at TP1 & TP3 may be due to incorrect AGC action in the preamp stages of the splice detector or saturation of the tape due to low bias adjustment.

FIG. 31. Maintenance Cartridges

SECTION VII

ACCESSORIES

GENERAL

This section lists the available accessories for use with the CT2500B, CT3500B and CT4500B Series Tape Cartridge Systems.

TEST TAPE CARTRIDGES

AZIMUTH ALIGNMENT & FREQUENCY RESPONSE TAPE

A special test tape cartridge is available for checking head azimuth alignment, level adjustments and frequency response. The test tape is loaded in a 350 series cartridge and has a playing time of approximately 3 minutes.

Ordering information: Test tape, Azimuth-Frequency response - 9240-1

HEAD CLEANER CARTRIDGE

Provides 20 seconds of automatic, programmed head cleaning and conditioning. At the end of the cycle, a pre-recorded 1000 Hz cue tone stops the tape.

SPECIFICATIONS

Cleaning and Conditioning Program (20 seconds total):

Mild Abrasive Action (silicon carbide) . 5s
Head Lubrication 5s
Head Polishing 5s
Final Head Lubrication 5s
Automatic Stop. Pre-recorded cue tone

ORDERING INFORMATION

Head Cleaner Cartridge - 9241-1

TORQUE-TEST CARTRIDGE

Valuable in determining and adjusting the tape-pulling torque of cartridge-tape machines, the Torque-Test Cartridge fits into the machine in the normal manner. As the capstan and pinch roller pull tape, the force is displayed on a calibrated scale in the cartridge. If the pulling force is more or less than the 1.5 lb. NAB spec., the pinch roller pressure should be re-adjusted.

ORDERING INFORMATION

Torque-Test Cartridge - 9242-1

SPEED - TEST CARTRIDGE

The Speed-Test Cartridge contains 50 Hz and 60 Hz strobe discs that indicate the speed accuracy of cartridge-tape machines when viewed under the supplied strobe lamp (lamp for 115 volt operation only).

ORDERING INFORMATION

Speed-Test Cartridge (50 and 60 Hz) - 9243-1

REMOTE CONTROL PANELS

The Remote Control Panels provide convenient means for operating from one to four cartridge-tape playback units via connector directly to the playback units. Four momentary "Start" pushbuttons are mounted on an aluminum panel for control of up to four playback units.

ORDERING INFORMATION

Remote Panel, 9519-501 4 Play - Fig. 33

Remote control of a single record/playback cartridge tape system is provided by another Remote Control Panel. Parallel operational functions of the system are controlled to the remote control panel with its five pushbutton switches, labeled "Start", "Stop", "End", "Trip" and "Record".

ORDERING INFORMATION

Remote Panel, Record - 9520-501 See Figure 34

RACK & DESK TOP MOUNTING ACCESSORIES

A rack shelf is available for the mounting of all models in a standard 19" rack. Captive screws are provided to lock the units in place and attractive Rack Shelf Fill Panels are available for instances where the full capabilities of the rack shelf are not utilized.

Rack Mount Kit 9135-501
Rack Shelf Fill Panel 1/3 width 9521-1
Rack Shelf Fill Panel 1/2 width 9522-1

For Desk-Top mounting, a handsome wrap-around housing is provided along with four rubber suction cup feet. The rubber feet provide a shock and vibration absorbing mount and hold the unit securely to the desk to prevent "vibrational walking".

Desk-Top Cabinet for:

CT2500B 9523-501
CT3500B 9523-502
CT4500B 9523-503

MODULE EXTENDER BOARD [See Figure 32]

An extender board is available to facilitate trouble-shooting and maintenance of the printed circuit boards contained in the units. The printed circuit board to be extended is removed from the main chassis and the module extender board is put in its place. The printed circuit board is then plugged into the module extender board and, in effect, the printed circuit board is extended a full length above the main chassis.

ORDERING INFORMATION

Extender Board Assembly - 9216-501

ALIGNMENT TOOL KIT

A tool kit consisting of a tape guide height and perpendicularity gauge and a capstan shaft gauge is available for ease of mechanical adjustments. The first gauge is used to set the height of the tape guides on the unit, the perpendicularity of tape guides and heads, and can also be used as a rough adjustment for setting head heights. The second gauge is used to set the relationship between the capstan shaft and the pressure roller assembly to achieve maximum torque with minimum wow and flutter.

ORDERING INFORMATION

Tool & Gauge Kit - 9217-501

HIGH LEVEL INPUT TRANSFORMER

A high level input transformer is available for applications where the audio input lines have exceptionally high common mode noise, hum or transients present. Two units are required for stereo inputs.

ORDERING INFORMATION

High Level Input Transformer - 9230-501

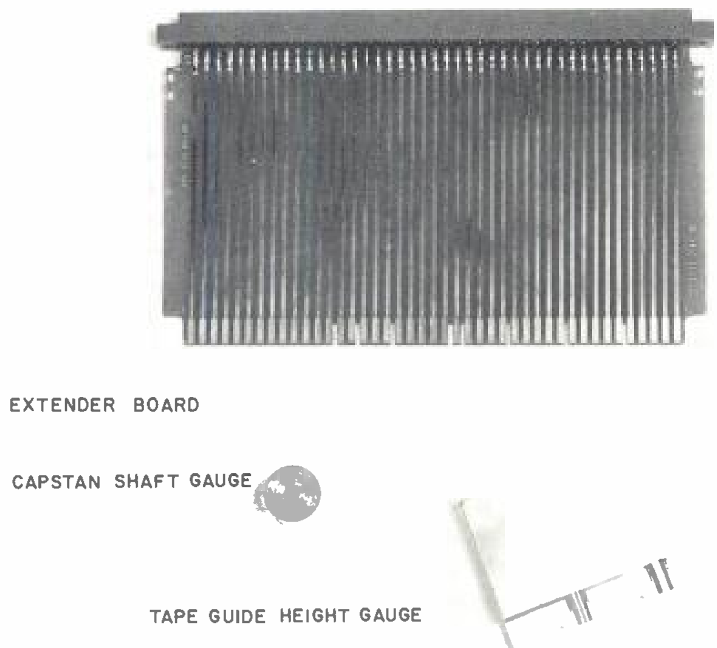


FIG. 32. Maintenance Tools

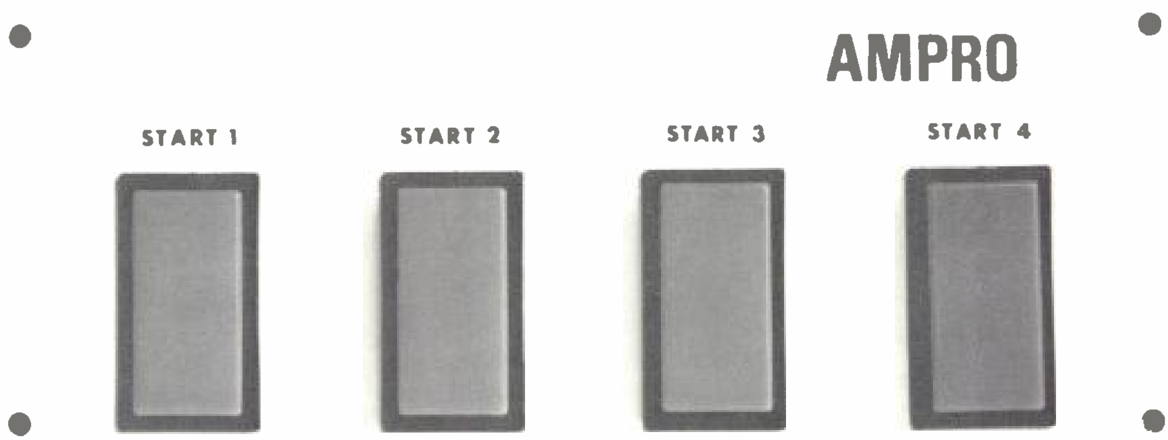


FIG. 33. Remote Panel, 4-Play

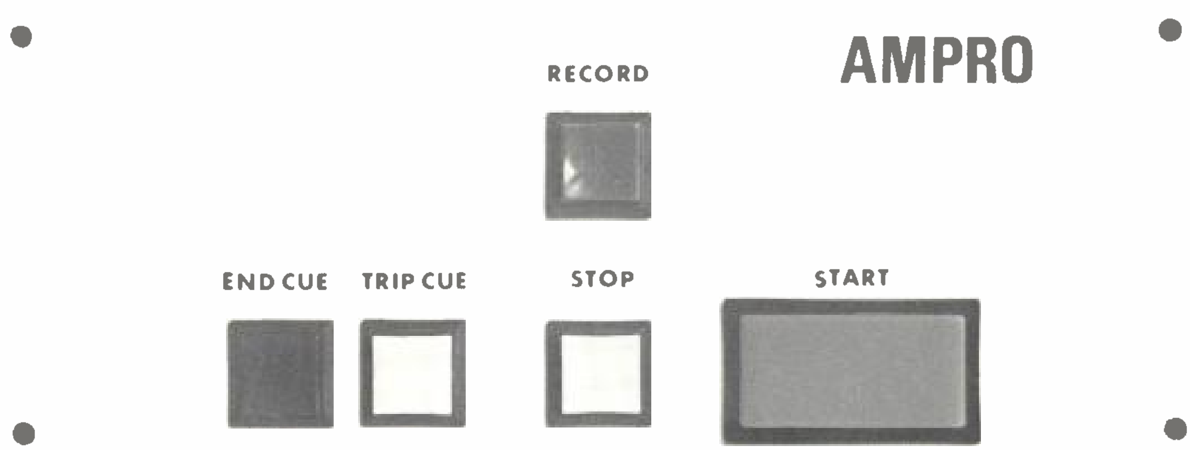


FIG. 34. Remote Panel, Record

INDEX OF MANUFACTURERS

FSC	MFR. NAME AND ADDRESS
01121	Allen-Bradley Co.;1201 2nd St. South; Milwaukee, WI 53204
01295	Texas Instruments Inc.; Semiconductor-Components Div.; P. O. Box 5012, 13500 N. Central Expressway; Dallas, TX 75222
03911	Clairex, 1239 Broadway, New York, N.Y. 10001
04713	Motorola Inc.; Semiconductor Products Div.; 5005 E. McDowell Roac; Phoenix, AZ 85008
04880	Arrow Electronics Inc.; 900 Route 110; Farmingdale, NY 11735
06540	Amatom Electronic Hardware Div. of Mite Corp.; 81 Rockdale Ave.; New Rochelle, NY 10802
07150	Electro-Mech Components Inc.; 1826 N. Floradale South; El Monte, CA 91733
07263	Fairchild Semiconductor; A Div. of Fairchild Camera and Instrument Corp.; 464 Ellis St.; Mountain View, CA 94040
09019	General Electric Co.; Semi-Conductor Products Dept.; Carrol Ave.; Lynchburg, VA 24502
09353	C and K Components, Inc.; 102 Morse St.; Watertown, MA 02172
18324	Signetics Corp.; 811 East Argues Ave.; Sunnyvale, CA 94086
18714	RCA Corp., Solid State Div.; Crestwood Road; Findlay, OH 45840
23783	British Radio Electronics Ltd.; 1742 Wisconsin Ave. N.W.; Washington, DC 20007
24759	Lenox-Fugle Electronics, Inc.; 100 Sylvania Place South; Plainfield, NJ 07080
27014	National Semi-Conductor Corp; 2950 San Ysidro Way; Santa Clara, CA 95051
27926	Ampro Corp.; 850 Pennsylvania Blvd.; Feasterville, PA 19047
31433	Union Carbide Corp.; Electronics Div. Components Dept.; Greenville, SC
31533	Ashland Industries, Inc.; Hwy. 13 South, P.O. Box 47, Ashland, WI 54806
32293	Intersil Inc.; 10900 N. Tantau Ave.; Cupertino, CA 95014
56289	Sprague Electric Co.; North Adams, MA 01247
71744	Chicago Miniature Lamp Works; 4433 Ravenswood Ave.; Chicago, IL 60640
71785	Cinch Mfg. Co.; Div. of TRW Inc.; 1501 Morse Ave.; Elk Grove, Village, IL 60007
72421	Sigma Instruments Inc.; Fisher-Pierce Div.; 170 Pearl St. South; Braintree, MA 02185
72928	Gudeman Div. of the Gulton Industries Inc.; Chicago, IL
72982	Erie Technological Products Inc.; 644 W. 12th St.; Erie, PA 61512
74840	Illinois Condenser Co.; 1225 W. Belmont Ave.; Chicago, IL 60657
75042	I R C Div. of TRW Inc.; 401 N. Broad St.; Philadelphia, PA 19108
75915	Littlefuse Inc.; 800 E. Northwest Hwy.; Des Plaines, IL 60016
82389	Switchcraft Inc.; 5555 N. Elston Ave.; Chicago, IL 60680
84830	Lee Spring Co Inc.; 30 Main St.; Brooklyn, NY 11201
86928	Seastrom Mfg. Co. Inc.; 701 Sonora Ave.; Glendale, CA 91201
90201	Mallory Capacitor Co.; 3029 East Washington St., P.O. Box 372, Indianapolis, IN 46206
93790	Cornell-Dubllier Electronics Div. Federal Pacific Electric Co.; 1605 Rodney French Blvd.; New Bedford, MA 02741
95146	Alco Electronics Products Inc.; P.O. Box 1348, 3 Walcott Ave.; Lawrence, MA 01843

Section VIII

PARTS LISTING

Schematics

P.C. Board Drawings

PANEL AND CHASSIS COMPONENTS

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
S1	Switch, Power	09353	7101P
S2	Switch. Start	07150	73-330
S3	Switch. Fast Forward	09353	7207P
S4	MTD On Deck Assembly		
S5	Switch Stop (Yel)	82389	LUS-08-1
S6	Switch, End Cue (Blu)	82389	LUS-04-1
S7	Switch, Trip Cue (Wht)	82389	LUS-05-1
S8	Switch, Record (Red)	82389	LUS-01-1
DS1	Not Used		
DS2	Bulb	71744	CM 327
DS3	Not Used		
DS4	Not Used		
DS5	Bulb	71744	CM7-7327
DS6	Bulb	71744	CM7-7327
DS7	Bulb	71744	CM7-7327
DS8	Bulb	71744	CM7-7327
M1	Meter VU	27926	9051-1
M2	Meter VU	27926	9051-1
R1	Resistor Variable, 10K	01121	70AIN048P103A
R2	Resistor Variable, 10K	01121	70AIN048P103A
	Knob		
C1	Capacitor, 2000ufd, 50V	93790	BR2000-50
C2	Capacitor Mylar, .33uf. 100V	23783	1R3X31717
C3	Capacitor, Electrolytic, 80uf, 250V	93790	BB0270A
C4	Capacitor, Electrolytic, 80uf, 250V	93790	BB0270A
C5	Capacitor Oil	93790	KKX66P105
C6	Capacitor Disc, .02uf, 1000V	56289	5GA-S20
CR1	Diode	01295	1N4004
CR2	Diode	01295	1N4004
Q1	Regulator, +24VDC	04713	MC7824CP
T1	Transformer, Power	27926	B9047-1
T2	Transformer, Audio	27926	B9048-1
T3	Transformer, Audio	27926	B9048-1
R1	Resistor, 75 ohms, 5 1/4W, 5%	75042	7431 PW-5
R2	Resistor, 75 ohms, 5 1/4W, 5%	75042	7431 PW-5
R3	Resistor, 6K, 5W, 10%	75042	7342 PW-5
R4	Resistor, 1.2K 2W, 5%	01121	RC42GF122J
F1	Fuse 1A	75915	3AG 1A
F2	Fuse 1A	75915	3AG 1A
J1A	Connector	71785	S315DB
J1B	Connector	71785	S324DB
J2	Connector	71785	S306DB
J3	Phone Jack	82389	N112B
J4	Connector	71785	P-306DB

MOUNTING DECK PARTS

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
	Motor	27926	C9026-1
	Mounting Plate A size	27926	D9054-1
	Mounting Plate B size	27926	D9027-1
	Mounting Plate C size	27926	D9056-1
	Bearing	31533	NG-2
	R. H. Cartridge Guide	27926	A9045-2
	Spacer. Micro Switch	06540	9207-B115
	Cartridge Guide, Movable	27926	A9036-1
S4	Micro Switch	27926	A9263-1
	Playback Head Mono	27926	A9103-1
	Playback Head Stereo	27926	A9102-1
	Record Head Mono	27926	A9086-1
	Record Head Stereo	27926	A9085-1
	Dummy Head	27926	A9115-1
	Cartridge Retaining Spring	27926	A9033-1
	Magnetic Shield	27926	A9238-1
	Guide Post	27926	A9030-1
	Tape Guide R.H. & Mid	27926	A9031-1
	Tape Guide L.H.	27926	A9032-1
	HD. MTG. Clamp	27926	A9029-2
	HD. MTG. Block	27926	B9028-1
	Pressure Roller Assembly	27926	PL9568-501
	Pressure Roller	27926	9571-1
	Pressure Roller Stud	27926	9569-1
	Teflon Washer	86928	5612-34-31
	Compression Spring	84830	LC-029C-5SS
	Solenoid	27926	A9050-1
	Roller Chain	27926	A9209-1
	Extension Spring	84830	LE-026C
	Chain Bushing	27926	A9038-1
	Pressure Roller Shaft	27926	A9114-1
	Motor Shield	27926	A9044-1
	Nylon Washer	86928	5606-16-31
	Plunger Retainer	27926	A9530-1
	Chain Stud	27926	A9053-1
	Solenoid Spacer	27926	A9052-1
CR3	Diode	01295	1N4004
R5	Resistor	01121	RC20GF821J

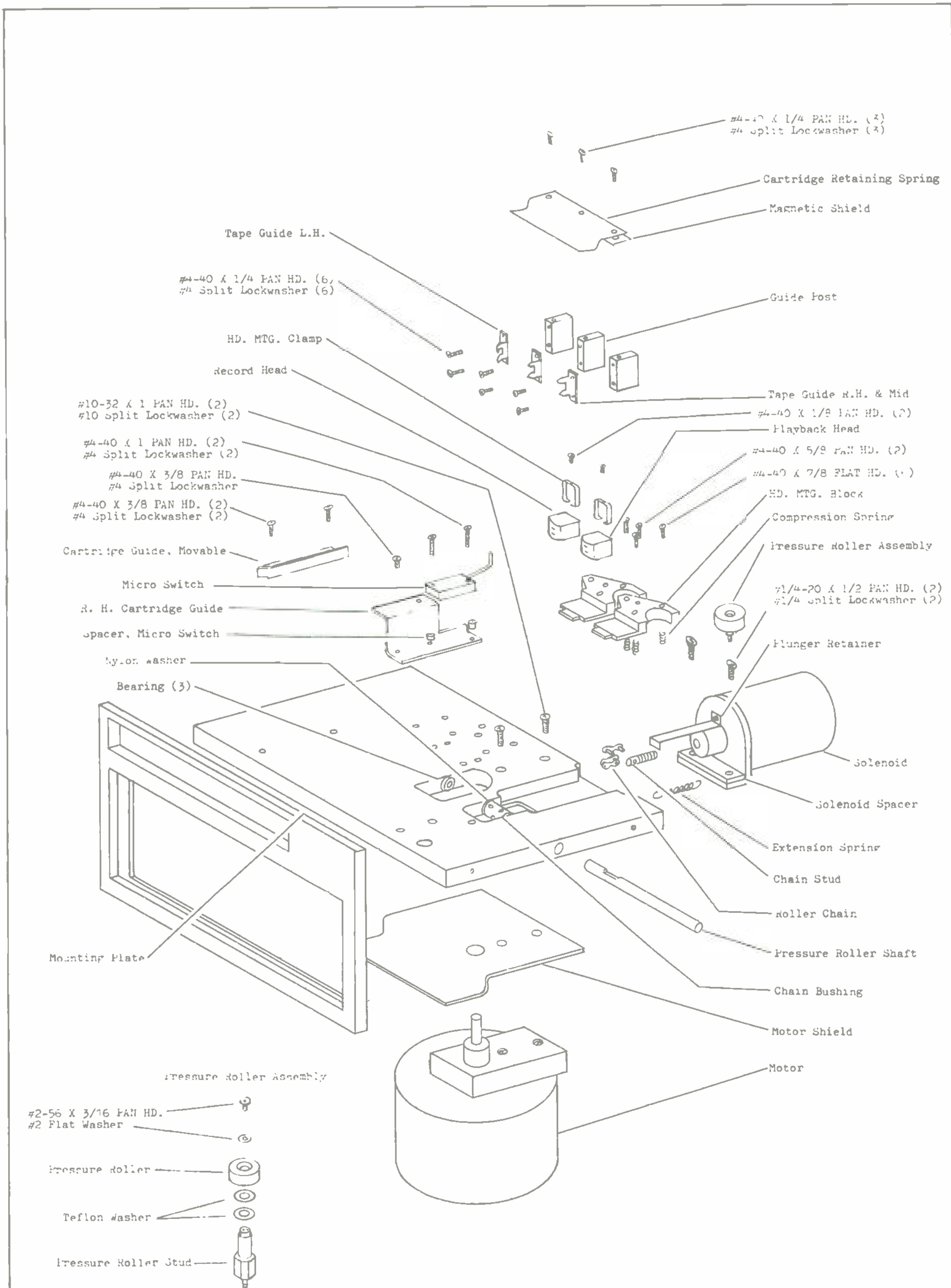


FIG. 35. Transport Exploded View

REPRODUCE LOGIC CIRCUIT BOARD
ASSEMBLY NO. PL9088 REV. H

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1C1	Capacitor Electrolytic, 47uf, 16V R	74840	
Z1C2	Capacitor Electrolytic, 50uf, 10V R	74840	
Z1C3	Capacitor Electrolytic, 220uf, 50V T	74840	
Z1C4	Capacitor Electrolytic,1000uf, 15V T	74840	
Z1C5	Capacitor Tantalum, 4.7uf, 10V	90201	CS13BC475K
Z1C6	Capacitor Tantalum, 4.7uf, 10V	90201	CS13BC475K
Z1C7	Capacitor Mylar, .1uf, 100V	23783	1R3X31624
Z1C8	Capacitor Electrolytic, 47uf, 6.3V R	74840	
Z1C9	Capacitor Tantalum, 4.7uf, 10V	90201	CS13BC475K
Z1C10	Not Used		
Z2C1	Capacitor Electrolytic, 1uf, 10V R	74840	
Z2C2	Capacitor Electrolytic, 4.7uf, 16V R	74840	
Z2C3	Capacitor Electrolytic, 4.7uf, 10V T	74840	
Z3C1	Capacitor Electrolytic, 10uf, 35V R	74840	
Z1CR1	Diode	01295	1N4148
Z1CR2	Diode	01295	1N4148
Z1CR3	Diode	01295	1N4148
Z1CR4	Diode	01295	1N4148
Z1CR5	Diode	01295	1N4148
Z1CR6	Diode	01295	1N4148
Z1CR7	Diode	01295	1N4004
Z1CR8	Diode	01295	1N4004
Z1CR9	Diode	01295	1N4004
Z1CR10	Diode	01295	1N4004
Z1CR11	Diode	01295	1N4004
Z1CR12	Diode	01295	1N4004
Z1CR13	Not Used		
Z1CR14	Diode	01295	1N4004
Z1CR15	Diode	01295	1N4004
Z1CR16	Diode	01295	1N4734A
Z1CR17	Diode	01295	1N4734A
Z1CR18	Diode	01295	1N4004
Z1CR19	Diode	01295	1N4004
Z1CR20	Diode	01295	1N4004
Z1CR21	Diode	01295	1N4004
Z1CR22	Diode	01295	1N4004
Z1CR23	Diode	01295	1N4004
Z1CR24	Diode	01295	1N4004
Z1CR25	Diode	01295	1N4004
Z2CR1	Diode	01295	1N4004
Z2CR2	Diode	01295	1N4004
Z2CR3	Diode	01295	1N4004
Z3CR1	Diode	01295	1N4148
Z1F1	Fuse, 1/2A	75915	275.500

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1Q1	Transistor	09019	2N5172
Z1Q2	Transistor	09019	2N5172
Z1Q3	Transistor	09019	2N5172
Z1Q4	Transistor	18714	2N4037
Z1Q5	Transistor	09019	2N5172
Z1Q6	Transistor	09019	2N5172
Z1Q7	Transistor	18714	2N4037
Z1Q8	Transistor	01295	T1P50
Z1Q9	Transistor	09019	2N5172
Z1Q10	Transistor	09019	D44C1
Z1Q11	Transistor	09019	2N5172
Z1Q12	Transistor	09019	2N5172
Z2Q1	Transistor	09019	2N5172
Z2Q2	Transistor	09019	2N5172
Z2Q3	Transistor	09019	2N5172
Z2Q4	Transistor	09019	2N5172
Z2Q5	Transistor	09019	2N5172
Z2Q6	Transistor	09019	2N5172
Z3Q1	Transistor	09019	2N5172
Z3Q2	Transistor	09019	2N5172
Z3Q3	Transistor	09019	2N5172
Z1R1	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z1R2	Resistor Carbon, 1/4W, 5%, 620 ohms	01121	RC07GF621J
Z1R3	Resistor Carbon, 1/4W. 5%, 4.7K	01121	RC07GF472J
Z1R4	Resistor Carbon, 1/4W. 5%, 39K	01121	RC07GF393J
Z1R5	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R6	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R7	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z1R8	Resistor Carbon, 1/4W, 5%, 2.7K	01121	RC07GF272J
Z1R9	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R10	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R11	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R12	Resistor Carbon, 1/4W,15%, 620 ohms	01121	RC07GF621J
Z1R13	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z1R14	Resistor Carbon, 1/2W, 5%, 2.2K	01121	RC20GF222J
Z1R15	Resistor Carbon, 1/4W, 5%, 1K	01121	RC07GF102J
Z1R16	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z1R17	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R18	Resistor Carbon, 1/4W, 5%, 2.7K	01121	RC07GF272J
Z1R19	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R20	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R21	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R22	Resistor Carbon 1/4W, 5%, 10K	01121	RC07GF103J
Z1R23	Resistor Carbon, 1/4W, 5%, 1K	01121	RC07GF102J
Z1R24	Resistor Carbon, 1/4W, 5%, 1K	01121	RC07GF102J
Z1R25	Not Used		

REPRODUCE LOGIC CIRCUIT BOARD
ASSEMBLY NO. PL9088 REV. H

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1R26	Resistor Carbon, 1W, 5%, 510 ohms	01121	RC32GF511J
Z1R27	Resistor Carbon, 1/4W, 5%, 120K	01121	RC07GF124J
Z1R28	Resistor Carbon, 1/4W, 5%, 24K	01121	RC07GF243J
Z1R29	Resistor Carbon, 1/4W, 5%, 6.2K	01121	RC07GF622J
Z1R30	Resistor Carbon, 1/4W, 5%, 120K	01121	RC07GF124J
Z1R31	Resistor Carbon, 1/4W, 5%, 24K	01121	RC07GF243J
Z1R32	Resistor Carbon, 1/4W, 5%, 6.2K	01121	RC07GF622J
Z1R33	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J
Z2R1	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z2R2	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z2R3	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z2R4	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z2R5	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF1C3J
Z2R6	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z2R7	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z2R8	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z2R9	Resistor Carbon, 1/2W, 5%, 22K	01121	RC20GF223J
Z2R10	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z2R11	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z2R12	Resistor Carbon 1/4W, 5%, 10K	01121	RC07GF103J
Z3R1	Resistor Carbon, 1/4W, 5% 3.9K	01121	RC07GF392J
Z3R2	Resistor Carbon, 1/4W, 5%, 1.2K	01121	RC07GF122J
Z3R3	Resistor Carbon, 1/4W, 5%, 560 ohms	01121	RC07GF561J
Z3R4	Resistor Carbon, 1/4W, 5%, 1K	01121	RC07GF102J
Z3R5	Resistor Carbon, 1/4W, 5%, 180K	01121	RC07GF184J
Z3R6	Resistor Carbon, 1/4W, 5%, 33K	01121	RC07GF333J
Z1U1	Integrated Circuit	01295	SN7405N-00
Z1U2	Integrated Circuit	01295	SN7401N-00
Z1U3	Integrated Circuit	01295	SN7410N-00
Z1U4	Integrated Circuit	09019	H11A4
Z3U1	Not Used		
Z3U2	Not Used		
Z3U3	Not Used		
Z3U4	Not Used		
Z3U5	Integrated Circuit	01295	SN7401N-00

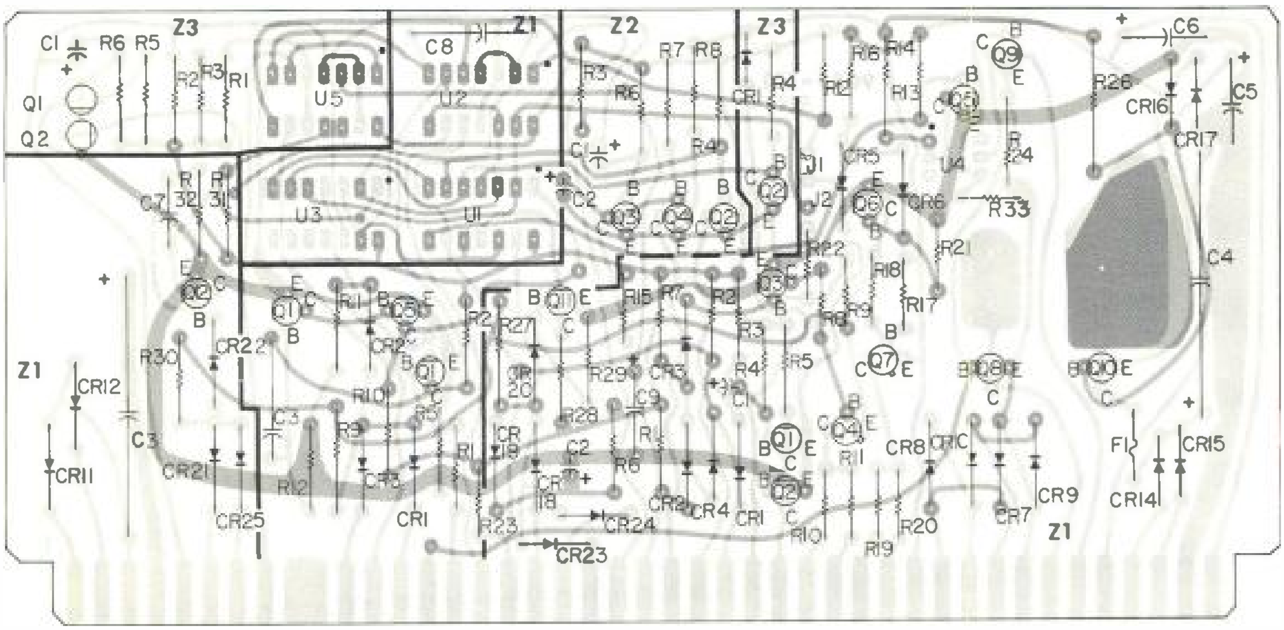


FIG. 36. Reproduce Logic P.C. Board Layout

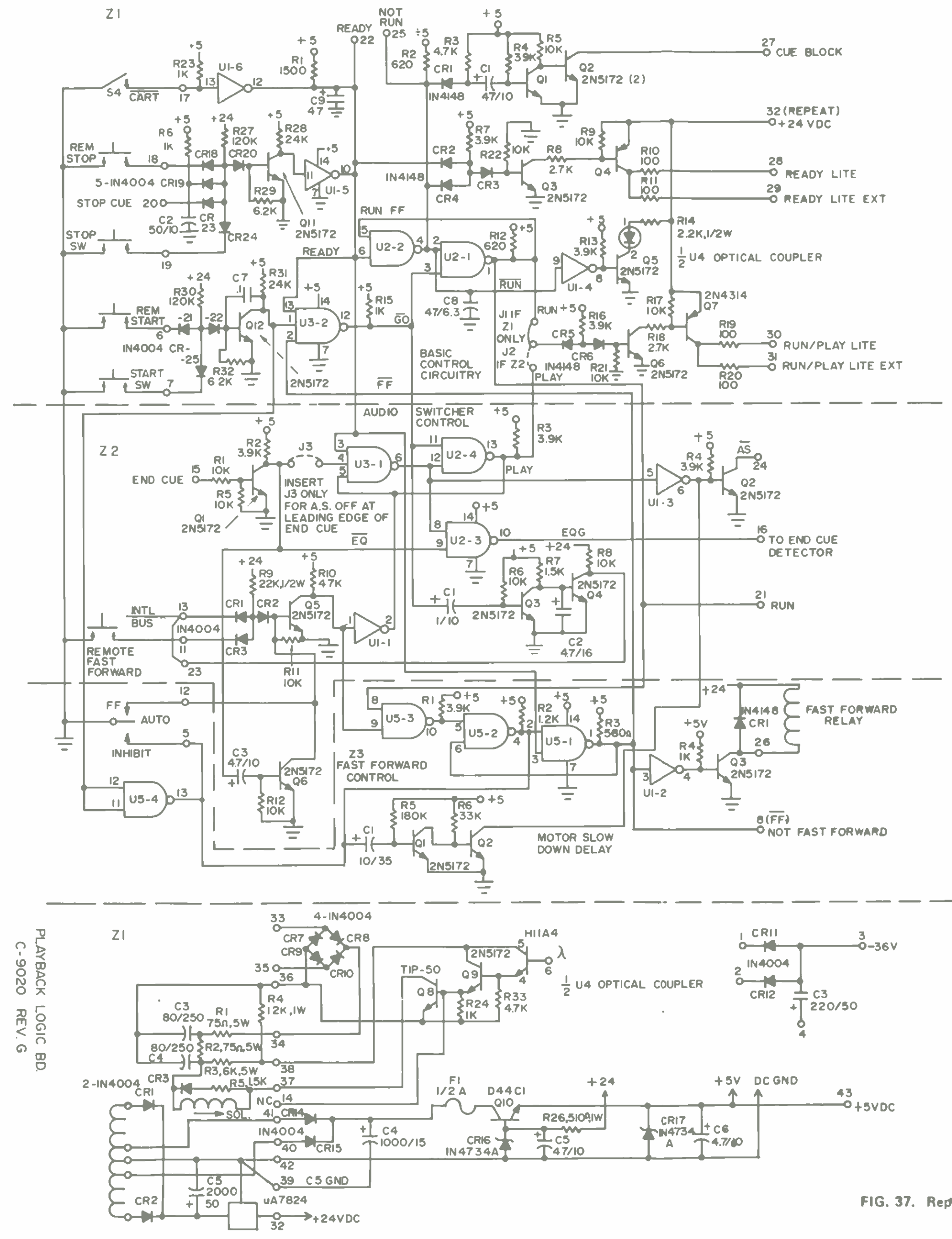


FIG. 37. Reproduce Logic Schematic

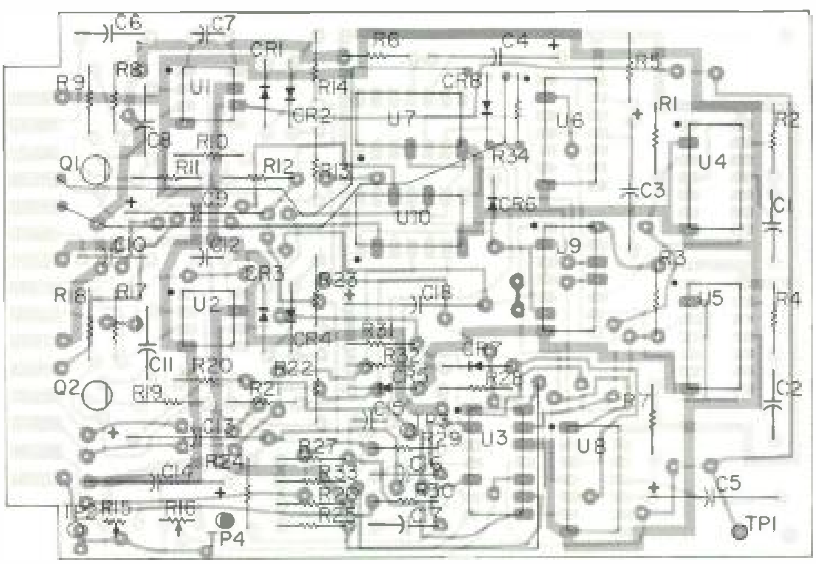


FIG. 48. Splice Finder P.C. Board Layout

SPLICE FINDER CIRCUIT BOARD
ASSEMBLY NO. PL-9573 REV.A

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
C1	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
C2	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
C3	Capacitor Electrolytic, 1uf,6V "T"	74840	
C4	Capacitor Electrolytic, 1uf,6V "T"	74840	
C5	Capacitor Electrolytic, 1uf,6V "T"	74840	
C6	Capacitor Mylar, .022uf,100V	23783	1R3X31499
C7	Capacitor Disc, 3.3pf, 1000V	56289	30GA-V33
C8	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
C9	Capacitor Electrolytic, 10uf,35V "T"	74840	
C10	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
C11	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
C12	Capacitor Disc, 3pf, 1000V	56289	30GA-V33
C13	Capacitor Electrolytic, 10uf,35V "T"	74840	
C14	Capacitor Electrolytic, 10uf,35V "T"	74840	
C15	Capacitor Disc, 50pf, 1000V	56289	5GA-Q50
C16	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
C17	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
CR1	Diode	01295	1N4733A
CR2	Diode	01295	1N4148
CR3	Diode	01295	1N4133A
CR4	Diode	01295	1N4148
CR5	Diode	01295	1N4742A
CR6	Diode	01295	1N295
CR7	Diode	01295	1N4148
U1	Integrated Circuit	27014	LM301A
U2	Integrated Circuit	27014	LM301A
U3	Integrated Circuit	27014	LM339
U4	Integrated Circuit	01295	SN74122N-00
U5	Integrated Circuit	01295	SN74122N-00
U6	Integrated Circuit	01295	SN74122N-00
U7	Integrated Circuit	01295	SN74121N-00
U8	Integrated Circuit	01295	SN74121N-00
U9	Integrated Circuit	01295	SN7400N-00
U10	Integrated Circuit	01295	SN7406N-00

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Q1	Transistor	09019	2N4360
Q2	Transistor	09019	2N4360
R1	Resistor Carbon,1/4W,5%,3.9K	01121	RC07GF392J
R2	Resistor Carbon,1/4W,5%,51K	01121	RC07GF513J
R3	Resistor Carbon,1/4W,5%,3.9K	01121	RC07GF392J
R4	Resistor Carbon,1/4W,5%,51K	01121	RC07GF513J
R5	Resistor Carbon,1/4W,5%,20K	01121	RC07GF203J
R6	Resistor Carbon,1/4W,5%,4.7K	01121	RC07GF472J
R7	Resistor Carbon,1/4W,5%,39K	01121	RC07GF393J
R8	Resistor Carbon,1/4W,5%,10K	01121	RC07GF103J
R9	Resistor Carbon,1/4W,5%,220K	01121	RC07GF224J
R10	Resistor Carbon,1/4W,5%,680K	01121	RC07GF684J
R11	Resistor Carbon,1/4W,5%,22K	01121	RC07GF223J
R12	Resistor Carbon,1/4W,5%,1 MEG	01121	RC07GF105J
R13	Resistor Carbon,1/4W,5%,22K	01121	RC07GF223J
R14	Resistor Carbon,1/4W,5%,10K	01121	RC07GF103J
R15	Resistor Trimmer,1/4W,5%,10K	04880	PT10H2.5 10K
R16	Resistor Trimmer,1/4W,5%,10K	04880	PT10H2.5 10K
R17	Resistor Carbon,1/4W,5%,100K	01121	RC07GF104J
R18	Resistor Carbon,1/4W,5%,2.4K	01121	RC07GF242J
R19	Resistor Carbon,1/4W,5%,22K	01121	RC07GF223J
R20	Resistor Carbon,1/4W,5%,220K	01121	RC07GF224J
R21	Resistor Carbon,1/4W,5%,1 MEG	01121	RC07GF105J
R22	Resistor Carbon,1/4W,5%,22K	01121	RC07GF223J
R23	Resistor Carbon,1/4W,5%,10K	01121	RC07GF103J
R24	Resistor Carbon,1/4W,5%,1 MEG	01121	RC07GF105J
R25	Resistor Carbon,1/4W,5%,1 MEG	01121	RC07GF105J
R26	Resistor Carbon,1/4W,5%,5.1K	01121	RC07GF512J
R27	Resistor Carbon,1/4W,5%,560K	01121	RC07GF564J
R28	Resistor Carbon,1/4W,5%,5.1K	01121	RC07GF512J
R29	Resistor Carbon,1/4W,5%,75K	01121	RC07GF753J
R30	Resistor Carbon,1/4W,5%,220K	01121	RC07GF224J
R31	Resistor Carbon,1/4W,5%,3.9K	01121	RC07GF392J
R32	Resistor Carbon,1/4W,5%,3.9K	01121	RC07GF392J
R33	Resistor Carbon,1/4W,5%,330 ohm	01121	RC07GF331J

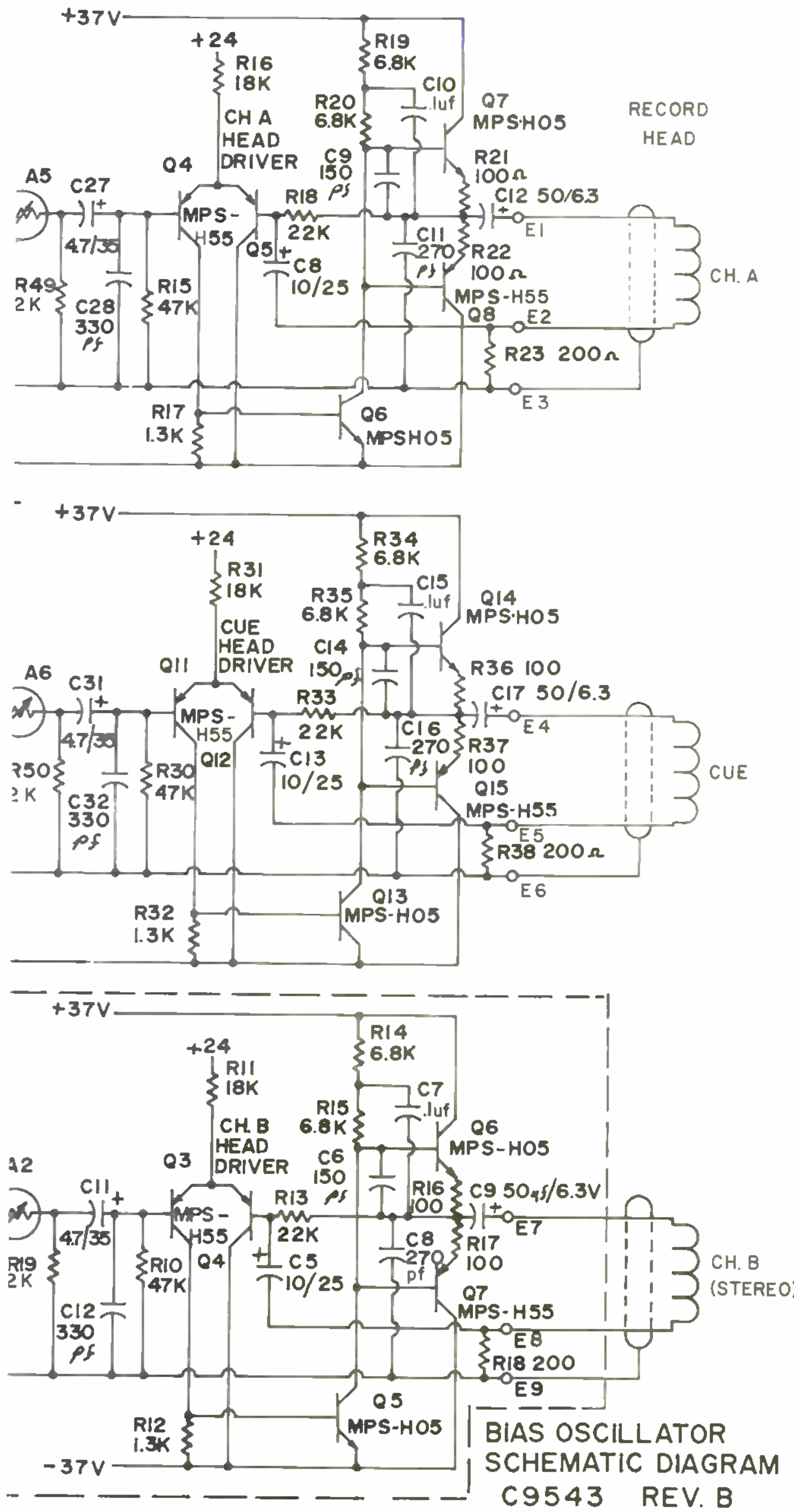


FIG. 47. Bias Oscillator Schematic

BIAS OSCILLATOR CIRCUIT BOARD
ASSEMBLY NO. PL9544 REV. B

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1R11	Resistor Carbon, 1/4W, 5%, 15K	01121	RC07GF153J
Z1R12	Resistor Carbon, 1/4W, 5%, 2K	01121	RC07GF202J
Z1R13	Resistor Carbon, 1/4W, 5%, 360 ohms	01121	RC07GF361J
Z1R14	Resistor Carbon, 1/4W, 5%, 11K	01121	RC07GF113J
Z1R15	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z1R16	Resistor Carbon, 1/4W, 5% 18K	01121	RC07GF183J
Z1R17	Resistor Carbon, 1/4W, 5%, 1.3K	01121	RC07GF132J
Z1R18	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R19	Resistor Carbon, 1/4W, 5%, 6.8K	01121	RC07GF682J
Z1R20	Resistor Carbon, 1/4W, 5%, 6.8K	01121	RC07GF682J
Z1R21	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R22	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R23	Resistor Carbon, 1/4W, 5%, 200 ohms	01121	RC07GF201J
Z1R24	Not Used		
Z1R25	Resistor Trimmer, 1/4W, 5%, 20K	04880	PT10H2.5 20K
Z1R26	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R27	Resistor Carbon, 1/4W, 5%, 2K	01121	RC07GF202J
Z1R28	Resistor Carbon, 1/4W, 5%, 2.4K	01121	RC07GF242J
Z1R29	Not Used		
Z1R30	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z1R31	Resistor Carbon, 1/4W, 5%, 18K	01121	RC07GF183J
Z1R32	Resistor Carbon, 1/4W, 5%, 1.3K	01121	RC07GF132J
Z1R33	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R34	Resistor Carbon, 1/4W, 5%, 6.8K	01121	RC07GF682J
Z1R35	Resistor Carbon, 1/4W, 5%, 6.8K	01121	RC07GF682J
Z1R36	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R37	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R38	Resistor Carbon, 1/4W, 5%, 200 ohms	01121	RC07GF201J
Z1R39	Resistor Carbon, 1/4W, 5%, 220K	01121	RC07GF224J
Z1R40	Resistor Carbon, 1/4W, 5%, 2.2K	01121	RC07GF222J
Z1R41	Resistor Carbon, 1/4W, 5%, 220K	01121	RC07GF224J
Z1R42	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z1R43	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z1R44	Resistor Carbon, 1W, 5%, 620 ohms	01121	RC32GF621J
Z1R45	Resistor Carbon, 1W, 5%, 620 ohms	01121	RC32GF621J
Z1R46	Resistor Carbon, 1/4W, 5%, 33K	01121	RC07GF333J
Z1R47	Resistor Carbon, 1/4W, 5%, 1K	01121	RC07GF102J
Z1R48	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R49	Resistor Carbon, 1/4W, 5%, 2K	01121	RC07GF202J
Z1R50	Resistor Carbon, 1/4W, 5%, 2K	01121	RC07GF202J
Z1R51	Resistor Carbon, 1/4W, 5%, 200 ohms	01121	RC07GF201J
Z1R52	Resistor Carbon, 1/4W, 5%, 200 ohms	01121	RC07GF201J
Z2R1	Resistor Carbon, 1/4W, 5%, 220K	01121	RC07GF224J
Z2R2	Resistor Carbon, 1/4W, 5%, 2.2K	01121	RC07GF222J
Z2R3	Resistor Carbon, 1/4W, 5%, 220K	01121	RC07GF224J
Z2R4	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z2R5	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z2R6	Resistor Carbon, 1/4W, 5%, 1K	01121	RC07GF102J
Z2R7	Resistor Trimmer 1/4W, 5%, 20K	04880	PT10H2.5 20K
Z2R8	Resistor Carbon, 1/4W, 5%, 15K	01121	RC07GF153J
Z2R9	Resistor Carbon, 1/4W, 5%, 2K	01121	RC07GF202J
Z2R10	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z2R11	Resistor Carbon, 1/4W, 5%, 18K	01121	RC07GF183J
Z2R12	Resistor Carbon, 1/4W, 5%, 1.3K	01121	RC07GF132J
Z2R13	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z2R14	Resistor Carbon, 1/4W, 5%, 6.8K	01121	RC07GF682J
Z2R15	Resistor Carbon, 1/4W, 5%, 6.8K	01121	RC07GF682J
Z2R16	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z2R17	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z2R18	Resistor Carbon, 1/4W, 5%, 200 ohms	01121	RC07GF201J
Z2R19	Resistor Carbon, 1/4W, 5%, 2K	01121	RC07GF202J
	Head Cable Wht/Blk	27926	A9180-1
	Head Cable Yel/Blu	27926	A9181-1
	Head Cable Red/Org	27926	A9182-1

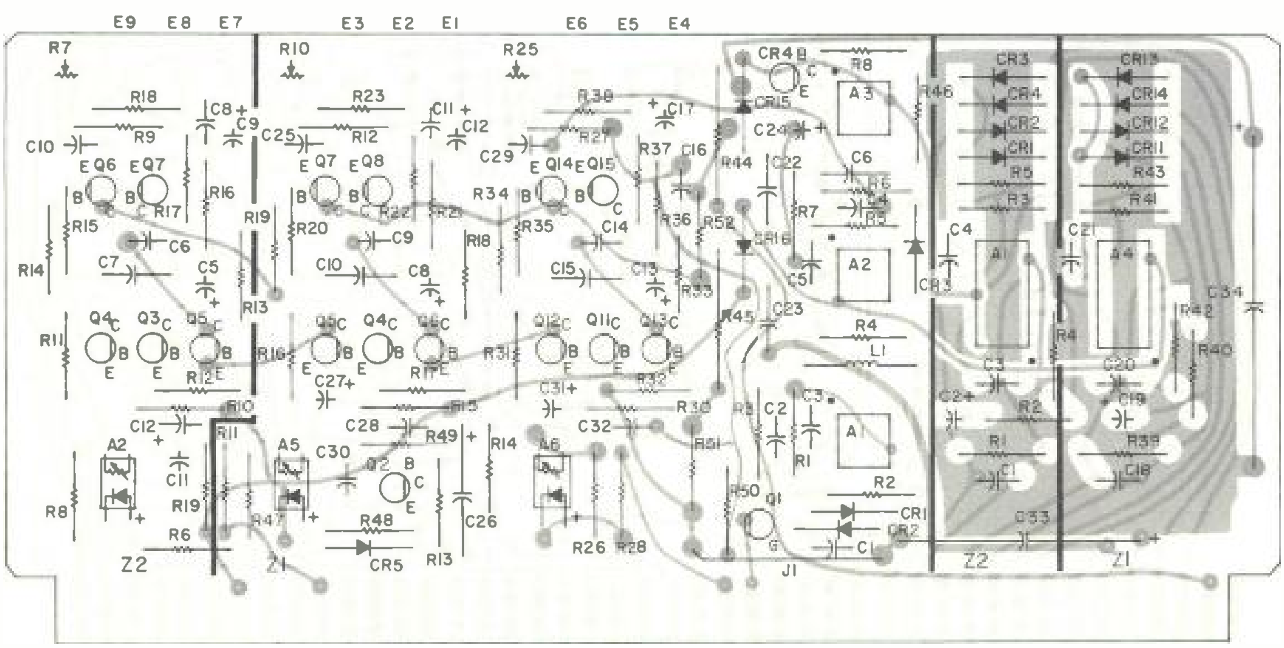


FIG. 46. Bias Oscillator P.C. Board Layout

BIAS OSCILLATOR CIRCUIT BOARD
ASSEMBLY NO. PL9544 REV. B

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1A1	Integrated Circuit	27014	LM301A
Z1A2	Integrated Circuit	27014	LM301A
Z1A3	Integrated Circuit	27014	uA741CA
Z1A4	Integrated Circuit	27014	uA709CA
Z1A5	Optical Coupler	03911	CLM6500
Z1A6	Optical Coupler	03911	CLM6500
Z2A1	Integrated Circuit	18324	ua709C
Z2A2	Optical Coupler	03911	CLM6500
Z1C1	Capacitor Disc, .001uf, 1000V	56289	10TS-D10
Z1C2	Capacitor Disc, 5pf, 1000V	56289	10TS-V50
Z1C3	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z1C4	Capacitor Disc, 3.3pf, 1000V	56289	10TS-V33
Z1C5	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z1C6	Capacitor Disc, .02uf, 1000V	56289	TG-S20
Z1C7	Not Used		
Z1C8	Capacitor Electrolytic, 10uf, 25V R	74840	
Z1C9	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z1C10	Capacitor Mylar, .1uf, 100V	23783	1R3X31624
Z1C11	Capacitor Disc, 270pf, 1000V	56289	10TS-T27
Z1C12	Capacitor Electrolytic, 50uf, 6.3V R	74840	
Z1C13	Capacitor Electrolytic 10uf, 25V R	74840	
Z1C14	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z1C15	Capacitor Mylar, .1uf, 100V	23783	1R3X31624
Z1C16	Capacitor Disc, 270pf, 1000V	56289	10TS-T27
Z1C17	Capacitor Electrolytic, 50uf, 6.3V R	74840	
Z1C18	Capacitor Disc, 68pf, 1000V	56289	10TS-Q68
Z1C19	Capacitor Electrolytic, 5uf, 6.3V R	74840	
Z1C20	Capacitor Disc, 100pf, 1000V	56289	10TS-T10
Z1C21	Capacitor Disc, 3.3pf, 1000V	56289	10TS-V33
Z1C22	Capacitor Mylar, .1uf, 100V	23783	1R3X31624
Z1C23	Capacitor Mylar, .1uf, 100V	23783	1R3X31624
Z1C24	Capacitor Electrolytic, 4.7uf, 35V R	74840	
Z1C25	Capacitor Disc, 330pf, 100V	56289	10TS-T33
Z1C26	Capacitor Tantalum, 4.7uf, 35V	90201	CS13BF475K
Z1C27	Capacitor Electrolytic, 4.7uf, 35V R	74840	
Z1C28	Capacitor Disc, 330pf, 1000V	56289	10TS-T33
Z1C29	Capacitor Disc, 330pf, 1000V	56289	10TS-T33
Z1C30	Capacitor. Disc 470pf, 1000V	56289	10TS-T47
Z1C31	Capacitor Electrolytic, 4.7uf, 35V R	74840	
Z1C32	Capacitor Disc, 330pf, 1000V	56289	10TS-T33
Z1C33	Capacitor Electrolytic, 220uf, 50V, T	74840	
Z1C34	Capacitor Electrolytic, 220uf, 50V, T	74840	
Z2C1	Capacitor Disc, 68pf, 1000V	56289	10TS-Q68
Z2C2	Capacitor Electrolytic, 5uf, 6.3V R	74840	
Z2C3	Capacitor Disc, 100pf, 1000V	56289	10TS-T10
Z2C4	Capacitor Disc, 3.3pf, 1000V	56289	10TS-V33
Z2C5	Capacitor Electrolytic, 10uf, 25V R	74840	
Z2C6	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z2C7	Capacitor Mylar, .1uf, 100V	23783	1R3X31624
Z2C8	Capacitor Disc, 270pf, 1000V	56289	10TS-T27
Z2C9	Capacitor Electrolytic, 50uf, 6.3V R	74840	
Z2C10	Capacitor Disc, 330pf, 1000V	56289	10TS-T33
Z2C11	Capacitor Electrolytic, 4.7uf, 35V R	74840	
Z2C12	Capacitor Disc, 330pf, 1000V	56289	10TS-T33

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1CR1	Diode	01295	1N4148
Z1CR2	Diode	01295	1N4148
Z1CR3	Diode	01295	1N4148
Z1CR4	Diode	09019	2N5172
Z1CR5	Diode	01295	1N4742A
Z1CR6	Not Used		
Z1CR7	Not Used		
Z1CR8	Not Used		
Z1CR9	Not Used		
Z1CR10	Not Used		
Z1CR11	Diode	01295	1N295
Z1CR12	Diode	01295	1N295
Z1CR13	Diode	01295	1N295
Z1CR14	Diode	01295	1N295
Z1CR15	Diode	01295	1N4744
Z1CR16	Diode	01295	1N4744
Z2CR1	Diode	01295	1N295
Z2CR2	Diode	01295	1N295
Z2CR3	Diode	01295	1N295
Z2CR4	Diode	01295	1N295
Z1L1	Inductor, 2.7mh	24759	MR-2700
Z1Q1	Transistor	04713	2N4342
Z1Q2	Transistor	09019	2N5366
Z1Q3	Not Used		
Z1Q4	Transistor	04713	MPS-H55
Z1Q5	Transistor	04713	MPS-H55
Z1Q6	Transistor	04713	MPS-H05
Z1Q7	Transistor	04713	MPS-H05
Z1Q8	Transistor	04713	MPS-H55
Z1Q9	Not Used		
Z1Q10	Not Used		
Z1Q11	Transistor	04713	MPS-H55
Z1Q12	Transistor	04713	MPS-H55
Z1Q13	Transistor	04713	MPS-H05
Z1Q14	Transistor	04713	MPS-H05
Z1Q15	Transistor	04713	MPS-H55
Z2Q1	Not Used		
Z2Q2	Not Used		
Z2Q3	Transistor	04713	MPS-H55
Z2Q4	Transistor	04713	MPS-H55
Z2Q5	Transistor	04713	MPS-H05
Z2Q6	Transistor	04713	MPS-H05
Z2Q7	Transistor	04713	MPS-H55
Z1R1	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R2	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R3	Resistor Carbon, 1/4W, 5%, 220K	01121	RC07GF224J
Z1R4	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J
Z1R5	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R6	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J
Z1R7	Resistor Carbon, 1/4W, 5%, 1 Meg	01121	RC07GF105J
Z1R8	Resistor Carbon, 1/4W 5%, 10K	01121	RC07GF103J
Z1R9	Not Used		
Z1R10	Resistor Trimmer, 1/4W, 5%, 20K	04880	PT10H2.5 20K

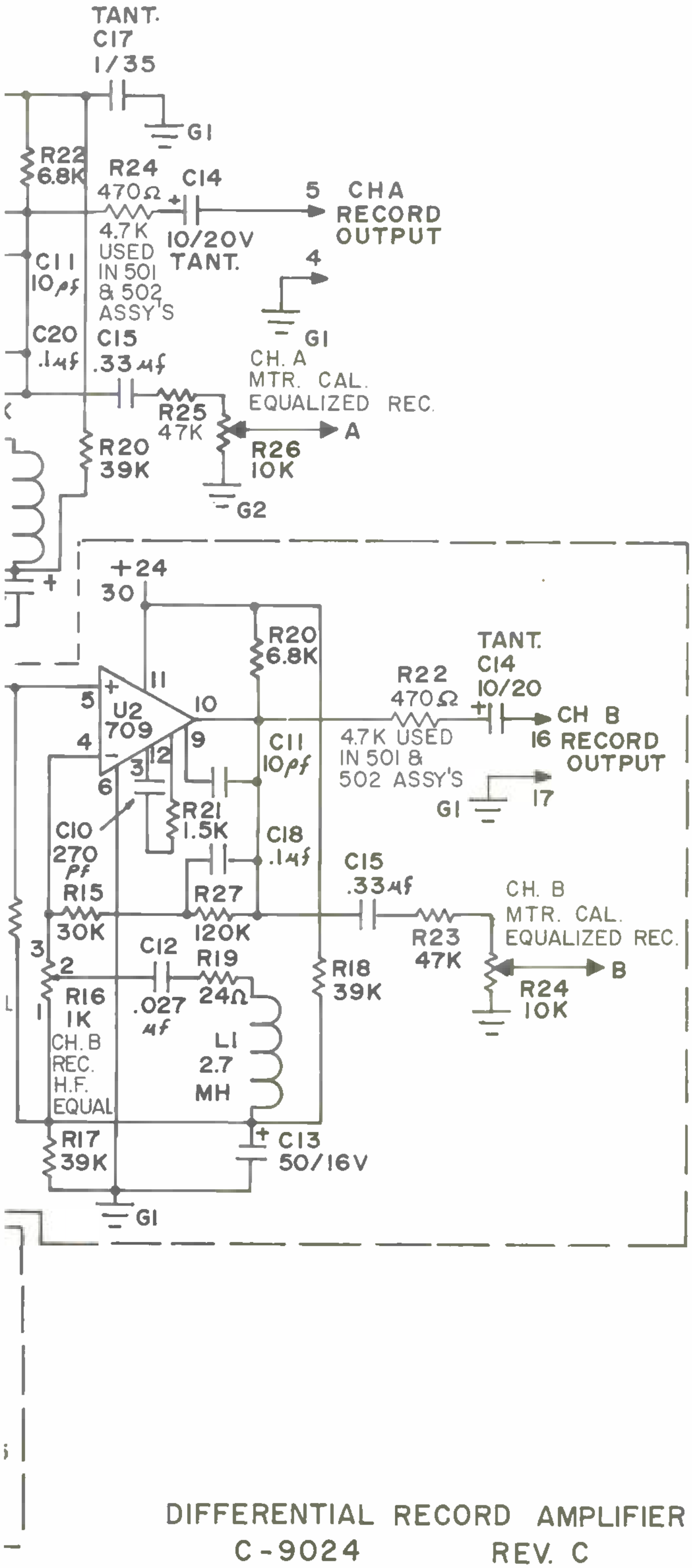


FIG. 45. Record Amplifier Schematic

RECORD AMPLIFIER CIRCUIT BOARD
ASSEMBLY NO. PL9125 REV. D

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.	REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1R29	Resistor Carbon, 1/4W, 5%, 120K	01121	RC07GF124J	Z2R17	Resistor Carbon, 1/4W, 5%, 39K	01121	RC07GF393J
Z1R30	Resistor Trimmer 1/4W, 5%, 1K	04880	PT10H2.5 1K	Z2R18	Resistor Carbon, 1/4W, 5%, 39K	01121	RC07GF393J
Z1R31	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J	Z2R19	Resistor Carbon, 1/4W, 5%, 24 ohms	01121	RC07GF240J
Z1R32	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J	Z2R20	Resistor Carbon, 1/4W, 5%, 6.8K	01121	RC07GF682J
				Z2R21	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z2R1	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J	Z2R22	Resistor Carbon, 1/4W, 5%, 470 OHM	01121	RC07GF471J
Z2R2	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J	Z2R23	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z2R3	Resistor Metal Film, 1/4W, 1%, 4.99K	01121	RN55D4991	Z2R24	Resistor Trimmer 1/4W, 5%, 10K	04880	PT10H2.5 10K
Z2R4	Resistor Metal Film, 1/4W, 1%, 4.99K	01121	RN55D4991	Z2R25	Resistor Trimmer 1/4W, 5%, 50K	04880	PT10H2.5 50K
Z2R5	Resistor Metal Film, 1/4W, 1%, 10K	01121	RN55D1002	Z2R26	Resistor Trimmer 1/4W, 5%, 50K	04880	PT10H2.5 50K
Z2R6	Resistor Metal Film, 1/4W, 1%, 10K	01121	RN55D1002	Z2R27	Resistor Carbon, 1/4W, 5%, 120K	01121	RC07GF124J
Z2R7	Resistor Metal Film, 1/4W, 1%, 15K	01121	RN55D1502	Z2R28	Resistor Trimmer 1/4W, 5%, 1K	04880	PT10H2.5 1K
Z2R8	Resistor Metal Film, 1/4W, 1%, 14.7K	01121	RN55D1472	Z1S1	Switch, Slide	95146	MSS4350R
Z2R9	Resistor Carbon, 1/4W, 5%, 39K	01121	RC07GF393J				
Z2R10	Resistor Carbon, 1/4W, 5%, 39K	01121	RC07GF393J	Z1U1	Integrated Circuit	27014	LM301AN
Z2R11	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J	Z1U2	Integrated Circuit	18324	uA709CA
Z2R12	Resistor Carbon, 1/4W, 5%, 3.3 Meg	01121	RC07GF335J	Z2U1	Integrated Circuit	27014	LM301AN
Z2R13	Resistor Carbon, 1/4W, 5%, 3.3 Meg	01121	RC07GF335J	Z2U2	Integrated Circuit	18324	uA709CA
Z2R14	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J				
Z2R15	Resistor Carbon, 1/4W, 5%, 30K	01121	RC07GF303J				
Z2R16	Resistor Trimmer 1/4W, 5%, 1K	04880	PT10H2.5 1K				

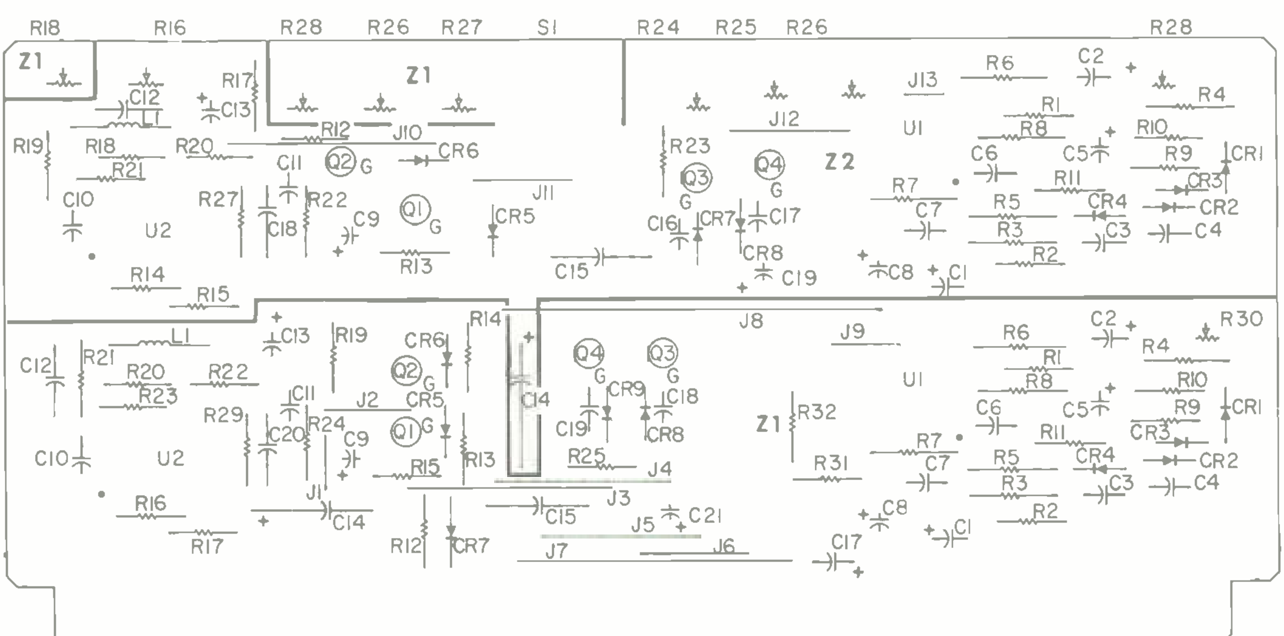
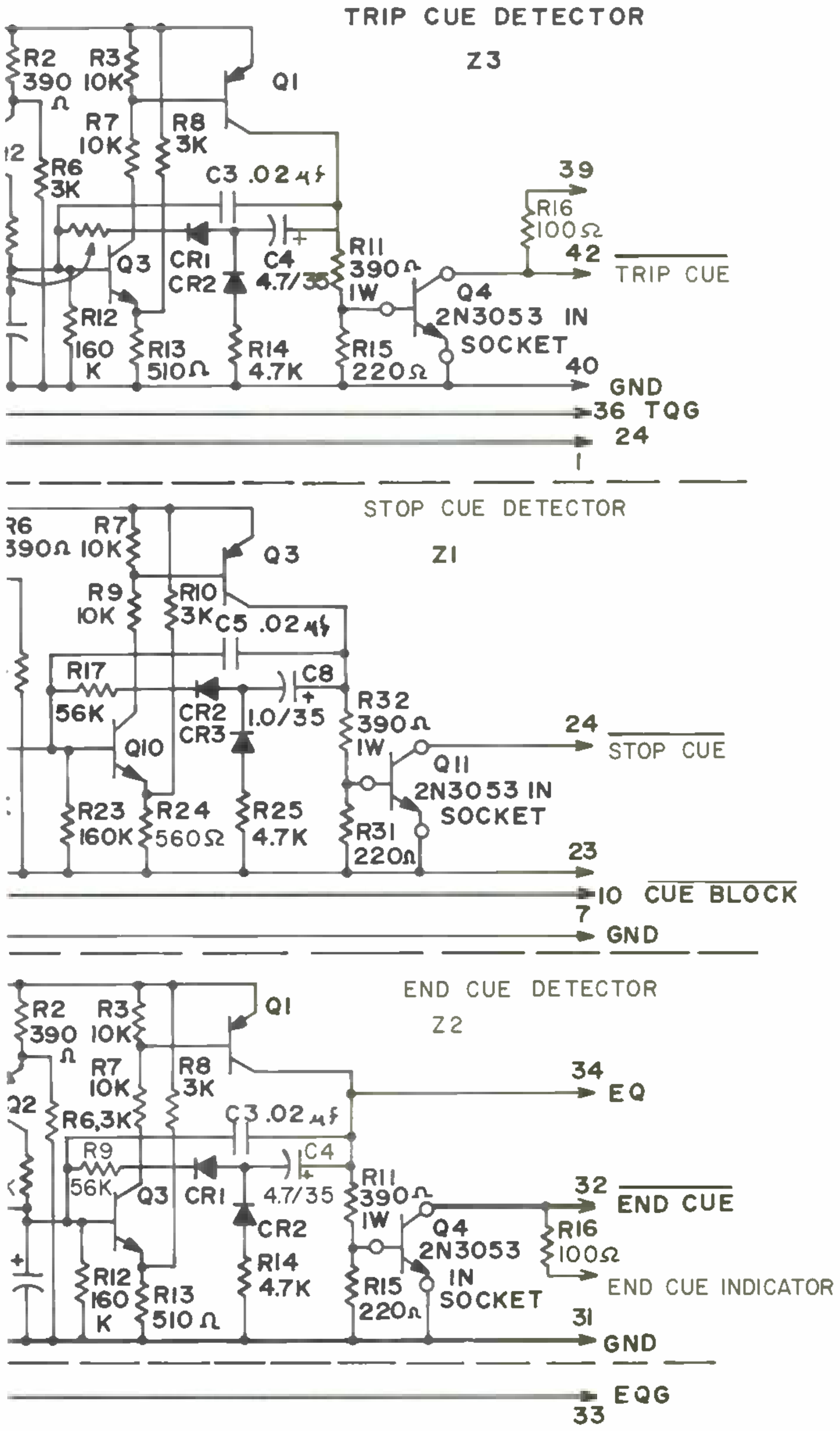


FIG. 44. Record Amplifier P.C. Board Layout

RECORD AMPLIFIER CIRCUIT BOARD
ASSEMBLY NO. PL9125 REV. D

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1C1	Capacitor Electrolytic, 50uf, 25V R	74840	
Z1C2	Capacitor Electrolytic, 50uf, 25V R	74840	
Z1C3	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z1C4	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z1C5	Capacitor Electrolytic, 50uf, 16V R	74840	
Z1C6	Capacitor Disc, 15pf, 1000V	56289	10TS-Q15
Z1C7	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z1C8	Capacitor Electrolytic, 2uf, 25V R	74840	
Z1C9	Capacitor Electrolytic, 1uf, 25V R	74840	
Z1C10	Capacitor Disc, 270pf, 1000V	56289	10TS-T27
Z1C11	Capacitor Disc, 10pf, 1000V	56289	10TS-Q10
Z1C12	Capacitor Mylar, .027uf, 100V	23783	1R3X31515
Z1C13	Capacitor Electrolytic, 50uf, 16V R	74840	
Z1C14	Capacitor Tantalum, 10uf, 20V	90201	CSR13-E106KM
Z1C15	Capacitor Mylar, .33uf, 100V	23783	1R3X31717
Z1C16	Not Used		
Z1C17	Capacitor Tantalum, .1uf, 35V	90201	TDC105M035EL
Z1C18	Capacitor Disc, 15pf, 1000V	56289	5GA-Q15
Z1C19	Capacitor Disc, 15pf, 1000V	56289	5GA-Q15
Z1C20	Capacitor Mylar, .1uf, 100V	23783	1R3X31623
Z1C21	Capacitor Electrolytic, 1uf, 6.3V R	74840	
Z2C1	Capacitor Electrolytic, 50uf, 25V R	74840	
Z2C2	Capacitor Electrolytic, 50uf, 25V R	74840	
Z2C3	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z2C4	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z2C5	Capacitor Electrolytic, 50uf, 16V R	74840	
Z2C6	Capacitor Disc, 15pf, 1000V	56289	10TS-Q15
Z2C7	Capacitor Disc, 150pf, 1000V	56289	10TS-T15
Z2C8	Capacitor Electrolytic, 2uf, 25V R	74840	
Z2C9	Capacitor Electrolytic, 1uf, 25V R	74840	
Z2C10	Capacitor Disc, 270pf, 1000V	56289	10TS-T27
Z2C11	Capacitor Disc, 10pf, 1000V	56289	10TS-Q10
Z2C12	Capacitor Mylar, .027uf, 100V	23783	1R3X31515
Z2C13	Capacitor Electrolytic, 50uf, 16V R	74840	
Z2C14	Capacitor Tantalum, 10uf, 20V	90201	CSR13-E106KM
Z2C15	Capacitor Mylar, .33uf, 100V	23783	1R3X31717
Z2C16	Capacitor Disc, 15pf, 1000V	56289	5GA-Q15
Z2C17	Capacitor Disc, 15pf, 1000V	56289	5GA-Q15
Z2C18	Capacitor Mylar, .1uf, 100V	23783	1R3X31623
Z2C19	Capacitor Electrolytic, 1uf, 6.3V R	74840	
Z1CR1	Diode	01295	1N4148
Z1CR2	Diode	01295	1N4148
Z1CR3	Diode	01295	1N4148
Z1CR4	Diode	01295	1N4148
Z1CR5	Diode	01295	1N4148
Z1CR6	Diode	01295	1N4148
Z1CR7	Diode	01295	1N4740
Z1CR8	Diode	01295	1N4148
Z1CR9	Diode	01925	1N4148

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z2CR1	Diode	01295	1N4148
Z2CR2	Diode	01295	1N4148
Z2CR3	Diode	01295	1N4148
Z2CR4	Diode	01295	1N4148
Z2CR5	Diode	01295	1N4148
Z2CR6	Diode	01295	1N4148
Z2CR7	Diode	01295	1N4148
Z2CR8	Diode	01295	1N4148
Z1L1	Inductor, 2.7mh	24759	MR-2700
Z2L1	Inductor, 2.7mh	24759	MR-2700
Z1Q1	Transistor	04713	2N4342
Z1Q2	Transistor	04713	2N5486
Z1Q3	Transistor	04713	2N4342
Z1Q4	Transistor	04713	2N5486
Z2Q1	Transistor	04713	2N4342
Z2Q2	Transistor	04713	2N5486
Z2Q3	Transistor	04713	2N4342
Z2Q4	Transistor	04713	2N5486
Z1R1	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R2	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R3	Resistor Metal Film, 1/4W, 1%, 4.99K	01121	RN55D4991
Z1R4	Resistor Metal Film, 1/4W, 1%, 4.99K	01121	RN55D4991
Z1R5	Resistor Metal Film, 1/4W, 1%, 10K	01121	RN55D1002
Z1R6	Resistor Metal Film, 1/4W, 1%, 10K	01121	RN55D1002
Z1R7	Resistor Metal Film, 1/4W, 1%, 15K	01121	RN55D1502
Z1R8	Resistor Metal Film, 1/4W, 1%, 14.7K	01121	RN55D1472
Z1R9	Resistor Carbon, 1/4W, 5% 39K	01121	RC07GF392J
Z1R10	Resistor Carbon, 1/4W, 5%, 39K	01121	RC07GF393J
Z1R11	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R12	Resistor Carbon, 1/4W, 5%, 270K	01121	RC07GF274J
Z1R13	Resistor Carbon, 1/4W, 5%, 100K	01121	RC07GF104J
Z1R14	Resistor Carbon, 1/4W, 5%, 3.3M	01121	RC07GF335J
Z1R15	Resistor Carbon, 1/4W, 5%, 3.3M	01121	RC07GF335J
Z1R16	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R17	Resistor Carbon, 1/4W, 5%, 30K	01121	RC07GF303J
Z1R18	Resistor Trimmer 1/4W, 5%, 1K	04880	PT10H2.5 1K
Z1R19	Resistor Carbon, 1/4W, 5%, 39K	01121	RC07GF393J
Z1R20	Resistor Carbon, 1/4W, 5%, 39K	01121	RC07GF393J
Z1R21	Resistor Carbon, 1/4W, 5%, 24 ohms	01121	RC07GF240J
Z1R22	Resistor Carbon, 1/4W, 5%, 6.8K	01121	RC07GF682J
Z1R23	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z1R24	Resistor Carbon, 1/4W, 5%, 470 OHM	01121	RC07GF471J
Z1R25	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z1R26	Resistor Trimmer, 1/4W, 5%, 10K	04880	PT10H2.5 10K
Z1R27	Resistor Trimmer, 1/4W, 5%, 50K	04880	PT10H2.5 50K
Z1R28	Resistor Trimmer, 1/4W, 5%, 50K	04880	PT10H2.5 50K

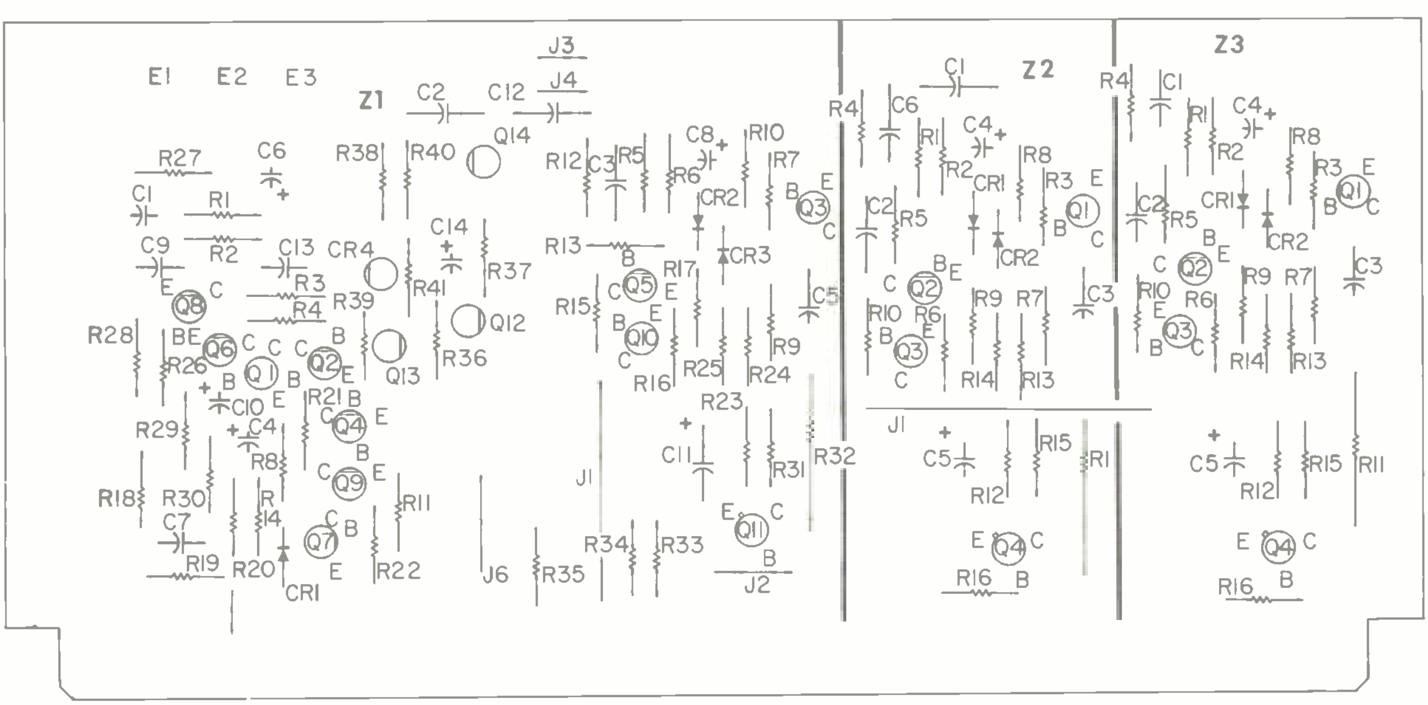


CUE DETECTOR
C-9022 REV. E

FIG. 43. Cue Det Schematic

CUE DETECTOR CIRCUIT BOARD
ASSEMBLY NO. PL9111 REV. D

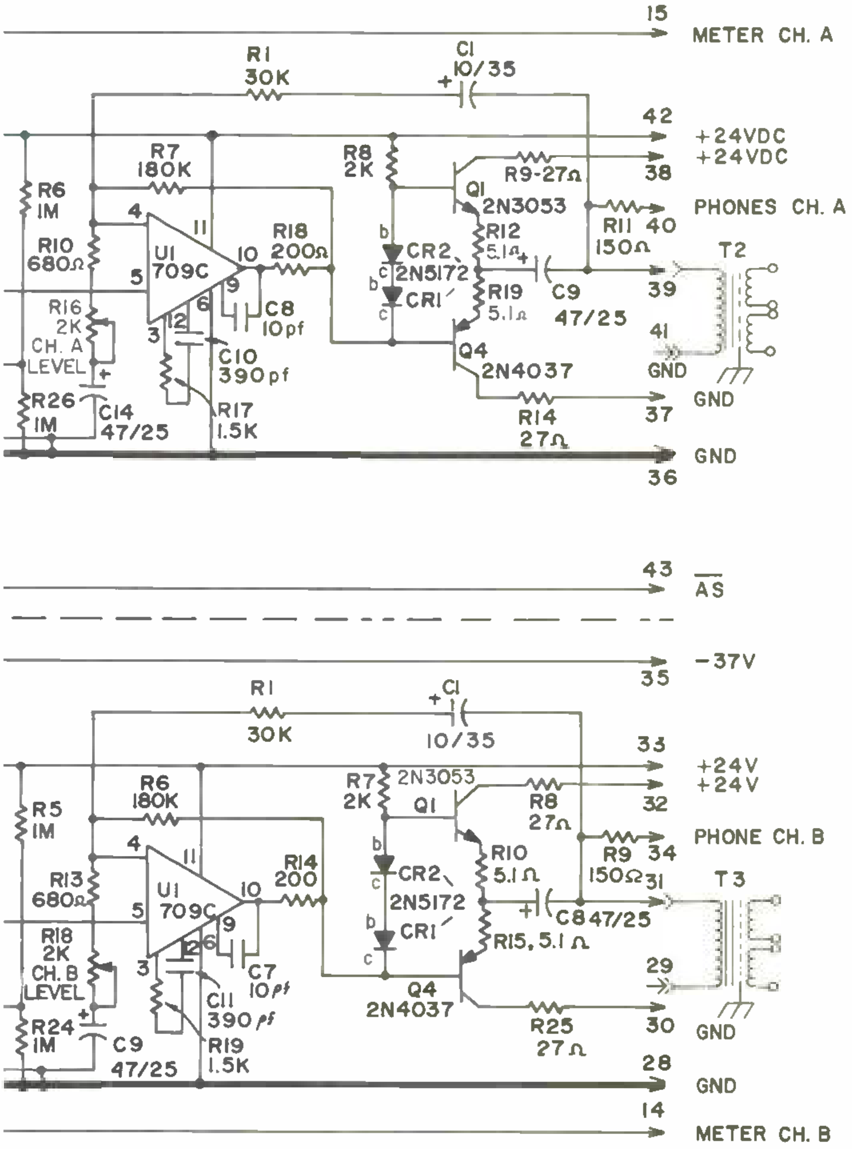
REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.	REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1R40	Resistor Carbon, 1/4W, 5%, 100K	01121	RC07GF104J	Z3R1	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R41	Resistor Carbon, 1/4W, 5%, 100K	01121	RC07GF104J	Z3R2	Resistor Metal Film 1/4W 2% 390 ohms	01121	RL07AD391G
Z2R1	Resistor Carbon 1/4W, 5%, 11K	01121	RC07GF113J	Z3R3	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z2R2	Resistor Metal Film 1/4W 2%, 390 ohms	01121	RL07AD391G	Z3R4	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z2R3	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J	Z3R5	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z2R4	Resistor Carbon, 1/4W, 5%, 11K	01121	RC07GF113J	Z3R6	Resistor Metal Film 1/4W, 2% 3K	01121	RL07AD302G
Z2R5	Resistor Carbon, 1/4W, 5%, 100K	01121	RC07GF104J	Z3R7	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z2R6	Resistor Metal Film 1/4W 2%, 3K	01121	RL07AD302G	Z3R8	Resistor Metal Film 1/4W 2% 3K	01121	RL07AD302G
Z2R7	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J	Z3R9	Resistor Carbon, 1/4W, 5%, 56K	01121	RC07GF563J
Z2R8	Resistor Metal Film 1/4W 2%, 3K	01121	RL07AD302G	Z3R10	Resistor Carbon, 1/4W, 5%, 160K	01121	RC07GF164J
Z2R9	Resistor Carbon, 1/4W, 5%, 56K	01121	RC07GF563J	Z3R11	Resistor Carbon, 1W, 5%, 390 ohms	01121	RC32GF391J
Z2R10	Resistor Carbon, 1/4W, 5%, 160K	01121	RC07GF164J	Z3R12	Resistor Carbon, 1/4W, 5%, 160K	01121	RC07GF164J
Z2R11	Resistor Carbon, 1W, 5%, 390 ohms	01121	RC32GF391J	Z3R13	Resistor Metal Film 1/4W 2% 510 ohms	01121	RL07AD511G
Z2R12	Resistor Carbon, 1/4W, 5%, 160K	01121	RC07GF164J	Z3R14	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J
Z2R13	Resistor Metal Film 1/4W,2% 510 ohms	01121	RL07AD511G	Z3R15	Resistor Carbon, 1/4W, 5%, 220 ohms	01121	RC07GF221J
Z2R14	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J	Z3R16	Resistor Carbon, 1/4W 5%, 100 ohms	01121	RC07GF101J
Z2R15	Resistor Carbon, 1/4W, 5%, 220 ohms	01121	RC07GF221J		Head Cable Blu-Yel	27926	A9181-1
Z2R16	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J				



CUE DETECTOR CIRCUIT BOARD
ASSEMBLY NO. PL9111 REV, D

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1C1	Capacitor Electrolytic, 10uf, 35V R	74840	
Z1C2	Capacitor Mylar, .015uf, 100V	23783	1R3X31468
Z1C3	Capacitor Mylar, .015uf, 100V	23783	1R3X31468
Z1C4	Capacitor Electrolytic, 4.7uf, 25V R	74840	
Z1C5	Capacitor Disc, .02uf, 1000V	56289	5GA-S20
Z1C6	Capacitor Electrolytic, 47uf, 6V R	74840	
Z1C7	Capacitor Disc, 2500pf, 1000V	56289	5GA-D25
Z1C8	Capacitor Electrolytic, 1.0uf, 35V R	74840	
Z1C9	Capacitor Disc, 100pf, 1000V	56289	5GA-T10
Z1C10	Capacitor Electrolytic, 47uf, 6V R	74840	
Z1C11	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
Z1C12	Capacitor Mylar, .015uf, 100V	23783	1R3X31468
Z1C13	Capacitor Disc, 25pf, 1000V	56289	5GA-Q25
Z1C14	Capacitor Electrolytic, 4.7uf, 35V	74840	
Z2C1	Capacitor Mylar, .15uf, 100V	23783	1R3X31654
Z2C2	Capacitor Mylar, .15uf, 100V	23783	1R3X31654
Z2C3	Capacitor Disc, .02uf, 1000V	56289	5GA-S20
Z2C4	Capacitor Electrolytic, 4.7uf, 35V R	74840	
Z2C5	Capacitor Tantalum, .68uf, 10V	90201	TDC684M050EL
Z2C6	Capacitor Mylar, .15uf, 100V	23783	1R3X31654
Z3C1	Capacitor Mylar, .0022uf, 250V	23783	1P2D43313
Z3C2	Capacitor Mylar, .0022uf, 250V	23783	1P2D43313
Z3C3	Capacitor Disc, .02uf, 1000V	56289	5GA-S20
Z3C4	Capacitor Electrolytic, 4.7uf, 35V R	74840	
Z3C5	Capacitor Mylar, .068, uf, 100V	23783	1R3X31592
Z1CR1	Diode	01295	1N4148
Z1CR2	Diode	01295	1N4148
Z1CR3	Diode	01295	1N4148
Z1CR4	Diode	09019	2N5172
Z2CR1	Diode	01295	1N4148
Z2CR2	Diode	01295	1N4148
Z3CR1	Diode	01295	1N4148
Z3CR2	Diode	01295	1N4148
Z1Q1	Transistor	01295	T1 S97
Z1Q2	Transistor	01295	2N3906
Z1Q3	Transistor	01295	2N3906
Z1Q4	Transistor	01295	2N3904
Z1Q5	Transistor	01295	2N3906
Z1Q6	Transistor	01295	T1 S97
Z1Q7	Transistor	01295	2N3904
Z1Q8	Transistor	01295	T1 S97
Z1Q9	Transistor	01295	2N3906
Z1Q10	Transistor	01295	2N3904
Z1Q11	Transistor	18714	2N3053
Z1Q12	Transistor	09019	2N5172
Z1Q13	Transistor	09019	2N5172
Z1Q14	Transistor	04713	2N5486

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z2Q1	Transistor	01295	2N3906
Z2Q2	Transistor	01295	2N3906
Z2Q3	Transistor	01295	2N3904
Z2Q4	Transistor	18714	2N3053
Z3Q1	Transistor	01295	2N3906
Z3Q2	Transistor	01295	2N3906
Z3Q3	Transistor	01295	2N3904
Z3Q4	Transistor	18714	2N3053
Z1R1	Resistor Carbon, 1/4W, 5%, 56K	01121	RC07GF563J
Z1R2	Resistor Carbon, 1/4W, 5%, 62K	01121	RC07GF623J
Z1R3	Resistor Carbon, 1/4W, 5%, 36K	01121	RC07GF363J
Z1R4	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R5	Resistor Carbon, 1/4W, 5%, 11K	01121	RC07GF113J
Z1R6	Resistor Metal Film 1/4W 2% 390 ohms	01121	RL07AD391G
Z1R7	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R8	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z1R9	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R10	Resistor Carbon, 1/4W, 2% 3K	01121	RL07AD302G
Z1R11	Resistor Carbon, 1/4W, 5%, 1.1 Meg	01121	RC07GF115J
Z1R12	Resistor Carbon, 1/4W, 5%, 11K	01121	RC07GF113J
Z1R13	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R14	Resistor Carbon, 1/4W, 5%, 62K	01121	RC07GF623J
Z1R15	Resistor Carbon, 1/4W, 5%, 160K	01121	RC07GF164J
Z1R16	Resistor Metal Film 1/4W 2%, 3K	01121	RL07AD302G
Z1R17	Resistor Carbon, 1/4W, 5%, 56K	01121	RC07GF563J
Z1R18	Resistor Carbon, 1/4W, 5%, 150K	01121	RC07GF154J
Z1R19	Resistor Carbon, 1/4W, 5%, 430K	01121	RC07GF434J
Z1R20	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R21	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R22	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J
Z1R23	Resistor Carbon, 1/4W, 5%, 160K	01121	RC07GF164J
Z1R24	Resistor Metal Film 1/4W 2% 560 ohms	01121	RL07AD561G
Z1R25	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J
Z1R26	Resistor Carbon, 1/4W, 5%, 100K	01121	RC07GF104J
Z1R27	Resistor Carbon, 1/4W, 5%, 10 ohms	01121	RC07GF100J
Z1R28	Resistor Carbon, 1/4W, 5%, 56 ohms	01121	RC07GF560J
Z1R29	Resistor Carbon, 1/4W, 5%, 2.2K	01121	RC07GF222J
Z1R30	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z1R31	Resistor Carbon, 1/4W, 5%, 220 ohms	01121	RC07GF221J
Z1R32	Resistor Carbon, 1W, 5%, 390 ohms	01121	RC32GF391J
Z1R33	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R34	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z1R35	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R36	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R37	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R38	Resistor Carbon, 1/4W, 5%, 220K	01121	RC07GF224J
Z1R39	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J



PLAYBACK AMPLIFIER
C 9021 REV. G

FIG. 41. Reproduce Amplifier Schematic

REPRODUCE AMPLIFIER CIRCUIT BOARD
ASSEMBLY NO. PL9104 REV. H

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z2R4	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z2R5	Resistor Carbon, 1/4W, 5%, 270K	01121	RC07GF274J
Z3R1	Resistor Carbon, 1/4W, 5%, 30K	01121	RC07GF303J
Z3R2	Resistor Carbon, 1/4W, 5%, 120K	01121	RC07GF124J
Z3R3	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z3R4	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z3R5	Resistor Carbon, 1/4W, 5%, 1 Meg	01121	RC07GF105J
Z3R6	Resistor Carbon, 1/4W, 5%, 180K	01121	RC07GF184J
Z3R7	Resistor Carbon, 1/4W, 5%, 2K	01121	RC07GF202J
Z3R8	Resistor Carbon, 1/4W, 5%, 27 ohms	01121	RC07GF270J
Z3R9	Resistor Carbon, 1/4W, 5%, 150 ohms	01121	RC07GF151J
Z3R10	Resistor Carbon, 1/4W, 5%, 5.1 ohms	01121	RC07GF5R1J
Z3R11	Resistor Carbon, 1/4W, 5%, 110K	01121	RC07GF114J
Z3R12	Resistor Carbon, 1/4W, 5%, 220K	01121	RC07GF224J
Z3R13	Resistor Carbon, 1/4W, 5%, 680 ohms	01121	RC07GF681J
Z3R14	Resistor Carbon, 1/4W, 5%, 200 ohms	01121	RC07GF201J
Z3R15	Resistor Carbon, 1/4W, 5%, 5.1 ohms	01121	RC07GF5R1J
Z3R16	Resistor Carbon, 1/4W, 5%, 2.2K	01121	RC07GF222J
Z3R17	Resistor Trimmer, 1/4W, 5%, 5K	04880	PT10H2.5 5K
Z3R18	Resistor Trimmer, 1/4W, 5%, 2K	04880	PT10H2.5 2K
Z3R19	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z3R20	Resistor Carbon, 1/4W, 5%, 10 ohms	01121	RC07GF100J
Z3R21	Resistor Carbon, 1/4W, 5%, 510 ohms	01121	RC07GF511J
Z3R22	Resistor Carbon, 1/4W, 5%, 470K	01121	RC07GF474J
Z3R23	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z3R24	Resistor Carbon, 1/4W, 5%, 1 Meg	01121	RC07GF105J
Z3R25	Resistor Carbon, 1/4W, 5%, 27 ohms	01121	RC07GF270J
Z3R26	Resistor Carbon, 1/4W, 5%, 6.2K	01121	RC07GF622J
Z3R27	Resistor Carbon, 1/4W, 5%, 750K	01121	RC07GF754J
Z4R1	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z4R2	Resistor Carbon, 1/4W, 5%, 1 Meg	01121	RC07GF105J
Z1U1	Integrated Circuit	18324	uA709CA
Z3U1	Integrated Circuit	18324	uA709CA
	Head Cable Blk-Wht	27926	A9180-1
	Head Cable Red-Org	27926	A9182-1

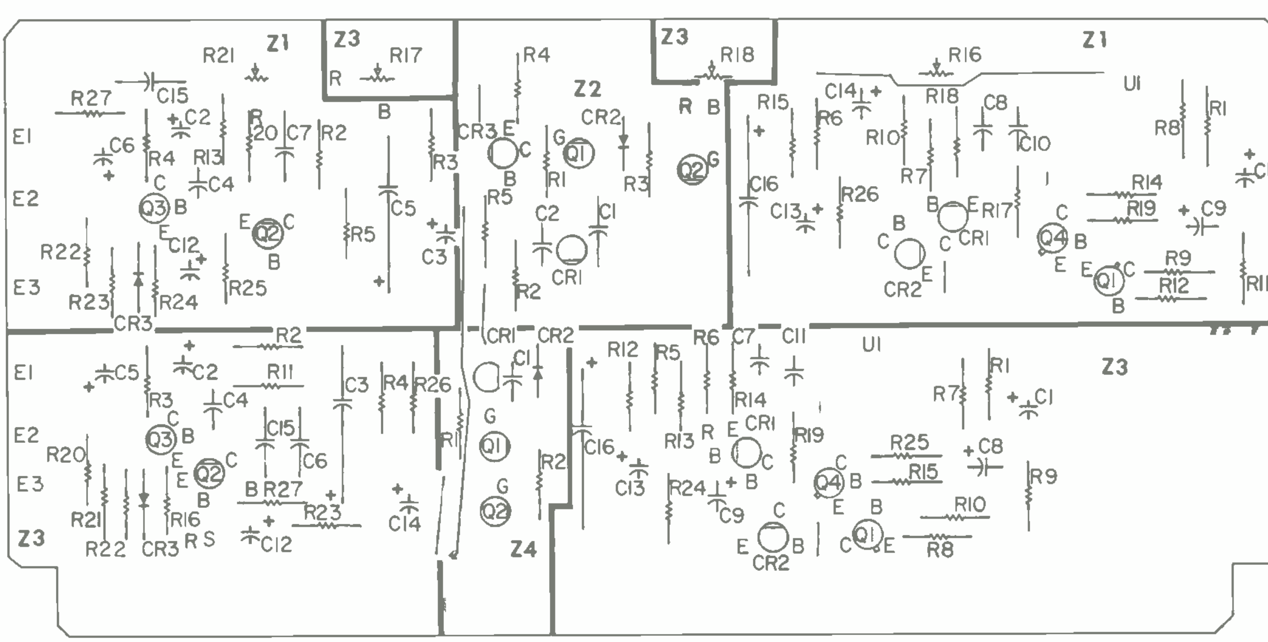


FIG. 40. Reproduce Amplifier P.C. Board Layout

REPRODUCE AMPLIFIER CIRCUIT BOARD
ASSEMBLY NO. PL9104 REV. H

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1C1	Capacitor Electrolytic, 10uf, 35V R	74840	
Z1C2	Capacitor Electrolytic, 10uf, 16V R	74840	
Z1C3	Capacitor Electrolytic, 100uf, 25V R	74840	
Z1C4	Capacitor Disc, 22pf, 1000V	56289	5GA-Q22
Z1C5	Capacitor Mylar, .82uf, 100V	23783	1R1D31795
Z1C6	Capacitor Electrolytic, 47uf, 6V R	74840	
Z1C7	Capacitor Mylar, .015uf, 100V	23783	1R3X31468
Z1C8	Capacitor Disc, 10pf, 1000V	56289	5GA-Q10
Z1C9	Capacitor Electrolytic, 47uf, 25V R	74840	
Z1C10	Capacitor Disc, 390pf, 1000V	56289	5GA-T39
Z1C11	Not Used		
Z1C12	Capacitor Electrolytic, 47uf, 6V R	74840	
Z1C13	Capacitor Electrolytic, 10uf, 35V R	74840	
Z1C14	Capacitor Electrolytic, 47uf, 25V R	74840	
Z1C15	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
Z1C16	Capacitor Mylar, .82uf, 100V	23783	1R1D31795
Z2C1	Capacitor Mylar, .1uf, 100V	23783	1R3X31623
Z2C2	Capacitor Disc, 470pf, 1000V	56289	5GA-T47
Z3C1	Capacitor Electrolytic, 10uf, 35V R	74840	
Z3C2	Capacitor Electrolytic, 10uf, 16V R	74840	
Z3C3	Capacitor Mylar, .82uf, 100V	23783	1R1D31795
Z3C4	Capacitor Disc, 22pf, 1000V	56289	5GA-Q22
Z3C5	Capacitor Electrolytic, 47uf, 6V R	74840	
Z3C6	Capacitor Mylar, .015uf, 100V	23783	1R3X31468
Z3C7	Capacitor Disc, 10pf, 1000V	56289	5GA-Q10
Z3C8	Capacitor Electrolytic, 47uf, 25V R	74840	
Z3C9	Capacitor Electrolytic, 47uf, 25V R	74840	
Z3C10	Not Used		
Z3C11	Capacitor Disc, 390pf, 1000V	56289	5GA-T39
Z3C12	Capacitor Electrolytic, 47uf, 6V R	74840	
Z3C13	Capacitor Electrolytic, 10uf, 35V R	74840	
Z3C14	Capacitor Electrolytic, 100uf, 25V R	74840	
Z3C15	Capacitor Mylar, .022uf, 100V	23783	1R3X31499
Z3C16	Capacitor Mylar, .82uf, 100V	23783	1R1D31795
Z4C1	Capacitor Disc, 470pf, 1000V	56289	5GA-T47
Z1CR1	Diode	09019	2N5172
Z1CR2	Diode	09019	2N5172
Z1CR3	Diode	01295	1N4148
Z2CR1	Diode	09019	2N5232
Z2CR2	Diode	01295	1N4148
Z2CR3	Diode	09019	2N5172
Z3CR1	Diode	09019	2N5172
Z3CR2	Diode	09019	2N5172
Z3CR3	Diode	01295	1N4148
Z4CR1	Diode	09019	2N5232A
Z4CR2	Diode	01295	1N4148
Z1Q1	Transistor	18714	2N3053
Z1Q2	Transistor	01295	T1S97
Z1Q3	Transistor	01295	T1S97
Z1Q4	Transistor	18714	2N4037
Z2Q1	Transistor	04713	2N4342
Z2Q2	Transistor	04713	2N5486
Z3Q1	Transistor	18714	2N3053
Z3Q2	Transistor	01295	T1S97
Z3Q3	Transistor	01295	T1S97
Z3Q4	Transistor	18714	2N4037
Z4Q1	Transistor	04713	2N4342
Z4Q2	Transistor	04713	2N5486
Z1R1	Resistor Carbon, 1/4W, 5%, 30K	01121	RC07GF303J
Z1R2	Resistor Carbon, 1/4W, 5%, 120K	01121	RC07GF124J
Z1R3	Resistor Carbon, 1/4W, 5%, 6.2K		RC07GF622J
Z1R4	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z1R5	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R6	Resistor Carbon, 1/4W, 5%, 1 Meg	01121	RC07GF105J
Z1R7	Resistor Carbon, 1/4W, 5%, 180K	01121	RC07GF184J
Z1R8	Resistor Carbon, 1/4W, 5%, 2K	01121	RC07GF202J
Z1R9	Resistor Carbon, 1/4W, 5%, 27 ohms	01121	RC07GF270J
Z1R10	Resistor Carbon, 1/4W, 5%, 680 ohms	01121	RC07GF681J
Z1R11	Resistor Carbon, 1/4W, 5%, 150 ohms	01121	RC07GF151J
Z1R12	Resistor Carbon, 1/4W, 5%,5.1 ohms	01121	RC07GF5R1J
Z1R13	Resistor Carbon, 1/4W, 5%, 110K	01121	RC07GF114J
Z1R14	Resistor Carbon, 1/4W, 5%, 27 ohms	01121	RC07GF270J
Z1R15	Resistor Carbon, 1/4W, 5%, 220K	01121	RC07GF224J
Z1R16	Resistor Trimmer, 1/4W, 5%, 2K	04880	PT10H2.5 2K
Z1R17	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z1R18	Resistor Carbon, 1/4W, 5%, 200 ohms	01121	RC07GF201J
Z1R19	Resistor Carbon, 1/4W, 5%, 5.1 ohms	01121	RC07GF5R1J
Z1R20	Resistor Carbon, 1/4W, 5%, 2.2K	01121	RC07GF222J
Z1R21	Resistor Trimmer, 1/4W, 5%, 5K	04880	PT10H2.5 5K
Z1R22	Resistor Carbon, 1/4W, 5%, 10 ohms	01121	RC07GF100J
Z1R23	Resistor Carbon, 1/4W, 5%, 510 ohms	01121	RC07GF511J
Z1R24	Resistor Carbon, 1/4W, 5%, 470K	01121	RC07GF474J
Z1R25	Resistor Carbon, 1/4W, 5%, 1.5K	01121	RC07GF152J
Z1R26	Resistor Carbon, 1/4W, 5%, 1 Meg	01121	RC07GF105J
Z1R27	Resistor Carbon, 1/4W, 5%, 750K	01121	RC07GF754J
Z2R1	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z2R2	Resistor Carbon, 1/4W, 5%, 120K	01121	RC07GF124J
Z2R3	Resistor Carbon, 1/4W, 5%, 1 Meg	01121	RC07GF105J

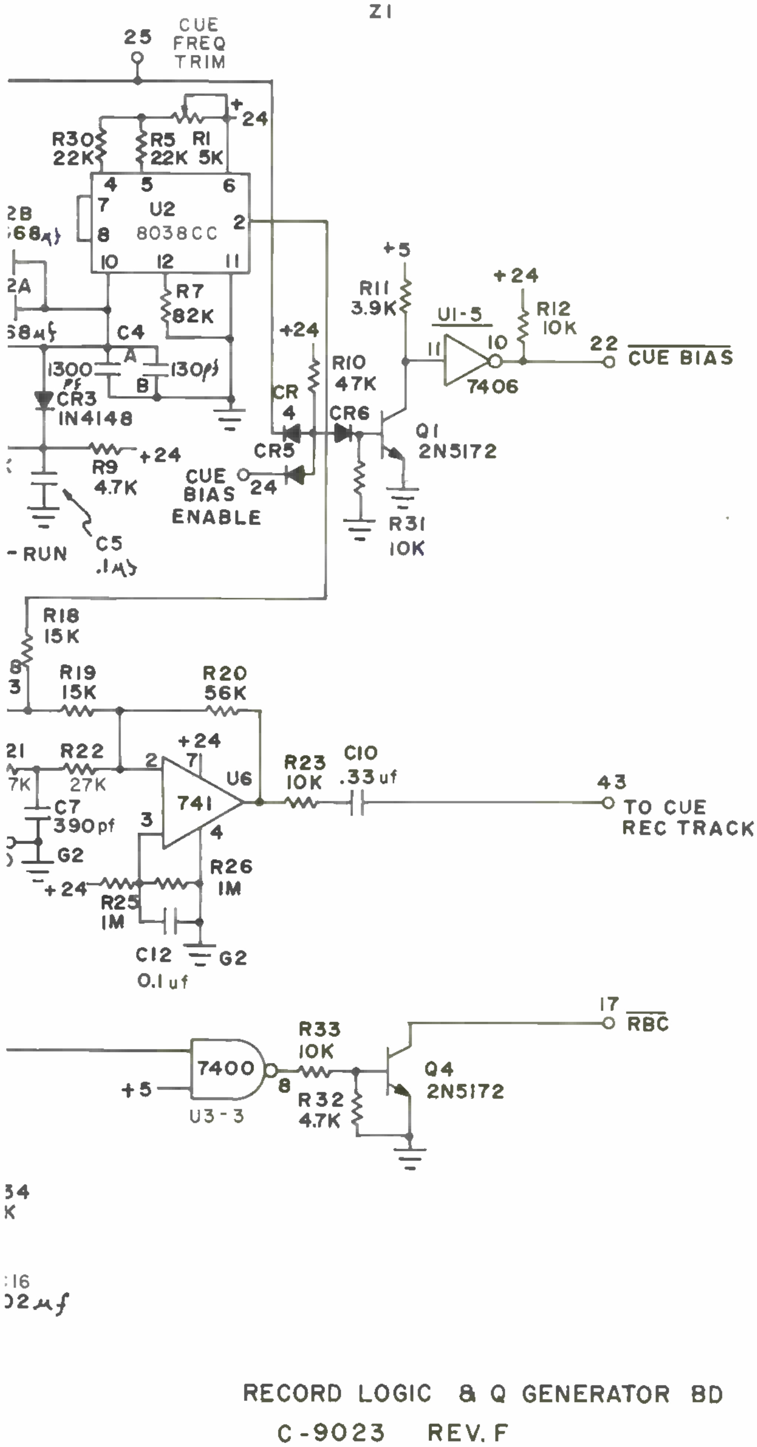


FIG. 39. Record Logic Schematic

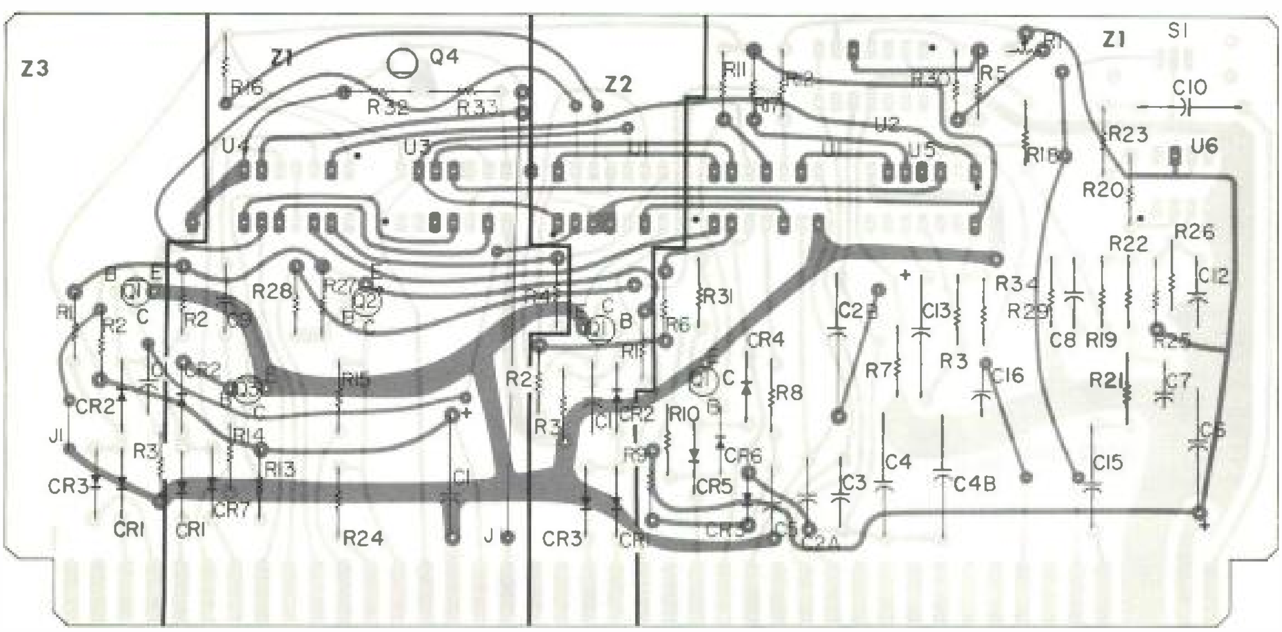
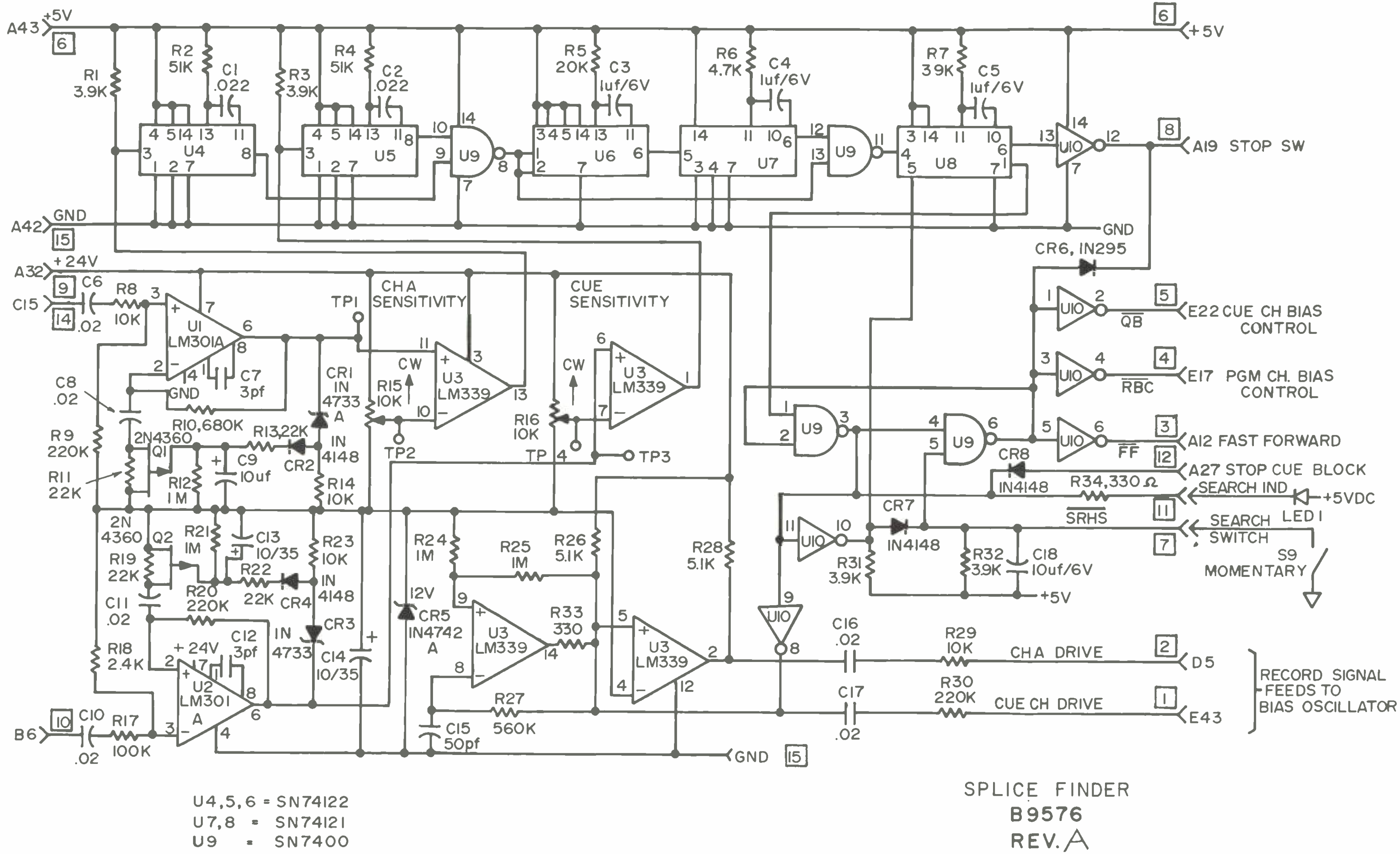


FIG. 38. Record Logic P.C. Board Layout

RECORD LOGIC CIRCUIT BOARD
ASSEMBLY NO. PL9091 REV. H

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1C1	Capacitor Tantalum, 39uf, 10V	90201	CS13BC396K
Z1C2A	Capacitor Mylar, .068uf, 100V	23783	1R3X31592
Z1C2B	Capacitor Polystyrene, .0068uf	90201	SX Series
Z1C3	Capacitor Mylar, .01uf, 100V	23783	1R3X31437
Z1C4	Capacitor Polystyrene, 1.3nf	90201	SX213
Z1C4B	Capacitor Polystyrene, 130pf	90201	SX313
Z1C5	Capacitor Mylar, .1uf, 100V	23783	1R3X31623
Z1C6	Capacitor Tantalum, 4.7uf, 35V	90201	CS13BF475K
Z1C7	Capacitor Disc, 390pf, 1000V	56289	5GA-T39
Z1C8	Capacitor Mylar, .033uf, 100V	23783	1R3X31530
Z1C9	Capacitor Mylar, .1uf, 100V	23783	1R3X31624
Z1C10	Capacitor Mylar, .33uf, 100V	23783	1R3X31717
Z1C11	Not Used		
Z1C12	Capacitor Mylar, .1uf, 100V	23783	1R3X31624
Z1C13	Capacitor Tantalum, 39uf, 10V	90201	CS13BC396K
Z1C14	Not Used		
Z1C15	Capacitor Mylar, .33uf, 100V	23783	1R3X31717
Z1C16	Capacitor Disc, .02uf, 1000V	56289	5GA-S20
Z2C1	Capacitor Electrolytic, 10uf, 35V R	74840	
Z3C1	Capacitor Electrolytic, 10uf, 35V R	74840	
Z1CR1	Diode	01295	1N4004
Z1CR2	Diode	01295	1N4004
Z1CR3	Diode	01295	1N4148
Z1CR4	Diode	01295	1N4004
Z1CR5	Diode	01295	1N4004
Z1CR6	Diode	01295	1N4004
Z1CR7	Diode	01295	1N4004
Z2CR1	Diode	01295	1N4004
Z2CR2	Diode	01295	1N4004
Z2CR3	Diode	01295	1N4004
Z3CR1	Diode	01295	1N4004
Z3CR2	Diode	01295	1N4004
Z3CR3	Diode	01295	1N4004
Z1Q1	Transistor	09019	2N5172
Z1Q2	Transistor	18714	2N4314
Z1Q3	Transistor	09019	2N5172
Z1Q4	Transistor	09019	2N5172
Z2Q1	Transistor	09019	2N5172
Z3Q1	Transistor	09019	2N5172
Z1S1	Switch, Slide	95146	MSS1200R
Z1R1	Resistor Trimmer, 5K	04880	PT10H2.5
Z1R2	Resistor Carbon, 1/4W, 5%, 120K	01121	RC07GF124J
Z1R3	Resistor Carbon, 1/4W, 5%, 18K	01121	RC07GF183J
Z1R4	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z1R5	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
Z1R6	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z1R7	Resistor Carbon, 1/4W, 5%, 82K	01121	RC07GF823J
Z1R8	Resistor Carbon, 1/4W, 5%, 4.3K	01121	RC07GF432J
Z1R9	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J
Z1R10	Resistor Carbon, 1/4W, 5%, 47K	01121	RC07GF473J
Z1R11	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z1R12	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R13	Resistor Carbon, 1/4W, 5%, 27K	01121	RC07GF273J
Z1R14	Resistor Carbon, 1/4W, 5%, 6.2K	01121	RC07GF622J
Z1R15	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R16	Resistor Carbon, 1/4W, 5%, 3.9K	01121	RC07GF392J
Z1R17	Resistor Carbon, 1/4W, 5%, 1K	01121	RC07GF102J
Z1R18	Resistor Carbon, 1/4W, 5%, 15K	01121	RC07GF153J
Z1R19	Resistor Carbon, 1/4W, 5%, 15K	01121	RC07GF153J
Z1R20	Resistor Carbon, 1/4W, 5%, 56K	01121	RC07GF563J
Z1R21	Resistor Carbon, 1/4W, 5%, 27K	01121	RC07GF273J
Z1R22	Resistor Carbon, 1/4W, 5%, 27K	01121	RC07GF273J
Z1R23	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R24	Resistor Carbon, 1/4W, 5%, 100 ohms	01121	RC07GF101J
Z1R25	Resistor Carbon, 1/4W, 5%, 1 Meg	01121	RC07GF105J
Z1R26	Resistor Carbon, 1/4W, 5%, 1Meg	01121	RC07GF105J
Z1R27	Resistor Carbon, 1/4W, 5%, 820 ohms	01121	RC07GF821J
Z1R28	Resistor Carbon, 1/4W, 5%, 2.7K	01121	RC07GF272J
Z1R29	Resistor Carbon, 1/4W, 5%, 1.2K	01121	RC07GF122J
Z1R30	Resistor Carbon, 1/4W, 5%, 22K	01121	RC07GF223J
Z1R31	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R32	Resistor Carbon, 1/4W, 5%, 4.7K	01121	RC07GF472J
Z1R33	Resistor Carbon, 1/4W, 5%, 10K	01121	RC07GF103J
Z1R34	Resistor Carbon, 1/4W, 5%, 1K	01121	RC07GF102J
Z2R1	Resistor Carbon, 1/4W, 5%, 13K	01121	RC07GF133J
Z2R2	Resistor Carbon, 1/4W, 5%, 2.7K	01121	RC07GF272J
Z2R3	Resistor Carbon, 1/4W, 5%, 470 ohms	01121	RC07GF471J
Z3R1	Resistor Carbon, 1/4W, 5%, 13K	01121	RC07GF133J
Z3R2	Resistor Carbon, 1/4W, 5%, 2.7K	01121	RC07GF272J
Z3R3	Resistor Carbon, 1/4W, 5%, 470 ohms	01121	RC07GF471J
Z1U1	Integrated Circuit	01295	SN7406N-00
Z1U2	Integrated Circuit	32293	8038CC
Z1U3	Integrated Circuit	01295	SN7400N-00
Z1U4	Integrated Circuit	01295	SN7410N-00
Z1U5	Integrated Circuit	01295	SN7412N-00
Z1U6	Integrated Circuit	18324	uA741CA
Z2U1	Integrated Circuit	01295	SN7410N-00



U4,5,6 = SN74122
U7,8 = SN74121
U9 = SN7400
U10 = SN7406

FIG. 49. Splice Finder Schematic

FAST FORWARD CIRCUIT BOARD
ASSEMBLY NO. PL-9172 REV. C

REF. SYM.	DESCRIPTION	MFR'S. CODE	MFR'S. PART NO.
C1	Capacitor Mylar, .luf, 500V	23783	1R1D59624
C2	Capacitor Mylar, .luf, 500V	23783	1R1D59624
C3	Capacitor Mylar, .luf, 500V	23783	1R1D59624
C4	Capacitor Mylar, .luf, 500V	23783	1R1D59624
C5	Capacitor Mylar, 2uf, 400V	72928	363E205
K1	Relay, 4PDT	27926	A7587-1
R1	Resistor Carbon, 1/2W, 5%, 10 ohms	01121	RC20GF100J
R2	Resistor Carbon, 1/2W, 5%, 10 ohms	01121	RC20GF100J
R3	Resistor Carbon, 1/2W, 5%, 10 ohms	01121	RC20GF100J
R4	Resistor Carbon, 1/2W, 5%, 10 ohms	01121	RC20GF100J

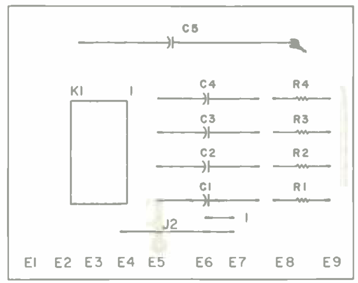


FIG. 50. Fast Forward P.C. Board Layout

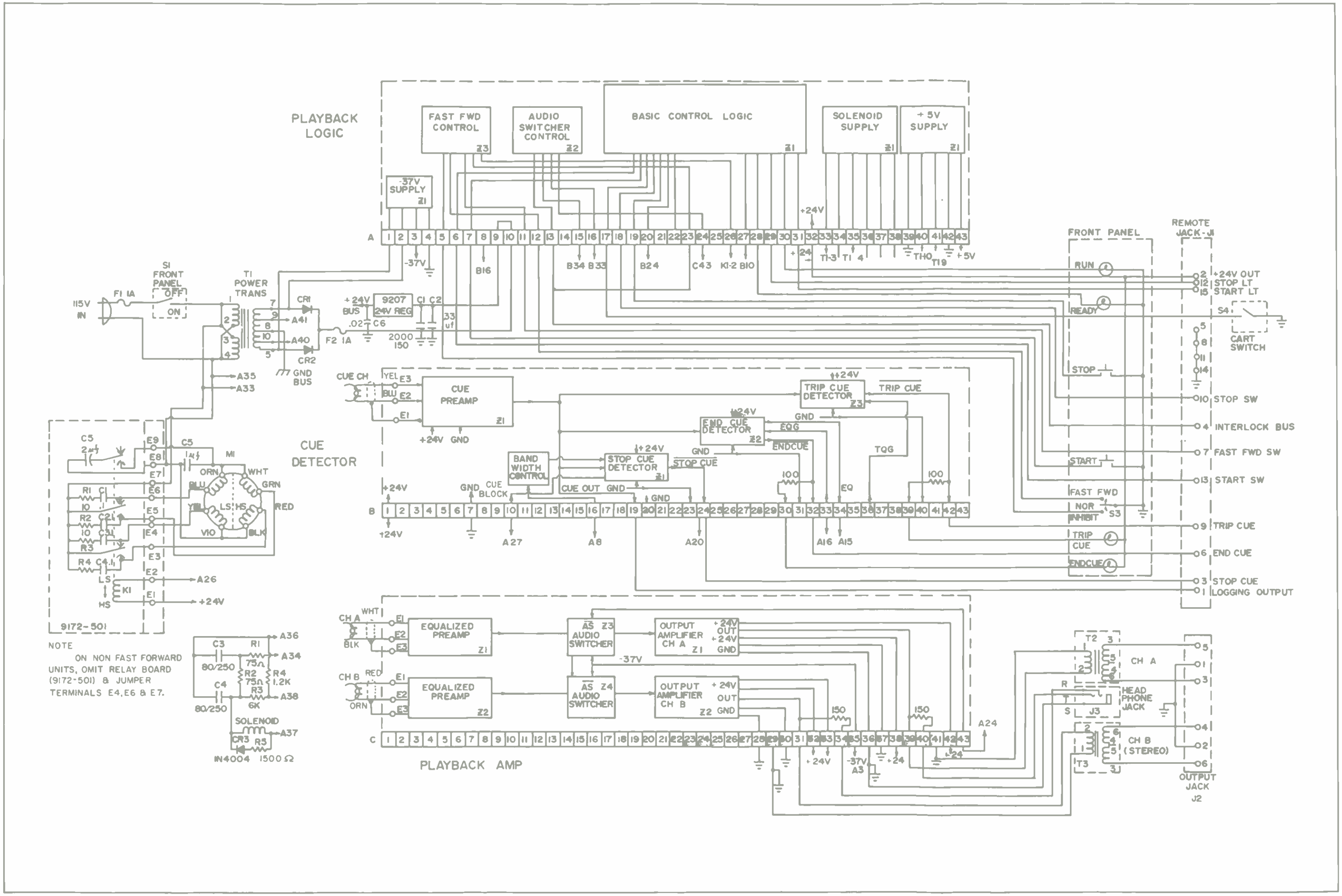
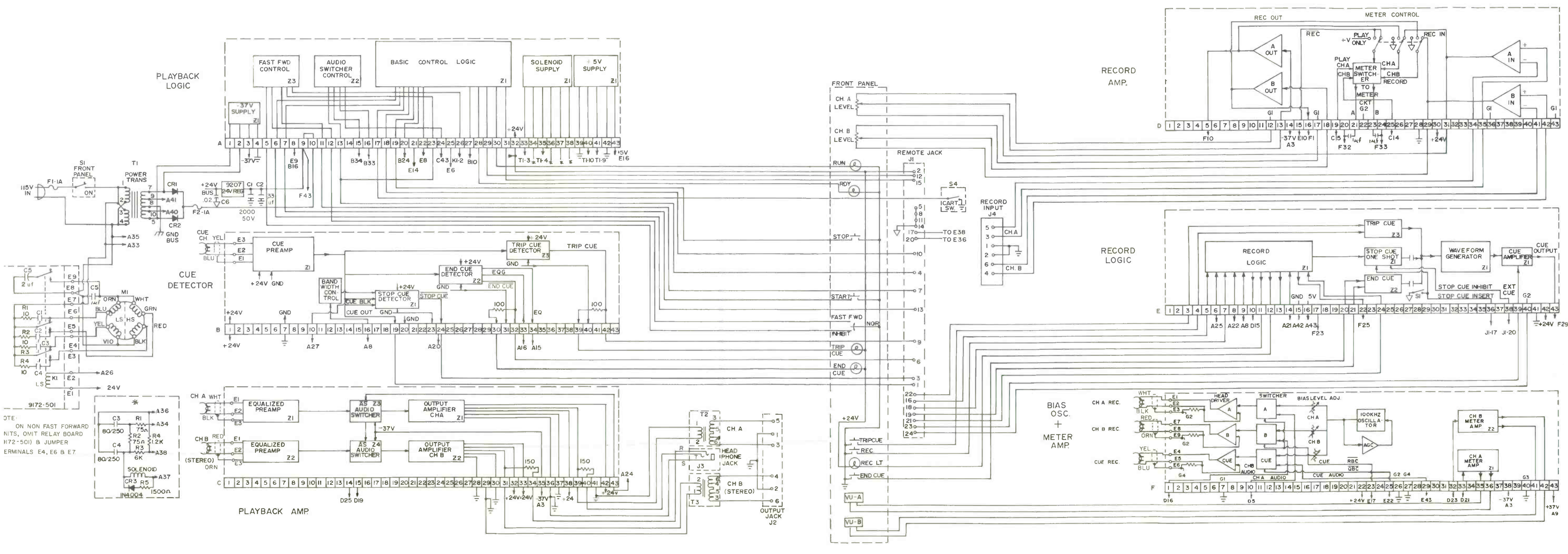


FIG. 51. Chassis Inter-Connect Diagram Reproducer



J1

REMOTE CONNECTIONS

PIN	FUNCTION
1	CUE OUT
2	+24V
3	STOP CUE
4	INTL BUS
5	GND
6	END CUE LT.
7	FAST FWD
8	GND
9	TRIP CUE LT.
10	STOP PUSHBUTTON
11	GND
12	STOP LT.
13	START PUSHBUTTON
14	GND
15	START LT.
16	RECORD PUSHBUTTON
17	STOP CUE INSERT
18	RECORD LT.
19	ENDCUE PUSHBUTTON
20	STOP CUE INHIBIT
21	CUE BIAS ENABLE
22	TRIPCUE PUSHBUTTON
23	CUE INPUT HIGH
24	CUE INPUT LOW

FIG. 52. Chassis Inter-Connect Diagram Record