

# INSTRUCTION MANUAL

MODEL 5409C AND 5410C  
RECORDERS FOR 5000  
SERIES CARTRIDGE  
MACHINES

NOVEMBER, 1983 IM NO. 597-0097-001

BROADCAST ELECTRONICS, INC.





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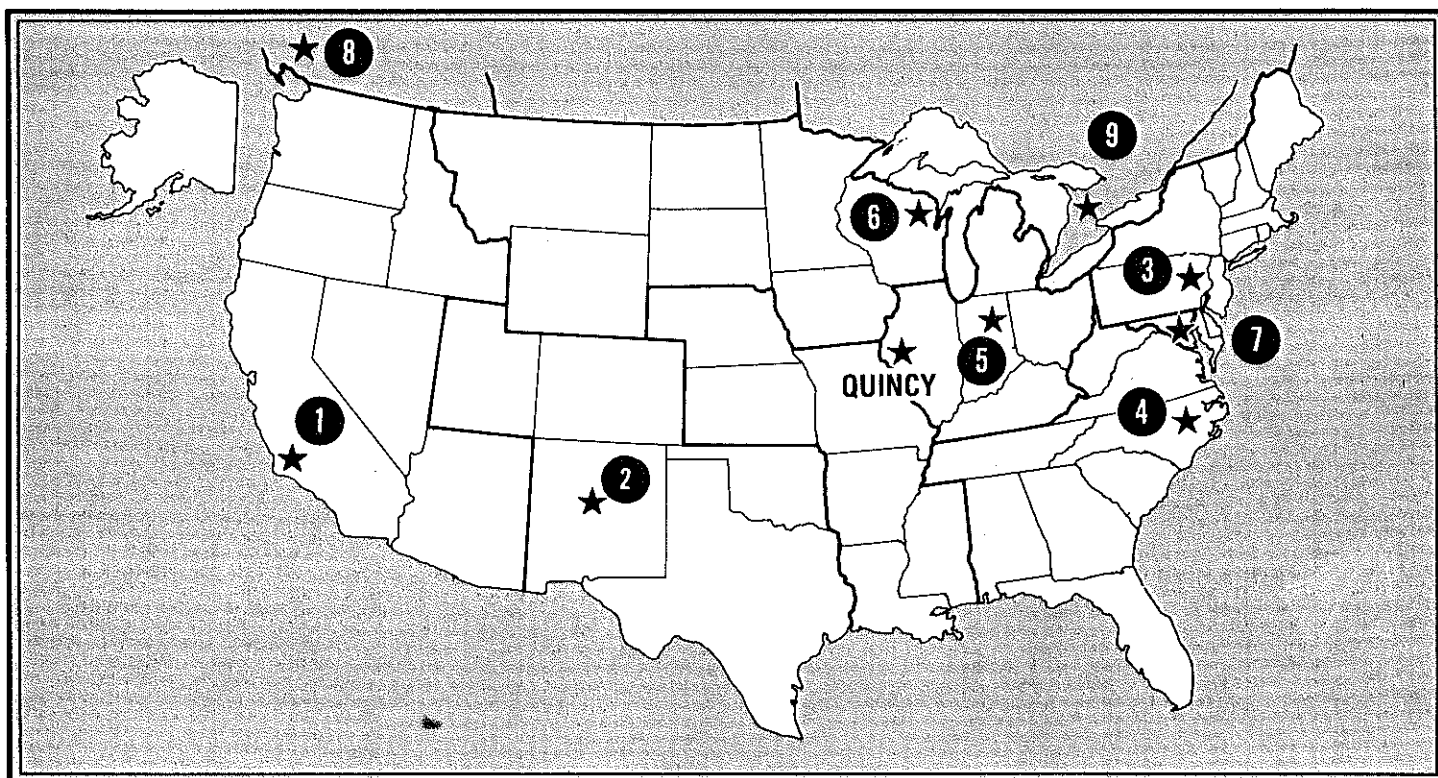
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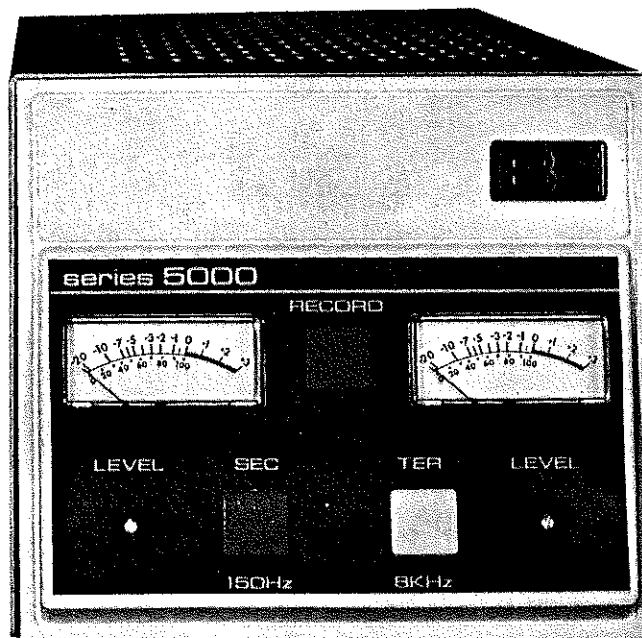
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**BROADCAST  
ELECTRONICS INC**

TECHNICAL MANUAL  
597-0097-001  
MODEL 5409C AND 5410C RECORDERS  
FOR 5000C SERIES CARTRIDGE MACHINES



<u>MODEL</u>	<u>PART NUMBER</u>	<u>DESCRIPTION</u>
5409	900-5409-011	Monophonic Recorder for 5300C/5400C/5500C and 9000 Series Cartridge Machines, 117V ac 60 Hz Operation.
5409C	900-5409-311	Monophonic Recorder for 5300C/5400C/5500C and 9000 Series Cartridge Machines, 220V ac 50 Hz Operation.
5410	900-5410-011	Stereophonic Recorder for 5300C/5400C/5500C and 9000 Series Cartridge Machines, 117V ac 60 Hz Operation.
5410C	900-5410-311	Stereophonic Recorder for 5300C/5400C/5500C and 9000 Series Cartridge Machines, 220V ac 50 Hz Operation.

#### OPTIONAL ASSEMBLIES

----	XXX-XXXX-050	Unit Designed for Rack Mounting.
----	XXX-XXXX-350	Unit Designed for Rack Mounting, 220V ac 50 Hz Operation.

#### ACCESSORIES

----	970-0095	Recommended Spare Parts Kit.
----	900-5406	Rack Mount Shelf for E1A 19 Inch Rack.
----	900-5415	Rack Shelf Filler Panel, 1/2 Rack.
----	900-5408	Rack Shelf Filler Panel, 1/2 Rack.

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SECTION I  
GENERAL INFORMATION

1-1.        INTRODUCTION.

1-2.        Information presented by this section provides a general description of the Broadcast Electronics 5409C and 5410C Recorders and lists equipment specifications.

1-3.        RELATED PUBLICATIONS.

1-4.        The following list of publications provides data required for the installation and adjustment of the 5409C and 5410C Recorders.

<u>PUBLICATION NUMBER</u>	<u>EQUIPMENT</u>
597-5301-001	5300C Cartridge Machine
597-5000-001	5400C/5500C Cartridge Machine
597-9000	9000 Cartridge Machine

1-5.        EQUIPMENT DESCRIPTION.

1-6.        The Broadcast Electronics monophonic 5409C and stereophonic 5410C Recorders provide the 5000C and 9000 Series Cartridge Machines with full record capability. The recorder system consists of a record amplifier unit, a cartridge machine record head assembly, and all associated cartridge machine interfacing cables. A wide range of optional assemblies provide flexibility for any installation requirement.

1-7.        The recorder operates in conjunction with the bottom deck of the cartridge machine. All recorder units are equipped with primary (1 kHz), secondary (150 Hz), and tertiary (8 kHz) cue tone record functions.

1-8.        All recorder circuitry is located on three plug-in circuit boards. Front-panel VU meter(s) provide accurate record level indications. The record level is adjusted through front-panel control(s).

1-9.        SPECIFICATIONS.

1-10.       Refer to Table 1-1 for electrical, physical, and environmental specifications of the Broadcast Electronics 5409C and 5410C Recorders.

TABLE 1-1. ELECTRICAL, PHYSICAL, AND ENVIRONMENTAL SPECIFICATIONS

PARAMETER	SPECIFICATIONS
<u>ELECTRICAL</u>	
INPUT IMPEDANCE	50 k Ohms, Transformer Balanced.
INPUT LEVEL	-20 dBv to +20 dBv.
POWER REQUIREMENTS	
Standard	105V to 125V ac 60 Hz.
Optional	210V to 230V ac 50 Hz.
OPERATING PARAMETERS	Operating Specifications are determined by the Companion Cartridge Machine. Refer to the Cartridge Machine Instruction Manual as Required.
<u>PHYSICAL</u>	
WEIGHT (Unpacked)	8 Pounds (3.6 kg).
DIMENSIONS:	
Height	5.25 Inches (13.3 cm).
Width	5.75 Inches (14.6 cm).
Depth	17.6 Inches (44.7 cm).
<u>ENVIRONMENTAL</u>	
AMBIENT OPERATING TEMPERATURE	+32°F to +122°F (0°C to +50°C).
ALTITUDE	0 to 15,000 Feet (4572 m) Above Sea Level.
HUMIDITY	95% Maximum, Non-Condensing.

## SECTION II INSTALLATION

### 2-1. INTRODUCTION.

2-2. This section contains information required for the installation of the Broadcast Electronics 5409 and 5410 Recorders.

### 2-3. UNPACKING.

2-4. The equipment becomes the property of the customer when the equipment is delivered to the carrier. Carefully unpack the recorder. Perform a visual inspection to determine that no apparent damage has been incurred during shipment. All shipping materials should be retained until it is determined that the unit has not been damaged. Claims for damaged equipment must be promptly filed with the carrier or the carrier may not accept the claim.

2-5. The contents of the shipment should be as indicated on the packing list. If the contents are incomplete, or if the unit is damaged electrically or mechanically, notify both the carrier and Broadcast Electronics, Inc.

### 2-6. INSTALLATION.

2-7. The 5409 and 5410 recorders may be ordered and pre-installed at the factory with a companion cartridge machine or purchased at a later date and field installed. Therefore, perform the procedures listed below for the type of installation required.

- A. For recorders requiring field installation, perform the following procedures:
  - 1. Record Head Assembly Installation.
  - 2. Recorder Placement.
  - 3. Recorder/Cartridge Machine Interface Cable Connections.
  - 4. AC Power Connection.
  - 5. Mechanical Adjustments.
  - 6. Electrical Adjustments.
- B. For factory pre-installed recorders, perform the following procedures:
  - 1. Recorder Placement.
  - 2. Recorder/Cartridge Machine Interface Cable Connections.
  - 3. AC Power Connection.

2-8. RECORD HEAD ASSEMBLY INSTALLATION.

WARNING

DISCONNECT ALL CARTRIDGE MACHINE POWER BEFORE PROCEEDING.

2-9. Disconnect all cartridge machine power.

2-10. To install a record head in a 5000C series cartridge machine bottom deck, removal of the upper decks is required. Refer to the DECK ACCESS AND REMOVAL procedure in SECTION V, MAINTENANCE of the applicable cartridge machine manual and remove the upper decks.

2-11. Disconnect the head lead assembly from the record head.

2-12. Route the head lead assembly through the cartridge machine as shown in the following drawings located in SECTION VII, DRAWINGS.

<u>DRAWING</u>	<u>CARTRIDGE MACHINE</u>
900-5309/ -5310-001	5300C
900-5409/ -5410	5400C
900-5509/ -5510	5500C
597-0097-70	9000

2-13. The record head replaces the dummy head in the head assembly. Install the record head by performing the HEAD REPLACEMENT procedure described in SECTION V, MAINTENANCE of the applicable cartridge machine manual. The record head lead connections are identical to the playback connections. Do not connect ac power, perform the head adjustments, or replace the decks at this time.

2-14. Reference the following list and remove the blank-plate from the connector opening on the cartridge machine rear-panel or interface panel. Retain the two Phillips-head mounting screws.

<u>CONNECTOR OPENING</u>	<u>CARTRIDGE MACHINE</u>
J401	5300C 5400C
J601	5500C
J119	9000

2-15. Install the 9-pin record connector in the opening using the two Phillips-head mounting screws.

2-16. The 9000 series cartridge machine requires a multiple conductor ribbon cable be installed internal to the unit. Refer to drawing 597-0097-70 in SECTION VII, DRAWINGS, and install the ribbon cable as shown.

2-17. RECORDER PLACEMENT.

2-18. The standard 5409C and 5410C Recorders are designed for desk-top placement. Rack mounted units are available by optional assembly. Place the recorder in any convenient location near the cartridge machine which allows the connection of the interface cables.

2-19. RECORDER/CARTRIDGE MACHINE INTERFACE CABLE CONNECTIONS.

2-20. Connect the recorder interface cables to the cartridge machine connectors as shown in the following drawings located in SECTION VII, DRAWINGS.

<u>DRAWING</u>	<u>CARTRIDGE MACHINE</u>
900-5309/ -5310-001	5300C
900-5409/ -5410	5400C
900-5509/ -5510	5500C
597-0097-70	9000

2-21. All record inputs and remote control functions enter the recorder through the rear-panel INPUT/REMOTE connector. Wiring diagram 900-5309/-5310-001/-5409/-5410 in SECTION VII, DRAWINGS presents the INPUT/REMOTE connector pin designations. An INPUT/REMOTE mating connector (located in the recorder accessory parts kit) is provided with the unit for record input and remote control cable interfacing.

2-22. Connect the record inputs to the INPUT/REMOTE mating connector with 2 conductor shielded audio cable such as Belden 8451 or Alpha 2400. For remote control operations, connect a single conductor to ground through a normally-open momentary-contact switch.

2-23. AC POWER CONNECTION.

2-24. The standard 5409C and 5410C recorders operate from a primary input potential of 117V ac at 60 Hz. Recorder units which operate from a primary input potential of 220V ac at 50 Hz are available by optional assembly. Operate the recorder rear-panel ON/OFF switch to OFF and connect line cord to the appropriate power supply.



2-25. MECHANICAL ADJUSTMENTS.

WARNING

ENSURE ALL CARTRIDGE MACHINE PRIMARY POWER  
IS DISCONNECTED BEFORE PROCEEDING.

2-26. Refer to the MECHANICAL ADJUSTMENTS procedure in SECTION V, MAINTENANCE and perform all associated mechanical adjustments for the playback and record heads.

2-27. ELECTRICAL ADJUSTMENTS.

2-28. Refer to the ELECTRICAL ADJUSTMENTS procedures in SECTION V, MAINTENANCE and perform all associated CUE CIRCUITRY ADJUSTMENTS and METER ADJUSTMENTS.

SECTION III  
OPERATION

3-1. INTRODUCTION.

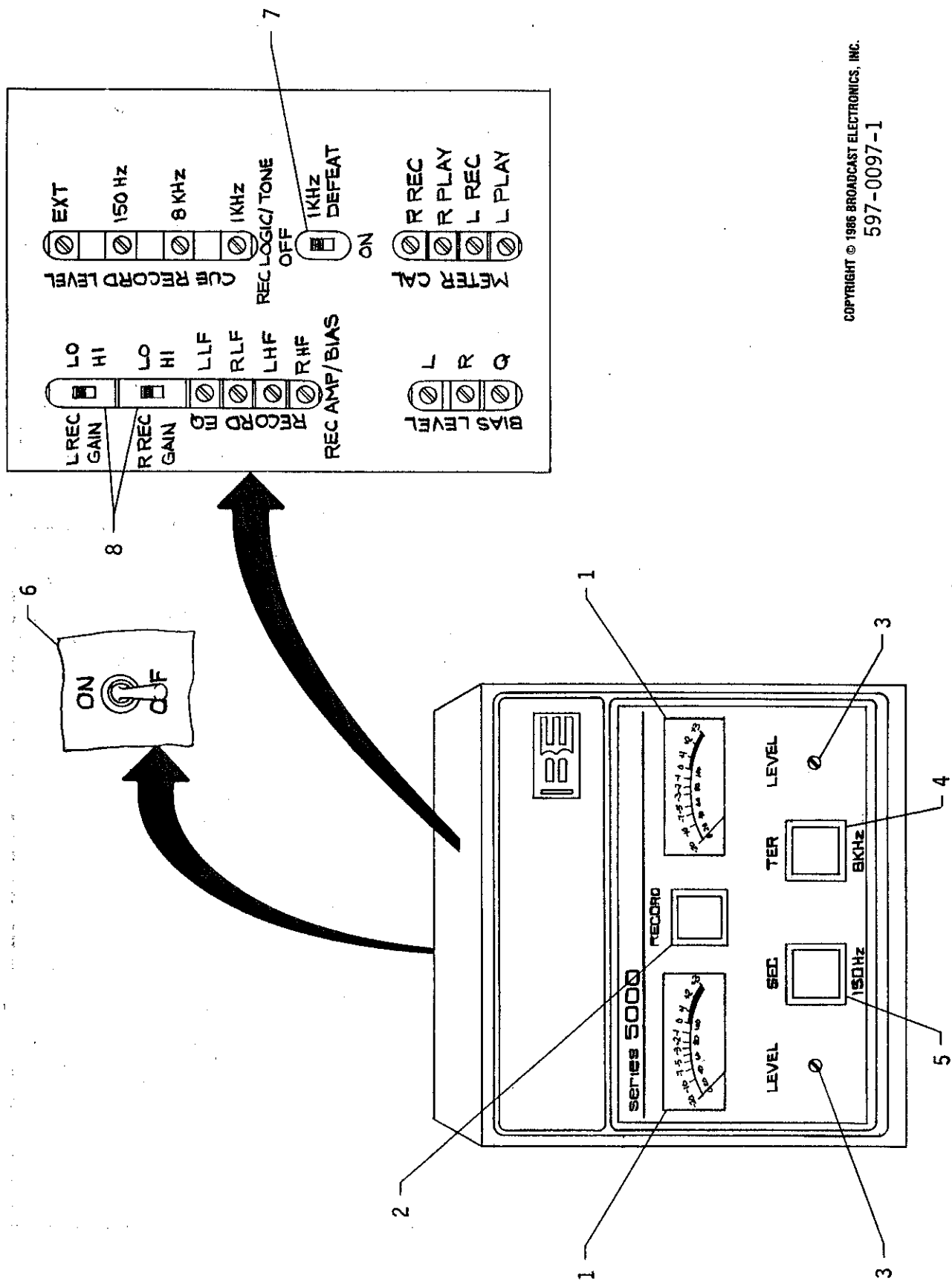
3-2. This section identifies all controls and indicators associated with the 5409C and 5410C Recorders and provides standard operating procedures.

3-3. CONTROLS AND INDICATORS.

3-4. Refer to Figure 3-1 for the location of all controls and indicators associated with the 5409C and 5410C Recorders. The function of each control or indicator is described by Table 3-1.

TABLE 3-1. CONTROLS AND INDICATORS  
(Sheet 1 of 2)

INDEX NO.	NOMENCLATURE	FUNCTION
1	VU Meter	Provides level indication of the record signal. Also, provides level indication of playback audio from a 5300C series cartridge machine record deck.
2	RECORD Switch/Indicator	SWITCH: Operates the recorder into record mode.  INDICATOR: Illuminates to indicate the recorder is operating in the record mode.
3	LEVEL Control	Adjusts the record level.
4	TER/8 KHz Switch	When depressed, records an 8 kHz tertiary cue tone on the cue track. The tertiary cue tone may be recorded when the recorder is operating in the record or playback mode.
5	SEC/150 Hz Switch	When depressed, records a 150 Hz secondary cue tone on the cue track. The secondary cue tone may be recorded when the recorder is operating in the record or playback mode.
6	ON/OFF Switch	Controls the application of ac power to the recorder.



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FIGURE 3-1. RECORDER CONTROLS AND INDICATORS

TABLE 3-1. CONTROLS AND INDICATORS  
(Sheet 2 of 2)

INDEX NO.	NOMENCLATURE	FUNCTION
7	1 KHz REC ON/OFF Switch	Controls the recorder 1 kHz cue tone record circuitry.  OFF: Disables the 1 kHz cue tone record circuitry. No affect on previously recorded tones.  ON: Enables the 1 kHz cue tone record circuitry. The tone is recorded at the beginning of program material.
8	R REC GAIN HI/LO and L REC GAIN HI/LO Switches	Controls the gain of the program amplifier circuitry.  HI Position: For low level inputs (Not applicable for 5409C and 5410C recorders).  LO Position: For high level inputs.

3-5. OPERATION.

3-6. RECORDER AND CARTRIDGE MACHINE PRELIMINARY SET-UP.

3-7. Select the program material to be recorded. Ensure the playback system output level is within recorder input level specifications.

3-8. Remove the recorder top-panel. Operate the L REC GAIN HI/LO and R REC GAIN HI/LO switches to the LO positions.

3-9. Operate the 1 kHz REC ON/OFF switch to the desired position.

3-10. Replace the recorder top-panel.

3-11. Operate the recorder and the cartridge machine ON/OFF power switches to ON.

3-12. Select a bulk erased cartridge that is approximately 2 seconds longer than the selected material to be recorded.

3-13. Insert the cartridge into the record deck. The record deck STOP switch/indicator will illuminate.

3-14. Start the record deck. Play the tape for several seconds to align the tape in the guides and to locate the tape splice. Stop the record deck just beyond the tape splice to avoid recording on the splice.

3-15. RECORD LEVEL ADJUSTMENT.

NOTE THE RECORDER WILL NOT OPERATE TO THE RECORD  
MODE UNLESS A CARTRIDGE IS INSERTED IN THE  
NOTE RECORD DECK.

NOTE ALL RECORDERS ARE SHIPPED FROM THE FACTORY  
FOR A RECORD LEVEL OF 0 dBm WHEN THE VU  
NOTE METERS INDICATE 0 VU.

3-16. Ensure a bulk erased cartridge is inserted into the record deck.

3-17. Operate the recorder to the record mode by depressing the RECORD switch/indicator. The RECORD indicator will illuminate.

3-18. Start the program material.

3-19. Adjust the recorder LEVEL control(s) until the VU meter(s) indicate 0 VU.

3-20. Stop and re-cue the program material.

3-21. RECORDING PROGRAM MATERIAL.

3-22. Ensure the recorder is operated to the record mode. The RECORD switch indicator will be illuminated.

3-23. Depress the record deck START switch/indicator. The START switch/indicator will illuminate.

3-24. Wait approximately one-half second, then start the program material. If the 1 kHz cue tone record circuitry is enabled, a stop tone will be automatically recorded on the cue track.

NOTE THE RECORDING PROCESS MAY BE MONITORED IF  
DESIRED BY CONNECTING A SPEAKER SYSTEM TO  
NOTE THE RECORD DECK OUTPUT.

3-25. At the end of the program material, stop the record deck manually by depressing the STOP switch/indicator if the 1 kHz stop tone record circuitry is disabled. If the 1 kHz record circuitry is enabled, the tape will stop automatically.

3-26. When the record deck is stopped, the following events will occur:



- A. The record deck STOP switch/indicator will illuminate, indicating a ready status.
- B. The recorder will automatically be operated to the playback mode. The RECORD switch/indicator will extinguish.

3-27. SECONDARY AND TERTIARY CUE TONE RECORDING.

3-28. Secondary and tertiary cue tones may be recorded in the playback or record modes of operation. If secondary and tertiary cue tone recording is desired, proceed as follows:

NOTE

DO NOT RECORD SECONDARY OR TERTIARY CUE TONE  
WITHIN THE FIRST 2.5 SECONDS OF THE PROGRAM  
MATERIAL.

NOTE

- A. Start the recording system in the playback mode or record mode of operation.
- B. Depress the SEC/150 Hz switch or the TER/8 KHz switch for the amount of time the tone is desired. Do not record a secondary or tertiary cue tone of less than one second.

SECTION IV  
THEORY OF OPERATION

4-1.        INTRODUCTION.

4-2.        This section presents the theory of operation for the Broadcast Electronics 5409C and 5410C recorders.

4-3.        FUNCTIONAL DESCRIPTION.

4-4.        RECORD AMPLIFIER/BIAS CIRCUIT BOARD.

4-5.        PROGRAM CHANNELS. The following text describes the operation of the left and right program channel amplifier circuits. The circuits operate identically, therefore only the left channel circuit will be described. Refer to schematic 910-1050/-1049/-1048 as required.

4-6.        Left channel record inputs are applied to input transformer T1 which provides balanced-to-unbalanced impedance conversion. The input impedance is determined by resistors R1, R2, and R3. Audio from the secondaries of T1 is applied to first-stage non-inverting amplifier U1A. The gain of U1A is determined by switch S1. S1 shunts feedback resistor R7 in the L0 position and provides an additional gain of 35 dB in the HI position.

4-7.        Amplified audio from U1A is routed through coupling capacitor C6 to front-panel record level control R1. From R1, audio is returned to the record amplifier/bias circuit board and applied to second-stage non-inverting amplifier U2A. The gain of U2A is established by feedback resistor R11. The output of U2A is routed through capacitor C6 to the circuit equalization network.

4-8.        The equalization network consists of U3A, U3B, R14, R19, and subsequent associated circuitry. Low frequency equalization control R14 and operational amplifier U3A provide low frequency compensation. High frequency equalization control R19 and operational amplifier U3B provide high frequency compensation.

4-9.        The equalized signal is applied to the record head drive transistor (Q1). The output of Q1 is applied to transistor Q2 which operates as a program record control switch. Q2 is controlled by the program control line (pin 16). When the system is operated to the record mode, a ground from the program control line is applied through diode D1 to Q2. This ground biases Q2 on which routes program audio through record bias trap L1/C15 to the record head. When the system is operated to the playback mode, a positive voltage from the program control line reverse biases D1 and disables transistor Q2.

4-10. Program Record Head Shunt Circuit. A circuit consisting of D2, Q3, D3, Q4, and associated circuitry shunts the record head inputs to ground when the system is in the playback mode. This circuit is required to prevent the application of bias to the record head when recording secondary and tertiary cue tones in the playback mode.

4-11. Transistor Q3 controls the operation of the shunt circuit. When the system is operated to the playback mode, a positive voltage from the program control line reverse biases diode D2 and disables transistor Q3. With Q3 cut-off, voltage is applied through zener diode D3 to transistor Q4. This voltage biases Q4 on which shunts the record head input terminals to ground. When the system is operated to the record mode, a ground biases D2 on and enables Q3. With Q3 enabled, bias for transistor Q4 is shunted to ground.

4-12. Record Bias Circuit. Record bias from the secondary of bias transformer T3 is routed through LDR1 and left channel bias level control R31 to the left channel program amplifier circuit. LDR1 is controlled by the program control line and provides isolation for the application of bias. Bias is applied to the amplifier circuit when a ground from the program control line disables transistor Q14. With Q14 cut-off, bias voltage is applied to LDR1.

4-13. Left channel bias level control R31 permits the adjustment of the recording bias level for minimum distortion, maximum signal to noise ratio, and maximum frequency response. Left channel bias trap L1/C15 isolates the bias signal from the amplifier circuitry to prevent possible intermodulation distortion of the program audio.

4-14. CUE CHANNEL. Cue record inputs from the record control and tone generator circuit board are applied to cue bias trap L3/C42 which isolates the bias signal from the cue channel driving circuit. Transistors Q12, Q13, and associated circuitry function as a cue record head shunt circuit. The operation of the circuit is controlled by the cue bias switch control line (pin 20). When cue channel recording is required, a positive voltage from the cue bias switch control line is applied to Q12, biasing Q12 on. With Q12 on, transistor Q13 is cut-off which allows cue audio to be routed to the cue record head. When cue channel recording is not required, a ground from the cue bias switch control line disables Q12. With Q12 cut-off, bias is applied to Q13 which shunts the cue record head inputs to ground.

4-15. BIAS OSCILLATOR. The push-pull oscillator consisting of Q9 and Q10 provides a 100 kHz low distortion sine wave for record bias in the left channel, right channel, and cue channel record heads. Positive feedback from the collector of Q9 is applied through C37 to Q10. C38 provides positive feedback from the collector of Q10 to Q9. Operating frequency is determined by the inductance of T3 and the capacitance of C39. Low distortion is achieved by a small amount of negative feedback from emitter resistors R63, R64, and capacitor C36. Capacitor C40 minimizes start-up transients by providing a gradual turn-on of oscillation.

4-16. Control logic on the record control and tone generator circuit board enables the bias oscillator when: 1) the system is operated to the record mode and 2) the system is required to record secondary, tertiary, or external cue tones. When record bias is required, a ground from the bias switch control line is applied to bias switch transistor Q11. This ground enables Q11 which routes a +24V supply to the oscillator. When record bias is not required, a positive voltage is applied to transistor Q11. Q11 is cut-off which removes the supply voltage from the oscillator.

4-17. VOLTAGE REGULATOR. A voltage regulator consisting of Q5, C20, C18, and resistor R35 regulates the +24 volt power supply for proper circuit operation.

4-18. RECORD CONTROL AND TONE GENERATOR CIRCUIT BOARD.

4-19. GENERAL. The record and tone generator circuit board houses the record logic circuit, the VU meter amplifier circuits, and three cue tone generator circuits. Refer to schematic 906-3112 as required for the following discussion.

4-20. RECORD LOGIC CIRCUIT. A bistable multivibrator consisting of transistors Q8 and Q9 activates all record functions and record indications of the system, except for the secondary and tertiary cue tone record modes. This flip-flop is preset to the playback state by resistor R42 when power is initially applied to the unit.

4-21. A HIGH entering the circuit through the record set control line (pin 12) sets the flip-flop to the record state by biasing transistor Q8 on. This action may be inhibited, however, by the run interlock control line (pin 11). If the record deck is operating when the record switch/indicator is depressed, the run interlock control line will be LOW, preventing the flip-flop from entering the record mode. If the record deck is in the ready state, the interlock control line will be HIGH, permitting the flip-flop to enter the record mode. Additionally, Q9 is cut-off which biases transistor Q13 on. This action places subsequent logic elements in the record mode unless cancelled by a HIGH from the record cancel control line (pin 8). The cancel logic is derived from circuitry on the power supply circuit board. However, record status will be cancelled by any of the following operating conditions:

1. A cartridge not inserted into the record deck.
2. Record deck stopped manually.
3. Record deck stopped by a 1 kHz stop tone.

4-22. When the record switch/indicator is depressed, a HIGH will be routed to resistor R45. If the record deck is operating, the HIGH will be shunted to ground through diode CR15. If the record deck is in the ready state, the HIGH will be routed through CR14 and trigger the flip-flop to the record state (Q8 conducting). This action biases Q9 off, allowing transistor Q13 to conduct. Q13 will supply a ground to the record switch/indicator lamp and the program record circuitry on the record amplifier/bias circuit board.

4-23. When the record deck stop switch is depressed, a 1 kHz cue tone is detected, or the cartridge is removed from the record deck, a positive pulse will be applied through R69 to transistor Q9. This action will bias Q9 on and transistor Q8 off. Transistor Q12 will supply a ground to the record interlock control line (pin 10). Transistor Q13 will remove the ground from the record lamp and program control circuitry.

4-24. 1KHZ STOP CUE GENERATOR AND CONTROL. The stop cue tone generator consists of IC2A and IC-2B which oscillate at 1kHz as determined by R11, R58, R59, C14, and C15. The generator oscillates when positive feedback is available through R48 and R49. The output of the generator is routed through R55, C28, level control R6, R46, and C12 to Q5. Emitter follower stage Q5 acts as a current source to drive the cue record head. The cue output is routed from pin 7 to the record amplifier/bias circuit board.

4-25. The 1 kHz generator automatically records a stop cue tone burst when the recorder begins a record sequence. This control is accomplished by IC-2C and IC-2D which form a monostable multivibrator. A 12 volt dc reference is supplied to IC-2C and IC-2D through R64 and R66 from voltage divider R60 and R61. The output of the multivibrator will go HIGH only when the input from R62 goes HIGH.

4-26. A potential of +24 volts dc is available on S1. In the ON position, the +24 volts dc is applied to R29. If the recorder is in the playback mode, the voltage will be grounded through CR8 and Q12. Also, if the record deck is stopped, the voltage will be routed to ground through the 1kHz interlock and CR9. If the unit is in the record mode and the record deck is operating, the voltage from R29 will be applied through CR7 and CR18 to IC-2C. IC-2C will go HIGH and the voltage is routed through C28 and R63 sending IC-2D HIGH. When C28 fully charges, the dc path to IC-2D is blocked and the output of IC-2D goes LOW and remains LOW until IC-2C is unlatched and relatched.

4-27. When multivibrator IC-2C/IC-2D goes HIGH, a voltage is supplied through CR17 and CR24 to the cue bias switch circuit on the record amplifier/bias circuit board. CR20 is reverse biased through CR16 allowing voltage to be applied to the gate of Q10, biasing Q10 on. Q10 enables the 1kHz generator by allowing positive feedback through R48 and R49.

4-28. When the multivibrator IC-2C/IC-2D goes LOW, the voltage applied to Q10 is shunted to ground through CR20 and R68. This action biases Q10 off and disables the generator. With the 1kHz generator disabled, a stop tone of approximately three-quarters of a second is produced.

4-29. SECONDARY AND TERTIARY CUE TONE GENERATORS AND CONTROL. The following text describes the operation of the secondary (150 Hz) and tertiary (8 kHz) cue tones generator circuits. The circuits operate identically, therefore only the secondary cue tone generator circuit will be described.



4-30. The secondary cue tone generator consists of IC-3A and IC-3B. The frequency is determined by the network R10, R50, R51, C22, and C23. Oscillation occurs when positive feedback is supplied by R73. The output of the generator is supplied through level control R8 to cue head driver transistor Q5.

4-31. The secondary cue tone generator is controlled manually by the front-panel switch or through the remote connector. When the secondary cue tone record switch is not depressed, biasing voltage for transistor Q11 in the feedback circuit is shunted to ground through diode CR21 and resistor R82. When the secondary cue tone record switch is depressed, a positive voltage is applied through CR29 to the control circuit. CR21 is reversed biased which enables transistor Q11 and the secondary cue tone generator.

4-32. When the secondary cue tone record switch is depressed, voltage is also applied through CR26 and CR24 to enable the cue bias switching circuit on the record amplifier/bias circuit board. To supply bias for external cue tone recording, a positive voltage from the external cue tone record control circuit on the power supply circuit board is applied through CR25 to the cue bias switching circuit (record amplifier/bias circuit board).

4-33. Transistor Q14 is designed to permit the recording of the secondary, tertiary, or external cue tones in the playback mode. When a secondary, tertiary, or external cue tone record control switch is operated, positive voltage is coupled through resistor R5 and diode CR23 to transistor Q14. Q14 outputs a ground to the bias oscillator switch control line (pin 6), enabling the bias oscillator. The cue tone generator circuit activates the cue bias switch, allowing a cue tone to be recorded.

4-34. VU METER AMPLIFIER CIRCUITS. The following text describes the operation of the left and right channel VU meter amplifier circuits. The circuits operate identically, therefore only the left channel circuit will be described.

4-35. When the recorder operates in conjunction with a 5300C series cartridge machine, the VU meter indicates the record input level when the recorder is in the record mode and the record deck output level when the recorder is in the playback mode. When the recorder operates in conjunction with a 5400C/5500C series cartridge machine, the VU meter will indicate only the record input level.

4-36. The record input signal is routed from the record amplifier/bias circuit board through calibration control R2 to transistor Q2. The record deck output signal is routed from the power supply circuit board through calibration control R1 to transistor Q1. Transistors Q1 and Q2 determine which signal is applied to the VU meter amplifier circuit.

4-37. A bias voltage of +12 volts dc is applied to transistors Q1 and Q2 through voltage divider R13, R15, and R17. This bias voltage enables transistor Q1 and cuts-off Q2 allowing the record deck output signal to be routed to the VU meter amplifier circuit. When the record logic circuit is enabled, a ground is applied through CR1 to Q1 and Q2. This ground cuts-off Q1 and biases Q2 on allowing the record input signal to be routed to the VU meter amplifier circuit.

4-38. The VU meter amplifier circuit consists of IC-1A and associated circuitry. Capacitors C1 and C5 function as blocking capacitors for the dc bias on the transistors. Bias for IC-1A is supplied from R30. After amplification, the signal is rectified by a bridge rectifier (CR2, CR3, CR4, and CR5) for application to the VU meter.

4-39. POWER SUPPLY. Transistor Q7 provides power supply decoupling and a controlled enabling of the VU meter circuit. When ac power is first applied to the recorder, the meter circuit is damped to prevent full-scale deflection.

4-40. POWER SUPPLY CIRCUIT BOARD.

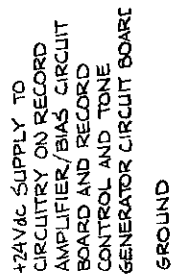
4-41. POWER SUPPLY CIRCUIT. AC power from the line cord is applied through an ac input and fuse receptacle to on/off switch S1 (refer to Figure 4-1). The line fuse provides primary overload protection. Switch S1 provides control of primary ac power.

4-42. AC voltage from switch S1 is applied to terminal strip TB1. TB1 allows the selection of a wide range of power supply voltages. From TB1, power is routed to the primaries of power transformer T1. The secondaries of T1 produce a 21V ac supply for a rectifier circuit on the power supply circuit board.

4-43. The rectifier circuit consists of bridge rectifier D1, filter capacitors C1, and C2, and 24 volt regulator Q1. The 21V ac supply is full-wave rectified and filtered into a +30V dc supply by D1, C1, and C2. The +30V dc supply is applied to +24V regulator Q1. Protection for Q1 is provided by D2 which protects the regulator from a short circuit applied to the input and D3 which protects the regulator from a reverse polarity potential applied to the output.

4-44. PLAYBACK AUDIO VOLTAGE DIVIDER. Resistors R23, R24, R25, and R26 form a voltage divider network that attenuates playback audio from the 5300C cartridge machine playback channels (refer to schematic 910-1820). The divider circuit also provides isolation for the meter amplifier circuits. The output(s) from the divider network is routed to the record/playback VU meter circuitry on the record control and tone generator circuit board.

4-45. CONTROL LOGIC. Integrated circuits U1 and U2 function as current comparators (refer to schematic 910-1820). If current into the non-inverting input is greater than the current into the inverting input, the comparator output will go HIGH. If the current into the inverting input is greater than the non-inverting input, the comparator output will go LOW.



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4-7

4-46. Record Logic Inverters. Comparators U2B, U2C, and U2D are controlled respectively by the RECORD, SEC/150 Hz, and TER/8 kHz switches. The comparators convert low logic level inputs to high logic level signals required to drive the record circuitry on the record control and tone generator circuit board.

4-47. Run Interlock. Comparator U1A outputs a control signal which prevents the system from operation to the record mode when the record switch is depressed with the record deck in operation. The logic signal that controls U1A is derived from the start verify signal on the cartridge machine control logic circuit board. U1A monitors the start verify control line (pins 8 and J) and will output a LOW through the run interlock control line to the record flip-flop when the record switch is depressed with the record deck in operation. This LOW prevents the flip-flop from triggering a record mode start sequence.

4-48. Record Cancel Logic. The record cancel logic consists of U1A, U1B, U1C, U1D, and U2A. This circuitry acts to cancel the record mode status of the flip-flop when:

- A. A cartridge is not loaded into the record deck.
- B. A cartridge is removed from the record deck.
- C. The record deck is stopped manually.
- D. The record deck is stopped by a 1kHz stop tone.

4-49. External Cue Bias Control Circuit. The external cue bias control circuit consists of resistors R27, R28, and transistor Q2. When external cue tone recording is required, a ground is applied from an external cue record switch to transistor Q2. This ground biases Q2 on which outputs a positive voltage to the cue bias switch logic on the record control and logic circuit board.

SECTION V  
MAINTENANCE

5-1.        INTRODUCTION.

5-2.        This section provides general maintenance information, mechanical and electrical adjustment procedures, and troubleshooting information for the Broadcast Electronics 5409C and 5410C recorders.

5-3.        SAFETY CONSIDERATIONS.

5-4.        Low voltages are used throughout the 5409C and 5410C recorder circuitry, however maintenance with power energized is always considered hazardous and caution should be observed. All high voltages have been shielded, however do not touch any component within the recorder chassis with power energized. Good judgement, care, and common sense must be practiced to prevent accidents. The procedures contained in this section should be performed only by experienced and trained maintenance personnel.

5-5.        FIRST LEVEL MAINTENANCE.

5-6.        First level maintenance consists of precautionary procedures applied to the equipment to prevent future failures. The procedures are performed on a regular basis and the results recorded in a performance log.

WARNING

DISCONNECT ALL RECORDER POWER BEFORE ATTEMPTING  
ANY EQUIPMENT MAINTENANCE.

5-7.        The recorder should be cleaned of accumulated dust using a brush and vacuum cleaner. Check the circuit boards for improperly seated semiconductors and components damaged by overheating.

5-8.        SECOND LEVEL MAINTENANCE.

5-9.        Second level maintenance consists of procedures required to restore the recorder to operation after a fault has occurred. The following procedures are divided into mechanical adjustments, electrical adjustments, and troubleshooting.

5-10.       MECHANICAL ADJUSTMENTS.

5-11.       Due to the playback/record function of the bottom deck, the mechanical adjustments involve the alignment of both the record head and playback head. In order to adjust the record head, the playback head must be checked for proper alignment and adjusted if required.



5-12. The following equipment is required for the mechanical adjustment procedures.

- A. Calibrated Oscilloscope, 5 MHz bandwidth, single channel with horizontal and vertical inputs.
- B. Calibrated Low Distortion Audio Generator, 600 Ohm output, 20 Hz to 20 kHz audio range.
- C. Head and Tape Guide Adjustment Fixture (BE P/N 836-0009-1).
- D. Allen Wrenches (supplied with the cartridge machine).
- E. External VU meter.
- F. Cut-Away Test Cartridge (BE P/N 710-0132).
- G. Reproduce Alignment Test Tape:
  - A. BE P/N 800-1005 for 5400C Series Cartridge Machines.
  - B. BE P/N 800-0004 for 5300C and 5500C Series Cartridge Machines.
- H. Bulk Erased Cartridge.
- I. No. 1 Phillips Screwdriver, 4 Inch (10.2 cm) blade.
- J. Extender Circuit Board (BE P/N 919-1806).
- K. Non-metallic Adjustment Tool.

5-13. RECORD/PLAYBACK HEAD ADJUSTMENTS. The playback/record head adjustments involve the alignment of the tape guide height, head height, head zenith, head azimuth, and the phase response (for stereophonic recorders only). The playback and record heads are adjusted as follows.

5-14. Procedure. To adjust the playback and record heads, proceed as follows:

5-15. Disconnect all cartridge machine power.

5-16. Refer to the DECK ACCESS AND REMOVAL procedure in SECTION V, MAINTENANCE of the applicable cartridge manual and remove the upper decks.

5-17. Refer to the HEAD ADJUSTMENTS procedure in SECTION V, MAINTENANCE of the applicable cartridge machine manual and adjust all the parameters for the playback head.

5-18. Refer to the HEAD ADJUSTMENTS procedure in SECTION V, MAINTENANCE of the applicable cartridge machine manual and adjust the following parameters for the record head.

- A. Tape Guide Height Adjustment.
- B. Head Height Adjustment.
- C. Head Zenith Adjustment.

5-19. To establish the correct program level for the record head azimuth adjustment procedure, refer to the ELECTRICAL ADJUSTMENTS procedure in the following text and perform the PROGRAM BIAS TRAP ADJUSTMENT and PROGRAM BIAS LEVEL ADJUSTMENT procedures. After completion of the bias level procedure, do not re-calibrate the recorder for a 0 dBm record level.

5-20. Complete the record head adjustments by performing the procedures listed below for the type of record unit. The adjustment procedures are located throughout the following text.

#### MONOPHONIC RECORDERS

- A. The Record Head Azimuth Adjustment procedure.
- B. The RECORD EQUALIZATION adjustment procedure.

#### STEREOPHONIC RECORDERS

- A. The Record Head Azimuth Adjustment procedure.
- B. The Record Phase Adjustment procedure.
- C. The RECORD EQUALIZATION adjustment procedure.

5-21. Record Head Azimuth Adjustment. The record head azimuth adjusts the parallelism of the record head. The record head azimuth is adjusted as follows.

5-22. Procedure. To adjust the record head azimuth, proceed as follows:

5-23. Disconnect power from the recorder and the cartridge machine.

5-24. Demagnetize the record head, the playback head, and all surrounding ferrous parts.

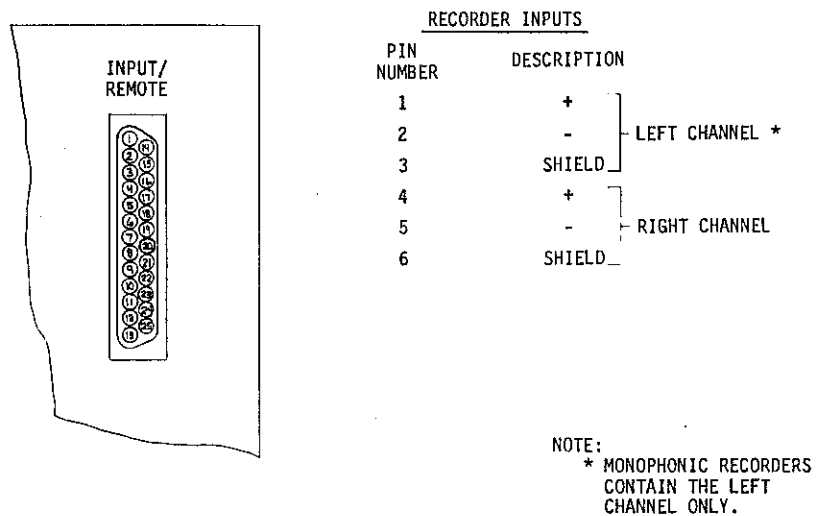
5-25. Ensure the recorder is calibrated for a -10 dBm record level as described in the PROGRAM BIAS LEVEL ADJUSTMENT procedure.

5-26. Connect the audio generator to the recorder left channel input (located on the INPUT/REMOTE connector). The recorder input pin designations are shown in Figure 5-1.

5-27. Connect the oscilloscope to the record deck left channel output (located on the rear-panel remote connector). The record deck output pin designations are shown in the remote connector wiring diagram in SECTION VII, DRAWINGS of the applicable cartridge machine manual.

5-28. Apply power to the recorder and the cartridge machine.

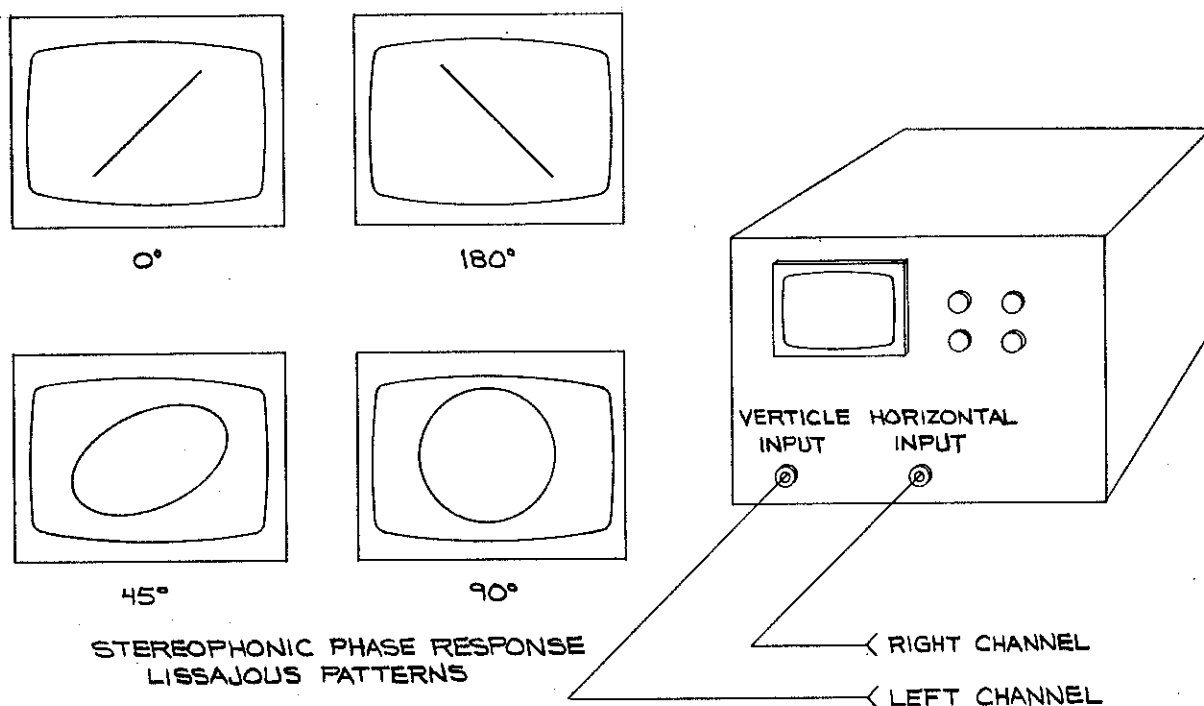
5-29. Adjust the audio generator for a 15 kHz output at -20 dBm.



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FIGURE 5-1. RECORDER INPUTS



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FIGURE 5-2. STEREOPHONIC PHASE RESPONSE LISSAJOUS PATTERNS

- 5-30. Operate the recorder system and begin recording the 15 kHz tone.
- 5-31. Refer to the HEAD ADJUSTMENT SCREWS illustration in SECTION V, MAINTENANCE of the applicable cartridge manual and adjust the record head azimuth screw for a maximum peak-to-peak voltage indication.
- 5-32. Disconnect power from the recorder and the cartridge machine and remove the test equipment.
- 5-33. Record Phase Adjustment (For Stereophonic Recorders Only). The phase adjustment involves the fine alignment of the record head azimuth for maximum phase response. The recorder phase response is adjusted as follows.
- 5-34. Procedure. To adjust the recorder phase response, proceed as follows:
- 5-35. Ensure the oscilloscope produces a  $0^\circ$  phase response pattern (refer to Figure 5-2).
- 5-36. Disconnect power from the recorder and the cartridge machine.
- 5-37. Demagnetize the record head, playback head, and all surrounding ferrous parts.
- 5-38. Ensure the recorder is calibrated for a -10 dBm record level as described in the PROGRAM BIAS LEVEL ADJUSTMENT procedure.
- 5-39. Connect the audio generator to the recorder left and right channel inputs (located on the INPUT/REMOTE connector). The recorder input pin designations are shown in Figure 5-1.
- 5-40. Connect the oscilloscope to the record deck left and right channel outputs (located on the rear-panel remote connector) as shown in Figure 5-2. The record deck output pin designations are shown in the remote connector wiring diagram in SECTION VII, DRAWINGS of the applicable cartridge machine manual.
- 5-41. Apply power to the recorder and the cartridge machine.
- 5-42. Adjust the audio generator for a 15 kHz output at -20 dBm.
- 5-43. Operate the recorder system and begin recording the 15 kHz tone.
- 5-44. Refer to the HEAD ADJUSTMENT SCREWS illustration in SECTION V, MAINTENANCE of the applicable cartridge manual and adjust the record head azimuth screw for a  $0^\circ$  lissajous pattern (refer to Figure 5-2).
- 5-45. Repeat the procedure as required to assure the correct phase response.

- 5-46. Disconnect power from the recorder and the cartridge machine.
- 5-47. Disconnect the test equipment and replace the cartridge machine decks.
- 5-48. ELECTRICAL ADJUSTMENTS.
- 5-49. The recorder electrical adjustment procedures are presented in the following order.
- A. Program Circuitry Adjustments.
  - B. Cue Circuitry Adjustments.
  - C. Meter Adjustments.
- 5-50. PROGRAM CIRCUITRY ADJUSTMENTS.
- 5-51. The following text describes the adjustment procedures associated with the program circuitry. The procedures describe the adjustment of the left channel controls. Adjustment of the right channel controls is identical. For monophonic recorders, perform the procedures for the left channel only. The adjustment procedures are presented as follows:
- A. Program Bias Trap Adjustment.
  - B. Program Bias Level Adjustment.
  - C. Record Equalization.
- 5-52. The following equipment is required for the program circuitry adjustment procedures.
- A. Calibrated Low Distortion Audio Generator, 600 Ohm output, 20 Hz to 20 kHz audio range.
  - B. Calibrated Oscilloscope, 5 MHz bandwidth, single channel with horizontal and vertical inputs.
  - C. External VU meter.
  - D. Extender Circuit Board (BE P/N 919-1806).
  - E. Bulk Erased Cartridge.
  - F. Non-metallic Adjustment Tool.
  - G. No. 1 Phillips Screwdriver, 4 Inch (10.2 cm) blade.
- 5-53. PROGRAM BIAS TRAP ADJUSTMENT. Left channel bias trap control L1 and right channel bias trap control L2 on the record amplifier/bias circuit board isolate the program amplifier circuitry from the 100 kHz program bias. The bias trap controls are adjusted as follows.
- 5-54. Procedure. To adjust the controls, proceed as follows:

CAUTION

TO PREVENT DAMAGE TO THE RECORDER, DISCONNECT  
POWER BEFORE REMOVING OR INSERTING PRINTED  
CIRCUIT BOARDS.

CAUTION

- 5-55. Disconnect power from the recorder and remove the top-panel.
- 5-56. Remove the circuit board cage cover-plate.
- 5-57. Remove the record amplifier/bias circuit board and insert the extender circuit board.
- 5-58. Insert the record amplifier/bias circuit board into the extender circuit board.
- 5-59. Refer to Figure 5-3 and connect the oscilloscope to the left channel bias trap test point TP1.
- 5-60. Apply power to the recorder.
- 5-61. Operate the recorder to the record mode.
- 5-62. With the non-metallic adjustment tool, adjust left channel bias trap control L1 (refer to Figure 5-3) to minimize the 100 kHz bias indication.
- 5-63. For stereophonic recorders, adjust the right channel bias trap as follows:
  - A. Refer to Figure 5-3 and connect the oscilloscope to the right channel bias trap test point TP2.
  - B. With the non-metallic adjustment tool, adjust right channel bias trap control L2 (refer to Figure 5-3) to minimize the 100 kHz bias indication.
- 5-64. Disconnect power from the recorder.
- 5-65. Remove all test equipment, replace the record amplifier/bias circuit board, and replace the recorder chassis panels.
- 5-66. PROGRAM BIAS LEVEL ADJUSTMENT. The L BIAS LEVEL and R BIAS LEVEL controls on the record control and tone generator circuit board adjust the level of program bias. The bias level controls are adjusted as follows.
- 5-67. Procedure. To adjust the controls, proceed as follows:
- 5-68. Calibrate the recorder for a -10 dBm record level as follows:
  - A. Disconnect power from the recorder and the cartridge machine.

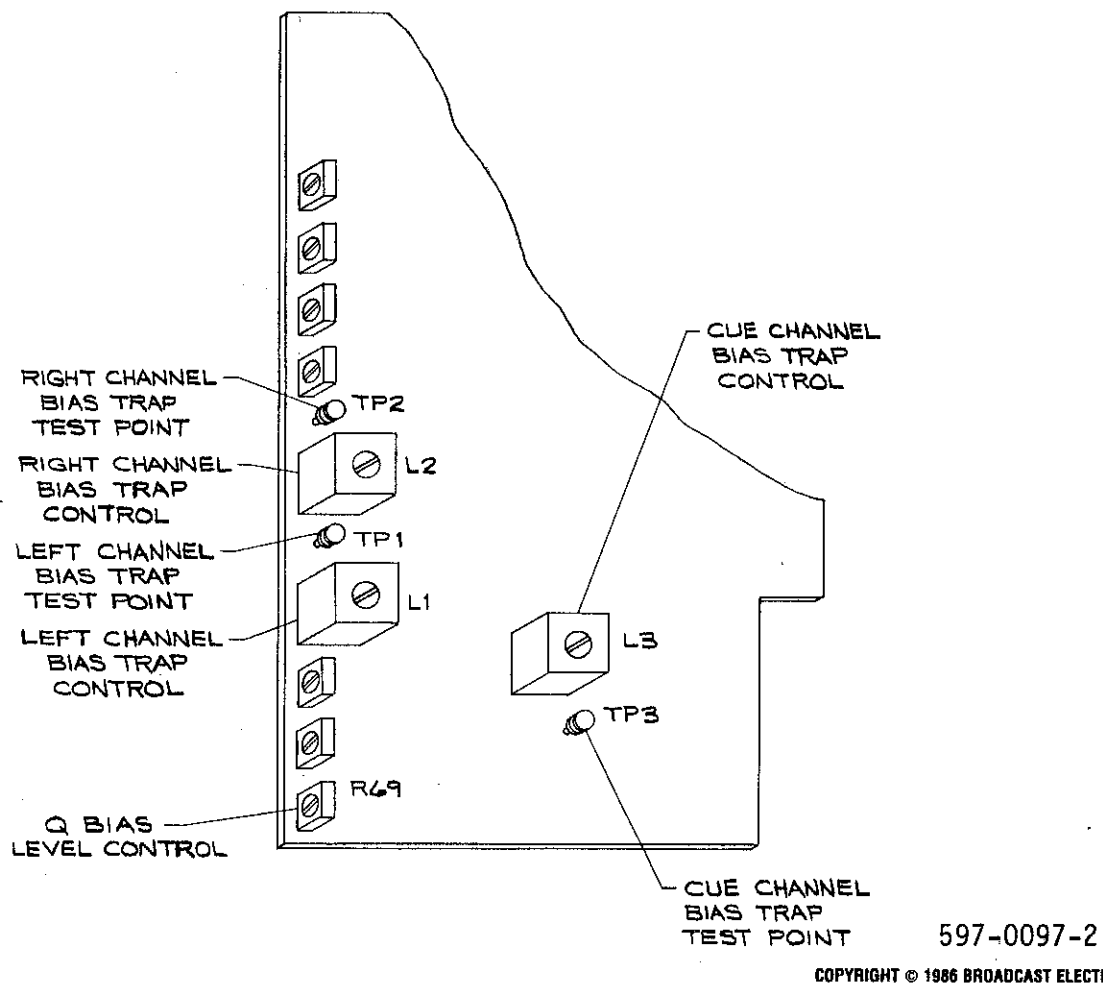
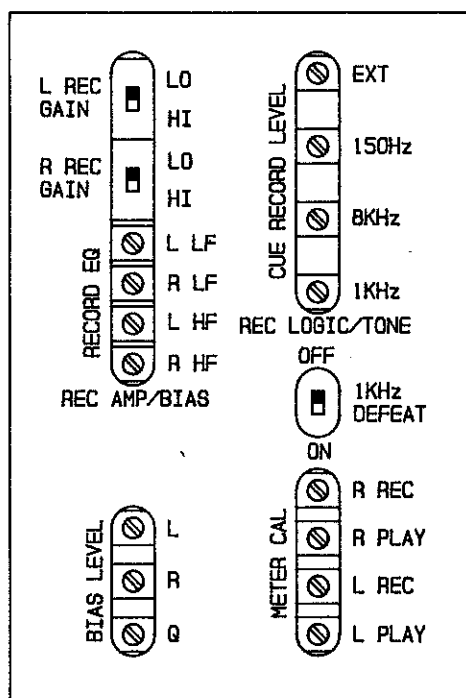


FIGURE 5-3. RECORD AMPLIFIER/BIAS CIRCUIT BOARD CONTROLS

- B. Connect the audio generator to the recorder left channel input (located on the INPUT/REMOTE connector). The recorder input pin designations are shown in Figure 5-1.
- C. Connect the external VU meter to the record deck left channel output (located on the rear-panel remote connector). The record deck output pin designations are shown in the remote connector wiring diagram in SECTION VII, DRAWINGS of the applicable cartridge machine manual.
- D. Apply power to the recorder and the cartridge machine.
- E. Adjust the audio generator for a 1 kHz output at -20 dBm.
- F. Operate the recorder system and begin recording the 1 kHz tone.
- G. Adjust the recorder left channel LEVEL control until the external VU meter indicates -10 dBm.

- H. Depress the record deck STOP switch.
  - I. For stereophonic recorders, repeat steps A through H for the right channel.
  - J. Disconnect power from the cartridge machine and remove the VU meter.
- 5-69. Connect the oscilloscope to the record deck left channel output.
- 5-70. Apply power to the cartridge machine.
- 5-71. Operate the recorder system and begin recording the 1 kHz tone.
- 5-72. Refer to Figure 5-4 and adjust the L BIAS LEVEL control for a maximum peak-to-peak 1 kHz waveform without distortion.
- 5-73. For stereophonic recorders, repeat the procedure for the right channel. Adjust the right channel bias level with the R BIAS LEVEL control (refer to Figure 5-4).
- 5-74. Re-calibrate the recorder for a 0 dBm record level by performing the VU METER CALIBRATION procedure in the following text.
- 5-75. Disconnect power from the recorder and the cartridge machine and remove the test equipment.



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FIGURE 5-4. CIRCUIT BOARD CONTROLS



- 5-76. RECORD EQUALIZATION. Record equalization involves the adjustment of the RECORD EQ controls to obtain a consistent record level at various frequencies. The record equalization is adjusted as follows.
- 5-77. Procedure. To adjust the equalization controls, proceed as follows:
- 5-78. Calibrate the recorder for a -10 dBm record level as described in the PROGRAM BIAS LEVEL ADJUSTMENT procedure.
- 5-79. Disconnect power from the recorder and the cartridge machine.
- 5-80. Connect the audio generator to the recorder left channel input (located on the INPUT/REMOTE connector). The recorder input pin designations are shown in Figure 5-1.
- 5-81. Connect the external VU meter to the record deck left channel output (located on the rear-panel remote connector). The record deck output pin designations are shown in the remote connector wiring diagram in SECTION VII, DRAWINGS of the applicable cartridge machine manual.
- 5-82. Apply power to the recorder and the cartridge machine.
- 5-83. Adjust the audio generator for a 50 Hz output at -20 dBm.
- 5-84. Operate the recorder system and begin recording the 50 Hz tone.
- 5-85. Refer to Figure 5-4 and adjust LLF RECORD EQ control until the external VU meter indicates -10 dBm.
- 5-86. Adjust the audio generator for a 12 kHz output at -20 dBm.
- 5-87. Refer to Figure 5-4 and adjust the LHF RECORD EQ control until the external VU meter indicates -10 dBm.
- 5-88. Repeat the procedure for the right channel. Adjust the right channel equalization with the RLF and RHF RECORD EQ controls (refer to Figure 5-4).
- 5-89. Re-calibrate the recorder for a 0 dBm record level by performing the VU METER CALIBRATION procedure in the following text.
- 5-90. Disconnect power from the recorder and the cartridge machine and remove the test equipment.
- 5-91. CUE CIRCUITRY ADJUSTMENTS.
- 5-92. The following text presents the adjustment procedures associated with the cue circuitry. The adjustment procedures are presented as follows:

- A. Cue Bias Trap Adjustment.
- B. Cue Bias Level Adjustment.
- C. Cue Tone Record Level Adjustments.
- D. Cue Tone Frequency Adjustments.

5-93. The following equipment is required for the cue circuitry adjustment procedures.

- A. Calibrated Low Distortion Audio Generator, 600 Ohm output, 20 Hz to 20 kHz audio range.
- B. Calibrated Oscilloscope, 5 MHz bandwidth, single channel with horizontal and vertical inputs.
- C. Frequency Counter.
- D. External VU meter.
- E. Extender Circuit Board (BE P/N 919-1806).
- F. Bulk Erased Cartridge.
- G. Non-metallic Adjustment Tool.
- H. No. 1 Phillips Screwdriver, 4 inch (10.2 cm) blade.
- I. NAB 1 kHz, 150 Hz, and 8 kHz Cue Tone Test Tapes.

5-94. CUE BIAS TRAP ADJUSTMENT. Cue bias trap control L3 on the record amplifier/bias circuit board isolates the cue tone generator circuitry from the 100 kHz cue bias. The cue bias trap control is adjusted as follows.

5-95. Procedure. To adjust the control, proceed as follows:

5-96. Refer to the PROGRAM BIAS TRAP ADJUSTMENT procedure in the preceding text and perform the procedure for the cue bias trap control. Refer to Figure 5-3 as required for the location of cue bias trap test point TP3 and cue bias trap control L3.

5-97. CUE BIAS LEVEL ADJUSTMENT. The Q BIAS LEVEL control on the record control and tone generator circuit board adjusts the level of cue bias. The cue bias control is adjusted as follows.

5-98. Procedure. To adjust the control, proceed as follows:

5-99. Disconnect power from the recorder and the cartridge machine.

5-100. Remove the recorder top-panel and the circuit board cage cover-plate.

5-101. Remove the record control and tone generator circuit board.

5-102. Activate the 1 kHz oscillator on the record control and generator circuit board by connecting a temporary jumper from the cathode of diode CR16 to the cathode of diode CR17. Refer to record control and tone generator circuit board assembly 914-1503/-1513/-1523/-1533 as required for the component locations.

5-103. Re-insert the record control and tone generator circuit board.

5-104. Activate the cue bias switch by connecting a temporary jumper between pins 23 and 24 on the INPUT/REMOTE connector.

5-105. Connect the oscilloscope to the record deck cue channel output (located on the rear-panel remote connector). The record deck output pin designations as shown in the remote connector wiring diagram in SECTION VII, DRAWINGS of the applicable cartridge machine manual.

5-106. Apply power to the recorder and the cartridge machine.

5-107. Operate the recorder system and begin recording the 1 kHz tone.

5-108. Refer to Figure 5-4 and adjust the Q BIAS LEVEL control for a maximum peak-to-peak 1 kHz waveform without distortion.

5-109. Disconnect power from the recorder and the cartridge machine.

5-110. Remove the test equipment, remove the temporary jumpers, and replace circuit boards and chassis panels.

5-111. 1 kHz CUE TONE RECORD LEVEL ADJUSTMENT. Potentiometer R6 on the record logic and tone generator circuit board adjusts the 1 kHz cue tone record level. The 1 kHz cue tone record level control is adjusted as follows.

5-112. Procedure. To adjust control R6, proceed as follows:

A. Measure the NAB 1 kHz cue tone level standard as follows:

1. Disconnect the power to the cartridge machine.
2. Connect an oscilloscope to the record deck cue channel output on the rear-panel remote connector. The record deck remote connections are presented in the remote connector wiring diagram in SECTION VII of the applicable cartridge machine manual.
3. Apply power to the cartridge machine.
4. Insert the 1 kHz record cue tone test tape into the record deck.
5. Initiate deck operation and record the peak-to-peak level as indicated on the oscilloscope \_\_\_\_\_.

- B. Disconnect primary power to the cartridge machine and recorder.
- C. Remove the recorder top-panel and the circuit board cage cover-plate.
- D. Temporarily connect a jumper between the cathode of diode CR16 and the cathode of diode CR17 to enable the 1 kHz oscillator. Refer to record control and tone generator circuit board assembly diagram D906-3112 for the component locations.
- E. Install the record control and tone generator circuit board.
- F. Replace the circuit board cage cover-plate.
- G. Refer to rear-panel connector wiring diagram B906-5128 and temporarily connect a jumper between J4 pins 23 and 24 to enable the cue bias circuit.
- H. Apply power to the cartridge machine and the recorder.
- I. Operate the recorder system and begin recording a 1 kHz tone.

WARNING

DO NOT TOUCH ANY CIRCUIT BOARD TRACES OR COMPONENTS ON THE POWER SUPPLY CIRCUIT BOARD WITH POWER APPLIED.

WARNING

- J. Refer to Figure 5-4. With the non-metallic adjustment tool, adjust the 1 kHz CUE RECORD LEVEL control until the oscilloscope indicates the level recorded in step A.
- K. Disconnect the power to the cartridge machine and the recorder.
- L. Remove the test equipment and temporary jumpers. Replace all circuit boards and the top-panel.

5-113. 150 Hz CUE TONE RECORD LEVEL ADJUSTMENT. Potentiometer R8 on the record logic and tone generator circuit board adjusts the 150 Hz cue tone record level. The 150 Hz cue tone record level control is adjusted as follows.

5-114. Procedure. To adjust control R8, proceed as follows:

- A. Remove the recorder top-panel.
- B. Measure the NAB 150 Hz cue tone level standard by performing level measurement step A of the 1 kHz CUE TONE RECORD LEVEL ADJUSTMENT procedure. Record the level

- C. Operate the recorder system and begin recording a 150 Hz cue tone.

WARNING

DO NOT TOUCH ANY CIRCUIT BOARD TRACES OR COMPONENTS ON THE POWER SUPPLY CIRCUIT BOARD WITH POWER APPLIED.

WARNING

- D. Refer to Figure 5-4 and adjust the 150 Hz CUE TONE RECORD LEVEL control until the oscilloscope indicates the level recorded in step B.
- E. Disconnect the power to the cartridge machine and the recorder.
- F. Remove the test equipment and replace the recorder top-panel.

5-115. 8 kHz CUE TONE RECORD LEVEL ADJUSTMENT. Potentiometer R7 on the record logic and tone generator circuit board adjusts the 8 kHz cue tone record level. The 8 kHz cue tone record level control is adjusted as follows.

5-116. Procedure. To adjust control R7, proceed as follows:

- A. Remove the recorder top-panel.
- B. Measure the NAB 8 kHz cue tone level standard by performing level measurement step A of the 1 kHz CUE TONE RECORD LEVEL ADJUSTMENT procedure. Record the level \_\_\_\_\_.
- C. Operate the recorder system and begin recording an 8 kHz cue tone.

WARNING

DO NOT TOUCH ANY CIRCUIT BOARD TRACES OR COMPONENTS ON THE POWER SUPPLY CIRCUIT BOARD WITH POWER APPLIED.

WARNING

- D. Refer to Figure 5-4 and adjust the 8 kHz CUE TONE RECORD LEVEL control until the oscilloscope indicates the level recorded in step B.
- E. Disconnect the power to the cartridge machine and the recorder.
- F. Remove the test equipment and replace the recorder top-panel.

- 5-117. External Cue Tone Record Level Adjustment. To adjust the external cue tone level, proceed as follows:
- 5-118. Disconnect power from the recorder and the cartridge machine.
- 5-119. Remove the recorder top-panel.
- 5-120. Enable the cue bias switch by connecting a temporary jumper between pins 23 and 24 on the INPUT/REMOTE connector.
- 5-121. Connect the audio generator to the recorder external cue tone input (located on the INPUT/REMOTE connector). The recorder external cue input pin designations are illustrated in wiring diagram 900-5309/-5310-001/-5409/-5410.
- 5-122. Connect an external VU meter to the record deck cue channel output (located on the rear-panel remote connector). The record deck output pin designations are shown in the remote connector wiring diagram in SECTION VII, DRAWINGS of the applicable cartridge machine manual.
- 5-123. Apply power to the recorder and the cartridge machine.
- 5-124. Adjust the audio generator for a 1 kHz output at 0 dBm.
- 5-125. Operate the recorder system and begin recording the 1 kHz tone.
- 5-126. Refer to Figure 5-4 and adjust the EXT CUE LEVEL control until the external VU meter indicates 0 dBm.
- 5-127. Disconnect power from the recorder and the cartridge machine.
- 5-128. Remove all test equipment, remove the temporary jumper, and replace the recorder top-panel.
- 5-129. CUE TONE FREQUENCY ADJUSTMENTS. The cue tone frequency adjustment procedures involve the calibration of the recorder cue tone frequencies. The following text is divided into 1 kHz, 150 Hz, and 8 kHz adjustment procedures.

CAUTION

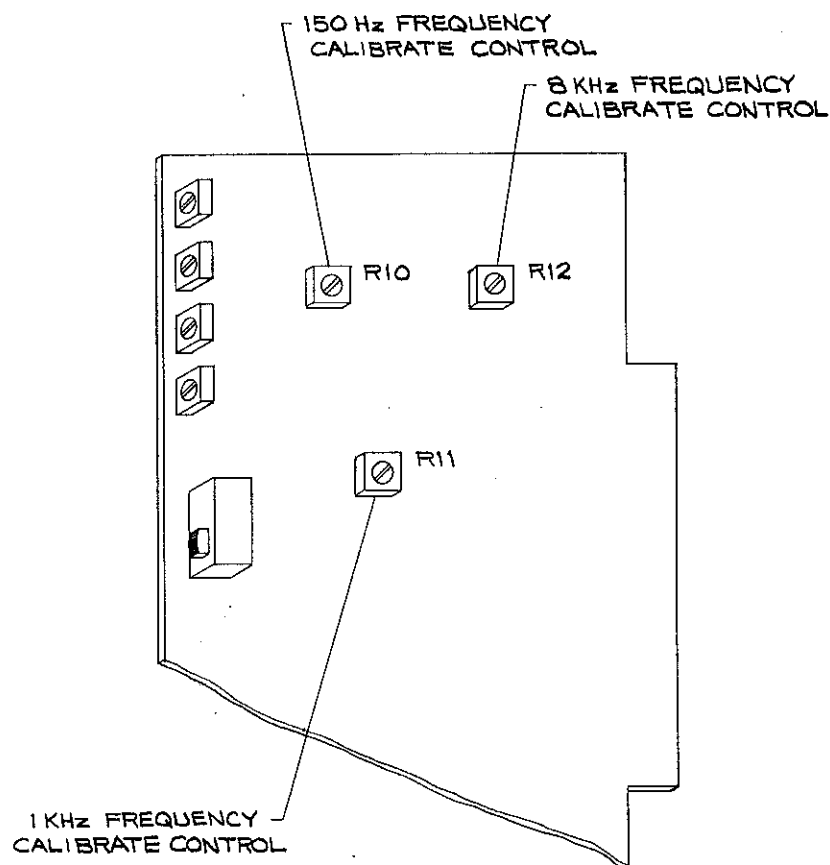
TO PREVENT DAMAGE TO THE RECORDER, DISCONNECT POWER BEFORE REMOVING OR INSERTING PRINTED CIRCUIT BOARDS.

CAUTION

- 5-130. 1 kHz Cue Tone Frequency Adjustment. To calibrate the 1 kHz cue tone frequency, proceed as follows:

- 5-131. Disconnect power from the recorder and the cartridge machine.
- 5-132. Remove the recorder top-panel and the circuit board cage cover-plate.

- 5-133. Remove the record control and tone generator circuit board and insert the extender circuit board.
- 5-134. Enable the 1 kHz oscillator on the record control and tone generator circuit board by connecting a temporary jumper from the cathode of diode CR16 to the cathode of diode CR17. Refer to record control and tone generator circuit board assembly 914-1503/-1513/-1523/-1533 as required for the component locations.
- 5-135. Insert the record control and generator circuit board into the extender circuit board.
- 5-136. Enable the cue bias switch by connecting a temporary jumper between pins 23 and 24 on the INPUT/REMOTE connector.
- 5-137. Connect the frequency counter to the record deck cue channel output (located on the rear-panel remote connector). The record deck output pin designations are shown in the remote connector wiring diagram in SECTION VII, DRAWINGS of the applicable cartridge machine manual.
- 5-138. Apply power to the recorder and the cartridge machine.
- 5-139. Operate the recorder system and begin recording the 1 kHz tone.
- 5-140. Refer to Figure 5-5 and adjust 1 kHz frequency calibrate control R11 until the frequency counter indicates 1 kHz  $\pm 50$  Hz.
- 5-141. Disconnect power from the recorder and the cartridge machine.
- 5-142. Remove the test equipment, remove the temporary jumpers, and replace all circuit boards and chassis panels.
- 5-143. 150 Hz Cue Tone Frequency Adjustment. To calibrate the 150 Hz cue tone, proceed as follows:
- 5-144. Disconnect power from the recorder and the cartridge machine.
- 5-145. Remove the recorder top-panel and the circuit board cage cover-plate.
- 5-146. Remove the record control and tone generator circuit board and insert the extender circuit board.
- 5-147. Insert the record control and generator circuit board into the extender circuit board.
- 5-148. Connect the frequency counter to the record deck cue channel output (located on the rear-panel remote connector). The record deck output pin designations are shown in the remote connector wiring diagram in SECTION VII, DRAWINGS of the applicable cartridge machine manual.



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FIGURE 5-5. RECORD CONTROL AND TONE GENERATOR CIRCUIT BOARD CONTROLS

- 5-149. Operate the recorder system and begin recording a 150 Hz cue tone.
- 5-150. Refer to Figure 5-5 and adjust 150 Hz frequency calibrate control R10 until the frequency counter indicates 150 Hz  $\pm$ 8 Hz.
- 5-151. Disconnect power from the recorder and the cartridge machine.
- 5-152. Remove the test equipment, remove the temporary jumpers, and replace all circuit boards and chassis panels.
- 5-153. 8 kHz Cue Tone Frequency Adjustment. To calibrate the 8 kHz cue tone, proceed as follows:
- 5-154. Refer to the 150 Hz Cue Tone Frequency Adjustment procedure in the preceding text and perform the procedure for the 8 kHz cue tone. Adjust 8 kHz frequency calibrate control R12 (refer to Figure 5-5) until the frequency counter indicates 8 kHz  $\pm$ 400 Hz.



5-155. METER ADJUSTMENTS.

5-156. The following text describes the procedures associated with the meter adjustments. The procedures describe the adjustment of the left channel controls. Adjustment of the right channel controls is identical. For monophonic recorders, perform the procedures for the left channel only.

5-157. The following equipment is required for the meter adjustment procedures.

- A. Calibrated Low Distortion Audio Generator, 600 Ohm output, 20 Hz to 20 kHz audio range.
- B. External VU meter.
- C. Bulk Erased Cartridge.
- D. Non-metallic Adjustment Tool.
- E. No. 1 Phillips Screwdriver, 4 inch (10.2 cm) blade.
- F. NAB 1 kHz Tone Test Tape.

5-158. VU METER CALIBRATION. The METER CAL controls on the record control and tone generator circuit board calibrate the recorder VU meters. The controls are divided into record and playback adjustments. Only recorders that operate in conjunction with a 5300B cartridge machine will require playback VU meter calibration. The following text is divided into record and playback adjustment procedures.

5-159. Record VU Meter Calibration Procedure. To adjust the record VU meter calibration controls, proceed as follows:

5-160. Disconnect power from the recorder and the cartridge machine.

5-161. Remove the recorder top-panel.

5-162. Connect the audio generator to the recorder left channel input (located on the INPUT/REMOTE connector). The recorder input pin designations are shown in Figure 5-1.

5-163. Connect the external VU meter to the record deck left channel output (located on the rear-panel remote connector). The record deck output pin designations are shown in the remote connector wiring diagram in SECTION VII, DRAWINGS of the applicable cartridge machine manual.

5-164. Apply power to the recorder and the cartridge machine.

5-165. Adjust the audio generator for 1 kHz output at -20 dBm.

5-166. Operate the recorder system and begin recording the 1 kHz tone.

5-167. Adjust the left channel LEVEL control until the external VU meter indicates 0 dBm.

- 5-168. Refer to Figure 5-4 and adjust the L REC METER CAL control until the left channel meter indicates 0 VU.
- 5-169. For stereophonic recorders, repeat the procedure for the right channel. Adjust the right channel meter with the R REC METER CAL control (refer to Figure 5-4).
- 5-170. Disconnect power from the recorder and the cartridge machine.
- 5-171. Remove the test equipment and replace the recorder top-panel.
- 5-172. Playback VU Meter Calibration Procedure. To adjust the playback meter calibration controls, proceed as follows:
- 5-173. Remove the recorder top-panel.
- 5-174. Refer to the OUTPUT LEVEL adjustment procedure in SECTION V, MAINTENANCE of the applicable cartridge machine manual and adjust the record deck for a 0 dBm output level.
- 5-175. Insert the NAB 1 kHz tone test tape into the record deck.
- 5-176. Depress the record deck START switch.
- 5-177. Refer to Figure 5-4 and adjust the L PLAY METER CAL control until the left channel VU meter indicates 0 VU.
- 5-178. For stereophonic recorders, adjust the right channel VU meter with the R PLAY METER CAL control (refer to Figure 5-4).
- 5-179. Replace the recorder top-panel.
- 5-180. TROUBLESHOOTING.
- 5-181. Troubleshooting within the recorder is not considered hazardous due to the low voltages and currents involved. All high voltages used within the recorder have been shielded, however do not touch any component within the recorder when power is energized.
- 5-182. The troubleshooting philosophy for the 5409C and 5410C recorders consists of isolating a problem to a specific circuit board. The problem may be isolated by referencing the following warnings and Table 5-1 which provides a general guide to recorder troubleshooting.

WARNING

REMOVE ALL JEWELRY BEFORE TROUBLESHOOTING.

WARNING

DISCONNECT ALL RECORDER PRIMARY POWER BEFORE REMOVING OR INSERTING PRINTED CIRCUIT BOARDS OR REPLACING ANY COMPONENTS.

WARNING

CAUTION

INADVERTENT CONTACT BETWEEN ADJACENT COMPONENTS OR CIRCUIT BOARDS WITH TEST EQUIPMENT CAN CAUSE SERIOUS DAMAGE TO THE RECORDER.

CAUTION

5-183. Once the trouble is isolated and power is totally deenergized, refer to the schematic diagrams and the theory of operation to assist in problem resolution. The defective component may be repaired locally or the entire device may be returned to Broadcast Electronics Inc. for repair or replacement.

TABLE 5-1. 5409C and 5410C RECORDER TROUBLESHOOTING

SYMPTOM	DEFECT/REMEDY
NO RECORD MODE OPERATION	1. Check power supply circuitry.
	2. Check record flip-flop Q8/Q9 on the record control and tone generator circuit board.
NO PROGRAM RECORDING	1. Check the bias circuitry on the record amplifier/bias circuit board.
	2. Check U1A and U2A on the record amplifier/bias circuit board.
NO CUE TONE RECORDING - 1 kHz, 150 Hz, or 8 kHz	1. Check the missing cue tone oscillator circuit on the record control and tone generator circuit board.
	2. Check the bias circuitry.

CAUTION

DISCONNECT POWER BEFORE REMOVING OR REPLACING  
CIRCUIT BOARDS OR COMPONENTS.

CAUTION

WHEN REPLACING A COMPONENT MOUNTED ON A HEAT-  
SINK, ENSURE A THIN FILM OF A ZINC-BASED  
HEAT-SINK COMPOUND IS USED (BE P/N 700-0028)  
TO ASSURE GOOD HEAT DISSIPATION.

CAUTION

5-184. COMPONENT REPLACEMENT. The circuit boards used in the 5409C and 5410C recorders are double-sided boards with plated through-holes. Because of the plated through-holes, solder fills the holes by capillary action. These conditions require that defective components be removed carefully to avoid damage to the circuit board.

5-185. On all circuit boards, the adhesion of the copper trace to the board fails at almost the same temperature as solder melts. A circuit board trace can be destroyed by excessive heat or lateral movement during soldering. Use of a small iron with steady pressure is required for circuit board repairs.

5-186. To remove a component other than the plug-in type from a circuit board, cut the leads from the body of the defective component while the device is still soldered to the board.

5-187. Grip each component lead, one at a time, with long nose pliers. Turn the board over and touch the soldering iron to the lead at the solder connection. When the solder begins to melt, push the lead through the back side of the board and cut off the clinched end of the lead. Each lead may now be heated independently and pulled out of each hole. The holes may be cleared of solder by carefully re-heating with a low wattage iron and removing the residual solder with a soldering vacuum tool.

5-188. Install the new component and apply solder from the bottom side of the board. If no damage has been done to the plated through-holes, soldering of the top side is not required.

WARNING

MOST SOLVENTS WHICH WILL REMOVE ROSIN FLUX ARE  
VOLATILE AND TOXIC BY THEIR NATURE AND SHOULD  
BE USED ONLY IN SMALL AMOUNTS IN A WELL VEN-  
TILATED AREA, AWAY FROM FLAME, CIGARETTES, OR  
HOT SOLDERING IRONS.

WARNING

WARNING

WARNING

OBSERVE THE MANUFACTURES CAUTIONARY  
INSTRUCTIONS.

5-189. After soldering, remove residual flux with a cotton swab moistened with a suitable solvent. Rubbing alcohol is highly diluted and is not effective. Solvents are available from electronic supply houses which are useful.

5-190. The board should be checked to ensure the flux has been removed and not just smeared about. Rosin flux is not normally corrosive, but it will absorb enough moisture in time to become conductive and cause problems.

5-191. INTEGRATED CIRCUITS. Extra care should be exercised with integrated circuits. Each integrated circuit must be oriented so that its notch matches the notch on the socket. Do not attempt to remove an integrated circuit with your fingers. Use an integrated circuit puller to lightly pry the circuit from its socket.

# SECTION VI PARTS LIST

## 6-1. INTRODUCTION.

6-2. This section provides descriptions and part numbers of electrical components, assemblies, and selected mechanical parts required for maintenance of the Broadcast Electronics 5409C and 5410C Recorders. Each table entry in this section is indexed by reference designators appearing in the applicable schematic diagram.

6-3. Table 6-1 indexes all tables listing assemblies and sub-assemblies having replaceable parts, the table number listing the parts, and the page number of the applicable table.

TABLE 6-1. REPLACEABLE PARTS LIST INDEX

TABLE NO.	DESCRIPTION	PART NO.	PAGE
6-2	5409C MONOPHONIC RECORDER BASIC ASSEMBLY AND OPTIONAL ASSEMBLIES	900-5409-011, XXX-XXXX-050/ -300/-350	6-2
6-3	5410C STEREOPHONIC RECORDER BASIC ASSEMBLY AND OPTIONAL ASSEMBLIES	900-5410-011, XXX-XXXX-050/ -300/-350	6-2
6-4	BASIC MONOPHONIC AND STEREOPHONIC RECORDER UNITS	950-5409, 950-5410	6-3
6-5	MONOPHONIC AND STEREOPHONIC RECORD CABLE ASSEMBLIES	940-0018, 940-0019	6-3
6-6	POWER SUPPLY CIRCUIT BOARD ASSEMBLY	910-1820	6-3
6-7	MONOPHONIC AND STEREOPHONIC RECORD AMPLIFIER/BIAS CIRCUIT BOARD ASSEMBLIES	910-1049-001, 910-1050-001	6-4
6-8	MONOPHONIC AND STEREOPHONIC RECORD CONTROL AND TONE GENERATOR CIRCUIT BOARD ASSEMBLIES	914-1513, 914-1533	6-7
6-9	CARTRIDGE MACHINE MONOPHONIC RECORD HEAD LEAD ASSEMBLY	940-0016	6-9
6-10	CARTRIDGE MACHINE STEREOPHONIC RECORD HEAD LEAD ASSEMBLY	940-0017	6-9
6-11	ASSEMBLY, CABLE HARNESS	940-0015	6-9
6-12	ACCESSORY PARTS KIT FOR 117V AC/60 Hz RECORDER MODELS INTERFACING WITH 5400C/5500C SERIES CARTRIDGE MACHINES	950-5400	6-9
6-13	ACCESSORY PARTS KIT FOR 220V AC/50 Hz RECORDER MODELS INTERFACING WITH 5400C/5500C SERIES CARTRIDGE MACHINES	950-5402	6-9
6-14	MONOPHONIC AND STEREOPHONIC RECORD INTER- CONNECTION KIT FOR 9000 CARTRIDGE MACHINES	970-0088	6-10

TABLE 6-2. 5409C MONOPHONIC RECORDER BASIC ASSEMBLY - 900-5409-011  
AND OPTIONAL ASSEMBLIES: XXX-XXXX-050, XXX-XXXX-300, XXX-XXXX-350

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Basic Monophonic Recorder Unit	950-5409	1
----	Power Supply Circuit Board Assembly	910-1820	1
----	Monophonic Record Amplifier/Bias Circuit Board Assembly	910-1049-001	1
----	Monophonic Record Control and Tone Generator Circuit Board Assembly	914-1513	1
----	Cartridge Machine Record Head Lead Assembly, Monophonic	940-0016	1
<p>ADDITIONAL PARTS FOR 117V AC/60 Hz RECORDER MODELS INTERFACING WITH 5400C/5500C/5300C SERIES CARTRIDGE MACHINES 900-5409-011, 900-5409-050</p>			
F1	Fuse, AGC, 1 Ampere	330-0100	1
XF1	Fuse Holder (Designed for Operation with the AC Input Receptacle)	415-0006	1
----	Accessory Parts Kit, 117V AC/60 Hz Recorder Models Interfacing with 5400C/5500C Series Cartridge Machines	950-5400	1
<p>ADDITIONAL PARTS FOR 220V AC/50 Hz RECORDER MODELS INTERFACING WITH 5400C/5500C/5300C SERIES CARTRIDGE MACHINES 900-5409-311, 900-5409-350</p>			
F1	Fuse, GMA, 0.5 Ampere	330-0051	1
XF1	Fuse Holder (Designed for Operation with the AC Input Receptacle)	415-0007	1
----	Accessory Parts Kit, 220V AC/50 Hz Recorder Models Interfacing with 5400/5500 Series Cartridge Machines	950-5402	1

TABLE 6-3. 5410C STEREOPHONIC RECORDER BASIC ASSEMBLY - 900-5410-011  
AND OPTIONAL ASSEMBLIES: XXX-XXXX-050, XXX-XXXX-300, XXX-XXXX-350

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Basic Stereophonic Recorder Unit	950-5410	1
----	Power Supply Circuit Board Assembly	910-1820	1
----	Stereophonic Record Amplifier/Bias Circuit Board Assembly	910-1050-001	1
----	Stereophonic Record Control and Tone Generator Circuit Board Assembly	914-1533	1
----	Cartridge Machine Head Lead Assembly, Stereophonic	940-0017	1
<p>ADDITIONAL PARTS FOR 117V AC/60 Hz RECORDER MODELS INTERFACING WITH 5400C/5500C/5300C SERIES CARTRIDGE MACHINES 900-5410-011, 900-5410-050</p>			
F1	Fuse, AGC, 1 Ampere	330-0100	1
XF1	Fuse Holder (Designed for Operation with the AC Input Receptacle)	415-0006	1
----	Accessory Parts Kit, 117V AC/60 Hz Recorder Models Interfacing with 5400C/5500C Series Cartridge Machines	950-5400	1
<p>ADDITIONAL PARTS FOR 220V AC/50 Hz RECORDER MODELS INTERFACING WITH 5400C/5500C/5300C SERIES CARTRIDGE MACHINES 900-5410-311, 900-5410-350</p>			
F1	Fuse, GMA, 0.5 Ampere	330-0051	1
XF1	Fuse Holder (Designed for Operation with the AC Input Receptacle)	415-0007	1
----	Accessory Parts Kit, 220V AC/50 Hz Recorder Models Interfacing with 5400C/5500C Series Cartridge Machines	950-5402	1

TABLE 6-4. BASIC MONOPHONIC AND STEREOPHONIC RECORDER UNITS - 950-5409, 950-5410

REF. DES.	DESCRIPTION	PART NO.	QTY.
DS1	Lamp, No. 85, Incandescent, Subminiature, Wedge Base, 28V, 0.04 Ampere (for RECORD Switch/Indicator Only)	321-0085	1
J1 THRU J3	Socket, Circuit Board, 22-Pin	417-2100	3
P1	Connector, 2-Pin (Transformer to Power Supply Circuit Board)	418-0701	1
P301	Connector, Male, D-Type, 25-Pin (To Cartridge Machine Record Deck Input/Output Connector)	417-0251	1
S1	Switch, Toggle, SPDT, 5 Ampere @ 120V AC or 2 Amperes @ 250V AC (ON/OFF Switch)	348-7101	1
S2 THRU S4	Switch with Bezel, Push, Illuminated, Normally Open, Momentary Contact, DPDT, 3 Amperes @ 125V AC or 2 Amperes @ 250V AC (RECORD, SEC/150 Hz, YER/8 kHz Switch/Indicators)	343-0042	3
T1	Transformer, Power Dual Primary: 108V Thru 115V AC, 50/60 Hz Secondary: 21V @ 1.3 Ampere, 23V @ 500 mA	376-7656	1
TB1	Barrier Strip, 12 Terminal	412-0060	1
----	Switch Cap, Red (For RECORD Switch/Indicator)	343-0043	1
----	Switch Cap, White (For YER/8 kHz Switch)	340-0049	1
----	Switch Cap, Blue (For SEC/150 Hz Switch)	340-0059	1
----	Guide, Circuit Board	409-0020	6
----	AC Input Receptacle	418-0043	1
----	Socket, Pins (For P1)	417-0053	2
----	Assembly, Cable Harness	940-0015	1
ADDITIONAL PARTS FOR THE BASIC MONOPHONIC RECORDER UNIT 950-5409			
M1	VU Meter, 1.5 Inch (3.8 cm), DC Microammeter Type, 200 uA Movement 225 Ohm Resistance	319-0081	1
R1	Potentiometer, 10 k Ohm $\pm 10\%$ , 1/2W (LEVEL Control)	190-1050	1
----	Overlay, Front Panel	595-0012	1
----	Record Cable Assembly, Monophonic	940-0019	1
ADDITIONAL PARTS FOR THE BASIC STEREOPHONIC RECORDER UNIT 950-5410			
M1,M2	VU Meter, 1.5 Inch (3.8 cm), DC Microammeter Type, 200 uA Movement 225 Ohm Resistance	319-0081	2
R1,R2	Potentiometer, 10 k Ohm $\pm 10\%$ , 1/2W (LEVEL Control)	190-1050	2
----	Overlay, Front Panel	595-0013	1
----	Record Cable Assembly, Stereophonic	940-0018	1

TABLE 6-5. MONOPHONIC AND STEREOPHONIC RECORD CABLE ASSEMBLIES - 940-0018, 940-0019

REF. DES.	DESCRIPTION	PART NO.	QTY.
P401	Connector, Male, D-Type, 9-Pin (To Cartridge Machine Record Head Connection)	417-0900	1
----	Pins (For 9-Pin Connector)	417-0142	9

TABLE 6-6. POWER SUPPLY CIRCUIT BOARD ASSEMBLY - 910-1820  
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1,C2	Capacitor, Electrolytic, 1000 uF, 50V	014-1094	2
C3	Capacitor, Electrolytic, 33 uF, 35V	024-3335	1
C4	Capacitor, Electrolytic, 100 uF, 25V	023-1083	1
C5	Capacitor, Electrolytic, 33 uF, 35V	024-3335	1
CR1	Bridge Rectifier, MDA970-A3, Single-Phase Full-Wave, 4 Amperes, 50-200V	239-0003	1
CR2,CR3	Diode, 1N4005, Silicon, 600V, 1 Ampere	203-4005	2
CR4 THRU CR9	Diode, 1N4148, Silicon, 75V, 0.3 Ampere, Fast Switching	203-4148	6



TABLE 6-6. POWER SUPPLY CIRCUIT BOARD ASSEMBLY - 910-1820  
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
IC1,IC2	Integrated Circuit, LM3900, Quad Operational Amplifier, 14-Pin DIP	221-3900	2
J1	Connector, 2-Pin	417-0700	1
Q1	Voltage Regulator, MC7824CK, Fixed Positive, 24V, YO-3 Case	227-7824	1
Q2	Transistor, GE55817, Silicon, PNP, YO-92 Case	210-5817	1
R1	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R2	Resistor, 3.9 k Ohm $\pm 5\%$ , 1/4W	100-3943	1
R3 THRU R5	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	3
R6	Resistor, 3.9 k Ohm $\pm 5\%$ , 1/4W	100-3943	1
R7	Resistor, 47 k Ohm $\pm 5\%$ , 1/4W	100-4753	1
R8,R9	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R10	Resistor, 47 k Ohm $\pm 5\%$ , 1/4W	100-4753	1
R11,R12	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R13	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R14,R15	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R16	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R17,R18	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R19	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R20,R21	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R22	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R23	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R24,R25	Resistor, 1 k Ohm $\pm 5\%$ , 1/4W	100-1043	2
R26	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R27	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R28	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
XIC1,XIC2	Socket, 14-Pin, DIP	417-1400	2
----	Transistor Insulator, Mica, YO-3 Case	418-0010	1
----	Blank Circuit Board	514-1820	1

TABLE 6-7. MONOPHONIC AND STEREOPHONIC RECORD AMPLIFIER/BIAS CIRCUIT BOARD ASSEMBLIES  
910-1049-001, 910-1050-001 (Sheet 1 of 3)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1,C2	Capacitor, Electrolytic, 100 $\mu$ F, 25V	023-1083	2
C3	Capacitor, Electrolytic, 4.7 $\mu$ F, 35V	024-4764	1
C4	Capacitor, Electrolytic, 47 $\mu$ F, 16V	013-4750	1
C5,C6	Capacitor, Electrolytic, 10 $\mu$ F, 16V	023-1074	2
C7	Capacitor, Mylar Film, 0.1 $\mu$ F, 100V	030-1053	1
C8	Capacitor, Ceramic, 10 pF $\pm 10\%$ , 1kV, Non-Polarized	001-1014	1
C9	Capacitor, Mica, 150 pF, 500V	040-1522	1
C10	Capacitor, Electrolytic, 1 $\mu$ F, 50V	024-1064	1
C11	Capacitor, Electrolytic, 4.7 $\mu$ F, 35V	024-4764	1
C12	Capacitor, Ceramic, 0.01 $\mu$ F, 100V	030-1043	1
C13	Capacitor, Electrolytic, 1 $\mu$ F, 50V	024-1064	1
C14	Capacitor, Mica, 220 pF, 500V	040-2223	1
C15	Capacitor, Mica, 150 pF, 500V	040-1522	1
C16	Capacitor, Electrolytic, 4.7 $\mu$ F, 35V	024-4764	1
C17	Capacitor, Electrolytic, 33 $\mu$ F, 35V	024-3335	1
C18	Capacitor, Electrolytic, 4.7 $\mu$ F, 35V	024-4764	1
C19	Capacitor, Mylar Film, 0.1 $\mu$ F, 100V	030-1053	1
C20	Capacitor, Electrolytic, 33 $\mu$ F, 35V	024-3335	1
C36 THRU C38	Capacitor, Ceramic, 0.0047 $\mu$ F $\pm 10\%$ , 200V	032-4733	3
C39	Capacitor, Mylar Film, 0.02 $\mu$ F, 100V	030-2043	1
C40	Capacitor, Electrolytic, 33 $\mu$ F, 35V	024-3335	1
C41	Capacitor, Mica, 220 pF, 500V	040-2223	1
C42	Capacitor, Mica, 150 pF, 500V	040-1522	1
C43	Capacitor, Electrolytic, 33 $\mu$ F, 35V	024-3335	1
C44	Capacitor, Mylar Film, 0.1 $\mu$ F, 100V	030-1053	1
C45	Capacitor, Mica, 22 pF, 500V	040-2213	1
D1,D2	Diode, 1N4148, Silicon, 75V @ 0.3A, Fast Switching	203-4148	2
D3	Diode, Zener, 1N4739A, 9.1V $\pm 5\%$ , 1W	200-0009	1
D5	Diode, 1N4148, Silicon, 75V @ 0.3A, Fast Switching	203-4148	1
D6	Diode, Zener, 1N4739A, 9.1V $\pm 5\%$ , 1W	200-0009	1

TABLE 6-7. MONOPHONIC AND STEREOHONIC RECORD AMPLIFIER/BIAS CIRCUIT BOARD ASSEMBLIES  
910-1049-001, 910-1050-001 (Sheet 2 of 3)

REF. DES.	DESCRIPTION	PART NO.	QTY.
J4 THRU J6, J10 THRU J12	Pins, Disconnect, Male, Printed Circuit Board Mount	418-0161	6
L1,L3	Adjustable Shielded Coil, 8-20 mH	363-9061	2
LDR1	Optical Isolator, LDR/LED Type, VYL5C2 On Resistance: 500 Ohms Off Resistance: 1 Meg Ohm Cell Voltage: 200V Maximum Cell Current: 10 to 40 mA	323-7345	1
Q1	Transistor, MPS6566, NPN, Silicon, Small Signal, TO-92 Case	211-6566	1
Q2	Transistor, 2N5462, JFET, P-Channel, 40V, TO-92 Case	212-5462	1
Q3	Transistor, PN3644, PNP, Silicon, TO-92 Case	210-3644	1
Q4,Q5	Transistor, GES5816, NPN, Small Signal, TO-92 Case	211-5816	2
Q9,Q10	Transistor, 2N3053, NPN, TO-5 Case	211-3053	2
Q11	Transistor, GES5817, Silicon, PNP, TO-92 Case	210-5817	1
Q12,Q13	Transistor, GES5816, NPN, Small Signal, TO-92 Case	211-5816	2
Q14	Transistor, 2N3904, Silicon, NPN, TO-92 Case	211-3904	1
R1,R2	Resistor, 18 k Ohm $\pm 5\%$ , 1/4W	100-1853	2
R3	Resistor, 62 k Ohm $\pm 5\%$ , 1/4W	100-6253	1
R4	Resistor, 8.2 k Ohm $\pm 5\%$ , 1/4W	100-8243	1
R5	Resistor, 470 Ohm $\pm 5\%$ , 1/4W	100-4733	1
R6	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R7	Resistor, 27 k Ohm $\pm 5\%$ , 1/4W	100-2753	1
R8	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R9	Resistor, 1 k Ohm $\pm 5\%$ , 1/4W	100-1043	1
R10	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R11	Resistor, 2.2 k Ohm $\pm 5\%$ , 1/4W	100-2243	1
R12	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R13	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R14	Potentiometer, 250 k Ohm $\pm 10\%$ , 1/2W	180-0001	1
R15,R16	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R17	Resistor, 240 k Ohm $\pm 5\%$ , 1/4W	100-2463	1
R18	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R19	Potentiometer, 100 k Ohm $\pm 10\%$ , 1/2W	178-1064	1
R20	Resistor, 240 k Ohm $\pm 5\%$ , 1/4W	100-2463	1
R21	Resistor, 270 k Ohm $\pm 5\%$ , 1/4W	100-2763	1
R22	Resistor, 22 k Ohm $\pm 5\%$ , 1/4W	100-2253	1
R23	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R24	Resistor, 1 k Ohm $\pm 5\%$ , 1/4W	100-1043	1
R25	Resistor, 2.7 k Ohm $\pm 5\%$ , 1/4W	100-2743	1
R26	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R27	Resistor, 1 Meg Ohm $\pm 5\%$ , 1/4W	100-1073	1
R28	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R29	Resistor, 27 k Ohm $\pm 5\%$ , 1/4W	100-2753	1
R30	Resistor, 5.6 k Ohm $\pm 5\%$ , 1/4W	100-5643	1
R31	Potentiometer, 100 k Ohm $\pm 10\%$ , 1/2W	178-1064	1
R32	Resistor, 27 k Ohm $\pm 5\%$ , 1/4W	100-2753	1
R33	Resistor, 8.2 k Ohm $\pm 5\%$ , 1/4W	100-8243	1
R34	Resistor, 22 k Ohm $\pm 5\%$ , 1/4W	100-2253	1
R35	Resistor, 1 k Ohm $\pm 5\%$ , 1/4W	100-1043	1
R63,R64	Resistor, 12 Ohm $\pm 5\%$ , 1/4W	100-1223	2
R65,R66	Resistor, 1 k Ohm $\pm 5\%$ , 1/4W	100-1043	2
R67,R68	Resistor, 22 k Ohm $\pm 5\%$ , 1/4W	100-2253	2
R69	Potentiometer, 100 k Ohm $\pm 10\%$ , 1/2W	178-1064	1
R70	Resistor, 5.6 k Ohm $\pm 5\%$ , 1/4W	100-5643	1
R71,R72	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R73	Resistor, 39 k Ohm $\pm 5\%$ , 1/4W	100-3953	1
R74	Resistor, 47 k Ohm $\pm 5\%$ , 1/4W	100-4753	1
R75	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R77	Resistor, 4.7 k Ohm $\pm 5\%$ , 1/4W	100-4743	1
R78,R79	Resistor, 470 Ohm $\pm 5\%$ , 1/2W	110-4733	2
S1	Switch, Slide, MSS1200R, SPDT, 300 mA @ 125V ac (Gain Switch)	345-0120	1
Y1	Transformer, Audio Input, 0.5 dB, 30 Hz to 20 kHz Dual Primary: 150 Ohm and 15 k Ohm Secondary: 60 k Ohm	370-0020	1
Y3	Transformer, Bias Oscillator, BE Manufactured, 100 kHz $\pm 5\%$ , dc Supply, 24V dc $\pm 0.1\%$	370-0095	1
YP1,YP3	Pin, Amplifier Disconnect	418-0161	2

TABLE 6-7. MONOPHONIC AND STEREOPHONIC RECORD AMPLIFIER/BIAS CIRCUIT BOARD ASSEMBLIES  
910-1049-001, 910-1050-001 (Sheet 3 of 3)

REF. DES.	DESCRIPTION	PART NO.	QTY.
U1 THRU U3	Integrated Circuit, TL072CP, Quad JFET-Input Operational Amplifier, 8-Pin DIP	221-0072	3
XU1 THRU XU3	Socket, 8-Pin DIP	417-0800	3
----	Transistor Mounting Pads (For Q9, Q10)	409-0005	2
----	Blank Circuit Board	510-1050	1
ADDITIONAL PARTS FOR STEREOPHONIC CIRCUIT BOARD ONLY 910-1050-001			
C21	Capacitor, Electrolytic, 100 uF, 25V	023-1083	1
C22	Capacitor, Electrolytic, 4.7 uF, 35V	024-4764	1
C23	Capacitor, Electrolytic, 47 uF, 16V	013-4750	1
C24, C25	Capacitor, Electrolytic, 10 uF, 16V	023-1074	2
C26	Capacitor, Mylar Film, 0.1 uF, 100V	030-1053	1
C27	Capacitor, Ceramic, 10 pF $\pm 10\%$ , 1 kV, Non-Polarized	001-1014	1
C28	Capacitor, Mica, 150 pF, 500V	040-1522	1
C29	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
C30	Capacitor, Electrolytic, 4.7 uF, 35V	024-4764	1
C31	Capacitor, Ceramic, 0.01 uF, 100V	030-1043	1
C32	Capacitor, Mica, 220 pF, 500V	040-2223	1
C33	Capacitor, Mica, 150 pF, 500V	040-1522	1
C34	Capacitor, Electrolytic, 33 uF, 35V	024-3335	1
C35	Capacitor, Mylar Film, 0.1 uF, 100V	030-1053	1
C46	Capacitor, Mica, 22 pF, 500V	040-2213	1
D4	Diode, Zener, 1N4739A, 9.1V $\pm 5\%$ , 1W	200-0009	1
J7 THRU J9	Pin, Disconnect, Male, Printed Circuit Board Mount	418-0161	3
L2	Adjustable Shielded Coil, 8-20 uH	363-9061	1
Q6	Transistor, MPS6566, Silicon, NPN, Small Signal, TO-92 Case	211-6566	1
Q7	Transistor, 2N5462, JFET, P-Channel, 40V, TO-92 Case	212-5462	1
Q8	Transistor, GES5816, Silicon, NPN, Small Signal, TO-92 Case	211-5816	1
R36, R37	Resistor, 18 k Ohm $\pm 5\%$ , 1/4W	100-1853	2
R38	Resistor, 62 k Ohm $\pm 5\%$ , 1/4W	100-6253	1
R39	Resistor, 8.2 k Ohm $\pm 5\%$ , 1/4W	100-8243	1
R40	Resistor, 470 Ohm $\pm 5\%$ , 1/4W	100-4733	1
R41	Resistor, 27 k Ohm $\pm 5\%$ , 1/4W	100-2753	1
R42	Resistor, 1 k Ohm $\pm 5\%$ , 1/4W	100-1043	1
R43	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R44	Resistor, 2.2 k Ohm $\pm 5\%$ , 1/4W	100-2243	1
R45	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R46	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R47	Potentiometer, 250 k Ohm $\pm 10\%$ , 1/2W	180-0001	1
R48, R49	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R50	Resistor, 240 k Ohm $\pm 5\%$ , 1/4W	100-2463	1
R51	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R52	Potentiometer, 100 k Ohm $\pm 10\%$ , 1/2W	178-1064	1
R53	Resistor, 240 k Ohm $\pm 5\%$ , 1/4W	100-2463	1
R54	Resistor, 270 k Ohm $\pm 5\%$ , 1/4W	100-2763	1
R55	Resistor, 22 k Ohm $\pm 5\%$ , 1/4W	100-2253	1
R56	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R57	Resistor, 1 k Ohm $\pm 5\%$ , 1/4W	100-1043	1
R58	Resistor, 2.7 k Ohm $\pm 5\%$ , 1/4W	100-2743	1
R59	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R60	Resistor, 5.6 k Ohm $\pm 5\%$ , 1/4W	100-5643	1
R61	Potentiometer, 100 k Ohm $\pm 10\%$ , 1/2W	178-1064	1
R62	Resistor, 22 k Ohm $\pm 5\%$ , 1/4W	100-2253	1
R76	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
S2	Switch, Slide, MSS1200R, SPST, 300 mA @ 125V ac (Gain Switch)	345-0120	1
T2	Transformer, Audio Input, 0.5 dB, 30 Hz to 20 kHz Dual Primary: 150 Ohm and 15 k Ohm Secondary: 60 k Ohm	370-0020	1
YP2	Pin, Amplifier Disconnect	418-0161	1
U4	Integrated Circuit, TL072CP, Quad JFET-Input Operational Amplifier, 8-Pin DIP	221-0072	1
XU4	Socket, 8-Pin DIP	417-0800	1

TABLE 6-8. MONOPHONIC AND STEREOPHONIC RECORD CONTROL AND TONE GENERATOR CIRCUIT BOARD  
ASSEMBLIES - 914-1513, 914-1533 (Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C7	Capacitor, Tantalum, 1 uF $\pm 10\%$ , 35V	064-1063	1
C11	Capacitor, Electrolytic, 33 uF, 35V	024-3335	1
C12	Capacitor, Tantalum, 1 uF $\pm 10\%$ , 35V	064-1063	1
C13	Capacitor, Monolithic Ceramic, 2200 pF $\pm 10\%$ , 200V	030-2033	1
C14,C15	Capacitor, Mylar Film, 0.039 uF, 100V	030-3942	2
C16,C17	Capacitor, Ceramic, 0.01 uF, 200V	030-1043	2
C18 THRU C20	Capacitor, Tantalum, 1 uF $\pm 10\%$ , 35V	064-1063	3
C21	Capacitor, Ceramic, 0.01 uF, 200V	030-1043	1
C22,C23	Capacitor, Mylar Film, 0.15 uF, 100V	030-1553	2
C24,C25	Capacitor, Mylar Film, 0.0033 uF, 100V	030-3333	2
C26	Capacitor, Mica, 500 pF, 500V	041-5023	1
C27	Capacitor, Mylar Film, 0.1 uF, 100V	030-1053	1
C28,C30	Capacitor, Tantalum, 1 uF $\pm 10\%$ , 35V	064-1063	2
CR1	Diode, 1N4148, Silicon, 75V @ 0.3 Ampere, Fast Switching	203-4148	1
CR2 THRU CR5	Diode, 1N98, Germanium, 20 mA, 100V	202-0098	4
CR7 THRU CR9, CR14 THRU CR29	Diode, 1N4148, Silicon, 75V @ 0.3 Ampere, Fast Switching	203-4148	19
IC1	Integrated Circuit, RC4558DN, Operational Amplifier, 8-Pin DIP	221-4558	1
IC2,IC3	Integrated Circuit, LM3900, Quad Operational Amplifier, 14-Pin DIP	221-3900	2
Q1	Transistor, 2N5457, JFET, N-Channel, 25V	212-5457	1
Q2	Transistor, 2N5462, JFET, P-Channel, 40V	212-5462	1
Q5	Transistor, MPS6566, NPN, Silicon, Small Signal	211-6566	1
Q7	Transistor, GES5816, NPN, Small Signal, Y0-92 Case	211-5816	1
Q8,Q9	Transistor, MPS6566, NPN, Silicon, Small Signal	211-6566	2
Q10,Q11	Transistor, 2N5457, JFET, N-Channel, 25V	212-5457	2
Q12,Q13	Transistor, GES5816, NPN, Small Signal, Y0-92 Case	211-5816	2
Q14	Transistor, MPS6566, NPN, Silicon, Small Signal	211-6566	1
Q15	Transistor, 2N5457, JFET, N-Channel, 25V	212-5457	1
R1,R2	Potentiometer, 50 k Ohm $\pm 10\%$ , 1/2W	178-5054	2
R5	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R6 THRU R8	Potentiometer, 10 k Ohm $\pm 10\%$ , 1/2W	178-1054	3
R9	Potentiometer, 50 k Ohm $\pm 10\%$ , 1/2W	178-5054	1
R10	Potentiometer, 5 k Ohm $\pm 10\%$ , 1/2W	177-5044	1
R11	Potentiometer, 2 k Ohm $\pm 10\%$ , 1/2W	177-2044	1
R12	Potentiometer, 5 k Ohm $\pm 10\%$ , 1/2W	177-5044	1
R13 THRU R17	Resistor, 330 k Ohm $\pm 5\%$ , 1/4W	100-3363	5
R18	Resistor, 2.7 k Ohm $\pm 5\%$ , 1/4W	100-2743	1
R19	Resistor, 330 k Ohm $\pm 5\%$ , 1/4W	100-3363	1
R20	Resistor, 2.7 k Ohm $\pm 5\%$ , 1/4W	100-2743	1
R29	Resistor, 4.7 k Ohm $\pm 5\%$ , 1/4W	100-4743	1
R30,R31	Resistor, 2.7 k Ohm $\pm 5\%$ , 1/4W	100-2743	2
R32	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R34,R36	Resistor, 15 k Ohm $\pm 5\%$ , 1/4W	100-1553	2
R37	Resistor, 4.7 k Ohm $\pm 5\%$ , 1/4W	100-4743	1
R38,R39	Resistor, 3.9 k Ohm $\pm 5\%$ , 1/4W	100-3943	2
R40,R41	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R42	Resistor, 39 k Ohm $\pm 5\%$ , 1/4W	100-3953	1
R43	Resistor, 47 k Ohm $\pm 5\%$ , 1/4W	100-4753	1
R44	Resistor, 2.7 k Ohm $\pm 5\%$ , 1/4W	100-2743	1
R45	Resistor, 4.7 k Ohm $\pm 5\%$ , 1/4W	100-4743	1
R46,R47	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R48	Resistor, 180 k Ohm $\pm 5\%$ , 1/4W	100-1863	1
R49	Resistor, 68 k Ohm $\pm 5\%$ , 1/4W	100-6853	1
R50	Resistor, 1 k Ohm $\pm 5\%$ , 1/4W	100-1043	1
R51	Resistor, 4.7 k Ohm $\pm 5\%$ , 1/4W	100-4743	1
R52	Resistor, 75 k Ohm $\pm 5\%$ , 1/4W	100-7553	1
R53	Resistor, 56 k Ohm $\pm 5\%$ , 1/4W	100-5653	1
R54	Resistor, 120 k Ohm $\pm 5\%$ , 1/4W	100-1263	1
R55	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R56,R57	Resistor, 39 k Ohm $\pm 5\%$ , 1/4W	100-3953	2
R58,R59	Resistor, 620 Ohm $\pm 5\%$ , 1/4W	100-6233	2
R60,R61	Resistor, 47 k Ohm $\pm 5\%$ , 1/4W	100-4753	2

TABLE 6-8. MONOPHONIC AND STEREOPHONIC RECORD CONTROL AND TONE GENERATOR CIRCUIT BOARD  
ASSEMBLIES - 914-1513, 914-1533 (Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R62	Resistor, 1 Meg Ohm $\pm 5\%$ , 1/4W	100-1073	1
R63	Resistor, 200 k Ohm $\pm 5\%$ , 1/4W	100-2063	1
R64 THRU R66	Resistor, 1 Meg Ohm $\pm 5\%$ , 1/4W	100-1073	3
R67	Resistor, 330 k Ohm $\pm 5\%$ , 1/4W	100-3363	1
R68	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	1
R69	Resistor, 47 k Ohm $\pm 5\%$ , 1/4W	100-4753	1
R70	Resistor, 2.7 k Ohm $\pm 5\%$ , 1/4W	100-2743	1
R71, R72	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	2
R73	Resistor, 39 k Ohm $\pm 5\%$ , 1/4W	100-3953	1
R74	Resistor, 560 k Ohm $\pm 5\%$ , 1/4W	100-5663	1
R75	Resistor, 82 k Ohm $\pm 5\%$ , 1/4W	100-8253	1
R76	Resistor, 56 k Ohm $\pm 5\%$ , 1/4W	100-5653	1
R77	Resistor, 120 k Ohm $\pm 5\%$ , 1/4W	100-1263	1
R78	Resistor, 47 k Ohm $\pm 5\%$ , 1/4W	100-4753	1
R79	Resistor, 330 k Ohm $\pm 5\%$ , 1/4W	100-3363	1
R80, R81	Resistor, 39 k Ohm $\pm 5\%$ , 1/4W	100-3953	2
R82, R83	Resistor, 100 k Ohm $\pm 5\%$ , 1/4W	100-1063	2
R84	Resistor, 270 k Ohm $\pm 5\%$ , 1/4W	100-2763	1
R85	Resistor, 75 k Ohm $\pm 5\%$ , 1/4W	100-7553	1
R86	Resistor, 56 k Ohm $\pm 5\%$ , 1/4W	100-5653	1
R87	Resistor, 120 k Ohm $\pm 5\%$ , 1/4W	100-1263	1
R88	Resistor, 10 k Ohm $\pm 5\%$ , 1/4W	100-1053	1
R89, R90	Resistor, 39 k Ohm $\pm 5\%$ , 1/4W	100-3953	2
R91, R92	Resistor, 1.5 k Ohm $\pm 5\%$ , 1/4W	100-1543	2
R93	Resistor, 220 k Ohm $\pm 5\%$ , 1/4W	100-2263	1
R94	Resistor, 68 k Ohm $\pm 5\%$ , 1/4W	100-6853	1
S1	Switch, Slide, MSS1200R, SPDT, 300 mA @ 125V ac (1 KHZ DEFEAT ON/OFF)	345-0120	1
----	Socket, 8-Pin DIP	417-0800	1
----	Socket, 14-Pin DIP	417-1400	2
----	Blank Circuit Board	514-1503	1
ADDITIONAL PARTS FOR MONOPHONIC RECORD CONTROL CIRCUIT BOARD ONLY - 914-1513			
C1, C5, C6, C10, C29	Capacitor, Tantalum, 4.7 $\mu$ F $\pm 10\%$ , 35V,	064-4763	5
ADDITIONAL PARTS FOR STEREOPHONIC RECORD CONTROL CIRCUIT BOARD ONLY - 914-1533			
C1, C3, C5, C6	Capacitor, Electrolytic, 4.7 $\mu$ F $\pm 10\%$ , 35V	024-4753	4
C8	Capacitor, Tantalum, 1 $\mu$ F $\pm 10\%$ , 35V	064-1063	1
C9, C10, C29	Capacitor, Electrolytic, 4.7 $\mu$ F $\pm 10\%$ , 35V	024-4753	3
C31	Capacitor, Tantalum, 1 $\mu$ F $\pm 10\%$ , 35V	064-1063	1
CR6	Diode, 1N4148, Silicon, 75V @ 0.3 Ampere, Fast Switching	203-4148	1
CR10 THRU CR13	Diode, 1N98, Germanium, 80V @ 0.2 Ampere	202-0098	4
Q3	Transistor, 2N5457, JFET, N-Channel, TO-92 Case	212-5457	1
Q4	Transistor, 2N5462, JFET, P-Channel, TO-92 Case	212-5462	1
R3, R4	Potentiometer, 50 k Ohm $\pm 10\%$ , 1/2W	178-5054	2
R21 THRU R25	Resistor, 330 k Ohm $\pm 5\%$ , 1/4W	100-3363	5
R26, R27	Resistor, 2.7 k Ohm $\pm 5\%$ , 1/4W	100-2743	2
R28	Resistor, 330 k Ohm $\pm 5\%$ , 1/4W	100-3363	1

TABLE 6-9. CARTRIDGE MACHINE MONOPHONIC RECORD HEAD LEAD ASSEMBLY - 940-0016

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, Female, D-Type, 9-Pin (Cartridge Machine Record Jack)	417-0901	1
----	Socket, Pins (for 9-Pin Connector)	417-0143	6
----	Head Leads:		
	Orange and Red	906-5127-1	1
	Blue and Yellow	906-5127-2	1
----	Head, Record, Monophonic, 2-Channel, Model LMR Inductance: 50 mH Impedance at 1 kHz: 330 Ohms DC Resistance: 115 Ohms per Channel	252-0018	1

TABLE 6-10. CARTRIDGE MACHINE STEREOPHONIC RECORD HEAD LEAD ASSEMBLY - 940-0017

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, Female, D-Type, 9-Pin (Cartridge Machine Record Jack)	417-0901	1
----	Socket, Pins (for 9-Pin Connector)	417-0143	6
----	Head Leads:		
	Orange and Red	906-5127-1	1
	Blue and Yellow	906-5127-2	1
	Black and White	906-5127-3	1
----	Head, Record, Stereophonic, 3-Channel, Model LSR Inductance: 50 mH Impedance at 1 kHz: 400 Ohms DC Resistance: 100 Ohms per Channel	253-0015	1

TABLE 6-11. ASSEMBLY, CABLE HARNESS - 940-0015

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, Female, D-Type, 25-Pin (INPUT/REMOTE)	417-0252	1
----	Pins, Connector (for INPUT/REMOTE Connector)	417-0143	20

TABLE 6-12. ACCESSORY PARTS KIT FOR 117V AC/60 Hz RECORDER MODELS INTERFACING WITH  
5400C/5500C SERIES CARTRIDGE MACHINES - 950-5400

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, D-Type, 25-Pin (Mating Connector for INPUT/REMOTE Jack)	417-0251	1
----	Pins, Connector (for INPUT/REMOTE Jack)	418-0048	25
----	117V AC Line Cord	682-0001	1

TABLE 6-13. ACCESSORY PARTS KIT FOR 220V AC/50 Hz RECORDER MODELS INTERFACING WITH  
5400C/5500C SERIES CARTRIDGE MACHINES - 950-5402

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Connector, Male, D-Type, 25-Pin (Mating Connector for INPUT/REMOTE Jack)	417-0251	1
----	Pins, Connector (for INPUT/REMOTE Jack)	418-0048	25
----	220V AC Line Cord	682-0003	1

TABLE 6-14. MONOPHONIC AND STEREOGRAPHIC RECORD INTERCONNECTION KIT  
FOR 9000 CARTRIDGE MACHINES - 970-0088

REF. DES.	DESCRIPTION	PART NO.	QTY.
J118	Plug, Ribbon Cable, 25-Pin	417-0159	1
J119	Receptacle, 9-Pin	417-0901	1
P108	Plug, Ribbon Cable, 26-Pin Dual In-line	418-2600	1
----	Pins, Socket	417-0143	9

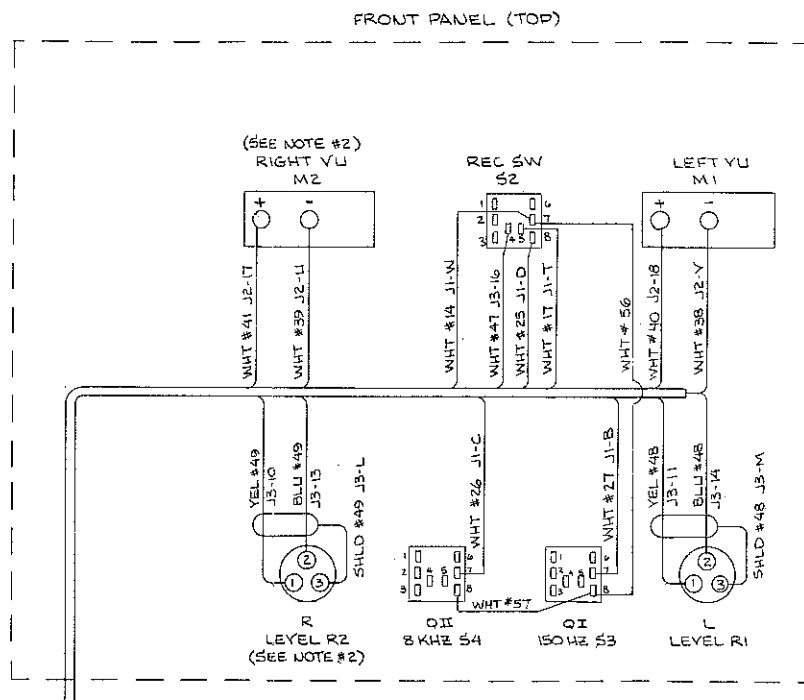
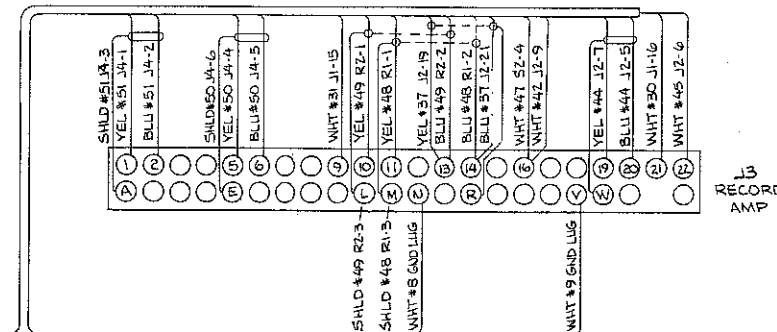
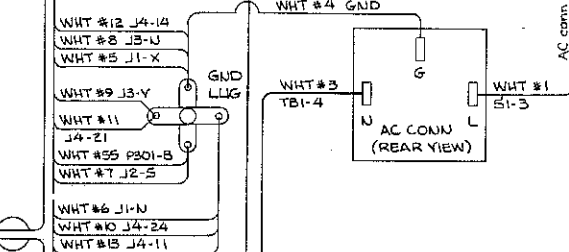
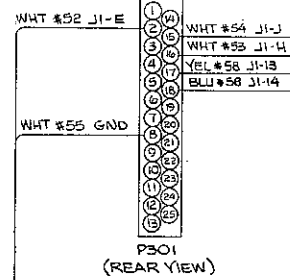
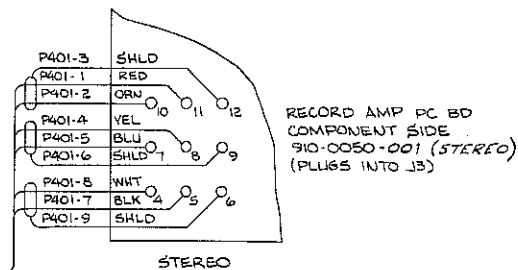
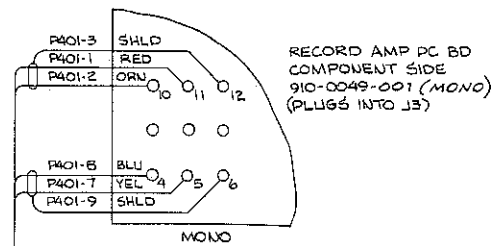
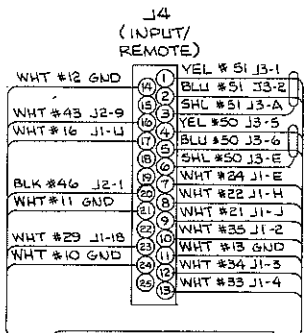
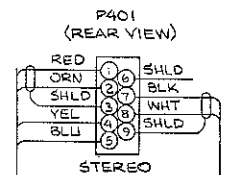
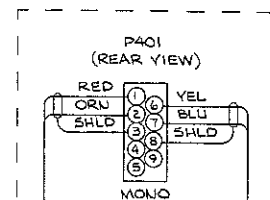
SECTION VII  
DRAWINGS

7-1.        INTRODUCTION.

7-2.        This section provides assembly drawings, wiring diagrams, schematic diagrams, and interconnection diagrams as listed below for the Broadcast Electronics 5409C and 5410C recorders.

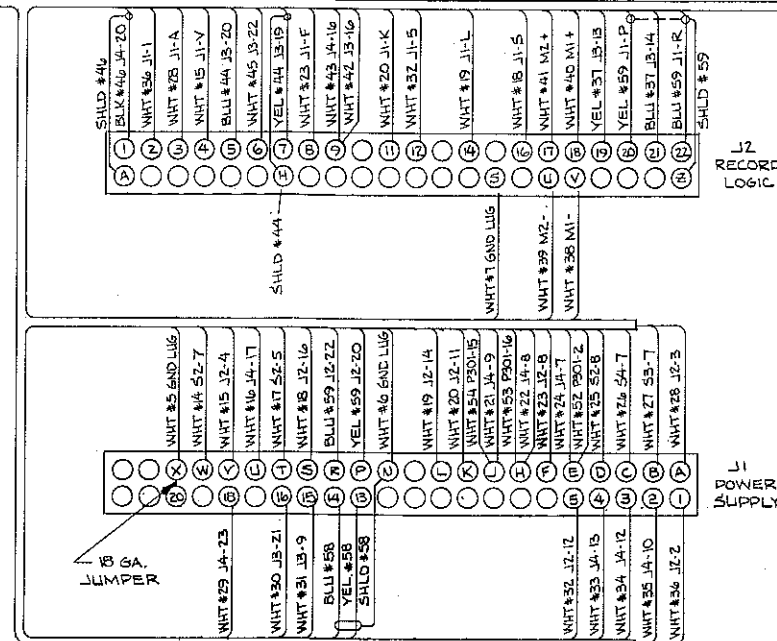
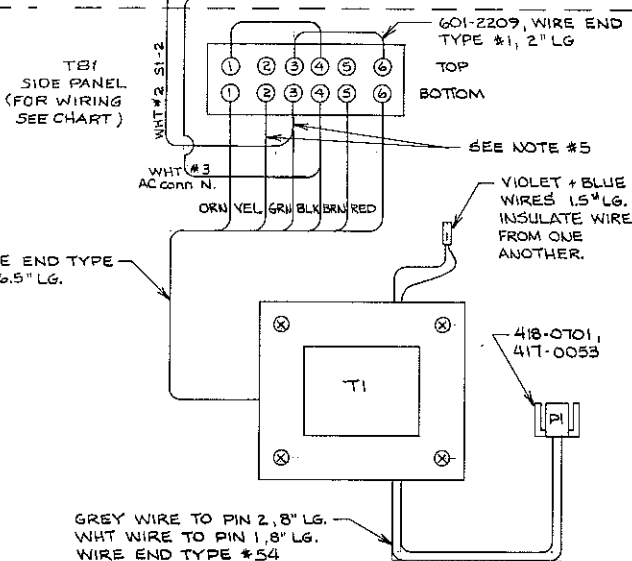
<u>FIGURE</u>	<u>TITLE</u>	<u>NUMBER</u>
7-1	WIRING DIAGRAM, 5409C AND 5410C RECORDER UNITS OVERALL	WD900-5312-XXX/ -5410-XXX
7-2	ASSEMBLY DIAGRAM, BASIC RECORDER UNIT	AC950-5409/ -5410
7-3	SCHEMATIC DIAGRAM, RECORD AMPLIFIER/BIAS CIRCUIT BOARD	SD910-1050/ -1049/ -1048/ -1049-001/ -1050-001
7-4	ASSEMBLY DIAGRAM, RECORD AMPLIFIER/BIAS CIRCUIT BOARD	AC910-1050/ -1049/ -1048/ -1049-001/ -1050-001
7-5	SCHEMATIC DIAGRAM, RECORD CONTROL AND TONE GENERATOR CIRCUIT BOARD	SD906-3112
7-6	ASSEMBLY DIAGRAM, RECORD CONTROL AND TONE GENERATOR CIRCUIT BOARD	AC914-1503/ -1513/ -1523/ -1533
7-7	SCHEMATIC DIAGRAM, POWER SUPPLY CIRCUIT BOARD	SC910-1820
7-8	ASSEMBLY DIAGRAM, POWER SUPPLY CIRCUIT BOARD	AD910-1820
7-9	WIRING DIAGRAM, REAR PANEL CONNECTOR	WC900-5309/ -5310-001 -5409/ -5410
7-10	CABLE INTERCONNECTION DIAGRAM, 5400C RECORDER TO A 5300C CARTRIDGE MACHINE	597-0097-71
7-11	CABLE INTERCONNECTION DIAGRAM, 5400C RECORDER TO A 5400C CARTRIDGE MACHINE	597-0097-72
7-12	CABLE INTERCONNECTION DIAGRAM, 5400C RECORDER TO A 5500C CARTRIDGE MACHINE	597-0097-73
7-13	CABLE INTERCONNECTION DIAGRAM, 5400C RECORDER TO A 9000 CARTRIDGE MACHINE	597-0097-70





WIRE CHART #1				
TERM.	120 V	110 V	240 V	220 V
1	ORN	ORN	ORN	ORN
2	YEL	YEL	YEL	YEL
3	GRN	GRN	GRN	GRN
4	BLK	BLK	BLK	BLK
5	BRN	BRN	BRN	BRN
6	RED	RED	RED	RED

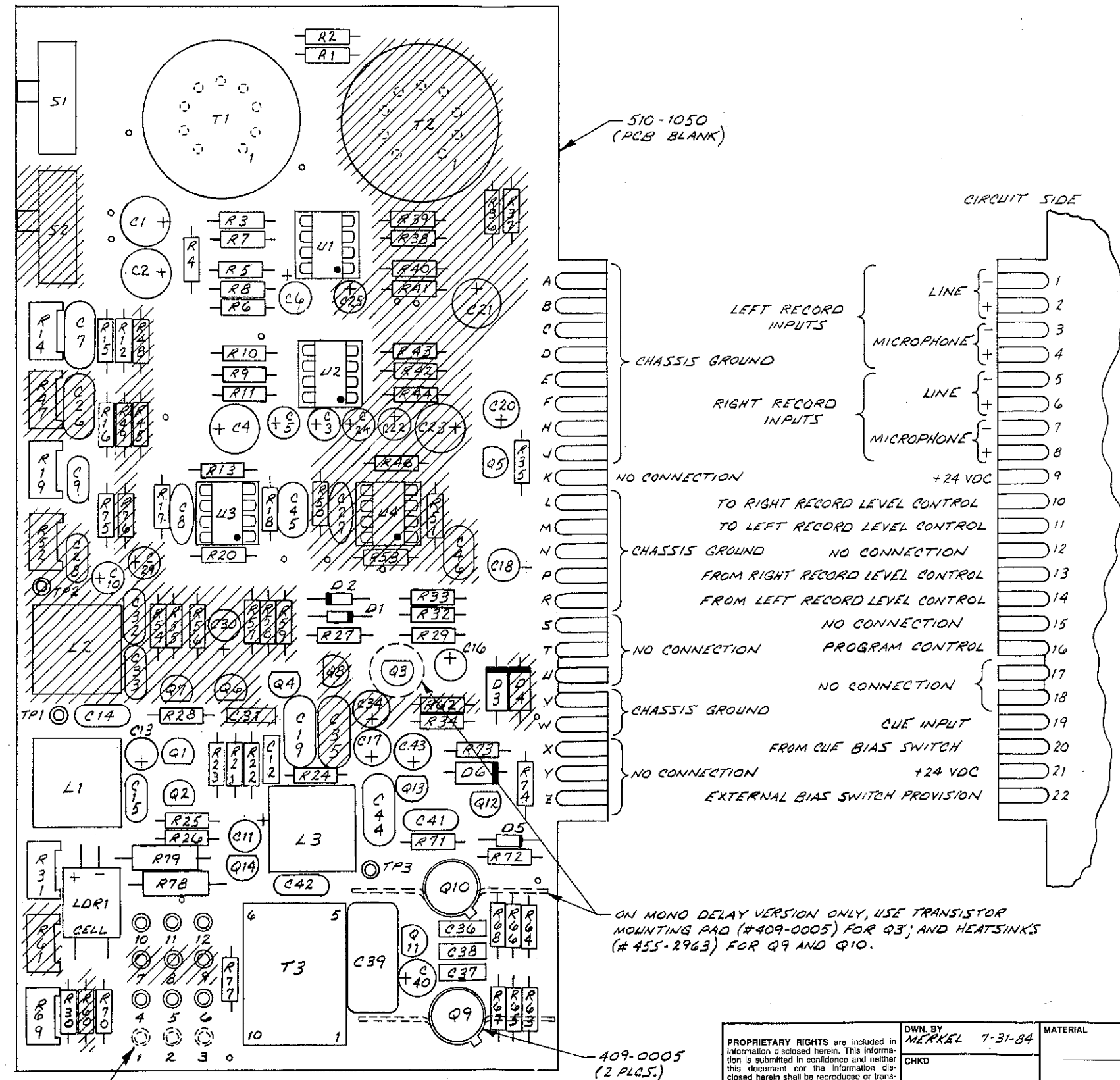
WIRE CHART #2	
VOLTAGE	TBI JUMPERS (TOP)
120 V	JUMPER 1 TO 4 AND JUMPER 3 TO 6
110 V	JUMPER 1 TO 4 AND JUMPER 2 TO 5
240 V	JUMPER 1 TO 6
220 V	JUMPER 1 TO 5



- NOTES:
- 1) SLEEPING TO BE INSTALLED ON ALL SHIELDS, WIRES + UNUSED PIN AT 51 + LINE INPUT CONN.
  - 2) MONO UNITS - FOLD BACK + INSULATE WIRE ENDS, USE HEAT-SHRINK TUBING.
  - 3) CABLES SHOULD MEASURE 18" FROM REAR OF UNIT TO CONNECTORS P301 + P401.
  - 4) USE CABLE HARNESS ASSY. PART NO. 940-0015 (MAIN) + 940-0018 (STEREO) OR 940-0019 (MONO)
  - 5) THE PLACEMENT OF THESE TWO WIRES DEPEND UPON SELECTED VOLTAGE. SEE WIRING CHART #1 FOR PLACEMENT OF WIRES.
  - 6) ON RECORDERS TO BE USED WITH MODEL 5300 CONNECT #58 YELLOW + BLUE TO PINS 24 + 25 AS SHOWN. ON RECORDERS TO BE USED WITH MODELS 5400 + 5500 DO NOT CONNECT WIRES, USE HEAT-SHRINK TUBING.
  - 7) THE PLACEMENT OF THESE JUMPERS DEPENDS UPON SELECTED VOLTAGE. SEE WIRING CHART #2 FOR PLACEMENT OF JUMPERS.
  - 8) THIS DRAWING IS ALSO USED FOR WIRING ON THE TOP LEVEL.

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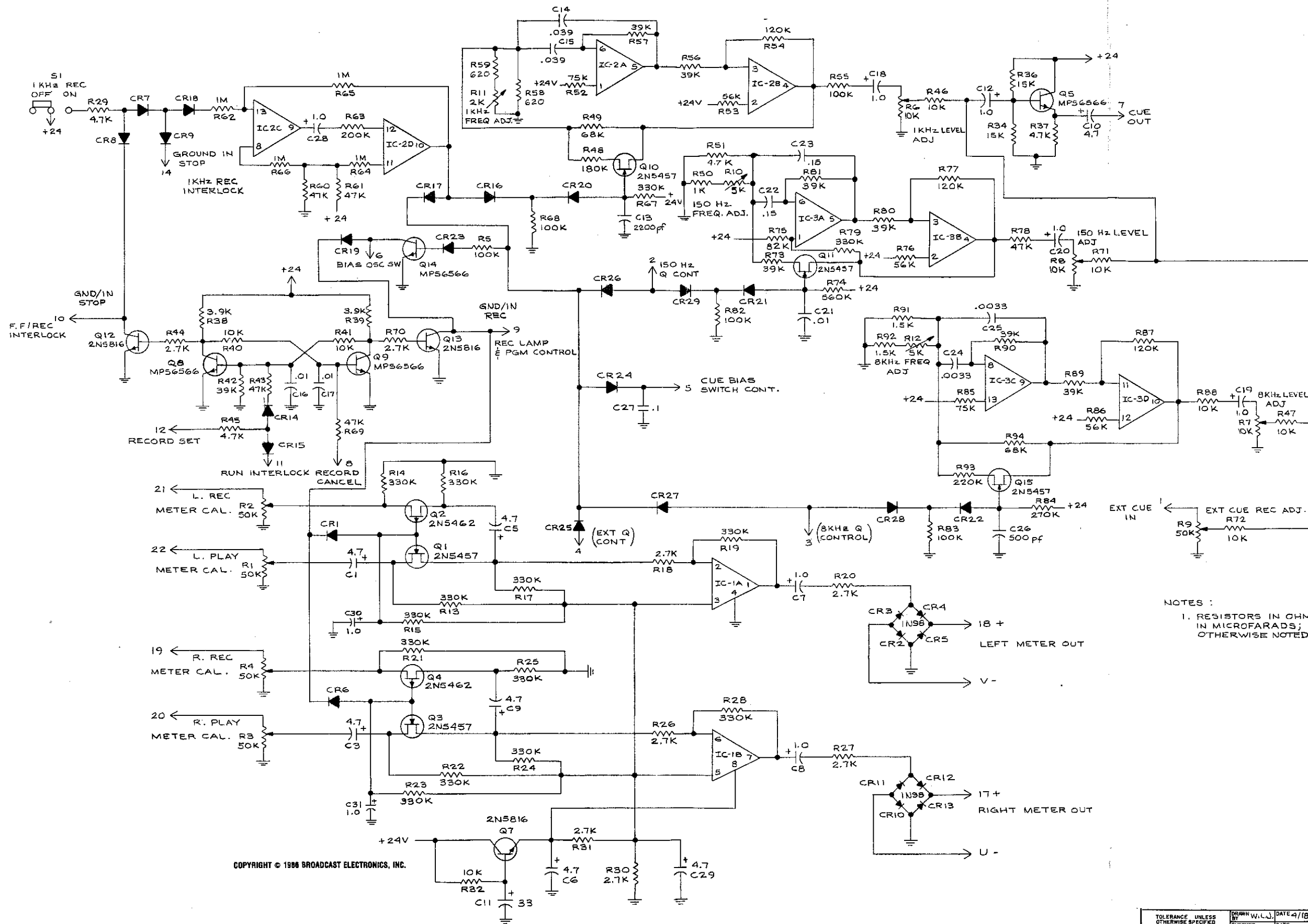




- NOTES:
1. FOR 910-1050, 910-1050-001 (STEREO), USE ALL PARTS.
  2. -INDICATES COMPONENTS NOT USED ON 910-1049, 910-1049-001, (MONO).
  3. FOR 910-1048 (MONO DELAY), USE PINS 1, 2 & 3; DO NOT USE COMPONENTS INDICATED IN NOTE #2.
  4. SEE B/M # 910-1050 (STEREO)  
# 910-1050-001 (STEREO)  
# 910-1049 (MONO)  
# 910-1049-001 (MONO)  
# 910-1048 (MONO DELAY)
  5. SEE SCHEMATIC # SD 910-1050;  
910-1050-001; 910-1049;  
910-1049-001; 910-1048.

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TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°		CHKD ME PROJ. ENGR. JRC/HP/ER	FINISH NEXT ASSY.
BROADCAST ELECTRONICS, INC. 4100 N. 24TH ST., P.O. BOX 3906 QUINCY, IL 62305 217/224-9600 TELEX 250142 CABLE BROADCAST		TITLE PCB ASSEMBLY - RECORD AMP BIAS	
TYPE A C		DWG. NO. 910-1050; 910-1050-001; 910-1049; 910-1049-001; 910-1048	REV H
MODEL 3000 SERIES		SCALE 2/1	SHEET 1 OF 1



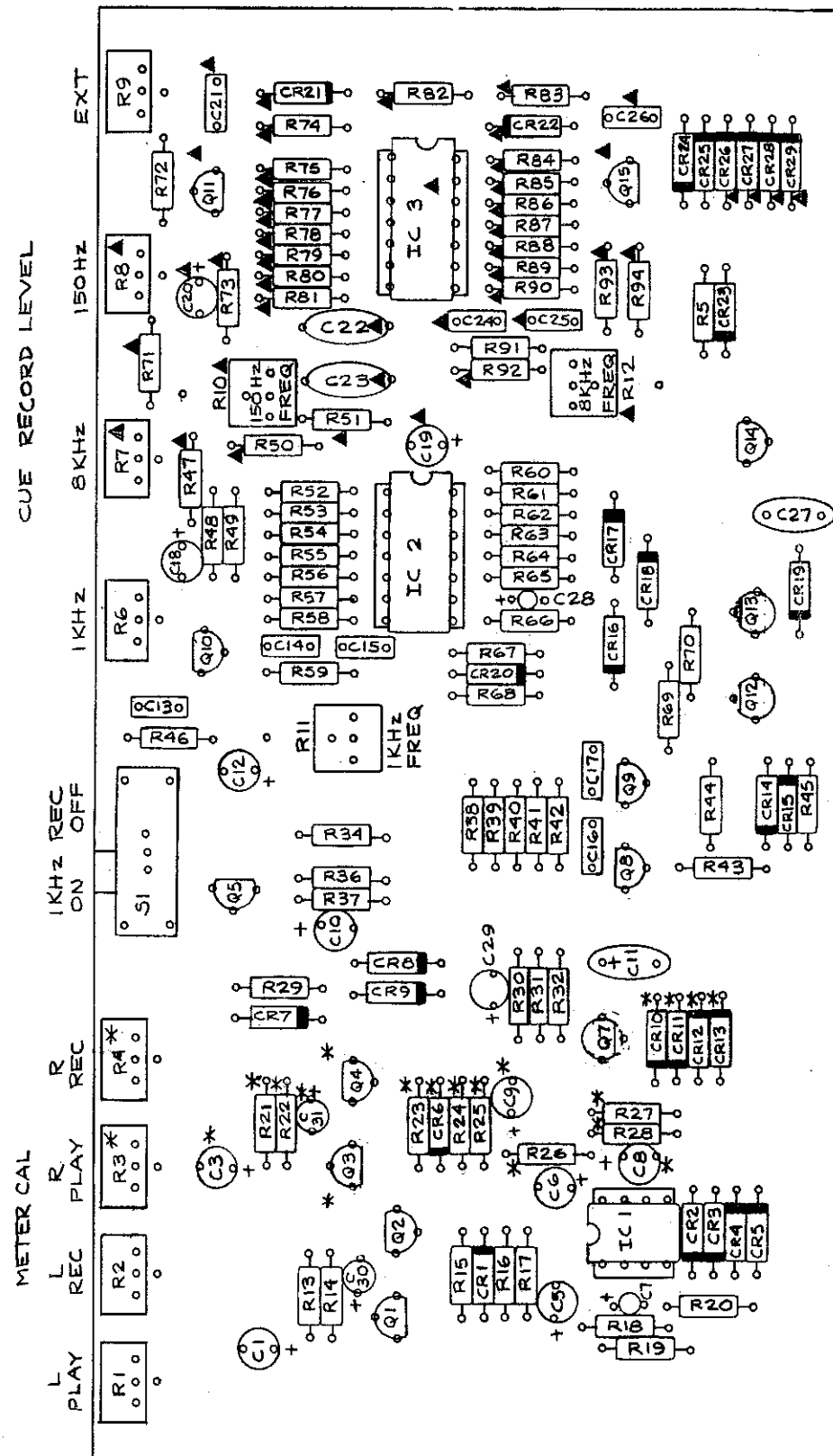
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NOTES:  
1. RESISTORS IN OHMS, 1/4 WATT; CAPACITORS IN MICROFARADS; DIODES IN 457 UNLESS OTHERWISE NOTED.

TOLERANCE, UNLESS OTHERWISE SPECIFIED		DRAWN BY W.L.J. DATE 4/18/75		BROADCAST ELECTRONICS, INC.	
DECIMAL 2 PL - 01 3 PL - 005		CHECKED BY DATE		- A FILMWAYS COMPANY -	
FRACTIONAL 1/64		PROJECT NO.		TITLE (SCHEMATIC)	
ANGULAR 5°		DATE		RECORD LOGIC TONE GENERATOR	
SHARP EDGES		APPROVED BY		DWS NO. 906-3112	
BEND RADIUS		MATERIAL		3000 SERIES	
FILLET RADIUS		TREATMENT OR FINISH		SHEET 1 OF 1	

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COMPONENT SIDE



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514-1503

SHIELD

SHIELD

+ METER RIGHT  
+ METER LEFT  
SHIELD  
SHIELD  
SHIELD  
SHIELD

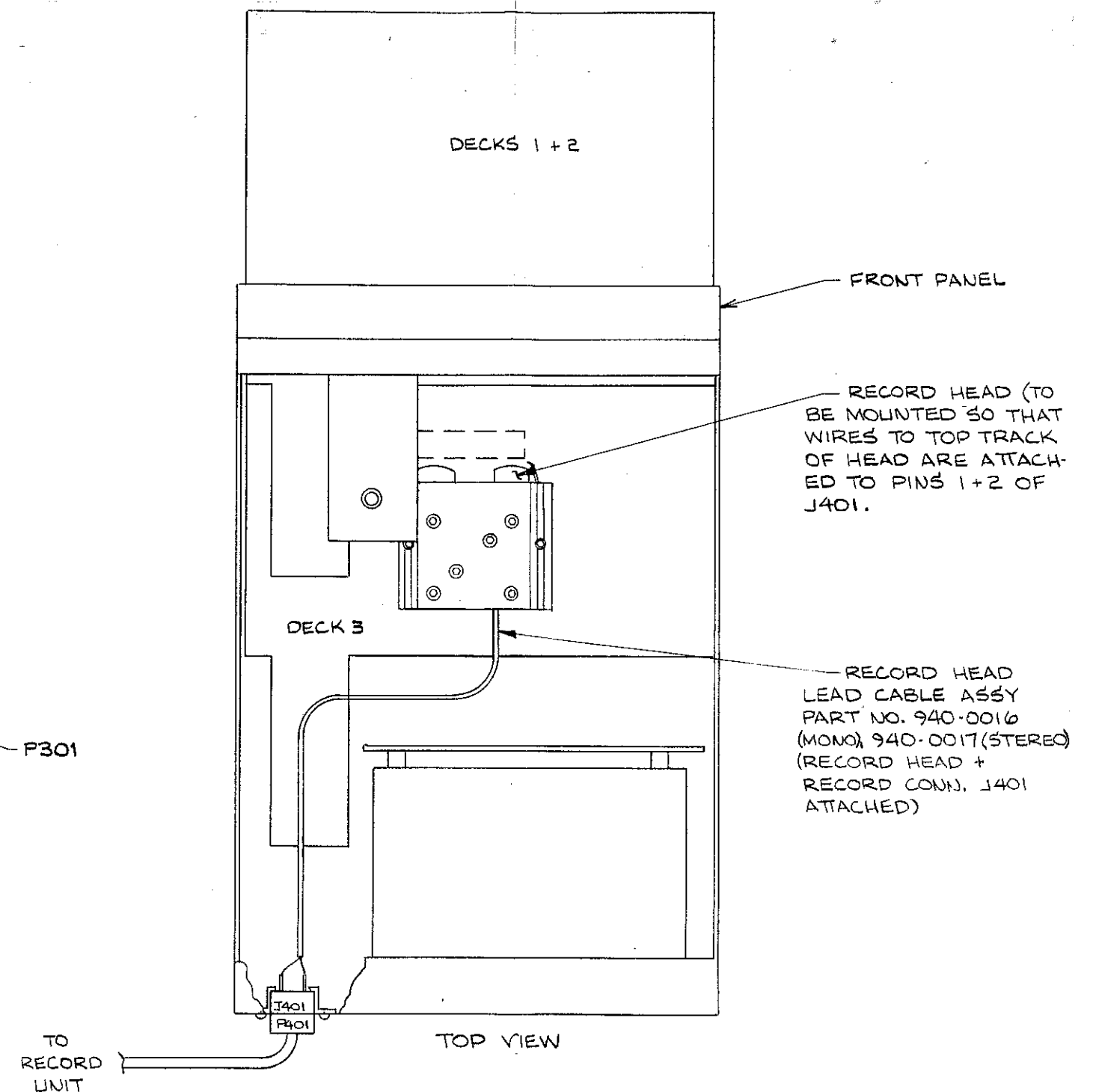
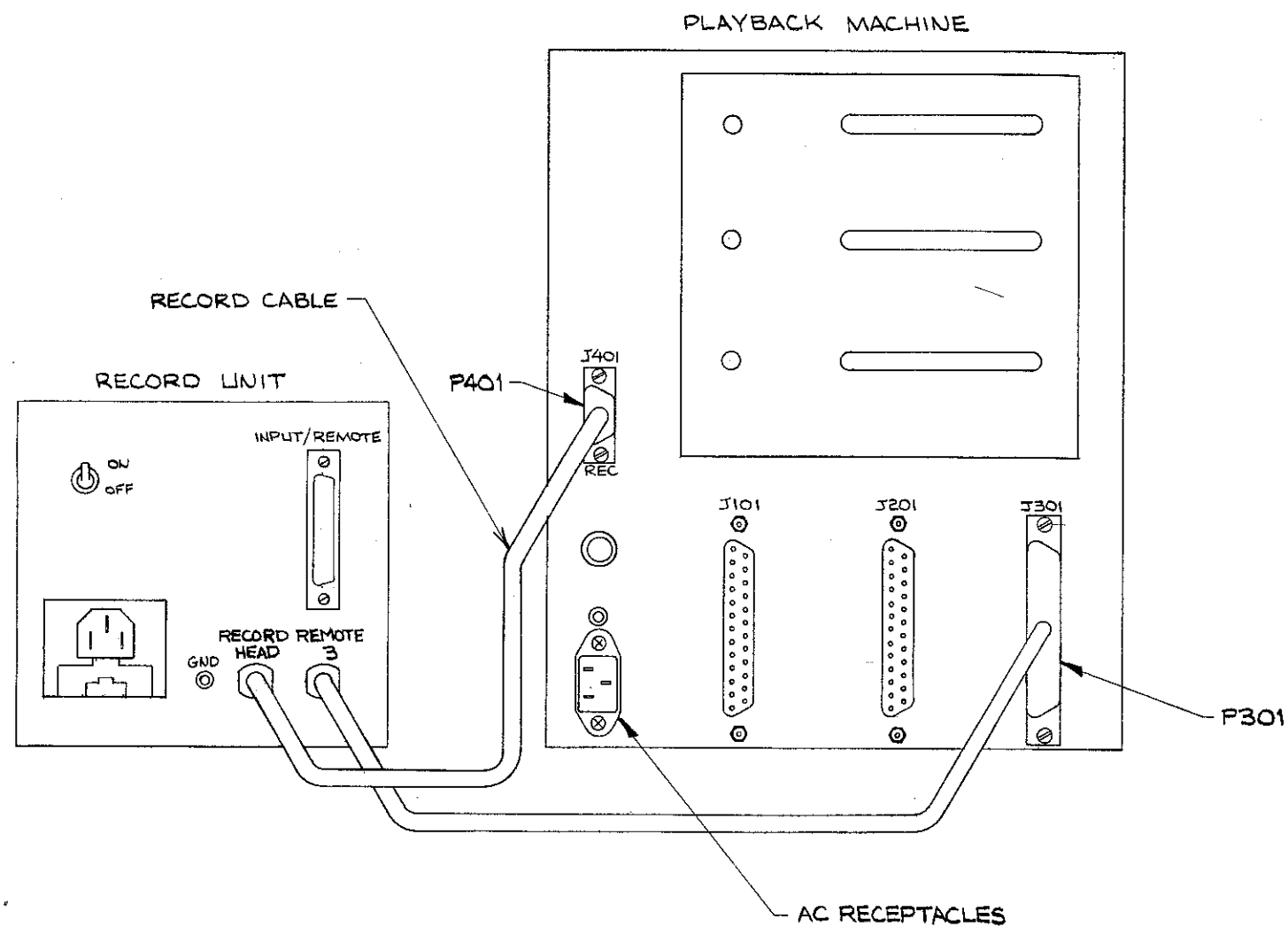
EXTERNAL CUE IN  
150 HZ CUE CONTROL  
8 KHz CUE CONTROL  
EXTERNAL CUE CONTROL  
CUE BIAS SWITCH  
BIAS OSCILLATOR SWITCH  
CUE OUT  
STOP SWITCH  
RECORD LAMP & PROGRAM CONTROL  
FAST FORWARD/RECORD INTERLOCK  
GND IN RUN  
RECORD SWITCH  
BLANK  
1 KHz RECORD INTERLOCK  
GND  
+24 V  
- METER RIGHT OUT  
- METER LEFT OUT  
RIGHT RECORD METER IN  
RIGHT PLAYBACK METER IN  
LEFT RECORD METER IN  
LEFT PLAYBACK METER IN

NOTES:

1. PART NUMBER & B/M 914-1503 - MONOPHONIC  
" " " " 914-1513 - MONOPHONIC W/Q TRIPS  
" " " " 914-1523 - STEREOPHONIC  
" " " " 914-1533 - STEREOPHONIC W/Q TRIPS
2. \* ITEMS NOT USED WITH MONO VERSIONS 914-1503 & 914-1513.
3. ▲ ITEMS NOT USED WITH STANDARD VERSIONS 914-1503 & 914-1523.
4. SEE SCHEMATIC D906-3112.

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MATERIAL:		TREATMENT OR FINISH:		REV. L		



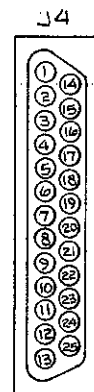
NOTES:

- 1) REMOVE PLATE ON REAR OF 5300C SERIES PLAYBACK MACHINE + INSTALL REC CONNECTOR (J401) USING SAME HARDWARE. REMOVE DUMMY HEAD FROM DECK 3 + INSTALL REC HEAD IN ITS PLACE.
- 2) PLUG P301 ON REMOTE 3 CABLE INTO REMOTE CONN J301.
- 3) PLUG P401 ON RECORD CABLE INTO RECORD-CONN J401.

5300C SERIES PLAYBACK MACHINE SHOWN WITH TOP COVER REMOVED AND DECKS 1+2 EXTENDED SO DECK 3 IS ACCESSIBLE.

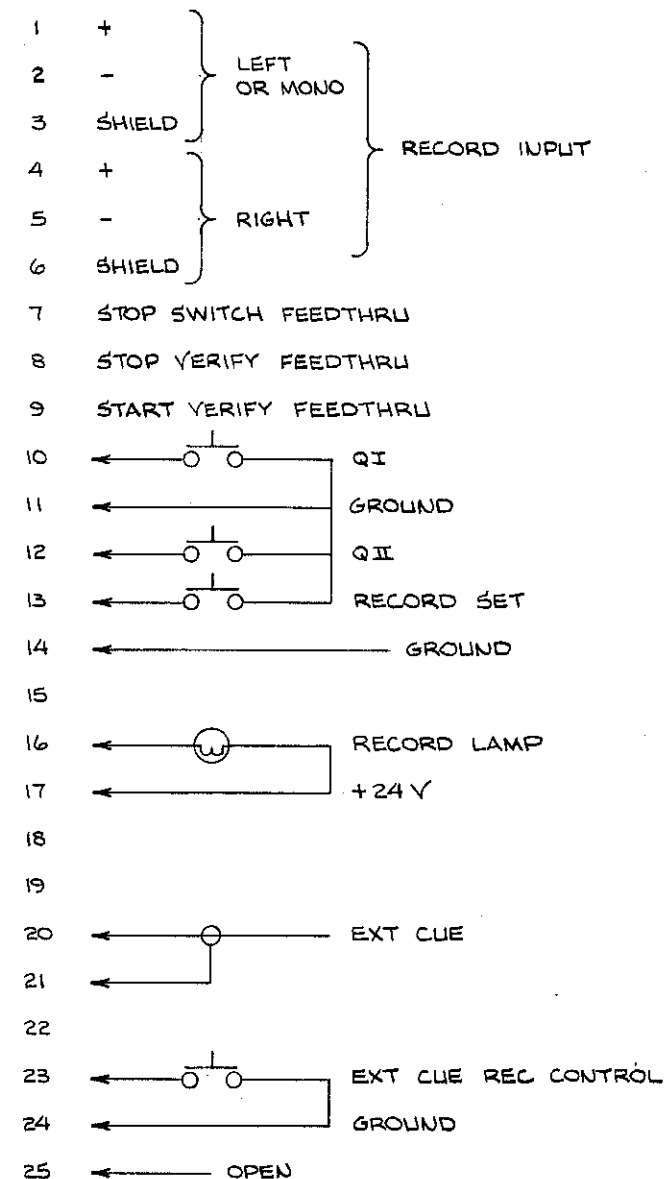
597-0097-71

FIGURE 7-10. 5400C RECORDER TO A 5300C CARTRIDGE MACHINE INTERCONNECTION DIAGRAM.



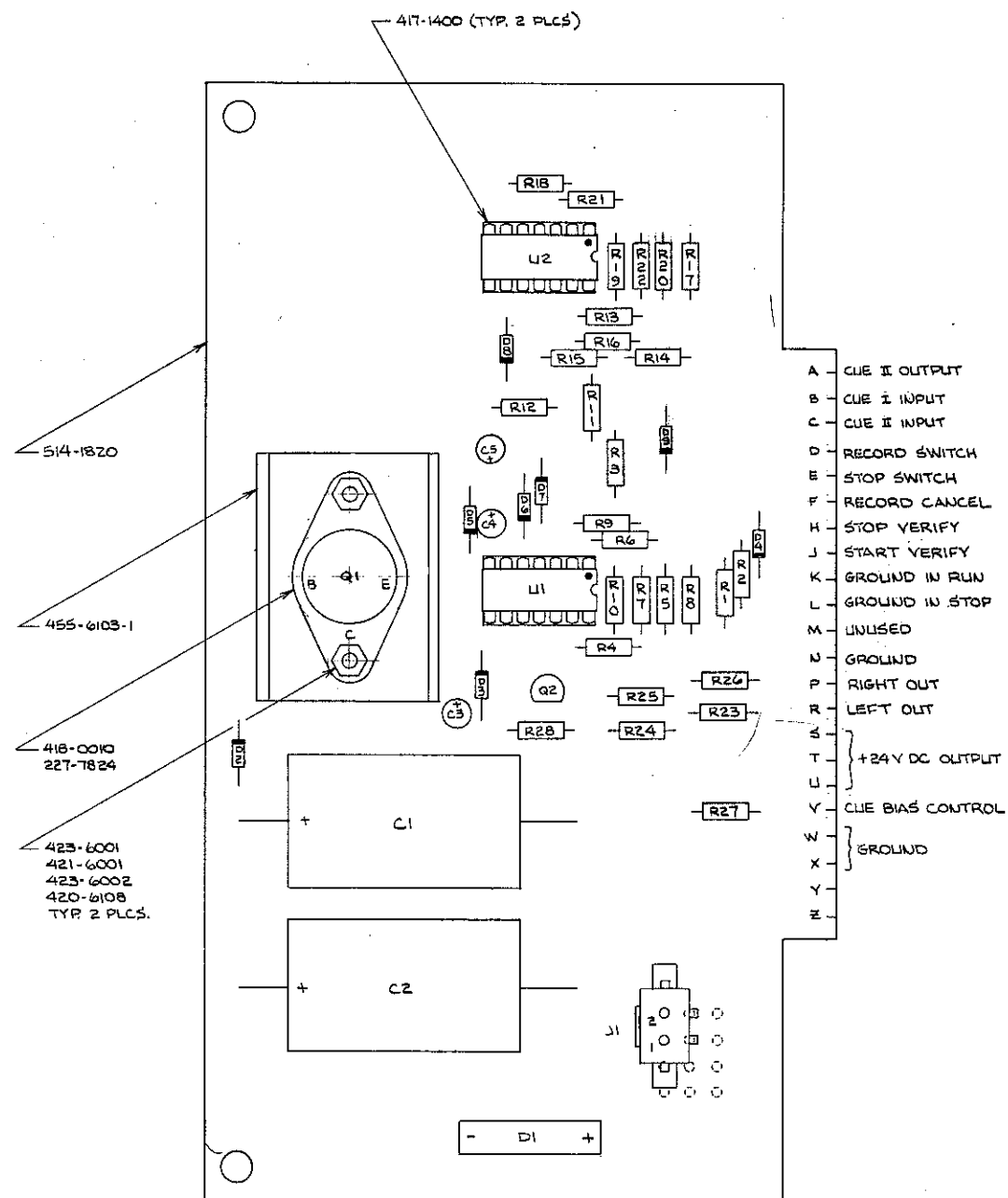
REAR VIEW  
417-0015

PIN  
NO.



- NOTES:
- 1) UNBALANCED INPUT CONNECTS (-) TO SHIELD.
  - 2) ALL LAMPS 28V, .05A OR LESS.

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		CHKD		
		ME	FINISH	TITLE WIRING DIAGRAM, REAR PANEL CONNECTOR
		PROJ. ENGR. JRC 7-5-85		TYPE W C
		MFG.	NEXT ASSY.	SIZE DWG. NO. 900-5309, 900-5310-001, 900-5409, 900-5410
TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°				REV A
				MODEL 5309C 5310C 5409C 5410C
			SCALE	SHEET 1 OF 1

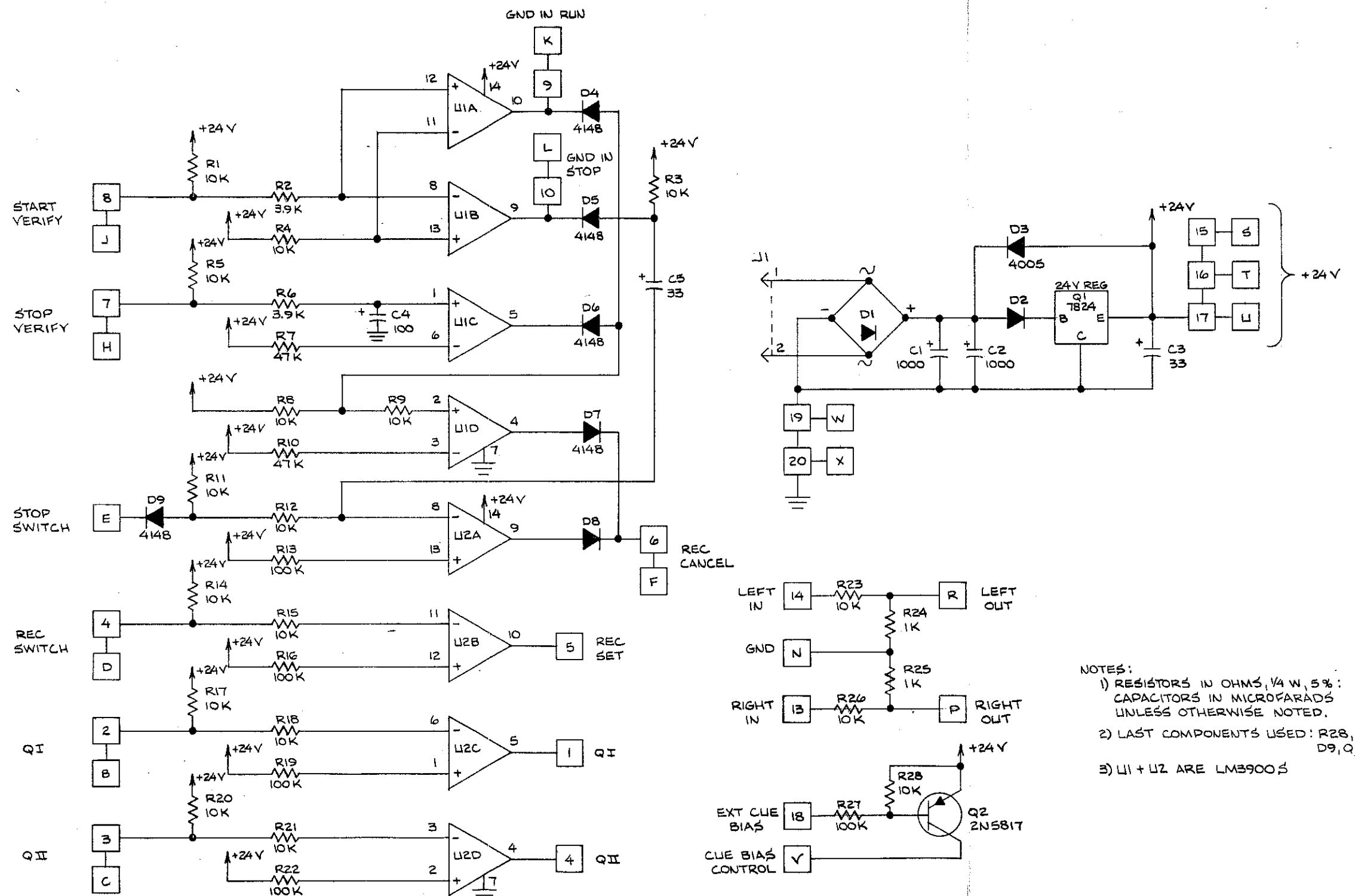


CUE I OUTPUT 1  
CUE I INPUT 2  
CUE II INPUT 3  
RECORD SWITCH 4  
RECORD SET 5  
RECORD CANCEL 6  
STOP VERIFY 7  
START VERIFY 8  
GROUND IN RUN 9  
GROUND IN STOP 10  
UNUSED 11  
GROUND 12  
RIGHT IN 13  
LEFT IN 14  
+24VDC OUTPUT 15  
EXTERNAL CUE BIAS 16  
GROUND 17  
GROUND 18  
GROUND 19  
GROUND 20  
GROUND 21  
GROUND 22

SEE SCHEMATIC C910-1820

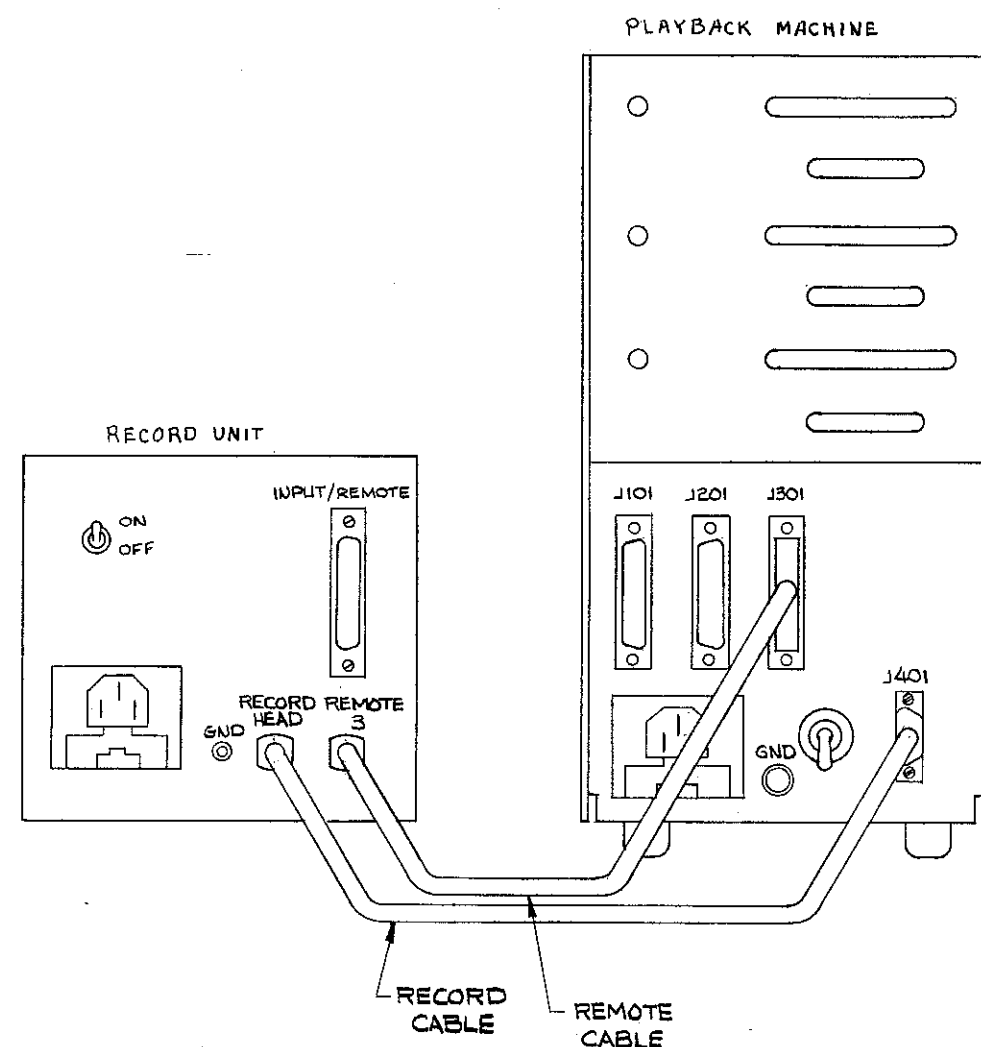
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	CHND	FINISH	
TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°	PROJ. ENGR. JPC 7-5-85 MFG. JAN 6-19-85	NEXT ASSY.	TITLE PCB ASSY., POWER SUPPLY BD. TYPE A SIZE D DWG. NO. 910-1820 MODEL 5409,5410 SCALE 2/1 SHEET 1 OF 1





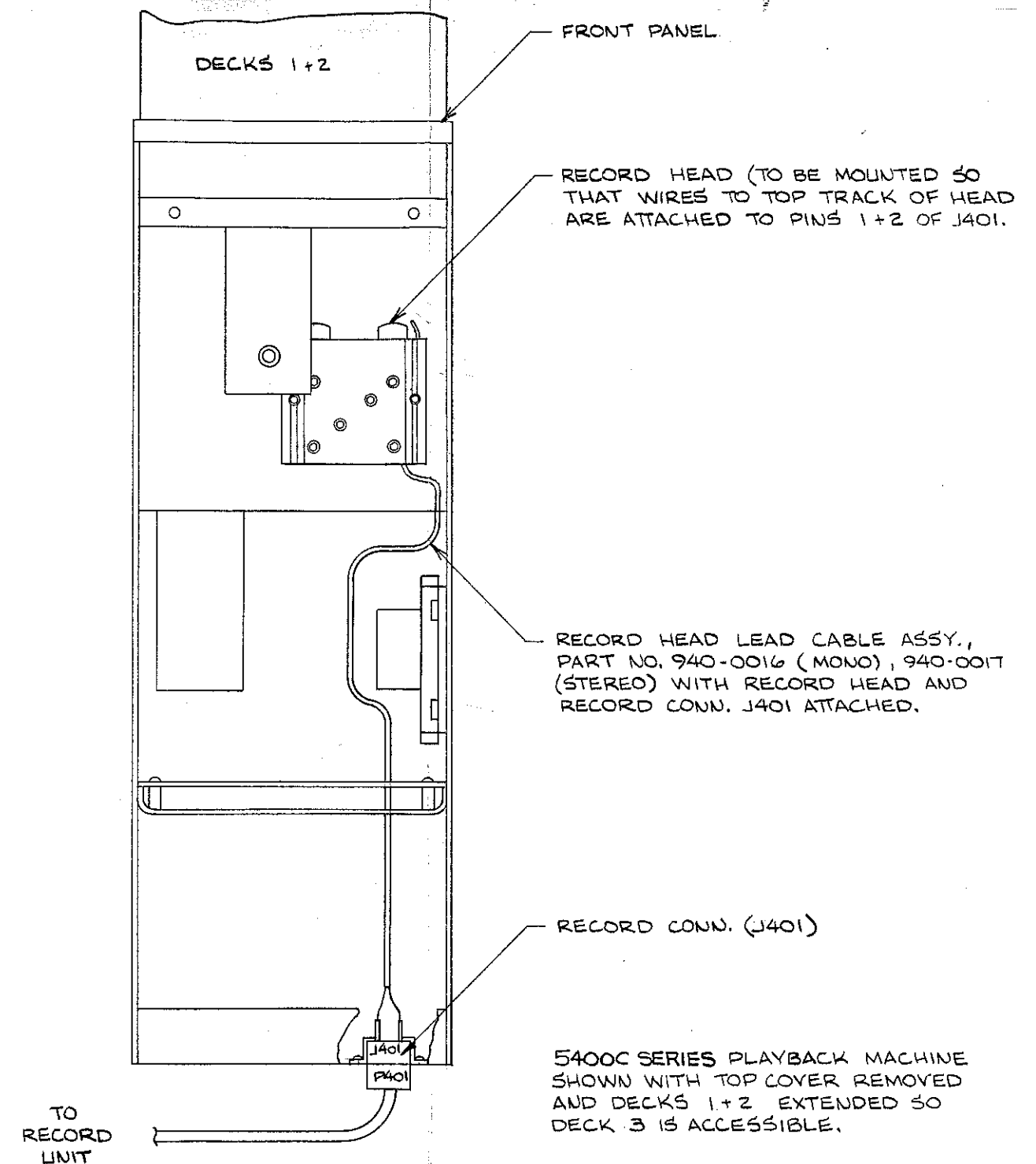
- NOTES:
- 1) RESISTORS IN OHMS, 1/4 W, 5%:  
CAPACITORS IN MICROFARADS  
UNLESS OTHERWISE NOTED.
  - 2) LAST COMPONENTS USED: R28, C5,  
D9, Q2
  - 3) U1 + U2 ARE LM3900'S

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ME PROJ. ENGR. JPC 9-5-85 MFG. LPH 6-19-85		FINISH NEXT ASSY.	TITLE SCHEMATIC, POWER SUPPLY BOARD	TYPE S	SIZE C
TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°		DWG. NO. 910-1820	REV B	MODEL 5409	SCALE 5410
		SHEET 1 OF 1			



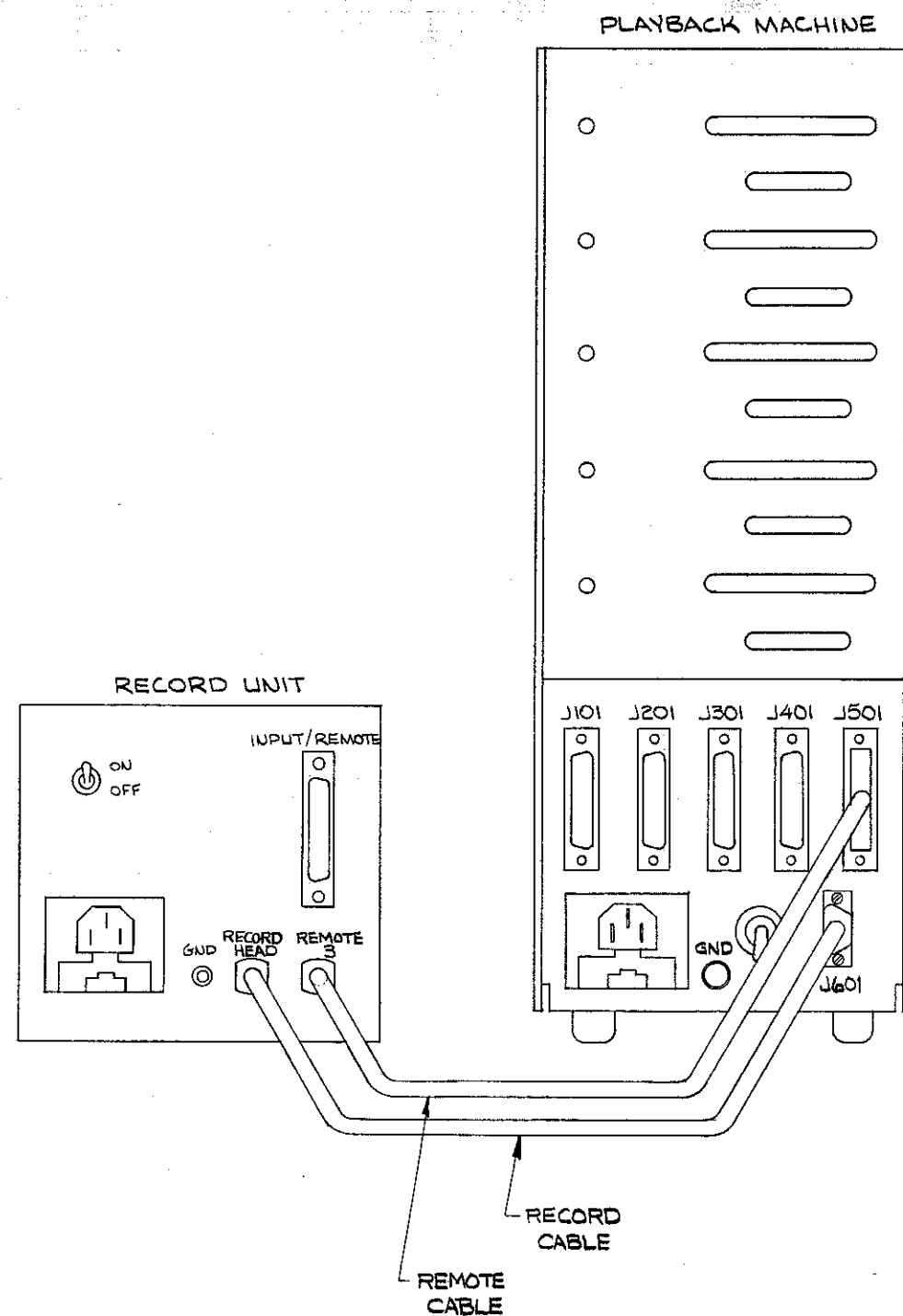
NOTES:

- 1) REMOVE PLATE ON REAR OF 5400C SERIES PLAYBACK MACHINE + INSTALL REC. CONN. J401 USING SAME HARDWARE. REMOVE DUMMY HEAD FROM DECK 3 + INSTALL REC. HEAD IN ITS PLACE.
- 2) PLUG P301 ON REMOTE CABLE INTO REMOTE CONN. J301
- 3) PLUG P401 ON RECORD CABLE INTO RECORD CONN. J401



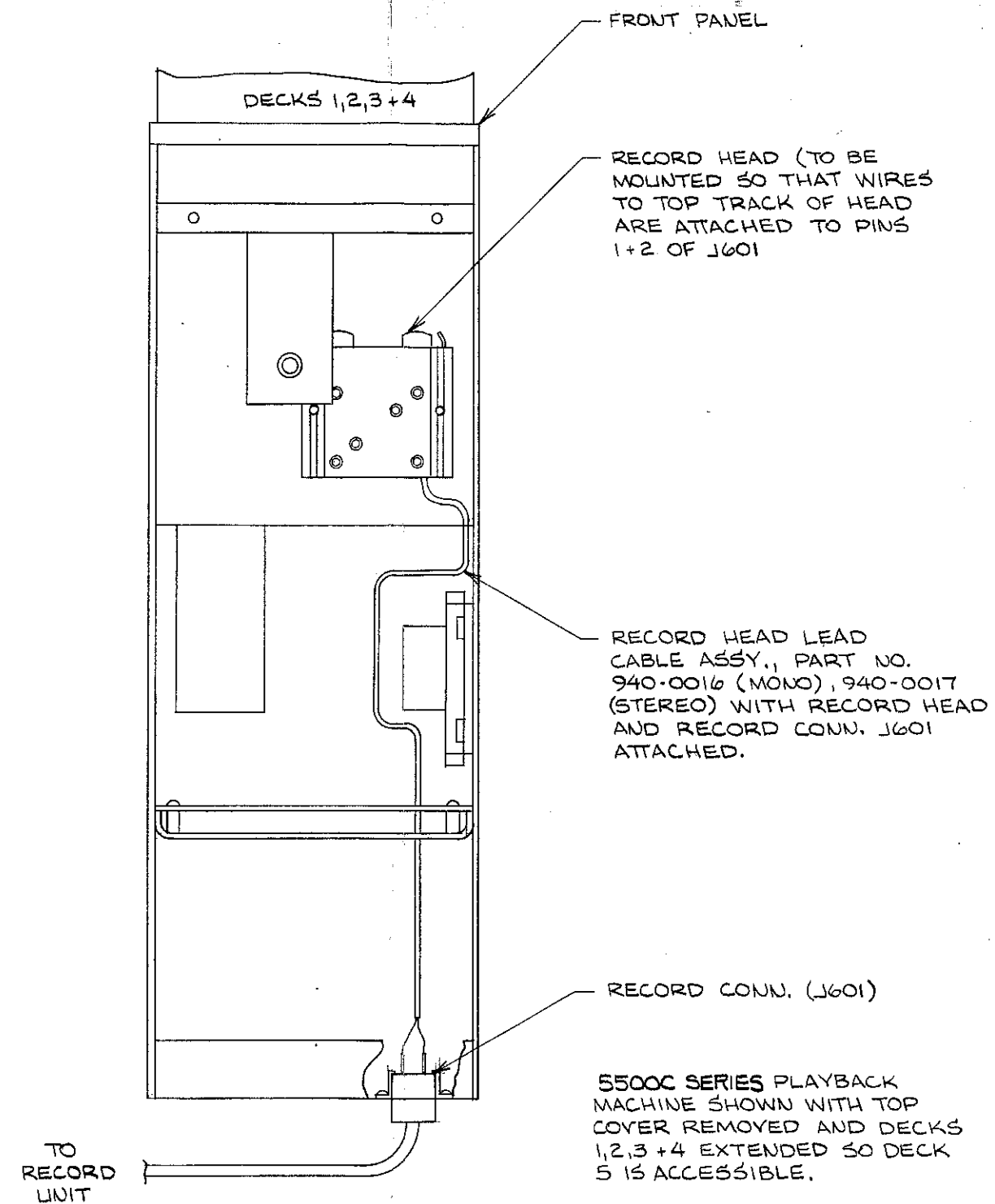
597-0097-72

FIGURE 7-11. 5400C RECORDER TO A 5400C CARTRIDGE MACHINE INTERCONNECTION DIAGRAM.



NOTES:

- 1) REMOVE PLATE ON REAR OF 5500C SERIES PLAYBACK MACHINE + INSTALL REC. CONN. (J601) USING SAME HARDWARE. REMOVE DUMMY HEAD FROM DECK 5 + INSTALL REC. HEAD IN ITS PLACE.
- 2) PLUG P501 ON REMOTE CABLE INTO REMOTE CONN. J501.
- 3) PLUG P601 ON RECORD CABLE INTO RECORD CONN. J601.

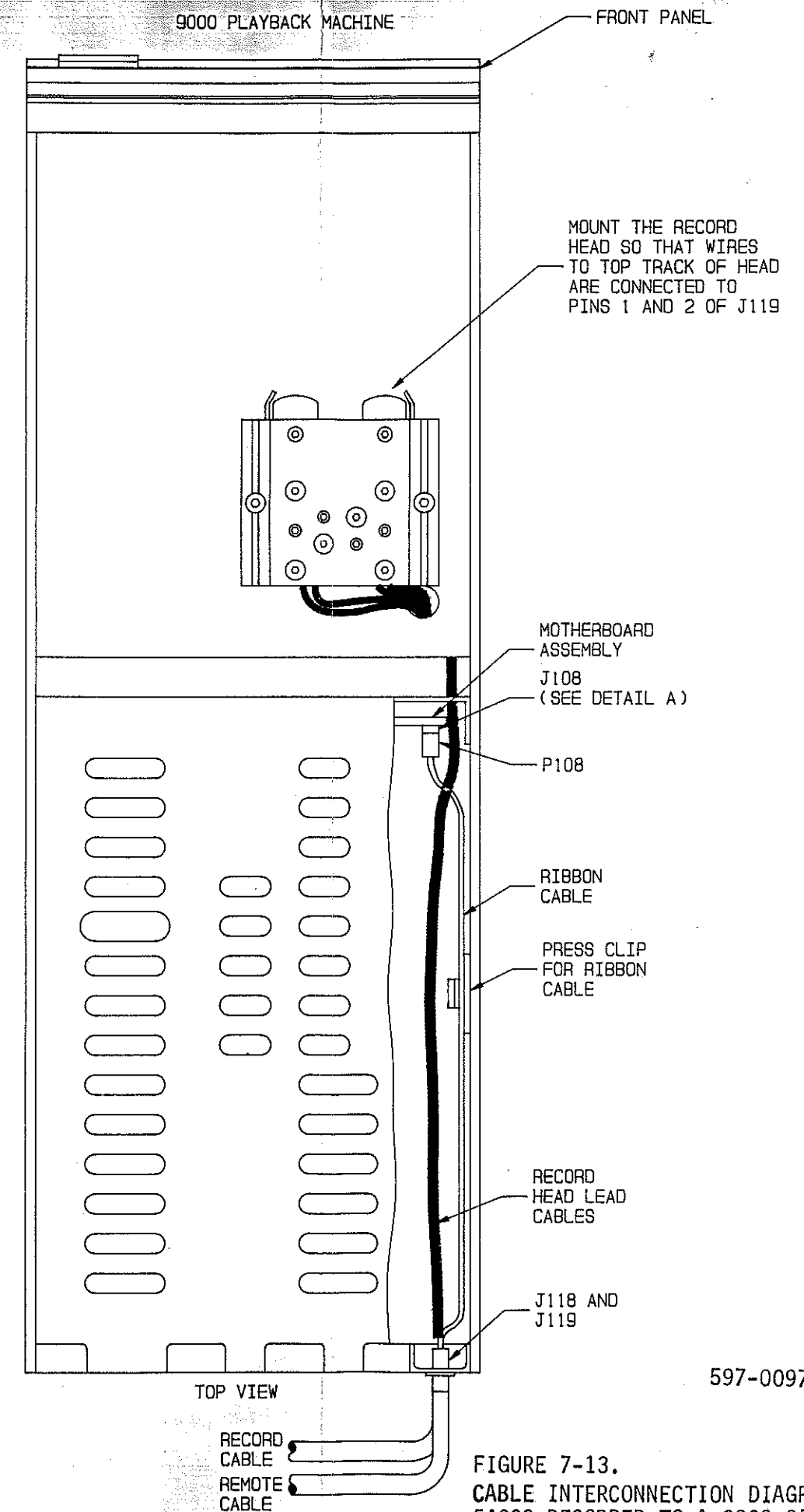
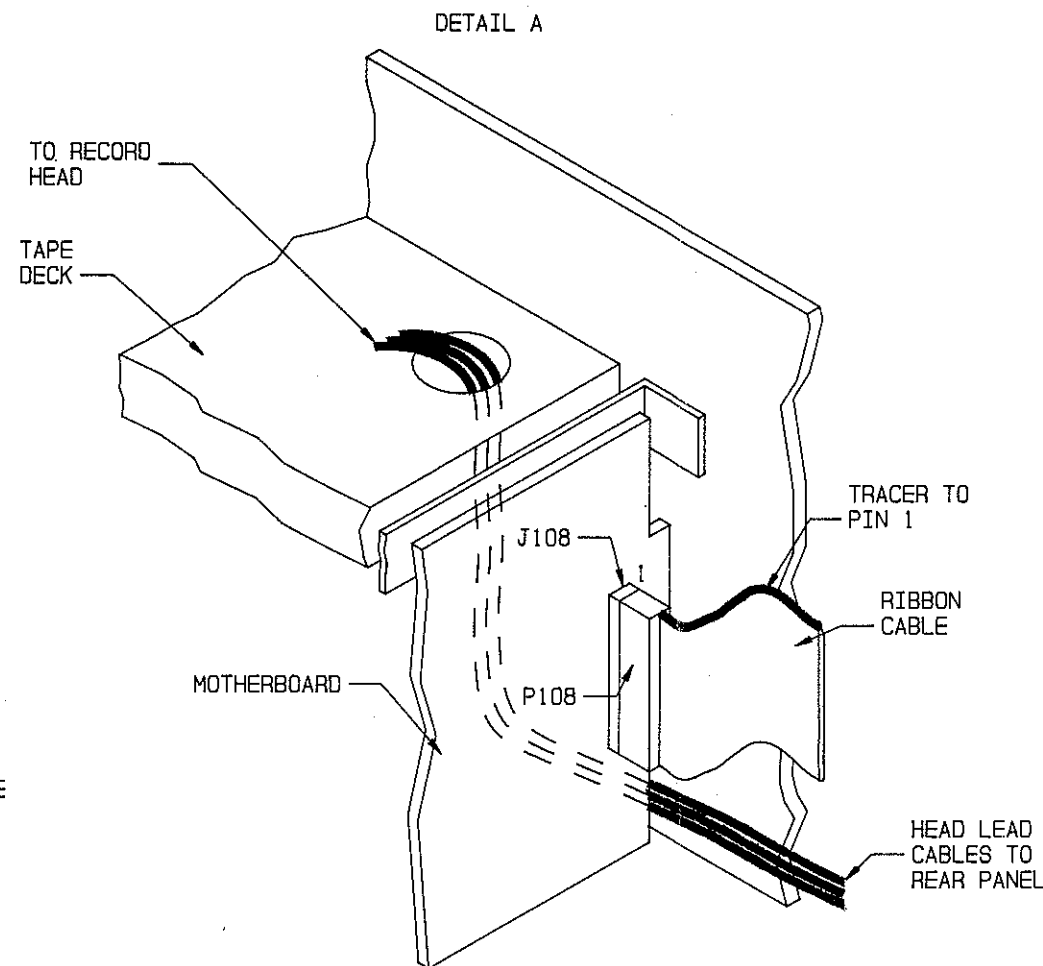
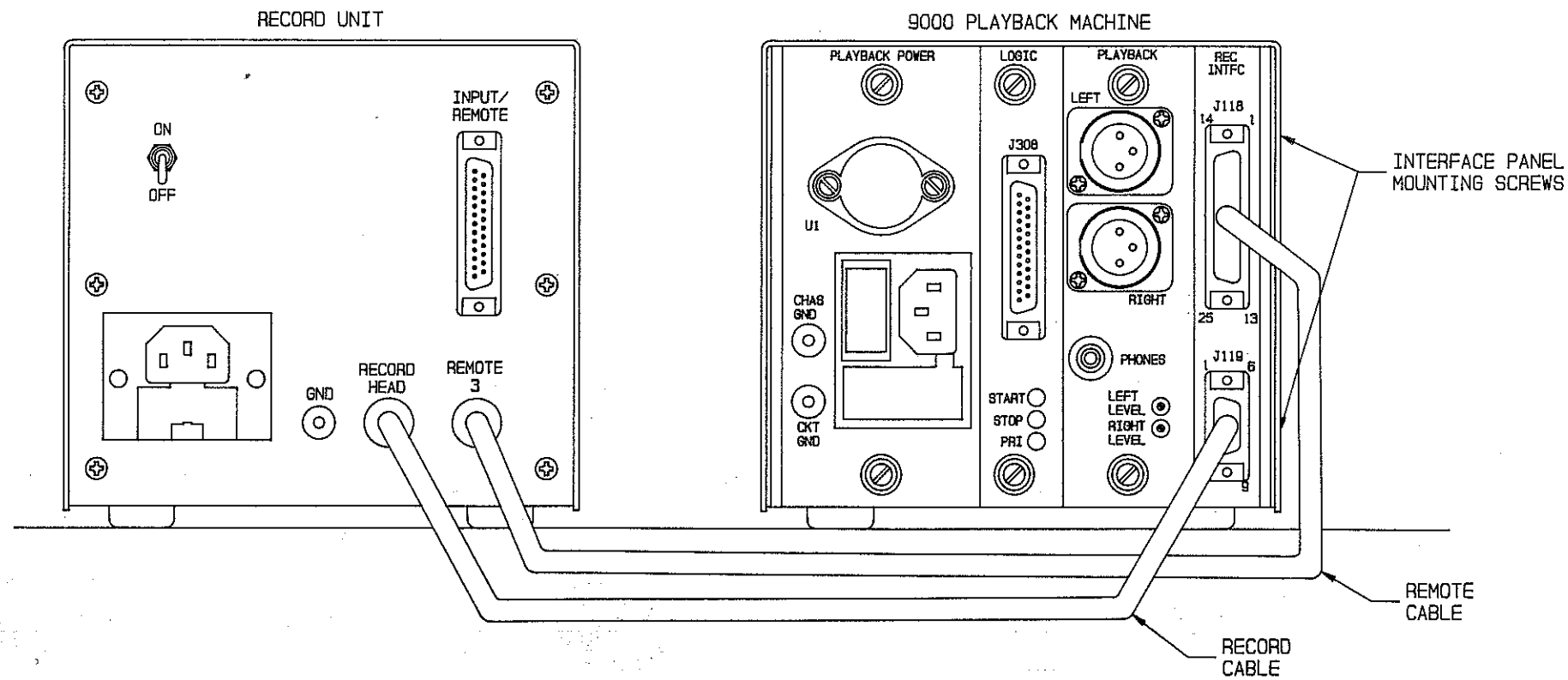


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FIGURE 7-12. 5400C RECORDER TO A 5500C CARTRIDGE MACHINE INTERCONNECTION DIAGRAM

NOTES:

1. REMOVE THE PLAYBACK POWER, LOGIC, PLAYBACK MODULES, AND THE BOTTOM FRONT-PANEL.
2. REMOVE THE TWO RECORD INTERFACE PANEL MOUNTING SCREWS AT THE REAR OF SIDE-PANEL AND REMOVE THE INTERFACE PANEL.
3. INSTALL J119 ON THE INTERFACE PANEL AND ROUTE THE RECORD CABLES TO THE HEAD ASSEMBLY.
4. CONNECT THE HEAD CABLES TO THE RECORD HEAD AND INSTALL IN THE HEAD ASSEMBLY.
5. INSTALL J118 ON THE INTERFACE PANEL AND CONNECT P108 TO J108 ON THE MOTHERBOARD.
6. REPLACE ALL MODULES, THE INTERFACE PANEL, AND THE BOTTOM FRONT-PANEL.



597-0097-70

FIGURE 7-13.  
CABLE INTERCONNECTION DIAGRAM,  
5400C RECORDER TO A 9000 CARTRIDGE  
MACHINE

## PRODUCT WARRANTY

### LIMITED TWO YEAR

While this warranty gives Purchaser specific legal rights, which terminate two (2) years (one year on cartridge and blower motors) from the date of shipment, Purchaser may also have other rights which vary state to state.

Broadcast Electronics, Inc. ("Seller") hereby warrants cartridge machines, consoles, and other new Equipment manufactured by Seller against any defects in material or workmanship at the time of delivery thereof, that develop under normal use within a period of two (2) years (one year for cartridge and blower motors) from the date of shipment, as such term is defined herein. Other manufacturer's and suppliers' Equipment and services, if any, including electronic tubes, solid state devices, transmission line, antennas, towers, related equipment and installation and erection services, shall carry only such manufacturer's or suppliers' standard warranty. This warranty extends to the original user and any subsequent purchaser during the warranty period. Seller's sole responsibility with respect to any equipment or parts not conforming to this warranty is to replace such equipment or parts upon the return thereof F.O.B. Seller's factory or authorized repair depot within the period aforesaid.

In the event of replacement pursuant to the foregoing warranty, only the unexpired portion of the warranty from the time of the original purchase will remain in effect for any such replacement. However, the warranty period will be extended for the length of time that Purchaser is without the services of the Equipment due to its being serviced pursuant to this warranty. The terms of the foregoing warranty shall be null and void if the Equipment has been altered or repaired without specific written authorization of Seller, or if Equipment is operated under environmental conditions or circumstances other than those specifically described in Seller's product literature or instruction manual which accompany the Equipment. Seller shall not be liable for any expense of any nature whatsoever incurred by the original user without prior written consent of Seller.

Seller shall not be liable to Purchaser for any and all incidental or consequential damages for breach of either expressed or implied warranties. However, some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to Purchaser. All express and implied warranties shall terminate at the conclusion of the period set forth herein. Any card which is enclosed with the equipment will be used by Seller for survey purposes only.

If the Equipment is described as used, it is sold as is and where is. If the contract covers equipment not owned by Seller at this date, it is sold subject to Seller's acquisition of possession and title.

**EXCEPT AS SET FORTH HEREIN, AND EXCEPT AS TO TITLE, THERE ARE NO WARRANTIES, OR ANY AFFIRMATIONS OF FACT OR PROMISES BY SELLER, WITH REFERENCE TO THE EQUIPMENT, OR TO MERCHANTABILITY, FITNESS FOR A PARTICULAR APPLICATION, SIGNAL COVERAGE, INTERFERENCE, OR OTHERWISE, WHICH EXTEND BEYOND THE DESCRIPTION OF THE EQUIPMENT ON THE FACE HEREOF.**

**BROADCAST ELECTRONICS, INC.**

4100 North 24th Street, P.O. Box 3606, Quincy, Illinois 62305