INSTRUCTION MANUAL

9000 SERIES CARTRIDGE MACHINES

July, 1987

IM No. 597-9000

BROADCAST ELECTRONICS, INC.

IMPORTANT INFORMATION

EQUIPMENT LOST OR DAMAGED IN TRANSIT

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

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

TECHNICAL ASSISTANCE AND REPAIR SERVICE

Technical assistance is available from Broadcast Electronics by letter or prepaid telephone or telegram. Equipment requiring repair or overhaul should be sent by common carrier, prepaid, insured and well protected. Do not mail equipment. We can assume no liability for inbound damage, and necessary repairs become the obligation of the shipper. Prior arrangement is necessary. Contact Customer Service Department for a Return Authorization.

FOR TECHNICAL ASSISTANCE
Phone (217) 224-9600 Customer Service

WARRANTY ADJUSTMENT

Broadcast Electronics, Inc. warranty is included in the Terms and Conditions of Sale. In the event of a warranty claim, replacement or repair parts will be supplied F.O.B. factory. At the discretion of Broadcast Electronics, the customer may be required to return the defective part or equipment to Broadcast Electronics, Inc. F.O.B. Quincy, Illinois. Warranty replacements of defective merchandise will be billed to your account. This billing will be cleared by a credit issued upon return of the defective item.

RETURN, REPAIR AND EXCHANGES

Do not return any merchandise without our written approval and Return Authorization. We will provide special shipping instructions and a code number that will assure proper handling and prompt issuance of credit. Please furnish complete details as to circumstances and reasons when requesting return of merchandise. All returned merchandise must be sent freight prepaid and properly insured by the customer.

REPLACEMENT PARTS

Replacement and Warranty Parts may be ordered from the address below. Be sure to include equipment model and serial number and part description and part number.

Broadcast Electronics, Inc.
4100 N. 24th St., P.O. Box 3606
Quincy, Illinois 62305
Tel: (217) 224-9600
Telex: 25-0142
Cable: BROADCAST

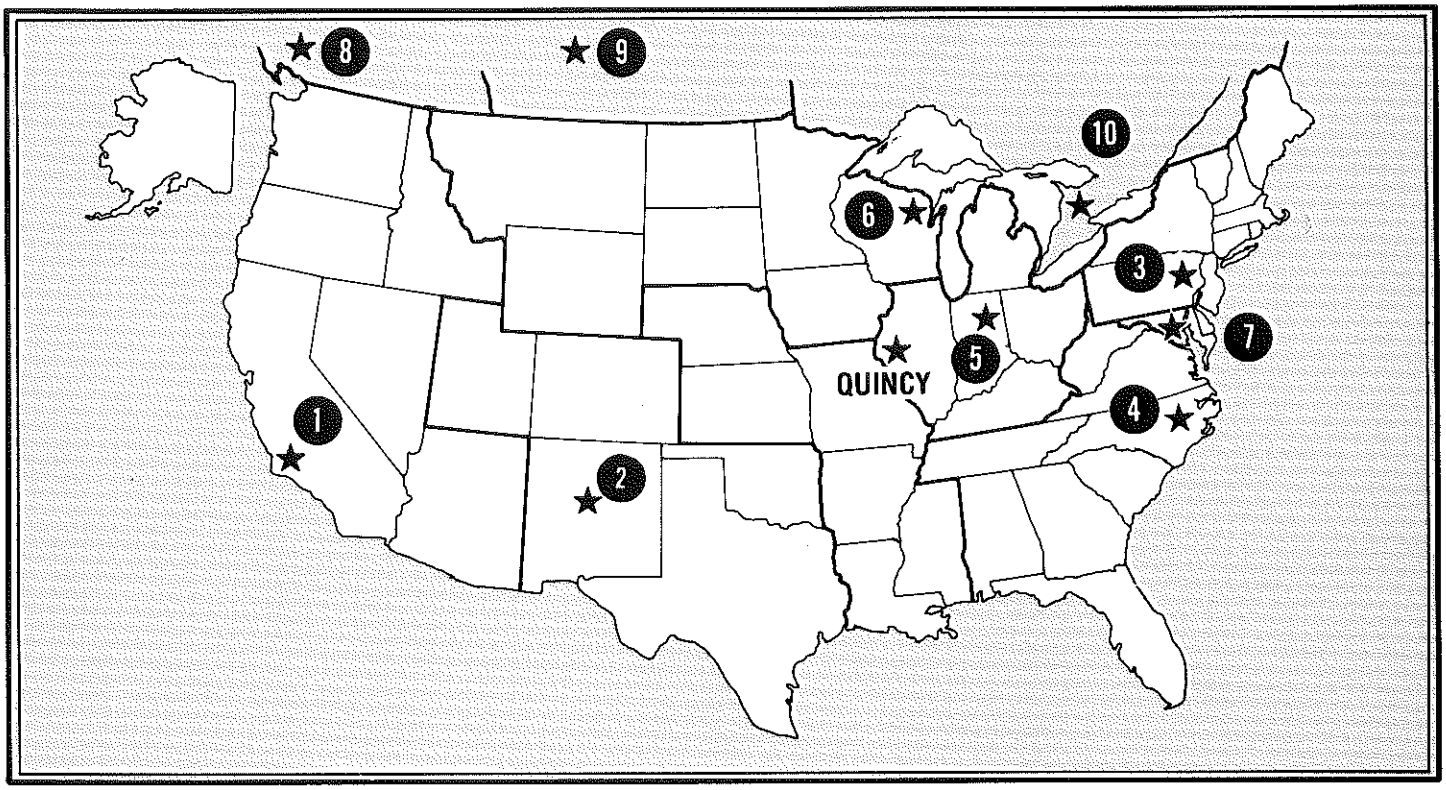
PROPRIETARY NOTICE

MODIFICATIONS

Broadcast Electronics, Inc. reserves the right to modify the design and specifications of the equipment in this manual without notice. Any modifications shall not adversely affect performance of the equipment so modified.

AUTHORIZED SERVICE CENTERS

- **Equipped to serve you with Broadcast Electronics parts and repairs—both in and out of warranty**
- **Regional depots reduce parts delivery time and repair turn-around time**



UNITED STATES

1. Riggins Electronics
3272 E. Willow Street
Long Beach, CA 90815
Ph: (213) 598-7007

States Covered:
Alaska
Arizona
California
Hawaii
Nevada
Oregon
Washington

2. Dyma Engineering
367 Main Street S.E.
Box 1535
Los Lunas, NM 87031
Ph: (505) 867-6700

States Covered:
Colorado
New Mexico
Oklahoma
Texas
Utah

3. Radio Systems Design
5131 West Chester Pike
Edgemont, PA 19028
Ph: (215) 356-4700

States Covered:
Connecticut
Maine
Massachusetts
New Hampshire
New Jersey
New York
Pennsylvania
Rhode Island
Vermont

4. Broadcast Services
Rt. #3, Box 45E
Four Oaks, NC 27524
Ph: (919) 934-6869

States Covered:
Alabama
Florida
Georgia
North Carolina
South Carolina
Tennessee
Virginia
West Virginia

5. Allied Broadcasting Equipment
635 South E. Street
Richmond, IN 47374
Ph: (317) 962-8596

States Covered:
Illinois
Indiana
Kentucky
Michigan
Ohio

6. Electronic Industries
19 East Irving Avenue
Oshkosh, WI 54902
Ph: (414) 235-8930

States Covered:
Iowa
Minnesota
Montana
North Dakota
South Dakota
Wisconsin
Wyoming

7. Midwest Telecommunications
4720-B Boston Way
Lanham (Wash., D.C.) MD 20801
Ph: (301) 577-4903

States Covered:
District of Columbia
Delaware
Maryland

CANADA

8. Nortec West, Ltd.
325 West Fifth Avenue
Vancouver V5Y 1J6,
B.C., Canada
Ph: (604) 872-8525

Provinces Covered:
British Columbia
Yukon Territory

9. Nortec West, Ltd.
705 B Farrell Road
Calgary, Alta., Canada
Ph: (403) 252-8141

Provinces Covered:
Alberta
Manitoba
NW Territory
Saskatchewan

10. J-Mar Electronics, Ltd.
6 Banigan Drive
Toronto M4H 1E9,
Ontario, Canada
Ph: (416) 421-9080

Provinces Covered:
New Brunswick
Nova Scotia
Ontario
Quebec

BROADCAST ELECTRONICS INC

4100 N. 24th ST., P.O. BOX 3606, QUINCY, IL 62305 U.S.A., TELEX: 25-0142, CABLE: BROADCAST, PHONE: (217) 224-9600

TECHNICAL MANUAL

BROADCAST ELECTRONICS

9000 SERIES

TAPE CARTRIDGE MACHINE

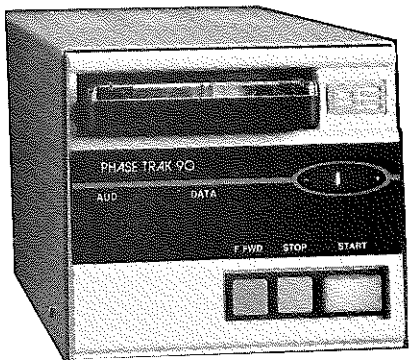
597-9000

TECHNICAL MANUAL

BROADCAST ELECTRONICS, INC.

9000 SERIES

CARTRIDGE MACHINES



MODEL	PART NUMBER	DESCRIPTION
PT90P	900-9000-000	Single-Deck Monophonic Cartridge Machine with Primary, Secondary, Tertiary, and FSK Detection Circuitry. NAB A or AA Cartridge Operation, 117V ac 60 Hz Power Supply.
PT90PS	900-9002-000	Single-Deck Stereophonic Playback Cartridge Machine with Primary, Secondary, Tertiary, and FSK Detection Circuitry. NAB A or AA Cartridge Operation, 117V ac 60 Hz Power Supply.

OPTIONAL ASSEMBLIES

----	900-9016	Tape Time Display, Factory Installed. Includes Front-panel Four Digit LED Display and Digital Clock Circuitry.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

SECTION I

GENERAL INFORMATION

1

1-1. INTRODUCTION.

1-2. Information presented by this section provides a general description of the Broadcast Electronics 9000 series cartridge machine and lists equipment specifications.

1-3. EQUIPMENT DESCRIPTION.

1-4. The Broadcast Electronics model 9000 is a totally solid-state, single deck playback cartridge machine designed for continuous operation. The 9000 series includes monophonic and stereophonic models equipped with primary, secondary, tertiary, and frequency-shift-keying (FSK) cue tone detection circuitry. The 9000 series accepts NAB A or AA size cartridges. A wide range of accessories provide the flexibility required for any type of installation.

1-5. ELECTRICAL DESCRIPTION.

1-6. All PT-90 cartridge machines feature a dc servo motor, automatic/manual fast forward, automatic elevated level cartridge sensing, and noise reduction circuitry. Stereophonic units also feature automatic phase correction circuitry. Primary, secondary, tertiary, and FSK detection circuitry is standard on all models. The PT-90 power supply, logic, and audio circuitry is implemented on plug-in modules designed for ease of service.

1-7. PHASE CORRECTION CIRCUITRY. The automatic non-encoding phase correction circuitry is implemented on three hybrid circuits located on a plug-in audio playback module. The circuits continually monitors and corrects the phase relationship between the left channel playback audio signal and the right channel playback audio signal to provide a constant in-phase stereophonic signal. Non-encoding phase correction allows the processing of stereophonic cartridges originally recorded with any cartridge machine. When processing a stereophonic signal, a front-panel moving bar LED display provides a visual indication of relative phase correction.

1-8. FAST FORWARD CIRCUITRY. An automatic/manual fast forward feature is incorporated into the control logic design for rapid recuing of tape cartridges. A programmable jumper on the logic module enables or disables the automatic fast forward circuitry. Manual fast forward operation is initiated by a front-panel switch/indicator.

1-9. ELEVATED LEVEL SENSING CIRCUITRY. The automatic elevated level sensing circuitry consists of a reflective sensor on the cartridge deck and a level switching circuit on the audio module. When an elevated level cartridge (recorded at 250 nW/m) with special reflective tape is inserted into the deck, the gain of the audio circuitry will be automatically reduced by 4 dB.

1-10. NOISE REDUCTION CIRCUITRY. The PT-90 audio output circuits feature a DYNAFEX® noise reduction system to enhance the quality of the reproduced audio. The noise reduction circuit improves the signal-to-noise ratio by approximately 20 dB.

1-11. FSK DECODER. A precision FSK (3.5 kHz) decoder is incorporated into the circuitry on the logic module. This circuit generates an RS-232 serial data output for cartridge logging applications.

1-12. MECHANICAL DESCRIPTION.

1-13. The 9000 series cartridge machine deck is equipped with a cartridge guidance system, an air-damped solenoid, and the Broadcast Electronics PHASE LOK V head assembly. The cartridge guidance system is designed with spring-loaded components to channel a cartridge into the proper play position. An air-damped solenoid provides a rapid response to start commands. The PHASE LOK V head assembly provides the tape heads with a secure and stable environment. The head assembly is designed to permit independent adjustment of the head height/zenith and head azimuth.

1-14. The 9000 series cartridge machine also features a direct-drive dc servo motor for precise tape movement. The motor is mounted to the half-inch thick rigid aluminum deck for maximum stability.

1-15. OPTIONS AND ACCESSORIES.

1-16. Refer to Table 1-1 for options and accessories available for the 9000 series cartridge machine.

1-17. EQUIPMENT SPECIFICATIONS.

1-18. Refer to Table 1-2 for the electrical, mechanical, physical, and environmental specifications of the Broadcast Electronics 9000 series cartridge machine.

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TABLE 1-1. 9000 SERIES CARTRIDGE MACHINE OPTIONS AND ACCESSORIES
(Sheet 1 of 2)

OPTIONS AND ACCESSORIES	PART NUMBER
RECORDING EQUIPMENT	
MODEL 5409 MONOPHONIC RECORDER FOR THE 9000 CARTRIDGE MACHINE.	900-5409-001
Description: Model 5409 recorder provides monophonic recording capabilities including primary, secondary, and tertiary cue tones for the model PT90P cartridge machine.	
MODEL 5410 STEREOPHONIC RECORDER FOR THE 9000 CARTRIDGE MACHINE.	900-5410-001
Description: Model 5410 recorder provides stereophonic recording capabilities including primary, secondary, and tertiary cue tones for the model PT90PS cartridge machine.	
INTERFACE CABLE KIT FOR PT90P/PS CARTRIDGE MACHINES TO 5409/5410 RECORDERS.	970-0087
RECORD HEAD CONNECTOR KIT FOR PT90P/PS WHEN INTERFACED WITH 5409/5410 RECORDERS.	970-0088
TELEPHONE ANSWERING EQUIPMENT	
MODEL PC-1 TELEPHONE INTERFACE.	900-0010
Description: The PC-1 telephone interface provides cartridge machine/telephone network communication. The unit answers incoming telephone calls and enables a cartridge machine for the purpose of transmitting a prerecorded message.	
RACK MOUNTING ACCESSORIES	
RACK MOUNT SHELF FOR EIA 19 INCH RACK, 7 INCH HEIGHT.	900-9013
1/3 RACK FILLER PANEL FOR 7 INCH RACK SHELF.	900-9014

TABLE 1-1. 9000 SERIES CARTRIDGE MACHINE OPTIONS AND ACCESSORIES
(Sheet 2 of 2)

OPTIONS AND ACCESSORIES	PART NUMBER
1/2 RACK FILLER PANEL FOR 7 INCH RACK SHELF.	900-9015
RACK MOUNT SHELF FOR EIA 19 INCH RACK, 5 1/4 INCH HEIGHT.	900-9113
1/3 RACK FILLER PANEL FOR 5 1/4 INCH RACK SHELF.	900-9114
1/2 RACK FILLER PANEL FOR 5 1/4 INCH RACK SHELF.	900-9115
TOP COVER FOR 9013 SHELF.	900-9010
SPARE PARTS KITS	
SPARE PARTS KIT FOR 9000 CARTRIDGE MACHINES.	970-0094
TEST EQUIPMENT	
EXTENDER CIRCUIT BOARD FOR 9000 SERIES CARTRIDGE MACHINE.	910-9007
TAPE HEAD, TAPE GUIDE, AND MOTOR ALIGNMENT GAUGE.	300-0002
MOTOR ALIGNMENT GAUGE.	300-0070
CARTRIDGE MACHINE TEST TAPES:	
NAB Monophonic/Stereophonic Reproduce Alignment Test Tape, 185 nWb/m.	808-0004
NAB Monophonic/Stereophonic Reproduce Alignment Tape, 160 nWb/m.	800-1005
Tape Alignment Cue-Away Test Cartridge	710-0132
Monophonic Reproduce Alignment Tape, 1 kHz Cue Tone.	808-0026-1
Monophonic Reproduce Alignment Tape, 150 Hz Cue Tone.	808-0023-1
Monophonic Reproduce Alignment Tape, 8 kHz Cue Tone.	808-0025-1
Stereophonic Reproduce Alignment Tape, 1 kHz Cue Tone.	808-0020-1
Stereophonic Reproduce Alignment Tape, 150 Hz Cue Tone.	808-0017-1
Stereophonic Reproduce Alignment Tape, 8 kHz Cue Tone.	808-0019-1

TABLE 1-2. 9000 SERIES CARTRIDGE MACHINE SPECIFICATIONS
(Sheet 1 of 2)

PARAMETER	SPECIFICATIONS
ELECTRICAL	
MOTOR	DC Servo.
TAPE SPEED	Programmable For: 3.75 Inches/Second, 7.5 Inches/Second, or 15 Inches/Second operation. Factory programmed at 7.5 Inches/Second.
WOW AND FLUTTER	0.12% Maximum DIN. Referenced at 7.5 Inches/Second.
AUDIO OUTPUT IMPEDANCE	600 Ohms, Electronic Balanced, Floating.
AUDIO OUTPUT LEVEL	-20 dBm to +10 dBm, Continuously Variable. +24 dBm Clip Level.
DISTORTION	1.5% or Less. Reference: 1 kHz at 250 nWb/m.
NOISE (See Note)	
Hum and Noise	
Monophonic Noise Reduction Circuit Enabled	-80 dB. Reference: 1 kHz at 250 nWb/m.
Noise Reduction Circuit Disabled	-60 dB. Reference: 1 kHz at 250 nWb/m.
Stereophonic Noise Reduction Circuit Enabled	-80 dB. Reference: 1 kHz at 250 nWb/m.
Noise Reduction Circuit Disabled	-58 dB. Reference: 1 kHz at 250 nWb/m.
Squelch Noise	-80 dB. Reference: 1 kHz at 250 nWb/m.
CROSSTALK	-50 dB or greater, Program Channel-to-Program Channel or Program Channel-to-Cue Channel at 1kHz.
FREQUENCY RESPONSE (See Note)	±2 dB, 40 Hz to 16 kHz.

TABLE 1-2. 9000 SERIES CARTRIDGE MACHINE SPECIFICATIONS
(Sheet 2 of 2)

PARAMETER	SPECIFICATIONS
EQUALIZATION	
Standard	1975 NAB.
Optional	I.E.C., CCIR.
POWER REQUIREMENTS	
Standard	105V ac to 132V ac, 60 Hz.
Optional	210V ac to 264V ac, 50 Hz.
CUE TONES	1kHz (Primary), 150 Hz (Secondary), 8 kHz (Tertiary), and 3.5 kHz (FSK).
MECHANICAL	
NUMBER OF DECKS	One
CARTRIDGE DECK SIZE	A or AA Size Cartridges.
TRANSPORT TYPE	Direct Drive Capstan.
PHYSICAL	
WEIGHT (Packed)	28 Pounds (12.7 kg).
MOUNTING	
Standard	Desk-Top.
Optional	Rack Mount. 19 Inch (48.3 cm) EIA rack.
DIMENSIONS	
Height	5.62 Inches (14.3 cm).
Width	5.875 Inches (14.9 cm).
Depth	15.5 Inches (39.4 cm).
ENVIRONMENTAL	
AMBIENT OPERATING TEMPERATURE	32°F to 122°F (Ø°C to 50°C).
HUMIDITY	95% Maximum. Non-Condensing.

NOTE: Specifications measured using 1975 NAB Standard Equalization.

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains the information required for the installation of the Broadcast Electronics 9000 series cartridge machines.

2-3. UNPACKING.

2-4. The equipment becomes the property of the customer when the equipment is delivered to the carrier. Carefully unpack the cartridge machine. 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

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. PLACEMENT.

2-8. The standard 9000 series cartridge machines are designed for desk-top placement. Units designed for rack mounting are available by optional assembly. To provide adequate structural support, it is recommended the rack mounted unit be installed in a 9000 series rack shelf. Observe the following requirements and place the unit in any convenient location.

A. Place the cartridge machine within reach of signal and power cables.

B. Do not place the cartridge machine near heat generating equipment.

C. To minimize noise, do not place the cartridge machine near equipment generating excessive 50 Hz or 60 Hz radiation.

D. For rack mounted cartridge machines, allow one inch of rack space above and below the unit for heat dissipation.

WARNING ENSURE NO PRIMARY POWER IS CONNECTED TO THE UNIT BEFORE PROCEEDING.

2-9. PT-90 CIRCUIT BOARD PROGRAMMING.

2-10. The PT-90 cartridge machine is designed with multiple programmable circuits which determine the operating characteristics of the unit. The following text presents several control and operating parameters. Perform the circuit board programming and connection procedures as required for the desired operating or control parameter.

2-11. MOTOR SPEED. The cartridge machine motor speed is determined by control circuitry on the motor control circuit board. The unit is shipped from the factory for 7.5 inches-per-second (IPS) operation. The circuitry may be programmed for 3.75 IPS or 15 IPS operation. Refer to Figure 2-1 and 2-2 to program the logic and motor control modules as required for the desired motor speed.

2-12. END-OF-MESSAGE (EOM) CIRCUIT OPERATION. The PT-90 control logic is designed to select either the secondary (150 Hz) or tertiary (8 kHz) cue tone for EOM operation. Refer to Figure 2-1 and program the logic module for the desired cue tone.

2-13. FREQUENCY-SHIFT-KEYING (FSK) DECODER OUTPUT COMMUNICATION. An FSK decoder circuit is incorporated into the logic module design for cartridge data logging applications. The circuit is designed to interface with any RS-232 peripherial device (example: computer, terminal, or printer). The unit is shipped from the factory for single peripherial device communication in a single unit installation. For communication with a single peripherial device in multiple unit installations, refer to Figure 2-1 and program the logic module as required. Refer to Figure 2-5 for the FSK data output connections.

2-14. START LOCK-OUT OPERATION. A start lock-out circuit is provided to prevent duplicate on-air cartridge play. Start lock-out may be initiated from the termination of cartridge play by a primary (1 kHz) stop tone and/or by a cartridge-not-cued condition. If start lock-out operation is desired, refer to Figure 2-1 and program the logic module for the desired application. Start lock-out conditions are indicated to the operator by the stop indicator flasher circuitry.

2-15. STOP INDICATOR FLASHER OPERATION. A circuit is provided to generate stop indicator flashing for two special operating conditions. The circuit will generate stop indicator flashing at a 1 Hz rate to indicate the termination of cartridge play by a primary (1 kHz) stop tone. The circuit will generate stop indicator flashing at a 2 Hz rate to indicate a cartridge-not-cued condition. If stop indicator flashing operation is desired, refer to Figure 2-1 and program the logic module as required. For multiple unit applications, stop indicator flasher operations may be synchronized by: 1) the appropriate circuit board programming and 2) the connection of a control line. Refer to Figure 2-5 for stop indicator flashing synchronization connections.

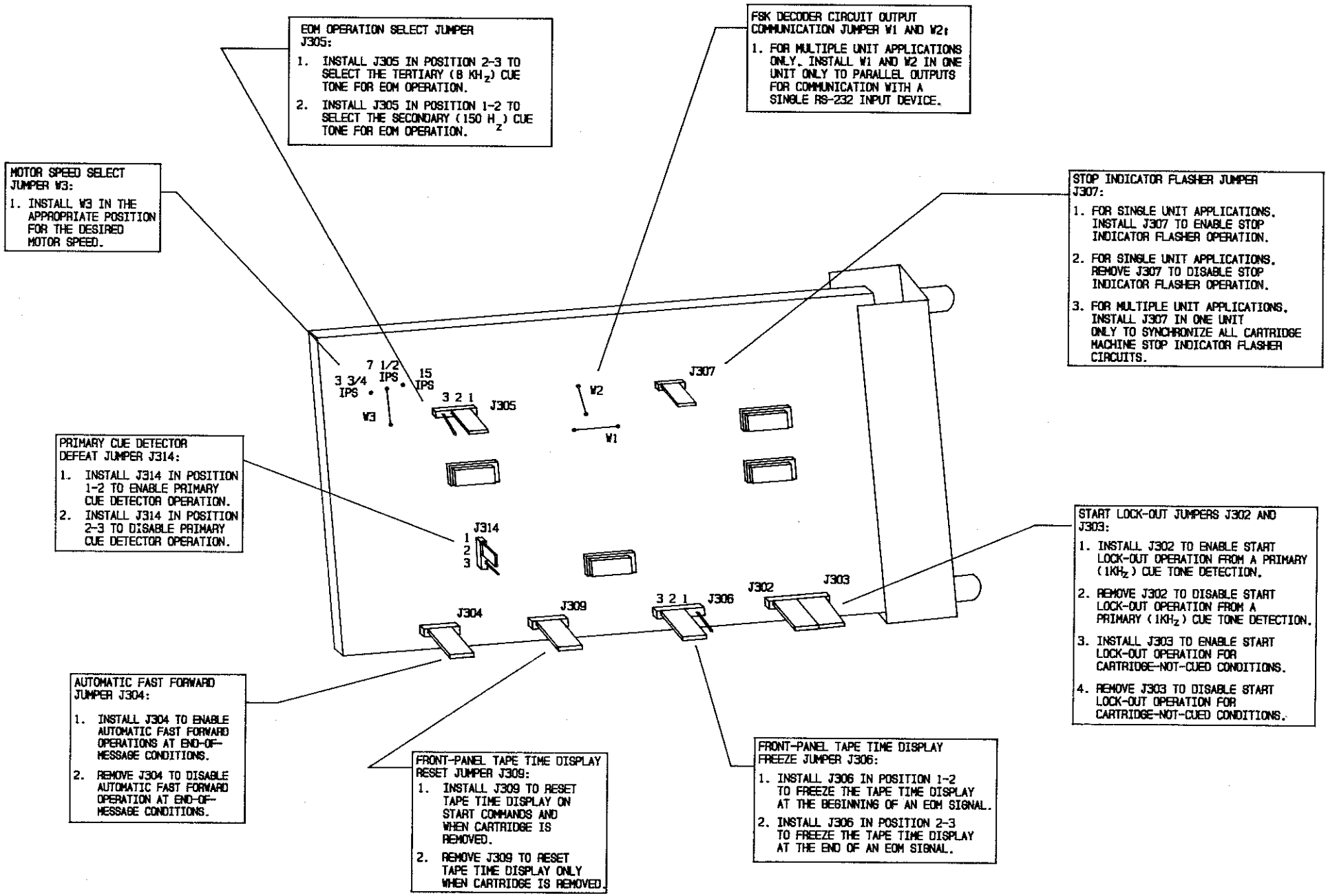

FIGURE 2-1. PLAYBACK LOGIC MODULE JUMPER PROGRAMMING

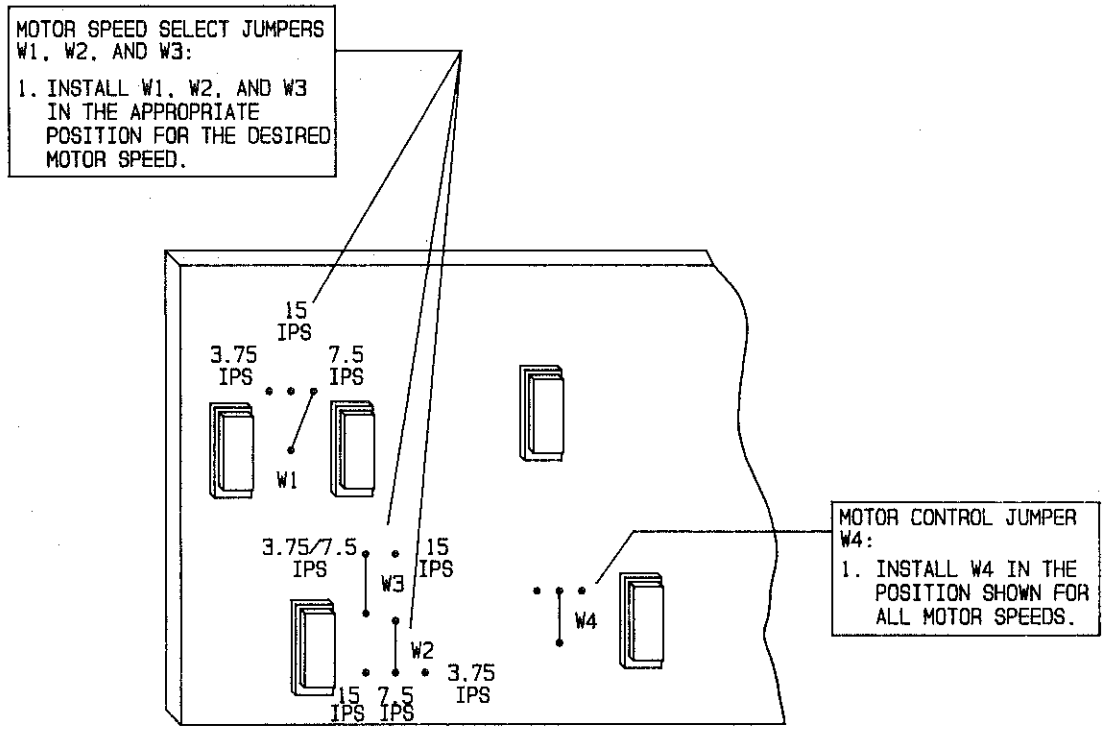

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FIGURE 2-2. MOTOR CONTROL CIRCUIT BOARD JUMPER PROGRAMMING

2-16. FRONT-PANEL TAPE TIME DISPLAY OPERATION. The tape time display control circuit may be programmed to freeze the time display at the beginning or the end of an EOM tone. Refer to Figure 2-1 and program the logic module for the desired operating condition.

2-17. FRONT-PANEL TAPE TIME DISPLAY RESET OPERATION. The tape time display control circuit may be programmed to reset on start commands and when the cartridge is removed from the deck or only when the cartridge is removed from the deck. Refer to Figure 2-1 and program the logic module for the desired operating condition.

2-18. AUTOMATIC FAST FORWARD OPERATION. Automatic fast forward operation may be initiated during End-Of-Message operations. Refer to Figure 2-1 and program the logic module as required for the desired operating condition.

2-19. PRIMARY CUE TONE OPERATION. The primary cue tone detector may be disabled if required. Refer to Figure 2-1 and program the logic module as required for the desired operating condition.

2-20. AUTOMATIC PHASE CORRECTION OPERATION. The automatic phase correction circuitry may be disabled if required. Refer to Figure 2-3 and enable or disable the automatic phase correction circuitry on the audio module as desired.

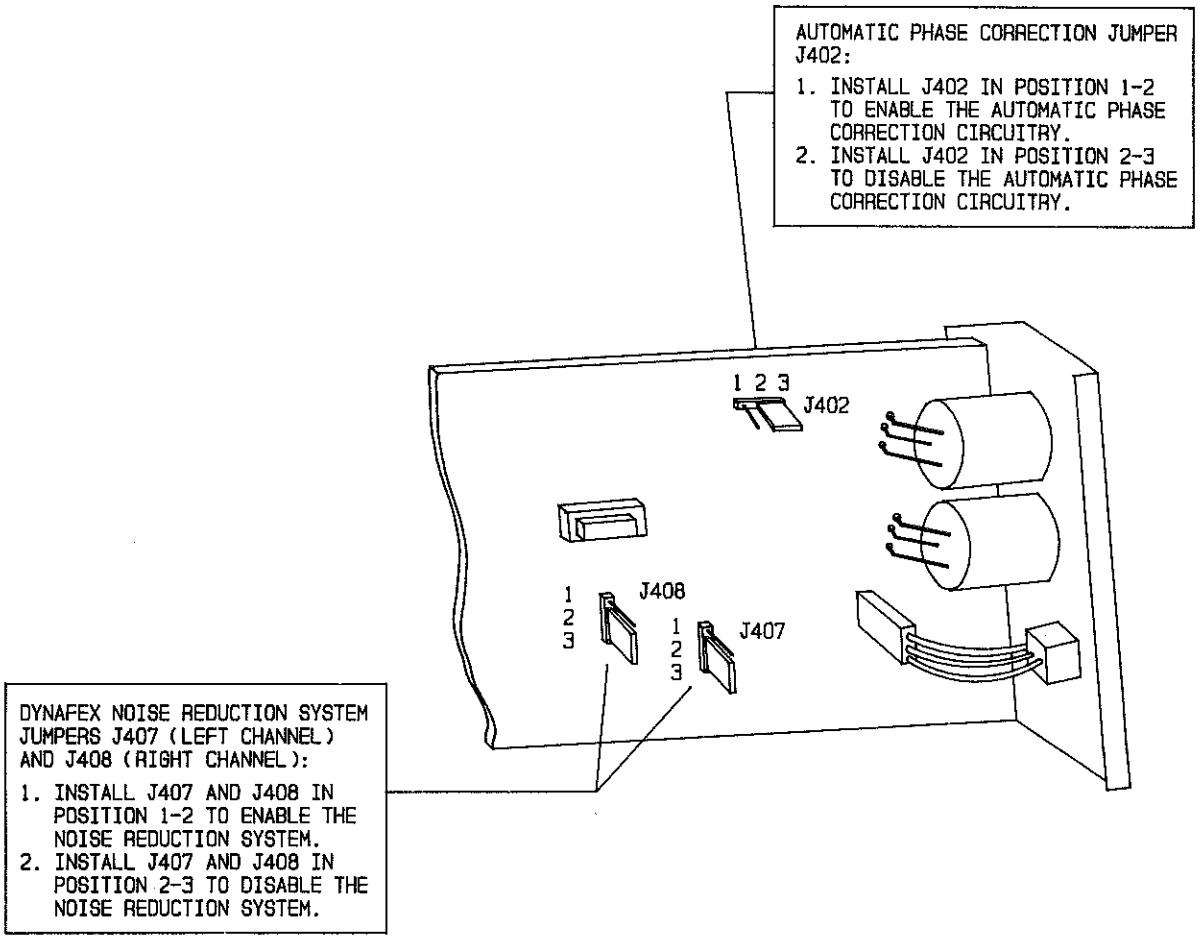

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FIGURE 2-3. AUDIO MODULE JUMPER PROGRAMMING

2-21. NOISE REDUCTION SYSTEM OPERATION. The noise reduction system may be disabled if required. Refer to Figure 2-3 and enable or disable the noise reduction system on the audio module as desired.

2-22. AUDIO INTERFACING.

2-23. The 9000 series cartridge machines are equipped with separate remote control and audio output connectors to provide interfacing with external equipment. A miniature headphone jack on the playback module is also provided for monitoring the left channel and right channel audio outputs.

2-24. AUDIO OUTPUT CONNECTIONS. XLR type audio output connectors J405 and J406 on the audio module provide interfacing with external equipment (refer to Figure 2-4). XLR type mating receptacles are supplied with the unit for interface cable construction (located in the accessory parts kit). The mating connector terminal descriptions are as follows:

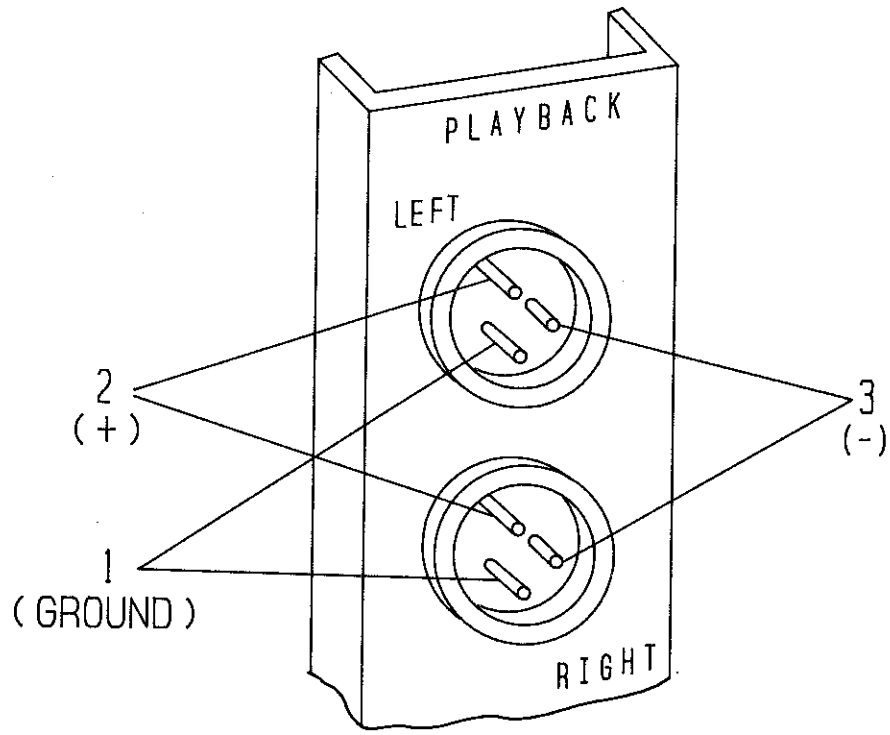

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FIGURE 2-4. XLR CONNECTOR TERMINAL DESIGNATIONS

XLR CONNECTOR TERMINAL	DESCRIPTION
1	Ground
2	+
3	-

2-25. REMOTE CONTROL AND INDICATION INTERFACING.

2-26. The 9000 series cartridge machines are designed with remote control, remote indication, and remote status circuitry. Remote control, indication, and status circuitry is accessible at rear-panel remote connector J308 on the logic module. A remote mating connector is supplied with the unit for interface cable construction (located in the accessory parts kit). If remote control and indication is desired, refer to Figure 2-5 and the following text to connect the appropriate circuitry to connector J308 as required.

2-27. START OPERATION AND INDICATION. Remote start operation is accessible at J308 pin 1. A momentary contact to ground is required to initiate remote start operation. Remote start indications are available at J308 pin 3. A logic LOW is provided to indicate start operation.

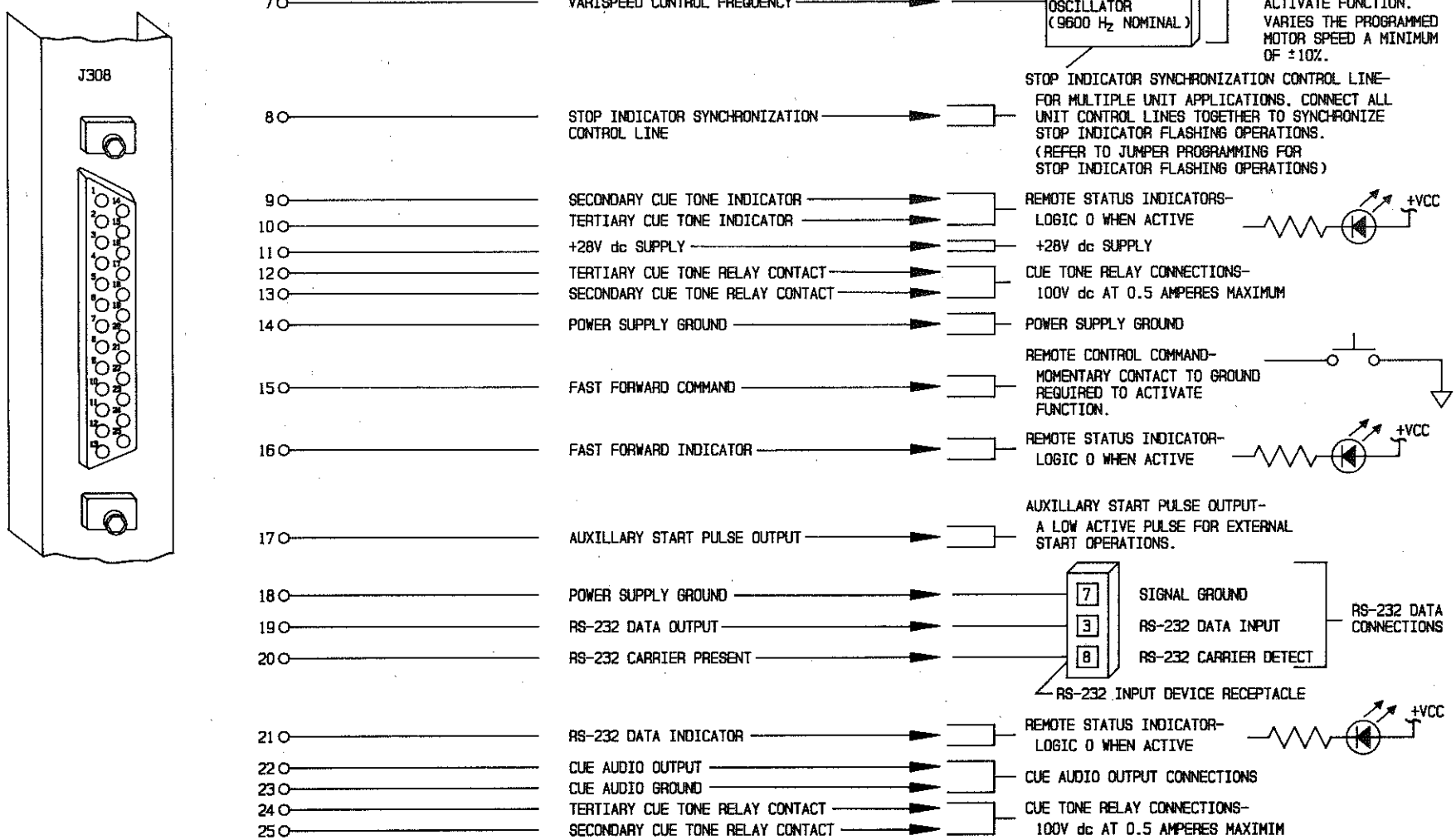


FIGURE 2-5. REMOTE CONTROL RECEPTACLE CONNECTION 597-9000-5

2-28. STOP OPERATION AND INDICATION. Remote stop operation is accessible at J308 pin 2. A momentary connection to ground is required to initiate remote stop operation. Remote stop indications are available at J308 pin 4 which duplicates the front-panel stop indicator operation.

2-29. AUDIO MUTE OPERATION. Remote audio mute operation is accessible at J308 pin 5. A momentary contact to ground is required to initiate the audio mute operation.

2-30. SECONDARY CUE TONE RELAY CONTACTS AND INDICATION. The secondary cue tone relay contacts are accessible at J308 pins 13 and 25 for control of external equipment. The relay contacts are rated for 100V dc at 0.5 amperes maximum. Remote secondary cue tone indications are available at J308 pin 9. A logic LOW is provided to indicate secondary cue tone relay operation.

2-31. TERTIARY CUE TONE RELAY CONTACTS AND INDICATION. The tertiary cue tone relay contacts are accessible at J308 pins 12 and 24 for control of external equipment. The relay contacts are rated for 100V dc at 0.5 amperes maximum. Remote tertiary cue tone indications are available at J308 pin 10. A logic LOW is provided to indicate tertiary cue tone relay operation.

2-32. FAST FORWARD OPERATION AND INDICATION. Remote fast forward operation is accessible at remote connector J308 pin 15. A momentary connection to ground is required to initiate fast forward operation. Remote fast forward indication circuitry is available at J308 pin 16. A logic LOW is provided to indicate fast forward operation.

2-33. VARI-SPEED MOTOR OPERATION. The 9000 series cartridge machines are equipped with a vari-speed feature which allows the operator to vary the cartridge machine motor speed a minimum of ±10%. An adjustable 9600 Hz reference is required at J308 pin 7 for motor control. Connect a logic LOW to J308 pin 6 to initiate vari-speed operation. When vari-speed operation is initiated and the motor reference is varied (example: 10%), the control circuitry will act to vary the programmed motor speed a corresponding amount (10%).

2-34. AUXILIARY START PULSE OUTPUT. An auxiliary start pulse is accessible at J308 pin 17. An active logic LOW pulse is provided for external start applications.

2-35. CUE AUDIO OUTPUT CIRCUITRY. The cue audio output is accessible at J308 pins 22 and 23 for remote monitoring applications.

2-36. RS-232 DATA CIRCUITRY AND INDICATION. The RS-232 data output is available at J308 pins 18, 19, and 20 for communication with an external peripheral device. A logic LOW is provided at J308 pin 21 to indicate data detection.

2-37. GROUND SYSTEM PROGRAMMING.

WARNING DO NOT REMOVE THE JUMPER BETWEEN TERMINALS E3 AND E4 DURING GROUND SYSTEM PROGRAMMING.

2-38. The PT-90 is equipped with a programmable ground system. The system consists of a jumper network and two ground terminals located on the power supply module (refer to Figure 2-6). The jumper network and the ground terminals are designed to distribute and isolate ground circuits as required for optimum performance. The unit is shipped from the factory in a star ground configuration. If an alternate ground configuration is desired, refer to Figure 2-6 and program the system as required. Ensure the chassis ground circuit is connected to earth ground using a braided or solenoid copper conductor.

2-39. When the ground system programming is completed, an important consideration in assuring low noise performance from the cartridge machine is the grounding and shielding of the various audio interconnections. First, ensure the cartridge machine circuit ground and any required internal ground terminal is connected to an earth ground using a braided or solid copper conductor. Second, the shields from audio conductors must be grounded to avoid ground loops (inadvertent signal paths through shields and ground connections). Generally, the shields are grounded at the cartridge machine. However, the shields may require grounding at the subsequent device in the audio chain or at a point between the subsequent audio device and cartridge machine. Particular care must be exercised to avoid ground loops at patch panels, external switching equipment, uninsulated jacks on associated equipment, and grounded racks or cabinets.

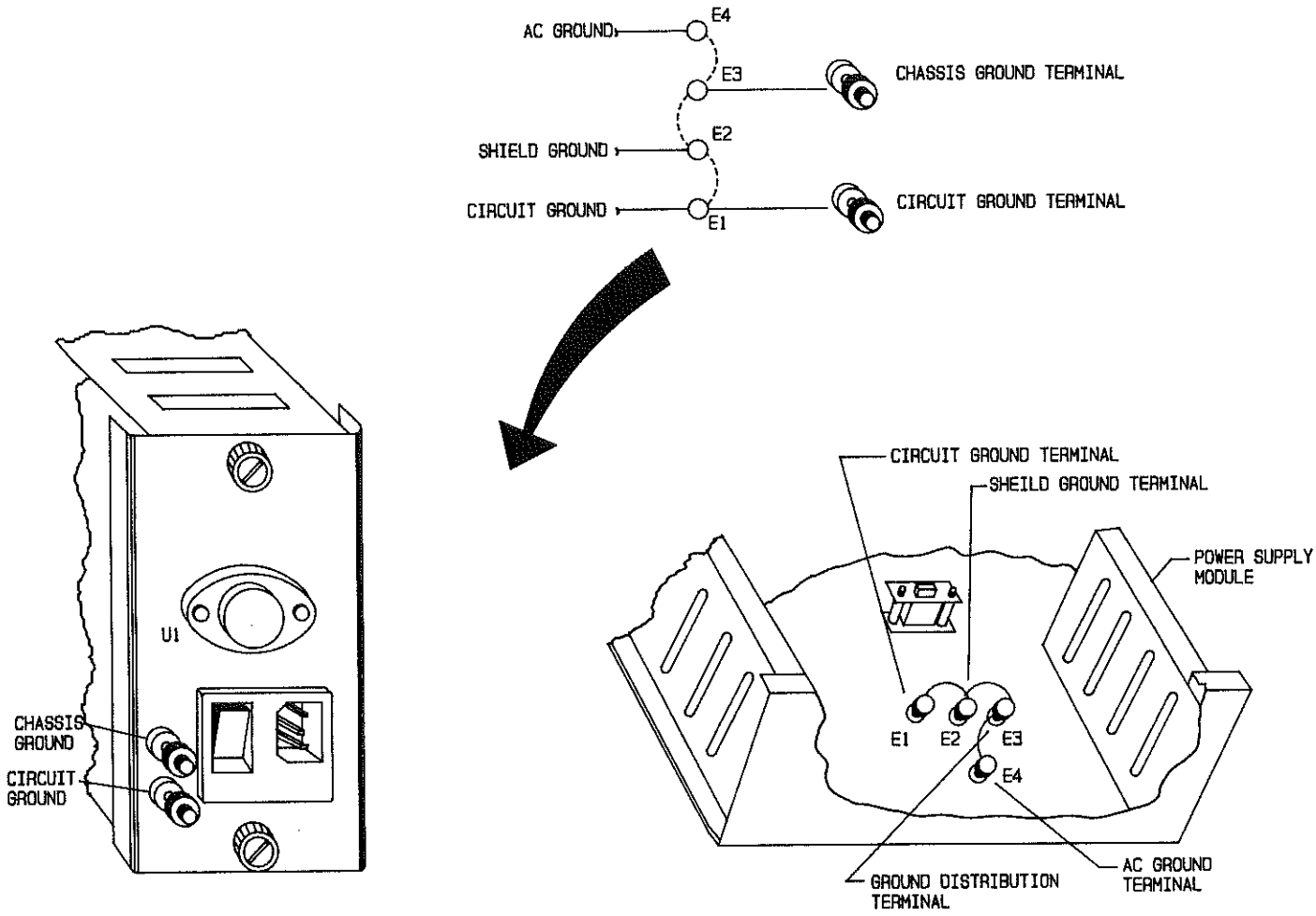
2-40. AC POWER CONNECTION.

WARNING ENSURE ALL PRIMARY POWER IS DISCONNECTED BEFORE PROCEEDING.

2-41. The 9000 series cartridge machines are programmed for the proper power supply voltage when shipped from the factory. The operating voltage requirement for the unit is indicated on the cartridge machine identification plate which is located on the cartridge machine side-panel. If the unit is to be operated from an ac power source other than the original factory programmed source, re-program the unit by operating the 110V/220V power switch on the power supply module to the desired position.

2-42. Remove the fuse from the rear-panel fuse-holder. Ensure the fuse is a slow-blow type rated at 0.5A for 105V to 132V operation or 0.25A for 210V to 264V operation.

2-43. Ensure the rear-panel power switch is operated to OFF and connect the cartridge machine line cord to the appropriate power source.



597-9000-6

FIGURE 2-6. PT-90 GROUND SYSTEM

2-44. ELECTRICAL ADJUSTMENTS.

2-45. AUDIO OUTPUT LEVEL ADJUSTMENT. The cartridge machine audio output level is factory adjusted to Ø dBm. If an alternate output level is required, refer to the ELECTRICAL ADJUSTMENTS procedures in SECTION V, MAINTENANCE and perform the OUTPUT LEVEL ADJUSTMENT procedure.

2-46. OPTIONAL EQUIPMENT INSTALLATION.

2-47. GENERAL. The following list presents related publications which provide data required for the installation of options and accessories associated with the 9000 series cartridge machines.

OPTION OR ACCESSORY	PUBLICATION NUMBER
Model 5409 or 5410 Recorder	597-0097-001
Model PC-1 Telephone Interface	597-0047

SECTION III

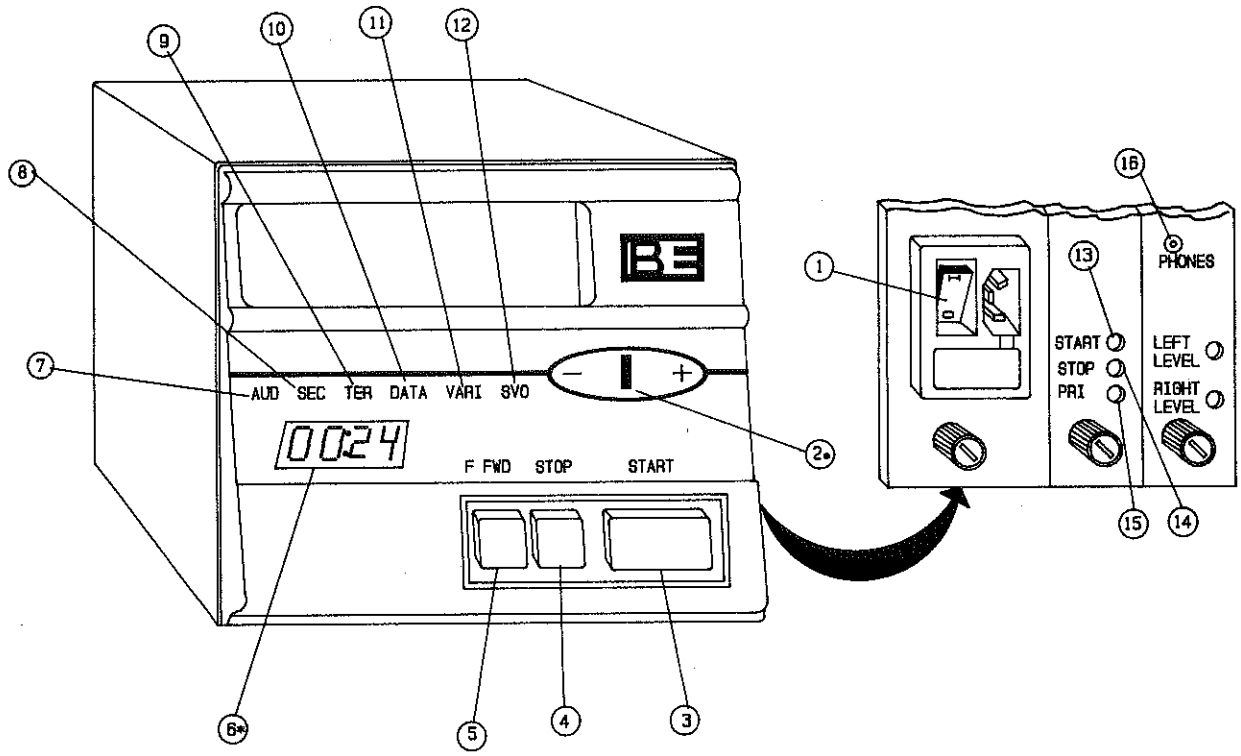
OPERATION

3-1. INTRODUCTION.

3-2. This section identifies all controls and indicators associated with the 9000 series cartridge machines 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 unit. The function of each control or indicator is described in Table 3-1.



• STEREOPHONIC MODELS ONLY
* OPTIONAL

597-9000-7

FIGURE 3-1. 9000 SERIES CONTROLS AND INDICATORS

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

INDEX NO.	NOMENCLATURE	FUNCTION
1	Power Switch	Controls the application of ac power to the unit.
2	Phase Correction Display	Indicates the intensity of relative phase correction during stereophonic reproduction.
3	START Switch/ Indicator	SWITCH: A. Initiates playback operation. B. When momentarily depressed during fast forward operation, returns the unit to the selected operating speed. Audio is enabled after motor is synchronized with selected operating speed. C. Initiates maintenance mode operation when simultaneously operated with the STOP switch/indicator. The motor and solenoid will remain energized for approximately 90 seconds. D. When momentarily depressed in a start lock-out condition, instructs the tape time display to indicate total cartridge tape time. INDICATOR: Illuminates to indicate deck operation.
4	STOP Switch/ Indicator	SWITCH: A. Terminates deck operation. B. When momentarily depressed, initiates a maintenance mode motor operation for approximately 90 seconds. C. Initiates maintenance mode operation when simultaneously operated with the START switch/indicator. The motor and solenoid will remain energized for approximately 90 seconds. D. Resets the start lock-out operation.

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

INDEX NO.	NOMENCLATURE	FUNCTION
		E. Resets the stop indicator flashing operation. INDICATOR: A. Illuminates to indicate the unit is in the ready mode (a cartridge fully inserted and power ON). B. Flashes once per second to indicate a cartridge played condition if the appropriate circuitry is enabled. C. Flashes twice per second to indicate a cartridge-not-cued condition if the appropriate circuitry is enabled.
5	F FWD Switch/ Indicator	SWITCH: A. When momentarily depressed, initiates fast forward operation. Tape advances at three times the normal speed until a 1 kHz stop tone is detected or the STOP switch/indicator is depressed. Audio is muted. B. When continuously depressed, initiates fast forward operation. Tape advances at three times the normal speed until the switch is released. Audio is enabled. INDICATOR: Illuminates to indicate the unit is in the fast forward mode.
6	Tape Time Display	Displays elapsed message time or total tape time in minutes and seconds. Display operation is terminated when the STOP switch/ indicator is depressed or when a primary (1 kHz) stop tone is detected. Tape time display reset and freeze operation are described below. A. The tape time display will always reset when the cartridge is inserted into the deck and optionally when the START switch/indicator is depressed depending on circuit programming.

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

INDEX NO.	NOMENCLATURE	FUNCTION
		B. The tape time display will freeze at the beginning or end of an EOM tone depending on circuit programming to display message time and continue operation for total tape time applications.
7	AUD Indicator	Illuminates to indicate audio is enabled.
8	SEC Indicator	Illuminates to indicate a secondary (150 Hz) cue tone detection.
9	TER Indicator	Illuminates to indicate a tertiary (8 kHz) cue tone detection.
10	DATA Indicator	Illuminates to indicate FSK (3.5 kHz) information detection.
11	VARI Indicator	Illuminates to indicate the unit is operating in the vari-speed mode.
12	SVO Indicator	Illuminates to indicate the dc servo motor is not synchronized with the selected operating speed. The SVO indicator will momentarily flash when power is initially applied to the motor and during fast forward operation.
13	START Indicator	Illuminates to indicate deck operation.
14	STOP Indicator	Illuminates to indicate the following: A. Illuminates to indicate the unit is in the ready mode (a cartridge fully inserted and power ON). B. Flashes once per second to indicate a cartridge played condition if the appropriate circuitry is enabled. C. Flashes twice per second to indicate a cartridge-not-cued condition if the appropriate circuitry is enabled.
15	PRI Indicator	Illuminates to indicate the presence of a primary (1 kHz) cue tone.
16	PHONES Receptacle	Headphone receptacle.

3-5. OPERATION.

NOTE

THE FOLLOWING PROCEDURE ASSUMES THAT THE CARTRIDGE MACHINE IS COMPLETELY INSTALLED AND IS FREE OF ANY DISCREPANCIES.

NOTE

3-6. PLAYBACK.

3-7. Operate the rear-panel power switch to ON.

3-8. Insert an NAB tape cartridge into the deck. When the cartridge is inserted, the following events will occur:

A. The deck STOP switch/indicator will illuminate.

B. The tape time display will illuminate.

3-9. Depress the deck START switch/indicator to begin cartridge play operation. When the START switch/indicator is depressed, the following events will occur:

A. The deck START switch/indicator will illuminate.

B. The deck STOP switch/indicator will extinguish.

C. The AUD indicator will illuminate.

D. The rear-panel START indicator will illuminate.

E. The tape time display will begin operation.

F. On stereophonic models, the phase correction display will begin operation.

3-10. The deck will operate until a primary (1 kHz) stop tone is detected or the deck STOP switch/indicator is depressed. When deck operation is terminated, the following events will occur:

A. The START switch/indicator will extinguish.

B. The rear-panel START indicator will extinguish.

C. The AUD indicator will extinguish.

D. The tape time display will indicate the elapsed time of tape play.

E. On stereophonic models, the phase correction display will extinguish.

F. The STOP switch/indicator will illuminate or flash.

3-11. The 9000 series cartridge machines are equipped with primary, secondary, and tertiary cue tone detection circuitry. Cue tone detection is indicated as follows:

A. The rear-panel PRI indicator will illuminate to indicate the presence of a primary (1 kHz) cue tone.

B. The SEC indicator will illuminate to indicate the detection of a secondary (150 Hz) cue tone.

C. The TER indicator will illuminate to indicate the detection of a tertiary (8 kHz) cue tone.

3-12. The 9000 series cartridge machines are also equipped with an FSK decoder. The DATA indicator will illuminate to indicate the detection of FSK (3.5 kHz) information.

3-13. STOP INDICATOR FLASHING. Stop indicator flashing is designed to provide indications of special operating conditions. If the function is enabled, the STOP indicator will flash once per second to indicate a cartridge played condition or twice per second to indicate a cartridge-not-cued condition.

3-14. To reset the STOP indicator flashing, depress the STOP switch/indicator or remove the cartridge.

3-15. DECK START LOCK-OUT. Deck start lock-out is provided to prevent duplicate on-air cartridge play. If the function is enabled, deck start lock-out will be initiated from a cartridge played condition or a cartridge-not-cued condition. Start lock-out operation is indicated to the operator by stop indicator flashing.

3-16. To reset the start lock-out circuitry, remove the cartridge or depress the STOP switch/indicator.

3-17. FAST FORWARD.

3-18. MANUAL FAST FORWARD. The manual fast forward mode will operate with the audio muting circuit enabled or disabled. To operate the unit in the manual fast forward mode with audio muted, momentarily depress the front-panel F FWD switch/indicator. To operate the unit in the manual fast forward mode with audio enabled, continuously depress the F FWD switch/indicator. The F FWD switch/indicator will illuminate to indicate the fast forward circuitry is enabled. Fast forward advance will continue until a stop tone is detected, the STOP switch/indicator is depressed or the START switch/indicator is depressed. Once fast forward operation is terminated, the STOP switch/indicator will illuminate or flash.

3-19. AUTOMATIC FAST FORWARD. To operate the unit in the automatic fast forward mode, the appropriate circuitry on the logic circuit board must be enabled. Insert the cartridge into the deck and initiate playback operation. When the EOM is detected, the unit will operate to fast forward advance with audio muted. Fast forward advance will continue until a stop tone is detected, the STOP switch/indicator is depressed or the START switch/indicator is depressed. Once fast forward operation is terminated, the STOP switch/indicator will illuminate or flash.

3-20. TAPE TIME DISPLAY OPERATION.

3-21. The tape time display normally indicates elasped message time. The display will also indicate total cartridge tape time. At a EOM detection, the tape time display will freeze to indicate message time and continue operation for total tape time applications. The unit will indicate total tape time only when in a start lock-out condition. To display total tape time, momentarily depress the START switch/indicator when the unit is in a start lock-out condition.

3-22. ELEVATED LEVEL CARTRIDGE SENSING OPERATION.

3-23. The PT-90 is equipped with an elevated level cartridge sensor. If elevated level cartridge detection is required, attach a reflective label (supplied in the accessory parts kit) to the cartridge near the capstan shaft opening for tapes recorded at a 250 nWb/m level.

3-24. MAINTENANCE MODE OPERATION.

3-25. The PT-90 is equipped with a maintenance mode which energizes the motor or motor and solenoid to allow routine pressure roller and capstan shaft cleaning. To generate a motor only maintenance mode command, momentarily depress the STOP switch/indicator. To generate a motor and solenoid maintenance mode command, simultaneously depress the START and STOP switch/indicators and release the STOP switch/indicator prior to the START switch/indicator.

3-26. AUDIO MONITORING.

3-27. The PT-90 is equipped with a miniature headphone receptacle for monitoring the left channel and right channel audio outputs. To monitor the audio output, insert the high impedance headphones into the PHONES receptacle.

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. This section presents the theory of operation for the Broadcast Electronics PT-90 cartridge machine. A detailed block diagram of the PT-90 is presented in Figure 4-1. Refer to Figure 4-1 as required for the following general equipment description.

4-3. GENERAL DESCRIPTION.

4-4. The PT-90 cartridge machine is equipped with a direct drive dc servo motor, a precision-manufactured deck assembly, and solid-state electronics. The deck assembly is designed to provide precise tape movement for accurate audio reproduction. The cartridge machine electronics are implemented on six circuit board assemblies: 1) power supply, 2) motor control, 3) front panel, 4) logic, 5) motherboard, and 6) audio. The logic, audio, and the power supply assemblies are plug-in modules designed for ease of maintenance.

4-5. TAPE TRANSPORT SYSTEM.

4-6. The PT-90 tape transport system consists of a direct drive dc servo motor and a precision-manufactured deck assembly. The brushless dc motor is mounted directly to the cartridge deck with the capstan shaft extending vertically upward through the deck for direct drive operation. Precision control of motor operations is provided by the motor control circuit board. The dc servo motor system exhibits precise motor operation for accurate tape movement.

4-7. The cartridge machine deck assembly is equipped with a cartridge guidance system, an air-damped solenoid, a deck microswitch, an elevated level tape sensor, and the Broadcast Electronics PHASE LOCK V head assembly. The cartridge guidance system consists of several spring-loaded components designed to channel a cartridge into the proper play position. The air-damped solenoid is designed for high tape pulling force and provides a rapid response to start commands. A deck microswitch generates a ready status signal for application to the start logic when a cartridge is inserted into the deck. An infrared sensor is incorporated into the deck design to indicate the presence of an elevated level cartridge.

4-8. The Broadcast Electronics PHASE LOK V head assembly is a modular device designed to provide the tape heads with a mechanically secure and stable environment. The head assembly permits independent adjustment of the head height/zenith and head azimuth. Locking components for the head adjustment controls and the unique head assembly design act to maintain tape head alignment. Due to the modular design, the entire PHASE LOK V assembly may be removed from the deck for alignment or service.

4-9. POWER SUPPLY MODULE.

4-10. The PT-90 power supply module is a self-contained power supply device designed for ease of maintenance. The module is equipped with: 1) an ac input receptacle, 2) a toroid power transformer, 3) rectifier and filter circuitry, and 4) a solenoid driver circuit. The power supply module is designed to accept either 110V or 220V ac input potentials.

4-11. Primary ac power is applied to the PT-90 cartridge machine through the ac input receptacle. The ac input receptacle is equipped with built-in ac power control and overload protection components. Primary ac power conversion is accomplished by a toroid power transformer. DC power conversion is accomplished by positive and negative rectifier and filter networks. A programmable grounding network isolates and distributes ground circuits for special applications. A solenoid driver circuit functions to initiate and maintain solenoid operation.

4-12. DC SERVO MOTOR.

4-13. The cartridge machine motor is a dc servo type constructed in a three stator wye configuration. Each stator is equipped with a hall effect sensor and a permanent magnet. The hall effect sensors are strategically placed in the motor assembly to accurately monitor and control stator operation. The motor is also equipped with a tachometer winding which routes motor speed information to the motor control circuit.

4-14. The sensors operate on the hall effect principle which refers to a voltage developed between two metallic strips when passed through a magnetic field. Each sensor outputs a varying dc voltage which is proportional to the magnetic field in the winding. The voltage is routed to the motor control circuit board as feedback for stator control.

4-15. MOTOR CONTROL CIRCUIT BOARD.

4-16. The motor control circuit board and the cartridge machine motor function as a closed-loop dc servo motor system. The motor control circuit acts to initiate and maintain motor operation to a high degree of precision. The control circuitry also protects the motor from over-current and loss-of-reference conditions.

4-17. A precision reference signal for servo control operations is generated by a crystal oscillator circuit. The reference signal and motor speed information are routed to a frequency comparator. The comparator evaluates the information and outputs a corresponding control signal to the motor driver circuit. The driver circuit processes the signal and outputs dc control information to the motor. A commutator circuit functions to control motor operation by processing and routing the hall effect sensor information to the motor windings. Motor braking operations are controlled by a motor brake control circuit and the motor commutator circuit.

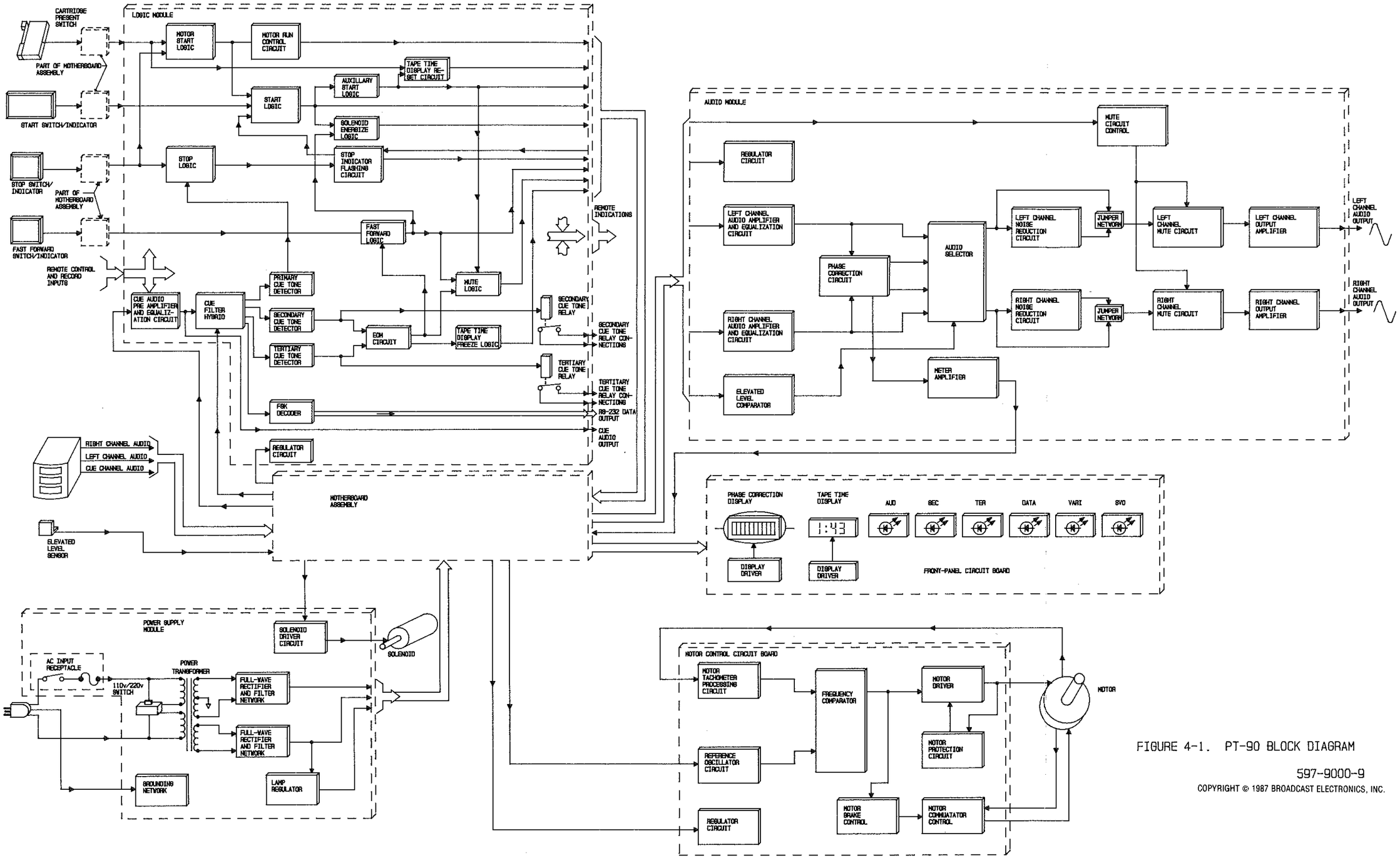


FIGURE 4-1. PT-90 BLOCK DIAGRAM

597-9000-9

4-18. FRONT PANEL DISPLAY CIRCUIT BOARD.

4-19. The cartridge machine phase correction display and the optional tape time display are housed on the front panel display circuit board. The front panel display circuit board also contains the AUD, SEC, TER, DATA, VARI, and SVO indicators.

4-20. MOTHERBOARD ASSEMBLY.

4-21. The PT-90 motherboard assembly provides all required internal circuit communication. The motherboard assembly also distributes audio, elevated level cartridge sensor, and deck status information to the proper circuit board assemblies.

4-22. AUDIO MODULE.

4-23. All PT-90 audio circuitry is housed on the audio module. Stereophonic units are equipped with left and right channel audio circuits and automatic phase correction circuitry. Monophonic units are equipped with only the left channel audio circuit.

4-24. Each audio channel is equipped with an amplifier/equalization stage. The amplifier/equalization stage is designed to provide ±6 dB low frequency equalization, ±10 dB high frequency equalization, and an overall a gain of approximately 50 dB.

4-25. The PT-90 phase correction circuitry is implemented on three hybrids: 1) left channel phase corrector, 2) right channel phase corrector, and 3) phase detector. The circuit utilizes time delay techniques to correct audio phase errors. Audio is sampled in the left channel phase corrector use for use as a reference. The phase detector evaluates the sampled audio and directs the right channel phase corrector to delay the audio for the appropriate amount of time. As a result of the processing, an in-phase audio signal is generated for stereophonic or monophonic applications.

4-26. Internal circuit audio routing is provided by an audio selector. The selector routes either non-phase corrected audio, phase corrected audio, or elevated level samples of each for application to the audio output network. A meter amplifier circuit processes phase correction samples for application to the front panel phase correction display.

4-27. Each channel is equipped with a DYNAFEX® noise reduction circuit. The circuit utilizes dynamically variable bandwidth limiting and a downward expander to effectively limit noise. Audio muting is provided by dual field-effect transistor networks. Solid-state output amplifier sections provide a floating electronically balanced, output impedance, and short circuit protection.

DYNAFEX® is a registered trademark of Circuit Research Laboratories.

4-28. LOGIC MODULE.

4-29. All PT-90 operating parameters are controlled by the circuitry on the logic module. The logic module consists of individual CMOS logic gates which are organized into functional circuits. The circuits control all cartridge machine functions such as motor start, deck stop/start, fast forward, audio muting, and end-of-message operations. The module also contains the cue tone processing and detection circuitry.

4-30. START SEQUENCE. Cartridge machine motor operation is initiated via the motor start logic when a cartridge is inserted into the deck. Once the motor is operational, a command from the start switch/indicator will initiate a start sequence from the start logic. The start logic will energize the solenoid, illuminate the start indicators, generate an auxiliary start output, and reset the front panel tape time display via a programmable jumper.

4-31. STOP SEQUENCE. Cartridge deck operation is terminated when the stop switch/indicator is depressed or when a primary cue tone is detected. The stop logic will deenergize the solenoid and extinguish the start indicators via the start logic. The stop logic will also illuminate the stop indicator and initiate start lock-out operation via the stop indicator flashing circuit.

4-32. FAST FORWARD OPERATION. Fast forward operation is initiated when the fast forward switch/indicator is depressed. The command will initiate fast forward operation and generate a mute command from the mute logic.

4-33. CUE CIRCUIT OPERATION. All cue channel information is processed for application to a decoding circuit by an amplifier and equalization circuit. Cue channel decoding operations are performed by a cue filter hybrid. The hybrid will decode the applied information into primary (1 kHz), secondary (150 Hz), tertiary (8 kHz), and Frequency-Shift-Keying (FSK) signals. The outputs from the hybrid are routed to individual detector circuits.

4-34. END-OF-MESSAGE (EOM) OPERATION. An EOM circuit is incorporated into the control logic design to initiate end-of-message functions. EOM circuit operation is initiated by a secondary or tertiary cue tone detection. The EOM circuit will: 1) enable the tape time display freeze logic, 2) enable the mute logic, and 3) provide for automatic fast forward operation via a programmable jumper.

4-35. FUNCTIONAL DESCRIPTION.

4-36. POWER SUPPLY MODULE.

4-37. AC INPUT CIRCUIT. Primary ac power is applied to the module through the ac input receptacle (refer to schematic diagram 950-0032/-001 in SECTION VII, DRAWINGS). The ac input receptacle contains built-in overload (fuse F1) and ac control (switch S201) components. Power from the receptacle is routed to the primaries of power transformer T1. The secondaries of T1 produce 20 volt and 25.6 volt ac potentials. Switch S202 provides 110V or 220V operation of the power supply circuitry.

4-38. RECTIFIER AND FILTER CIRCUIT. The 20 volt ac potential from transformer T1 is full-wave rectified by diodes D1 through D4 and filtered by capacitors C1 and C2 into ±22.5 volt dc supplies. The ±22.5 volt dc potentials provide operating supplies for all PT-90 cartridge machine circuitry with the exception of the indicator lamps, the deck solenoid, and the motor.

4-39. The 25.6 volt ac potential from T1 is full-wave rectified by diodes D5 through D8 and filtered by capacitor C4 into a +28 volt dc supply. The +28 volt potential is routed to the motor, the deck solenoid, and to an indicator lamp regulator circuit consisting of transistor Q5, zener diode D15, resistor R1, and capacitor C3.

4-40. GROUND SYSTEM. The power supply circuit is equipped with a programmable ground system. The ground system consists of a jumper network and two ground terminals on the power supply module rear panel. The system is provided to isolate and distribute ground circuits as required for special applications. The system is shipped from the factory in a star ground configuration.

4-41. SOLENOID DRIVER AND FOLDBACK CIRCUIT. The solenoid driver and foldback circuit initiates and maintains solenoid operation. The circuit functions to provide a +28 volt dc operating potential to energize the solenoid and after a specified time period, foldback the operating potential to maintain cool and efficient solenoid operation.

4-42. Before the initiation of a deck start sequence, a +28 volt potential is applied to: 1) charge an RC circuit consisting of resistor R4 and capacitor C7 and 2) bias transistor Q3 on. With Q3 on, transistor Q4 will be biased on to provide a +28 volt potential for initial solenoid operation. +12 volt regulator IC-1 is temporarily isolated from the circuit. Potentiometer R9 provides calibration of the +28V dc supply.

4-43. When a deck start start sequence is initiated, a HIGH from the solenoid start circuit on the logic module will bias driver transistor Q1 on. Q1 will bias transistor Q2 on to energize the solenoid. With Q2 on, RC circuit R4 and C7 will discharge. After approximately 100 milliseconds, transistor Q3 will be biased off which disables transistor Q4. With Q4 off, the +28 volt potential is routed through regulator IC-1 to maintain a constant current source of 0.325 amperes at approximately +12V for continuous solenoid operation.

4-44. MOTOR CONTROL CIRCUIT BOARD.

4-45. REFERENCE CIRCUIT. A precision reference signal for servo circuit operation is generated by a 460.8 kHz crystal controlled oscillator circuit consisting of crystal Y1, capacitors C30, C31, and resistor R54 (refer to Figure 4-2). The oscillator circuit output is applied to divider U11.

4-46. Divider U11 is designed to generate motor frequency references. The output of U11 and motor speed jumper network W1 is applied to divide-by-three stage U12A/B. The output of divider U12A/B is routed to multiplexer network U13A/B. U13A/B is designed to switch between normal and fast forward motor frequency references. Jumper network W3 provides input information for the multiplexer network. The output of multiplexer U13A/B is routed for application to a frequency comparator circuit. The following is a list of motor reference frequencies and corresponding motor speeds.

MOTOR REFERENCE FREQUENCY (Hz)		MOTOR SPEED (Inches-Per-Second)	
NORMAL	FAST FORWARD	NORMAL	FAST FORWARD
1200	3600	15	45
600	1800	7.5	22.5
300	900	3.75	11.25

4-47. Normal/Fast Forward Operation. With the unit in the normal mode and programmed for 7.5 IPS operation, divider U11 will output an 1800 Hz reference to divider U12A/B and multiplexer U13A/B via jumper network W3. U12A/U12B will output a 600 Hz reference input to multiplexer U13A/B. The vari-speed and fast forward control lines will be HIGH to instruct multiplexer U13A/B to output a 600 Hz motor reference frequency for application to a frequency comparator circuit.

4-48. When the unit is operated to the fast forward mode, the fast forward control line will go LOW. The LOW instructs multiplexer U13A/B to output an 1800 Hz reference for application to a frequency comparator circuit.

4-49. TACHOMETER PROCESSING CIRCUIT. An indication of cartridge machine motor speed is generated by a tachometer winding. When the unit is programmed for 7.5 IPS operation and the motor is at full speed, the tachometer will output a sinusoidal 600 Hz signal to high gain amplifier stage U2A. U2A is configured for a gain of approximately 1000. The output of U2A is applied to inverters U15F and U15G. U15F generates square-wave tachometer pulses for application to the logic module. U15G generates square-wave tachometer pulses for application to a frequency comparator circuit.

4-50. FREQUENCY COMPARATOR CIRCUIT. The frequency comparator circuit consists of a one-shot network, a frequency comparator, and shift register. The one-shot network consists of integrated circuits U3A/B. The reference circuit output (600 Hz for 7.5 IPS operation) is applied to one-shot U3B. The motor tachometer reference is applied to one-shot U3A. The one-shots are designed to generate precision square-wave signals for application to the freqency comparator.

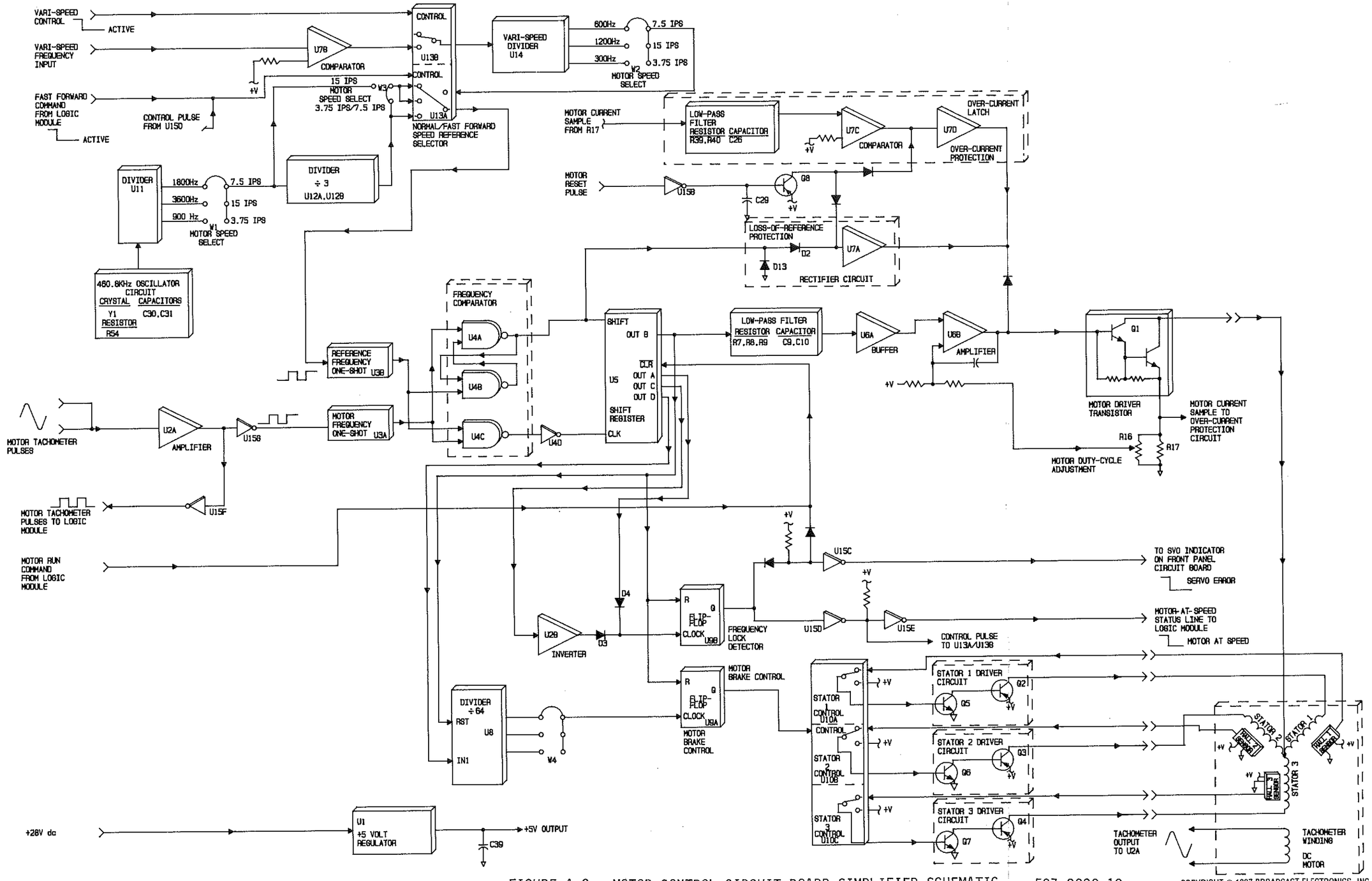


FIGURE 4-2. MOTOR CONTROL CIRCUIT BOARD SIMPLIFIED SCHEMATIC 597-9000-10

4-51. The frequency comparator network consists of NAND gates U4A/B/C. The circuit functions to compare the applied frequencies and generate corresponding shift and clock signals to shift register U5 and a rectifier network. Shift register U5 will generate four outputs which represent operating parameters such as motor load and speed. The outputs provide motor information for a motor driver circuit, a motor brake control circuit, and a motor protection circuit.

4-52. MOTOR DRIVER CIRCUIT. One output from shift register U5 is filtered into a dc level by a passive low-pass filter consisting of resistors R7, R8, R9 and capacitors C9 and C10. The dc level is buffered by operational amplifier U6A and applied to amplifier stage U6B. U6B will output a varying bias voltage to motor driver transistor Q1. Q1 is designed to provide a dc supply voltage which controls the speed of the motor. Potentiometer R16 provides motor drive calibration.

4-53. MOTOR PROTECTION CIRCUIT. The motor is monitored for loss of reference frequency and over-current conditions by a protection circuit. A rectifier circuit consisting of diodes D2 and D3 and operational amplifier U7A function as a reference frequency monitor network. With a reference frequency input signal, the output of U7A will be HIGH and allow normal motor drive operation. With the loss of the reference frequency input, the output of U7A will go LOW to bias Q1 off and terminate motor operation.

4-54. Motor over-current conditions are monitored by a circuit consisting of a passive low pass filter, comparator U7C, and latch U7D. A motor current sample is filtered into a dc level by a low-pass filter consisting of resistors R39, R40, and capacitor C26. The dc signal is routed for application to comparator U7C and latch U7D. When the motor current sample is below the reference level at U7C, U7C will output a HIGH to latch U7D. U7D will output a HIGH to allow normal motor drive operation. When the motor current sample increases above the comparator reference level, U7C will output a LOW to latch U7D. U7D will output a LOW to bias Q1 off and terminate motor operation. A timing circuit consisting of inverter U15B, transistor Q8, and capacitor C29 functions to disable the over-current protection circuit for approximately 3 seconds during initial motor operation.

4-55. LOCK DETECTOR CIRCUIT. Samples from U5 are monitored for motor unlocked conditions by inverter U2B, diode D4, and flip-flop U9B. When the motor is operating in a locked condition, a HIGH is applied to inverter U2B and a LOW to diode D4. U2B will output a LOW to frequency lock detector flip-flop U9B. The output of U9B will go LOW. The LOW is routed through inverters U15D and U15E to output a LOW to indicate a motor-at-speed condition. When an unlocked motor condition occurs, the output of U2B will go HIGH or diode D4 will conduct to generate a clock pulse for flip-flop U9B. The output of U9B will go HIGH. Inverter U15C will output a LOW to illuminate the front panel SVO indicator. The HIGH from U9B is applied through inverters U15D and U15E to indicate an unlocked motor condition.

4-56. MOTOR COMMUTATOR CONTROL CIRCUIT. The motor commutator control circuit consists of a stator control/driver network and a brake control circuit. Multiplexer U10A/B/C and transistors Q2 through Q7 operate together to control the direction of the motor stators. Divider U8 and motor brake control flip-flop U9A initiate motor braking operations when: 1) the motor is operating at a fast forward rate and required to return to the normal operating speed and 2) at motor termination.

4-57. When the motor is in normal or fast forward operation, output samples from U5 will force the output of divider U8 LOW. The LOW is applied to motor brake control flip-flop U9A. The output of U9A will go LOW. With the output of U9A LOW, stator control logic U10A/B/C and the transistor driver circuits operate individually to control each motor stator. A signal from hall effect sensor 1 will be routed through stator control device U10A to the stator 1 driver circuit. The driver circuit will output the signal to control the operation of stator 1. Stator 2 and 3 control/driver networks operate in an identical manner. The stator control/driver circuitry will respond in the appropriate sequence to initiate and control motor commutator rotation.

4-58. When a motor braking operation is required, the motor drive samples from U5 will produce a square-wave clock signal from U8. The clock signal is applied to flip-flop U9A which outputs a corresponding square-wave control signal to the stator control logic. The stator control logic will respond by simultaneously appling a +28 volt pulse to each stator to provide a motor braking action. When the motor returns to a locked condition, the output of U9A will go LOW to terminate motor braking operation and provide normal stator control.

4-59. VARI-SPEED CIRCUIT. The cartridge machine motor may be varied a minimum ±10% for special audio applications by a vari-speed feature. The vari-speed circuitry consists of comparator U7B, divider U14, and jumper network U2. The circuit operates from a nominal 9600 Hz external signal source.

4-60. The vari-speed signal source is applied to comparator U7B. U7B is designed to generate a square-wave reference signal for application to multiplexer U13B. When a LOW is applied to the vari-speed control line, multiplexer U13B will route the reference signal to divider U14. U14 will output a corresponding reference signal for application to U13A and the reference circuitry.

4-61. POWER SUPPLY CIRCUIT. The motor control circuit board power supply circuit consists of regulator U1 and capacitor C39. U1 and capacitor C39 regulate the +28V dc voltage into a +5 volt supply for circuit operations.

4-62. AUDIO MODULE.

4-63. The following text describes the operation of the audio module. Stereophonic only units are equipped with left and right channel audio circuits and automatic phase correction circuitry. Monophonic units are equipped with only the left channel audio circuit. The left and right channel audio circuits are identical; therefore, only the left channel circuit will be discussed.

4-64. A simplied schematic diagram of the audio module is presented in Figure 4-3. Refer to Figure 4-3 as required for the following circuit description.

4-65. AUDIO INPUT CIRCUIT. Left channel audio from the tape head is applied to operational amplifier U1. U1 is configured as an audio amplifier and equalization stage with a gain of approximately 50 dB. Potentiometer R11 provides ±6 dB of low frequency equalization. Potentiometer R6 provides ±10 dB of high frequency equalization. The output of amplifier/equalization stage U1 is applied to the automatic phase correction circuit.

4-66. AUTOMATIC PHASE CORRECTION CIRCUIT. The automatic phase correction circuitry is implemented on three hybrid circuits: 1) left channel phase corrector PC-2, 2) right channel phase corrector PC-3, and 3) phase detector PC-1. The circuit is designed to continuously monitor left and right channel audio and automatically correct phase errors to produce in-phase audio.

4-67. The phase correction circuitry operates from time delay principles to correct audio phase errors. Left channel audio is applied to phase corrector PC-2 which contains a fixed time delay segment. The audio at PC-2 is sampled and used as reference by phase detector PC-1. Phase detector PC-1 evaluates the left channel audio sample and outputs a control oscillator signal to right channel corrector PC-3. PC-3 contains a variable time delay segment which delays the right channel audio from 0.8 to 1.2 milliseconds as directed by the oscillator signal from PC-1. As a result of the processing, an in-phase audio signal is produced for application to an audio selection circuit.

4-68. Phase correction calibration is provided by potentiometer R35. A sample from phase detector PC-1 is used for phase correction display applications. The sample is applied to U3B which is configured as a differential amplifier. U3B outputs a varying control voltage to drive the front panel phase correction display.

4-69. AUDIO SELECTION CIRCUIT. Integrated circuit U4 operates as an audio selector. U4 is designed to select one of the following types of audio as determined by phase correction circuit programming and elevated level comparator U3A. Elevated level audio is synthesized by resistors R32, R33, R36, and R37. The output of U4 is routed for application to the noise reduction circuit.

AUDIO TYPE

1. Non-phase corrected audio.
2. Phase corrected audio.
3. Elevated level non-phase corrected audio.
4. Elevated level phase corrected audio.

4-70. Elevated level comparator U3A and phase correction enable/disable jumper J402 control the operation of audio selector U4. Elevated level operation is initiated when the deck elevated level sensor outputs a control signal to comparator U3A. The output of U3A will go HIGH to configure U4 for elevated level operation. The phase correction circuit may be disabled at U4 by installing jumper J402 in the appropriate position.

4-71. NOISE REDUCTION CIRCUIT. The noise reduction circuit incorporates dynamic variable bandwidth limiting and a downward expansion technique to effectively reduce the noise level. The operational noise reduction circuitry is housed on integrated circuit U11. Operational amplifier U10A is configured as a high-pass filter/amplifier stage which controls the circuit sensitivity. The output of U11 is applied through U10B which operates as a current-to-voltage converter.

4-72. MUTE CIRCUIT. The noise reduction circuit output is applied to an audio mute circuit. The mute circuit consists of a control device and field-effect-transistor network. When audio muting is required, a LOW is applied to mute control transistor Q3 and left channel mute transistor Q4. The LOW is inverted by transistor Q3 which routes a HIGH to transistor Q1. The LOW will bias Q4 on and the HIGH will bias Q1 off to mute the applied audio signal.

4-73. OUTPUT AMPLIFIER CIRCUIT. Audio from the mute circuit is applied to U5A which is configured as an amplifier stage. Potentiometer R40 provides left channel output level control. The output of U5A is applied to the left channel output amplifier network consisting of inverter U6A and amplifier stages U7A/B and U6B. The amplifier network is configured for a gain of two. The unique operation of the circuit provides a balanced or unbalanced output without loss of audio signal.

4-74. Audio from U5A routed through inverter U6A and applied to the amplifier stage in an inverted and non-inverted format. Inverted audio is applied to amplifier stage U7A and non-inverted audio to amplifier stage U7B. Together, U7A and U7B operate as a balanced audio output amplifier stage with a gain of two. Amplifier U6B functions as a monitoring and gain stage for a shorted audio output condition.

4-75. When the audio output impedance balanced, the input to U6B is at virtual ground which isolates the stage from the circuit. When either the positive or negative output terminals are grounded, an audio signal will be applied to U6B. U6B will output a signal to increase the gain of the remaining amplifier network operating stage. As a result, the network will output a full signal into the shorted output condition.

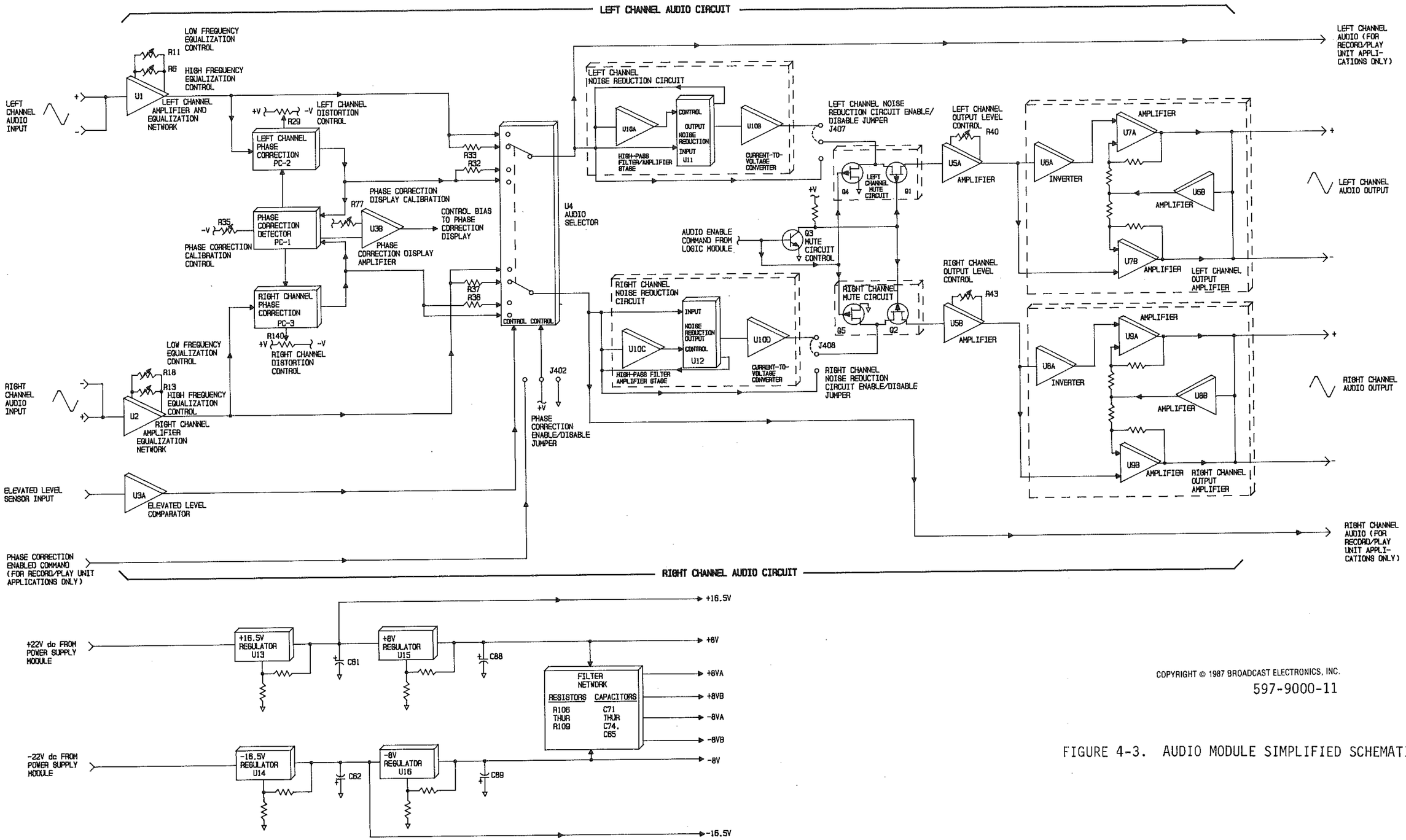


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FIGURE 4-3. AUDIO MODULE SIMPLIFIED SCHEMATIC

4-76. POWER SUPPLY CIRCUIT. The module power supply circuit consists of a positive and negative regulator and filter network. A +22 volt dc supply from the power supply module is regulated into a +16.5 volt potential by regulator U13 and capacitor C61. The +16.5 volt supply is re-regulated into a +8 volt supply by regulator U15 and capacitor C88.

4-77. A -22.0 volt potential from the power supply module is regulated into a -16.5 volt dc potential by regulator U14 and capacitor C62. The -16.5 volt potential is re-regulated into a -8 volt dc supply by regulator U16 and capacitor C89.

4-78. The ±8 volt potentials are routed to a special filter network. The network provides additional filtering for the phase correction circuit.

4-79. LOGIC MODULE.

4-80. All cartridge machine operating parameters are controlled by the logic module (refer to Figure 4-4). The module design utilizes individual CMOS logic components. The logic gates are organized into circuits which control motor and solenoid operations, deck stop/start operations, fast forward operation, audio muting, end-of-message functions, and operating indicators.

4-81. MOTOR CONTROL LOGIC. Motor operations are directed by the motor start and control circuits. A normal cartridge machine motor start sequence is initiated when a cartridge is inserted into the deck. A LOW from the deck micro-switch is applied to a motor start circuit consisting of inverter U6A and OR gate U7A. U7A gates a HIGH from U6A and a LOW from inverter U16C to output a continuous HIGH motor start command to the motor control circuit, the start logic, and the stop logic.

4-82. The motor control logic consists of comparator U12A and an RC timing circuit. U12A is designed to control motor operations in response to a normal or maintenance mode start sequence. With the initiation of a normal start sequence, the continuous HIGH from U7A will be above the reference at U12A. The output of U12A will go HIGH to initiate motor operation. When the cartridge is removed, RC circuit R99 and C68 will begin to discharge. After approximately 90 seconds, U12A will output a LOW to terminate motor operation.

4-83. Maintenance Mode Operation. The motor control circuit also responds to a maintenance mode start sequence. A maintenance mode motor start command is generated when a cartridge is removed from the deck and the stop switch/indicator is momentarily depressed. OR gate U7A will output a momentary HIGH to charge RC circuit R99 and C68. With the voltage from the RC circuit above the reference at U12A, the output of U12A will go HIGH to start the motor. After approximately 90 seconds, the RC circuit will completely discharge. The output of U12A will go LOW to terminate motor operation.

4-84. DECK START LOGIC. A deck start sequence is initiated when the front-panel START switch/indicator is depressed. A LOW from the switch/indicator is inverted by U16B and routed to the start logic, stop logic, and the tape time display freeze circuit.

4-85. The deck start logic consists of AND gate U26C, latch U25A, and NOR gate U19A. U26C gates HIGH control commands from the motor start circuit, inverter U16B, and start lock-out select jumper J303. The output of U26A will go HIGH to reset start latch U25A. U25A will output a LOW to start indicator driver network U19B and U14A/B. U14A/B will output a LOW to illuminate start indicator DS2 and the local/remote start indicators. The LOW from U25A is also routed to: 1) NOR gate U19A, 2) the stop indicator driver network, 3) the fast forward logic, and 4) the mute circuit. U19A gates a LOW from start latch U25A and a LOW from the motor-at-speed control line to output a HIGH to the auxiliary start logic and to the solenoid start circuit.

4-86. Solenoid Start Logic. OR gate U17B functions as the solenoid start logic. U17B gates a HIGH command from U19A of the start logic and LOW from the fast forward logic. The output of U17B will go HIGH to enable the solenoid driver circuit.

4-87. Auxiliary Start Logic. NAND gate U18A and one-shot U27B are configured as the auxiliary start logic. An auxiliary start command sequence is initiated when U18A gates HIGH logic commands from U19A and U16A. The output of U18A will go LOW to trigger one-shot U27B. U27B will output a HIGH through inverter U15B to output a LOW auxiliary start command. U27B also routes HIGH logic commands to the tape time display reset logic, cue filter circuit, and the mute logic. LOW reset commands from U27B are routed to the fast forward logic and the EOM circuit.

4-88. DECK STOP LOGIC. The deck stop logic consists of a stop circuit and a stop indicator flashing circuit. Together, the circuits are responsible for generating deck stop commands, start lock-out commands, and stop indicator control.

4-89. Deck Stop Operation, Manual. When deck operation is terminated manually, a LOW from the front-panel STOP switch/indicator is applied through inverters U16C and U16E to OR gate U17C. U17C gates LOW logic commands from U16E and U16B to output a LOW. U20A gates the LOW from U17C and a HIGH motor start command from U17A to output a LOW which resets the auxiliary start logic. U20A also routes a LOW to NAND gates U18C and U18D and one-shot U27A. U18C is designed to monitor the motor over-current status line. With normal motor current conditions, U18C will gate a HIGH from the status line and the LOW from U20A to output a HIGH to AND gate U20B and OR gate U21A.

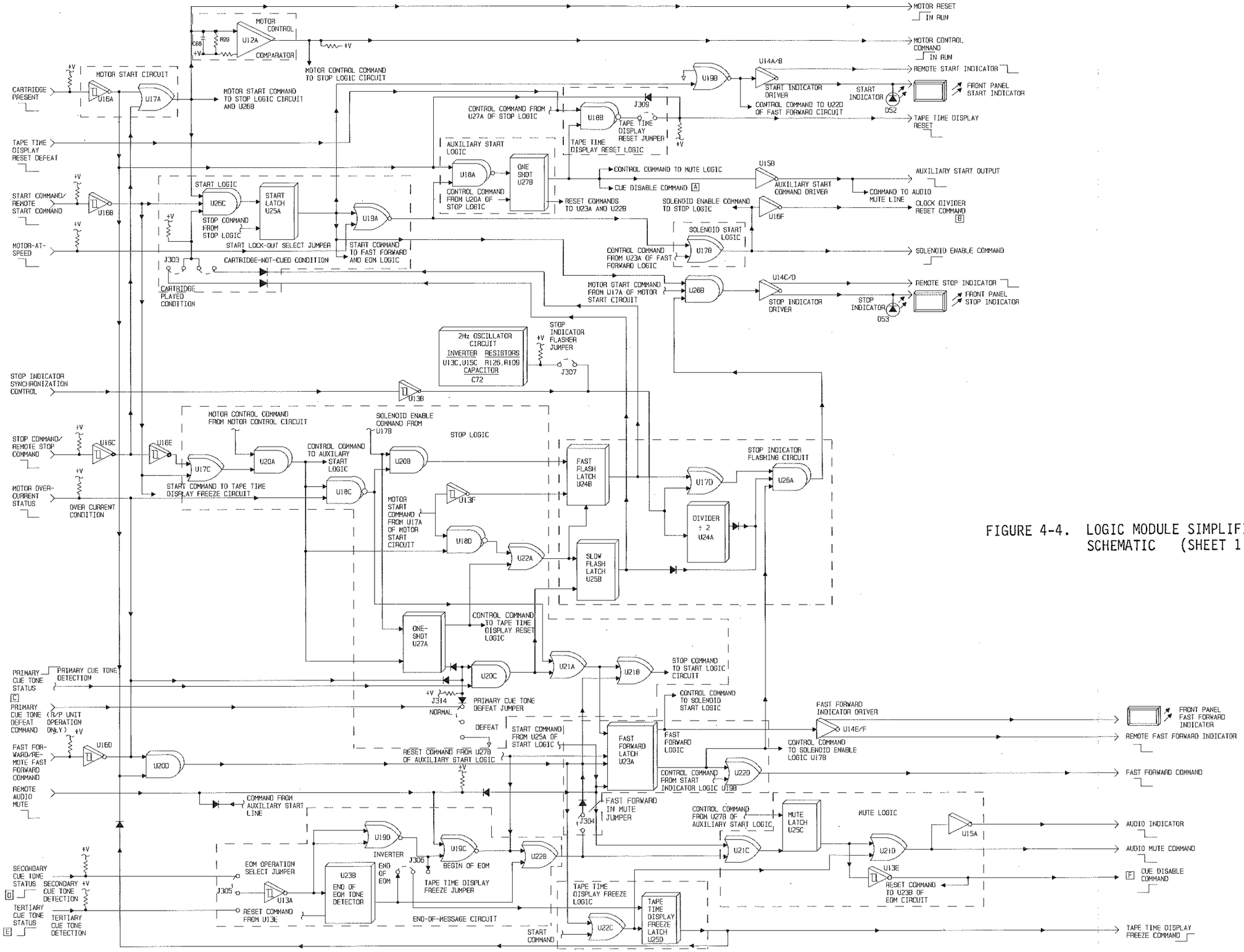

FIGURE 4-4. LOGIC MODULE SIMPLIFIED SCHEMATIC (SHEET 1 of 2)

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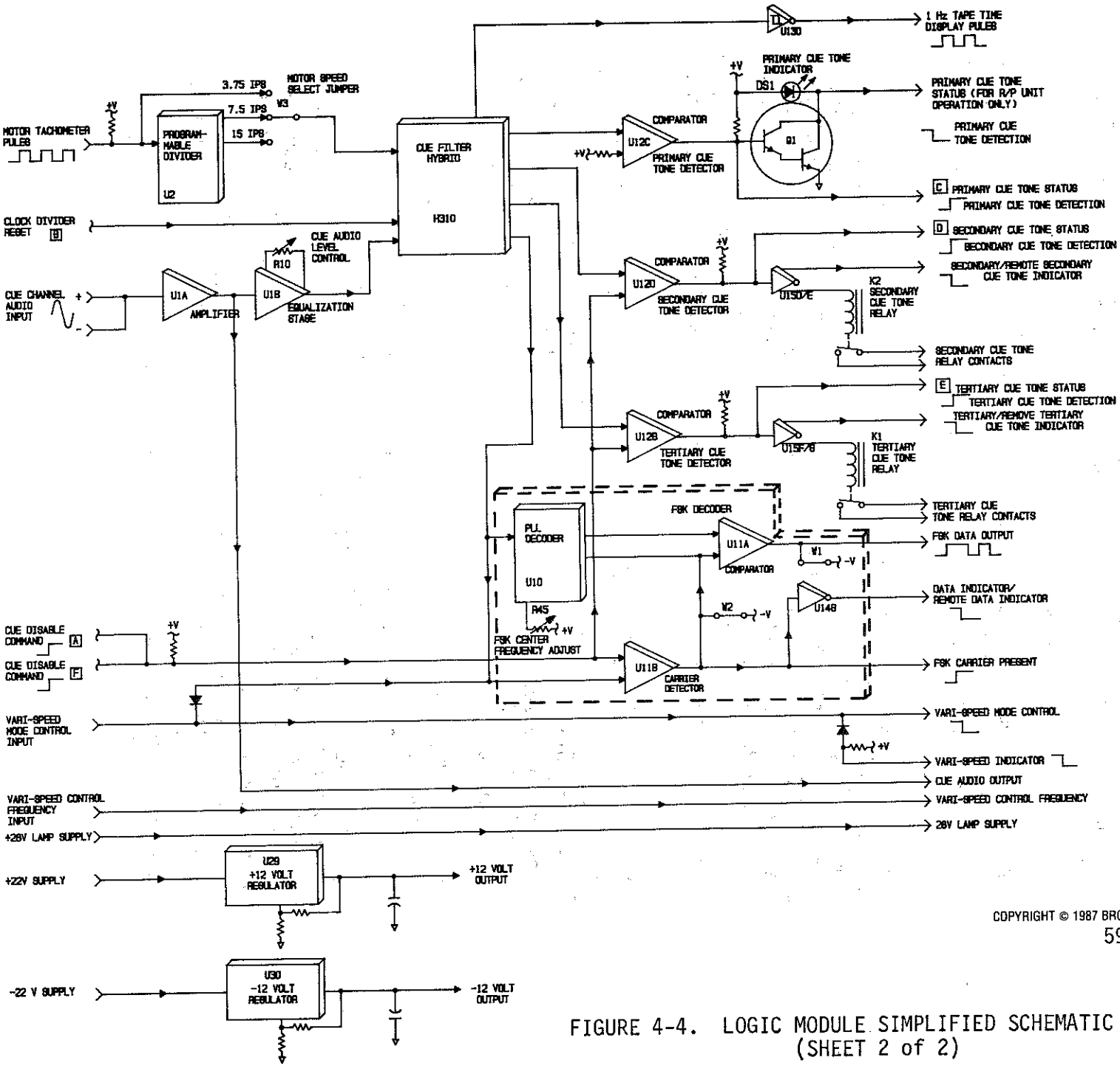

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FIGURE 4-4. LOGIC MODULE SIMPLIFIED SCHEMATIC (SHEET 2 of 2)

4-90. With the LOW reset command from U20A, one-shot U27A will output both HIGH and LOW logic commands. HIGH logic commands are routed to OR gate U22A and the tape time display reset logic. A LOW is applied to AND gate U20C which monitors the primary cue tone status line. U20C will output a LOW to OR gate U21A and to the stop indicator flashing circuit. U21A gates a LOW from U20C and a HIGH from U18C to output a HIGH to OR gate U21B. U21B gates the HIGH from U21A and a LOW from U20D to route a HIGH stop command to reset the start logic. U19A of the start logic will output a LOW to extinguish the start indicator via U19B and U14A/B and deenergize the solenoid via U17B. The stop indicator will illuminate as directed by a control circuit and the stop indicator flashing circuit.

4-91. Deck Stop Operation, Primary Cue Tone. When a primary (1 kHz) cue tone is detected, the primary cue tone status line will go HIGH. U20C gates HIGH logic commands from the primary cue tone status line and one-shot U27A to output a HIGH through OR gate U21A to OR gate U21B. U21B will output a HIGH to reset the start logic. With the start logic reset, U19A will output a LOW to extinguish the start indicator and deenergize the solenoid. The stop indicator will illuminate as directed by a control circuit and the stop indicator flashing circuit. Jumper J314 is incorporated into the logic to disable primary cue tone operation.

4-92. Stop Indicator Control Logic. The cartridge machine deck stop indicator is designed to provide indications of special operations. Control commands for stop indicator operation are generated by logic gates U20B, U13F, U18D, and U22A of the stop circuit. The control commands are processed through the stop indicator flashing circuit consisting of latches U24B and U25B, divider U24A, OR gate U17D, AND gate U26A to generate the appropriate indicator response.

4-93. When deck operation is terminated by the local or remote stop switch/indicator, U20B gates a HIGH solenoid enable command from U17B and a HIGH from NAND gate U18C. U20B will route a HIGH to set fast flash latch U24B. The output of U24B will go LOW. U22A gates HIGH logic commands from NAND gate U18D and one-shot U27A to output a HIGH to set slow flash latch U25B. With the output of latch U24B LOW and the stop indicator flashing oscillator circuit disabled at jumper J307, a HIGH from U13B is routed through U17D to AND gate U26A. U26A gates HIGH control commands from U17D, slow flash latch U25B, and fast forward latch U23A to output a HIGH to AND gate U26B. U26B gates HIGH logic commands from U26A, U17A, and start latch U25A. U26B will output a HIGH through inverter U14C/D to illuminate stop indicator DS3, the front panel stop indicator, and the remote stop indicator.

4-94. Stop Indicator Flashing/Start Lock-out Operation. Stop indicator flashing is enabled when jumper J307 is installed. A two Hz reference signal from an oscillator circuit consisting of inverters U13C, U15C, resistors R126, R109, and capacitor C72 is routed to divider U24A and OR gate U17D. When deck operation is terminated by the local or remote stop switch/indicator, U20B will gate a HIGH solenoid enable command and a HIGH command from U18C to output a HIGH to set latch U24B. U24B will output a LOW to start lock-out jumper J303 and to OR gate U17D. The LOW will initiate start lock-out operation for a cartridge-not-cued condition if jumper J303 is installed. With one input to U17D LOW, the two Hz pulse from the oscillator circuit is routed to U26A. With HIGH commands from U25B and U23A, U26A will route the oscillator signals to U26B to generate a two Hz stop indicator flashing rate for a cartridge-not-cued condition.

4-95. If deck operation is terminated by a primary cue tone detection, HIGH logic commands from latch U27A and the primary cue tone status line are gated at U20C. U20C will output a HIGH to reset slow flash latch U25B. U25B will output a LOW to start lock-out jumper J302. The LOW will initiate start lock-out operation for a cartridge played condition if start lock-out jumper J302 is installed.

4-96. An indication of the primary cue tone detection is generated by the oscillator circuit and the operation of divider U24A, OR gate U17D, and AND gate U26A. The two Hz pulses from the oscillator circuit are routed through divider U24A to generate a one Hz pulse. With the output of U25B HIGH, U26A gates HIGH commands from U17D and U23A and the one Hz pulses from U24A. U26A will output the oscillator pulses through U26B to generate a one Hz stop indicator flashing rate for a cartridge played condition.

4-97. Stop indicator flashing and stop lock-out operation are reset when the local/remote stop switch/indicator is depressed or when the cartridge is removed. U20B will gate a LOW solenoid enable command and a HIGH from U18C to output a LOW to latch U24B. U18D will gate a HIGH motor start command and a LOW from U20A to output a HIGH to OR gate U22A. U22A will output a HIGH clock pulse to reset latch U24B and set latch U25B. The outputs of U24B and U25B will go HIGH to reset the stop indicator flashing and start lock-out operation.

4-98. FAST FORWARD LOGIC. When the fast forward switch/indicator is depressed, a LOW is applied through inverter U16D to AND gate U20D. U20D gates HIGH logic commands from U16D and U16A to output a HIGH to fast forward latch U23A, the tape time display freeze logic, and to U21B of the stop logic. U21B will output a HIGH to reset the start logic. The start logic will extinguish the start indicator and output a LOW to solenoid start logic U17B. The tape time display freeze logic will enable tape time display and output a LOW to U21D of the mute logic. The output of U21D will go LOW to enable the audio mute circuit on the audio module.

4-99. Fast forward latch U23A will respond by generating both HIGH and LOW logic commands. A HIGH logic command will be routed to the solenoid start logic to maintain solenoid operation. A HIGH is also routed through inverter U14E/F to illuminate the local and remote fast forward indicators. A LOW logic command is applied to OR gate U22D. U22D gates a LOW from U23A and a LOW from the start logic to output a LOW fast forward command to the motor control circuit board. A LOW is also applied to the stop indicator flashing circuit to extinguish the stop indicator. Jumper J304 provides automatic fast forward operation during audio mute conditions.

4-100. END-OF-MESSAGE (EOM) LOGIC. The EOM circuit is designed to initiate a variety of control operations at the end of a tape cartridge message. The EOM circuit consists of four logic gates and a end-of-tone detector.

4-101. EOM circuit operation is initiated by a secondary or tertiary cue tone. Jumper J305 dedicates either the secondary or tertiary cue tone for EOM operation. When the selected cue tone is detected, a HIGH is applied through jumper J305 to inverter U13A. U13A will output a LOW to inverter U19D and to end-of-tone detector U23B. U19C gates a HIGH from U19D and a HIGH from the remote audio mute line to output a LOW to OR gate U22B. At the end of the pulse from U13A, end-of-tone detector U23B will output a HIGH to tape time display freeze jumper J306 and to U22B. J306 determines if the tape time display is frozen at the beginning or the end of the EOM tone. U22B gates a HIGH from U23B and a LOW from U19C to output a HIGH to U21C to enable the mute logic.

4-102. TAPE TIME DISPLAY FREEZE LOGIC. The tape time display freeze logic consists of OR gate U22C and latch U25D. At the beginning or end of the EOM tone, the EOM circuit will output a HIGH to tape time display freeze latch U25D. U25D will output a HIGH to freeze the tape time display. When the fast forward or start switch/indicators are depressed, U22C will route a HIGH to latch U25D. U25D will respond by routing a LOW to enable the tape time display.

4-103. TAPE TIME DISPLAY RESET LOGIC. The tape time display reset logic consists of NAND gate U18B and jumper J309. The logic will output a LOW to reset the tape time display on start commands.

4-104. MUTE LOGIC. The mute logic controls the operation of the muting circuits on the audio module. When the end of a message is detected by the EOM circuit or when the remote audio mute command goes LOW, U21C will output a HIGH to mute latch U25C. The output of U25C will go LOW. U21D gates a LOW from U25C and a LOW from the tape time display logic to output a LOW audio mute command. The LOW from U21D is inverted by U15A to extinguish the front-panel audio indicator. A LOW from U25C is also applied through inverter U13E to provide a HIGH disable command to the cue circuitry.

4-105. CUE CIRCUIT. The cue circuit is designed to amplify and decode all cue channel information. The cue circuit consists of: 1) a preamplifier and equalization stage, 2) a cue filter hybrid, 3) individual primary, secondary, and tertiary cue tone detectors, and 4) an FSK decoder.

4-106. Cue Audio Amplifier Circuit. Cue audio information from the tape head is applied to amplifier stage U1A. U1A is configured for a gain of approximately 30 dB. The output of amplifier U1A is routed to operational amplifier U1B which is configured as an equalization stage. Potentiometer R10 provides cue audio level control. The output of U1B is routed for application to the cue filter hybrid.

4-107. Cue Filter Hybrid. All cue channel information is processed by cue filter hybrid H310. H310 consists of a reference processing circuit and individual 1 kHz, 3.5 kHz, 8 kHz and 150 Hz bandpass filters. The hybrid will filter all applied primary, secondary, and tertiary cue tone information into corresponding dc levels for application the detector circuits. FSK information is filtered and routed to the FSK decoder. The hybrid also generates one Hz reference pulses for application to the tape time display.

4-108. A reference for cue filter hybrid H310 is provided by programmable divider U2. Motor tachometer pulses are routed through divider U2 and motor speed select jumper W3 to output a constant 300 Hz reference for cue filter operations.

4-109. Primary, Secondary, And Tertiary Comparator Circuits. Primary, secondary, and tertiary cue tone information from cue filter hybrid H310 is routed to primary cue tone comparator U12C, secondary cue tone comparator U12D, and tertiary cue tone comparator U12B. When the primary cue tone output from H310 increases above the reference at U12C, the output of comparator U12C will go HIGH. The HIGH is applied to the primary cue tone status line and will illuminate primary indicator DS1 by enabling transistor Q1.

4-110. When the secondary cue tone output from H310 increases above the reference at U12D, the output of comparator U12D will go HIGH. The HIGH is applied to the secondary cue tone status line and to inverter U15D/E. U15D/E will output a LOW to illuminate the local and remote indicators and to energize secondary cue tone relay K2. Tertiary cue tone comparator U12B operates in an identical manner.

4-111. Frequency-Shift-Keying (FSK) Decoder Circuit. The FSK decoder consists of PLL decoder U10, comparator U11A, and detector U11B. FSK information is binary data which frequency modulates a carrier. In broadcast applications, the carrier frequency is 3500 Hz. Binary 1 data will shift the carrier to 3650 Hz (space frequency). Binary Ø data will shift the carrier to 3350 Hz (mark frequency).

4-112. The FSK information from cue filter hybrid H310 is applied to PLL decoder U10 and carrier detector U11B. Decoder U10 locks to the FSK carrier frequency and generates a corresponding dc output as the carrier shifts to the mark and space frequencies. The output of decoder U10 is applied to comparator U11A which processes the data into an RS-232 format. Potentiometer R45 provides FSK decoder circuit center frequency calibration. The decoder circuit will be disabled if the unit is operated in the vari-speed mode, fast forward, or when the audio is muted.

4-113. Operational amplifier U11B operates as a carrier detector. If information from cue filter hybrid H310 is present, U11B will output a HIGH to the carrier present status line. The HIGH is also inverted at U14G to illuminate the local and remote data indicator.

4-114. POWER SUPPLY. Operating potentials for logic module components are generated by a voltage regulator circuit. A +22V supply is regulated into a +12 volt dc operating potential by regulator U29. A -22V supply is regulated into a -12 volt dc potential by regulator U30.

4-115. MOTHERBOARD.

4-116. The PT-90 motherboard provides all cartridge machine internal circuit communication. The motherboard assembly also distributes audio, elevated level tape sensor information, and deck status information to the proper circuit board assemblies.

4-117. FRONT PANEL DISPLAY CIRCUIT BOARD.

4-118. The front panel display circuit board houses the phase correction display, the optional tape time display, and the AUD, SEC, TER, DATA, VARI, and SVO indicators. The circuit board also contains the associated display driver and control networks.

4-119. PHASE CORRECTION DISPLAY. A varying dc control voltage input from the phase correction display driver circuit on the audio module is applied to integrated circuit U1. U1 is a dot/bar display driver which controls the operation of phase correction display DS7. DS7 is a ten-segment LED display operated in a moving bar format. Driver U1 evaluates the applied input voltage and illuminates the correct segments of the display.

4-120. OPTIONAL TAPE TIME DISPLAY. The tape time display is controlled by logic circuitry on the logic module. Tape time display freeze/count control, one Hz reference signals, and reset control information is applied to integrated circuit U2. U2 is a four-digit up/down counter and display driver. U2 processes the applied control information and generates the appropriate output commands to operate four digit seven segment tape time display DS8.

4-121. AUD, SEC, TER, DATA, VARI, AND SVO INDICATORS. The AUD, SEC, TER, DATA, VARI, and SVO indicators provide status information on various cartridge machine operating parameters. LOW control commands from the logic circuit board will be applied to illuminate the appropriate indicator as required. The following list presents a description and reference designator of each indicator.

INDICATOR	REFERENCE DESIGNATOR	DESCRIPTION
AUD	DS1	AUDIO INDICATOR
SEC	DS2	SECONDARY CUE TONE INDICATOR
TER	DS3	TERTIARY CUE TONE INDICATOR
DATA	DS4	DATA INDICATOR
VARI	DS5	VARI-SPEED MODE INDICATOR
SVO	DS6	SERVO MOTOR INDICATOR

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 9000 series cartridge machines.

5-3. SAFETY CONSIDERATIONS.

5-4. Low voltages are used throughout 9000 series cartridge machine audio, logic, front panel display, and motor control circuit board assemblies. Maintenance with power energized is always considered hazardous and caution should be observed. Good judgment, 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 CARTRIDGE MACHINE PRIMARY POWER BEFORE ATTEMPTING ANY EQUIPMENT
WARNING MAINTENANCE.

5-7. GENERAL.

5-8. Periodically remove abrasions from the cartridge machine chassis with a cloth moistened with a mild household cleaner. Remove dust from the chassis exterior with a brush and vacuum cleaner as required.

5-9. ELECTRICAL.

5-10. The cartridge machine circuitry should be periodically cleaned of accumulated dust using a brush and vacuum cleaner. Check the circuit boards for improperly seated semiconductors and components damaged by overheating.

5-11. MECHANICAL.

WARNING
WARNING
WARNING

MOST SOLVENTS WHICH REMOVE TAPE RESIDUE ARE VOLATILE AND TOXIC BY NATURE AND MUST BE APPLIED IN SMALL AMOUNTS IN A WELL VENTILATED AREA. OBSERVE THE SOLVENT CONTAINER SAFETY INFORMATION AND DO NOT USE THE SOLVENT NEAR FLAME, CIGARETTES, AND HOT SOLDERING IRONS.

5-12. Each day clean the heads, tape guides, pressure roller, and capstan shaft with a suitable cleaning solution to remove accumulated oxide. The pressure roller and capstan shaft may be cleaned utilizing the maintenance mode (refer to MAINTENANCE MODE OPERATION in SECTION III).

5-13. Approximately once a week, demagnetize the heads and other ferrous components in the tape path. Perform the demagnetizing with an appropriate degausser. Observe the degausser operating instructions to prevent damage to the heads.

5-14. TAPE CARTRIDGES.

5-15. Regularly inspect the tape cartridges for accumulated dust, mechanical defects, and tape wear. Additional tape cartridge maintenance information is presented in SECTION VIII, APPENDIX.

5-16. SECOND LEVEL MAINTENANCE.

5-17. Second level maintenance consists of procedures required to restore a 9000 series cartridge machine to operation after a fault has occurred. The procedures are divided into mechanical adjustments, electrical adjustments, mechanical components replacement procedures, electrical component replacement procedures, and troubleshooting.

5-18. The 9000 series cartridge machine maintenance philosophy consists of isolating a problem to a specific assembly with subsequent troubleshooting to isolate defective components. The defective components may be repaired locally or the entire assembly may be returned to Broadcast Electronics, Inc. for repair or replacement.

5-19. MECHANICAL ADJUSTMENTS.

5-20. The following text provides adjustment procedures for mechanical components associated with the 9000 series cartridge machines. The procedures are presented in the following order.

ADJUSTMENT PROCEDURES

A. Motor Alignment Procedure.

B. Solenoid Response Adjustment.

C. Head Adjustments.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING

5-21. The following test equipment is required for the mechanical adjustment procedures. Refer to the following list as required for each procedure.

TEST EQUIPMENT

A. Calibrated Oscilloscope, 5 MHz Bandwidth, Dual Channel With Lissajous Display of Inputs.

B. Tape Head, Tape Guide, and Motor Alignment Gauge (BE P/N 300-0002).

C. Motor Alignment Gauge (BE P/N 300-0700).

D. Allen Wrenches (supplied with the Cartridge Machine).

E. Tape Alignment Cut-Away Test Cartridge (BE P/N 710-0132).

F. Monophonic/Stereophonic Reproduce Alignment Tape (BE P/N 800-1005).

G. No. 1 Phillips Screwdriver, 4 Inch (10.2 cm) Blade.

5-22. MOTOR ALIGNMENT PROCEDURE. The deck pressure roller operates in conjunction with the motor capstan shaft to provide tape movement. The pressure roller and the motor capstan shaft must be properly aligned to prevent improper tape movement across the heads.

5-23. Procedure. To align the cartridge machine motor and deck solenoid, proceed as follows:

5-24. Disconnect the cartridge machine primary power.

5-25. Manually retract the deck solenoid plunger (refer to Figure 5-1) and remove the pressure roller E-ring, pressure roller, and the nylon washers.

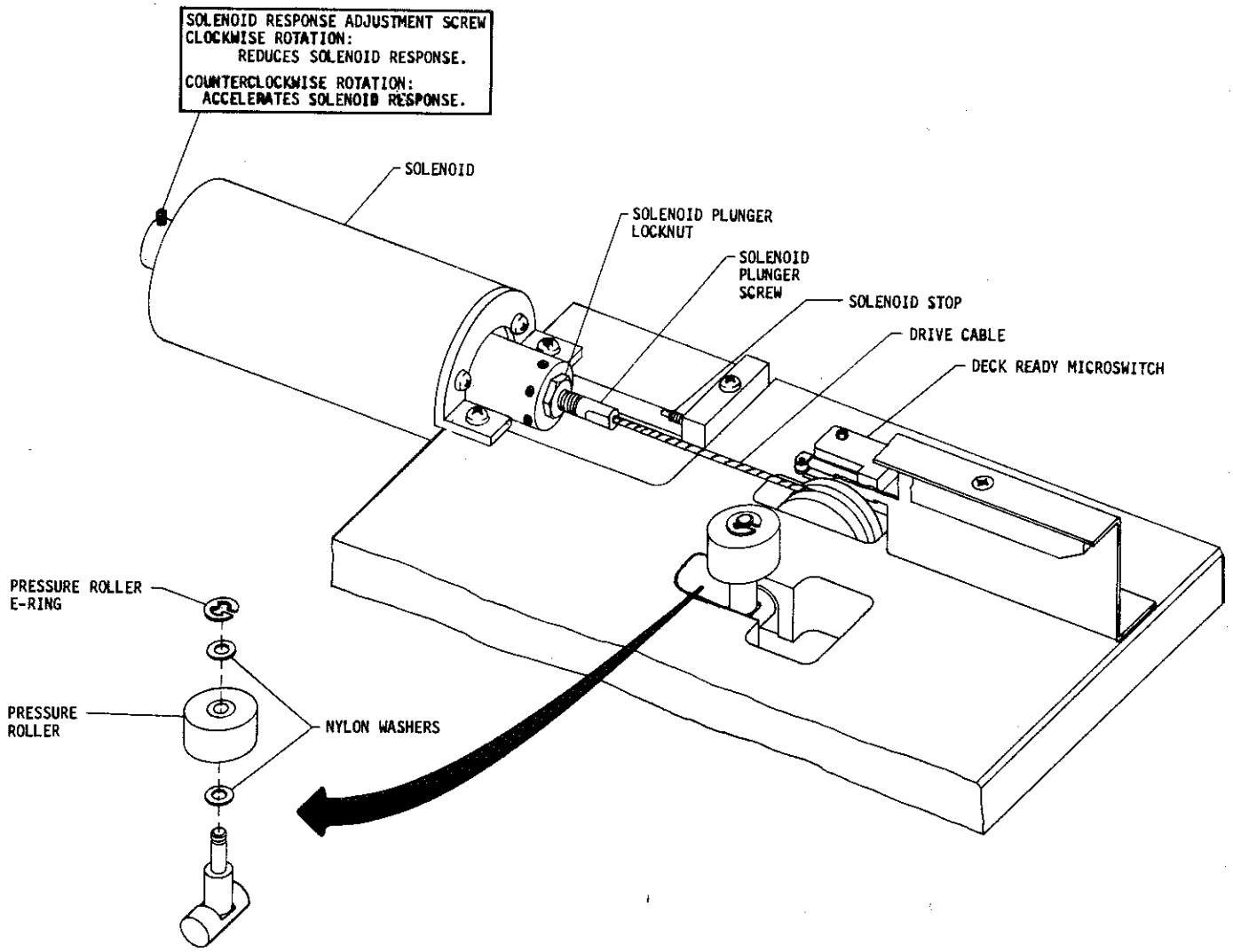
5-26. Refer to Figure 5-2 and loosen the two motor mounting screws to allow movement of the motor assembly.

5-27. Refer to Figure 5-3A and place either tape head, tape guide, and motor alignment gauge 300-0002 or motor alignment gauge 300-0700 on the deck pressure roller shaft.

5-28. Refer to Figure 5-3A and move the motor assembly until the capstan shaft is tangent with the alignment gauge.

5-29. Secure the two motor mounting screws. Secure the screws alternately to ensure correct motor alignment.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING



597-9000-30

FIGURE 5-1. CARTRIDGE DECK ASSEMBLY

5-30. Refer to Figure 5-3B and adjust the solenoid plunger stroke as follows:

A. Loosen the solenoid plunger locknut.

B. Rotate the solenoid plunger clockwise or counter-clockwise as required until the plunger front-surface is aligned with the solenoid bracket.

C. Secure the solenoid plunger locknut.

5-31. Remove the alignment gauge.

5-32. Refer to Figure 5-1 and re-install the pressure roller, the nylon washers, and the pressure roller E-ring.

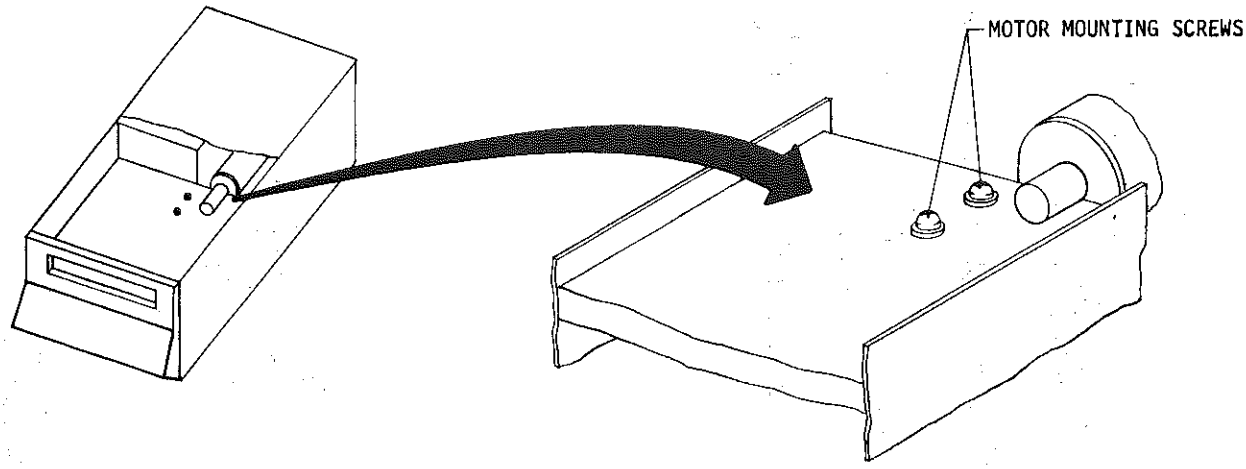


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FIGURE 5-2. MOTOR MOUNTING SCREWS

5-33. Refer to Figure 5-1 and adjust the solenoid plunger stop until the pressure roller is just below the deck surface when the solenoid is deenergized.

5-34. Fine adjust the solenoid plunger stroke by referring to Figure 5-4 and adjusting the solenoid plunger as required to obtain the correct pressure roller/capstan shaft alignment.

5-35. SOLENOID RESPONSE ADJUSTMENT. The solenoid is equipped with a control to adjust the response of the plunger. The control adjusts the rate of air movement through a relief valve to establish the response of the plunger and the level of noise generated. The control is factory adjusted for a compromise between response and noise level. Generally, the solenoid response will not require adjustment. However, the response may be adjusted to obtain any individual requirements. The solenoid response is adjusted as follows.

5-36. Procedure. To adjust the solenoid response, proceed as follows:

5-37. Disconnect the cartridge machine primary power.

5-38. Refer to Figure 5-9C and adjust solenoid response control AIR DAMP ADJ clockwise 1/4 of a revolution to reduce the response and decrease the noise level of the solenoid. Adjust the solenoid response control counterclockwise 1/4 of a revolution to accelerate the response and increase the noise level of the solenoid.

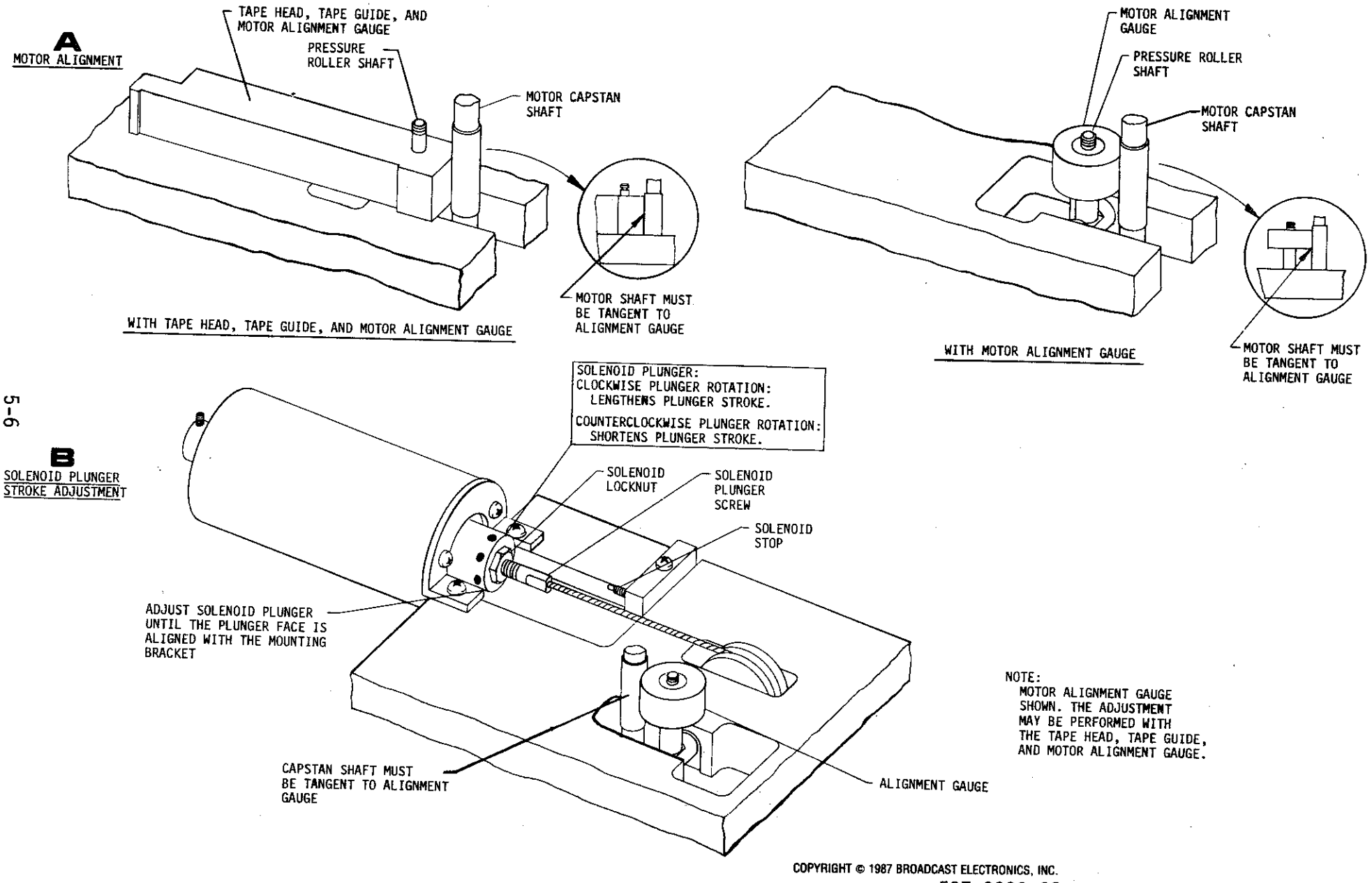

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FIGURE 5-3. MOTOR ALIGNMENT

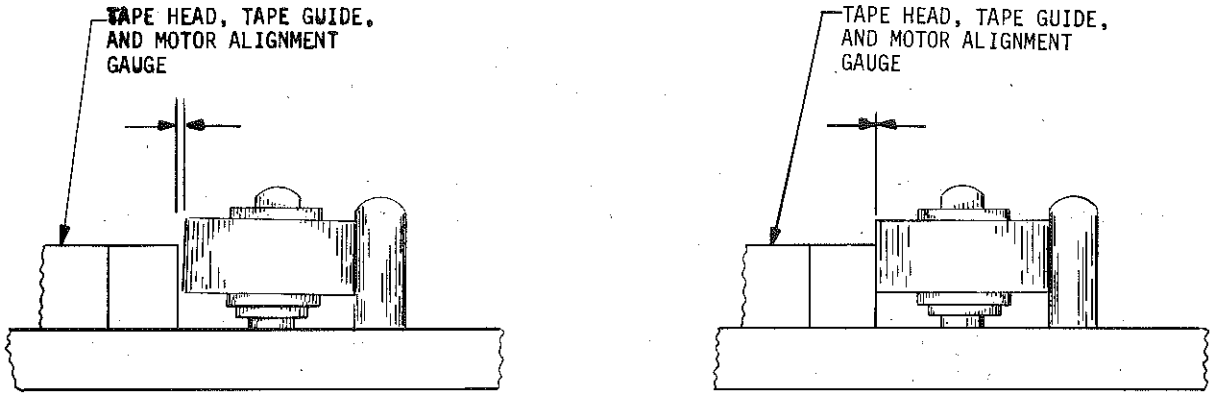

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FIGURE 5-4. CAPSTAN SHAFT/PRESSURE ROLLER ALIGNMENT

5-39. Perform an operational test to ensure the deck performs as desired. If required, repeat the procedure to obtain the desired results.

CAUTION TO PREVENT DAMAGE TO THE PHASE LOK V HEAD ASSEMBLY, PERFORM ALL HEAD ASSEMBLY ADJUSTMENTS USING THE ALLEN WRENCH PROVIDED WITH THE UNIT.

CAUTION

5-40. HEAD ADJUSTMENTS. The head adjustments involve the alignment of the tape guide height, head height, head zenith, head azimuth, and head phase response parameters. The head parameters are presented as individual adjustment procedures. Due to the design of the PHASE LOK V head bracket, only head azimuth and the related electrical parameters will require periodic adjustment (example: prior to extensive continuous operation). The following list presents the procedures required for periodic maintenance. When a replacement head is installed, all head adjustment procedures must be performed (refer to the HEAD REPLACEMENT PROCEDURE specific replacement information).

5

PERIODIC PLAYBACK HEAD ADJUSTMENT PROCEDURES

MONOPHONIC CARTRIDGE MACHINES

A. The Playback Head Azimuth Adjustment Procedure.

B. The Playback Equalization Procedure.

STEREOPHONIC CARTRIDGE MACHINES

A. The Playback Head Azimuth Procedure.

B. The Playback Phase Response Adjustment Procedure.

C. The Playback Equalization Procedure.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING

5-41. The following text presents adjustment procedures for the playback and dummy heads. Align the playback head before adjusting the dummy head.

5-42. An adjustment tool (located in the Accessory Parts Kit) is provided with the unit for head assembly alignment. Perform all head alignments using the adjustment tool.

5-43. Tape Guide Height Adjustment Procedure. To ensure proper tape movement, perform the height adjustment procedure for each tape guide. To adjust the tape guide height, proceed as follows:

5-44. Refer to Figure 5-5A and check the tape guide height. The inside edge of the upper tape guide must be aligned with the T-end of the alignment gauge.

5-45. If adjustment is required, refer to Figure 5-6 and loosen the tape guide adjustment screws.

5-46. Adjust the tape guide to obtain proper alignment.

5-47. Secure the tape guide adjustment screws.

5-48. Head Height Adjustment Procedure. To adjust the playback or dummy head height, proceed as follows:

5-49. Refer to Figure 5-5B and check the playback head height. The head upper pole must be aligned with the top of the alignment gauge.

5-50. Insert the tape alignment cut-away test cartridge into the cartridge deck and begin deck operation to visually inspect the tape movement across the heads. The magnetic tape must cover the top and bottom of the head poles (refer to Figure 5-7).

5-51. If adjustment is required, refer to Figure 5-6 and loosen the appropriate head height/zenith lock-screw.

5-52. Refer to Figure 5-6 and adjust the appropriate front and rear head height/zenith adjustment screws as required to obtain the proper head height. The height/zenith screws must be adjusted equally to retain the zenith adjustment.

5-53. Secure the head height/zenith lock-screw.

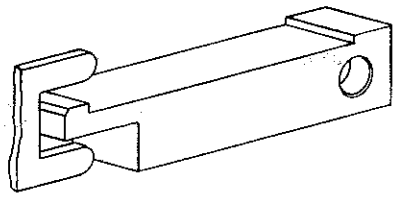
5-54. For playback only cartridge machines, the top of the dummy head must be aligned with the top of the playback head. Visually check the height of the dummy head. If required adjust the dummy head height as required. Refer to Figure 5-6 for the location of the dummy head height/zenith adjustment screws.

5-55. Head Zenith Adjustment Procedure. To adjust the playback or dummy head zenith, proceed as follows:

A

TAPE GUIDE ADJUSTMENT

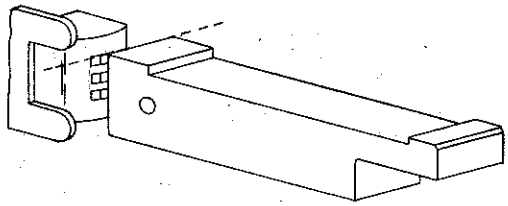
THE INSIDE EDGE OF UPPER TAPE GUIDE MUST BE ALIGNED WITH THE T-END OF ALIGNMENT GAUGE.



B

HEAD HEIGHT ADJUSTMENT

THE UPPER HEAD POLE MUST BE ALIGNED WITH THE TOP OF THE ALIGNMENT GAUGE.



C

ZENITH ADJUSTMENT

THE HEAD MUST BE PERPENDICULAR TO DECK SURFACE.

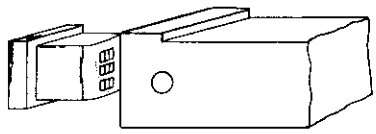


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FIGURE 5-5. HEAD AND TAPE GUIDE ADJUSTMENTS

5-56. Refer to Figure 5-5C and check the playback head zenith. The head must be perpendicular to the deck surface.

5-57. If adjustment is required, refer to Figure 5-6 and loosen the appropriate head height/zenith lock-screw.

5-58. Refer to Figure 5-6 and adjust the appropriate head front or rear height/zenith screw to obtain the proper alignment.

5-59. Refer to the Head Height Adjustment Procedure and check the head height. If required, re-adjust the head height.

5-60. Repeat the procedure until the head zenith and head height are properly adjusted.

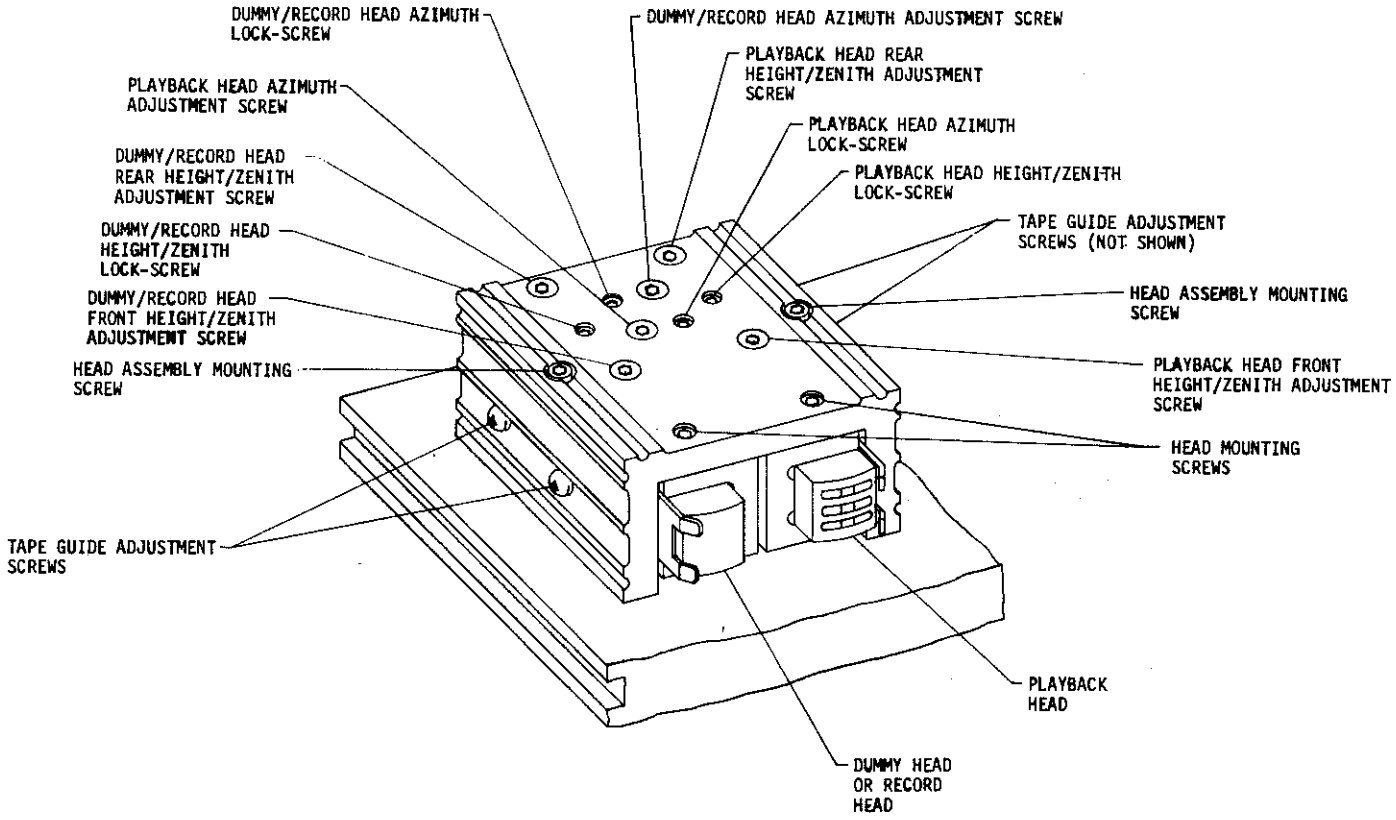

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FIGURE 5-6. HEAD ADJUSTMENT CONTROLS

5-61. Secure the head height/zenith lock-screw.

5-62. For playback only cartridge machines, repeat the procedure for the dummy head. Refer to Figure 5-6 for the location of the dummy head height/zenith adjustment screws.

5-63. Playback Head Azimuth Adjustment Procedure. To adjust the playback head azimuth, proceed as follows:

5-64. Disconnect the cartridge machine primary power.

5-65. Demagnetize the playback head, the dummy head, and all surrounding ferrous components.

5-66. Refer to the OUTPUT LEVEL ADJUSTMENT procedure (located in the ELECTRICAL ADJUSTMENT procedures) and calibrate the cartridge deck for the desired output level.

5-67. Refer to Figure 2-3 and disable the phase correction circuitry.

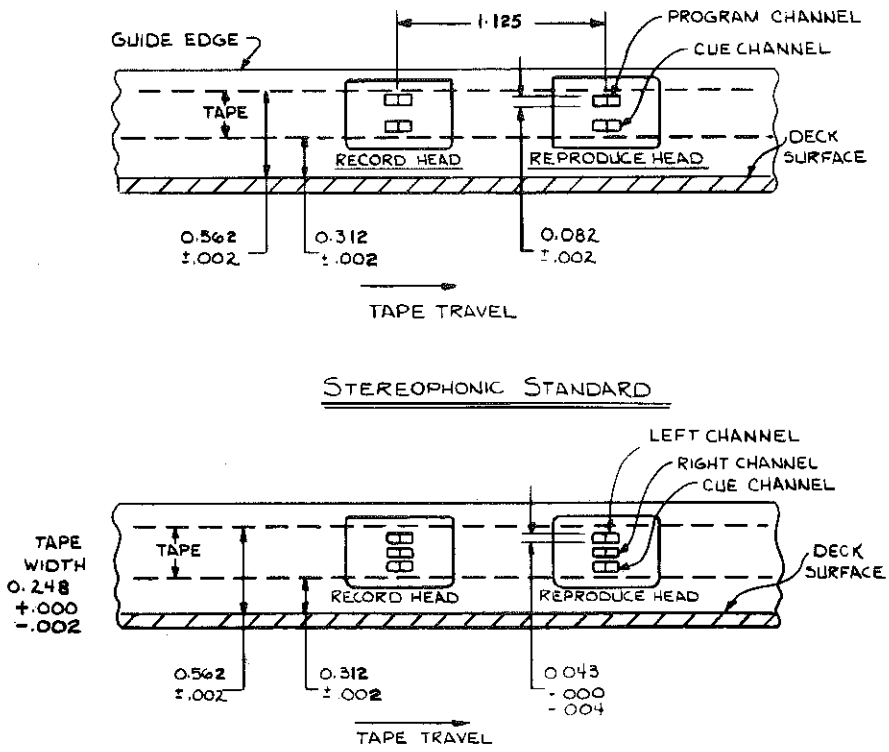

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FIGURE 5-7. HEIGHT CARTRIDGE TAPE TRACKING

5-68. Refer to Figure 2-4 and connect the oscilloscope to cartridge deck left channel output receptacle J405.

5-69. Refer to Figure 5-6 and loosen the playback head azimuth lock-screw.

5-70. Apply power to the cartridge machine.

5-71. Insert the reproduce alignment test tape into the cartridge deck and reproduce the 12.5 kHz test tone.

5-72. Refer to Figure 5-6 and adjust the playback head azimuth screw for a maximum peak-to-peak voltage indication.

5-73. Secure the playback head azimuth lock-screw.

5-74. Disconnect power from the cartridge machine and remove the test equipment.

5-75. Playback Head Phase Response Adjustment Procedure (For Stereophonic Cartridge Machines Only). The phase adjustment involves the fine alignment of the playback head azimuth for maximum phase response. To adjust the playback head phase response, proceed as follows:

5-76. Disconnect the cartridge machine primary power.

5-77. Demagnetize the playback head, the dummy head, and all surrounding ferrous components.

5-78. Refer to the OUTPUT LEVEL ADJUSTMENT procedure (located in the ELECTRICAL ADJUSTMENT procedures) and calibrate the cartridge deck for the desired output level.

5-79. Refer to Figure 2-3 and disable the phase correction circuitry.

5-80. Refer to Figure 2-4 and connect an oscilloscope to output receptacles J405 and J406 as shown in Figure 5-8.

5-81. Refer to Figure 5-6 and loosen the playback head azimuth lock-screw.

5-82. Apply power to the cartridge machine.

5-83. Operate the oscilloscope for lissajous display of inputs.

5-84. Insert the reproduce alignment test tape into the cartridge deck and reproduce the 12.5 kHz test tone.

5-85. Refer to Figure 5-6 and adjust the playback head azimuth screw for a Ø° lissajous pattern (refer to Figure 5-8).

5-86. Secure the playback head azimuth lock-screw.

5-87. Disconnect power from the cartridge machine, remove the test equipment and program the phase correction circuitry as required.

5-88. ELECTRICAL ADJUSTMENTS.

5-89. The following text provides electrical adjustment procedures for all controls associated with the 9000 cartridge machines. The procedures are presented in the following order:

A. Output Level Adjustment.

B. Playback Equalization Adjustment.

C. Phase Bias Adjustment.

D. Phase Distortion Adjustment.

E. Phase Display Adjustment.

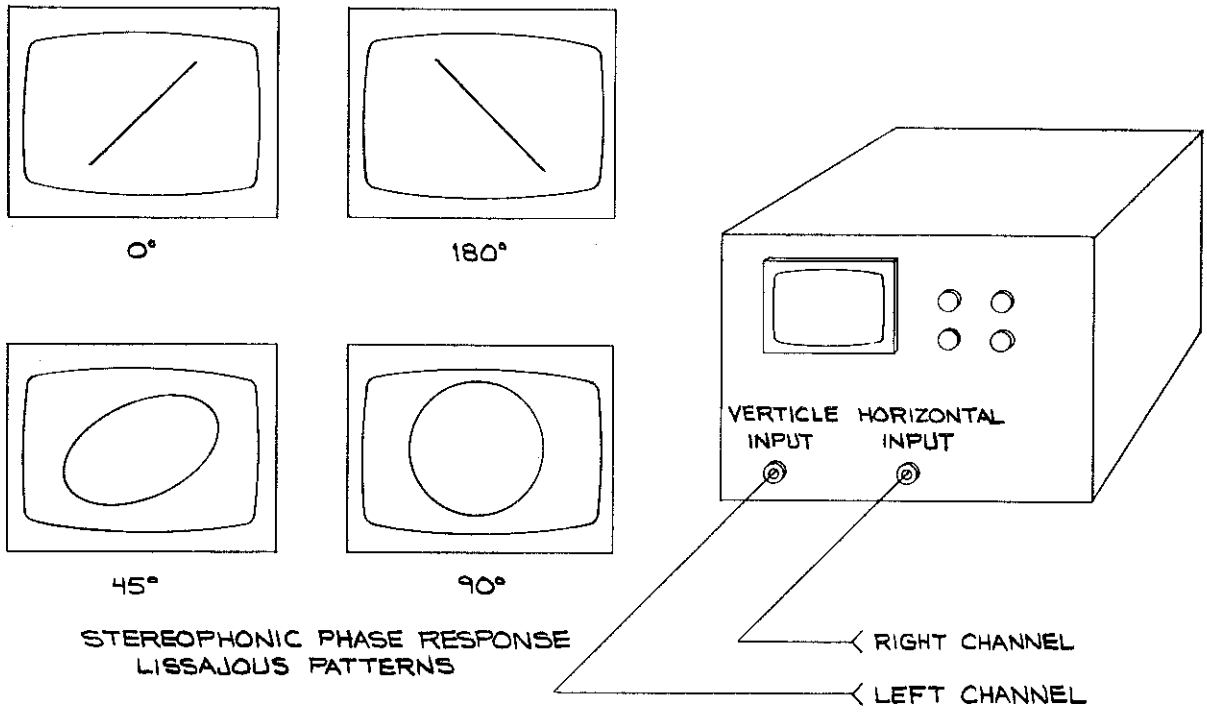

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FIGURE 5-8. STEREOPHONIC PHASE RESPONSE LISSAJOUS PATTERNS

F. Cue Sensitivity Adjustment.

G. FSK Frequency Adjustment.

H. Motor Drive Pulse Adjustment.

I. Solenoid Current Adjustment.

5-90. The following equipment is required for the electrical adjustment procedures:

A. Frequency Counter (HP Model 5381A or equivalent).

B. Calibrated Oscilloscope, 5 MHz Bandwidth, Single Channel.

C. DC Voltmeter.

D. VU Meter (or decibel calibrated voltmeter).

E. Extender Circuit Board (BE P/N 910-9007).

F. Reproduce Alignment Test Tape (BE P/N 800-1005).

G. Insulated Non-Metallic Adjustment Tool.

H. Cue Tone Test Tapes (refer to SECTION I, INTRODUCTION).

5-91. OUTPUT LEVEL ADJUSTMENT. Left channel level control R40 and right channel level control R43 on the audio module adjust the output level of the cartridge machine. The output level control(s) are adjusted as follows.

5-92. Procedure. To adjust the cartridge deck output level, proceed as follows:

5-93. Disconnect the cartridge machine primary power and remove the audio playback module.

5-94. Refer to Figure 2-3 and enable the phase correction circuitry (stereophonic models only).

5-95. Refer to Figure 2-3 and disable the noise reduction circuitry.

5-96. Re-install the audio playback module.

5-97. Refer to Figure 2-4 and connect a VU meter to the left channel output.

5-98. Apply power to the cartridge machine.

5-99. Insert the reproduce alignment test tape into the deck and reproduce the operating level portion of the test tape.

5-100. Refer to Figure 5-9B and adjust LEFT LEVEL control R40 for the desired output level.

5-101. For stereophonic cartridge machines, repeat the procedure for the right channel. Refer to Figure 5-9B and adjust the right channel with RIGHT LEVEL control R43 for the desired level.

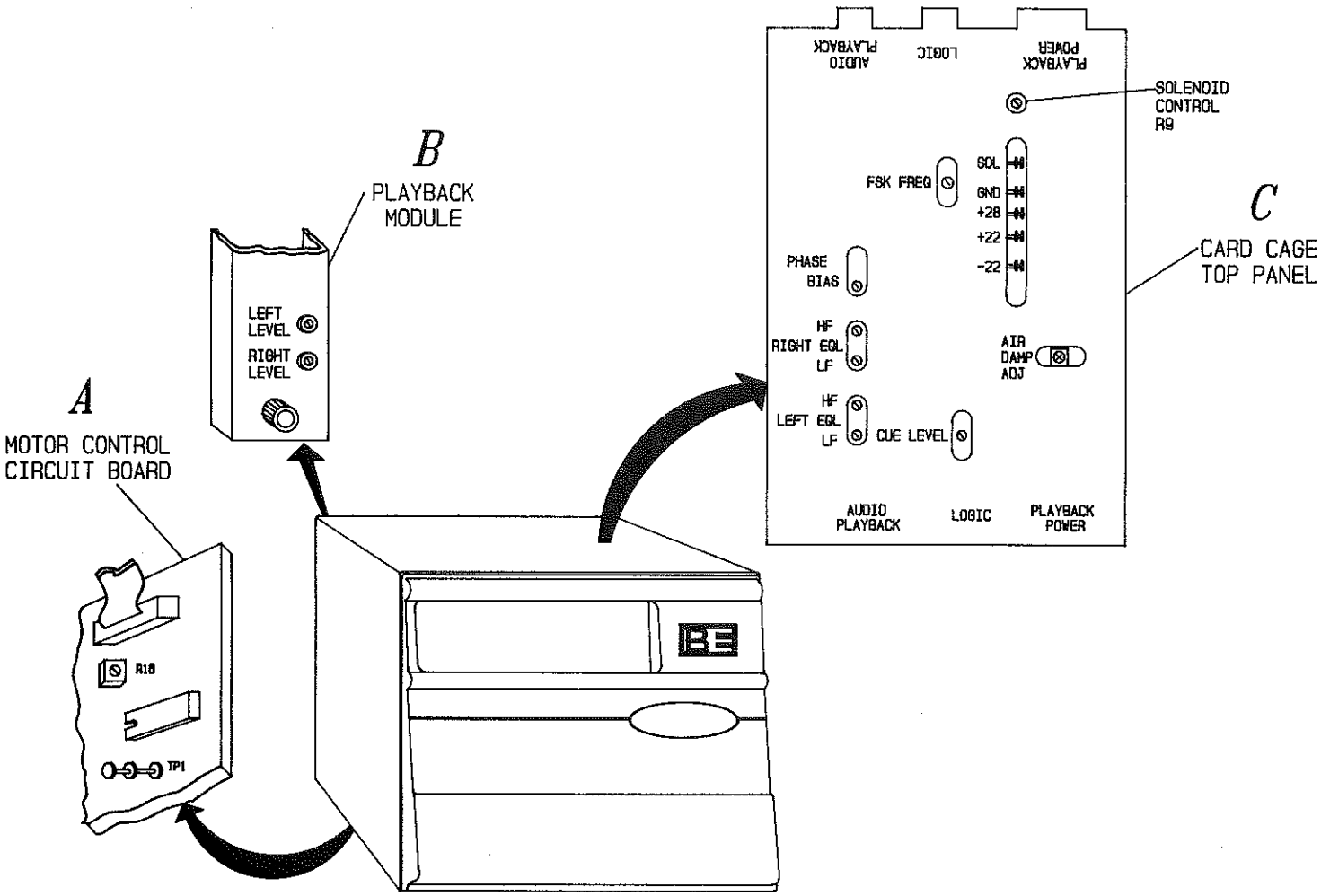
5-102. Disconnect the cartridge machine primary power and remove the test equipment.

5-103. PLAYBACK EQUALIZATION ADJUSTMENT. Equalization controls R6, R11, R13, and R18 on the audio playback circuit board adjust the left channel and right channel playback response. Adjustment of the equalization circuits will not be required unless replacement components are installed in the circuit or the complete audio module is replaced. The playback equalization circuitry is adjusted as follows.

5-104. Procedure. To adjust the equalization controls, proceed as follows:

5-105. Refer to the OUTPUT LEVEL ADJUSTMENT procedure in the preceding text and calibrate the cartridge deck for the desired level.

5-106. Disconnect the cartridge machine primary power and remove the top-panel.



597-9000-38

5

FIGURE 5-9. PLAYBACK, LOGIC, AND MOTOR CONTROL CIRCUIT BOARD CONTROLS

5-107. Refer to Figure 2-3 and disable the noise reduction circuitry.

5-108. Refer to Figure 2-4 and connect a VU meter to the left channel output.

5-109. Insert the reproduce alignment tape and reproduce the test tones portion of the tape.

5-110. At the 50 Hz test tone, adjust LEFT EQL LF control R11 (refer to Figure 5-9C) until the VU meter indicates a level within -1 dB to Ø dB of the reference tone level.

5-111. At the 12.5 kHz test tone, adjust LEFT EQL HF control R6 (refer to Figure 5-9C) until the VU meter indicates the level of the reference tone.

5-112. For stereophonic cartridge machines, repeat the procedure for the right channel. Refer to Figure 5-9C and adjust the right channel equalization with RIGHT EQL LF control R18 and RIGHT EQL HF control R13.

5-113. Disconnect the cartridge machine primary power. Remove the test equipment and replace the top-panel.

5-114. PHASE BIAS ADJUSTMENT. Phase bias control R35 adjusts the phase correction circuitry for a maximum correction range with a minimum offset between the left and right channels. Due to the critical operation of the correction circuitry, phase bias adjustment is not recommended. Therefore, it is suggested the defective audio circuit board be returned to Broadcast Electronics, Inc. for repair or exchange. If shipment to the factory is impractical, contact the Broadcast Electronics Customer Service Department for a recommended adjustment procedure and a list of required equipment.

5-115. PHASE DISTORTION ADJUSTMENT. Potentiometers R29 and R140 on the audio playback circuit board adjust for minimum phase distortion. Due to the critical operation of the circuit, phase distortion adjustment is not recommended. Therefore, it is suggested the defective audio circuit board be returned to Broadcast Electronics, Inc. for repair or exchange. If shipment to the factory is impractical, contact the Broadcast Electronics Customer Service Department for a recommended adjustment procedure and a list of required equipment.

5-116. PHASE DISPLAY ADJUSTMENT. Phase display control R77 on the audio playback circuit board calibrates the phase display. Due to the critical operation of the phase display circuitry, phase display adjustment is not recommended. Therefore, it is suggested the defective audio circuit board be returned to Broadcast Electronics, Inc. for repair or exchange. If shipment to the factory is impractical, contact the Broadcast Electronics Customer Service Department for a recommended adjustment and a list of required equipment.

5-117. CUE SENSITIVITY ADJUSTMENT. Cue level control R10 on the logic circuit board adjusts the threshold level for the primary (1 kHz), secondary (150 Hz), tertiary (8 kHz) cue tone detection circuits, and the FSK decoder circuit. Adjustment of the cue sensitivity circuit will not be required unless replacement parts are installed in the circuit or the complete logic circuit board is replaced. The cue sensitivity circuit is adjusted as follows.

5-118. Procedure. To adjust the cue sensitivity control, proceed as follows:

5-119. Remove the top-panel.

5-120. Insert the 8 kHz reproduce cue tone test tape (recorded at a -6 dB level) into the deck and initiate playback operation.

5-121. Refer to Figure 5-9C and adjust CUE LEVEL control R10 until the TER indicator illuminates (refer to Figure 3-1).

5-122. Insert the 150 Hz reproduce cue tone test tape (recorded at a -6 dB level) into the deck and initiate playback operation.

5-123. Refer to Figure 3-1 and ensure the SEC indicator is illuminated.

5-124. Insert the 1 kHz reproduce cue tone test tape (recorded at a -6 dB level) into the deck and initiate playback operation.

5-125. Ensure deck operation terminates within 3 seconds.

5-126. Insert a pre-recorded FSK encoded tape into the deck and initiate playback operation.

5-127. Refer to Figure 3-1 and ensure the DATA indicator is illuminated.

5-128. Replace the top-panel.

5-129. FSK FREQUENCY ADJUSTMENT. FSK frequency control R45 on the logic circuit board adjusts the operating frequency of the FSK decoder circuit. Adjustment of the circuit is not required unless replacement components are installed in the circuit or the complete logic circuit board is replaced. The FSK decoder circuit is adjusted as follows.

5-130. Procedure. To adjust the FSK frequency control, proceed as follows:

5-131. Refer to the preceding text and perform the CUE SENSITIVITY ADJUSTMENT procedure.

5-132. Disconnect the cartridge machine primary power.

5-133. Remove the logic circuit board and the top-panel.

5-134. Insert the extender circuit board and insert the logic circuit board into the extender circuit board.

5-135. Refer to Figure 5-10 and connect a frequency counter test probe to U10 pin 4.

5-136. Apply power to the cartridge machine.

5-137. Refer to Figure 5-10 and adjust FSK FREQ control R45 until the frequency counter indicates 3.25 kHz.

5-138. Insert a pre-recorded FSK encoded tape into the deck and initiate playback operation.

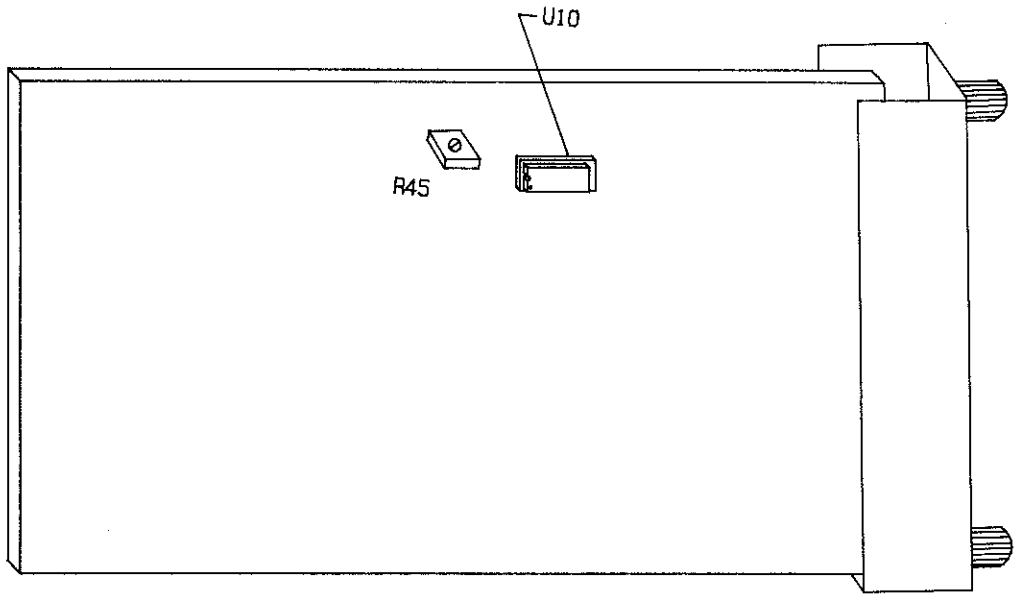


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FIGURE 5-10. LOCATION OF U10 ON THE LOGIC CIRCUIT BOARD

5-139. Refer to Figure 3-1 and ensure the DATA indicator is illuminated.

5-140. Disconnect the cartridge machine primary power.

5-141. Remove all test equipment and replace the logic circuit board and the top-panel.

5-142. MOTOR DRIVE-PULSE ADJUSTMENT. Motor control potentiometer R16 on the motor control circuit board calibrates the duty cycle of the motor drive-pulse. Adjustment of the motor control circuit is not required unless replacement components are installed in the circuit or the complete motor control circuit board is replaced. The motor drive-pulse circuit is adjusted as follows.

5-143. Procedure. To adjust the motor drive-pulse, proceed as follows:

5-144. Disconnect the cartridge machine primary power.

5-145. Remove the top-panel and the bottom-panel that shields the capstan motor.

5-146. Refer to Figure 5-9A and connect an oscilloscope test probe to TP1 on the motor control circuit board. Adjust the oscilloscope as follows:

A. Input: 1 Meg Ohm
B. Mode: Triggered
C. Vertical Sensitivity: 1V/Div
D. Horizontal Rate: 0.5 ms/Div

5-147. Apply power to the cartridge machine.

5-148. Insert a blank tape into the deck and initiate deck operation.

5-149. Refer to Figure 5-9A and adjust motor drive-pulse control R16 for an oscilloscope waveform as presented in Figure 5-11.

5-150. Disconnect the cartridge machine primary power.

5-151. Remove the test equipment and replace the bottom and top panels.

5-152. SOLENOID CURRENT ADJUSTMENT. Solenoid control R9 on the power supply circuit board adjusts the solenoid current. Solenoid current adjustment is not required unless replacement components are installed in the circuit or the complete power supply circuit board is replaced. The solenoid control circuit is adjusted as follows.

5-153. Procedure. To adjust the solenoid current, proceed as follows:

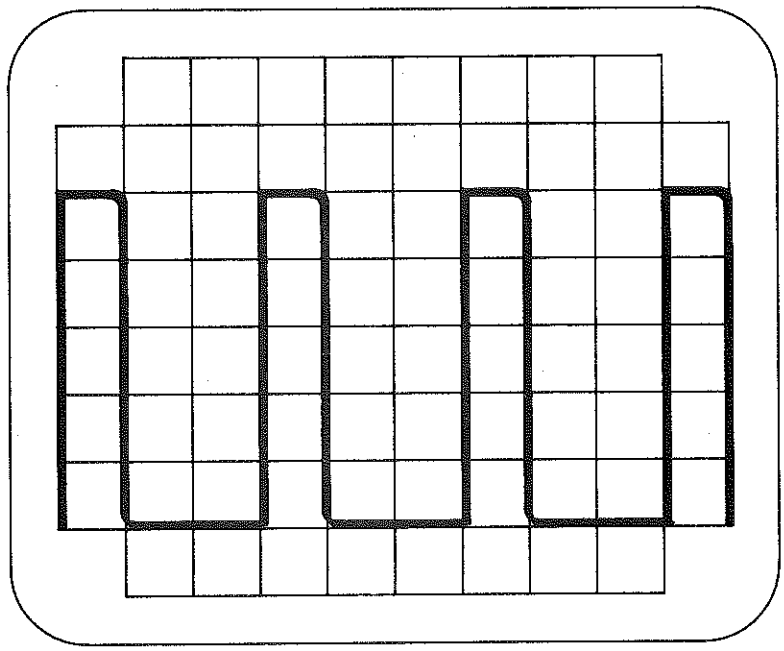

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FIGURE 5-11. MOTOR DRIVE-PULSE DUTY CYCLE

5-154. Disconnect the cartridge machine primary power. Remove the top-panel and allow the solenoid to cool to room temperature.

5-155. Refer to Figure 5-9C and connect a voltmeter between test points TP5 (SOL) and TP4 (GND).

5-156. Apply power to the cartridge machine.

5-157. Insert a blank tape into the deck and initiate deck operation.

5-158. Refer to Figure 5-9C and adjust solenoid control R9 until the voltmeter indicates +12V dc.

5-159. Disconnect the cartridge machine primary power.

5-160. Remove the test equipment and replace the top-panel.

5-161. MECHANICAL PARTS REPLACEMENT PROCEDURES.

5-162. The following text provides mechanical parts replacement procedures. The procedures are presented in the following order.

A. Pressure Roller Replacement.

B. Head Replacement.

C. Motor Replacement.

5-163. The following equipment is required for the replacement procedures. Refer to the list as required for each procedure.

EQUIPMENT

A. No. 1 Phillips Screwdriver, 4 Inch (10.2 cm) Blade.

B. Needle-nose pliers.

C. Allen Wrenches (supplied with the cartridge machine).

5-164. PRESSURE ROLLER REPLACEMENT PROCEDURE. To replace a cartridge deck pressure roller, proceed as follows:

5-165. Disconnect the cartridge machine primary power.

5-166. Refer to Figure 5-1 and manually retract the solenoid plunger.

5-167. Remove the pressure roller E-ring, the pressure roller, and the nylon washers (refer to Figure 5-1).

5-168. Refer to Figure 5-1 and replace the washers, the pressure roller, and the pressure roller E-ring.

5-169. Check the solenoid plunger stroke by performing the plunger adjustment steps described in the MOTOR ALIGNMENT PROCEDURE.

5-170. HEAD REPLACEMENT. To replace a tape head, proceed as follows:

5-171. Disconnect the cartridge machine primary power.

5-172. Loosen the head assembly mounting screws (refer to Figure 5-6) and remove the entire head assembly from the cartridge deck.

5-173. Refer to Figure 5-6 and loosen the defective tape head mounting screw.

5-174. Remove the defective head from the head assembly and disconnect the head leads.

5-175. Refer to Figure 5-12 and connect the head leads to the replacement head.

5-176. Firmly seat the replacement head into the head assembly and secure the mounting screw.

5-177. Replace the head assembly and secure the mounting screws.

5-178. Align the head by performing all the HEAD ADJUSTMENTS and associated ELECTRICAL ADJUSTMENT procedures.

5-179. MOTOR REPLACEMENT. To replace the cartridge machine motor, proceed as follows:

5-180. Disconnect the cartridge machine primary power.

5-181. Remove the cartridge machine top-panel and bottom-panel.

5-182. Place the cartridge machine on a side-panel.

5-183. Refer to the cartridge machine final assembly diagram in SECTION VII, DRAWINGS and disconnect motor power supply connector P601 from the motor control board (located near the motor).

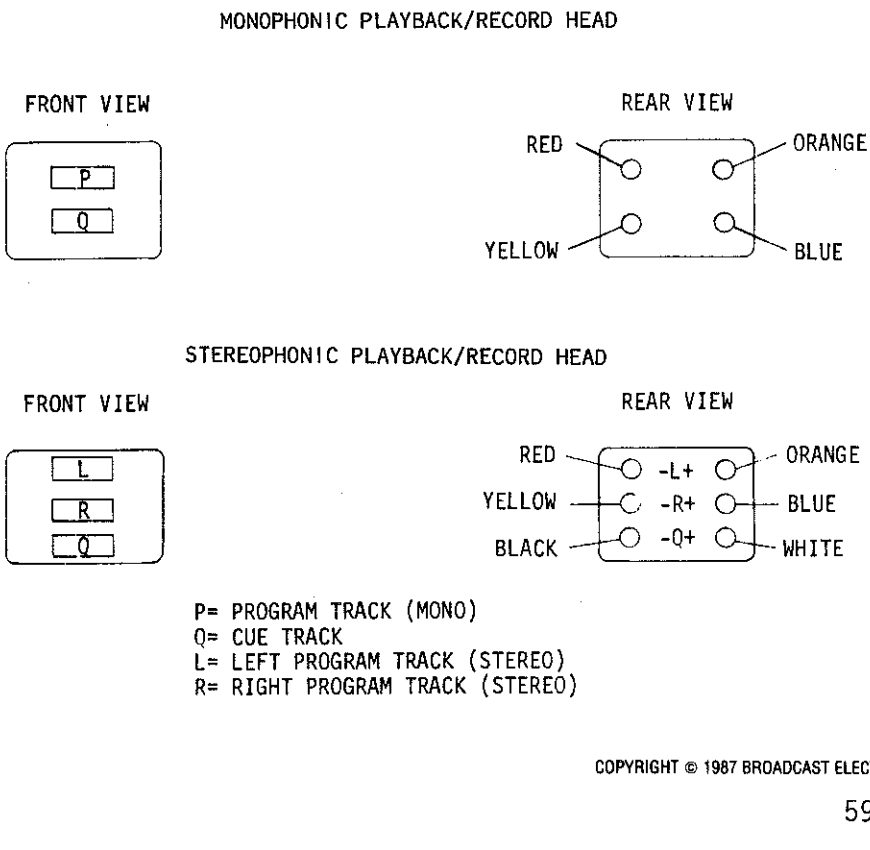
5-184. Refer to Figure 5-2 and locate the motor mounting screws. While supporting the motor, remove the motor mounting screws and carefully remove the motor from the cartridge machine chassis.

CAUTION EXERCISE CARE WHEN HANDLING THE CARTRIDGE MACHINE MOTOR TO AVOID DAMAGING THE BEARINGS.

CAUTION NEVER HANDLE THE MOTOR BY THE CAPSTAN SHAFT.

5-185. Carefully insert the new motor into the cartridge machine chassis and replace the motor mounting screws. Do not tighten the motor mounting screws at this time.

WARNING: DISCONNECT PRIMARY POWER BEFORE SERVICING



597-9000-41

FIGURE 5-12. TAPE HEAD CONFIGURATIONS

5-186. Reconnect motor power supply connector P601 to the motor control circuit board.

5-187. Align the motor by performing the MOTOR ALIGNMENT PROCEDURE described in the preceding text.

5-188. Replace the cartridge machine top-panel and bottom-panel.

5-189. TROUBLESHOOTING.

5-190. Low voltages are used throughout the 9000 series cartridge machine playback and control circuitry. The power supply circuit board assembly contains primary ac line voltage. Therefore, do not perform any maintenance or troubleshooting procedures on the power supply circuit board with power energized. Troubleshooting with power energized is always considered hazardous and caution should be observed. Good judgment, care, and common sense must be practiced to prevent accidents.

5-191. The troubleshooting philosophy for the 9000 series cartridge machines consists of isolating a problem to a specific circuit board. The problem may be isolated by referencing the following information and Table 5-1 which presents the 9000 series cartridge machine troubleshooting.

WARNING DISCONNECT ALL CARTRIDGE MACHINE 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 MAY CAUSE SERIOUS DAMAGE TO THE CARTRIDGE MACHINE.
CAUTION

5-192. Once 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.

WARNING 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 TO ASSURE GOOD HEAT DISSIPATION.
CAUTION

5-193. COMPONENT REPLACEMENT. The circuit boards used in the 9000 cartridge machines are double-sided with plated-through holes. Due to the plated-through hole design, solder fills the holes by capillary action. This condition requires that defective components be removed carefully to avoid damage to the circuit board.

5-194. On all circuit boards, the adhesion between the copper trace and the circuit 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 soldering iron with steady pressure is required for circuit board repairs.

5-195. To remove a soldered component from a circuit board, cut the leads from the body of the defective component while the device is still soldered to the board. Grip a component lead with needle-nose pliers. Touch the soldering iron to the lead at the solder connection on the circuit side of the board. 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 by careful re-heating with a low wattage iron and removing the residual solder with a soldering vacuum tool.

5-196. Install the new component and apply solder from the circuit side of the board. If no damage has been incurred to the plated-through holes, soldering of the component side of the board will not be required.

WARNING MOST SOLVENTS WHICH REMOVE ROSIN FLUX ARE VOLATILE AND TOXIC BY NATURE AND SHOULD BE USED ONLY IN SMALL AMOUNTS IN A WELL VENTILATED AREA AWAY FROM FLAME, CIGARETTES, AND HOT SOLDERING IRONS.

WARNING OBSERVE THE MANUFACTURERS CAUTIONARY INSTRUCTIONS.

5-197. After soldering, remove residual flux with a suitable solvent. Rubbing alcohol is highly diluted and is not effective.

5-198. The board should be checked to ensure the flux has been completely removed. Rosin flux is not normally corrosive, however in time, the flux will absorb enough moisture to become conductive and create problems.

5-199. INTEGRATED CIRCUITS. Special care should be exercised with integrated circuits. Each integrated circuit must be installed by matching the integrated circuit notch with the notch on the socket. Do not attempt to remove an integrated circuit from a socket with your fingers. Use an integrated circuit puller to lightly pry the component from the socket.

TABLE 5-1. PT-90 CARTRIDGE MACHINE TROUBLESHOOTING
(Sheet 1 of 2)

SYMPTOM	DEFECT
NO MOTOR OPERATION	1. Check the cartridge deck status switch. 2. Refer to Table 5-2 and troubleshoot the logic module. 3. Refer to Figure 5-13 and troubleshoot the motor control circuit board. 4. Check the cartridge machine motor.
NO DECK START OPERATION	1. Check front panel start switch/ indicator S1. 2. Refer to Table 5-2 and troubleshoot the logic module. 3. Check integrated circuit IC-1 on the cartridge machine rear panel.

TABLE 5-1. PT-90 CARTRIDGE MACHINE TROUBLESHOOTING
(Sheet 2 of 2)

SYMPTOM	DEFECT
	4. Check transistors Q1 and Q2 on the power supply module.
	5. Check the deck solenoid.
NO DECK TERMINATION, MANUAL	1. Check front panel stop switch/ indicator S2.
	2. Refer to Table 5-2 and troubleshoot the logic module.
NO FAST FORWARD OPERATION	1. Check front panel fast forward switch/indicator S3.
	2. Refer to table 5-2 and troubleshoot the logic module.
NO AUDIO OUTPUT	1. Refer to Figure 5-14 and trouble-shoot the audio module.
NO INTERNAL OPERATIONS (EXAMPLE: EOM, MUTE, CUE TONE ETC.)	1. Refer to Table 5-2 and troubleshoot the logic module.
NO PHASE CORRECTION DISPLAY OPERATION	1. Check integrated circuit U3B on the audio module.
	2. Check integrated circuits U1 and DS7 on the front panel display circuit board.
NO TAPE TIME DISPLAY OPERATION	1. Refer to Table 5-2 and troubleshoot the logic module.
	2. Check integrated circuits U2 and DS8 on the front panel display cir-cuit board.

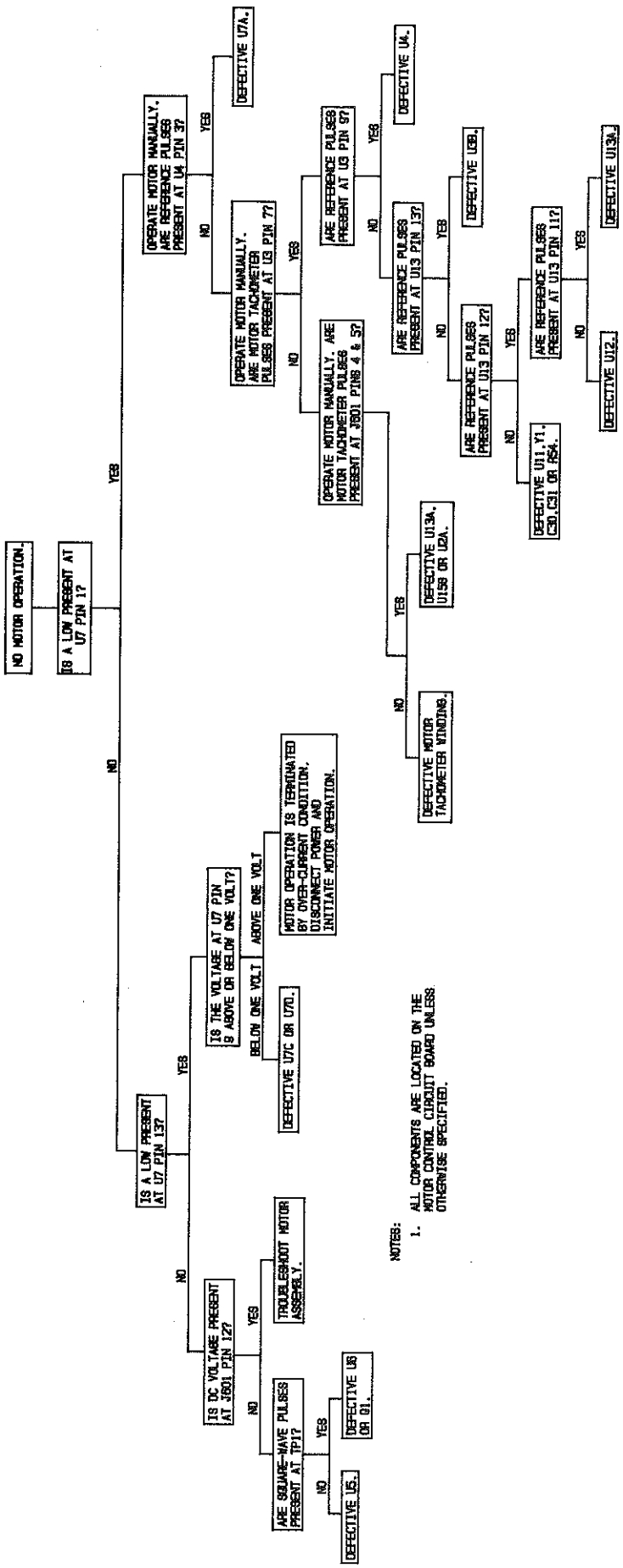
TABLE 5-2. LOGIC MODULE TROUBLESHOOTING.
(Sheet 1 of 2)

SYMPTOM	DEFECT
NO MOTOR OPERATION	1. Check integrated circuits U16A and U17A. 2. Check integrated circuit U12A.
NO DECK START OPERATION	1. Check for a HIGH at motor-at-speed status line P301 pin 14. 2. Check for a LOW at motor over-current status line P301 pin 15. 3. Check integrated circuits U25A, U19A, and U17B.
NO DECK TERMINATION, MANUAL	1. Check integrated circuits U21B and U25A.
NO DECK TERMINATION, PRIMARY CUE TONE	1. Ensure jumper J314 is installed in position 1-2. 2. Check integrated circuits U20C, U21B, and U12C. 3. Check for a LOW at primary cue tone defeat control line P301 pin 7.
NO FAST FORWARD OPERATION	1. Check integrated circuits U23A and U22D.
NO EOM OPERATION	1. Ensure jumper J305 is installed for the correct cue tone. 2. Check integrated circuits U13A, U23B, and U22B.
NO MUTE OPERATION	1. Check integrated circuits U25C and U21D.
TAPE TIME DISPLAY CONTROL PROBLEMS (EXAMPLE: RESET, FREEZE ETC.)	1. Ensure jumper J306 is installed in the correct position for the desired operation. 2. Ensure jumper J309 is installed in the appropriate position for the desired operation.

TABLE 5-2. LOGIC MODULE TROUBLESHOOTING.
(Sheet 2 of 2)

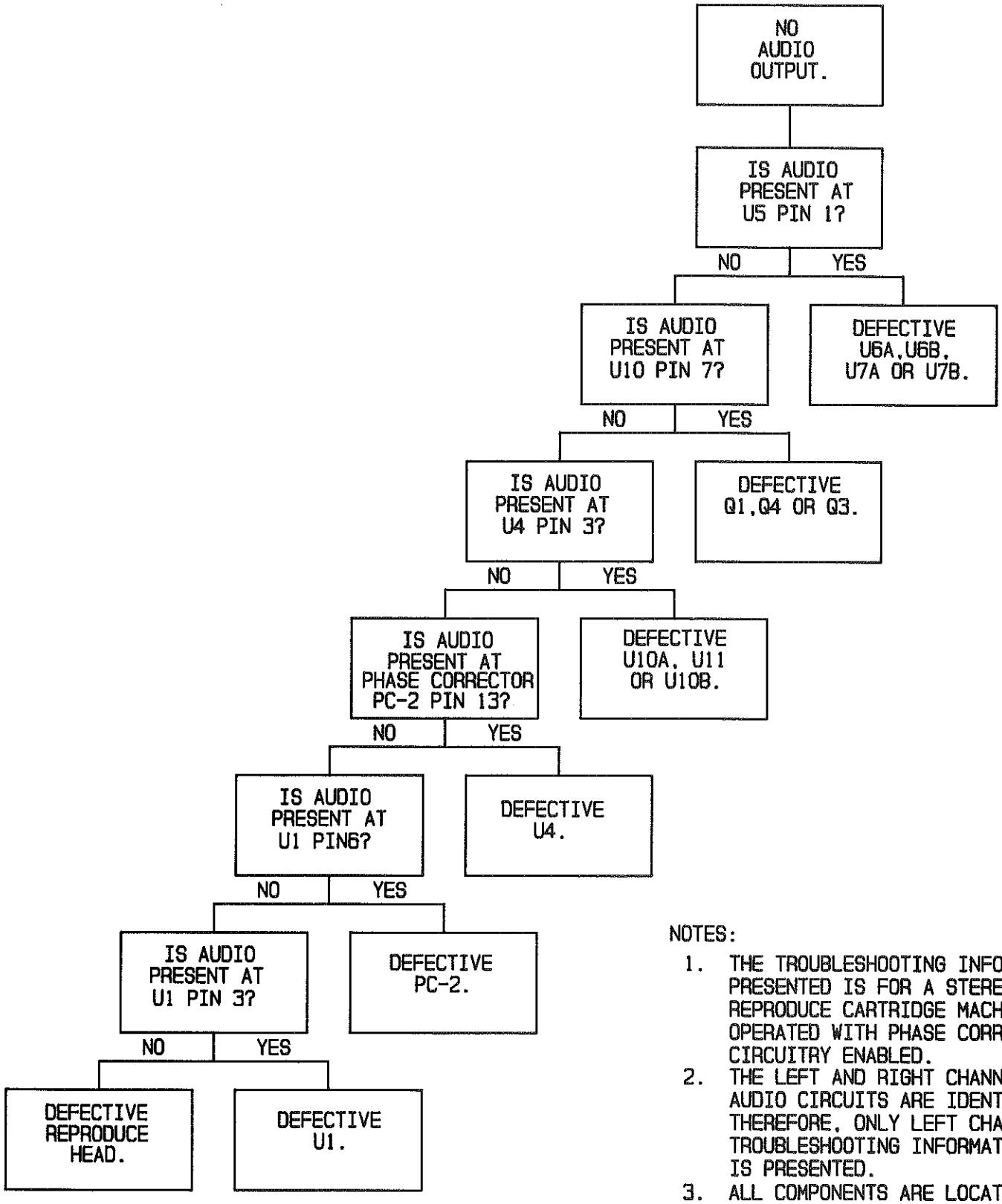
SYMPTOM	DEFECT
	3. Check P301 pin 43 for one Hz pulses. 4. Check integrated circuit U16F.
NO CUE TONE OPERATION (INCLUDES PRIMARY, SECONDARY, TERTIARY, AND FSK.)	1. Ensure jumper W3 is installed in the appropriate position. 2. Check integrated circuit U1.
NO INDIVIDUAL PRIMARY, SECONDARY, OR TERTIARY CUE TONE OPERATION	1. Check cue filter hybrid H310 at the defective cue tone output. Primary — 19 Secondary — 21 Tertiary — 11 2. Check defective cue tone detector. Primary — U12C Secondary — U12D Tertiary — U12B
NO FSK OUTPUT	1. Check cue filter hybrid H310 at pin 13. 2. Check integrated circuits U10 and U11.

5



597-9000-13

FIGURE 5-13. TROUBLESHOOTING TREE, NO MOTOR OPERATION



NOTES:

1. THE TROUBLESHOOTING INFORMATION PRESENTED IS FOR A STEREO PT-90 REPRODUCE CARTRIDGE MACHINE OPERATED WITH PHASE CORRECTION CIRCUITRY ENABLED.
2. THE LEFT AND RIGHT CHANNEL AUDIO CIRCUITS ARE IDENTICAL. THEREFORE, ONLY LEFT CHANNEL TROUBLESHOOTING INFORMATION IS PRESENTED.
3. ALL COMPONENTS ARE LOCATED ON THE AUDIO CIRCUIT BOARD UNLESS OTHERWISE SPECIFIED.

FIGURE 5-13. TROUBLESHOOTING TREE,NO MOTOR OPERATION 597-9000-14

SECTION VI

PARTS LISTS

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 9000 series cartridge machine. Each table entry in this section is indexed by reference designators appearing on the applicable schematic diagram.

TABLE 6-1. REPLACEABLE PARTS LIST INDEX

TABLE 6-2. 9000 CARTRIDGE MACHINE FINAL ASSEMBLIES - 900-9000-000, 900-9002-000

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Head, Dummy, H801016	407-0001	1
----	Head Box Assembly	950-0302	1
----	Accessory Kit	950-0081	1
----	9000 Basic Assembly	950-9000	1
	ADDITIONAL PARTS FOR MONOPHONIC ASSEMBLY 900-9000-000		
----	Head, Playback, Monophonic, 2-Channel, Model NPD1484 Inductance at 1 kHz: 475 mH Impedance at 1 kHz: 3.3 Ohms DC Resistance: 500 Ohms	250-0006	1
----	Monophonic Audio Module Assembly	950-0033	1
	ADDITIONAL PARTS FOR STEREOPHONIC ASSEMBLY 900-9002-000		
----	Head, Playback, Stereophonic, 3-Channel, Model NPD1496 Inductance at 1 kHz: 475 mH Impedance at 1 kHz: 3.3 Ohms DC Resistance: 500 Ohms	250-0007	1
----	Stereophonic Audio Module Assembly	950-0034	1

TABLE 6-3. HEAD BOX ASSEMBLY - 950-0302

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Tape Guide	445-0004	2
----	Spring, Head Box	430-0012	6

TABLE 6-4. ACCESSORY KIT - 950-0081

REF. DES.	DESCRIPTION	PART NO.	QTY.
F1	Fuse, AGC, 1/2A, 250V, Slow-Blow	334-0050	1
----	AC Line Cord, N.E.M.A. 3-Wire North American Plug	682-0001	1
----	Receptacle, Female, 3-Pin, XLR Type	829-4216	2
----	Connector Plug, 25-Pin	417-0251	1
----	Pins	418-0048	25
----	Kit, Cable Clamp Assembly (with spring latch), 25-Pin	418-2501	1
----	Label, Elevated Level (For Cartridges)	594-0093	25

TABLE 6-5. MONOPHONIC/STEREOPHONIC AUDIO MODULE ASSEMBLIES - 950-0033, 950-0034
(Sheet 1 of 5)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C3	Capacitor, Mica, 68 pF ±5%, 500V	040-6813	1
C5	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C6	Capacitor, Mica, 10 pF ±5%, 500V	042-1012	1
C7	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C8	Capacitor, Ceramic, 0.001 uF ±10%, 200V	030-1033	1
C9	Capacitor, Electrolytic, 4.7 uF, 35V	024-4764	1
C10	Capacitor, Electrolytic, 47 uF, 16V	013-4750	1
C17	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C19,C20	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C21	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1

TABLE 6-5. MONOPHONIC/STEREOPHONIC AUDIO MODULE ASSEMBLIES - 950-0033, 950-0034
(Sheet 2 of 5)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C25 THRU C27,C29	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	4
C30,C31	Capacitor, Silvered Mica, 100 pF ±5%, 500V	040-1022	2
C32,C37	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C38	Capacitor, Mica, 22 pF, 500V	040-2213	1
C39,C40	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C45	Capacitor, Electrolytic, 47 uF, 16V	013-4750	1
C47	Capacitor, Silvered Mica, 100 pF ±5%, 500V	040-1022	1
C49	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C51	Capacitor, Mica, 1000 pF ±1%, 100V	041-1031	1
C52	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
C53	Capacitor, Mylar Film, 0.047 uF ±10%, 100V	030-4743	1
C54	Capacitor, Monolythic Ceramic, 0.0047 uF ±5%, 100V	003-4723	1
C55	Capacitor, Silvered Mica, 100 pF ±5%, 500V	040-1022	1
C56 THRU C58	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	3
C59,C60	Capacitor, Electrolytic, 4.7 uF, 35V	024-4764	2
C61,C62	Capacitor, Electrolytic, 10 uF, 35V	023-1076	2
C63,C64	Capacitor, Electrolytic, 4.7 uF, 35V	024-4764	2
C67	Capacitor, Electrolytic, 47 uF, 16V	013-4750	1
C68,C69	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C70	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
C81	Capacitor, Mica, 10 pF ±5%, 500V	042-1012	1
C85	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C88,C89	Capacitor, Electrolytic, 10 uF, 35V	023-1076	2
C90	Capacitor, Mylar Film, 0.022 uF ±10%, 200V	031-2243	1
C92	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
D1	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203-4148	1
J402	Connector, Header, 3-Pin	417-0003	1
J405	Connector, Audio, XLB Series, 3-Pin	418-0049	1
J407,J408	Connector, Header, 3-Pin	417-0003	2
J412	Jack, Phone	417-0150	1
P401	Receptacle, 50-Pin Dual In-line	417-0147	1
P402,P407	Jumper Switch, Programmable, 2-Pin	340-0004	2
Q1	Field Effect Transistor, J271, P-Channel JFET, TO-92 Case	210-0271	1
Q3	Transistor, 2N3904, NPN, Silicon, TO-92 Case	211-3904	1
Q4	Field Effect Transistor, J271, P-Channel JFET, TO-92 Case	210-0271	1
R1	Resistor, 100 Ohm ±5%, 1/4W	100-1033	1
R3	Resistor, 270 k Ohm ±5%, 1/4W	100-2763	1
R5	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R7	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R8	Resistor, 68 k Ohm ±5%, 1/4W	100-6853	1
R9	Resistor, 470 Ohm ±5%, 1/4W	100-4733	1
R10	Resistor, 1.2 k Ohm ±5%, 1/4W	100-1243	1
R11	Potentiometer, 10 k Ohm ±10%, 1/2W	178-1054	1
R19	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R20	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R21	Resistor, 220 k Ohm ±5%, 1/4W	100-2263	1
R22	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R23	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R24	Resistor, 110 k Ohm ±5%, 1/4W	100-1163	1
R25	Resistor, 200 k Ohm ±5%, 1/4W	100-2063	1
R26	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R27	Resistor, 56 k Ohm ±5%, 1/4W	100-5653	1
R32	Resistor, 4.53 k Ohm ±1%, 1/4W	103-4534	1
R38	Resistor, 100 Ohm ±5%, 1/4W	100-1033	1
R40	Potentiometer, 500 k Ohm ±10%, 1/2W	178-5065	1
R41	Resistor, 2.2 k Ohm ±5%, 1/4W	100-2243	1
R42	Resistor, 47 k Ohm ±5%, 1/4W	100-4753	1
R47	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R48	Resistor, 4.7 k Ohm ±5%, 1/4W	100-4743	1
R49,R53, R54,R57, R58	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	5
R61,R62	Resistor, 15 Ohm ±5%, 1/4W	100-1523	2
R63	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R64	Resistor, 5.1 k Ohm ±5%, 1/4W	100-5143	1

TABLE 6-5. MONOPHONIC/STEREOPHONIC AUDIO MODULE ASSEMBLIES - 950-0033, 950-0034
(Sheet 3 of 5)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R65,R66	Resistor, 15 Ohm ±5%, 1/4W	100-1523	2
R73,R74	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	2
R82	Resistor, 46.4 k Ohm ±1%, 1/4W	103-4645	1
R83	Resistor, 34.8 k Ohm ±1%, 1/4W	103-3485	1
R84	Resistor, 221 k Ohm ±1%, 1/4W	103-2216	1
R85	Resistor, 15.4 k Ohm ±1%, 1/4W	103-1551	1
R86	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R87	Resistor, 15.4 k Ohm ±1%, 1/4W	103-1551	1
R88	Resistor, 150 k Ohm ±1%, 1/4W	103-1561	1
R89	Resistor, 4.75 k Ohm ±1%, 1/4W	103-4741	1
R90	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R91,R92	Resistor, 1.5 Meg Ohm ±5%, 1/4W	100-1573	2
R93	Resistor, 46.4 k Ohm ±1%, 1/4W	103-4645	1
R94,R95	Resistor, 1.5 k Ohm ±1%, 1/4W	103-1504	2
R96,R97	Resistor, 124 Ohm ±1%, 1/4W	103-1241	2
R100,R101	Resistor, 665 Ohm ±1%, 1/4W	103-6653	2
R102,R103	Resistor, 124 Ohm ±1%, 1/4W	103-1241	2
R104	Resistor, 71.5 k Ohm ±1%, 1/4W	103-7155	1
R105	Resistor, 46.4 k Ohm ±1%, 1/4W	103-4645	1
R110	Resistor, 4.7 k Ohm ±5%, 1/4W	100-4743	1
R112 THRU R115	Resistor, 10 Ohm ±5%, 1/4W	100-1023	4
R126	Resistor, 27.4 k Ohm ±1%, 1/4W	103-2751	1
R127	Resistor, 22.1 k Ohm ±1%, 1/4W	103-2211	1
R132	Resistor, 47 k Ohm ±5%, 1/4W	100-4753	1
R135,R136	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R137,R138	Resistor, 68 Ohm ±5%, 1/2W	110-6823	2
U1	Integrated Circuit, NE5534AN, Low Noise Operational Amplifier, 8-Pin DIP	221-5534	1
U3	Integrated Circuit, TL072CP, Dual JFET-Input Operational Amplifier, 8-Pin DIP	221-0072	1
U4	Integrated Circuit, MC14052B, Dual 4-Channel Analog Multiplexers/Demultiplexers, CMOS MSI, 2P4T, 16-Pin DIP	220-4052	1
U5	Integrated Circuit, TL072CP, Dual JFET-Input Operational Amplifier, 8-Pin DIP	221-0072	1
U6,U7	Integrated Circuit, NE5532AP, Dual Low Noise Operational Amplifier, 8-Pin DIP	221-5532-001	2
U10	Integrated Circuit, TL074CN, Quad JFET-Input Operational Amplifier, 14-Pin DIP	221-0074	1
U11	Integrated Circuit, CRL2200, Single-Channel Noise Reduction System, 16-Pin DIP	220-2200	1
U13	Integrated Circuit, LM317T, Adjustable Positive Voltage Regulator, 1.2V to 37V, 1.5 Ampere, TO-220 Case	227-0317	1
U14	Integrated Circuit, LM337T, Adjustable Negative Voltage Regulator, 1.2V to 37V, 1.5 Ampere, TO-220 Case	227-0337	1
U15	Integrated Circuit, LM317T, Adjustable Positive Voltage Regulator, 1.2V to 37V, 1.5 Ampere, TO-220 Case	227-0317	1
U16	Integrated Circuit, LM337T, Adjustable Negative Voltage Regulator, 1.2V to 37V, 1.5 Ampere, TO-220 Case	227-0337	1
XU1,XU3	Socket, 8-Pin DIP	417-0804	2
XU4	Socket, 16-Pin DIP	417-1604	1
XU5 THRU XU7	Socket, 8-Pin DIP	417-0804	3
XU10	Socket, 14-Pin DIP	417-1404	1
XU11	Socket, 16-Pin DIP	417-1604	1
----	Pins, Crimp Type	417-8766	3
----	Blank Circuit Board, Audio	510-9000	1

ADDITIONAL PARTS FOR MONOPHONIC ASSEMBLY 950-0033

R6	Potentiometer, 250 k Ohm ±10%, 1/2W	180-0001	1
J407	Connector Housing, 3-Pin	417-0003-001	1

TABLE 6-5. MONOPHONIC/STEREOPHONIC AUDIO MODULE ASSEMBLIES - 950-0033, 950-0034
(Sheet 4 of 5)

REF. DES.	DESCRIPTION	PART NO.	QTY.
	ADDITIONAL PARTS FOR STEREOPHONIC ASSEMBLY 950-0034		
C2	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C4	Capacitor, Mica, 68 pF ±5%, 500V	040-6813	1
C11	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C12	Capacitor, Mica, 10 pF ±5%, 500V	042-1012	1
C13	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C14	Capacitor, Ceramic, 0.001 uF ±10%, 200V	030-1033	1
C15	Capacitor, Electrolytic, 4.7 uF, 35V	024-4764	1
C16	Capacitor, Electrolytic, 47 uF, 16V	013-4750	1
C18	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C22	Capacitor, Electrolytic, 2.2 uF, 25V	013-2064	1
C23,C24	Capacitor, Electrolytic, 10 uF, 35V	023-1076	2
C28,C33	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C34,C35	Capacitor, Mica, 100 pF, 500V	040-1022	2
C36,C41	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C42	Capacitor, Mica, 22 pF, 500V	040-2213	1
C43,C44	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C46	Capacitor, Electrolytic, 47 uF, 16V	013-4750	1
C48	Capacitor, Mica, 100 pF, 500V	040-1022	1
C50	Capacitor, Mylar Film, 0.01 uF, 100V	031-1043	1
C65	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C71 THRU C74	Capacitor, Electrolytic, 47 uF, 16V	013-4750	4
C75	Capacitor, Mica, 1000 pF ±1%, 100V	041-1031	1
C76	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
C77	Capacitor, Mylar Film, 0.047 uF, 100V	030-4743	1
C78	Capacitor, Monolythic Ceramic, 0.0047 uF ±5%, 100V	003-4723	1
C79	Capacitor, Mica, 100 pF, 500V	040-1022	1
C80	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C82	Capacitor, Mica, 10 pF ±5%, 500V	042-1012	1
C83	Capacitor, Electrolytic, 47 uF, 16V	013-4750	1
C84	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C86	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
C87	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C91	Capacitor, Mylar Film, 0.022 uF, 200V	031-2243	1
J403	Connector Header, 3-Pin	417-0003	1
J406	Connector, Audio, XLB Series, 3-Pin	418-0049	1
P403	Connector Housing, 3-Pin	417-0003-001	1
P408	Jumper Switch, Programmable	340-0004	1
PC1	Phase Detector	220-9000	1
PC2,PC3	Phase Corrector	220-9001	2
Q2,Q5	Field Effect Transistor, J271, P-Channel JFET, TO-92 Case	210-0271	2
R2	Resistor, 100 Ohm ±5%, 1/4W	100-1033	1
R4	Resistor, 270 k Ohm ±5%, 1/4W	100-2763	1
R6	Potentiometer, 250 k Ohm ±10%, 1/2W	180-0001	1
R12	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R13	Potentiometer, 250 k Ohm ±10%, 1/2W	180-0001	1
R14	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R15	Resistor, 68 k Ohm ±5%, 1/4W	100-6853	1
R16	Resistor, 470 Ohm ±5%, 1/4W	100-4733	1
R17	Resistor, 1.2 k Ohm ±5%, 1/4W	100-1243	1
R18	Potentiometer, 10 k Ohm ±10%, 1/2W	178-1054	1
R28	Resistor, 27 k Ohm ±5%, 1/4W	100-2753	1
R29	Potentiometer, 10 k Ohm ±10%, 1/2W	177-1054	1
R30,R31	Resistor, 22 k Ohm ±5%, 1/4W	100-2253	2
R33	Resistor, 4.53 k Ohm ±1%, 1/4W	103-4534	1
R34	Resistor, 20 k Ohm ±5%, 1/4W	100-2053	1
R35	Potentiometer, 20 k Ohm ±10%, 1/2W	178-2054	1
R36,R37	Resistor, 4.53 k Ohm ±1%, 1/4W	103-4534	2
R39	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R43	Potentiometer, 500 k Ohm ±10%, 1 1/4W	178-5065	1
R44	Resistor, 2.2 k Ohm ±5%, 1/4W	100-2243	1
R45	Resistor, 47 k Ohm ±5%, 1/4W	100-4753	1
R46	Resistor, 100 Ohm ±5%, 1/4W	100-1033	1
R50	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R51	Resistor, 4.7 k Ohm ±5%, 1/4W	100-4743	1

TABLE 6-5. MONOPHONIC/STEREOPHONIC AUDIO MODULE ASSEMBLIES - 950-0033, 950-0034
(Sheet 5 of 5)

REF. DES.	DESCRIPTION	PART NO.	QTY.
	ADDITIONAL PARTS FOR STEREOPHONIC ASSEMBLY 950-0034 (Cont'd)		
R52,R55, R56,R59, R60	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	5
R67,R68	Resistor, 15 Ohm ±5%, 1/4W	100-1523	2
R69	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	1
R70	Resistor, 5.1 k Ohm ±5%, 1/4W	100-5143	1
R71,R72	Resistor, 15 Ohm ±5%, 1/4W	100-1523	2
R75,R76	Resistor, 10 k Ohm ±1%, 1/4W	100-1051	2
R77	Potentiometer, 10 k Ohm ±10%, 1/2W	177-1054	1
R78	Resistor, 2.2 Meg Ohm ±5%, 1/4W	100-2273	1
R79	Resistor, 2.0 Meg Ohm ±5%, 1/4W	100-2073	1
R80,R81	Resistor, 1.8 Meg Ohm ±5%, 1/4W	100-1873	2
R106 THRU R109	Resistor, 10 Ohm ±5%, 1/4W	100-1023	4
R111	Resistor, 4.7 k Ohm ±5%, 1/4W	100-4743	1
R116	Resistor, 46.4 k Ohm ±1%, 1/4W	103-4645	1
R117	Resistor, 34.8 k Ohm ±1%, 1/4W	103-3485	1
R118	Resistor, 221 k Ohm ±1%, 1/4W	103-2216	1
R119	Resistor, 15.4 k Ohm ±1%, 1/4W	103-1551	1
R120	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R121	Resistor, 15.4 k Ohm ±1%, 1/4W	103-1551	1
R122	Resistor, 1.5 Meg Ohm ±5%, 1/4W	100-1573	1
R123	Resistor, 150 k Ohm ±1%, 1/4W	103-1561	1
R124	Resistor, 4.75 k Ohm ±1%, 1/4W	103-4741	1
R125	Resistor, 1.5 Meg Ohm ±5%, 1/4W	100-1573	1
R128	Resistor, 46.4 k Ohm ±1%, 1/4W	103-4645	1
R129	Resistor, 100 k Ohm ±1%, 1/4W	103-1062	1
R130	Resistor, 71.5 k Ohm ±1%, 1/4W	103-7155	1
R131	Resistor, 46.4 k Ohm ±1%, 1/4W	103-4645	1
R133,R134	Resistor, 20 k Ohm ±5%, 1/4W	100-2053	2
R139	Resistor, 27 k Ohm ±5%, 1/4W	100-2753	1
R140	Potentiometer, 10 k Ohm ±10%, 1/2W	177-1054	1
R141,R142	Resistor, 22 k Ohm ±5%, 1/4W	100-2253	2
U2	Integrated Circuit, NE5534AN, Low Noise Operational Amplifier, 8-Pin DIP	221-5534	1
U8,U9	Integrated Circuit, NE5532AP, Dual Low Noise Operational Amplifier, 8-Pin DIP	221-5532-001	2
U12	Integrated Circuit, CRL2200, Single-Channel Noise Reduction System, 16-Pin DIP	220-2200	1
XU2,XU8, XU9	Socket, 8-Pin DIP	417-0804	3
XU12	Socket, 16-Pin DIP	417-1604	1

TABLE 6-6. 9000 SERIES CARTRIDGE MACHINE BASIC ASSEMBLY - 950-9000
(Sheet 1 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
E1 THRU E9	Turret Terminal, Double Shoulder	413-1597	9
S1	Switch, Pushbutton, Rectangular, Momentary Contact, Illuminated (START Switch)	340-0103	1
S2,S3	Switch, Pushbutton, Square, Momentary Contact, Incandescent (F FWD and STOP Switches)	340-0104	2
----	Switch Cap, Yellow, Square (STOP)	340-0014	1
----	Switch Cap, Blue, Square (F FWD)	340-0059	1
----	Switch Cap, Green, Rectangular (START)	340-0089	1
----	Lamp, Wedge Base, No. 85, 28V @ 0.04 Amperes	321-0085	3
----	Cartridge Guide, Left	445-0008	1
----	Spring, Cartridge Guide, Left	430-0010	1
----	Pressure Pad, Cartridge Guide	459-0123	1
----	Spring, Pressure Pad	430-0011	2
----	Guide, Circuit Board 2 1/2 Inch	409-0020	4

TABLE 6-6. 9000 SERIES CARTRIDGE MACHINE BASIC ASSEMBLY - 950-9000
(Sheet 2 of 2)

REF. DES.	DESCRIPTION	PART NO.	QTY.
----	Guide, Circuit Board	409-0002	4
----	Blank Circuit Board, Front Panel Switch	510-9002	1
----	Deck Assembly	950-0300-004	1
----	Power Supply Module Assembly	950-0032	1
----	Logic Module Assembly	950-0035	1
----	Motherboard Circuit Board Assembly	910-9006	1
----	Front Panel Status Circuit Board Assembly	910-9003	1
----	Motor Control Circuit Board Assembly	910-9005	1
----	9000 Series Cartridge Machine Motor Assembly	950-0037	1
----	Playback Cable Assembly	940-0030	1

TABLE 6-7. DECK ASSEMBLY - 950-0300-004

REF. DES.	DESCRIPTION	PART NO.	QTY.
S4	Switch, Micro, Roller Actuator, SPDT, 5 Amperes @ 125V ac (Deck Ready Switch)	346-0027	1
----	Pressure Roller	444-0700	1
----	Pressure Roller Shaft	446-0056	1
----	Pressure Roller Cross Shaft	446-0059	1
----	Retainer, "E" Ring	454-3318	1
----	Washer, Nylon (for Pressure Roller) Outside Diameter: 0.312 Inches (0.792 cm) Inside Diameter: 0.190 Inches (0.483 cm) Height: 0.010 Inches (0.254 cm)	423-5008	1
----	Washer, Nylon (for Pressure Roller) Outside Diameter: 0.312 Inches (0.792 cm) Inside Diameter: 0.190 Inches (0.483 cm) Height: 0.015 Inches (0.381 cm)	423-5009	1
----	Cartridge Guide, Right	445-0006	1
----	Pressure Pad, Cartridge Guide	459-0123	1
----	Pressure Pad Spring	430-0011	2
----	Solenoid Stop	459-0125	1
----	Spring, Solenoid Return	430-0014	1
----	Solenoid Assembly	950-0303-001	1
----	Reflective Sensor Assembly	950-0306	1

TABLE 6-8. SOLENOID ASSEMBLY - 950-0303-001

REF. DES.	DESCRIPTION	PART NO.	QTY.
L1	Solenoid, 32V dc, 1.75 Diameter, Resistance: 37.5 Ohms ±10% at 25°C	280-0003	1
----	Pins, Crimp Type	417-8766	2

TABLE 6-9. REFLECTIVE SENSOR - 950-0306

REF. DES.	DESCRIPTION	PART NO.	QTY.
LP1	Reflective Assembly, HOA-1180-1	320-0019	1
----	Connector Housing, 5-Pin In-line	417-0165	1
----	Pins, Crimp Type	417-8766	4
----	Keying Plug	417-0144	1

TABLE 6-10. POWER SUPPLY MODULE ASSEMBLY - 950-0032

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1,C2	Capacitor, Electrolytic, 1000 uF, 35V	024-1000	2
C3	Capacitor, Electrolytic, 10 uF ±20%, 50V	020-1074	1
C4	Capacitor, Electrolytic, 4700 uF ±20%, 50V	020-4794	1
C6	Capacitor, Silvered Mica, 100 pF ±5%, 500V	040-1022	1
C7,C8	Capacitor, Electrolytic, 1 uF, 50V	024-1064	2
D1 THRU D4	Diode, 1N4005, Silicon, 600V @ 1 Ampere	203-4005	4
D5 THRU D8	Diode, MR502, Silicon, 200V @ 3 Amperes	202-0502	4
D13,D14	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203-4148	2
D15	Diode, Zener, 1N4750A, 27V ±10%, 1 Watt	200-0027	1
E1 THRU E4	Turret Terminal, Double Shoulder	413-1597	4
F1	Fuse, AGC, 1/2A, 250V, Slow-Blow	334-0050	1
J201	Receptacle, 40-Pin, Dual In-line	417-4041	1
J202	Connector, 9-Pin	418-0900	1
J203	Connector, Header, 3-Pin	417-0003	1
P202	Connector Plug, 9-Pin	417-0059	1
P203	Connector Housing, 3-Pin	417-0003-001	1
Q1	Transistor, 2N3904, Silicon, NPN, TO-92 Case	211-3904	1
Q2	Transistor, TIP120, NPN Darlington-Connected Silicon Power, 65W @ 25°C Case	210-0120	1
Q3	Transistor, 2N3904, Silicon, NPN, TO-92 Case	211-3904	1
Q4	Transistor, TIP125, Silicon, PNP, Darlington, TO-220 Case	210-0125	1
Q5	Transistor, TIP31A, Silicon, NPN, TO-220 AB Case	219-0031	1
R1	Resistor, 470 Ohm ±5%, 1/4W	100-4733	1
R2	Resistor, 68 k Ohm ±5%, 1/4W	100-6853	1
R3	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R4	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R5,R6	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R7	Resistor, 5 Ohm ±1%, 1W, W/W	120-5011	1
R8	Resistor, 15 Ohm ±5%, 1/4W	100-1523	1
R9	Potentiometer, 50 Ohm ±10%, 1/2W	178-5002	1
R11 THRU R14	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	4
S202	Switch, Slide, DPDT, Miniature, 1 Ampere @ 125V ac	345-0126	1
T1	Transformer, Rectifier, Toroid, 115V/220V 50/60 Hz (Broadcast Electronics Part)	370-4327	1
TP1 THRU TP5	Terminal, Turret, Double Shoulder	413-1597	5
U1	Integrated Circuit, LM317K, Three-Terminal Adjustable Positive Voltage Regulator, 1.2 to 37V, 1.5 Ampere Maximum, TO-3 Case	227-0318	1
----	Socket, Transistor, TO-3	417-0298	1
----	Socket, Connector	417-0053	6
----	Pins, Crimp Type	417-8766	3
----	Connector, Power, Snap-in, Black (Combination fuse holder, switch, and IEC Connector)	418-0050	1
----	Blank Circuit Board, Power Supply	510-9001	1

TABLE 6-11. LOGIC MODULE ASSEMBLY - 950-0035
(Sheet 1 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C2	Capacitor, Mica, 220 pF ±5%, 500V	040-2223	1
C3	Capacitor, Electrolytic, 100 uF, 25V	023-1084	1
C4	Capacitor, Mylar Film, 0.01 uF ±10%, 100V	031-1043	1
C5,C6	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C8	Capacitor, Ceramic Disc, 10 pF ±10%, 1 kV, Non-Polarized	001-1014	1
C9,C10	Capacitor, Monolythic Ceramic, 0.01 uF ±5%, 100V	003-1013	2
C11	Capacitor, Mylar Film, 0.022 uF ±10%, ~~200V~~ 100V	031-2243	1
C12,C19, C20	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	3
C21,C22	Capacitor, Electrolytic, 4.7 uF, 35V	024-4753	2
C23,C24	Capacitor, Electrolytic, 10 uF, 35V	023-1076	2
C35	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1

TABLE 6-11. LOGIC MODULE ASSEMBLY - 950-0035
(Sheet 2 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C37,C39	Capacitor, Electrolytic, 1 uF, 50V	024-1064	2
C40	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C41	Capacitor, Mylar Film, 0.022 uF ±10%, ~~200V~~ 100V	031-2243	1
C42	Capacitor, Ceramic, 0.001 uF ±10%, 200V	030-1033	1
C43	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C44	Capacitor, Mylar Film, 0.047 uF ±10%, 100V	030-4743	1
C45 THRU C47	Capacitor, Mylar Film, 0.022 uF ±10%, ~~200V~~ 100V	031-2243	3
C48 THRU C51	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	4
C52,C53	Capacitor, Electrolytic, 100 uF, 25V	023-1084	2
C54	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C55	Capacitor, Electrolytic, 4.7 uF, 35V	024-4753	1
C56,C57	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C58	Capacitor, Monolythic Ceramic, 0.01 uF ±5%, 100V	003-1013	1
C59 THRU C67	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	9
C68	Capacitor, Electrolytic, 4.7 uF, 35V	024-4753	1
C69,C70	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C71	Capacitor, Electrolytic, 4.7 uF, 35V	024-4753	1
C72	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C73,C74	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C75	Capacitor, Ceramic Disc, 10 pF ±10%, 1 kV, Non-Polarized	001-1014	1
C76,C77	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C78,C79	Capacitor, Mylar Film, 0.01 uF ±10%, 100V	031-1043	2
C80	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
C81 THRU C83	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	3
D1 THRU D11, D13 THRU D24, D26 THRU D28	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203-4148	26
D29	Diode, 1N34, Germanium, 8.5 mA, 10V	202-0034	1
D31 THRU D33,D35 THRU D40,D42 THRU D46	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203-4148	14
DS1 THRU DS3	Indicator, LED, Red, 5300E1, 2.3V @ 50 mA Maximum	320-0011	3
H310	Cue Filter Circuit, Hybrid	220-0001	1
J303	Connector Header, 4-Pin In-Line	417-0070	1
J304	Connector Header, 2-Pin In-Line	417-4004	1
J305,J306	Connector Header, 3-Pin In-Line	417-0003	2
J307	Connector Header, 2-Pin In-Line	417-4004	1
J308	Connector, 25-Pin D-Type	418-2500	1
J309	Connector Header, 2-Pin In-Line	417-4004	1
J310	Socket, 21-Pin DIP	417-0149	1
J311 THRU J313	Socket, 2-Pin DIP	417-0151	3
J314	Connector Header, 3-Pin In-Line	417-0003	1
K1,K2	Relay, Coil: 12V dc, 800 Ohms Contacts: 100V dc @ 0.5 Amperes Maximum	270-0056	2
P301	Connector, 50-Pin Dual In-line	417-0147	1
P302 THRU P307,P309, P314	Jumper Switch, Programmable, 1-Pin	340-0004	8
Q1	Transistor, MPS-A14, Silicon, NPN, Darlington, TO-92 Case	211-0014	1
R1	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R2	Resistor, 100 Ohm ±5%, 1/4W	100-1033	1
R3	Resistor, 270 Ohm ±5%, 1/4W	100-2733	1
R4	Resistor, 300 k Ohm ±5%, 1/4W	100-3063	1
R5,R6	Resistor, 10 Ohm ±5%, 1/4W	100-1023	2
R7	Resistor, 4.3 k Ohm ±5%, 1/4W	100-4343	1
R8	Resistor, 2 k Ohm ±5%, 1/4W	100-2043	1
R9	Resistor, 75 Ohm ±5%, 1/4W	100-7523	1
R10	Potentiometer, 10 k Ohm ±10%, 1/2W	178-1054	1
R11	Resistor, 2 k Ohm ±5%, 1/4W	100-2043	1

TABLE 6-11. LOGIC MODULE ASSEMBLY - 950-0035
(Sheet 3 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R12	Resistor, 30 k Ohm ±5%, 1/4W	100-3053	1
R13	Resistor, 3 k Ohm ±5%, 1/4W	100-3043	1
R14	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R15	Resistor, 15 k Ohm ±5%, 1/4W	100-1553	1
R16	Resistor, 30 k Ohm ±5%, 1/4W	100-3053	1
R19	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R20	Resistor, 118 Ohm ±1%, 1/4W	100-1111	1
R21,R22	Resistor, 1.02 k Ohm ±1%, 1/4W	103-1024	2
R23	Resistor, 118 Ohm ±1%, 1/4W	100-1111	1
R43	Resistor, 390 k Ohm ±5%, 1/4W	100-3963	1
R44	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R45	Potentiometer, 5 k Ohm ±10%, 1/2W	178-5044	1
R46	Resistor, 1.8 k Ohm ±5%, 1/4W	100-1843	1
R47	Resistor, 3.9 k Ohm ±5%, 1/4W	100-3943	1
R48,R49	Resistor, 10 Ohm ±5%, 1/4W	100-1023	2
R50 THRU R52	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	3
R53	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R55	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R56	Resistor, 30 k Ohm ±5%, 1/4W	100-3053	1
R57	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R59	Resistor, 2 k Ohm ±5%, 1/4W	100-2043	1
R60	Resistor, 24 k Ohm ±5%, 1/4W	100-2453	1
R61	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R62	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R63	Resistor, 200 Ohm ±5%, 1/4W	100-2033	1
R67	Resistor, 3 k Ohm ±5%, 1/4W	100-3043	1
R68	Resistor, 27 k Ohm ±5%, 1/4W	100-2753	1
R69	Resistor, 390 k Ohm ±5%, 1/4W	100-3963	1
R70	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R71	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R72	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R73	Resistor, 1.5 k Ohm ±5%, 1/4W	100-1543	1
R74	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R77	Resistor, 2 k Ohm ±5%, 1/4W	100-2043	1
R78	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R79	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R80	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R81	Resistor, 200 Ohm ±5%, 1/4W	100-2033	1
R82,R83	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R84	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R85 THRU R87	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	3
R88	Resistor, 510 k Ohm ±5%, 1/4W	100-5163	1
R89	Resistor, 360 k Ohm ±5%, 1/4W	100-3663	1
R90 THRU R94	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	5
R95	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R96,R97	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R98	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R99	Resistor, 7.5 Meg Ohm ±5%, 1/4W	100-7573	1
R100	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R101,R102	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R103,R104	Resistor, 1.5 k Ohm ±5%, 1/4W	100-1543	2
R105	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R106,R107	Resistor, 1.5 k Ohm ±5%, 1/4W	100-1543	2
R108	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R109	Resistor, 160 k Ohm ±5%, 1/4W	100-1663	1
R110	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R111	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R112	Resistor, 1.5 k Ohm ±5%, 1/4W	100-1543	1
R113 THRU R115	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	3
R116	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R117 THRU R120	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	4

TABLE 6-11. LOGIC MODULE ASSEMBLY - 950-0035
(Sheet 4 of 4)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R121	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R122	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R123	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R124,R125	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R126	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R127	Resistor, 33 Ohm ±5%, 1/4W	100-3323	1
R128	Resistor, 47 Ohm ±5%, 2W, W/W	130-4724	1
R130	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R131	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R132	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R133 THRU R135	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	3
R136	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R137	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R138	Resistor, 100 Ohm ±5%, 1/4W	100-1033	1
U1	Integrated Circuit, RC4559NB, Operational Amplifier, 8-Pin DIP	221-4559	1
U2	Integrated Circuit, MC14040B, CMOS MSI 12-Bit Binary Counter, 16-Pin DIP	220-4040	1
U10	Integrated Circuit, NE565N, Phase-locked Loop Linear, 14-Pin DIP	229-0565	1
U11	Integrated Circuit, RC4559NB, Operational Amplifier, 8-Pin DIP	221-4559	1
U12	Integrated Circuit, LM339AN, Quad Comparator, 14-Pin DIP	221-0339	1
U13	Integrated Circuit, MC14584, Hex Schmitt Trigger, CMOS, 14-Pin DIP	228-4584	1
U14,U15	Integrated Circuit, ULN2004, 7 NPN Darlington Driver Pack, 16-Pin DIP	226-2004	2
U16	Integrated Circuit, MC14584, Hex Schmitt Trigger, CMOS, 14-Pin DIP	228-4584	1
U17	Integrated Circuit, MC14071, OR Gate, CMOS, 14-Pin DIP	225-0005	1
U18	Integrated Circuit, MC14011BCP, Quad 2-Input NAND Gate, CMOS, 14-Pin DIP	228-4011	1
U19	Integrated Circuit, MC14001B, CMOS, Quad 2-Input NOR Gate, 14-Pin DIP	228-4001	1
U20	Integrated Circuit, MC14081, Quad 2-Input AND Gate, CMOS, 14-Pin DIP	225-0008	1
U21,U22	Integrated Circuit, MC14071, OR Gate, CMOS, 14-Pin DIP	225-0005	2
U23,U24	Integrated Circuit, MC14013BCP, Dual D-Type Flip-Flop, CMOS, 14-Pin DIP	228-4013	2
U25	Integrated Circuit, MC14043BP, CMOS, Quad NOR Gate, 16-Pin DIP	220-4043	1
U26	Integrated Circuit, MC14073B, Tripple 3-Input AND Gate, CMOS, 14-Pin DIP	228-4073	1
U27	Integrated Circuit, MC14538B, Dual Retriggerable, Resettable Monostable Multivibrator, CMOS, 16-Pin DIP	228-4538	1
U29	Integrated Circuit, LM317T, Adjustable Positive Voltage Regulator, 1.2V to 37V, 1.5 Ampere, TO-220 Case	227-0317	1
U30	Integrated Circuit, LM337L, Adjustable Negative Voltage Regulator, 1.2V to 37V, 0.1 Ampere Maximum, TO-92 Case	220-0337	1
XU1	Socket, 8-Pin DIP	417-0804	1
XU2	Socket, 16-Pin DIP	417-1604	1
XU10	Socket, 14-Pin DIP	417-1404	1
XU11	Socket, 8-Pin DIP	417-0804	1
XU12,XU13	Socekt, 14-Pin DIP	417-1404	2
XU14,XU15	Socket, 16-Pin DIP	417-1604	2
XU16 THRU XU24	Socket, 14-Pin DIP	417-1404	9
XU25	Socket, 16-Pin DIP	417-1604	1
XU26	Socket, 14-Pin DIP	417-1404	1
XU27	Socket, 16-Pin DIP	417-1604	1
W1 THRU W3	Fuseable Link, 22 AWG	601-0022	3
----	Blank Circuit Board	510-9004	1

TABLE 6-12. MOTHERBOARD CIRCUIT BOARD ASSEMBLY - 910-9006

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Electrolytic, 100 uF, 50V	020-1083	1
J104	Connector Header, 20-Pin In-line	417-0200	0.25
J105	Connector Header, ~~16~~-Pin Dual In-line	417-1603	1
J106	Connector Header, ~~26~~-Pin Dual In-line	417-2600	1
J107	Connector Header, 5-Pin	417-4000-002	1
J108	Connector Header, ~~26~~-Pin Dual In-line	417-2600	1
J109 THRU J117	Receptacle, Single Pin	417-0071-001	9
J201	Connector Header, 40-Pin Dual In-line	417-0134	1
J301,J401	Connector Header, 50-Pin Dual In-line	417-0146	2
R1	Resistor, 150 Ohm ±5%, 1/4W	100-1533	1
R2,R3	Resistor, 68 Ohm ±5%, 2W	132-6832	2
----	Blank Circuit Board	510-9006	1

TABLE 6-13. FRONT PANEL STATUS CIRCUIT BOARD ASSEMBLY - 910-9003

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
C2	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C3	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
C4	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C5	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
D1 THRU D4	Diode, Zener, 1N4739A, 9.1V ±5%, 1W	200-0009	4
DS1 THRU DS4	LED, Green, MV54173, Light Intensity I	320-0016	4
DS5, DS6	LED, Red, MV57173, Light Intensity G	320-0017	2
DS7	LED, Multicolor, HDSP4836, 10-Element Bar Graph Array	320-0013	1
J501	Connector Header, ~~26~~-Pin Dual In-line	417-2600	1
J502	Connector Header, 20-Pin In-line	417-0200	0.5
R1	Resistor, 5.1 k Ohm ±5%, 1/4W	100-5143	1
R2 THRU R4	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	3
R5	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R6	Resistor, 8.06 k Ohm ±1%, 1/4W	103-8064	1
R7	Resistor, 1.24 k Ohm ±1%, 1/4W	103-1244	1
R8	Resistor, 100 Ohm ±1%, 1/4W	100-1031	1
R9	Resistor, 316 Ohm ±1%, 1/4W	103-3163	1
R10	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R11 THRU R13	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	3
RN-1	Resistor Network, 7 resistors, 1 k Ohm ±2%, 8-Pin Single-In-line Package	226-1032	1
U1	Integrated Circuit, LM3914N, Dot/Bar Display Driver, 18-Pin DIP	229-3914	1
XU1	Socket, 18-Pin DIP	417-1804	1
XU2	Socket, 28-Pin DIP	417-2804	1
----	Blank Circuit Board	510-9003	1

TABLE 6-14. MOTOR CONTROL CIRCUIT BOARD ASSEMBLY - 910-9005
(Sheet 1 of 3)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C1	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C2	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C3,C4	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C5,C6	Capacitor, Silvered Mica, 100 pF ±5%, 500V	040-1022	2
C7,C8	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C9	Capacitor, Mylar Film, 0.22 uF ±10%, 100V	030-2253	1
C10	Capacitor, Mylar Film, 0.01 uF ±10%, 100V	031-1043	1
C11	Capacitor, Electrolytic, 1 uF, 50V	024-1064	1
C12 THRU C14	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	3

TABLE 6-14. MOTOR CONTROL CIRCUIT BOARD ASSEMBLY - 910-9005
(Sheet 2 of 3)

REF. DES.	DESCRIPTION	PART NO.	QTY.
C15	Capacitor, Mylar Film, 0.01 uF ±10%, 100V	031-1043	1
C16 THRU C19	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	4
C20	Capacitor, Mylar Film, 0.01 uF ±10%, 100V	031-1043	1
C21	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C22	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C23 THRU C25	Capacitor, Electrolytic, 10 uF, 35V	023-1076	3
C26	Capacitor, Electrolytic, 3.3 uF, 50V	020-3363	1
C27,C28	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C29	Capacitor, Electrolytic, 33 uF, 35V	024-3374	1
C30,C31	Capacitor, Mica, 22 pF ±5%, 500V	040-2213	2
C32 THRU C37	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	6
C38	Capacitor, Electrolytic, 10 uF, 35V	023-1076	1
C39,C40	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	2
C41	Capacitor, Electrolytic, 100 uF, 50V	020-1083	1
C42	Capacitor, Monolythic Ceramic, 0.1 uF ±20%, 50V	003-1054	1
C43	Capacitor, Ceramic, 0.001 uF ±10%, 200V	030-1033	1
D1 THRU D4	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203-4148	4
D5	Diode, 1N34, Germanium, 8.5 mA, ~~1W~~ 10V	202-0034	1
D6 THRU D8, D11 THRU D14	Diode, 1N4148, Silicon, 75V @ 0.3 Amperes	203-4148	7
J601	Connector, Header, 20-Pin IN-LINE	417-0200	0.6
J602	Connector, Header, 8-Pin Dual In-line	417-1603	1
Q1	Transistor, TIP120, Silicon, Power, NPN Darlington (check this in book)	210-0120	1
Q2 THRU Q4	Transistor, TIP32A, Silicon, PNP, TO-220 AB Case	218-0032	3
Q5 THRU Q7	Transistor, 2N3904, Silicon, NPN, TO-92 Case	211-3904	3
Q8	Transistor, 2N3906, Silicon, PNP, TO-92 Case	210-3906	1
R1	Resistor, 2.7 k Ohm ±5%, 1/4W	100-2743	1
R2	Resistor, 100 Ohm ±5%, 1/4W	100-1033	1
R3	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R5,R6	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R7 THRU R9	Resistor, 22.1 k Ohm ±1%, 1/4W	103-2211	3
R10	Resistor, 470 k Ohm ±5%, 1/4W	100-4763	1
R11	Resistor, 330 k Ohm ±5%, 1/4W	100-3363	1
R12	Resistor, 30 k Ohm ±5%, 1/4W	100-3053	1
R13	Resistor, 330 k Ohm ±5%, 1/4W	100-3363	1
R14	Resistor, 33 k Ohm ±5%, 1/4W	100-3353	1
R15	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R16	Potentiometer, 500 Ohm, 1/2W	178-5030	1
R17	Resistor, 1 Ohm ±1%, ~~1/4W~~ 1W	120-1013	1
R18	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R19,R20	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R21	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R22	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R23	Resistor, 51 k Ohm ±5%, 1/4W	100-5153	1
R24	Resistor, 220 k Ohm ±5%, 1/4W	100-2263	1
R25,R26	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R27	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R28	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R29,R30	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	2
R31	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R32 THRU R34	Resistor, 5.1 k Ohm ±5%, 1/4W	100-5143	3
R35	Resistor, 470 Ohm ±5%, 1/2W	110-4733	1
R36	Resistor, 47 Ohm ±5%, 1/2W	110-4723	1
R37,R38	Resistor, 470 Ohm ±5%, 1/2W	110-4733	2
R39	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R40	Resistor, 1 k Ohm ±5%, 1/4W	100-1043	1
R41	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R42	Resistor, 24 k Ohm ±5%, 1/4W	100-2453	1
R43	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R44	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	1
R45	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R46	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R47	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1

TABLE 6-14. MOTOR CONTROL CIRCUIT BOARD ASSEMBLY - 910-9005
(Sheet 3 of 3)

REF. DES.	DESCRIPTION	PART NO.	QTY.
R48	Resistor, 510 k Ohm ±5%, 1/4W	100-5163	1
R50	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R51,R52	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R54	Resistor, 10 Meg Ohm ±5%, 1/4W	100-1083	1
R56	Resistor, 68 k Ohm ±5%, 1/4W	100-6853	1
R57	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R58	Resistor, 1 Meg Ohm ±5%, 1/4W	100-1073	1
R59 THRU R61	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	3
R62	Resistor, 300 Ohm ±5%, 2W, W/W	130-3004	1
R63	Resistor, 316 Ohm ±1%, 1/4W	103-3163	1
R64	Resistor, 100 Ohm ±1%, 1/4W	100-1031	1
R65	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	1
R66,R67	Resistor, 10 k Ohm ±5%, 1/4W	100-1053	2
R68 THRU R70	Resistor, 100 k Ohm ±5%, 1/4W	100-1063	3
R71	Resistor, 9.1 k Ohm ±5%, 1/4W	100-9143	1
TP1	Terminal, Turret, Double Shoulder	413-1597	1
U1	Integrated Circuit, LM317T, Adjustable Positive Voltage Regulator, 1.2V to 37V, 1.5 Ampere, TO-220 Case	227-0317	1
U2	Integrated Circuit, LM358N, Dual Operational Amplifier, 8-Pin DIP	221-0358	1
U3	Integrated Circuit, MC14528BCP, Dual Monostable Multivibrator, CMOS, 16-Pin DIP	224-4528	1
U4	Integrated Circuit, MC14011BCP, Quad 2-Input NAND Gate, CMOS, 14-Pin DIP	228-4011	1
U5	Integrated Circuit, MC54/74HC195, 4-Bit Universal Shift Register, CMOS, 16-Pin DIP	220-0195	1
U6	Integrated Circuit, LM358N, Dual Operational Amplifier, 8-Pin DIP	221-0358	1
U7	Integrated Circuit, LM339AN, Quad Comparator, 14-Pin DIP	221-0339	1
U8	Integrated Circuit, MC14040BCP, 12-Bit Binary Counter, CMOS MSI, 16-Pin DIP	220-4040	1
U9	Integrated Circuit, MC14013BCP, Dual D-Type Flip-Flop, CMOS, 14-Pin DIP	228-4013	1
U10	Integrated Circuit, MC14053B, Analog Multiplexers/Demultiplexers, CMOS MSI, 16-Pin DIP	220-4053	1
U11	Integrated Circuit, MC14060B, 14-Bit Binary Counter and Oscillator, CMOS MSI, 16-Pin DIP	220-4060	1
U12	Integrated Circuit, CD4027BE, Dual J-K Master-Slave Flip-Flop, CMOS, 16-Pin DIP	225-0003	1
U13	Integrated Circuit, MC14052B, (Analog Multiplexers/Demultiplexers, CMOS MSI, 16-Pin DIP	220-4052	1
U14	Integrated Circuit, MC14040BCP, 12-Bit Binary Counter, CMOS MSI, 16-Pin DIP	220-4040	1
U15	Integrated Circuit, ULN2004, 7 NPN Darlington Driver Pack, 16-Pin DIP	226-2004	1
XU2	Socket, 8-Pin DIP	417-0804	1
XU3	Socket, 16-Pin DIP	417-1604	1
XU4	Socket, 14-Pin DIP	417-1404	1
XU5	Socket, 16-Pin DIP	417-1604	1
XU6	Socket, 8-Pin DIP	417-0804	1
XU7	Socket, 14-Pin DIP	417-1404	1
XU8	Socket, 16-Pin DIP	417-1604	1
XU9	Socket, 14-Pin DIP	417-1404	1
XU10 THRU XU15	Socket, 16-Pin DIP	417-1604	6
Y1	Crystal, 460.80 kHz ±0.01% from Ø°C to 50°C, R/DT Cut, NE33D Case	390-0019	1
----	Blank Circuit Board	510-9005	1

TABLE 6-15. 9000 CARTRIDGE MACHINE MOTOR ASSEMBLY - 950-0037

REF. DES.	DESCRIPTION	PART NO.	QTY.
M1	Motor, DC Servo Operating Supply: +24V ±1.2V dc, +5V ±0.2V dc Tachometer: 80 Hz per 1 RPS Operating Torque: 10 oz./in. Maximum Operating Current: 1.1A Maximum Operating Speed: Programmable Model: 58FPAK8003	380-0009	1
----	Bearing, Ball, 609ZZ (Upper Bearing) Outside Diameter: 0.9348 Inches (2.37 cm) Inside Diameter: 0.355 Inches (0.902 cm) Height: 0.275 Inches (0.698 cm)	442-0609	1
----	Bearing, Ball, 699ZZ (Lower Bearing) Outside Diameter: 0.7873 Inches (1.99 cm) Inside Diameter: 0.355 Inches (0.902 cm) Height: 0.2346 Inches (0.596 cm)	442-1023	1
----	Connector Housing, 12-Pin	417-1202	1
----	Pins, Crimp Type	417-8766	11

TABLE 6-16. 9000 SERIES PLAYBACK CABLE ASSEMBLY - 940-0030

REF. DES.	DESCRIPTION	PART NO.	QTY.
P104	Connector Housing, 5-Pin In-line	417-0165	1
P105	Connector, 16-Pin	417-0131	1
P106,P501	Connector, Ribbon Cable, 26-Pin Dual In-line	418-2600	2
P502	Connector Housing, 10-Pin	417-0148	1
P602	Connector, 16-Pin	417-0131	1
----	Pins, Crimp Type	417-8766	13
----	Pins, CONNECTOR	417-0142	9

TABLE 6-17. 9000 SERIES TIMER OPTION - 900-9016

REF. DES.	DESCRIPTION	PART NO.	QTY.
DS8	Light Emitting Diode, AND4125R, Red, Seven Segment Display	320-0015	1
U2	Integrated Circuit, ICM7217CIPI, 4-Digit (LED) Presettable Up/Down Counter, 28-Pin DIP	220-7217	1
U3	Integrated Circuit, LM337T, Adjustable Negative Voltage Regulator, 1.2V to 37V, 1.5 Ampere, TO-220 Case	227-0337	1

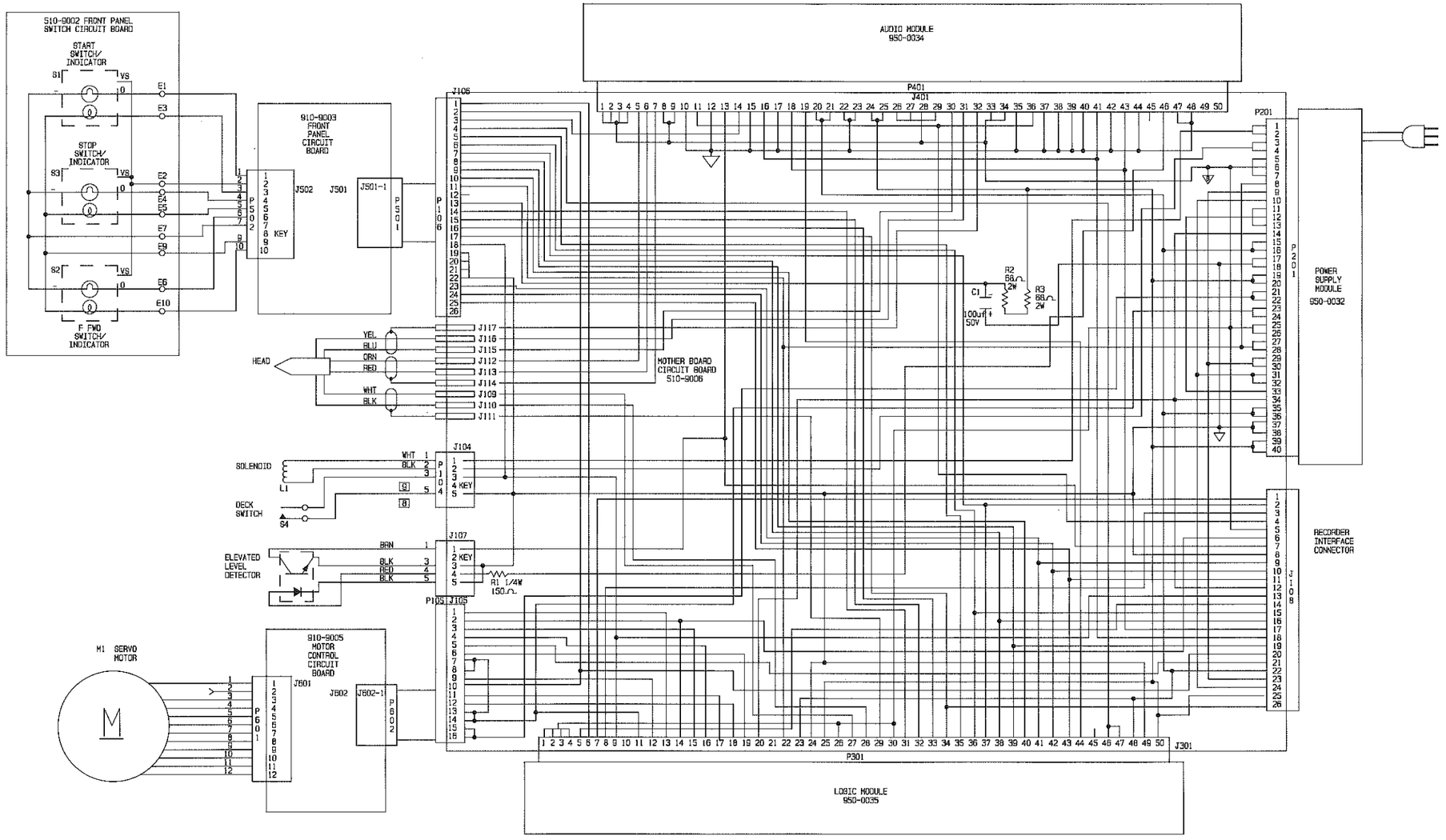
SECTION VII

DRAWINGS

7-1. INTRODUCTION.

7-2. This section provides assembly drawings, wiring diagrams, and schematic diagrams as listed below for the Broadcast Electronics 9000 series cartridge machines.

FIGURE	TITLE	NUMBER
7-1	9000 SERIES OVERALL SCHEMATIC DIAGRAM	SD900-9000-000, -300, 900-9002-000, -300
7-2	9000 SERIES HEAD TO MOTHERBOARD WIRING DIAGRAM	597-9000-100
7-3	9000 SERIES BASIC ASSEMBLY DIAGRAM	AD950-9000
7-4	AUDIO MODULE SCHEMATIC DIAGRAM	SD950-0033/ -0034
7-5	AUDIO MODULE ASSEMBLY DIAGRAM	AD950-0033/ -0034
7-6	LOGIC MODULE SCHEMATIC DIAGRAM	SD950-0035
7-7	LOGIC MODULE ASSEMBLY DIAGRAM	AD950-0035
7-8	MOTOR CONTROL CIRCUIT BOARD SCHEMATIC DIAGRAM	SD910-9005
7-9	MOTOR CONTROL CIRCUIT BOARD ASSEMBLY DIAGRAM	AC910-9005
7-10	POWER SUPPLY MODULE SCHEMATIC DIAGRAM	SC950-0032/-001
7-11	POWER SUPPLY MODULE ASSEMBLY DIAGRAM	AD950-0032/-001
7-12	MOTHERBOARD CIRCUIT BOARD ASSEMBLY DIAGRAM	AC910-9006
7-13	FRONT PANEL CIRCUIT BOARD SCHEMATIC DIAGRAM	SC910-9003
7-14	FRONT PANEL CIRCUIT BOARD ASSEMBLY DIAGRAM	AD910-9003
7-15	MOTOR ASSEMBLY DIAGRAM	597-9000-80
7-16	9000 SERIES CARTRIDGE MACHINE START SEQUENCING	597-9000-110



P105 TO P602
1. MOTOR RUN
2. MOTOR AT SPEED
3. MOTOR OVERCURRENT
4. TACH OUT
5. MOTOR CURRENT SAMPLE
6. MOTOR RESET
7. POWER SUPPLY GROUND
8. POWER SUPPLY GROUND
9. F FWD MODE
10. SERVO ERROR
11. VARISPEED MODE
12. VARISPEED INPUT 9800Hz
13. POWER SUPPLY GROUND
14. POWER SUPPLY GROUND
15. +28V
16. +28V

P601		
PIN	COLOR	FUNCTION
1.	PINK	+5V
2.		
3	GRN	GND
4.	ORN	TACH HIGH
5.	VIO	TACH LOW
6.	LT.BLU	HALL 2
7.	RED	HALL 3
8.	GRY	HALL 1
9.	BRN	STATOR 1
10.	BLU	STATOR 2
11.	YEL	STATOR 3
12.	WHT	STATOR COM

P105 TO P105
1. VARISPEED IND
2. SERVO IND
3. PHASE DISPLAY
4. +12V
5. START COMMAND
6. START LIGHT
7. STOP COMMAND
8. STOP LIGHT
9. FF COMMAND
10. FF LIGHT
11. +28V LAMP SUPPLY
12. GROUND
13. -22V I LIMITED
14. DATA IND
15. TEMT IND
16. SEC IND
17. AUDIO IND
18. CART PRESENT
19. GROUND
20. GROUND
21. GROUND
22. GROUND
23. TIMER FREEZE/COUNT
24. TIMER RESET
25. TIMER 1Hz INPUT
26. -5V

TOLERANCE (DECIMAL) U.O.B.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY TLL 7-8-87
CHKD
ENG
PROJ. ENGR.
MFG.

MATERIAL
FINISH
BBE DWG RA552-0000
NEXT ASSY.

BROADCAST ELECTRONICS INC.
4100 N.24TH ST. P.O.BOX 3606 QUINCY,IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST

TITLE PT-90 OVERALL SCHEMATIC

TYPE	SIZE	DWG. NO.			REV
S	D	900-9000-000	900-9002-000		A
		900-9000-300	900-9000-300		

MODEL PT-90 SCALE NONE SHEET 1 OF 1

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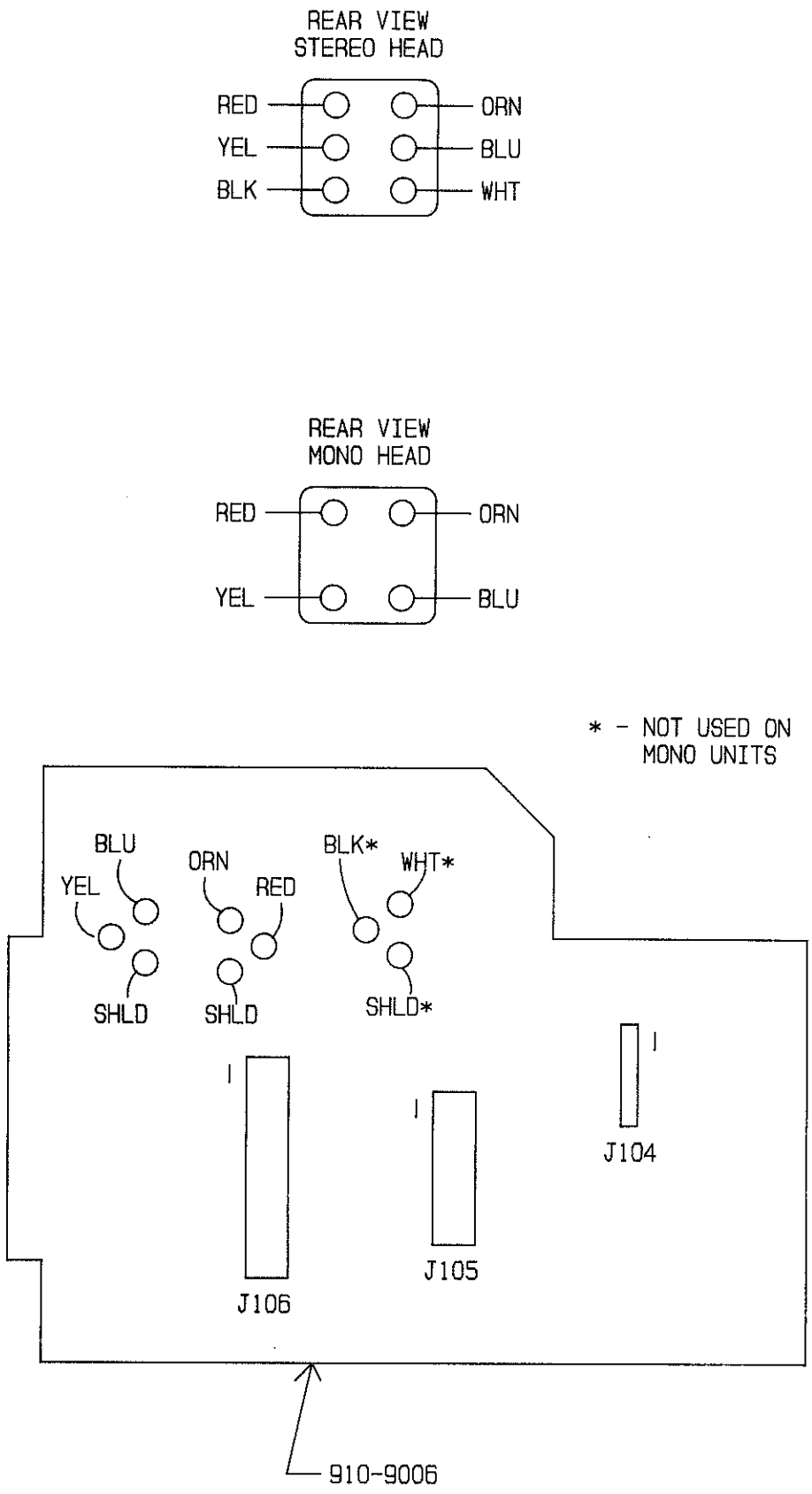
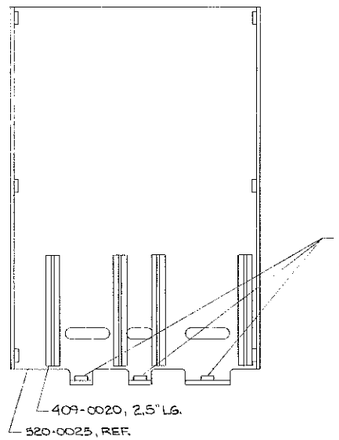


FIGURE 7-2. 9000 SERIES HEAD TO MOTHERBOARD WIRING DIAGRAM 597-9000-100

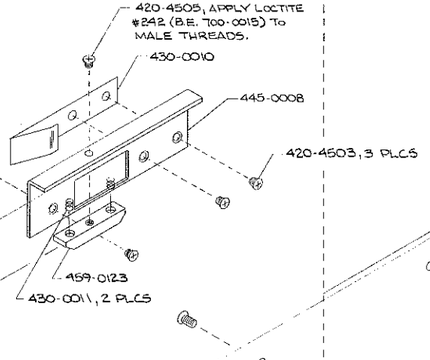
DETAIL 'C'



LIGHTLY LUBRICATE THREADS OF 'PEM' NUTS WITH SILICONE GREASE (B.E. 700-0137)

409-0020, 2.5" LG.

520-0025, REF.



420-4505, APPLY LOCTITE #242 (B.E. 700-0015) TO MALE THREADS.

430-0010

445-0008

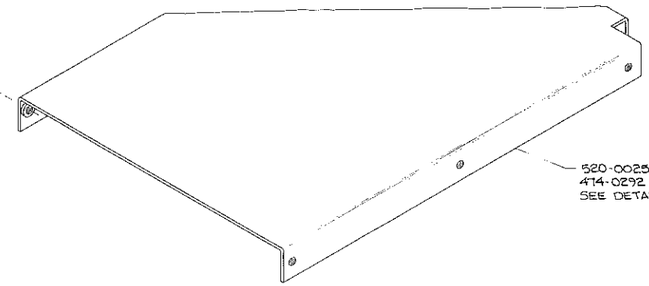
420-4503, 3 PLCS

.068±.010

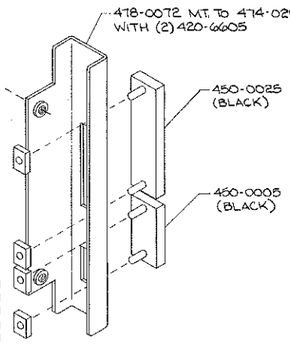
459-0123

430-0011, 2 PLCS

<-- DIM. AFTER ASSEMBLY



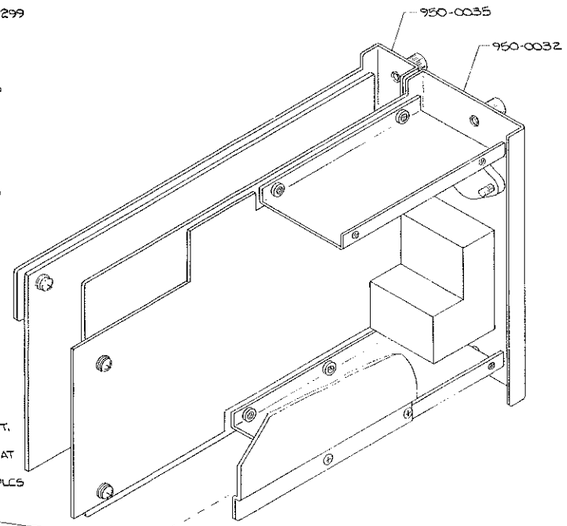
520-0025, MT. TO 474-0299 AND 474-0292 WITH (6) 420-6605, SEE DETAIL 'C'



478-0072 MT. TO 474-0299 WITH (2) 420-6605

450-0025 (BLACK)

450-0005 (BLACK)



950-0035

950-0032

474-0299, LEFT SIDE PLATE.
474-0292, RIGHT SIDE PLATE (NOT SHOWN FOR CLARITY)

(2) 420-6605

910-9006 MT. TO 520-0026 WITH (6) 420-6106 (6) 423-6002

P107 OF 950-0306

409-0002, MT. WITH 700-0148 CUT .25 LG. ONE AT EACH END AS SHOWN, TYP. 4 PLCS

910-9005 MT. TO 474-0299 WITH (3) 420-6605, TIGHTEN 9±1 IN LBS

J108

J107

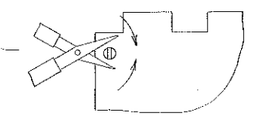
J106

J105

J104

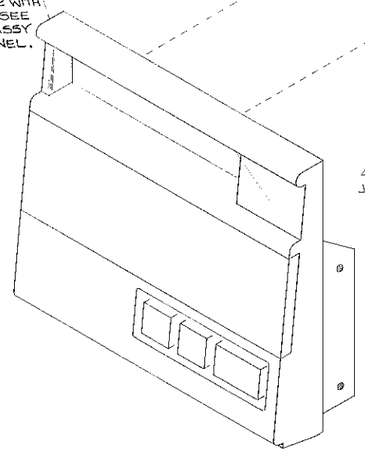
J602

LIGHTLY LUBRICATE THREADS OF 'PEM' NUTS WITH SILICONE GREASE (B.E. 700-0137)



TRIM LEGS ON 409-0002 FLUSH WITH BOTTOM OF 520-0026 AS SHOWN, 8 PLCS

471-0556-001 MT. TO 474-0299 AND 474-0292 WITH (4) 420-6605, SEE SHT. 2 FOR ASSY OF FRONT PANEL.



471-0567

CONNECTS TO J501 ON 910-9003

520-0026 MT. TO 474-0299 AND 474-0292 WITH (9) 420-6605

471-0555 MT. TO 474-0299 AND 474-0292 WITH (4) 420-6605.

403-2194, MT. TO 471-0555 WITH (1) 420-6106, (1) 423-6011, 4 PLCS.

TOLERANCE (DECIMAL) U.O.S.
.x ± .500 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY MSE 3-3-87
CHKD
MFG
PROJ. ENGR. 4-30-87
MFG
NEXT ASSY.

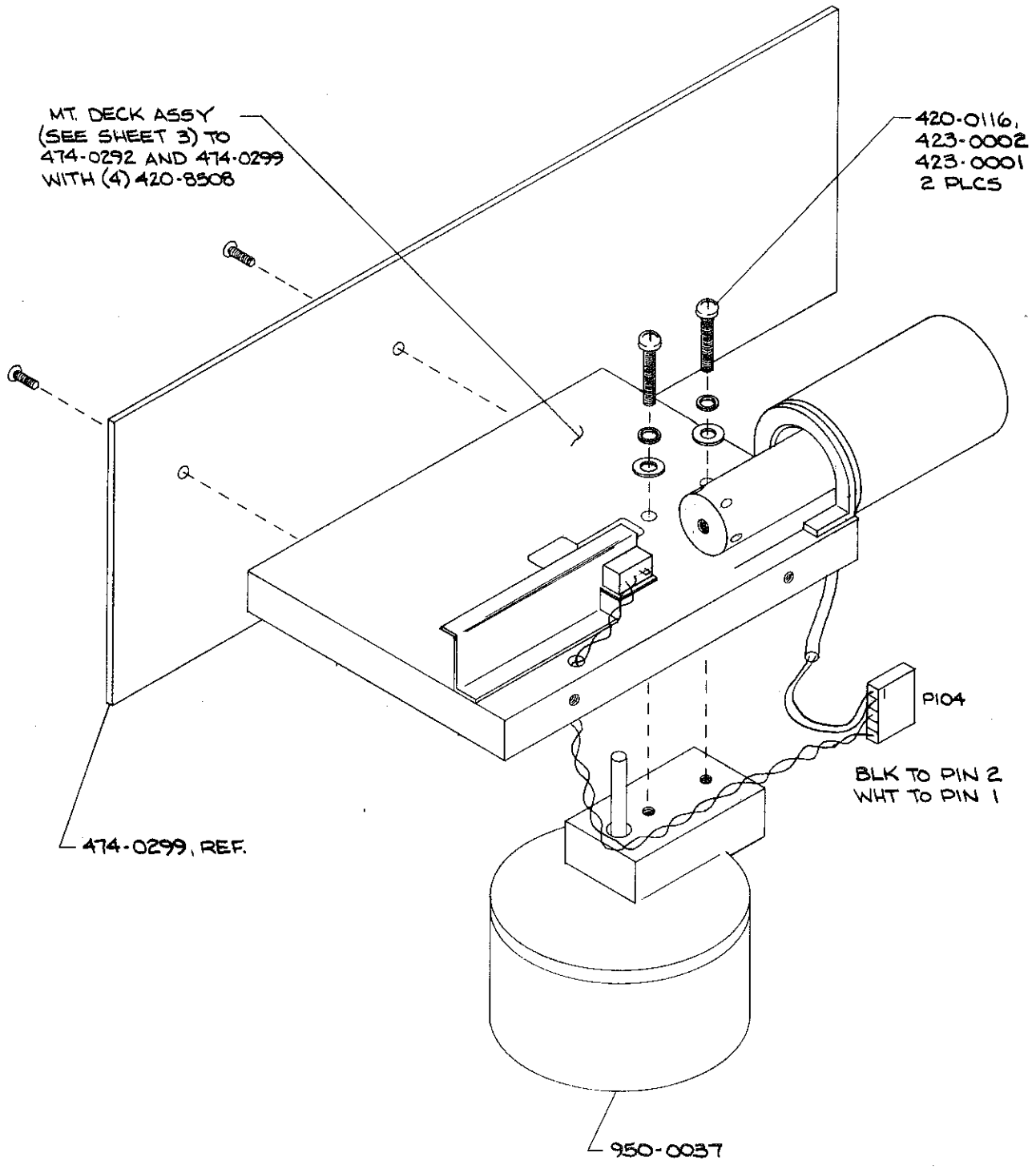
MATERIAL SEE B/M 950-9000
FINISH
SEE DWG RA552-0000

BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O. BOX 3606 QUINCY, IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST

TITLE ASSY, BASIC 9000 PLAYBACK

TYPE A | SIZE D | DWG. NO. 950-9000 | REV A

MODEL 9000 | SCALE ~ | SHEET 1 OF 3



597-9000-120A

FIGURE 7-3. ASSEMBLY, BASIC 9000 PLAYBACK (AD950-9000)

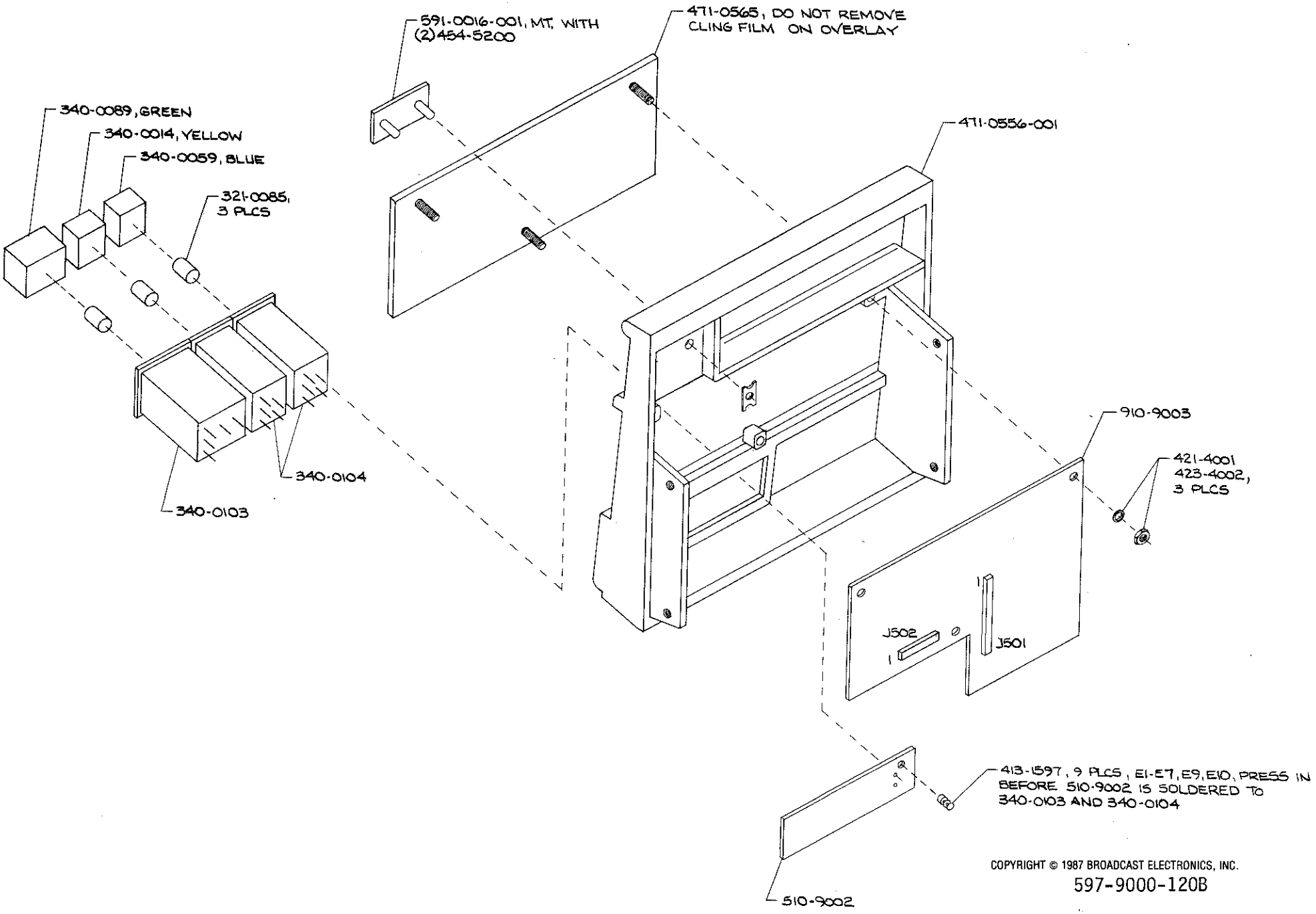
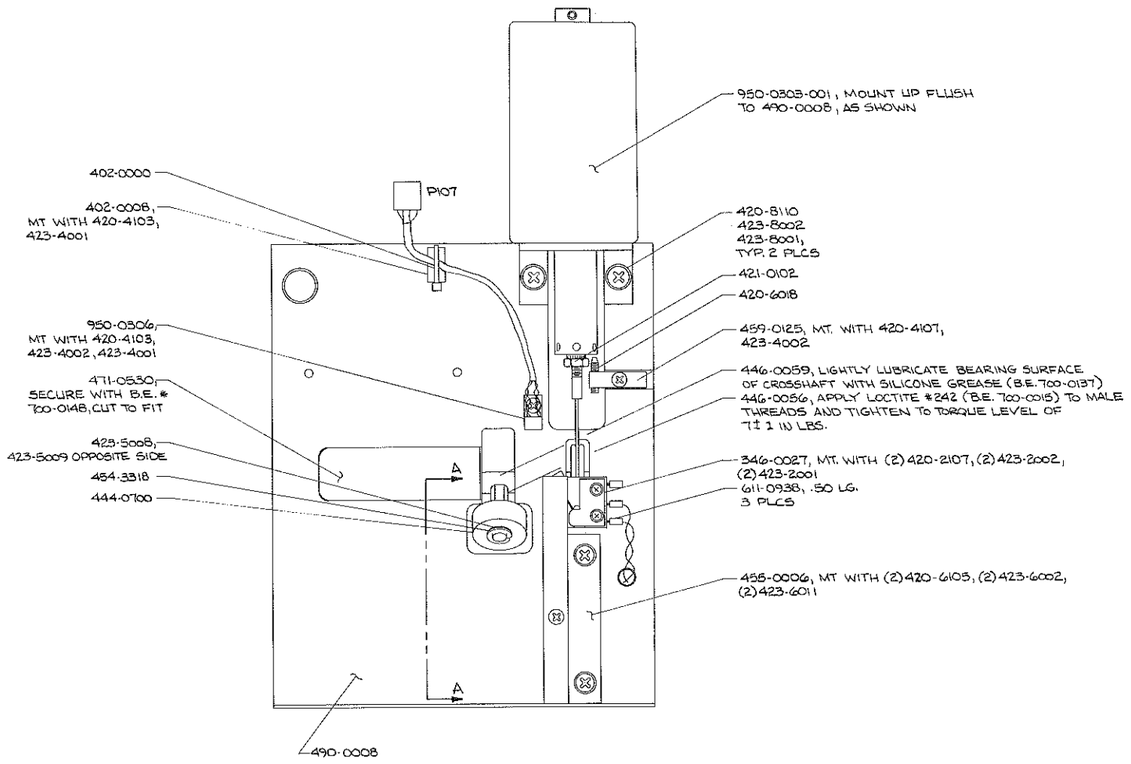
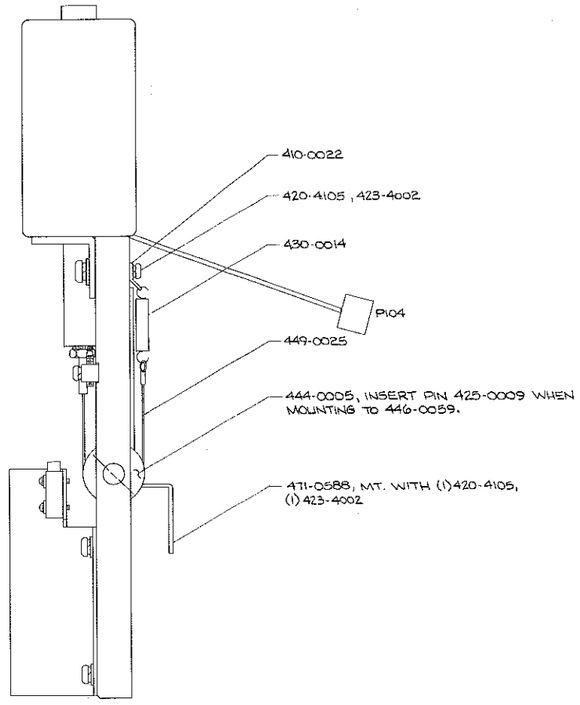
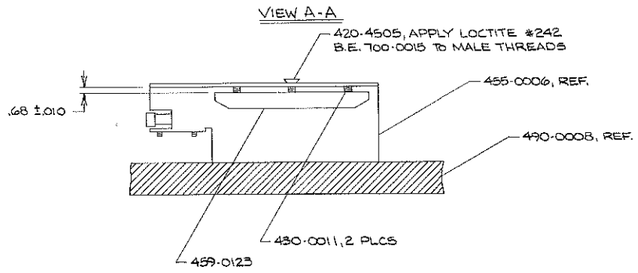
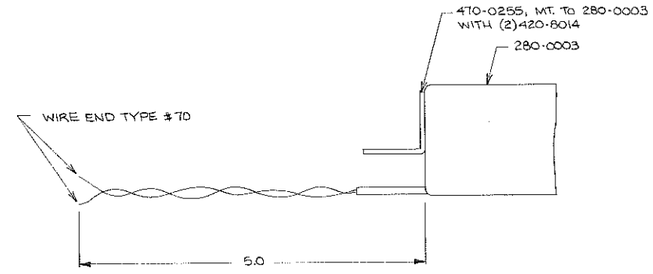


FIGURE 7-3. ASSEMBLY, BASIC 9000 PLAYBACK (AD950-9000)









SOLENOID ASSEMBLY #950-0303-001

TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY MSE 3-3-87
CHKD
MR
PROJ. ENGR. 5-1-87
MFG

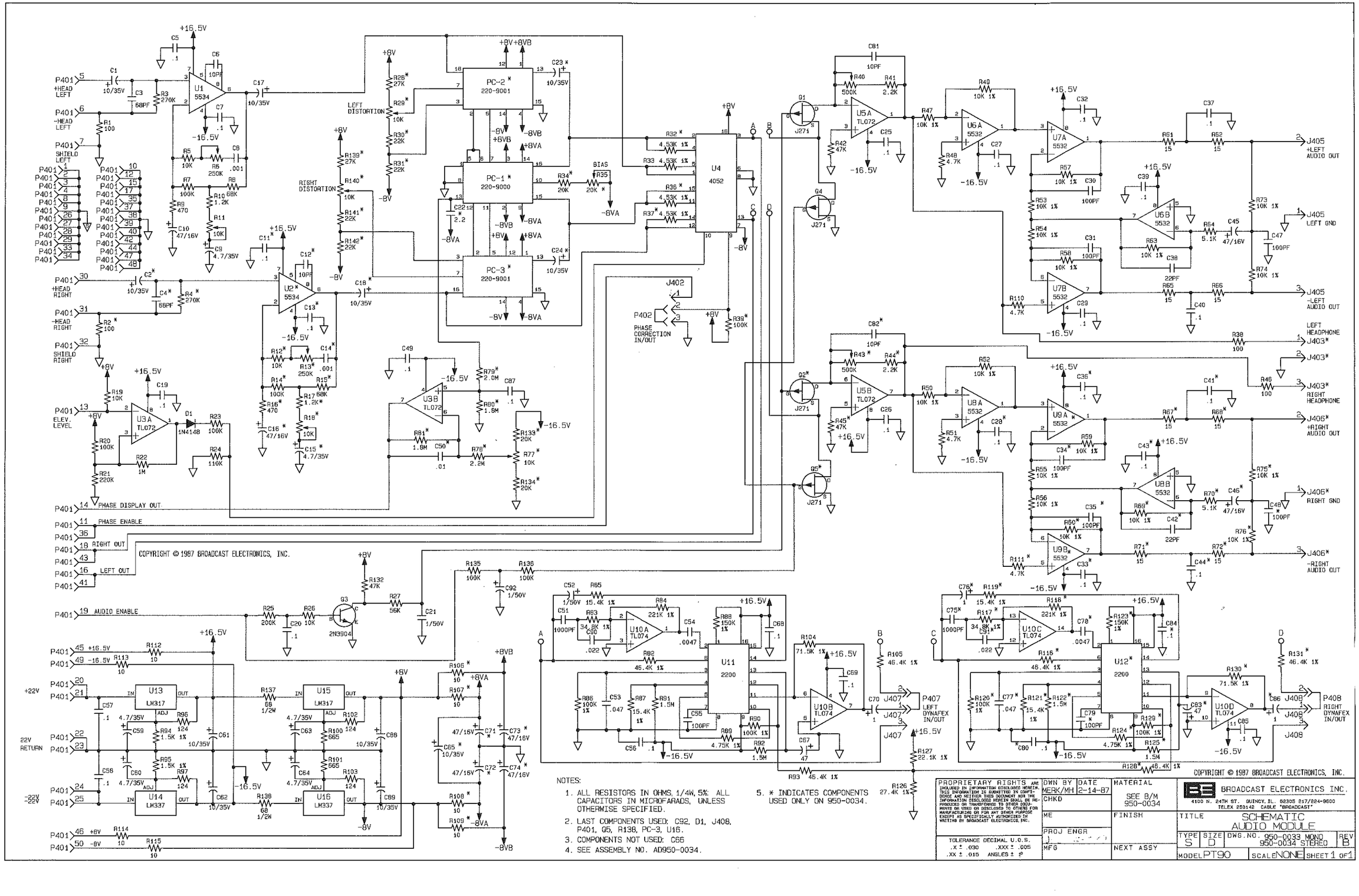
MATERIAL SEE B/M 950-9000
FINISH
SEE DWG RA592-0000
NEXT ASSY.

BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O. BOX 3606 QUINCY, IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST

TITLE ASSY, BASIC 9000 PLAYBACK

TYPE A | SIZE D | DWG. NO. 950-9000 | REV A

MODEL 9000 | SCALE ~ | SHEET 3 OF 3



NOTES:

1. ALL RESISTORS IN OHMS, 1/4W, 5%. ALL CAPACITORS IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENTS USED: C92, D1, J408, P401, Q5, R138, PC-3, U16.
3. COMPONENTS NOT USED: C66
4. SEE ASSEMBLY NO. AD950-0034.
5. * INDICATES COMPONENTS USED ONLY ON 950-0034.

TOLERANCE DECIMAL U.O.S.
.X ± .030 .XXX ± .005
.XX ± .015 ANGLES ± 2°

	DWN BY	DATE
	MERK/MH	2-14-87
	CHKD	
	ME	
	PROJ ENGR	
	MFG	

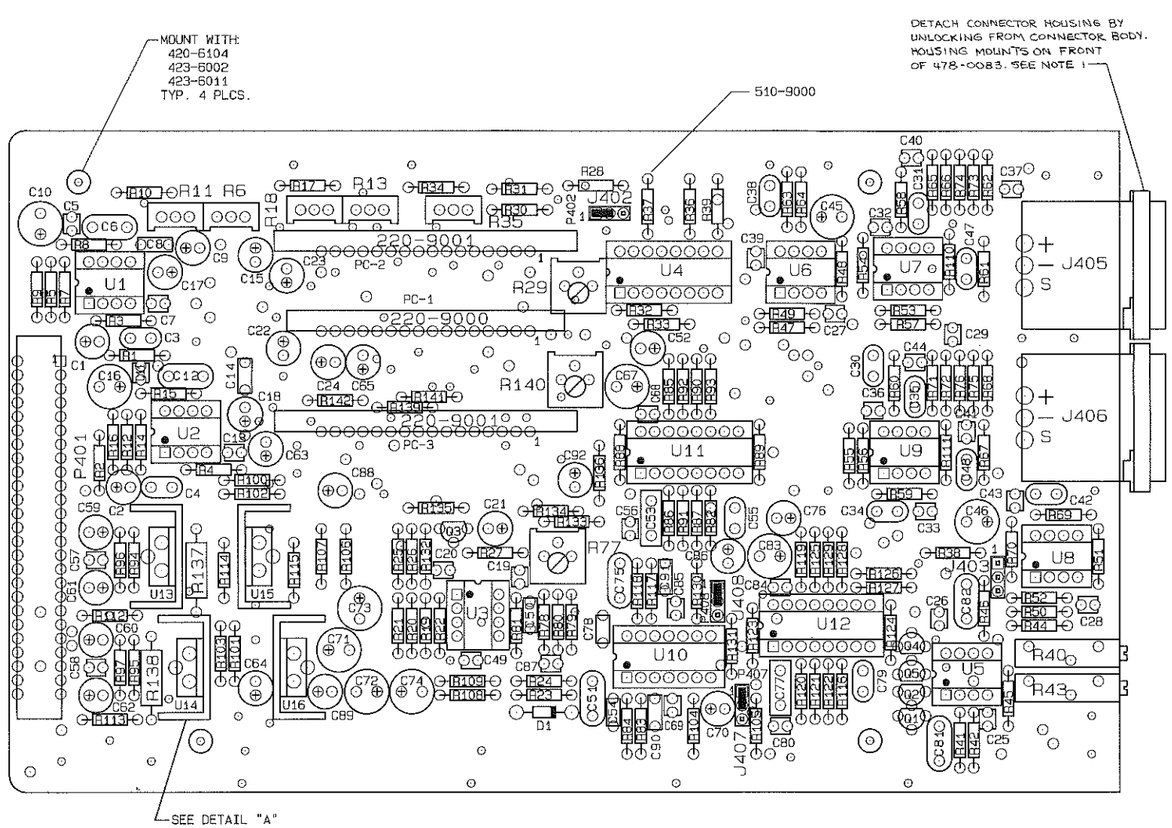
MATERIAL: SEE B/M 950-0034
FINISH:
NEXT ASSY:

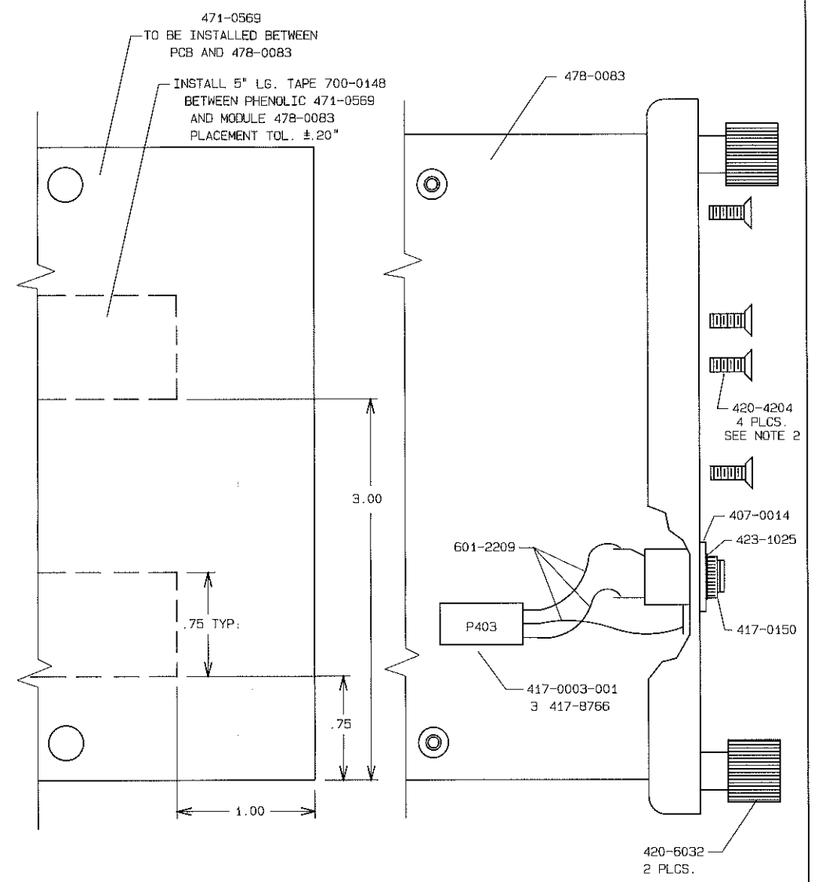
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE "BROADCAST"

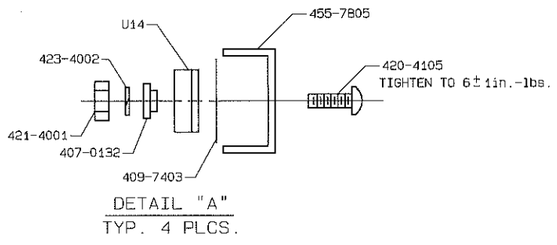
TITLE: SCHEMATIC AUDIO MODULE

TYPE	SIZE	DWG.NO.	REV
S	D	950-0033 MONO 950-0034 STEREO	B

MODEL FT90 SCALE NONE SHEET 1 OF 1







DETAIL "A"
TYP. 4 PLCS.

NOTES:

1. MOUNT J405 AND J406 TO 478-0083 BEFORE SOLDERING TO PCB.
2. APPLY LOCKTITE 242 700-0015 TO 420-4204, 4 PLCS.
3. TEST PCB BEFORE ADDING SHEETMETAL 478-0083.
4. TRIM ALL COMPONENT LEADS TO .040 ± .010.
5. COMPONENTS USED ON 950-0034 ONLY: R2, R4, R12-R18, R28-R32, R34-R37, R39, R43-R46, R50-R52, R55, R56, R59-R60, R67-R72, R75-R81, R106-R109, R111, R116-R125, R128-R131, R133, R134, R139-R142, C2, C4, C11-C16, C18, C22-C24, C28, C33-C36, C41-C44, C46, C48, C50, C65, C71-C80, C82-C84, C86, C91, Q2, G5, U2, U8, U9, U12, XU2, XU8, XU9, XU12, PC1-PC3, J408, P408, J406.

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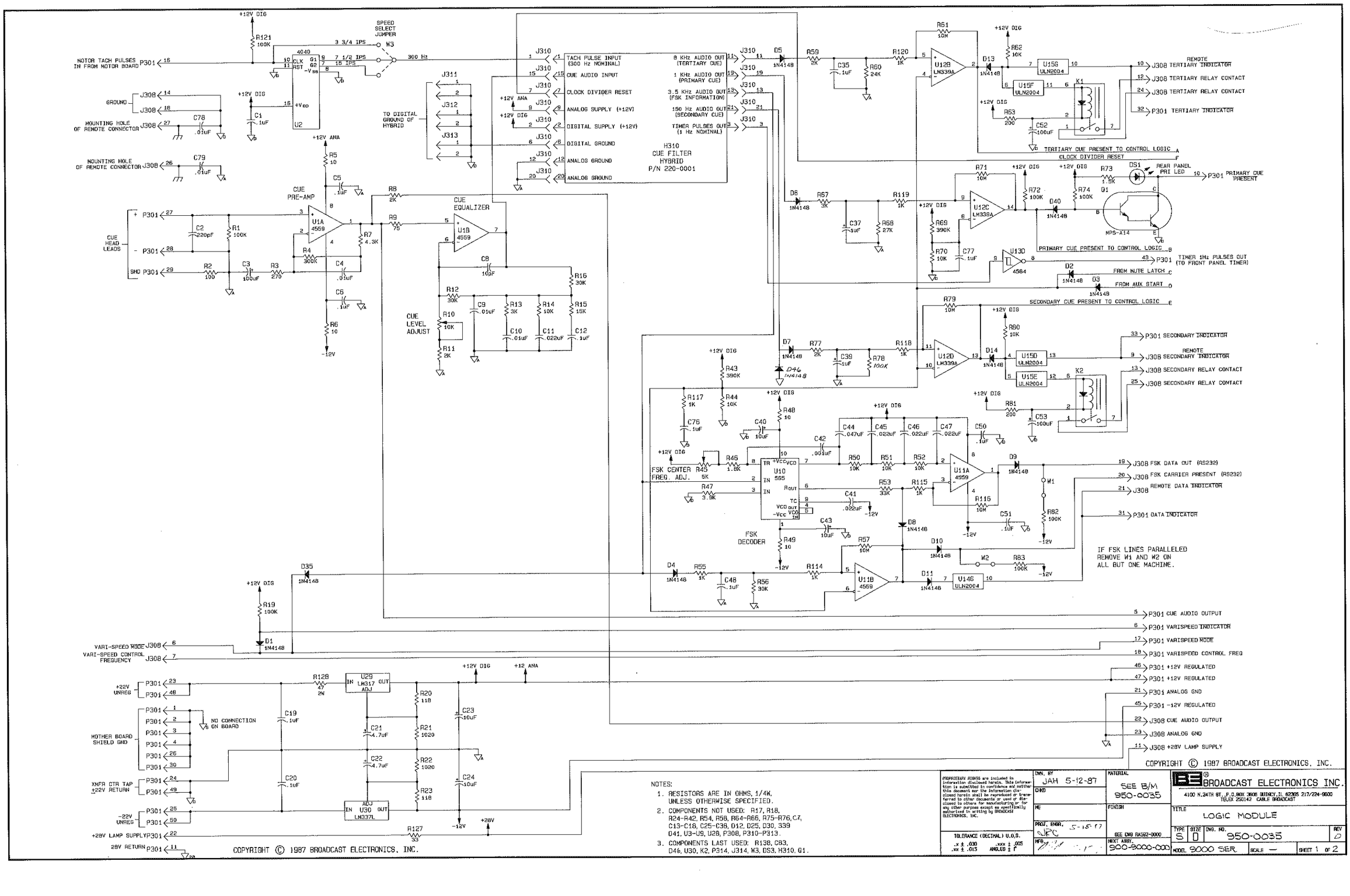
	CHKD		
	ME	FINISH	TITLE AUDIO MODULE ASSEMBLY
TOLERANCE DECIMAL U.O.S. .X ± .030 .XXX ± .005 .XX ± .015 ANGLES ± 1°	PROJ ENGR		TYPE A / SIZE D / DWG.NO. 950-0033/34 / REV A
	MFG	NEXT ASSY	MODEL PT90 / SCALE 2/1 / SHEET 1 OF 1


+12V DIG
R121 100K
SPEED SELECT JUMPER
3 3/4 IPS
W3
7 1/2 IPS
15 IPS
300 Hz
4040
CLK
RST
Q1
Q2
Q8
+Vss
-Vss
MOTOR TACH PULSES IN FROM MOTOR BOARD P301
GROUND J308
MOUNTING HOLE OF REMOTE CONNECTOR J308
C78 .01uF
C79 .01uF
C1 .1uF
U2
+Vdd
TO DIGITAL GROUND OF HYBRID
J311
J312
J313
J310
TACH PULSE INPUT (300 Hz NOMINAL)
CUE AUDIO INPUT
CLOCK DIVIDER RESET
+12V ANA
ANALOG SUPPLY (+12V)
DIGITAL SUPPLY (+12V)
DIGITAL GROUND
ANALOG GROUND
ANALOG GROUND
8 KHz AUDIO OUT (TERTIARY CUE)
1 KHz AUDIO OUT (PRIMARY CUE)
3.5 KHz AUDIO OUT (FSK INFORMATION)
150 Hz AUDIO OUT (SECONDARY CUE)
TIMER PULSES OUT (1 Hz NOMINAL)
H310
CUE FILTER HYBRID
P/N 220-0001
D5 1N4148
R59 2K
C35 .1uF
R60 24K
R120 1K
R61 10M
U12B LM339A
D13 1N4148
R62 10K
U15G ULN2004
U15F ULN2004
K1
R63 200
C52 100uF
REMOTE TERTIARY INDICATOR
J308 TERTIARY INDICATOR
J308 TERTIARY RELAY CONTACT
J308 TERTIARY RELAY CONTACT
P301 TERTIARY INDICATOR
TERTIARY CUE PRESENT TO CONTROL LOGIC
CLOCK DIVIDER RESET
CUE PRE-AMP
CUE HEAD LEADS
P301
SHD P301
C2 220pF
R1 100K
R2 100
C3 100uF
R3 270
R4 300K
U1A 4559
R5 10
C5 .1uF
R7 4.3K
C4 .01uF
C6 .1uF
R6 10
-12V
R8 2K
R9 75
CUE EQUALIZER
U1B 4559
C8 10pF
R16 30K
R12 30K
R10 10K
R11 2K
C9 .01uF
R13 3K
C10 .01uF
R14 10K
C11 .022uF
R15 15K
C12 .1uF
CUE LEVEL ADJUST
D6 1N4148
R67 3K
C37 1uF
R68 27K
R119 1K
R71 10M
U12C LM339A
R69 390K
R70 10K
C77 1uF
R72 100K
D40 1N4148
R73 1.5K
DS1
REAR PANEL PRI LED
R74 100K
Q1
MPS-A14
P301 PRIMARY CUE PRESENT
PRIMARY CUE PRESENT TO CONTROL LOGIC
U13D 4584
TIMER 1Hz PULSES OUT (TO FRONT PANEL TIMER)
D2 1N4148
D3 1N4148
FROM MUTE LATCH
FROM AUX START
SECONDARY CUE PRESENT TO CONTROL LOGIC
D7 1N4148
R77 2K
C39 1uF
R78 100K
R118 1K
R79 10M
U12D LM339A
D14 1N4148
R80 10K
U15D ULN2004
U15E ULN2004
K2
R81 200
C53 100uF
P301 SECONDARY INDICATOR
REMOTE
J308 SECONDARY INDICATOR
J308 SECONDARY RELAY CONTACT
J308 SECONDARY RELAY CONTACT
R43 390K
R117 1K
R44 10K
C76 .1uF
C40 10uF
R48 10
C42 .001uF
C44 .047uF
C45 .022uF
C46 .022uF
C47 .022uF
C50 .1uF
FSK CENTER FREQ. ADJ. R45 5K
R46 1.8K
U10 565
R47 3.9K
C41 .022uF
R50 10K
R51 10K
R52 10K
R53 33K
R115 1K
R116 10M
U11A 4559
C51 .1uF
D9 1N4148
W1
RB2 100K
J308 FSK DATA OUT (RS232)
J308 FSK CARRIER PRESENT (RS232)
J308 REMOTE DATA INDICATOR
P301 DATA INDICATOR
FSK DECODER
C43 10uF
R49 10
R57 10M
D8 1N4148
D10 1N4148
W2
RB3 100K
D4 1N4148
R55 1K
C48 1uF
R56 30K
R114 1K
U11B 4559
D11 1N4148
U14G ULN2004
IF FSK LINES PARALLELED REMOVE W1 AND W2 ON ALL BUT ONE MACHINE.
D35 1N4148
R19 100K
D1 1N4148
VARI-SPEED MODE J308
VARI-SPEED CONTROL FREQUENCY J308
P301 CUE AUDIO OUTPUT
P301 VARISPEED INDICATOR
P301 VARISPEED MODE
P301 VARISPEED CONTROL FREQ
P301 +12V REGULATED
P301 +12V REGULATED
P301 ANALOG GND
P301 -12V REGULATED
J308 CUE AUDIO OUTPUT
J308 ANALOG GND
J308 +28V LAMP SUPPLY
+22V UNREG
MOTHER BOARD SHIELD GND
NO CONNECTION ON BOARD
XMFR CTR TAP +22V RETURN
-22V UNREG
+28V LAMP SUPPLY
28V RETURN
R128 47 2W
U29 LM317 ADJ
C19 1uF
C20 1uF
C21 4.7uF
C22 4.7uF
R20 118
R21 1020
R22 1020
R23 118
C23 10uF
C24 10uF
ADJ U30 OUT LM337L
R127 33
+28V
+12V ANA
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NOTES:
1. RESISTORS ARE IN OHMS, 1/4W, UNLESS OTHERWISE SPECIFIED.
2. COMPONENTS NOT USED: R17, R18, R24-R42, R54, R58, R64-R66, R75-R76, C7, C13-C18, C25-C38, D12, D25, D30, 339 041, U3-U9, U28, P308, P310-P313.
3. COMPONENTS LAST USED: R138, CB3, D46, U30, K2, P314, J314, W3, DS3, H310, Q1.
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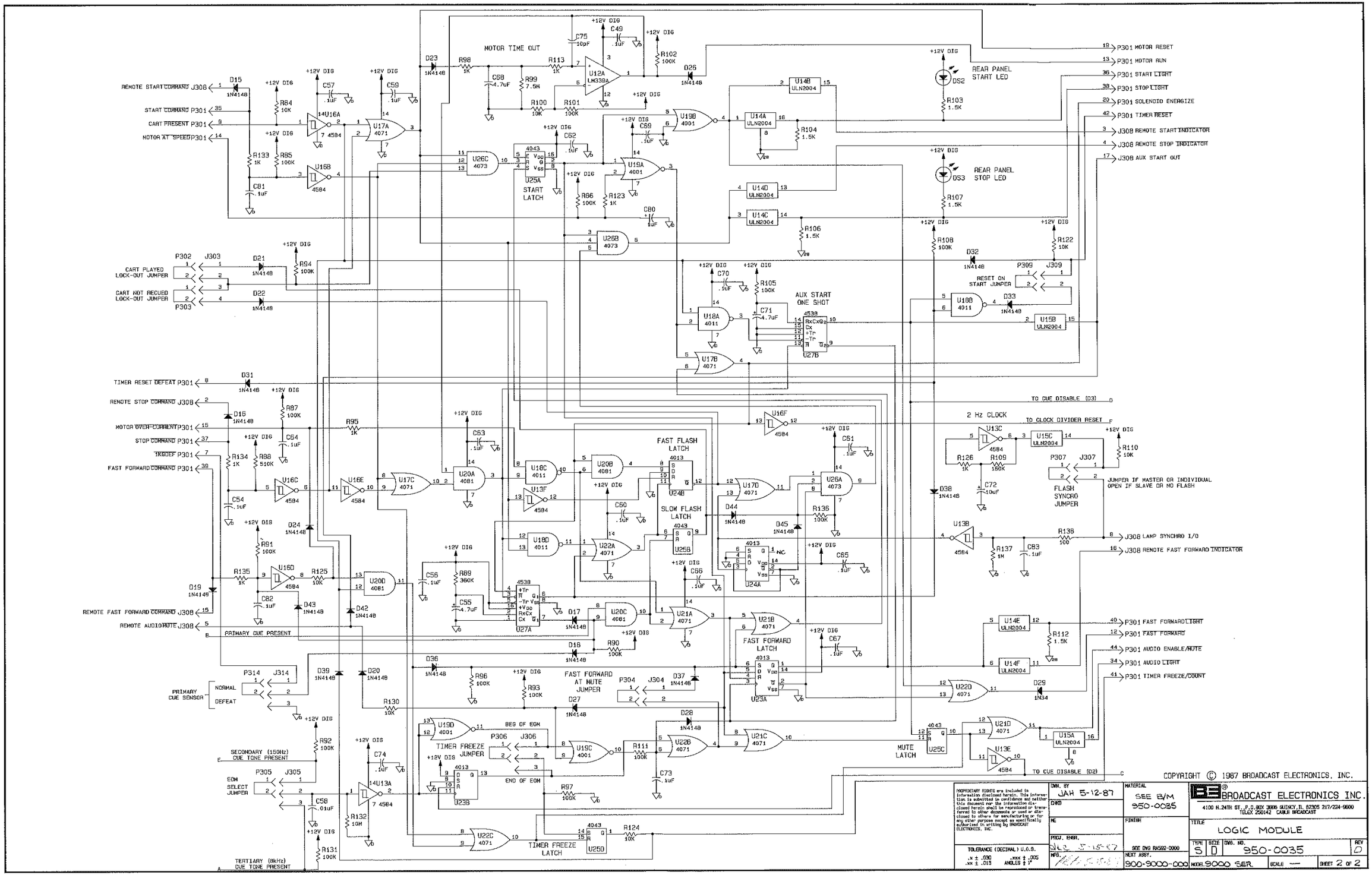
DWN. BY JAH 5-12-87
CHKD
ME
PROJ. ENGR. JFC 5-15-87
MFG
TOLERANCE (DECIMAL) U.O.S. .x ± .030 .xxx ± .005 .xx ± .015 ANGLES ± 1°
MATERIAL SEE B/M 950-0035
FINISH SEE DWG RA582-0000
NEXT ASSY. 900-9000-000
BROADCAST ELECTRONICS INC.
4100 N.24TH ST., P.O.BOX 3808 QUINCY,IL 62305 217/224-9600 TELEX 250142 CABLE BROADCAST
TITLE LOGIC MODULE
TYPE S SIZE D DWG. NO. 950-0035 REV D
MODEL 9000 SER. SCALE — SHEET 1 OF 2


MOTOR TIME OUT
REMOTE START COMMAND J308
START COMMAND P301
CART PRESENT P301
MOTOR AT SPEED P301
START LATCH
REAR PANEL START LED
REAR PANEL STOP LED
P301 MOTOR RESET
P301 MOTOR RUN
P301 START LIGHT
P301 STOP LIGHT
P301 SOLENOID ENERGIZE
P301 TIMER RESET
J308 REMOTE START INDICATOR
J308 REMOTE STOP INDICATOR
J308 AUX START OUT
CART PLAYED LOCK-OUT JUMPER
CART NOT RECUED LOCK-OUT JUMPER
RESET ON START JUMPER
AUX START ONE SHOT
TIMER RESET DEFEAT P301
REMOTE STOP COMMAND J308
MOTOR OVER-CURRENT P301
STOP COMMAND P301
TKODEF P301
FAST FORWARD COMMAND P301
TO CUE DISABLE (D3)
2 Hz CLOCK
TO CLOCK DIVIDER RESET
FLASH SYNCRO JUMPER
JUMPER IF MASTER OR INDIVIDUAL OPEN IF SLAVE OR NO FLASH
J308 LAMP SYNCHRO I/O
J308 REMOTE FAST FORWARD INDICATOR
REMOTE FAST FORWARD COMMAND J308
REMOTE AUDIO MUTE J308
PRIMARY CUE PRESENT
FAST FORWARD AT MUTE JUMPER
P301 FAST FORWARD LIGHT
P301 FAST FORWARD
P301 AUDIO ENABLE/MUTE
P301 AUDIO LIGHT
P301 TIMER FREEZE/COUNT
PRIMARY CUE SENSOR
NORMAL
DEFEAT
SECONDARY (150Hz) CUE TONE PRESENT
EOM SELECT JUMPER
TERTIARY (8kHz) CUE TONE PRESENT
TIMER FREEZE JUMPER
BEG OF EOM
END OF EOM
TIMER FREEZE LATCH
FAST FLASH LATCH
SLOW FLASH LATCH
FAST FORWARD LATCH
MUTE LATCH
TO CUE DISABLE (D2)
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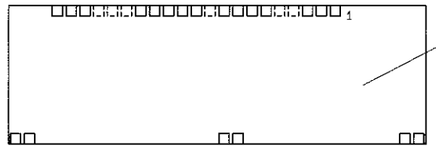
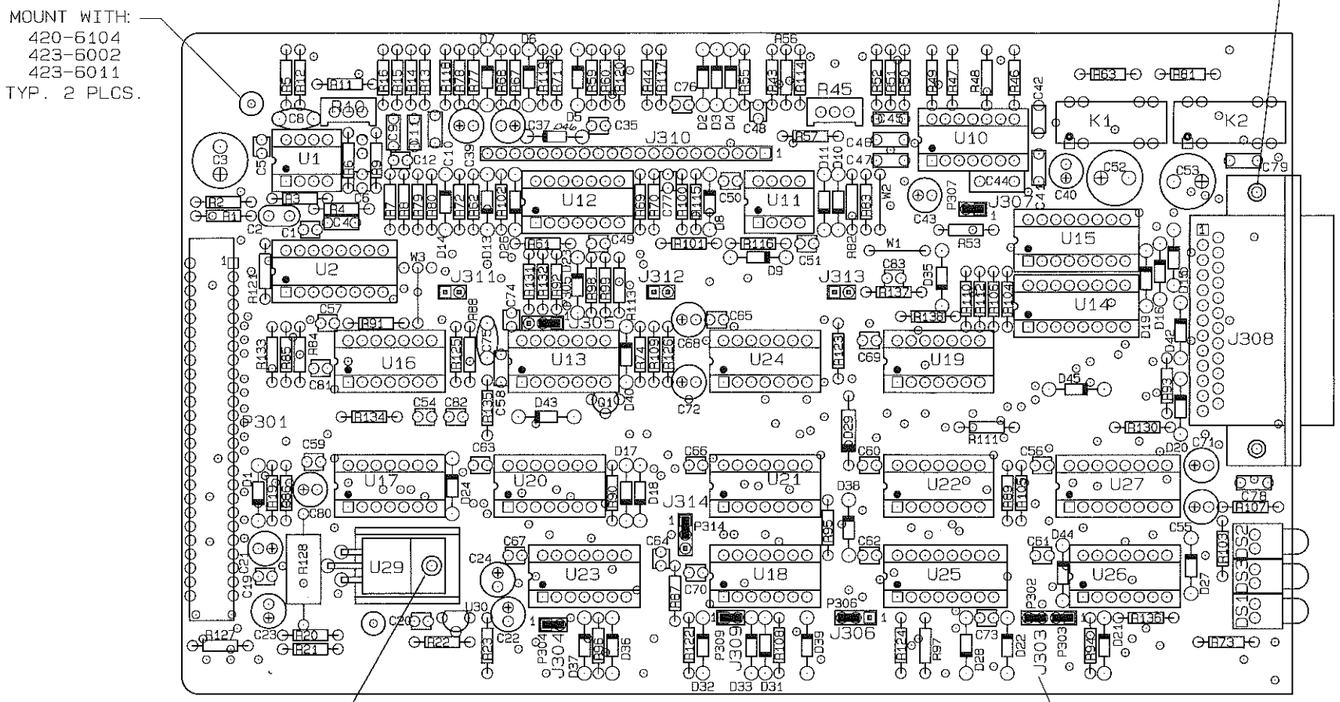
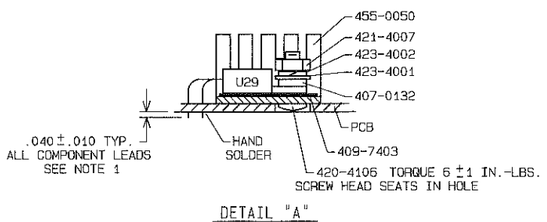
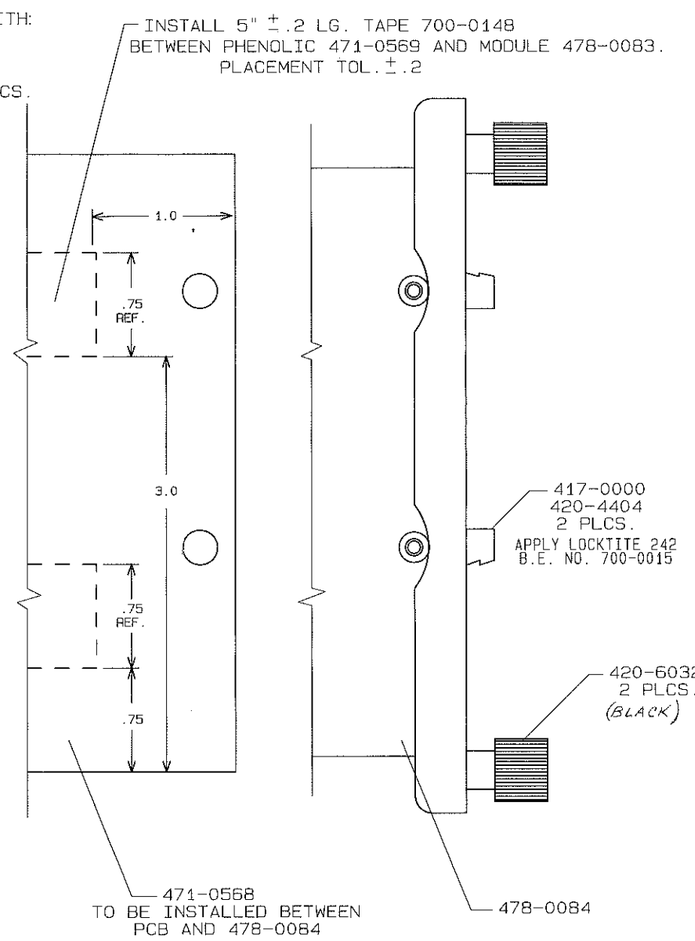
BROADCAST ELECTRONICS INC.
4100 N.24TH ST., P.O.BOX 3606 QUINCY, IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST
TITLE LOGIC MODULE
SIZE D DWG. NO. 950-0035 REV D
MODEL 9000 SER. SCALE — SHEET 2 OF 2
DWN. BY JAH 5-12-87
MATERIAL SEE B/M 950-0035
FINISH SEE DWG RA592-0000
NEXT ASSY. 900-9000-000







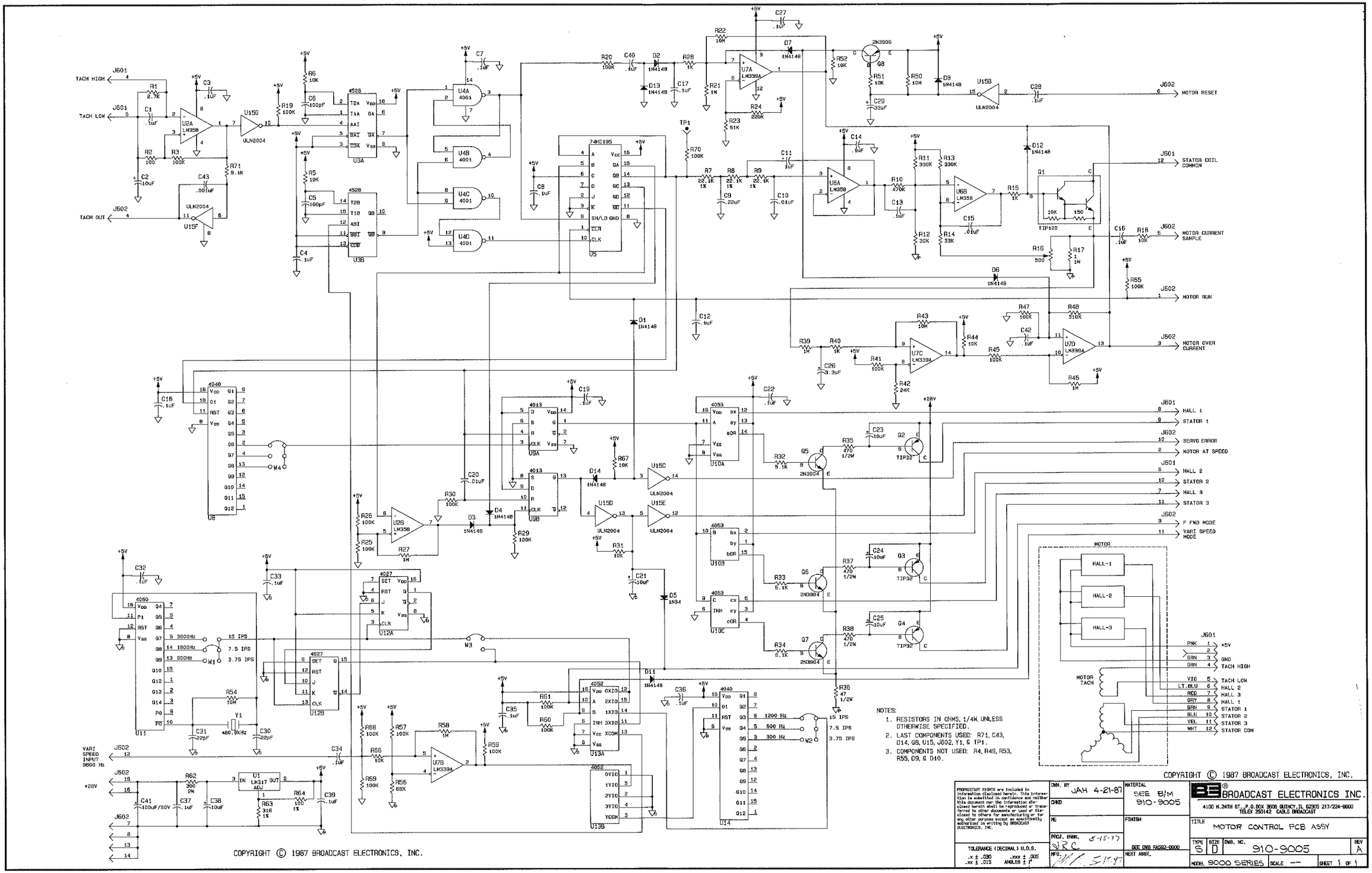
DETAIL "A"



NOTES:
1. TRIM ALL COMPONENT LEADS TO .040±.010
2. TEST PCB BEFORE SHEET METAL IS ADDED
3. SEE SCHEMATIC SD950-0035

TOLERANCE DECIMAL U.O.S.
X ± .030 .XXX ± .005
.XX ± .015 ANGLES ± 1°

DWN BY MDRK	DATE 1-19-87	MATERIAL SEE B/M 950-0035	BROADCAST ELECTRONICS INC. 4100 N. 24TH ST. QUINCY, IL. 62305 217/224-9800 TELEX 250142 CABLE "BROADCAST"
CHKD			
ENGR		FINISH	TITLE LOGIC MODULE ASSEMBLY
PROJ ENGR			TYPE A SIZE D DWG.NO. 950-0035 REV C
MFG		NEXT ASSY	MODEL PT90PS SCALE 2/1 SHEET 1 OF 1



NOTES:

1. RESISTORS IN OHMS, 1/4W, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENTS USED: R71, C43, D14, Q8, U15, J602, Y1, & TP1.
3. COMPONENTS NOT USED: R4, R49, R53, R55, D9, & D10.

TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

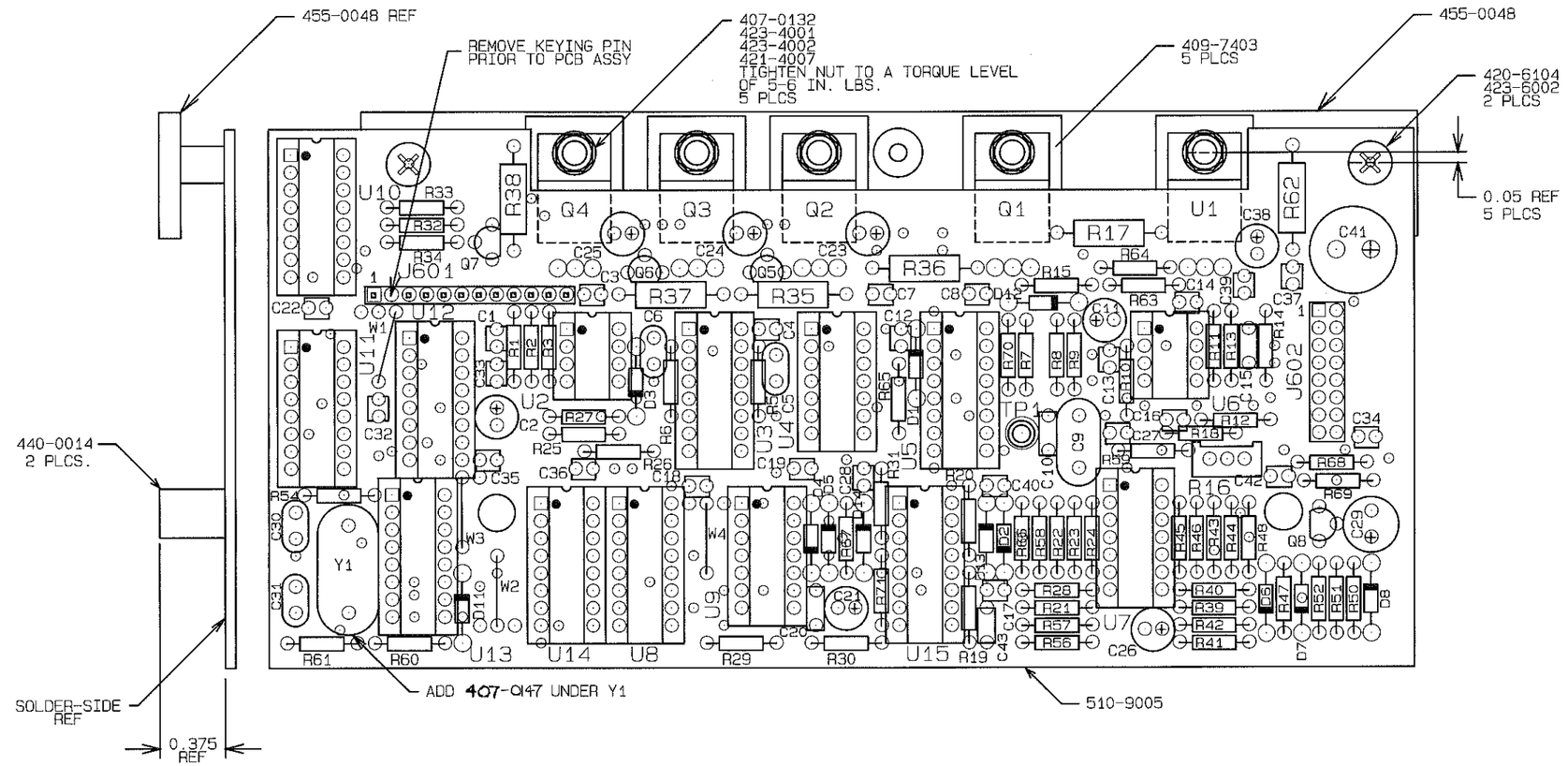
DWN. BY JAH 4-21-87
CHKD
ME
PROJ. ENGR. 5-15-87
MFG.
NEXT ASSY.

MATERIAL SEE B/M 910-9005
FINISH SEE DWG 8A592-0000

BROADCAST ELECTRONICS INC.
4100 N.24TH ST., P.O.BOX 3606 QUINCY,IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST

TITLE MOTOR CONTROL PCB ASSY

TYPE SD SIZE DWG. NO. 910-9005 REV A
MODEL 9000 SERIES SCALE — SHEET 1 OF 1



NOTES:

1. SEE SCHEMATIC NO. SD910-9005.

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TOLERANCE DECIMAL U.O.S.
.X ± .030 .XXX ± .005
.XX ± .015 ANGLES ± 1°

DWN BY	DATE
M. HAYDEN	11-19-86
CHKD	
ME	12-4-87
PROJ ENGR	
MFG	

MATERIAL
SEE B/M 910-9005

FINISH

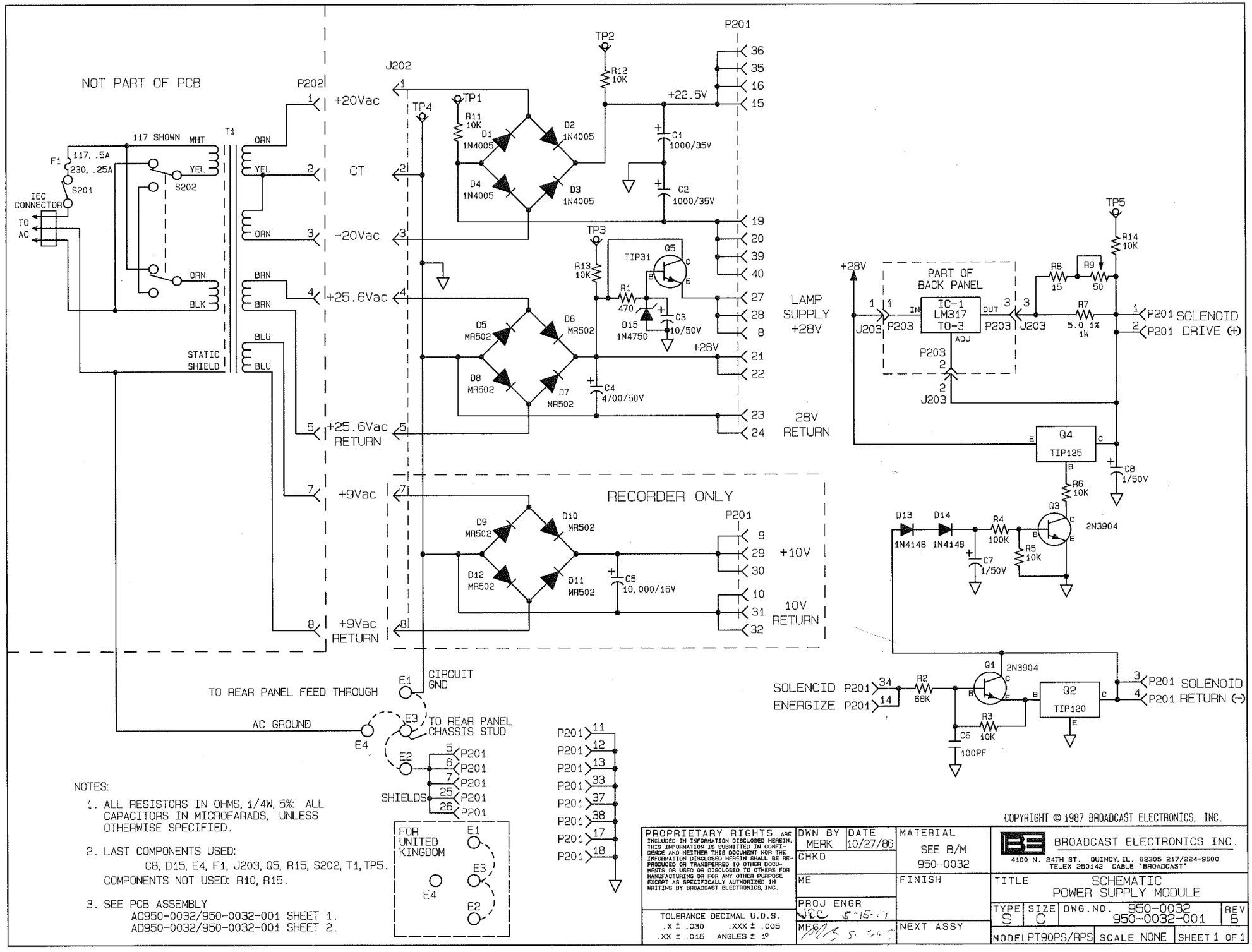
NEXT ASSY

BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE "BROADCAST"

TITLE PCB ASSEMBLY
MOTOR CONTROL BOARD

TYPE	SIZE	DWG.NO.	REV
A	C	910-9005	B

MODEL PT90 | SCALE 2/1 | SHEET 1 OF 1



NOTES:

1. ALL RESISTORS IN OHMS, 1/4W, 5%: ALL CAPACITORS IN MICROFARADS, UNLESS OTHERWISE SPECIFIED.
2. LAST COMPONENTS USED:
   C8, D15, E4, F1, J203, Q5, R15, S202, T1, TP5.
   COMPONENTS NOT USED: R10, R15.
3. SEE PCB ASSEMBLY
   AC950-0032/950-0032-001 SHEET 1.
   AD950-0032/950-0032-001 SHEET 2.

TOLERANCE DECIMAL U.O.S.
.X ± .030 .XXX ± .005
.XX ± .015 ANGLES ± 1°

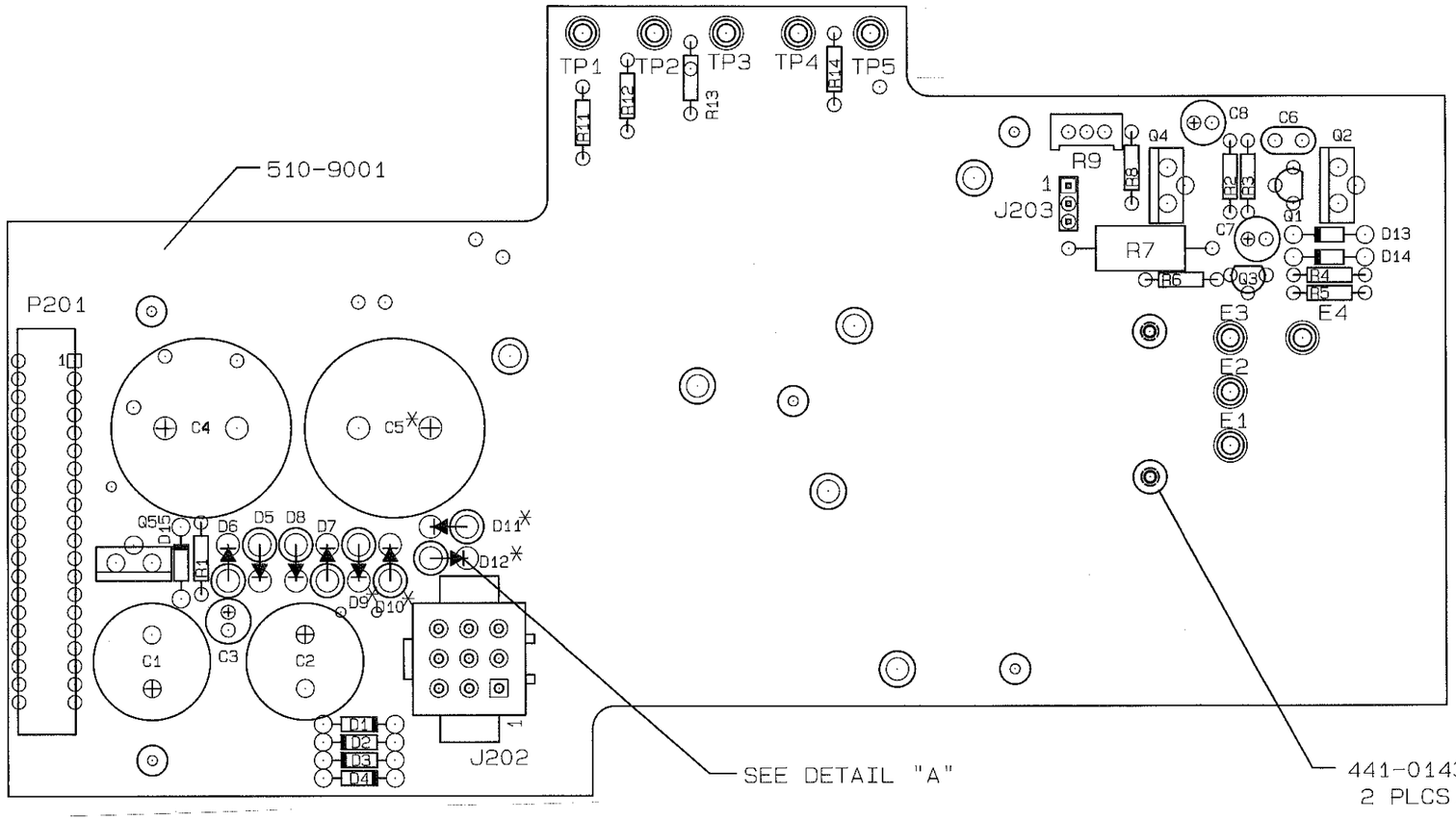
DWN BY	MERK
DATE	10/27/86
CHKD	
ME	
PROJ ENGR	JCC 5-15-87
MFG	5-15-87
MATERIAL	SEE B/M 950-0032
FINISH	
NEXT ASSY	

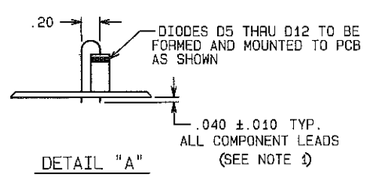
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE "BROADCAST"

TITLE SCHEMATIC
POWER SUPPLY MODULE

TYPE	SIZE	DWG.NO.	REV
S	C	950-0032 950-0032-001	B

MODELPT90PS/RPS | SCALE NONE | SHEET 1 OF 1





DETAIL "A"

NOTE:

1. TRIM ALL COMPONENT LEADS TO .040 ±.010
2. * INDICATES COMPONENTS ON 950-0032-001 ONLY.
3. SEE SCHEMATIC SC950-0032/950-0032-001.
4. SEE AD950-0032/950-0032-001 FOR SHEET 2.

TOLERANCE DECIMAL U.O.S.
.X ± .030 .XXX ± .005
.XX ± .015 ANGLES ± 1°

DWN BY MERK	DATE 10-29-86
CHKD	
ME	5-15-87
PROJ ENGR	5-15-87
MFG	5-15-87

MATERIAL: SEE B/M 950-0032 950-0032-001

FINISH

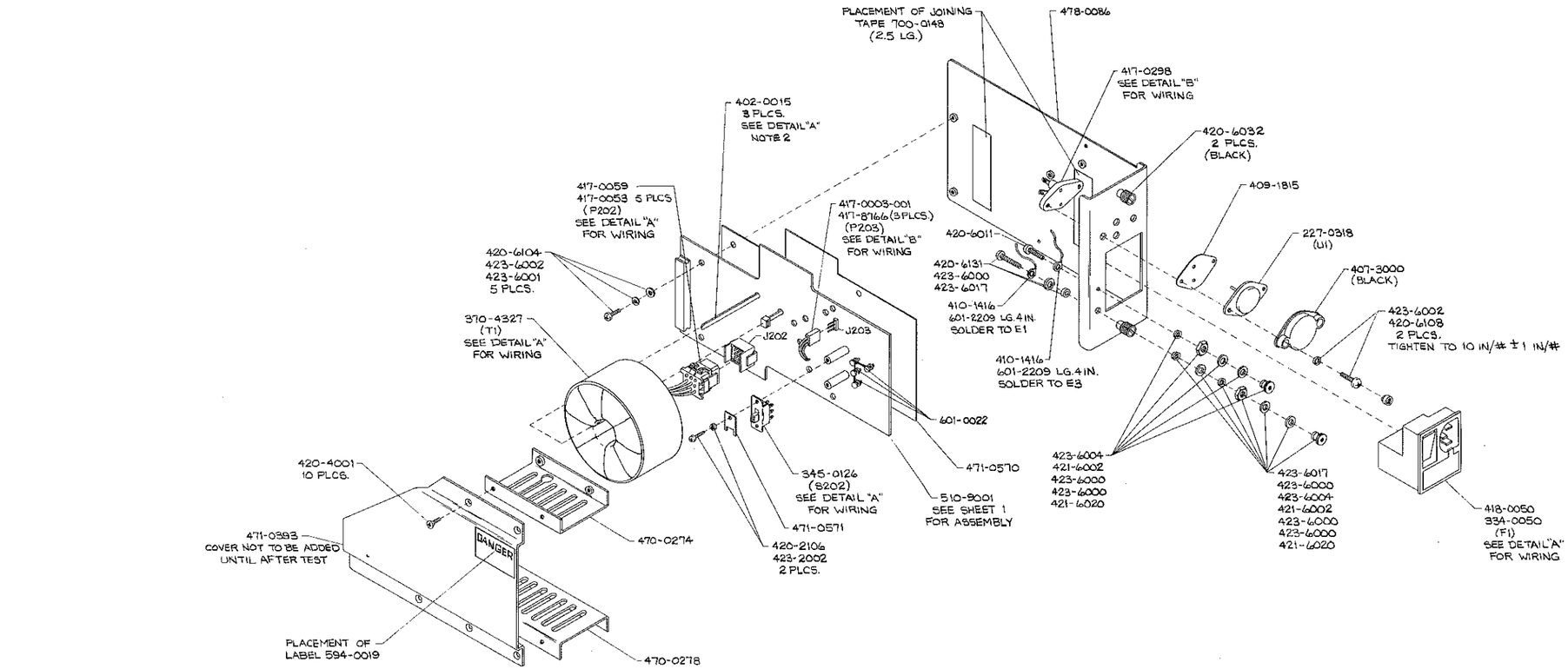
NEXT ASSY

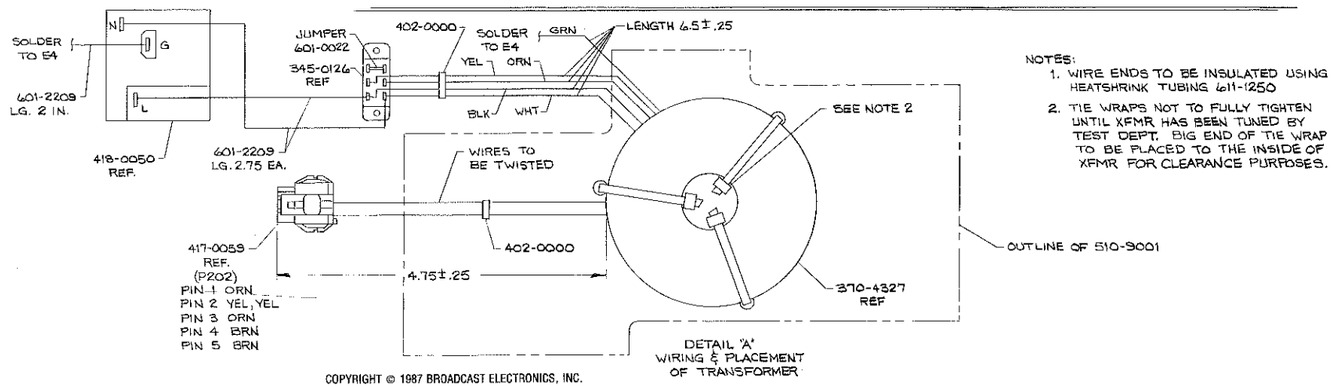
BROADCAST ELECTRONICS INC.
4100 N. 24TH ST. QUINCY, IL. 62305 217/224-9600
TELEX 250142 CABLE "BROADCAST"

TITLE: PCB ASSEMBLY POWER SUPPLY MODULE

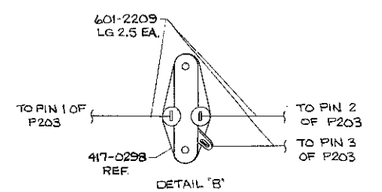
TYPE	SIZE	DWG. NO.	REV
A	C	950-0032 950-0032-001	A

MODEL PT90PS/RPS | SCALE 2/1 | SHEET 1 OF 2





NOTES:
1. WIRE ENDS TO BE INSULATED USING HEATSHRINK TUBING 611-1250
2. TIE WRAPS NOT TO FULLY TIGHTEN UNTIL XFMR HAS BEEN TUNED BY TEST DEPT. BIG END OF TIE WRAP TO BE PLACED TO THE INSIDE OF XFMR FOR CLEARANCE PURPOSES.



DETAIL "B"

NOTE
WIRES TO BE INSULATED USING HEATSHRINK TUBING 611-1250

SHEET 1 OF DRAWING IS "C" SIZE

TOLERANCE (DECIMAL) U.O.S.
x ± .030 xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY JAH 5-4-87
CHKD
ME 5-7-87
PROJ. ENGR. 5-6-87
MFG. 5-6-87

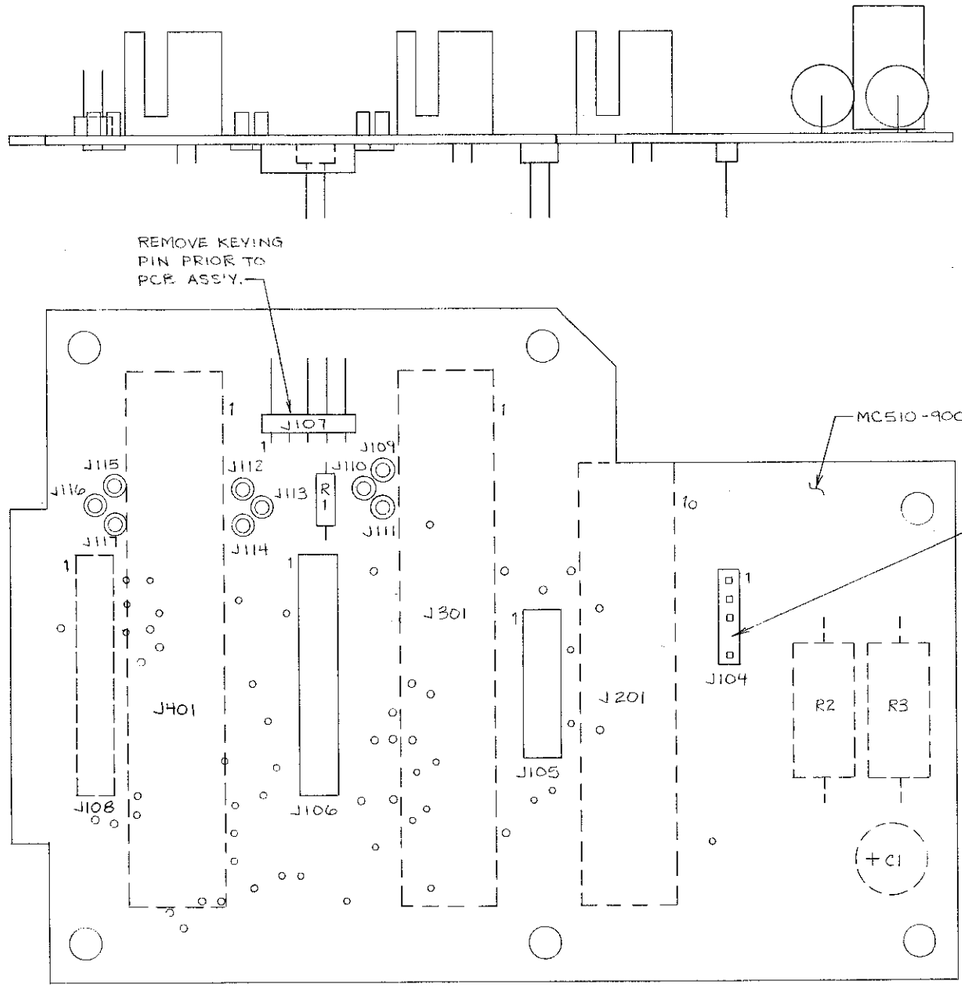
MATERIAL SEE B/M 950-0032
FINISH —
SEE DWG RA592-0000
NEXT ASSY.

BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O. BOX 3606 QUINCY, IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST

TITLE ASSEMBLY POWER SUPPLY MODULE

TYPE A | SIZE D | DWG. NO. 950-0032 | REV A

MODEL 3000 SER. | SCALE 1/2 | SHEET 2 OF 2



NOTES:

1. AFTER COMPONENTS ON COMPONENT SIDE OF BOARD ARE WAVE SOLDERED, THEN J201, J301, & J401 ARE TO BE INSTALLED USING APPROPRIATE SEATING TOOLS AS PER AMP APPLICATION SPECIFICATION NO. 114-9009 REV O SHEET 1 THRU 8 DATED 2-5-86

TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY KLS 11-4-86
CHKD MH 5-5-87
ME 5-5-87
PROJ. ENGR. 4-7-87
MFG. 5-4-87

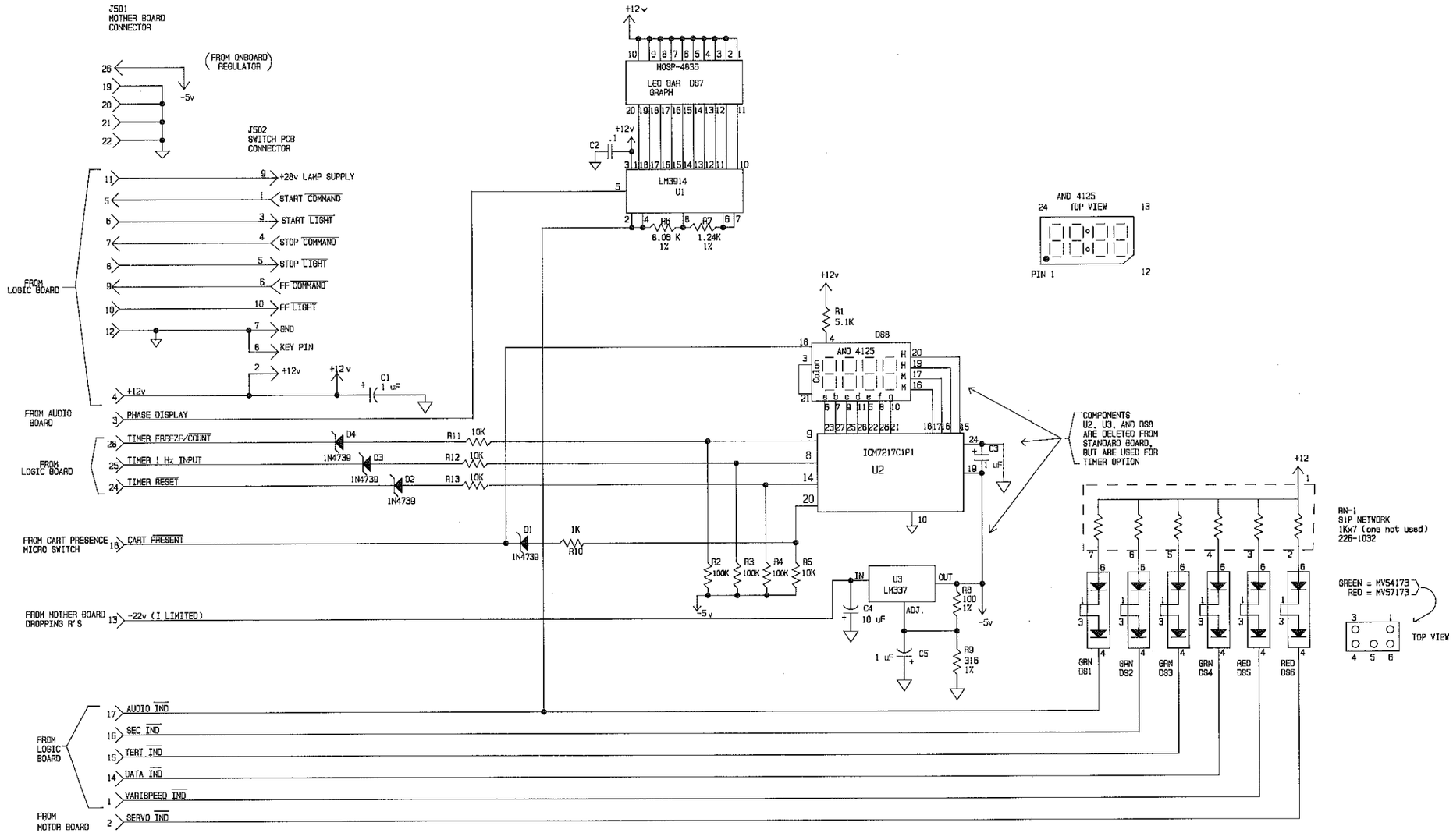
MATERIAL SEE B/M 910-9006
FINISH
~~SEE DWG RA592-9080~~
NEXT ASSY.

BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O. BOX 3606 QUINCY, IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST

TITLE PCB ASSEMBLY — MOTHER BD.

TYPE	SIZE	DWG. NO.	REV
A	C	910-9006	B

MODEL 9006 NEXT ASSY SCALE 2/1 SHEET 1 OF 1



TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY TLL 5-19-87
CHKD
ME
PROJ. ENGR. JRC 5-29-87
MFG.

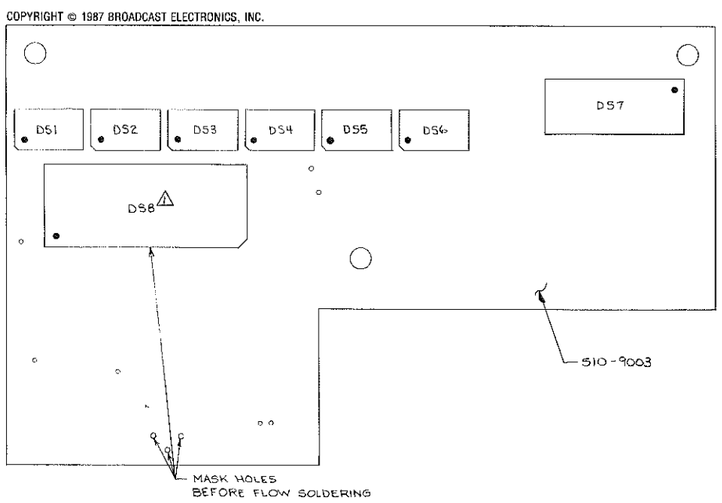
MATERIAL
FINISH
SEE DWG RA592-0000
NEXT ASSY.

BROADCAST ELECTRONICS INC.
4100 N.24TH ST., P.O.BOX 3606 QUINCY, IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST

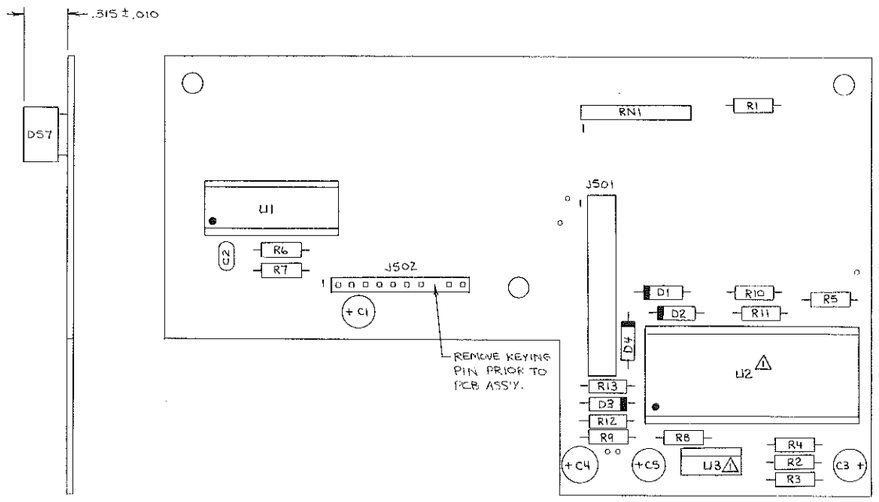
TITLE
SCHEMATIC FRONT PANEL
STATUS BOARD PT9OPS

TYPE	SIZE	DWG. NO.	REV
S	C	910-9003	A

MODEL | SCALE NONE | SHEET 1 OF 1



SOLDER SIDE



COMPONENT SIDE

⚠ COMPONENTS INSTALLED WITH TIMER OPTION B.E.I. NO. 900-9016 (I.C. SOCKET FOR U2 SHOULD BE INSTALLED AS A PART OF ASSY NO. 910-9003).

TOLERANCE (DECIMAL) U.O.S.
.x ± .030 .xxx ± .005
.xx ± .015 ANGLES ± 1°

DWN. BY KLS 9-23-86
CHKD MH 5-5-87
ME 4-29-87
PROJ. ENGR.
MFG.

MATERIAL SEE B/M 910-9003
FINISH
~~SEE DWG RA552-0090~~
NEXT ASSY.

BROADCAST ELECTRONICS INC.
4100 N. 24TH ST., P.O. BOX 3606 QUINCY, IL 62305 217/224-9600
TELEX 250142 CABLE BROADCAST

TITLE PCB ASSEMBLY — FRONT PANEL BD.

TYPE A | SIZE D | DWG. NO. 910-9003 | REV

MODEL PT90 PS | SCALE 2/1 | SHEET 1 OF 1

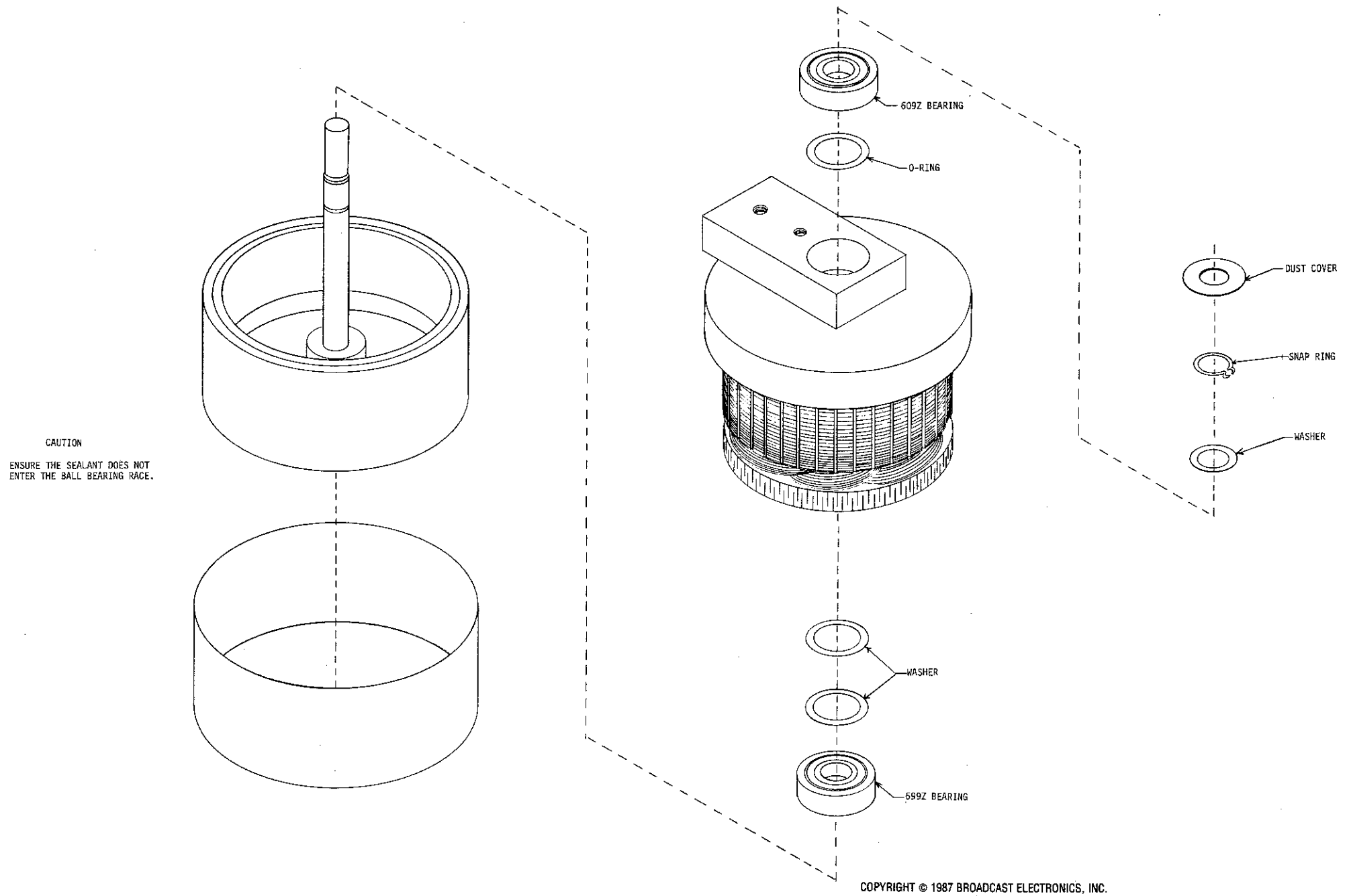
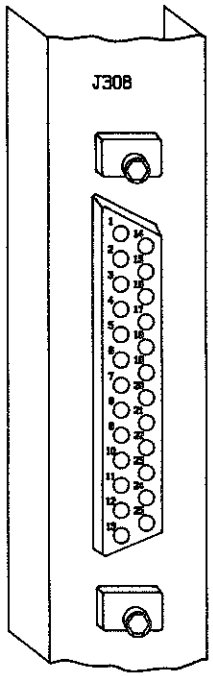
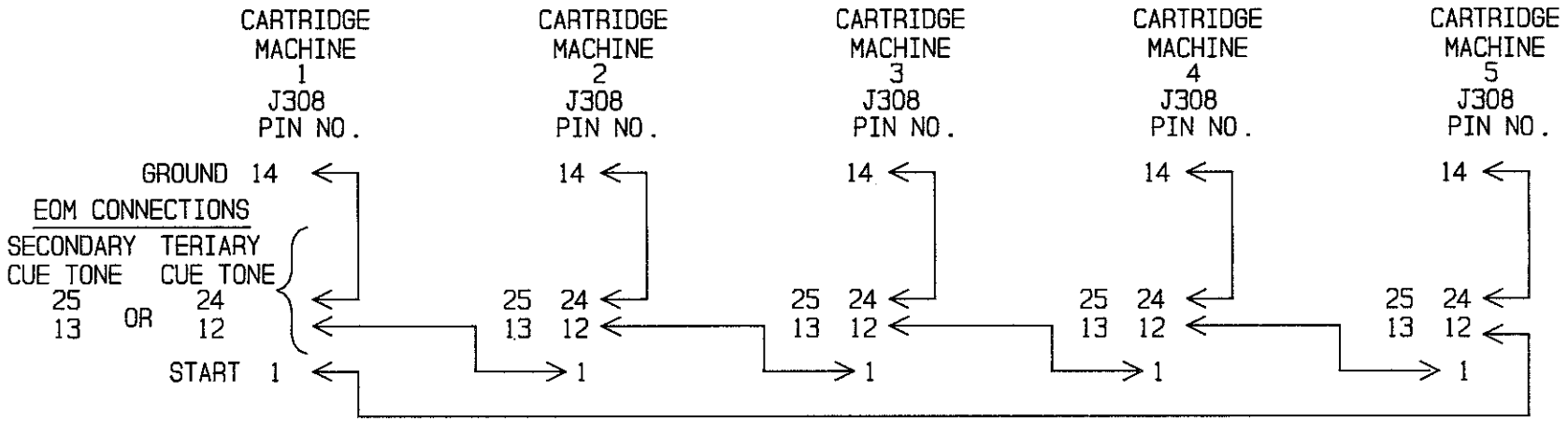


FIGURE 7-15. MOTOR ASSEMBLY DIAGRAM 597-9000-80





START SEQUENCE

1. CARTRIDGE MACHINE 1 WILL START CARTRIDGE MACHINE 2.
2. CARTRIDGE MACHINE 2 WILL START CARTRIDGE MACHINE 3.
3. CARTRIDGE MACHINE 3 WILL START CARTRIDGE MACHINE 4.
4. CARTRIDGE MACHINE 4 WILL START CARTRIDGE MACHINE 5.
5. CARTRIDGE MACHINE 5 WILL START CARTRIDGE MACHINE 1.

NOTE:

1. THE START SEQUENCE MAY BE MODIFIED TO ACHIEVE ANY START SEQUENCE REQUIREMENT.

FIGURE 7-16. 9000 SERIES CARTRIDGE MACHINE START SEQUENCING 597-9000-110

SECTION VIII

APPENDIX

8-1. INTRODUCTION.

8-2 This appendix provides technical data associated with the maintenance of the Broadcast Electronics 9000 series cartridge machine. The information contained in this appendix is presented in the following order.

A. The NAB Tape Cartridge and Associated Maintenance.

BROADCAST ELECTRONICS, INC.

The NAB Tape Cartridge and Associated Maintenance

THE NAB TAPE CARTRIDGE

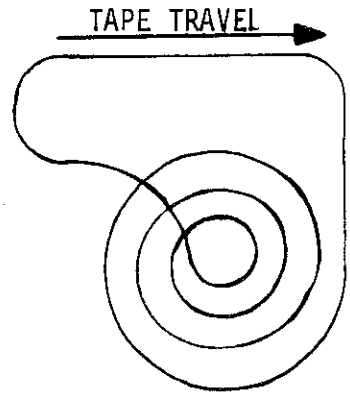
The National Association of Broadcasters (NAB) defines a cartridge as "a plastic or metal enclosure containing an endless loop of lubricated tape, wound on a rotatible hub in such a fashion as to allow continuous motion". Cartridges from various manufacturers differ slightly in design, but all cartridges used in NAB standardized systems fit the preceding definition.

THE TAPE

Cartridge tape consists of a synthetic base material approximately 1 mil (0.001 inch) thick. One side of the base is coated with ferrite oxide particles for magnetic recording. The other surface is coated with a graphite layer. The total thickness of the tape is approximately 1.5 mils (0.0015 inch). The tape is 0.248 (+0/-0.002) inches wide.

CARTRIDGE TAPE

An endless loop is formed by wrapping the tape with the oxide side out into a spiral. The two ends are spliced together so that as the tape is pulled from the center, the tape passes across the tape heads and returns to the outside of the tape spiral.

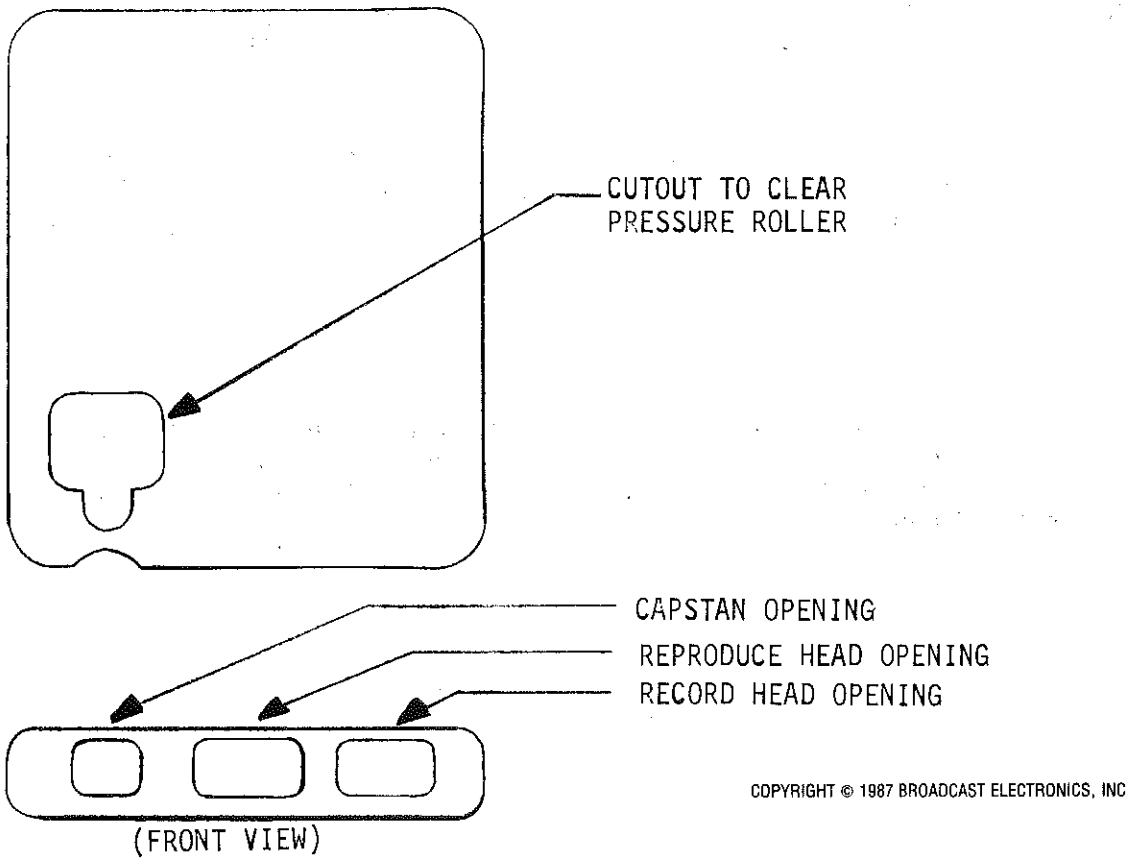


TAPE SPIRAL

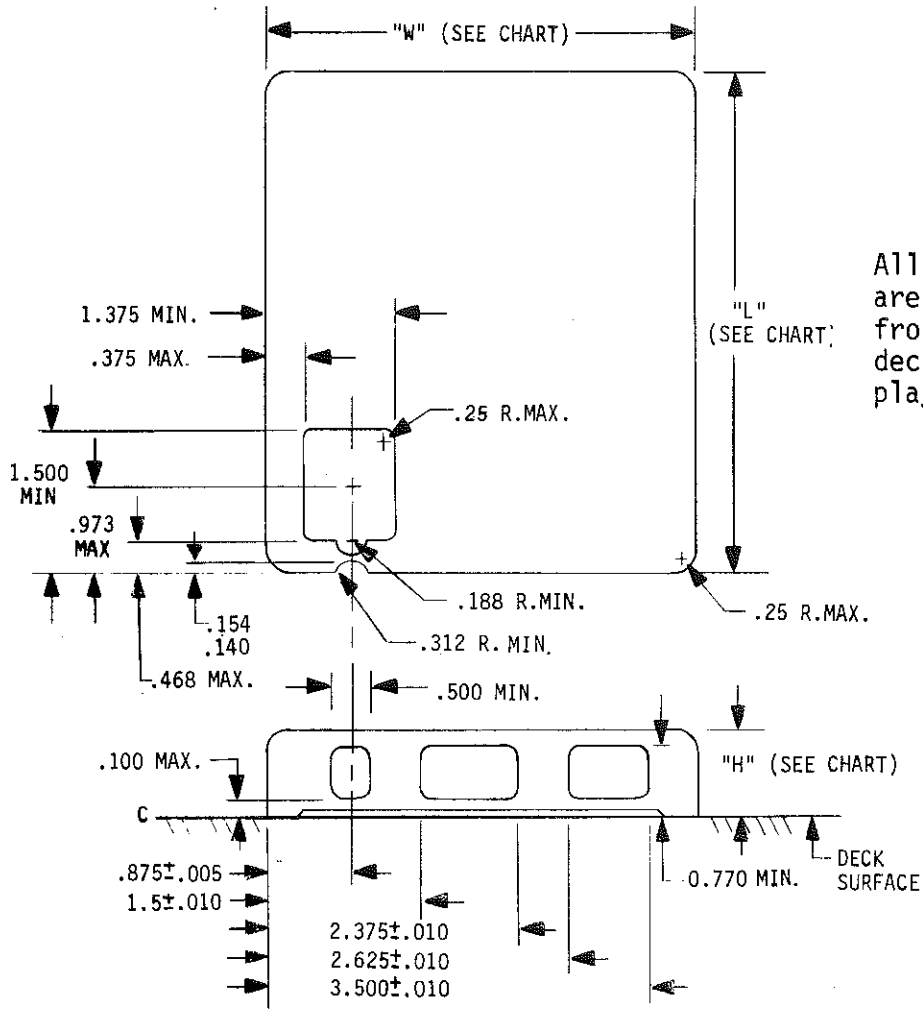
THE SHELL

The shell houses the tape and other mechanical components. Three nominal NAB size shells are available: 1) A or AA, 2) B or BB, or 3) C or CC. Assuming 1.5 mil tape, the A/AA size cartridge can be installed with up to 395 feet of tape, the B/BB with 650 feet, and the C/CC with 1,250 feet.

Three openings across the front of the cartridge allows the heads and capstan to penetrate the shell and contact the tape. In addition, an opening in the bottom is provided for the pressure roller to rotate through the cartridge behind the tape. Unlike cartridges used in consumer entertainment systems, the pressure roller (pinch roller or capstan idler) is a component of the cartridge player and not the cartridge.



NAB tape cartridge dimension standards are presented in Figure 1 and NAB tape head dimension standards are presented in Figure 2.



All dimensions are in inches and are referenced from the side and front of the cartridge and the deck surface of the cartridge tape player.

CARTRIDGE NAB TYPE	WIDTH ±0.015625	LENGTH MAXIMUM	HEIGHT MAXIMUM
A,AA	4"	5.25"	0.9375" FOR A 0.895" FOR AA
B,BB	6"	7"	0.9375" FOR B 0.895" FOR BB
C,CC	7.625"	8.5"	0.9375" FOR C 0.895" FOR CC

FIGURE 1. NAB CARTRIDGE DIMENSION STANDARDS

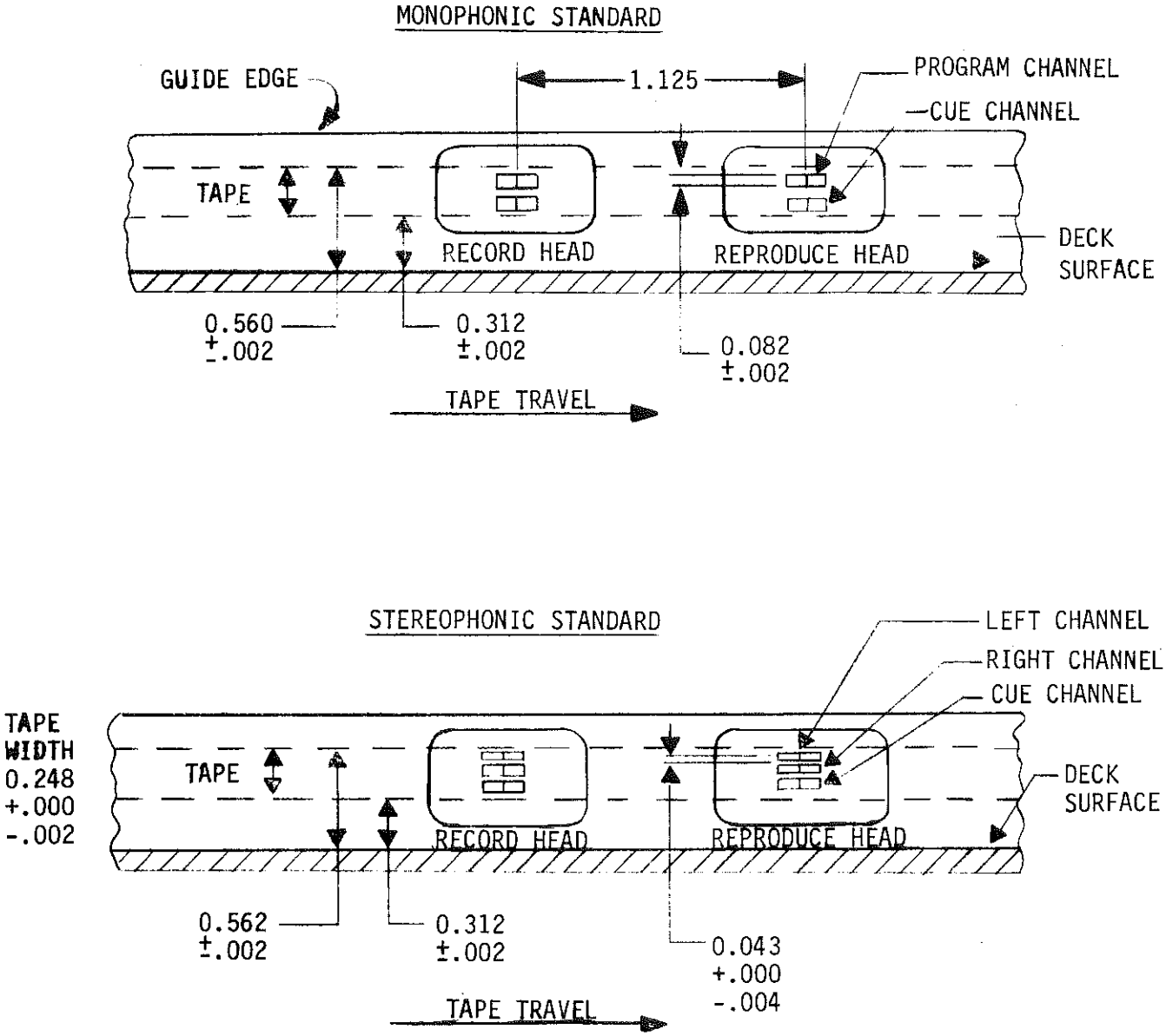
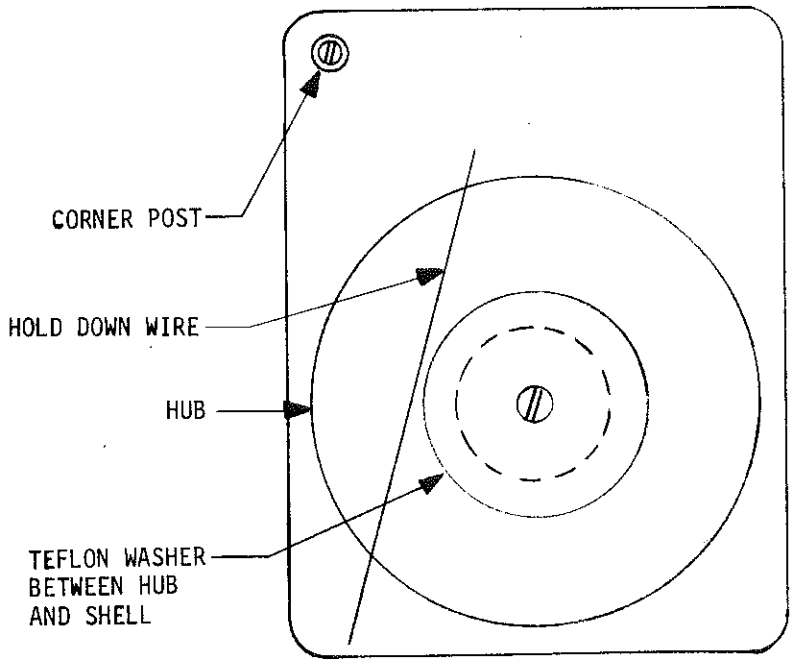


FIGURE 2. NAB TAPE HEAD DIMENSION STANDARDS

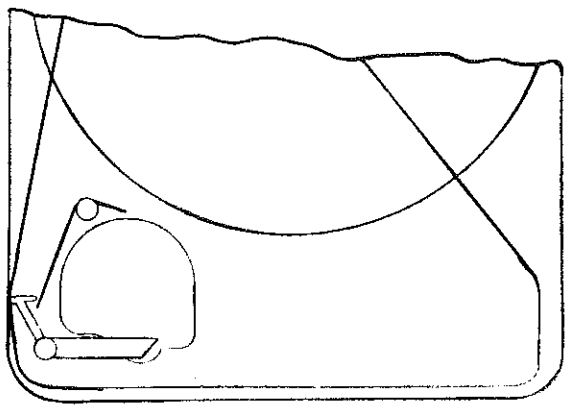
TAPE HUB, TEFLON WASHER, AND CENTER POST

The tape hub contains all cartridge tape. The hub is designed to rotate around a center post. To allow free rotation, a teflon washer is installed between the hub and the shell. To maintain proper tape placement on the hub, the cartridge design will include: 1) a separate hub cover, 2) a close-tolerance molded cover, or 3) a hold-down wire.



CLUTCH SPRING OR HUB BRAKE

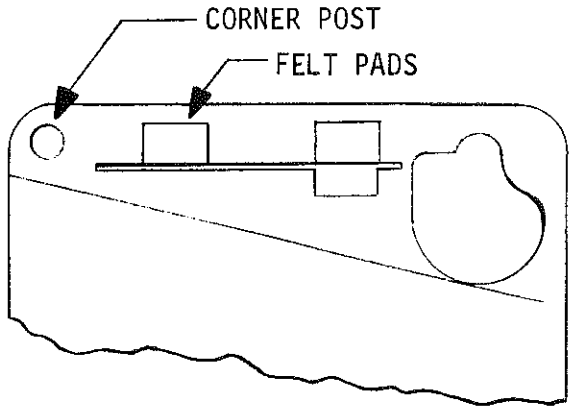
The clutch spring or hub brake prevents tape movement when the cartridge is not in operation. This is accomplished by applying a brake to the hub or by pressing the tape against the shell. The clutch or brake is released by the shaft of the pressure roller when the roller is in the play position.



PRESSURE PADS

The pressure pads maintain tape-to-head contact. A foam plastic is the most commonly used material for the pressure pads. The compression of the foam provides pressure to wrap the tape slightly around the heads.

The pads may be in a single block configuration mounted behind the two openings for the record and reproduce heads and secured to the cartridge shell. Alternately, the pads may be separated and fastened to a metal or plastic arm. A third type mounts the pads on a spring-loaded plastic block.



TAPE GUIDANCE

Primary control of the tape as it moves across the heads is maintained by external guides in the head bracket. Guidance is provided within the cartridge to maintain tape travel in the same path. This is generally accomplished with tabs and grooves molded into the shell. Of primary importance is the corner post which must straighten the tape before it passes across the front openings of the shell. This post may be molded into the shell or a separate component molded into a recessed area in the shell.

CARTRIDGE MAINTENANCE TIPS

The cartridge is the second half of the tape cartridge system. The cartridge requires regular maintenance for proper operation. The service department of Broadcast Electronics has developed over the years a rule of thumb for troubleshooting: Check the cartridge before adjusting the machine.

TAPE

For maximum performance, the tape must be in good condition. The tape in cartridges wears rapidly, particularly in short length cartridges (70 seconds or less) and cartridges that are used frequently. The tape should be inspected regularly and frequently for obvious signs of wear.

Cartridges should be rewound or replaced when the oxide side of the tape is shiny. Likewise the tape should be discarded if it is wrinkled, or contaminated with fingerprints, grease, or dirt. Less obvious are areas where the iron oxide particles have worn from the base of the tape. Missing oxide areas may not be visible, but will cause a loss of audio signal.

If possible only one type of tape should be used in a single installation. Different brands, and even different types of the same brand of tape require different bias recording levels for optimum response.

When rewinding cartridges, use only a graphite lubricated tape. Silicone lubricated tapes will not provide adequate service in rugged NAB cartridge operation.

Every cartridge tape must have one splice, but multiple splices can cause problems. If the top tape ends overlap at the splice or do not meet squarely, the audio may not reproduce. In addition, a poor splice will catch on the cartridge or the hub. After a splice has been in use for some time, the tape tension may pull the two ends of the tape apart slightly opening the splice.

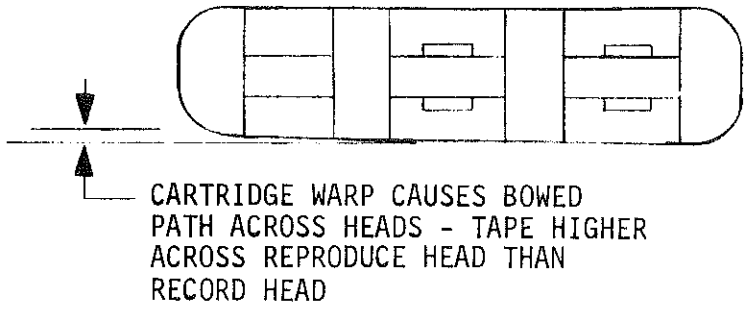
Proper tape tension is most critical. If the tension is too great, the tape will wear rapidly as it is squeezed against the hub, the pressure pads, the corner post, and the tape on the hub. If the tension is too light, the tape will not be pulled back into the hub.

The NAB specifies that tape tension at the capstan should not exceed 3 ounces. Cartridges greater than 70 seconds in length usually have less than 3 ounces, while cartridges less than 70 seconds usually have greater than 3 ounces. When in operation, a properly wound cartridge moves tape freely with no reluctance to wind onto the hub. To increase the tension in a cartridge, open up the splice and gently pull the tape as it wraps onto the hub. To decrease the tension, open up the splice and gently remove several loops from the center of the hub. Remove the excess and resplice the tape.

THE SHELL

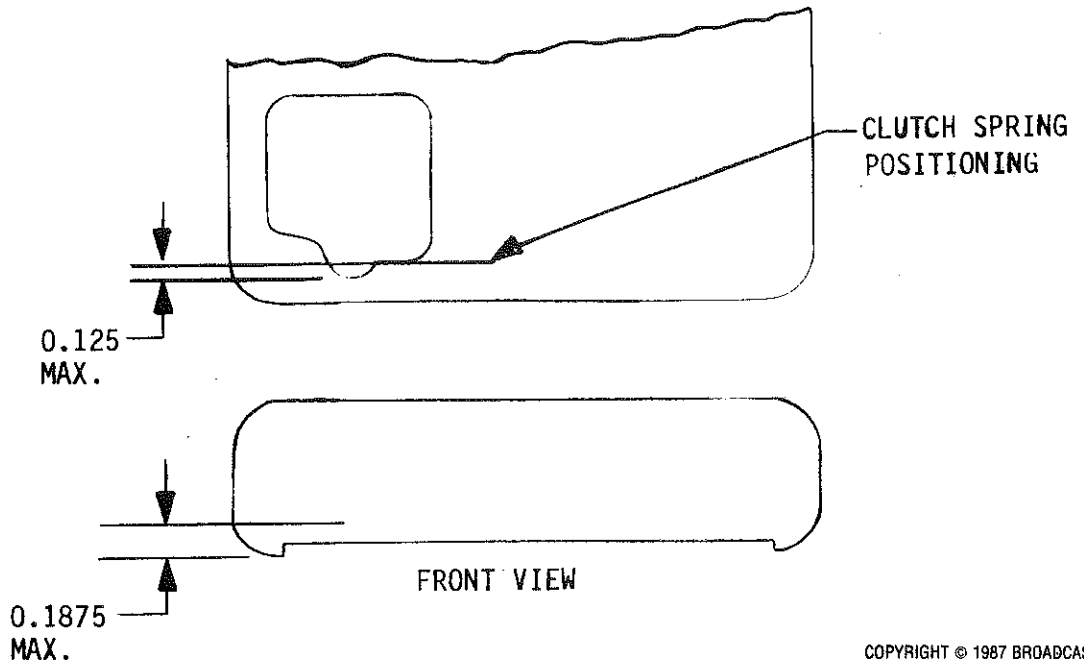
A deformed shell can adversely affect frequency response by distorting the tape path. In particular, a warped cartridge may cause the tape to traverse the head openings in an arc or bowed path rather than a straight line. Also, an misaligned top can spread the sides of the cartridge enough to cause this same problem. Check suspect cartridges on a flat surface.

Periodically, the cartridge center post should be cleaned. Deposits on the post increase tape tension by not allowing the tape hub to rotate freely. Also, check the tape hub washer. This washer should always be in place underneath the tape hub, between the hub and the shell. This washer is easily misplaced when the cartridge is opened and the hub removed.



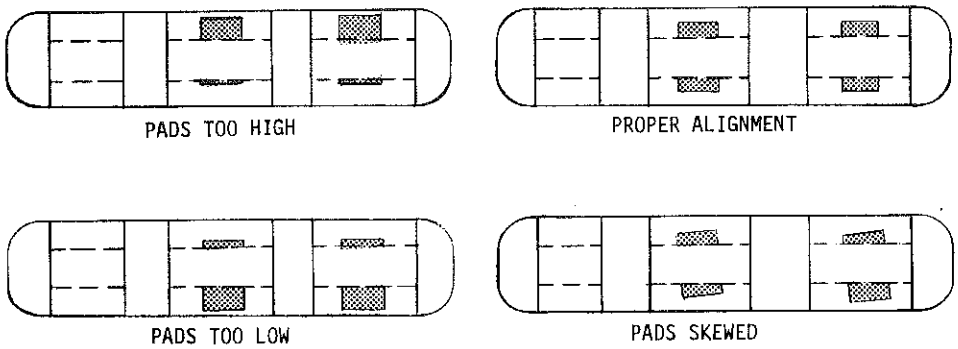
CLUTCH SPRING OR HUB BRAKE

The clutch spring or hub brake should completely release when the pressure roller is in the vertical position. This allows the hub and the tape to move freely. An improperly adjusted clutch spring or defective hub brake may prevent the roller from engaging or dis-engaging. The clutch should be parallel to the bottom of the shell and no more than 0.1875 inches above the surface of the tape deck. The clutch must not protrude more than 0.125 inch into the opening for the pressure roller. Less than 8 ounces should be required to release the clutch.



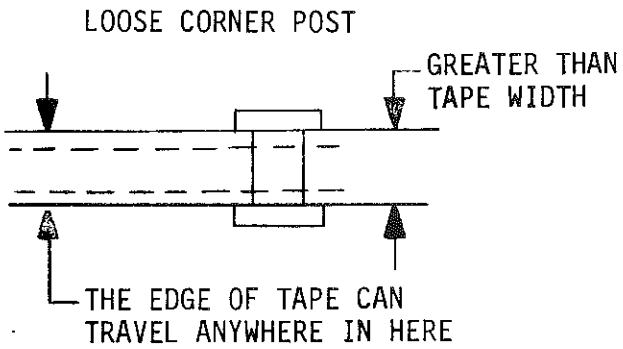
PRESSURE PADS

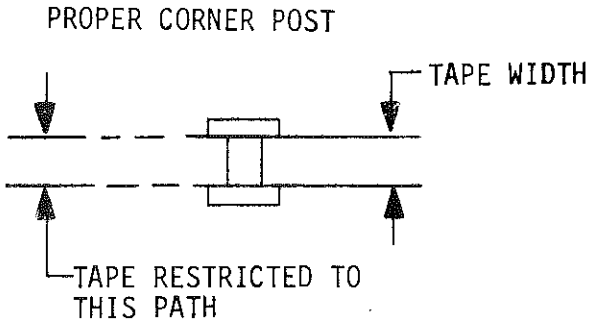
The pressure pads must wrap the tape around the front of the heads. The pressure applied must be uniform across the tape as it is in contact with the head. Periodically check the pads for proper alignment. If a portion of the tape is not in contact with the pads, the improper tape-to-head contact will occur. This will result in poor frequency response from an individual cartridge.



THE TAPE PATH

The most frequent cause of distortion of the tape path in the cartridge is a loose corner post. The post must be mounted 0.250 inches from the bottom of the shell. If the distance between the shell and post is greater than 0.250 inches, the tape will not pass straight across the heads. A loose post frequently causes muffled-sounding audio when the cartridge unit starts.





The hold-down wire used in many cartridges is important in maintaining proper tape travel. This wire maintains proper tape placement on the hub as tape is pulled from the center. The wire must not exert any pressure on the stored tape or the tape may wrinkle and jam. If a cartridge is dropped, this hold-down wire may unseat.

CARTRIDGE STORAGE

The cartridges should be stored away from direct sunlight, or heat from electronic equipment, radiators, etc. Ideal conditions are a temperature of 70° and a relative humidity of 50%. The cartridge storage area should be as free from dust as possible.

CARTRIDGE RECORDING PROCEDURE

The following procedure is particularly important when recording cartridges. When the cartridge is first inserted into the machine, operate the deck to allow the tape to seat properly in the tape guides.

Stop the tape. Do not remove the cartridge after the initial operation. Ensure the tape splice is between the end and the beginning of the program material.

CARTRIDGES FOR STEREOPHONIC SYSTEMS

MAINTENANCE

Cartridges operated in a stereophonic format require rigorous maintenance due to the generation of phase errors by improper tape movement. When the program material is combined, phase differences cause degradation of the frequency response.

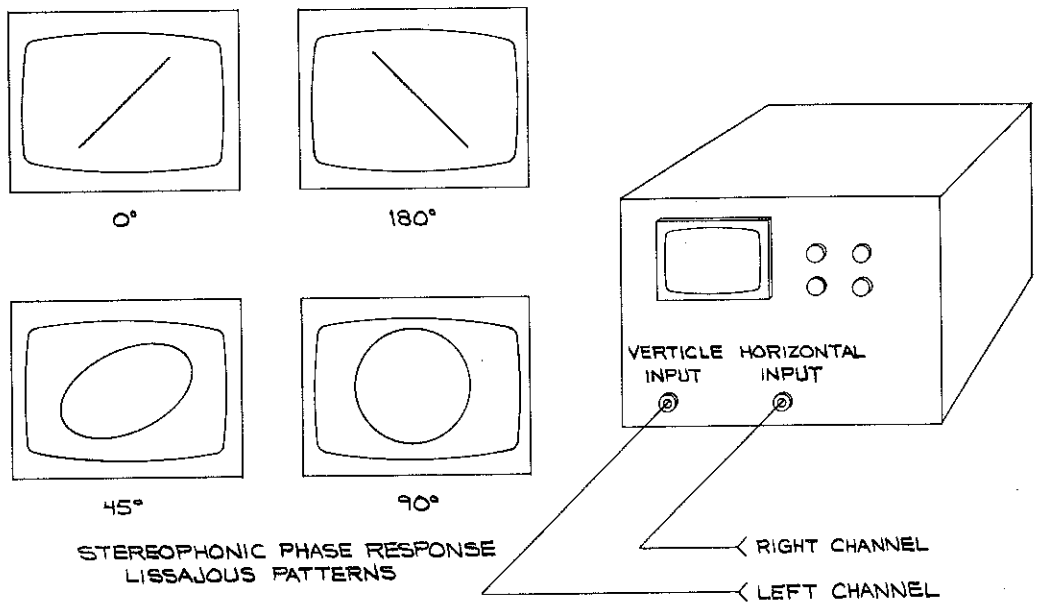
The most important characteristic of a cartridge operated in a stereophonic format is the ability to maintain an identical tape path each time the cartridge is inserted in the deck. This ensures reliable recording and subsequent accurate reproduction.

Cartridges used in a stereophonic system should initially be selected for phase repeatability using the phasing test outlined below. This test should be repeated on a regular basis throughout the life of the cartridge. A cartridge which fails this test should be discarded.

To provide better guidance within the cartridge, several manufacturers have introduced cartridges with an adjustable corner post. The post is threaded into the shell so that the precise post height may be maintained. These and other cartridges designed to improve performance should be considered for use in a stereophonic system.

STEREO PHASING TEST

Connect the output of a record/playback unit to an oscilloscope as shown. Connect an audio signal generator to both inputs of the recorder. While recording, observe the phase of the reproduce signals. Remove and re-insert the cartridge several times. Cartridges which exhibit poor phase repeatability of stability should be discarded. Do not test only at higher frequencies, also check selected frequencies across the audio band.



STEREOPHONIC PHASE RESPONSE
LISSAJOUS PATTERNS

PRODUCT WARRANTY

LIMITED ONE YEAR

While this warranty gives you specific legal rights, which terminate one (1) year (6 months on turntable motors) from the date of shipment, you may also have other rights which vary from state to state.

Broadcast Electronics, Inc. ("BE"), 4100 North 24th Street, P. O. Box 3606, Quincy, Illinois 62305, hereby warrants cartridge machines, consoles, transmitters and other new Equipment manufactured by BE against any defects in material or workmanship at the time of delivery thereof, that develop under normal use within a period of one (1) year (6 months for turntable motors) from the date of shipment. Other manufacturers' Equipment, if any, shall carry only such manufacturers' standard warranty. This warranty extends to the original user and any subsequent purchaser during the warranty period. BE'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. BE'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 the original user 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 BE, or if Equipment is operated under environmental conditions or circumstances other than those specifically described in BE's product literature or instruction manual which accompany the Equipment purchased. BE shall not be liable for any expense of any nature whatsoever incurred by the original user without prior written consent of BE.

BE shall not be liable to the original user 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 you. All express and implied warranties shall terminate at the conclusion of the period set forth herein.

Except as set forth herein, and except as to title, there are no warranties, or any affirmations of fact or promises by BE, with reference to the Equipment, or to merchantability, fitness for a particular application, signal coverage, infringement, or otherwise, which extend beyond the description of the Equipment in BE's product literature or instruction manual which accompany the Equipment. Any card which is enclosed with the Equipment will be used by BE for survey purposes only.

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