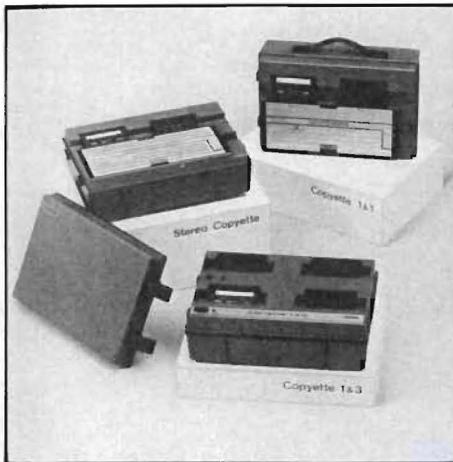


# Telex

## Authorized Communications Schedule Price List



FSC Group 58, Part III, Section B  
FSC Class 5835  
Special Item Numbers: 136-42, 43 & 54

Recording and Reproduction  
Audio and Video Equipment

**CONTRACTOR:** Telex Communications, Inc.  
9600 Aldrich Avenue South  
Minneapolis, MN 55420  
(612) 887-7403  
(800) 828-6107

Contract No.: GS00K89AGS0180  
Contract Period: July 28, 1989 - March 31, 1990

General Services Administration:  
Office of Information Resources Management  
GSA Mailing Code: OOC 5804 Audio and Video Equipment

# TELEX

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## Significant Differences

Significant differences in this contract include the following:

1. Product additions.
2. Product deletions.

## Information for Ordering Offices

- |  |  |
|--|--|
| 1. Geographic Scope:   | The 48 Contiguous States, the District of Columbia, Hawaii, Alaska and Puerto Rico.  |
| 2. Service and Distribution Points:  | From authorized service centers.   |
| 3. Contractor's Ordering Address:  | <b>Telex Communications, Inc.</b><br>c/o authorized dealer<br>(see appropriate dealer list) OR<br><b>Telex Communications, Inc.</b><br>9600 Aldrich Avenue South<br>Minneapolis, Minnesota 55420<br>Attn: Gov't Sales Department |
| 4. Payment Address —<br>As indicated on the invoice:<br>Duns No. 00-620-8086<br>Federal I.D. 13-352-1030 | <b>Telex Communications, Inc.</b><br>c/o (authorized dealer) OR<br><b>Telex Communications, Inc.</b><br>P.O. Box 1450-NW8072<br>Minneapolis, Minnesota 55485-8072  |
| 5. F.O.B. Point:   | A. F.O.B. Destination 48 contiguous states and District of Columbia. Point of embarkation for Alaska, Hawaii and Puerto Rico.<br>B. Production Points: Blue Earth, Minnesota;<br>Glencoe, Minnesota; Lincoln, Nebraska.          |
| 6. Delivery Time:  | 90 days from receipt of order.   |

# Information for Ordering Offices — (continued from page 2)

7. Discounts:
- A. Basic and Quantity Discounts: Prices listed herein are "Net", discount deducted.
  - B. Prompt Payment Discount: 1% 20 days. Net 30 days.
8. Minimum Order Amount: \$50.00
9. Size of Business Concern: Large
10. Foreign Items: None
11. Export Packing: Available outside the scope of contract.
12. Maximum Order Limitations:
- A. (All dollar amounts are exclusive of any discount for prompt payment.) The total dollar value of any order placed under this contract shall not exceed \$185,000; provided, that the dollar value for any single item ordered, whether ordered separately or in combination with other items, shall not exceed the dollar amounts set forth below for the items indicated: \$185,000
  - B. The contractor agrees not to accept or fulfill any orders in violation of this clause. Violation may result in termination of the contract pursuant to the Clause of the General Provisions entitled "Default".
13. Production Points:
- Audio Tape Equip. - Telex Communications, Inc.  
Blue Earth, Minnesota
  - Audio Headsets - Telex Communications, Inc.  
Glencoe, Minnesota
  - Audio Microphones - Telex Communications, Inc.  
Glencoe, Minnesota
  - Audio Wireless Microphones - Telex Communications, Inc.  
Lincoln, Nebraska
14. Notice to Ordering Agencies:
- Use of Group 58 Schedules Contracts.
- I. Competitive Procedures. In accordance with FIRMR 201-11.0011(c) (41 CFR Chapter 201) an order against a nonmandatory Telecommunications schedule contract is considered to be placed under full and open competition when (i) the ordering agency follows the procedures of 201.40.008(a), regardless of the type of specification, and (ii) the order provides the lowest overall cost alternative to meet the needs of the Government.
  - II. Synopsizing requirements. After consultation with the Administration of the Small Business Administration and the Office of Federal Procurement Policy, the Administrator of the General Services Administration determined that agencies must synopsize in the CBD their intent to place orders under both nonmandatory ADP and telecommunications schedule contracts at least 15 calendar days before placing the order when:
    - a. The purchase price of the equipment (whether purchased or leased) exceeds \$50,000;
    - b. The maintenance charges exceed an annual rate of \$50,000; or
    - c. The value of any order exceeds \$50,000.
15. Guarantee:
- All necessary adjustments of equipment procured hereunder not occasioned by accidents or misuse, shall be made by the contractor at his own expense, including transportation costs, if any, during the 90-day period after delivery. All equipment procured hereunder is guaranteed for a period of one year from date of delivery, except expendable items, such as tubes, transistors, etc., which are guaranteed for 90 days from date of delivery. During the guarantee period, all broken or defective parts not caused by accident or misuse through fault or negligence by the Government, must be replaced (including labor and parts) at the contractor's expense, and including transportation costs, if any.
16. Telecommunications Equipment Requirements:
- "End users/ordering activities are responsible for obtaining any required approval of the telecommunication company servicing their area before installing this equipment."
17. Security Requirements:
- In the event security requirements are necessary, the ordering activities may incorporate in their delivery order(s) a security clause in accordance with FAR, current laws, regulations and individual agency policy, however, the burden of administering the security requirements shall be with the ordering agency. If any costs are incurred as a result of the inclusion of security requirements, such costs will be negotiated with the Schedule Contractor on an open market basis outside the scope of the contract.
18. Responsibility of the Contractor:
- The contractor shall comply with all laws, ordinances and regulations (Federal, State, City or otherwise) covering work of this character and shall include all costs, if any, of such compliance in the prices quoted in this offer. In particular, the telephone service provided, associated equipment and distribution facilities shall comply with the Federal Communications Commission (FCC) rules and corresponding regulations of the National Telecommunications and Information Administration (NTIA). GSA will not exempt any carrier services, equipment, etc., which is on Government premises from the limits established to prevent harmful electromagnetic interference (see Part 15 of the FCC Rules and Chapter 7 of the NTIA Manual).
19. Logistic Support Privileges: Not Applicable.
20. New Materials: Any item contracted for must be new.
21. Installation: Installation supplied by Dealer at the time of delivery of equipment.
22. Manuals: Instruction Manual supplied with equipment.
23. Training: Training supplied by Dealer at the time of delivery of equipment.
24. Dealers: Contact Telex for a listing of local dealers.

# Audio Tape Cassette Copiers

## CD2M and CD2MS

These half track, two-channel master station duplicators copy standard, one hour monaural cassettes in less than two minutes. The CD2M has one copy position, while the CD2MS has three. Easy-to-use controls include copy, stop and rewind buttons, as well as record level LED's, audio level slide controls, auto/manual select and track select. Both models include precision tape guides and end-of-tape sensing. Expandable with the CD2S.

## CD2S

This two-position slave unit adds on to the CD2M or CD2MS, making two additional copies and relying on either master unit for control. For high volume applications, up to five CD2S's can be added to the CD2M and up to four CD2S's can be added to the CD2MS, making up to eleven copies simultaneously.

## CD4M and CD4MS

Top of the line, quarter track, four-channel master stations for duplicating stereo or mono cassette tapes. The CD4M has one copy position — the CD4MS has three. Features track select, end-of-tape sensing and easy-to-use controls, including record level LED's, audio level slide controls, auto/manual select and copy, stop and rewind buttons. Expandable with the CD4S.

## CD4S

Relying on the CD4M or CD4MS for control, the CD4S makes two more cassette copies in mono or stereo. Up to five CD4S's can be added to the CD4M and up to four CD4S's can be added to the CD4MS, making up to eleven copies (both sides) in one pass.

## Series II Copyette

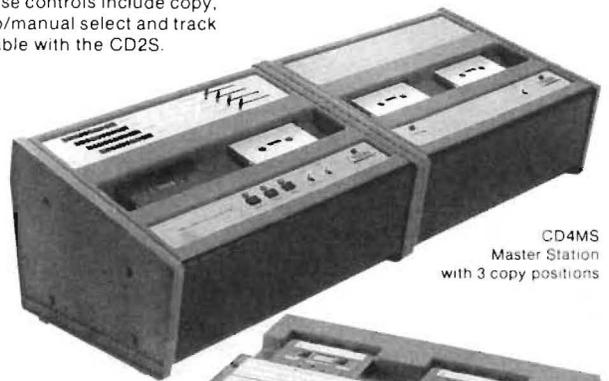
Copies standard monaural cassette tapes at 30 ips (76 cm/s), completing both sides of one C-60 cassette in less than two minutes. An automatic single-lever control enables easy operation while track select allows the operator to copy both sides of a tape simultaneously or to copy selected sides of two separate originals onto a single cassette. Program tapes containing inaudible cues for automatic slide advancement may also be copied.

## Copyette 1 & 3

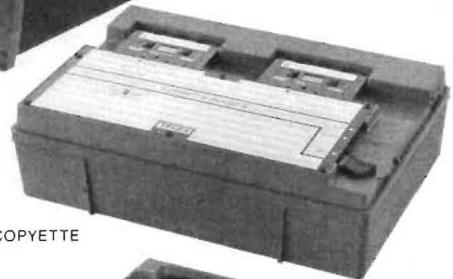
Copies three monaural cassette tapes simultaneously, at a 16:1 speed ratio, yet it's as portable and easy to operate as the Copyette 1 & 1. Copying time can be reduced by 60% when multiple copies are required.

## Series II Stereo Copyette

The Stereo Copyette copies both sides of either a standard C-60 monaural or stereo cassette master in less than three minutes. The unit offers single-lever control and track select for single or double side duplication. Will copy inaudible cues and has a patented drive mechanism for gentle tape handling.



CD4MS  
Master Station  
with 3 copy positions



SERIES II COPYETTE



COPYETTE 1&3

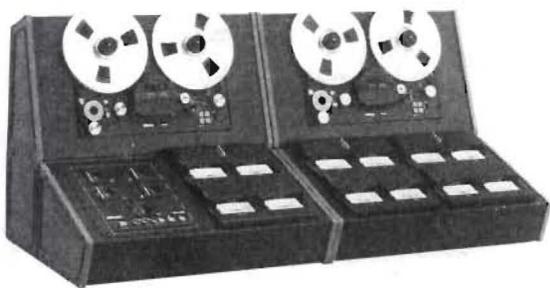


SERIES II  
STEREO COPYETTE

### HIGH SPEED CASSETTE COPIERS

SPECIAL ITEM NO.	ITEM DESCRIPTION	ORDER PRODUCT BY CATALOG NO.		U.S. GOVERNMENT PRICE		
		110-120 VOLT	220 VOLT	1 PC.	2-5	6 & UP
136-42	COPYETTE 1 & 1	96250-000	96250-004	\$316.88	\$306.88	\$296.88
136-42	STEREO COPYETTE	96275-000	96275-004	592.88	558.88	542.88
136-42	COPYETTE 1 & 3	92713-011	92713-015	897.88	885.88	870.88
136-54	DUST COVER	59860-000		5.62		
136-54	BULK ERASER	90624-000		13.14		
136-42	CD2M	94471-001	94471-003	984.30	854.72	800.38
136-54	CD2S	94472-000	94472-001	872.00	800.38	769.60
136-42	CD2MS	94706-000	94706-002	1598.60	1466.97	1415.56
136-42	CD4M	94474-001	94474-003	1240.25	1139.08	1094.68
136-54	CD4S	94475-000	94475-001	1101.30	1012.83	975.88
136-42	CD4MS	94706-001	94706-003	2282.35	2095.23	2014.32
136-54	DUST COVER	59842-000		7.40		
136-54	DUST COVER	59842-001		9.67		

# Audio Tape Duplicators



6120 DUPLICATION SYSTEM

## 6120 XL Duplication System

A professional quality high speed duplication system that allows duplication of open reel and/or cassette tapes at a 16:1 speed ratio. (The XLP provides 8:1 speed ratio.) The building block design of the 6120 allows you to buy the configuration you need and expand as your requirements increase. Base system can be expanded to 11 cassette slaves and 2 open reel slaves. Further upgrading is possible using the 6120 expansion module.

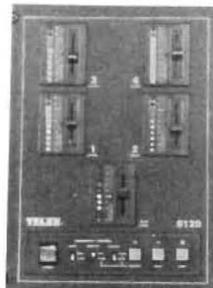
Many audio specifications are enhanced with the addition of the XL Life cassette head. The XL head lasts as much as ten times longer than standard heads and eliminates much of the oxide build-up that causes maintenance problems.

## 6120 XLP Pro Series Duplication System

Improved frequency response plus less distortion and crosstalk are technical gains achieved in the Telex Pro Series. By developing the 6120 XLP with an 8:1 speed ratio and adding new XL Life heads, important professional specifications are improved. A unique shielding design utilizes the same lamination techniques and materials between the tracks as is used throughout the head. This greatly improves crosstalk rejection.



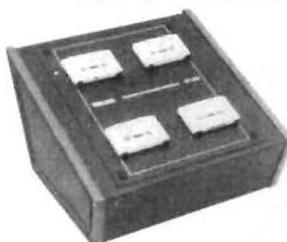
6120 REEL MODULE



6120 CONTROL MODULE



6120 CASSETTE MODULE



6120 REWIND MODULE

## Open Reel Modules

Open reel modules feature 7" and 10½" (178 and 267 mm) reel capacity, automatic equalization setting, motorized tape cleaner, automatic rewind/recue, photo transistor sensing, plug-in headblock assembly and plug-in, solid state electronic circuitry. A two-speed hysteresis synchronous motor provides maximum speed accuracy and quick start-up time.

## Control Module

All control functions are within easy reach of the operator. Includes large rocker-type power switch, plus copy, stop and rewind switches with LED's. Four copy modes, as well as automatic or manual rewind, are selectable with toggle switches. An LED bias level indicator allows bias level viewing at a glance and peak reading LED audio level indicators provide accurate audio monitoring. Plug-in, solid state electronic circuitry assures easy set-up and serviceability.

## Cassette Modules

Cassette modules have independent end-of-tape stop, short/jammed tape indicators, track select, precision tape guides and plug-in, solid state electronics. Systems available in half track, two-channel configuration — all with "in-line" metal face or hard core heads. Head adjustments for height, zenith and azimuth can be made from the top of the module. XL Life heads now available on XL or XLP series. Those heads will last up to 10 times longer than ordinary heads.

## Rewind Module

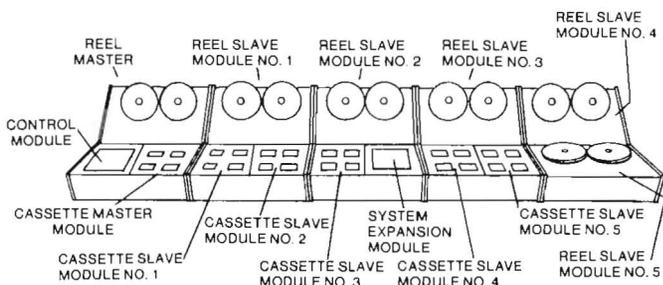
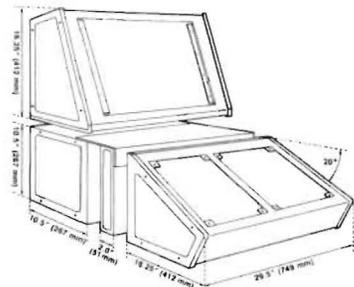
Provides high speed rewinding of cassette tapes. Operation is easy with a single ON/OFF switch, and tape damage is prevented by the clutch and low torque drive system. Mounts easily into a 6120 system or is available as a separate unit.

## Expansion Module

Allows further expansion of the base system for a total of up to 5 open reel slaves and 23 cassette slaves. Mounts in cassette/control console. Available in two-channel or four-channel configurations.



6120 WITH EXPANSION MODULE



# Audio Tape Duplicators

6120 SERIES HIGH SPEED TAPE DUPLICATING SYSTEMS		ORDER PRODUCT		U.S. GOVT PRICE
		BY CATALOG NO.		
MODEL 6120 CASSETTE-TO-CASSETTE DUPLICATOR (All Special Item 136-42)		110-120 VOLT	220 VOLT	
<b>STANDARD SERIES W/XL LIFE HEADS</b>				
Half Track, Two-Channel	3 slaves	93900-101	93900-103	\$ 3,840.27
	7 slaves	93900-107	93900-109	6,766.40
	11 slaves	93900-113	93900-115	9,550.16
Quarter Track, Four-Channel	3 slaves	93900-100	93900-102	4,514.57
	7 slaves	93900-106	93900-108	7,952.09
	11 slaves	93900-112	93900-114	11,247.24
<b>PRO SERIES (XLP) W/XL LIFE HEADS</b>				
Half Track, Two-Channel	3 slaves	93900-201	93900-203	3,891.12
	7 slaves	93900-207	93900-209	6,862.74
	11 slaves	93900-213	93900-215	9,691.99
Quarter Track, Four-Channel	3 slaves	93900-200	93900-202	4,559.52
	7 slaves	93900-206	93900-208	8,842.44
	11 slaves	93900-212	93900-214	11,382.99
<b>MODEL 6120 REEL AND CASSETTE-TO-CASSETTE (All Special Item 136-42, 43)</b>				
<b>STANDARD SERIES W/XL LIFE HEADS</b>				
Half Track, Two-Channel	3 slaves	93900-119	93900-121	6,790.05
	7 slaves	93900-125	93900-127	9,716.18
	11 slaves	93900-131	93900-133	12,499.94
Quarter Track, Four-Channel	3 slaves	93900-118	93900-120	7,689.20
	7 slaves	93900-124	93900-126	11,046.72
	11 slaves	93900-130	93900-132	14,341.87
<b>PRO SERIES (XLP) W/XL LIFE HEADS</b>				
Half Track, Two-Channel	3 slaves	93900-219	93900-221	6,840.90
	7 slaves	93900-225	93900-227	9,812.52
	11 slaves	93900-231	93900-233	12,641.77
Quarter Track, Four-Channel	3 slaves	93900-218	93900-220	7,654.15
	7 slaves	93900-224	93900-226	11,137.07
	11 slaves	93900-230	93900-232	14,517.62
<b>STANDARD SERIES W/XL LIFE HEADS — 16X SPEED</b>				
<b>Half Track, Two-Channel</b>				
Open Reel Master		92774-001	92774-003	2,670.85
Open Reel Slave		92774-005	92774-007	2,670.85
Cassette Master/Slave Module		94629-101	94629-103	2,688.50
Cassette Slave Module		94629-105	94629-107	2,783.76
Control Module		94628-102	94628-103	1,009.40
Expansion Module		94649-002	94649-003	579.85
<b>Quarter Track, Four-Channel</b>				
Open Reel Master		92774-000	92774-002	2,815.70
Open Reel Slave		92774-004	92774-006	2,815.70
Cassette Master/Slave Module		94629-100	94629-102	3,167.50
Cassette Slave Module		94629-104	94629-106	3,295.15
Control Module		94628-100	94628-101	1,204.65
Expansion Module		94649-000	94649-001	641.15
<b>PRO SERIES (XLP) W/XL LIFE HEADS — 8X SPEED</b>				
<b>Half Track, Two-Channel</b>				
Open Reel Master		92774-201	92774-203	2,670.85
Open Reel Slave		92774-205	92774-207	2,670.85
Cassette Master/Slave Module		94629-201	94629-203	2,739.35
Cassette Slave Module		94629-205	94629-207	2,829.25
Control Module		94628-202	94628-203	1,009.40
Expansion Module		94649-002	94649-003	579.85
<b>Quarter Track, Four-Channel</b>				
Open Reel Master		92774-200	92774-202	2,815.70
Open Reel Slave		92774-204	92774-206	2,815.70
Cassette Master/Slave Module		94629-200	94629-202	3,212.50
Cassette Slave Module		94629-204	94629-206	3,340.55
Control Module		94628-200	94628-201	1,204.65
Expansion Module		94649-000	94649-001	641.15
<b>REWIND MODULES</b>				
Four Position with Console		94640-000	94640-001	313.25
Four Position w/o Console		94639-000	94639-001	239.25
<b>CONSOLES AND ACCESSORIES</b>				
Reel Slave Extension Cable		93796-000		23.34
Reel Console		94630-001		159.35
Control/Cassette Console		94630-000		142.37
Base Console, 10.5 inches		93785-000		119.58
Base Console, Expander Kit		93785-001		71.73
Rewind Console		94634-000		75.77
Dust Cover (lower unit only)		93792-000		9.13
Dust Cover (upper and lower)		93792-001		13.67
Polishing Tape, 1 roll each		93780-000		5.13
Polishing Tape, case of 48		93780-001		244.79
Clear Leader, 1200 ft. roll		51814-026		10.26

NOTE: Base console expander kit required if reel slaves are placed horizontally in front of vertical console.

# Headsets and Headphones

## Economy Series

### Model 610 Headphone

With a limited two year warranty, the 610 headphone incorporates quality construction, lightweight comfort and low cost for an excellent value in educational/training equipment. Magnetic elements and steel diaphragms assure quality sound reproduction and heavy-duty construction. Available separately or in Group Listening Centers in blue with straight or coiled cord. Standard 600 ohm impedance.



### Model 600 Headset

Model 600 features the same high quality and value as the 610. It utilizes an identical magnetic headphone as the 610 with a fully adjustable, noise cancelling dynamic boom microphone for efficient monitoring or recording with minimal background noise.

## Standard Series

### Model 510 Headphone

A sensitive, monaural, dynamic headphone with an extended frequency response for excellent sound reproduction. Features heavy-duty construction with puncture proof, insulated electronic parts and sonically sealed, impact resistant plastic parts. Available in Group Listening Centers or as a separate unit.



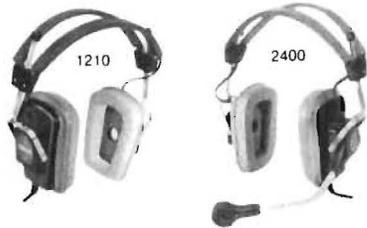
### Model 500 Headset

The same quality value and construction as the 510, but with a dynamic boom microphone for monitoring a recording with minimal background noise. The boom microphone is completely adjustable.

## Fine Quality Series

### Model 1210 Headphone

The best performance and reliability anywhere at any price. Superb sound quality makes the 1210 ideal for first rate learning labs, resource centers, training facilities or music appreciation courses. Engineered for heavy-duty use and comfort with stainless steel construction, impact resistant plastic parts and pliable, circumaural cushions.

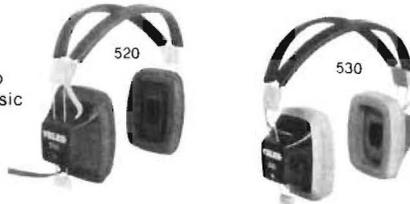


### Model 2400 Headset

The Model 2400 features the same dynamic headphone as the 1210 with the same quality construction and performance. A fully adjustable dynamic boom microphone provides excellent response for monitoring a recording with a minimum of background noise. The boom rotates a full 360 degrees so that it may be worn on the left or the right side. The microphone shuts off automatically when the boom is placed upright.

### Model 520 Stereo Headphone

Dynamic headphone elements in the 520 offer extended frequency response with superb stereo sound. Ideal for library resource centers and music appreciation courses.

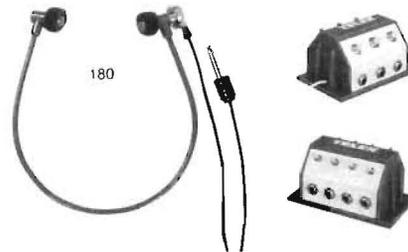


### Model 530 Cordless Headphone

With excellent performance and reliability, the 530 Cordless Headphone is a perfect compliment to any inductive loop system. Powered by a long life battery (included), it has a single on/off/volume control and a built-in integrated circuit amplifier that picks up the audio from the inductive loop.

### Model 180 Series Secretarial Training Headphone

Widely used in stenography labs and dictation classes in high schools, business schools and colleges. The 4 ft. (1.2 m) cord, magnetic receiver element and foam ear pads are easily replaceable. Weights 1.5 oz. (42.5 g).



### Model 753 Group Listening Station

Includes an impact-resistant jackbox, with or without volume controls for six or eight listening positions. The jackbox may be free standing or screw-mounted. A 4 foot (1.22 m) cord with standard 1/4" (6.35 mm) phone plug connects to any sound source.

### Carrying Case

A heavy-duty, plastic carrying case stores six or eight headsets and corresponding jackbox.

# Headsets and Headphones

## HEADPHONE/LISTENING SYSTEMS (All Special Item 136-54)

	ORDER PRODUCT BY CATALOG NO.	U.S. GOVERNMENT PRICE		
		1-5	6 & UP	
<b>BOOM MIKE HEADSETS WITH 360° ROTATING BOOM MICROPHONE</b>				
2400-142	Black with gray trim, 600 ohm headphone, 2 straight plugs	62400-142	\$ 60.34	\$ 53.59
2400-145	Black with gray trim, 600 ohm headphone, 2 right angle plugs	62400-145	60.34	53.59
2400-141	Black w/gray trim, 600 ohm headphone, 50 ohm mic, 2 straight plugs	62400-141	60.34	53.59
2400-146	Black with gray trim, 600 ohm headphone, 1 Nexus plug	62400-146	60.34	53.59
600-1	Brown with white trim	61630-010	38.84	34.34
500-1	Black with gray trim. With dynamic microphone	63500-001	44.59	39.09
500-3	Black with gray trim, 1/4" (6.4 mm) plug	63500-003	49.58	43.83

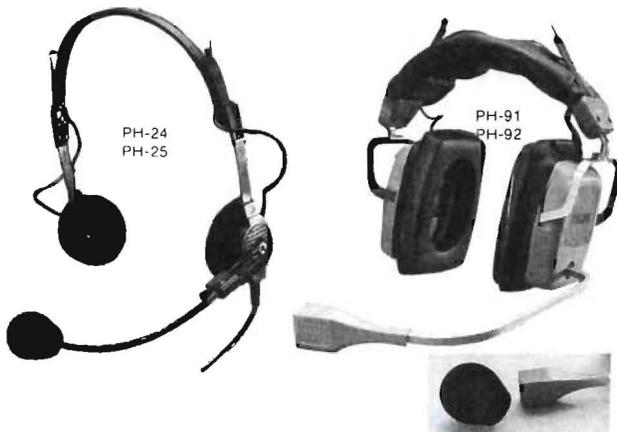
# Headsets and Headphones

## HEADPHONE/LISTENING SYSTEMS (All Special Item 136-54) (Cont)

	ORDER PRODUCT BY CATALOG NO.	U.S. GOVERNMENT PRICE			
		1-5	6 & UP		
<b>HEADPHONES</b>					
1210-03	Black with gray trim, 16 ohm impedance	61210-003	\$ 38.84	\$ 34.34	
1210-04	Black with gray trim, 600 ohm impedance	61210-004	38.84	34.34	
180-1	500 ohm, 1/4" (6.4 mm) plug	62180-001	13.42	11.67	
180-2	2000 ohm, 1/4" (6.4 mm) plug	62180-002	13.42	11.67	
180-4	500 ohm, 0.140" (3.6 mm) plug (mini)	62180-004	13.42	11.67	
530	Cordless, inductive Headphone, battery included	63530-001	39.99	35.24	
			<b>1-35</b>	<b>36-252</b>	<b>288-468 504 &amp; UP</b>
510-1 Box Pack	130 ohm impedance	63510-008	11.24		
510-1 Bulk Pack	130 ohm impedance	63510-007		10.54	\$10.54 \$10.54
610-1 Box Pack	Blue	62650-003	10.25		
610-1 Bulk Pack	Blue	62650-012		8.75	8.25 6.95
610-40 Bulk Pack	Blue	61630-077		9.80	9.05 8.95
610-1 Coil Cord	Blue	62650-016		9.80	9.05 8.95
<b>STEREO MUSIC HEADPHONE</b>					
520-1	Brown with white trim	63520-001	25.35	21.55	
			<b>1-5</b>	<b>12 &amp; UP</b>	
<b>GROUP LISTENING CENTERS</b>					
<b>GROUP LISTENING CENTER WITH SIX MODEL 510-1 HEADPHONES</b>					
	Includes Group Listening Station with volume controls	62790-032	108.33	101.08	88.05
	Includes Group Listening Station without volume controls	62790-033	103.68	97.28	84.31
<b>GROUP LISTENING CENTER WITH EIGHT MODEL 510-1 HEADPHONES</b>					
	Includes Group Listening Station with volume controls	63791-032	138.08	128.83	112.22
	Includes Group Listening Station without volume controls	63791-033	128.80	120.20	104.74
<b>GROUP LISTENING CENTER WITH SIX MODEL 610-1 HEADPHONES</b>					
	Includes Group Listening Station with volume controls, blue	62790-012	86.77	80.97	70.50
	Includes Group Listening Station without volume controls, blue	62790-018	81.78	76.38	66.47
<b>GROUP LISTENING CENTER WITH EIGHT MODEL 610-1 HEADPHONES</b>					
	Includes Group Listening Station with volume controls, blue	63791-012	108.33	101.08	88.05
	Includes Group Listening Station without volume controls, blue	63791-018	99.05	92.55	80.57
<b>CARRYING CASE ONLY, Black</b>					
		70222-003	22.02	20.52	17.84
<b>GROUP LISTENING STATIONS</b>					
			<b>1-24</b>	<b>25 &amp; UP</b>	
753-00 (6)	6 position group listening station w/individual volume controls	62753-000	14.69	13.14	
753-01 (6)	6 position group listening station w/o volume controls	62753-001	10.00	9.00	
753-03 (8)	8 position group listening station w/individual volume controls	62753-003	20.80	17.95	
753-04 (8)	8 position group listening station w/o volume controls	62753-004	12.30	10.75	

# Professional Headsets and Headphones

## Studio Announcing and Sportscasting Headsets



### PH-24 Lightweight Comfort

The miniature condenser microphone and smaller earphone element help make this the lightest, most comfortable monaural headset for on-the-air broadcast or recording. Superb sound and unbelievable comfort that lasts for hours. Also available in binaural Model PH-25.

### PH-91 Full Cushion Quiet

Ideal for studio or on-location broadcasts — especially in high noise sports situations. Acoustic controlled mic cavity allows crowd noise to be controlled by proximity of the mic to the mouth. Quality dynamic binaural (300 ohm) earphones and full fidelity.

### PH-92

Same as above except with 6000 ohm impedance earphones.

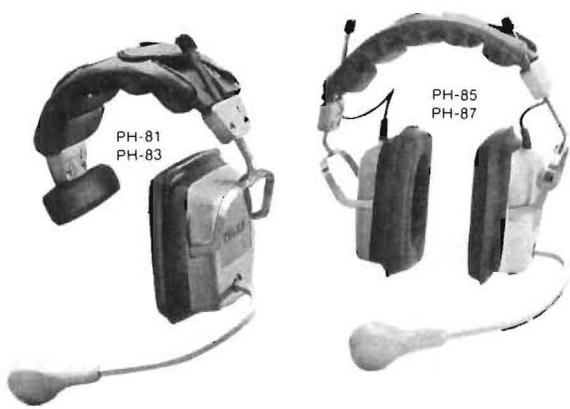
### PH-20 Headworn Microphone (mic only)

Great condenser mic sound for hands-free close talking vocal use where monitoring (earphones) are not necessary. Includes power supply. Also available is the PH-21 which connects to wireless systems using the WT-50 Belt-pack transmitter.



# Professional Headsets and Headphones

## Video and Film Camera Intercom Headsets



## Clear two-way communications in studio or on location

Carbon boom microphones with smooth voice frequency range and compatibility with Western Electric type intercom circuits. Dual-sided binaural and single-sided monaural versions available with or without push-to-talk switch. Extra long tangle-free cord.

### PH-81

Single-sided monaural.

### PH-83

Same but with push-to-talk switch.

### PH-85

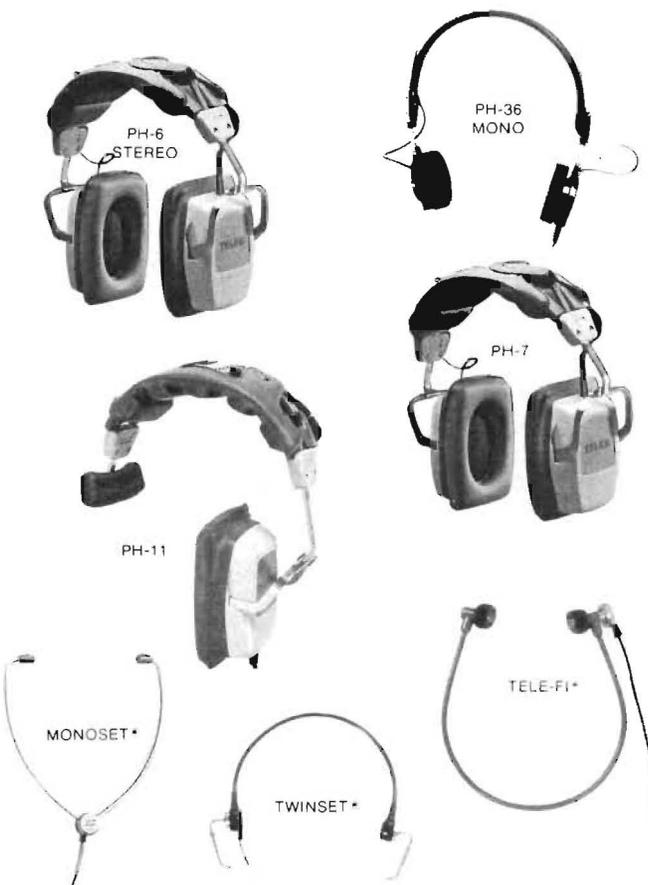
Dual-sided binaural.

### PH-87

Same but with push-to-talk switch.



In-line push-to-talk switch with clothing clip.



### Monitor Headphones

- PH-6 — Professional stereo headphone.
- PH-7 — Dual-sided monaural headphone.
- PH-11 — Single-sided monaural headphone.
- PH-35 — Lightweight stereo.
- PH-36 — Lightweight mono.

### Specialty Headphones

- Twinset — Monaural headband style.
- Tele-Fi — Monaural under-the-chin style.
- Monoset — Monaural under-the-chin style.



- PH-1 — Single-sided mono headphone with dynamic mic. Coil cord with A4F plug.
- PH-2 — Dual-sided mono headphone with dynamic mic. Coil cord with A4F plug.
- PH-3 — Dual-sided binaural headphone with dynamic mic. Coil cord with A5F plug.
- PH-45 — Dual-sided mono headphone with carbon mic. Straight cord with 1/4" plug.
- PH-61 — Dual-sided mono headphone with dynamic mic. Straight cord with 1/4" plug.
- PH-75 — Single-sided mono headphone with dynamic mic. Straight cord with 1/4" plug.
- PH-78 — Single-sided mono headphone with carbon mic. Straight cord with 1/4" plug.
- HD-3A — Dual-sided hear protection headset with noise cancelling dynamic mic. Straight cord with A4F plug.

# Professional Headsets and Headphones

## Announcers

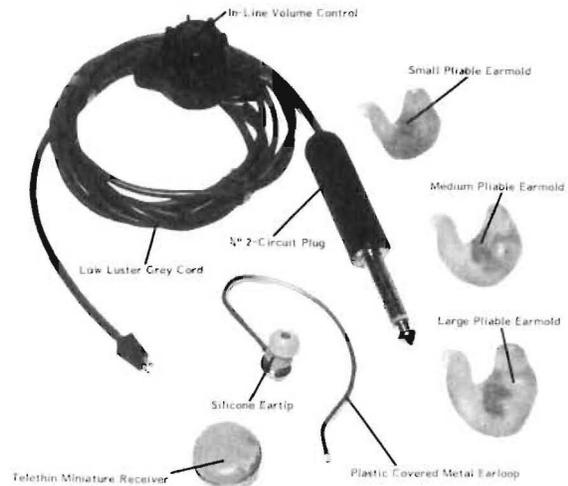
### Earset®

Professional, dependable and inconspicuous. Used by all major TV/Radio networks and stations. Each part available separately with snap-together versatility. Miniature receiver (15, 125, 500, 1000 or 2000 ohms) attaches to earloop or adapts to earmolds (small, medium, large) for the left or right ear. Non-reflecting gray cord, 0.25", 0.140", 0.097" (6.4, 3.6, 2.5 mm) dia. plugs with in-line volume controls (500, 2000 ohms) and clothing clip available.



Includes receiver, earloop and cord

## EARSET COMPONENTS



## HEADPHONES/HEADSETS (All Special Item 136-54)

		ORDER PRODUCT BY CATALOG NO.	U.S. GOV'T PRICE	
			1-11	12 & UP
<b>STUDIO &amp; SPORTSCASTING HEADSETS (w/Push-to-Cough Switch)</b>				
PH-91	Dynamic Dual, 300 ohms/side, 9' (2.7 m) cord (Dynamic Microphone 150/200 ohms)	64390-000	\$160.40	\$141.90
PH-92	Dynamic Dual, 6000 ohms/side, 9' (2.7 m) cord (Dynamic Microphone 150/200 ohms)	64390-001	195.08	172.58
PH-93	Dynamic Dual, 330 ohms/side, 9' (2.7 m) cord	64390-002	255.92	199.42
PH-94	Dynamic Dual (Dynamic Microphone 150/200 ohms - Cardioid)	64390-003	182.07	161.07
PH-24	Lightweight Mono, 150 ohms, 9' (2.7 m) cord (Noise Cancelling Condenser Microphone 150/250 ohms)	64356-000	182.07	161.07
PH-25	Lightweight Binaural, 300 ohms, 9' (2.7 m) cord (Condenser Microphone 150/250 ohms)	70425-000	212.42	187.92
<b>STUDIO &amp; VOCAL HEADBAND/BOOM MICROPHONES</b>				
PH-20	Electret Microphone System, 150 ohm microphone, 3' (.9 m) cord In-line power supply, XLR plug	64327-000	182.07	161.07
PH-21	Electret Microphone, 3' (.9 m) cord, TA4F plug	64327-001	99.71	88.21
PH-22	Electret Microphone, 3' (.9 m) cord, LEMO plug	64327-002	108.38	95.88
PS-10	Battery or Phantom Supply for PH-21	64239-000	99.71	88.21
<b>MONITOR HEADPHONES - STEREO</b>				
PH-6	Dynamic Dual, 600 ohms, 12' (3.7 m) coiled cord, 1/4" (6.4 mm) plug	64437-003	108.38	95.88
PH-35	Lightweight, 300 ohms/side, 6.5' (2 m) cord, 1/4" (6.4 mm) plug	64359-000	45.08	39.88
<b>MONITOR HEADPHONES - MONO</b>				
PH-7	Dynamic Dual, 600 ohms, 5' (1.5 m) cord, 1/4" (6.4 mm) plug	64437-000	86.70	76.70
PH-11	Dynamic Single, 600 ohms, 5' (1.5 m) cord, 1/4" (6.4 mm) plug	64438-000	58.96	52.16
PH-36	Lightweight Dual Side, 600 ohms, 6' (1.8 m) cord, 1/4" (6.4 mm) plug	64353-000	45.08	39.88
<b>PROFESSIONAL COMMUNICATIONS HEADSETS</b>				
PH-45	Dynamic Dual, 600 ohms, 5' (1.5 m) cord, 1/4" (6.4 mm) plug (Carbon Microphone 20/50 ohms)	64437-001	108.38	95.88
PH-61	Dynamic Dual, 600 ohms, 5' (1.5 m) cord, 1/4" (6.4 mm) plug (Noise Cancelling Dynamic Microphone 150 ohms)	64437-002	112.71	99.71
PH-75	Dynamic Single, 600 ohms, 5' (1.5 m) cord, 1/4" (6.4 mm) plug (Noise Cancelling Dynamic Microphone 150 ohms)	64438-001	99.71	88.21
PH-78	Dynamic Single, 600 ohms, 5' (1.5 m) cord, 1/4" (6.4 mm) plug (Carbon Microphone 20/50 ohms)	64438-002	99.71	88.21
PH-62	Dynamic Binaural Dual, 300 ohms/side, 5' (1.5 m) cord (Noise Cancelling Dynamic Microphone 150 ohms)	70362-000	95.37	84.37
<b>INTERCOM HEADSETS (with A4F or A5F connector)</b>				
Plug compatible with TELEX, CLEARCOM and HME Intercom Systems				
PH-1	Dynamic Single, 150 ohms, 6' (1.8 m) coiled cord, A4F plug (Noise Cancelling Dynamic Microphone 150/200 ohms)	64438-005	99.71	88.21
PH-2	Dynamic Dual, 150 ohms, 6' (1.8 m) coiled cord, A4F plug (Noise Cancelling Dynamic Microphone 150/200 ohms)	64437-006	121.38	107.38
PH-3	Dynamic Binaural, 150 ohms/side, 6' (1.8 m) coiled cord, A5F plug (Noise Cancelling Dynamic Microphone 150/200 ohms)	64437-007	126.55	112.55
PH-4	Dynamic Dual, 150 ohms, 6' (1.8 m) coiled cord, A4F plug (Noise Cancelling Dynamic Microphone 150/200 ohms)	70340-000	108.38	95.88
PH-5	Dynamic Binaural Dual, 300 ohms/side, 6' (1.8 m) coiled cord, A5F plug (Noise Cancelling Dynamic Microphone 150/200 ohms)	70350-000	117.05	103.55
PH-8	Lightweight Single (Noise Cancelling Dynamic Microphone 150/200 ohms)	70415-001	124.50	103.50
PH-10	Dynamic Dual (Noise Cancelling Dynamic Microphone 150 ohm)	70470-003	182.07	161.07
HS-6A	Handset (Telephone Style)	96145-000	75.86	67.11

# Professional Headsets and Headphones

## HEADPHONES/HEADSETS (All Special Item 136-54)

		ORDER PRODUCT BY CATALOG NO.	U.S. GOV'T PRICE	
			1-11	12 & UP
<b>VIDEO CAMERA HEADSETS (with carbon 20/50 ohm microphone)</b>				
PH-81	Magnetic Single, 275 ohms, 6' (1.8 m) coiled cord	64438-004	\$99.71	\$88.21
PH-83	Magnetic Single (w/PTT switch), 275 ohms, 6' (1.8 m) coiled cord	64438-003	112.71	99.71
PH-85	Magnetic Dual, 275/625 ohms, 6' (1.8 m) coiled cord	64437-005	160.40	141.90
PS-87	Magnetic Dual (w/PTT switch), 275/625 ohms, 6' (1.8 m) coiled Cord	64437-004	177.74	157.24
<b>HEARING PROTECTION HEADSETS</b>				
HD-3A	Dynamic Dual, 150 ohms, 6' (1.8 m) coiled cord, A4F plug (Noise Cancelling Dynamic Microphone 150 ohms)	63700-011	121.38	107.38
<b>HEADSET ACCESSORIES</b>				
B-3	Battery, 1.4 volt for PS-10	35355-004	1.30	1.15
CC-1	Cushion Cover - Sock (1) for all Circumaural Headsets	35772-000	3.03	2.68
C-3	Earcushion (1) for PH Series Full Cushion	63444-000	5.20	4.60
C-4	Earcushions (2) for PH Series Lightweight	64301-000	3.03	2.68
HP-2	Headband Pad for HD Series	63461-000	6.94	6.14
HP-3	Headband Pad for PH Series	63801-000	6.94	6.14
WS-5	Windscreen for PH-91/PH-92	59737-001	7.80	6.90
WS-7	Windscreen for PH-62	59835-000	3.47	3.07
WS-11	Windscreen for PH-20/PH-21/PH-22/PH-24/PH-25	59747-001	3.47	3.07
PT-400	DPDT Push-to-talk Switch Kit	63295-000	26.01	23.01
<b>DICTIONATION HEADSETS</b>				
EMV-2	Earset - 125 ohms	60194-001	15.61	13.81
EMY-2	Earset - 2000 ohms	60194-004	15.61	13.81
HTW-2	Twinset - 500 ohms	03775-000	39.02	34.52
HMV-2	Monoset - 125 ohms	18183-000	27.74	24.54
HMY-2	Monoset - 2000 ohms	18184-000	27.74	24.54
HFR-91	Tele-fi - 15 ohms	18135-000	19.07	16.87
HFW-91	Tele-fi - 500 ohms	18135-005	19.07	16.87
HFY-91	Tele-fi - 2000 ohms	18135-009	19.07	16.87
Single Pack	Persona-Phone - 8 ohm or 70V or 25V Line	62185-000	91.04	80.54
<b>TELETHIN MAGNETIC RECEIVERS</b>				
RTR-04	Earset, Tele-Fi - 15 ohms	60012-000	8.67	7.67
RTV-04	Earset, Tele-Fi - 125 ohms	60012-003	8.67	7.67
RTW-04	Earset, Tele-Fi - 500 ohms	60012-005	8.67	7.67
RTW-04V	Earset, Tele-Fi - 500 ohms, w/volume control	60150-039	26.01	23.01
RTX-04	Earset, Tele-Fi - 1000 ohms	60012-007	8.67	7.67
RTY-04	Earset, Tele-Fi, Persona Phone - 2000 ohms	60012-009	8.67	7.67
<b>EARSET/TELETHIN ACCESSORIES</b>				
AEM-2	Tele-Ear Acoustical Shell for Earset, Persona Phone, Telethin Rcvrs	18013-000	6.07	5.37
AEF-2	Plastic Covered Metal Earloop for Earset, Telethin Rcvrs	09252-000	2.60	2.30
AEF-3	Nylon Earloop for Earset, Telethin Rcvrs	18304-000	2.60	2.30
AFC-1	Under Chin Tube & Foam Cushion for Tele-Fi	18068-000	8.17	5.37
EML-1	Earmold, Large - Right for Earset	35401-014	8.67	7.67
EML-2	Earmold, Large - Left for Earset	35401-019	8.67	7.67
EMM-1	Earmold, Medium - Left for Earset	35401-012	8.67	7.67
EMM-2	Earmold, Medium - Right for Earset	35401-017	8.67	7.67
EMS-1	Earmold, Small - Right for Earset	35401-010	8.67	7.67
EMS-2	Earmold, Small - Left for Earset	35401-015	8.67	7.67
ET-1	Eartip for Earset	35608-000	3.47	3.07
ET-1	Eartip (Bulk-packed, Pkg of 25)	70594-000	25.01	—
ET-2	Coiled Acoustic Ear Tube w/Earpiece & Clothing Clip for Earset & Cord	70491-000	10.40	9.20
ET-3	Straight Acoustic Ear Tube w/Earpiece & Clothing Clip for Earset & Cord	70490-000	10.40	9.20
C-1	Ear Cushion for Tele-Fi Series	18009-000	0.43	0.38
<b>ACCESSORY CORDS FOR TELE-FI, MONOSET</b>				
CMT-2	5' (1.5 m) straight cord, 1/4" (6.4 mm) plug	60013-000	11.27	9.97
CMT-92	5' (1.5 m) straight cord, right angle, .140" (3.6 mm) plug	60013-013	11.27	9.97
CMT-98	5' (1.5 m) straight cord, straight, .140" (3.6 mm) plug	60013-015	9.54	8.44
CCT-2	5' (1.5 m) coil cord, 1/4" (6.4 mm) plug	19652-000	13.01	11.51
CMT-95	5' (1.5 m) straight cord, .097" (2.5 mm) plug	60013-073	11.27	9.97
CMM-2	5' (1.5 m) straight cord, 1/4" (6.4 mm) plug	03280-000	13.01	11.51
CCM-2	6' (1.8 m) coil cord, 1/4" (6.4 mm) plug	19652-001	15.61	13.81
VXT-3	5' (1.5 m) straight cord, 1/4" (6.4 mm) plug	19616-001	29.48	26.08
VYT-3	5' (1.5 m) straight cord, 1/4" (6.4 mm) plug	19616-000	29.48	26.08
CCX-2	5' (1.5 m) coil cord, RA Mini plug	19652-004	13.01	11.51

# Closed Circuit Intercom Systems

## Audiocom™

In portable and fixed installations, the Audiocom intercom system is ideal for film or TV studios, stage productions, concerts, sports stadiums, race tracks, military, industrial and public safety applications. Operable for distances up to five miles. Can be wired from the power source to portable or fixed intercom stations or can be "daisy-chained" from one station to another. A switchboard connects up to twelve intercom lines to four possible bus circuits or the lines can remain independent.

Options: paging, program feed and rechargeable battery packs. Accessories include power supplies, noise cancelling boom microphone headsets, desk or hand microphones, extension cords, cables, "T" connectors and interface units for 2, 3 or 4 wire systems using balanced or unbalanced circuitry.



IC-2A

IC-2B



IC-2A/F



HD-3A



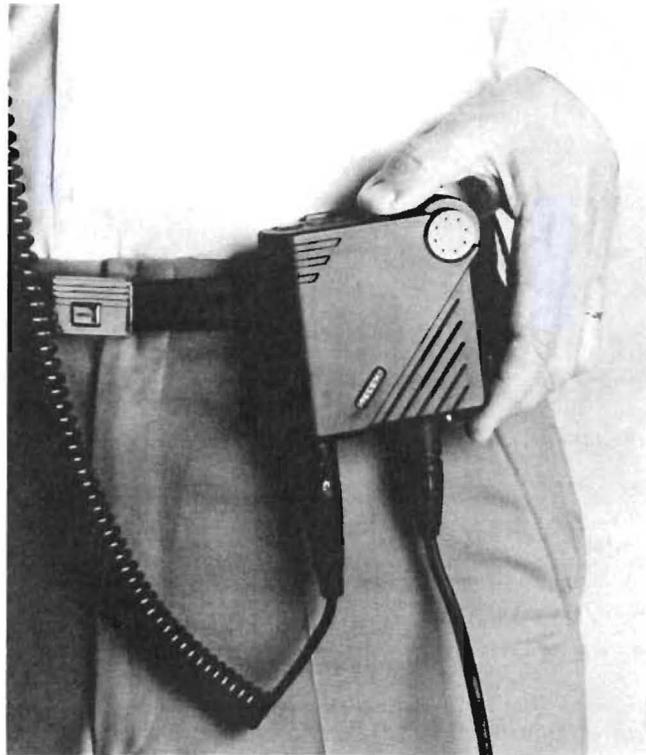
IC-4M



IC-4SX



IC-2S



BP-1  
BP-2

# Closed Circuit Intercom Systems

## AUDIOCOM INTERCOM SYSTEM (All Special Item 136-54)

		ORDER PRODUCT BY CATALOG NO.	U.S. GOV'T PRICE	
			1-11	12 & UP
<b>MASTER STATIONS AND POWER SUPPLIES</b>				
IC-2MAX	Switchboard main station, 2-channel w/IFB, sidetone	96461-000	\$589.30	
IC-4M	Main station, 4-channel w/IFB, sidetone, SA	96185-000	721.88	
IC-4R	Main station, 4-channel w/sidetone (no IFB or power supply)	96190-000	500.20	
IC-4SX	System expander (12 lines/5-channels to IC-4M or IC-4R)	96210-000	592.74	
IC-SR	Rack mount speaker option for IC-4M, IC-4R	96225-000	107.38	
<b>POWER SUPPLIES</b>				
PS-1F	Flush mount power supply, single-channel	92890-000	125.05	115.05
PS-2L	Portable power supply, two line	96167-000	290.95	
<b>REMOTE HEADSET STATIONS (portable)</b>				
BP-1	Lightweight, single-channel, Clearcom compatible	96600-001	165.17	137.31
BP-2	Lightweight, 2-channel, Clearcom compatible	96600-000	223.27	185.61
IC-1B	Circuit board for IC-1 belt-pack station	90906-148	78.03	63.00
IC-1/LS	Belt-pack station, single-channel w/call light	92850-004	169.57	146.50
IC-2A	Flush mount headset station, 2-channel w/call light & sidetone	96118-000	235.09	202.00
IC-2B	Belt-pack station, 2-channel, binaural, dynamic/carbon headset, sidetone	96099-000	262.60	218.50
<b>REMOTE HEADSET STATIONS (flush mount)</b>				
IC-1F/LS	Flush mount headset station, single-channel w/call light	92860-004	156.06	126.00
IC-2AF	Flush mount headset station, 2-channel w/call light & sidetone	96129-000	186.41	150.50
<b>SPEAKER STATIONS</b>				
IC-2S	Portable speaker station, two line w/PTT condenser mic, call light	90480-001	321.79	262.00
IC-2SF	Flush mount speaker station, two line w/PTT condenser mic, call light	90480-000	225.09	187.00
IC-2SP	Portable speaker station, two line w/PTT condenser mic, headset/ mic input, call light, balanced/unbalanced switch	96550-000	455.40	410.85
IC-2SPF	Flush mount speaker station, two line w/ptt condenser mic, headset/ mic input, call light, balanced/unbalanced switch	96544-000	386.40	348.60
<b>INTERFACE UNITS</b>				
IF-1	Interface unit for 2, 3 or 4 wires w/Telco holding coil	94400-000	526.03	442.50
CCB-1	Telex/Clearcom Interface	96230-000	85.87	74.50
	Belt Clip for CCB-1	90906-155	6.21	
<b>HEADSETS, MICROPHONES &amp; HANDSETS</b>				
PH-1	Single muff headset	64438-005	99.71	87.21
PH-2	Dual muff headset	64437-006	121.38	107.38
PH-3	Binaural dual muff headset	64437-007	126.55	112.55
PH-4	Lightweight dual muff headset	70340-000	108.38	95.88
PH-5	Binaural dual muff headset	70350-000	117.05	103.55
HD-3A	Noise attenuating dual muff headset	63700-011	121.38	107.38
PH-10	Super high noise attenuation dual muff headset	70470-003	182.07	161.07
HM-100	Noise cancelling hand microphone	60837-032	52.02	46.02
HS-6A	Handset (telephone style)	96145-000	75.86	67.11
GM-E	Electret Condenser Gooseneck mike	96212-000	86.70	
<b>ACCESSORIES</b>				
HE-15	15' (4.57 m) Headset Extension Cable	92925-000	43.35	
HE-30	30' (9.14 m) Headset Extension Cable	92925-001	55.86	
ME-25	25' (7.6 m) <b>Black</b> Intercom Cable	96150-000	36.41	
	25' (7.6 m) <b>Orange</b> Intercom Cable	96150-003	36.41	
	25' (7.6 m) <b>Green</b> Intercom Cable	96150-006	36.41	
	25' (7.6 m) <b>Blue</b> Intercom Cable	96150-009	36.41	
	25' (7.6 m) <b>Yellow</b> Intercom Cable	96150-012	36.41	
ME-50	50' (15.2 m) <b>Black</b> Intercom Cable	96150-001	61.56	
	50' (15.2 m) <b>Orange</b> Intercom Cable	96150-004	61.56	
	50' (15.2 m) <b>Green</b> Intercom Cable	96150-007	61.56	
	50' (15.2 m) <b>Blue</b> Intercom Cable	96150-010	61.56	
	50' (15.2 m) <b>Yellow</b> Intercom Cable	96150-013	61.56	
ME-100	100' (30.4 m) <b>Black</b> Intercom Cable	96150-002	90.17	
	100' (30.4 m) <b>Orange</b> Intercom Cable	96150-005	90.17	
	100' (30.4 m) <b>Green</b> Intercom Cable	96150-008	90.17	
	100' (30.4 m) <b>Blue</b> Intercom Cable	96150-011	90.17	
	100' (30.4 m) <b>Yellow</b> Intercom Cable	96150-014	90.17	
ME-25/2	25' (7.6 m) <b>Black</b> Intercom Cable (2-channel)	96151-000	55.86	
ME-50/2	50' (15.2 m) <b>Black</b> Intercom Cable (2-channel)	96151-001	65.03	
ME-100/2	100' (30.4 m) <b>Black</b> Intercom Cable (2-channel)	96151-002	108.88	
IC-T	15' (4.57 m) Intercom Cable w/tee connector	92917-000	60.69	
JB-2	Junction box	96139-000	117.05	
EMY-2	IFB Earset (requires field modification)	60194-004	15.61	
WP-1	Single-channel wall plate	96136-000	15.17	
WP-2	Single-channel wall plate w/2-channel switch	96136-001	20.81	
WP-3	2-channel wall plate	96136-002	20.81	
RM-11	Rack mounting brackets for single PS-1, IF-1 or IC-2MA	94398-000	30.85	
RM-12	Rack mounting brackets for 2 (side by side) PS-1, IF-1 or IC-2MA	92793-001	25.01	
RM-13	Rack mounting brackets for any belt pack station	96125-000	44.68	

# Wireless Microphone Systems

## Economy Receivers

FMR 25TD  
TRUE DIVERSITY



FMR-25



### Highest quality, affordably priced

The New FMR-25 series, available in single antenna or true diversity Pos-i-Phase models, stands out from the rest of the field of inexpensive wireless products with much less distortion and flatter frequency response. This advantage was accomplished with a revolutionary new IC and "straight line" audio architecture offering the economy and reliability of fewer parts and simple assembly.

## Pro Sound Receivers



FMR-50  
RECEIVER

FMR-2  
TRUE DIVERSITY



### Superior rejection of unwanted RF and extra narrow channel selectivity.

The latest in MOSFET electronics provides exceptionally high sensitivity while maintaining power rejection of unwanted signals.

### Linear phase filters enhance selectivity without distortion.

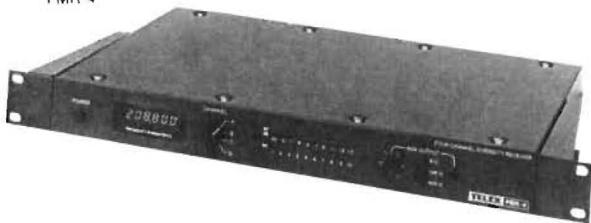
An exclusive system of computer designed IF filters permits the operation of multiple systems in a single location, simultaneously, without interference. These **linear phase filters** pass an amplified FM signal, selectively filtered, without distortion.

### Pos-i-Squelch™ resists unwanted RF energy for cleaner signal.

Telex squelch system developed for the FMR-50 and FMR-2 is especially resistant to spurious RF energy generated by many electrical sources. With Telex, only the desired signal is heard.

## Professional Broadcast Receivers

FMR-4



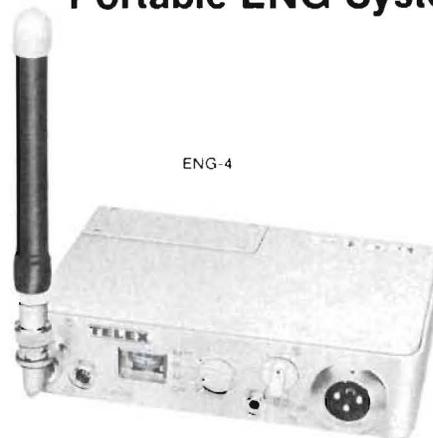
### Top-of-line Receiver is the most advanced available.

The full featured FMR-4 with four selectable frequencies is everything you could want in a wireless microphone receiver. Check this amazing list of features.

- TLX™ circuitry prevents "noise-ups".
- Pos-i-Phase™ true diversity eliminates drop outs.
- GaAsFET transistors help receive over longer distances with no coloration.
- Pos-i-Squelch™ resists spurious electrical energy interference.
- Compander boosts dynamic range without mistracking.
- Linear phase filters enhance adjacent channel selectivity.
- Four selectable frequencies provide freedom from channel conflicts.

## Portable ENG System

ENG-4



### Compact receiver has four frequencies.

Advanced technology reduces size, improves quality and provides frequency selectability. Small enough to attach to side of minicam! Telex has carefully combined several standard frequencies into groups of four so that the widest range of interference-free channels are available for each geographic area.

### Replace batteries in just seconds.

The entire battery compartment on the ENG-4 pops up for easy removal. Spare "sleds" are available to provide quick snap-in battery replacement in the field. The operator is only seconds away from full power in case of an unusually long taping session.

### Choice of power sources.

Depending on your application, the ENG-4 can be powered by four AA batteries internally or from an external power source (+12 to +24 Vdc), utilizing an ac/dc converter or battery pack.

# Wireless Microphone Systems

## Beltpack Transmitters



### WT-25 Unequaled Economy.

Combines a full featured transmitter with attached lapel mic for less than you would expect to pay for transmitter alone.

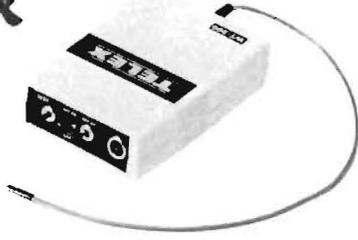


### WT-50 Sensitivity selection for microphone compatibility.

Sensitivity trimmer and mic gain switch provide the economy of adjusting transmitter gain so selected microphones will be compatible.

### WT-200 Turn wired microphones into wireless.

Convert any existing low-impedance (XLR type) microphone into wireless system with unique four foot (1.22 m) adapter cable included.



### WT-400 Two channel selectability.

New surface mount technology has made this unit the smallest and most reliable frequency selectable transmitter available today.



## Microphone/Transmitters

Telex Pro ★ Star

### HT-100 Series New design with wide selection.

Stylish HT-100 has an internal antenna design eliminating the common problem of hand interference while increasing its RF field strength for a stronger signal and longer operating range. A variety of models offer Telex and Shure\* heads with both dynamic and condenser elements.



\*Shure is a registered trademark of Shure Brothers Inc.



For complete versatility just plug in connector and screw on interchangeable mic heads.

Telex TE 10

### Telex Pro ★ Star HT-400 Series Two Channels in one microphone.

An internal switch provides a quick choice between two channels. Unique design allows microphone heads to be changed in an instant.

Shure SM-87



Solid three pin plug assures reliable connection.

Shure SM-58

### WLM-50 Lapel Microphone

Miniature electret, omnidirectional microphone supplied with horizontal tie clasp style and vertical mounting clips. Measures 3/4" (19 mm) long, 7/16" (11 mm) in diameter. Inconspicuous. Designed for use with the WT-50 beltpack transmitter. Equipped with 3' (1 m) anti-noise cord with standard 4 pin connector.



WLM-50 Actual Size

### PH-21 Headworn Wireless Microphone

Designed for close-talking hands-free vocal delivery, the Telex PH-21 headworn electret microphone combines professional sound quality with lightweight comfort and convenience. Designed to connect directly to the Telex WT-50 beltpack transmitter for wireless, hands-free mobility.



PH-21

# Wireless Microphone Systems

## SINGLE ANTENNA — ECONOMY SYSTEMS — 165-185 MHz

	ORDER PRODUCT BY CATALOG NO.	U.S. GOV'T PRICE	
		1-2	3 & UP
<b>FMR-25 LAPEL MICROPHONE SYSTEM</b> Includes: WT-25 Transmitter w/attached lapel mic, FMR-25 Receiver	70731-XXX	\$454.50	\$408.50
<b>FMR-25 HANDHELD MICROPHONE SYSTEM</b> Includes: HT-100/10 Mic/Transmitter, FMR-25 Receiver	70732-XXX	541.20	485.20

## Pos-i-Phase™ TRUE DIVERSITY — ECONOMY SYSTEMS — 165-185 MHz

<b>FMR-25TD LAPEL MICROPHONE SYSTEM</b> Includes: WT-25 Transmitter w/attached lapel mic, FMR-25TD True Diversity Receiver	70733-XXX	563.55	495.55
<b>FMR-25TD HANDHELD MICROPHONE SYSTEM</b> Includes: HT-100/10 Mic Transmitter, FMR-25TD True Diversity Receiver	70734-XXX	650.25	572.25

## SINGLE ANTENNA — PRO-SOUND SYSTEMS — 150-216 MHz

<b>FMR-50 LAPEL MICROPHONE SYSTEM</b> Includes: WT-50 Transmitter, FMR-50 Receiver, WLM-50 Lapel Microphone	64381-XXX	845.33	747.83
<b>FMR-50 HANDHELD CONDENSER MICROPHONE SYSTEM</b> Includes: HT-100/10 Mic Transmitter, FMR-50 Receiver	70774-XXX	797.64	705.64
<b>FMR-50 HANDHELD DYNAMIC MICROPHONE SYSTEM</b> Includes: HT-100/11 Mic/Transmitter, FMR-50 Receiver	70775-XXX	797.64	705.64
<b>FMR-50 HEADWORN MICROPHONE SYSTEM</b> Includes: PH-21 Headworn Microphone, WT-50 Transmitter, FMR-50 Receiver	64373-XXX	862.67	763.17
WLM-300 Unidirectional Electret Lapel Microphone (black) includes tie clips, LEMO connector	70483-000	111.04	92.04
PH-21 Headworn Vocal Microphone, TA4F Connector	64327-001	99.71	88.21
PH-22 Headworn Vocal Microphone, close-talking, noise-canceling electret w/windscreen, LEMO Connector	64327-002	108.38	95.88

### BATTERIES/CHARGERS

		1 PIECE	
BAT-1 Nicad Battery (WHM Series Transmitters) (one per transmitter)	64012-000	21.24	
BAT-2 Nicad Battery (WT & HT Series Transmitters)	63912-000	13.87	
BC-1 Battery Charger for BAT-1 (120V), Charges 3	63903-000	95.37	
BC-1E Battery Charger for BAT-1 (240V), Charges 3	63903-001	133.05	
BC-2 Battery Charger for BAT-2, Charges 1	64267-000	11.27	
BC-3 Battery Charger (ENG-4 & WT-400 Only)	70380-000	537.54	
BSH-1 Battery Sled for ENG-4	64480-000	79.78	

### ANTENNA ACCESSORIES

CX-4 Coax Cable 4'	63901-001	12.57	
CX-25 Coax Cable 25'	63901-000	17.34	
AD-11 1 to 4 Antenna Splitter for 150-163 MHz	64289-000	199.41	
AD-12 1 to 4 Antenna Splitter for 163-180 MHz	64289-001	199.41	
AD-13 1 to 4 Antenna Splitter for 180-198 MHz	64289-002	199.41	
AD-14 1 to 4 Antenna Splitter for 198-216 MHz	64289-003	199.41	
AN-58L 5/8 Wave Antenna w/coax 150-176 (3 Piece)	63900-000	52.02	
AN-58H 5/8 Wave Antenna w/coax 176-216 (3 Piece)	63900-001	52.02	
ANC-58L 5/8 Wave Antenna w/right angle 150-176	63905-000	49.85	
ANC-58H 5/8 Wave Antenna w/right angle 176-216	63905-001	49.85	
AN-14 1/4 Wave Antenna (FMR-25/25TD/50)	878326	21.24	
ALP-1 Directional Log Antenna (150 to 175 MHz)	63910-000	173.40	
AWB-1 Wall Mount Bracket for AN-58 Series Antennas	63906-000	9.97	
ASA-1 Mic Stand Bracket for AN-58 Series Antennas	63907-000	12.57	
ARD-1 ENG-4 Antenna 165-175 (Black Tip)	57032-000	7.34	
ARD-2 ENG-4 Antenna 175-185 (Brown Tip)	57032-001	7.34	
ARD-3 ENG-4 Antenna 185-195 (Red Tip)	57032-002	7.34	
ARD-4 ENG-4 Antenna 195-205 (Yellow Tip)	57032-003	7.34	
ARD-5 ENG-4 Antenna 205-216 (Blue Tip)	57032-004	7.34	

### CARRYING CASES

RC-2 Road Case for FMR-2	64219-000	147.39	
RC-50 Road Case for FMR-50	64219-001	130.05	
CC-4 Shoulder Pouch for ENG-4	70732-000	62.36	
CC-400 Belt Pouch — WT-400	59756-000	11.00	

### RACK MOUNTS

RM-11 Rack Mount Brackets for Single FMR-2	94398-000	34.68	
RM-12 Rack Mount Brackets for Dual FMR-2	92793-001	41.62	
RM-51 Rack Mount Brackets for Single FMR-50	64283-000	26.01	
RM-52 Rack Mount Brackets for Dual FMR-50 (Up to 2 FMR-50's)	64283-001	30.35	
RM-21 Rack Mount Brackets for Single FMR-25	64283-006	27.31	
RM-24 Rack Mount Brackets for Quad FMR-25 (up to 4 FMR-25's)	64283-007	30.45	
RM-31 Rack Mount Brackets for Single FMR-25TD	64283-008	27.31	
RM-34 Rack Mount Brackets for Quad FMR-25TD (Up to 4 FMR-25TD's)	64283-009	30.45	

# Wireless Microphone Systems

	ORDER PRODUCT BY CATALOG NO.	U.S. GOVT PRICE 1 PIECE	
<b>MICROPHONE ACCESSORIES</b>			
WS-10 Foam Windscreen for WLM-25/50/200	59703-001	\$ 6.07	
WS-11 Foam Windscreen for PH-21/22	59747-001	3.80	
WS-1 Foam Windscreen for HT-100/400	50178-1	6.94	
WS-12 Foam Windscreen for WLM-300/60	59875-001	5.37	
MS-S Replacement Slotted Screen for Telex Elements	87919	26.01	
MS-B Replacement Ball Screen for Telex Elements	64016-001	26.01	
MFS-1 Foam Handsleeve - HT-400 Only	64017-002	21.68	
MH-10 Telex TE-10 Plug-in Element for HT-400	70319-000	100.04	
MH-58 Shure SM-58 Plug-in Element for HT-400	70314-000	187.58	
MH-87 Shure SM-87 Plug-in Element for HT-400	70317-000	275.11	
TC-300 Universal Tie Clip for WLM-300/60	70478-000	5.65	
TC-200V Vertical Tie Clip for WLM-200/100/50/25	63850-007	5.65	
TC-200H Horizontal Tie Clip for WLM-200/100/50/25	63850-006	5.65	
TC-50V Vertical Tie Clip for WLM-200/200/50/25	63850-005	5.65	
TC-50H Horizontal Tie Clip for WLM-200/100/50/25	63850-004	5.65	
TT-200 Tie Tac for WLM-200/200/50/25	63848-004	3.13	
TTC-200 Back Clutch for TT-200	57861-000	1.21	
<b>GENERAL ACCESSORIES</b>			
RSB-1 Referee Switch Box - WT-200/400	64420-000	190.74	
IAC-1 Instrument Cable - WT-200/400	63946-001	32.10	
IAC-2 Instrument Cable - WT-50	63946-002	26.01	
MAC-2 XLR to TA4 Adapter Cord - WT-50	63841-002	27.74	
MAC-1 XLR to LEMO Adapter Cord - WT-200/400	63841-001	32.10	
PL-50 Replacement TA4F Plug - WLM-50/60	53986-002	13.01	
PL-100 Replacement LEMO Plug - WLM-100/200/300	53980-000	19.94	
GC-50 WT-50G Replacement Antenna/Audio Cable	64430-000	26.01	
PA-2 Power Supply FMR-2 (120V)	59702-001	30.35	
PA-2E Power Supply FMR-2 (240V)	59716-001	32.95	
<b>INDIVIDUAL SYSTEM COMPONENTS</b>			
<b>BELTPACK TRANSMITTERS</b>			
WT-25 Beltpack Transmitter w/attached lapel mic	70735-XXX	1-2 \$234.07	3 & UP \$207.09
WT-50 Beltpack Transmitter	64229-XXX	273.11	241.61
WT-50G Beltpack Transmitter including Instrument Antenna/Cable (For FMR-2G, FMR-50G only)	70361-XXX	273.11	241.61
WT-200 Beltpack Transmitter includes 3' XLR/LEMO microphone adapter cable (battery not included)	64182-XXX	429.17	379.67
WT-400 Beltpack Transmitter (2-Channel)	70279-XXX	731.77	665.27
<b>PROSTAR HANDHELD MICROPHONE/TRANSMITTERS</b>			
<b>Single Channel</b>			
HT-100/10 Handheld Mic/Transmitter w/Telex TE-10 Condenser Head	70660-XXX	320.79	283.79
HT-100/11 Handheld Mic/Transmitter w/Telex TD-11 Dynamic Head	70661-XXX	320.79	283.79
HT-100/58 Handheld Mic/Transmitter w/Shure SM-58 Dynamic Head	70662-XXX	372.81	329.81
HT-100/87 Handheld Mic/Transmitter w/Shure SM-87 Condenser Head	70663-XXX	537.54	475.54
<b>Two Channel (Interchangeable Heads)</b>			
HT-400/10 Handheld Mic/Transmitter w/Telex TE-10 Condenser Head	70331-XXX	811.55	737.80
HT-400/58 Handheld Mic/Transmitter w/Shure SM-58 Dynamic Head	70332-XXX	907.83	825.33
HT-400/87 Handheld Mic/Transmitter w/Shure SM-87 Condenser Head	70333-XXX	1004.12	912.87
<b>SINGLE ANTENNA RECEIVERS</b>			
FMR-25 Receiver (120 Vac) (includes one 1/4 wave antenna)	70736-XXX	225.42	206.42
FMR-50 Receiver (120 Vac) (includes one 1/4 wave antenna)	64256-XXX	476.85	421.85
FMR-50 Receiver (240 Vac) (includes one 1/4 wave antenna)	64256-1XX	476.85	421.85
FMR-50G Guitar Receiver (120 Vac) (includes one 1/4 wave antenna)	70358-XXX	476.85	421.85
FMR-50G Guitar Receiver (240 Vac) (includes one 1/4 wave antenna)	70358-1XX	476.85	421.85
ENG-4 Portable 4-Channel Selectable Receiver w/antenna	64490-XXX	1155.42	1050.42
<b>Pos-i-Phase™ TRUE DIVERSITY RECEIVERS</b>			
FMR-25TD Receiver (120 Vac) (includes two 1/4 wave antennas)	70737-XXX	329.46	288.46
FMR-2 Receiver (120 Vac) (includes two 5/8 wave antennas, one 25' (7.6 m) coax, one wall bracket)	64213-XXX	949.37	839.87
FMR-2 Receiver (240 Vac) (includes two 5/8 wave antennas, one 25' (7.6 m) coax, one wall bracket)	64213-1XX	949.37	839.87
FMR-2G Wireless Guitar Receiver (120 Vac) (includes two 5/8 wave antennas, one 25' (7.6 m) coax, one wall bracket)	70525-XXX	1122.77	993.27
FMR-2G Wireless Guitar Receiver (240 Vac) (includes two 5/8 wave antennas, one 25' (7.6 m) coax, one wall bracket)	70525-1XX	1122.77	993.27
FMR-4 Receiver (120/240 Vac selectable) (includes two 5/8 wave antennas, one 25' (7.6 m) coax, one 4' (1.2 m) coax, one wall bracket)	70270-XXX	1361.75	1238.00
<b>MICROPHONES</b>			
WLM-50 Omnidirectional Electret Lapel Microphone (gray), TA4F Connector	64277-000	95.37	84.37
WLM-100 Omnidirectional Electret Lapel Microphone (silver) includes tie/lapel clips, windscreen, LEMO connector	63852-000	112.71	99.71
WLM-200 Omnidirectional Electret Lapel Microphone (black) includes tie/lapel clips, windscreen, LEMO connector	63852-001	112.71	99.71
WLM-60 Unidirectional Electret Lapel Microphone (black) includes tie clips, TA4F connector	70482-000	95.37	84.37

# Wireless Microphone Systems

## WIRELESS SOUND ENHANCEMENT SYSTEM (All Special Item 136-54)

COMPONENTS	ORDER PRODUCT BY CATALOG NO.	U.S. GOV'T PRICE	
		1-3	4 & UP
AAT-2 — High Performance Transmitter	70676-XXX*	\$ 562.50	
AAR-1 — Battery powered personal receiver	19726-000	124.47	\$114.67
AAR-10 Battery powered single channel personal receiver w/single earbud	19791-XXX*	82.78	76.23
TW-6AA Battery powered portable transmitter	19758-XXX*	302.97	
<b>SYSTEMS</b>			
<b>SYSTEM PACKAGE</b>			
1 AAT-2		562.50	
3 AAR-10		248.60	
1 WALL PLAQUE		4.34	
3 SEB-1		22.17	
If Ordered Separately		837.61	
If Ordered As A System	70679-XXX*	670.08	
<b>EARPHONES/NECKLOOPS</b>			
Single Earbud w/cord	59840-005	6.94	6.14
Double Earbud w/cord	59840-001	6.07	5.37
TW-8 Single Earbutton w/cord	64115-001	26.44	23.39
NL-3S Neckloop w/cord	17703-006	39.02	34.52
<b>MISCELLANEOUS ACCESSORIES</b>			
TW-8 Wide Response Earbutton w/o cord	63699-008	19.07	16.87
Cord Only	35796-011	7.37	6.52
RTW-04 Magnetic Earphone (for use with IFB systems)	60012-005	8.67	
CMT-92 5' Cable w/right angle connector for RTW-04	60013-013	11.27	
CMT-98 5' Cable w/straight connector for RTW-04	60013-015	9.54	
ET-1 Eartip (for use w/earbutton)	35608-000	3.47	
AEF-2 Plastic covered metal earloop	09252-000	2.60	
NL-3 Neckloop w/o cord	17676-006	34.68	30.68
Cord Only	60013-104	7.80	6.90
Interconnect Cable 20' long XLR-3 male to 1/4" phone plug	96217-000	30.35	
NCM-1 Noise canceling boom mic w/earhook	70486-000	73.70	
NCM-1 Noise canceling boom mic w/headband	64100-000	73.70	
TLM-D Directional Lapel Mic, Clip, Windscreen	17765-003	39.02	
TLM-O Omni Lapel Mic, Clip, Windscreen	17765-002	39.02	
TLM-O Omni Lapel Mic w/12 foot cord	65645-000	43.35	
Cushion Cover for single and double earbuds	59840-006	3.47	
RM-53 Rack mount for single AAT-2's	64283-002	21.68	19.18
RM-54 Rack mount for double AAT-2's	64283-003	21.68	19.18
Lightweight Headphone w/cord	59840-003	8.67	7.67
System Carrying Case to hold 1 AAT-2 & 3 AAR-1's	59848-000	95.37	84.37
TC-100 120V Charger for 10 AAR-1's	19720-002	425.15	375.15
TC-100 240V Charger for 10 AAR-1's	19720-003	476.85	421.85
1/2 Wave Gain Antenna	19759-000	26.01	
Replacement Belt Clip	19728-000	2.60	
Wall Plaque	59864-000	4.22	
Spare Control Cover for AAR-1	19778-000	4.34	3.84
Rack Mount for Single AAT-2	64283-010	26.10	

# Wired Microphones



TE10

PS-2  
Portable  
Phantom  
Power  
Supply



## TE10 Vocal Handheld Microphone

A rugged, condenser microphone, featuring a wide flat response curve that is ideal for recording and broadcasting. Designed to meet the critical voice frequencies of live sound reinforcement applications as well. Phantom power can be supplied either from the sound system console or from the two-channel PS-2 portable phantom power supply.

## TD Series Cardioids

Heavy-duty pro-sound microphones designed for vocal applications. Wide frequency response with extended high end delivers clean, clear reproduction even in high sound level entertainment applications. Withstands rough handling and close micing situations.

The **TD11** utilizes a ball screen head and locking on/off switch. The **TD13** features a slotted screen head.

## TD14

Utilizes the same acoustic cavity design as the TD cardioids, but in an omnidirectional model. A good choice for handheld applications since mechanical handling noise is exceptionally low. On-off switch can be locked on to prevent inadvertent switching.



TD11

TD13

TD14

## The PH-20 Headworn Microphone

Designed for hands-free vocal delivery, utilizing a close-talking electret microphone with a wide range frequency response curve. A stable, split-piece headband mounts securely on the head. Features slip-proof foam temple cushions, a reversible swivel mount and 180° adjustable boom. Includes the PS-10 power supply.

Also available are the PH-21, without the PS-10 and the PH-22, which connects directly to Telex Wireless microphone systems, also without the PS-10.



## LM-100 Lapel Microphone System

Includes the super-small, omnidirectional LM-101 lapel microphone with the PS-10 in-line power supply. Features a condenser element for full, natural sound. An extra supple, quiet cord prevents clothing noise. The PS-10 can supply power either from a 1.4 volt calculator-type battery or it can be switched to phantom power from an external source.



PS10

# Wired Microphones

## Multi-zone Desk Paging with Lift-to-talk Feature

**SB253** A two zone, paging dynamic, featuring a split bar press-to-talk switch and durable satin chrome finish.

**MP753** Offers three paging zones with separate all-call feature and four prewired 3-position, center off rocker switches. Also includes a busy light for multi-station operations.

**MP755** An omnidirectional dynamic, featuring five paging zones with all-call. Also includes a busy light and three 3-position, center off rocker switches. Attractive die-cast housing.

**MP756** Same as the MP755, but with eleven paging zones and six 3-position, center off rocker switches.



SB253



MP753

## Single Zone Desk Paging

**750HL** An omnidirectional single zone microphone with a rugged, die cast metal casing. Dual impedance with lift-to-talk switch, push-to-talk bar and normally open switches for relay control.

**758** A low impedance, line shorting version of the 750HL.

**752** A noise attenuating cardioid with full voice clarity and minimum rear noise pickup. Low impedance, with a lift-to-talk switch.

**251** This low impedance dynamic features a convenient lift-to-talk switch that keys the microphone when picked up and lock-on press-to-talk bar.

**253** Same as the 251 without lift-to-talk switch.



750HL  
758



251  
253



752

## Gooseneck Paging with Long-life Sealed Switches

**MP785** Selective three zone and all-call paging in a gooseneck mounted dynamic microphone. Includes three double pole, double throw pushbutton switches, plus a heavy duty mounting flange and flex arm with satin chrome finish.

### SR785 Series

Single zone paging microphones with gooseneck mounting and heavy-duty die cast housing. Attractive, satin chrome finish.

The **SR785H** is a high impedance dynamic with switching normally shorted in the "off" position, while the **SR785L** is a low impedance version of the same microphone.

**SR785L/NO** is also low impedance, but with normally open switching.

**785L** This low impedance, paging microphone has no switch for convenient, hands-free operation. One of the most rugged and dependable gooseneck microphones available, with die cast housing, satin chrome finish, heavy-duty mounting flange and extra strong flex arm.

**NC585L** Another hands-free, low impedance microphone with noise cancelling advantages. Ideal for noisy environments such as restaurants and cashier counters.



MP785



SR785H  
SR785L  
NC585L



450D

NC450D

## Handheld Paging

**450D** Smooth, pleasant voice range response in a low impedance, paging dynamic. Includes spring strain relief to protect coil cord connection. Housed in a durable, black Cyclocac® case.

**NC450D** Noise cancelling version of the 450D for high noise applications.

**350D** This omnidirectional, paging dynamic is housed in an impact resistant black Cyclocac® case. Includes a strain relief grommet to protect the coil cord connection.

**NC350D** Noise cancelling version of the 350D for use in high noise environments.

Cyclocac® is a registered trademark of Borg-Warner Chemicals.



350D

NC350D

## Specialty Microphones

**WP200** Ideal for security monitoring, fast food and warehouse applications, this wall mounting dynamic features a flush plate mount in a single gang wall box, complete with rubber shock mount. High grade satin finish.

**WP200S** Line shorting version of the WP200 with double pole, double throw, push-to-talk switch.



WP200



WP200S

## S35A Lavalier Microphone

Light and rugged, this omnidirectional lavalier features combination matching lapel-clips and neck-cords. Ideal for applications where inconspicuous, hands-free operation is required. A handsome matte gold finish minimizes reflection.

Model **S35A** is low impedance dynamic. Includes an on/off switch.



S35A

# Wired Microphones

## PUBLIC ADDRESS AND PAGING MICROPHONES (All Special Item 136-54)

		ORDER PRODUCT BY CATALOG NO.	U.S. GOV'T PRICE	
			1-11	12 & UP
<b>WIRED MICROPHONES (Without Cable Assemblies)</b>				
TE10	Cardioid, Condenser Vocal Handheld	64235-001	\$117.05	\$103.55
TD11	Cardioid, Dynamic Ball Screen	64284-002	99.71	88.21
TD13	Cardioid, Dynamic Slotted Screen	64285-001	104.04	92.04
TD14	Omnidirectional, Dynamic	64286-001	78.03	69.03
<b>ELECTRET CONDENSER MICROPHONE SYSTEMS (Includes Power Supply)</b>				
LM-100	Lapel System	64172-000	190.74	168.74
LM-300	Cardioid Lapel Mic System	70481-000	190.74	168.74
CM-10	Conference System	64240-000	268.41	176.41
PH-20	Headworn Vocal Microphone System	64327-000	295.07	161.07
<b>ELECTRET SYSTEM COMPONENTS AND ACCESSORIES</b>				
PH-21	Headworn Boom Microphone w/TA4F Plug	64327-001	99.71	88.21
PH-22	Headworn Boom Microphone w/LEMO Plug	64327-002	108.38	95.88
PS-2	2-Channel Phantom Power Supply for TE10	64140-000	138.72	122.72
PS-10	Battery or Phantom Supply for PH-21	64239-000	95.37	84.37
LM-101	Lapel (3 ft. [.9 m] Cord w/TA4F Plug)	64241-000	95.37	84.37
LM-102	Lapel (15 ft. [4.6 m] Cord w/TA4F Plug)	64242-000	104.04	92.04
MF-10	Foam Muff for Conference Microphone	64243-000	8.67	7.67
WS-10	Windscreen - LM-100/200 Series	59703-001	6.07	5.37
WS-11	Windscreen for PH-20 Series	59747-001	3.47	3.07
WS-12	Windscreen for WLM-60/300	59875-001	6.07	5.37
WLM-60	Cardioid Lapel Mic w/TA4F Connector	70482-000	95.37	84.37
WLM-300	Cardioid Lapel Mic w/LEMO Connector	70483-000	104.04	92.04
<b>MULTI-ZONE PAGING</b>				
MP756	12 Zone - Low impedance	75008	99.71	88.21
MP755	6 Zone - Low impedance	75009	91.04	80.54
MP753	3 Zone + All Call - Low impedance	75007	125.72	111.22
MP785	3 Zone Gooseneck - Low impedance	46027	91.04	80.54
SB253	2 Zone - Low impedance	25413	91.04	80.54
<b>DESK PAGING</b>				
750HL	Normally Open High/Low-Dual impedance	75042-2	104.04	92.04
752	Cardioid - Normally Open - Low impedance	75016-2	138.72	122.72
758	Normally Closed - Low impedance	75004-1	104.04	92.04
251	Lift Switch - Normally Open - Low impedance	25001	95.37	84.37
253	Normally Open - Low impedance	25003	73.70	65.20
<b>GOOSENECK PAGING</b>				
SR785H	Line Shorting - High impedance	46000	\$65.03	\$57.53
SR785L	Normally Closed - Low impedance	46001	60.69	53.69
SR785L/NO	Normally Open - Low impedance	46002	60.69	53.69
785L	No Switch - Low impedance	46033	46.02	40.50
NC585L	No Switch Noise Cancelling - Low impedance	58816	46.02	40.50
<b>HANDHELD PAGING</b>				
450D	Normally Open - Low impedance	47000	39.02	34.52
NC450D	Noise Cancelling - Low impedance	47005	43.35	38.35
350D	Normally open - low impedance	35294	36.41	32.21
NC350D	Noise Cancelling - Low impedance	04303	43.35	38.35
<b>LAVALIER</b>				
S35A	On/Off Switch - Low impedance	03404	86.70	76.70
<b>WALL PLATE SERIES</b>				
WP300	Low impedance	70666-001	21.68	19.18
WP300S	DPDT Switch - Low impedance	70666-000	27.74	24.54
<b>ACCESSORIES FOR PUBLIC ADDRESS MICROPHONES</b>				
<b>STANDS, HOLDERS, WINDSCREENS, CABLES</b>				
02320	Holder (SE, TC)	02320	6.95	
35311	Lavalier Clipholder (35 Series)	35311	15.61	
WS-1	Windscreen (SE, TC)	50178-1	6.94	
ME-25	25' (7.6 m) Microphone Extension Cable	96150-000	36.41	
ME-50	50' (15.2 m) Microphone Extension Cable	96150-001	61.56	
ME-100	100' (30.5 m) Microphone Extension Cable	96150-002	90.17	
<b>MICROPHONE TRANSDUCER REPLACEMENTS</b>				
350D, NC350D, 450D, NC450D		02189	12.14	
785 Series		75329	13.01	
WP200 Series		22709	13.01	
250 Series		25535	13.01	
750 Series		75328	13.01	
SE Series - Cardioid		22710	34.68	
SE Series - Omni		22228-2	34.68	
TD Series - Cardioid		22710-1	34.68	
TD Series - Omni		22711	34.68	

# Aviation Products



## Airman 760 Headphone

Dual dynamic receivers with foam cushions for lightweight comfort.



## HTW-2A Twinset®

Dual magnetic receivers with adjustable tubular sound arms.



## Pilot Earset®

PEV-77 with built-in volume control and coil cord.

PEM-77 with coil cord

PEM-78 with straight cord



## A-610-1 Magnetic Headphone

Good reception and intelligibility.



## H-960 Dynamic Headphone

Lightweight and slim-line, it's the most comfortable of all noise reducing headphones with foam lined earcups and dual dynamic receivers.



## ProAir™ 1500 Headphone

Offers superior noise protection with trussed headband for adjustable attenuation and fitting comfort. Separate volume controls for dual, high output dynamic receivers.



## H-630 Dynamic Headphone

Dual dynamic receivers. Excellent sound at modest cost.



## MRB-600 Magnetic Headset

Good reception and transmission with noise cancelling carbon microphone.



## D-950 Dynamic Headset

Lightweight and slim-line, it's the most comfortable of all noise reducing headsets. Dynamic, noise cancelling microphone on reversible boom fits on right or left side of the head.



## E-951 Electret Microphone Headset

Same comfortable headset as D-950 but with superior noise cancelling, amplified electret microphone.



## ProAir™ 2000E Headset

Offers superior noise protection with trussed headband for adjustable attenuation and fitting comfort. Separate volume controls for dual, high output dynamic receivers. Noise cancelling electret microphone (field replaceable) mounted on fully articulated mic boom.



## Airman 750 Featherweight Comfort Headset

Dual dynamic receivers with soft foam cushions and superior noise-cancelling electret microphone on reversible boom fits left or right side of head.



## 5 x 5® PRO III Single Side Headset

Single side, soft eartip receiver with superior noise cancelling, amplified electret microphone. Fully adjustable for use on right or left side. Can be worn without headband by clipping to wire or plastic eyeglass bows.



## 5 x 5® PRO IR Dual Side Headset

Fully reversible with superior noise cancelling, amplified electret microphone. Dual receivers. Lightweight and completely adjustable.



## 5 x 5® Mark IIE Single Side Headset

Soft eartip receiver, noise cancelling, amplified electret microphone. Adjustable for use on right or left side. Complete with eyeglass clip, carrying pouch.



## 66C Carbon Microphone

Handheld, noise cancelling. Complete with cord, hang up bracket and hardware.



## 66CRA Carbon Microphone

Handheld, noise cancelling. Complete with cord, right angle plug, hang up bracket and hardware.



## 66T Dynamic Microphone

Amplified, handheld, noise cancelling. Complete with coil cord, hang up bracket and hardware.



## 66TRA Dynamic Microphone

Amplified, handheld, noise cancelling. Complete with coil cord, right angle plug, hang up bracket and hardware.



## 100 TRA Dynamic Microphone

Amplified, dynamic, handheld, noise cancelling. Complete with coil cord, right angle plug and hanger bracket.



## 500T Electret Microphone

Outstanding noise cancellation. Amplified, electret handheld. Complete with coil cord, plug and hanger bracket.



## 38T Electret Noise Cancelling Microphone

Replaces Telephonics RS 38 series. Hanger bracket not supplied.



## HS-500 Handset

Interphone and paging handset. Dynamic receiver and noise cancelling amplified electret microphone. Built-in push-to-talk switch.



## PT-300 Push-To-Talk Switch

With hook and pile back strap for quick removal or attachment to all wheel sizes. Complete with coiled cord and standard plug jack adapter.



## TC-200 Intercom

Voice activated for pilot and co-pilot, with individual listening volume controls. Works with standard aviation headsets and interfaces with aircraft radio. Accepts external audio program source for entertainment. Three operating modes are pilot selectable. Portable TC-200 also suitable for installation in or under the instrument panel.



## TC-300

Pilot/co-pilot side-mount headset jackbox.



## TC-400

Passenger intercom extension for positions three and four with individual listening volume controls.

# Aviation Products

## AVIATION PRODUCTS (All Special Item 136-54)

		ORDER PRODUCT BY CATALOG NO.	U.S. GOV'T PRICE 1 PIECE
<b>BOOM-MICROPHONE HEADSETS</b>			
Airman 750	Dual Dynamic Receiver, Electret Boom Mic	64300-000	\$174.40
5x5® Pro III	Single Dynamic Receiver, Electret Boom Mic	64000-000	183.12
5x5® Pro IR	Dual Magnetic Receivers, Electret Boom Mic	63800-000	187.48
5x5® Mark IIE	Single Magnetic Receiver, Magnetic Boom Mic	63515-003	109.00
MRB-600	Dual Magnetic Receivers, Carbon Boom Mic	62640-001	67.58
D-950	Dual Dynamic Receivers, Dynamic Boom Mic	63950-000	99.96
E-951	Dual Dynamic Receivers, Electret Boom Mic	63950-001	119.96
ProAir™ 2000E	Dual Dynamic Receivers, Electret Boom Mic	70470-000	226.72
ProAir™ 2000HE	Dual Dynamic Rcvrs, Electret Boom Mic w/coil cord, U93A/U plug	70470-001	247.43
PT-300	Push-To-Talk Switch w/Velcro® mounting strap	63966-000	34.88
<b>HEADPHONES</b>			
Airman 760	Dual Dynamic Receivers	64400-000	41.42
HTW-2A	Dual Magnetic Twinset®	03775-000	41.42
PEV-77	Pilot Earset® w/built-in volume control and coil cord	61563-020	37.06
PEM-77	Single Magnetic Pilot Earset® w/volume control	61563-001	30.52
PEM-78	Single Magnetic Pilot Earset5x5® w/o volume control	61563-008	21.80
A-610-1	Dual Magnetic Receivers	61650-001	23.98
H-960	Dual Dynamic Receivers	63690-000	74.12
ProAir™ 1500	Dual Dynamic Receivers	70470-002	135.16
H-630	Dual Dynamic Receivers	64060-000	54.50
<b>MICROPHONES</b>			
66C	Handheld Carbon Microphone	60837-003	41.42
66CRA	Handheld Carbon Microphone	60837-020	41.42
66T	Handheld Dynamic Microphone	60837-001	56.68
66TRA	Handheld Dynamic Microphone	60837-008	56.68
100TRA	Handheld Dynamic Microphone	62800-001	56.68
500T	Handheld Electret Microphone	63333-000	89.38
38T	Handheld Electret Microphone	63999-000	75.21
HS-500	Electret Handset w/dynamic receiver	63274-008	130.80
<b>INTERCOM</b>			
TC-200	Voice Activated for Pilot and Co-Pilot	64200-000	252.88
TC-300	Pilot/Co-Pilot Headset Jackbox	64057-000	47.96
TC-400	Extension for Positions 3 and 4	64055-000	109.08
<b>ACCESSORIES</b>			
CMM-2 Cord Unit		03280-000	11.34
Cord w/Volume Control		12227-002	27.90
Coiled Cord		19652-000	16.57
Coiled Cord		19652-001	16.57
Carbon Mic Element		35272-000	11.34
Eartip Assembly		35629-000	3.14
Cushion Cover		35772-000	1.57
Cord Unit		60013-080	13.08
500 Ohm Receiver		60150-037	14.82
Ear Cushion		63444-000	2.79
Headpad Assembly		63461-000	3.49
Headpad Assembly		63801-000	3.49
Headband Assembly		63993-001	20.00
Eyeglass Clip		64001-001	2.70
Eyeglass Adapter		64068-000	1.83

**TELEX 6120  
TAPE DUPLICATING SYSTEM**

**INSTALLATION  
INSTRUCTIONS**

**TELEX<sup>®</sup>**

TELEX COMMUNICATIONS, INC.

9600 Aldrich Ave. So., Minneapolis, MN 55420 U.S.A.

# INSTALLATION

## INTRODUCTION

The following paragraphs describe the procedures necessary for unpacking, assembling, and installing the Telex 6120 Tape Duplicating System. The modularized system permits versatility in system interconnection, and the compactness permits a minimum amount of required space. Physical orientation and environmental parameters are among the considerations when installing the system.

## UNPACKING

Reasonable care is to be exercised in unpacking the Telex 6120 Tape Duplicating System components. Attaching parts for assembling the consoles are packaged with the consoles. Attaching parts for installing the modules in the consoles are packaged with the modules. The control module and tape modules should be carefully inspected for shipping damage prior to installation and operation.

### IMPORTANT

Retain the packing material. Equipment will not be accepted at our factory for service, and warranty will be void, unless system components are shipped in the original packing material.

## SITE LOCATION

When selecting a site location for the Telex 6120 Tape Duplicating System, observe the following precautions:

1. The tape modules should be placed so the magnetic heads and interconnecting leads do not intercept hum fields that can be set up by motors, transformers, fluorescent lights, etc.
2. Adequate ventilation must be provided to prevent tape module motors from overheating.

## CAUTION

Most of the power consumed is dissipated as heat. Heat is the greatest single cause of malfunction and failure. Therefore, in order to derive maximum performance with a minimum of inconvenience, make the necessary provisions for adequate ventilation, both front and back. This is imperative, whether one module or several modules are to be mounted in the same enclosure. Warranty cannot be honored when units have suffered damage due to excessive heat caused by inadequate ventilation.

3. The control module is equipped with a 6 foot (1.8 m) ac power cord for system operation. The system should be located near an electrical receptacle that is capable of providing the required current (110V, 50/60 Hz or 220V, 50/60 Hz).
4. Place the system on a stable, vibration-free surface.
5. Provide ample space for the tape duplicating system. Dimensional data is given in Figure 1.

## CONSOLE ASSEMBLY

### GENERAL

Console configurations are adaptable to user space and operator requirements. The assembly procedures that follow provide instructions for a basic console setup that includes a control/cassette console (for one control module and one cassette module or two cassette modules), a reel console (for one reel module), and a base console (for joining one control/cassette or reel console that is to be arranged horizontally and another that is to be positioned vertically).

### NOTE

Extra attaching parts are included with each console to supplement the needed quantity in the event of loss or misplacement.

A typical installation may include from two to six consoles. The assembly procedures are basically the same regardless of the system configuration. Since replacement part numbers are included on the exploded views, it is suggested that the user retain these instructions for future use. Prior to assembly and installation, three basic assembly premises should be noted:

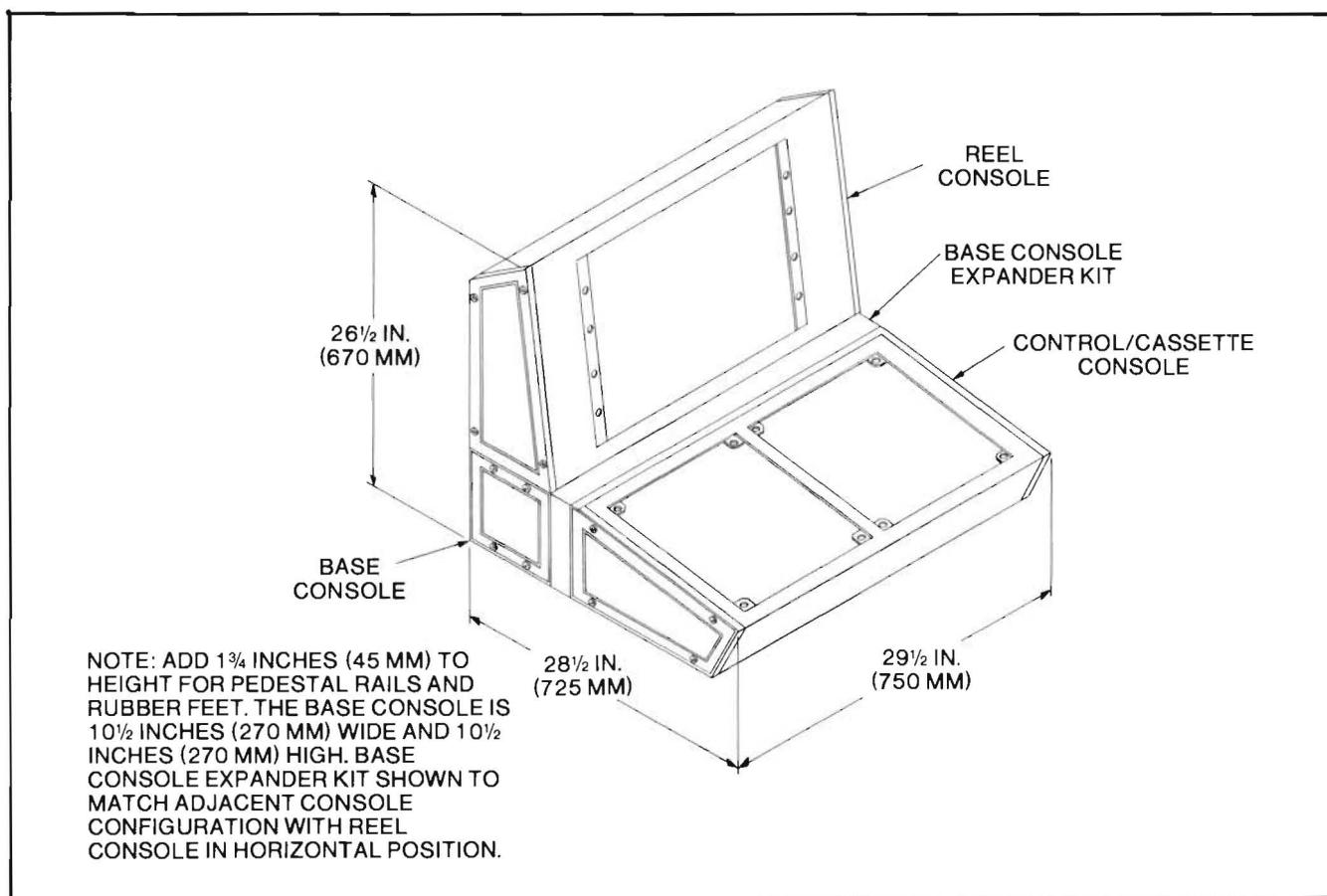
1. The control/cassette console is mounted horizontally when the console is to contain the control module and a cassette module. The console can be mounted horizontally or vertically when housing two cassette modules. Pedestal rails and a rear cover are included with the console for horizontal mounting.
2. The reel console can be mounted horizontally or vertically. Pedestal rails and a rear cover are included with the console for horizontal mounting. The optional 2-inch (51 mm) expander kit must be used when mounting the reel console to a base console in the horizontal position.
3. Rear covers are not used on control/cassette or reel consoles when joined to a base console. Rear covers (when used) are not assembled on consoles until modules have been assembled and cords and cables routed.

## CONTROL/CASSETTE CONSOLE (See Figure 2)

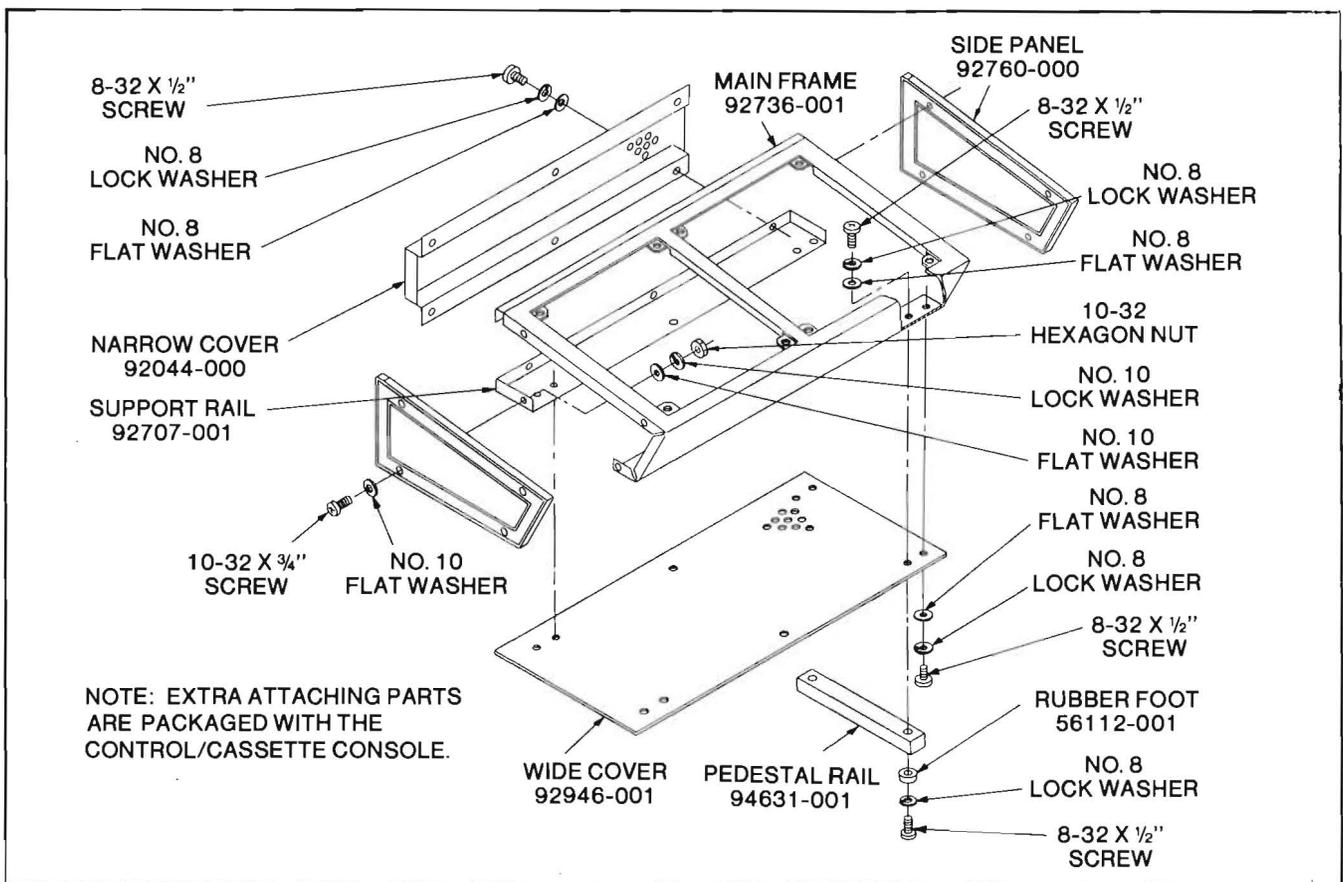
1. Assemble the two side panels to the main frame and bottom rail.
2. If mounting horizontally, assemble the wide cover, pedestal rails, and rubber feet. The narrow cover is not used if the console is to be joined to a base console.
3. If mounting vertically, assemble only the wide cover. The pedestal rails, rubber feet and narrow cover are not used.

## REEL CONSOLE (See Figure 3)

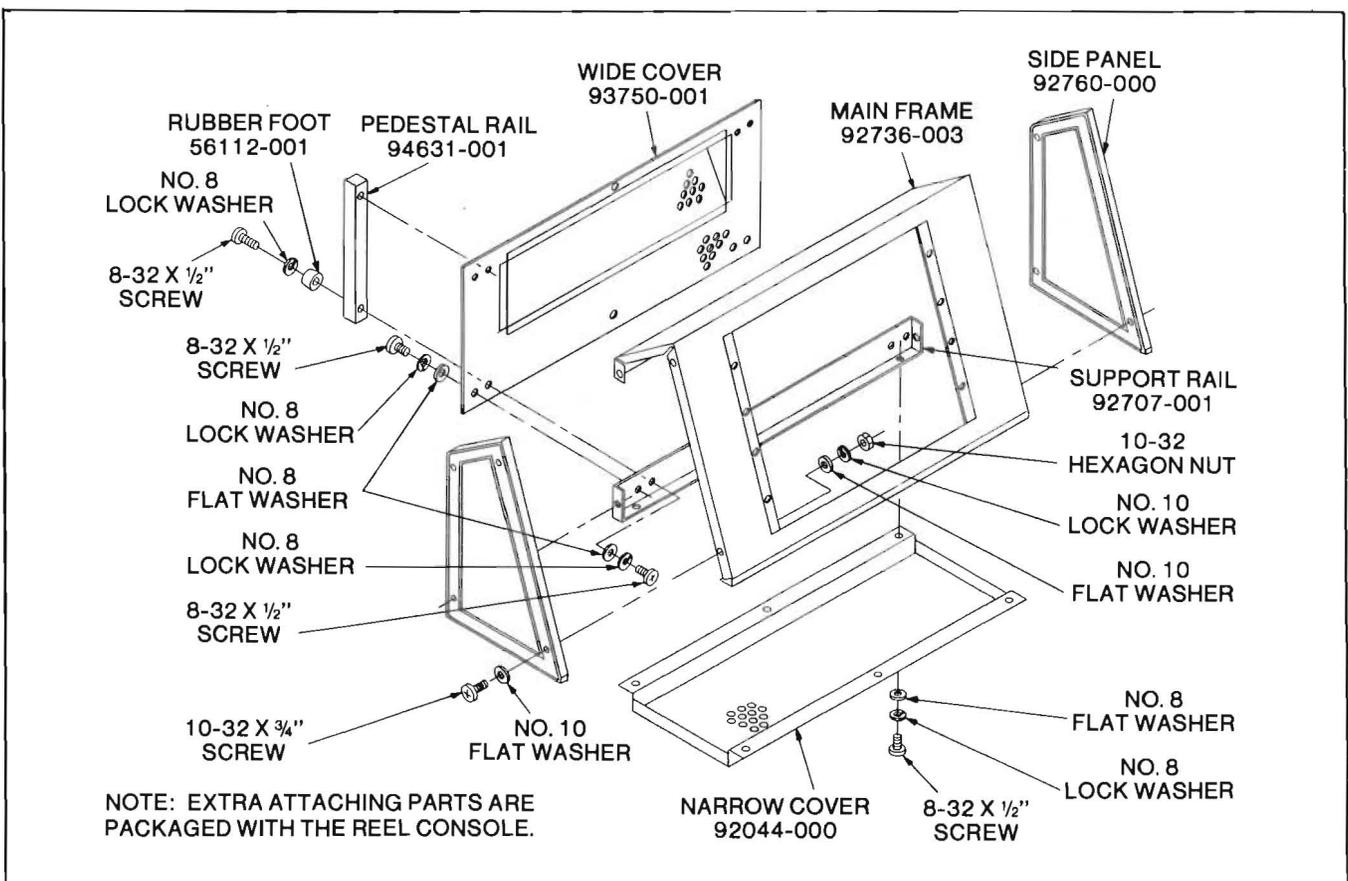
1. Assemble the two side panels to the main frame and bottom rail.
2. If mounting horizontally, assemble the wide cover, pedestal rails, and rubber feet. The narrow cover is not used if the console is to be joined to a base console.
3. If mounting vertically, assemble only the wide cover. The pedestal rails, rubber feet, and narrow cover are not used.



**Figure 1. Console Nominal Dimensions**



**Figure 2. Control/Cassette Console - Exploded View**



**Figure 3. Reel Console - Exploded View**

## BASE CONSOLE (See Figure 4)

1. Assemble the two side panels to the two bottom rails and two top rails.

### NOTE

When using the optional base console expander kit (for horizontally positioned reel console), the two rails included with the kit must replace the two front rails supplied with the base console. Part numbers for the two front replacement rails included in the kit are shown in parentheses in Figure 4.

2. Assemble the bottom cover, pedestal rails, and rubber feet.

### NOTE

Do not assemble the ribbon cable/power cord separators and the rear cover of the base console until the control module and tape modules are assembled to the consoles (to be joined to the base console).

## CONSOLE COMPLETION (See Figure 5)

1. If a base console is to be utilized, decide on the horizontal/vertical configuration that is desired. A base console expander kit must be used if a reel console is to be mounted horizontally.
2. Assemble the consoles together, using the attaching parts that are provided with the base console (and expander kit, if used).

### NOTE

Rear covers of base consoles are not assembled until all tape module ribbon cables and power cords are routed through the cable/cord separators and connections are made at the control module.

3. Assembled 3-console configurations can be placed flush against other 3-console configurations at the base console.

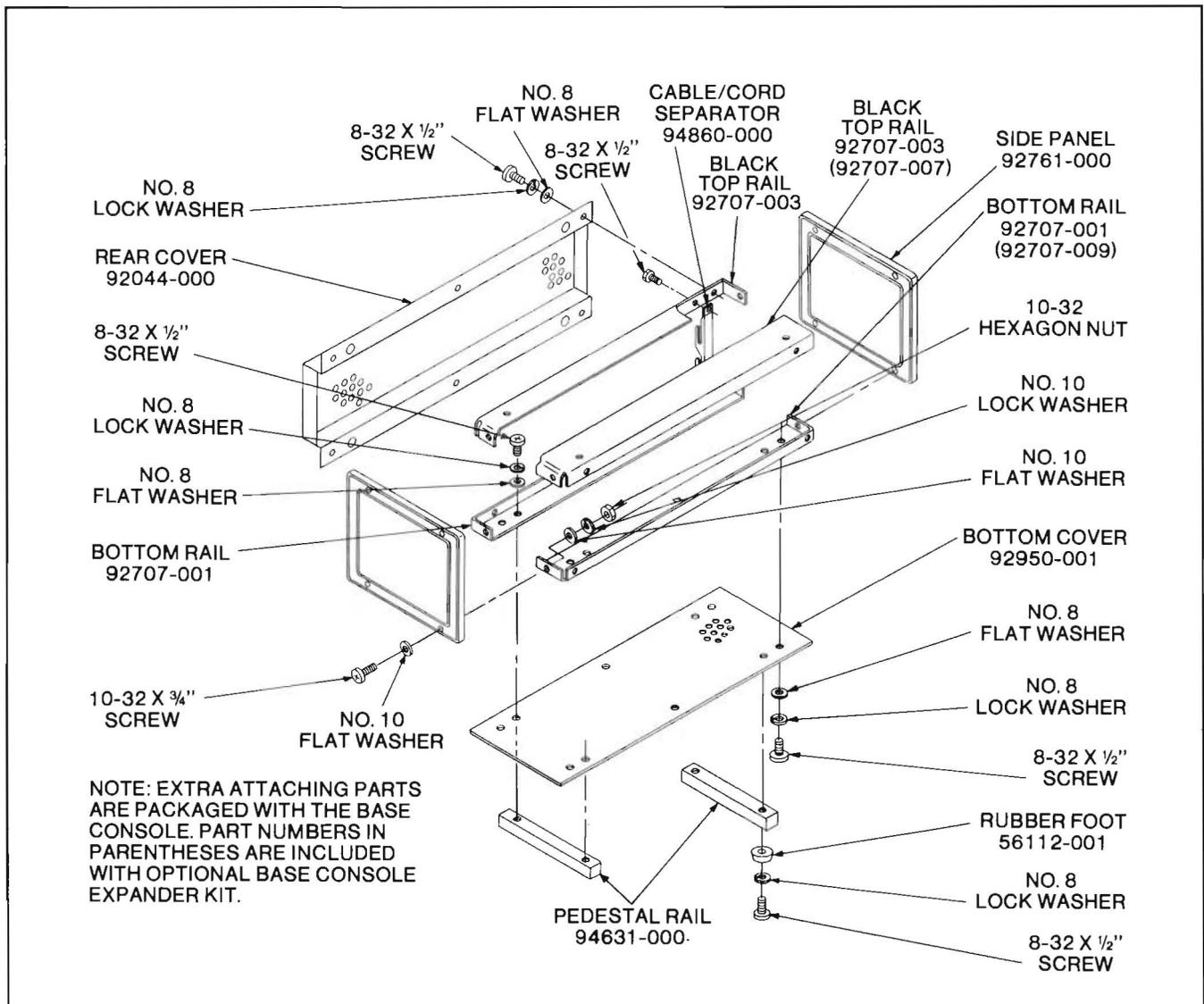
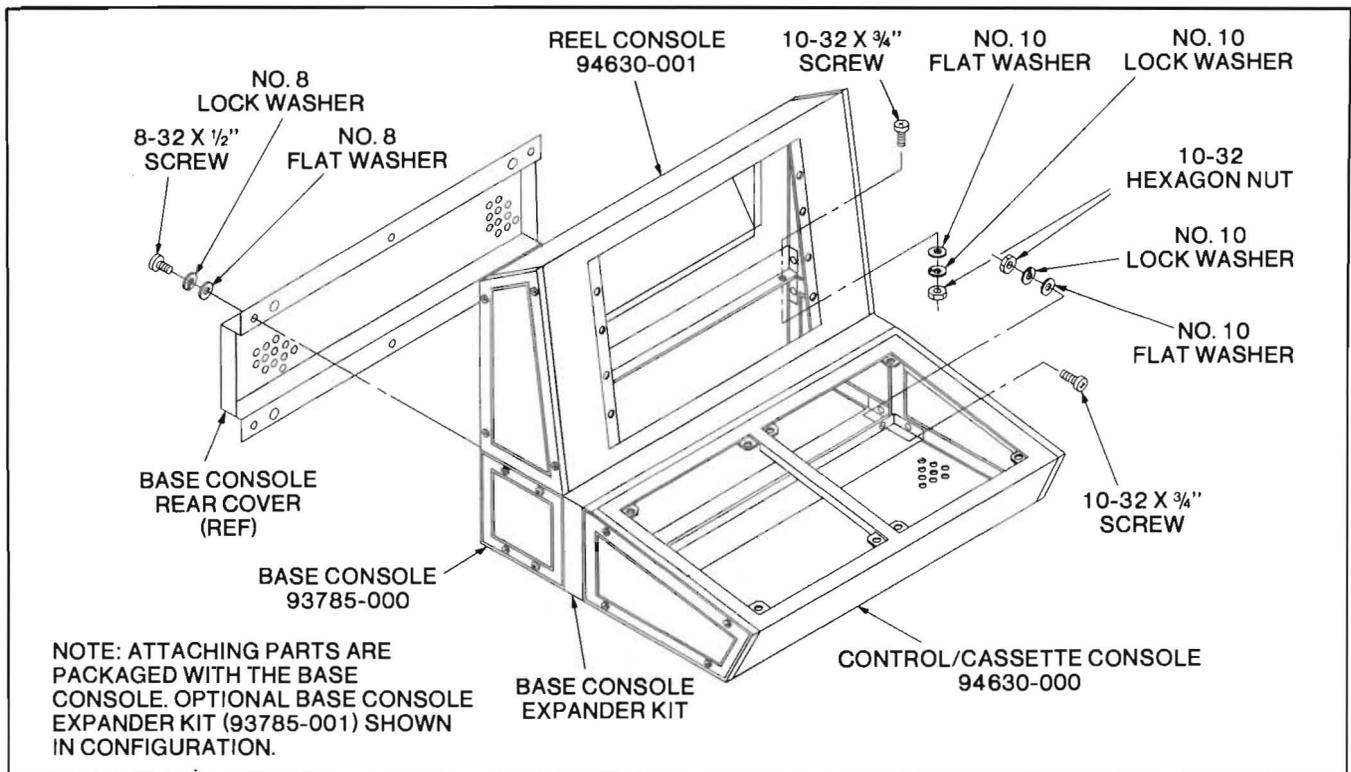


Figure 4. Base Console - Exploded View



**Figure 5. Typical Console Configuration**

## MODULE ASSEMBLY (See Figure 6)

### CONTROL MODULE

1. Mount and fasten the control module in the control/cassette console using the four number 10 black nylon countersunk finishing washers and four number 10-32 x 1/2-inch flat head screws that are supplied.
2. Route the ac line cord to a 10-ampere, 110 Vac, 50/60 Hz or 220 Vac, 50/60 Hz power outlet as applicable.
3. Using the 6-inch (152 mm) double-ended phone plug cables provided, interconnect the control module channel jacks to conform with the system record/play head format and desired channel arrangement as illustrated in Figure 7.

#### NOTE

Other patch panel configurations are also possible. Contact Telex for other possible configurations.

### CASSETTE MODULE

1. Remove the eight screws that secure the head covers to gain access to the mounting holes in the cassette module. (There are two number 6-32 x 3/16-inch black pan head screws and two number 6 lock washers per cassette well.) Retain the screws and lock washers for reassembly. (Do not replace these screws with longer ones.)
2. Mount and attach the cassette module in the control/cassette console using the four pan head screws that are provided.
3. Route the ac power cord and the flat ribbon cable to the control module. Plug the ac power cord into one of the five ac power receptacles at the back of the module. Plug the ribbon cable connector into either the CASS (cassette) ORIGINAL (master) receptacle or one of the two CASS COPY (slave) receptacles as appropriate.
4. Reattach the cassette module head covers, using the screws that were retained in step 1.

#### CAUTION

Take care not to damage the LEDs when reassembling the head covers.

# REEL MODULE

1. Mount and attach the reel module to the reel console using the eight number 10-32 x 1/2-inch black round head screws that are provided.
2. Route the ac power cord and flat ribbon cable to the control module. Plug the ac power cord into one of the five ac power receptacles at the back of the control module. Plug the ribbon cable connector into either the REEL ORIGINAL (master) receptacle or one of the two REEL COPY (slave) receptacles as appropriate.

# NOTE

Plug a reel slave module into the no. "1" REEL COPY (slave) receptacle if (1) it is used in conjunction with a reel master module and a cassette slave module or (2) if used with a cassette master module.

# FINAL ASSEMBLY

1. Make a final inspection of plug-in connections at the control module, and check the tightness of all attaching parts. Power cords should be routed through the lower slots and ribbon cables through the upper slots of the base console cable/cord separators.
2. When satisfied with the mounting configuration, assemble any console rear covers not previously assembled.

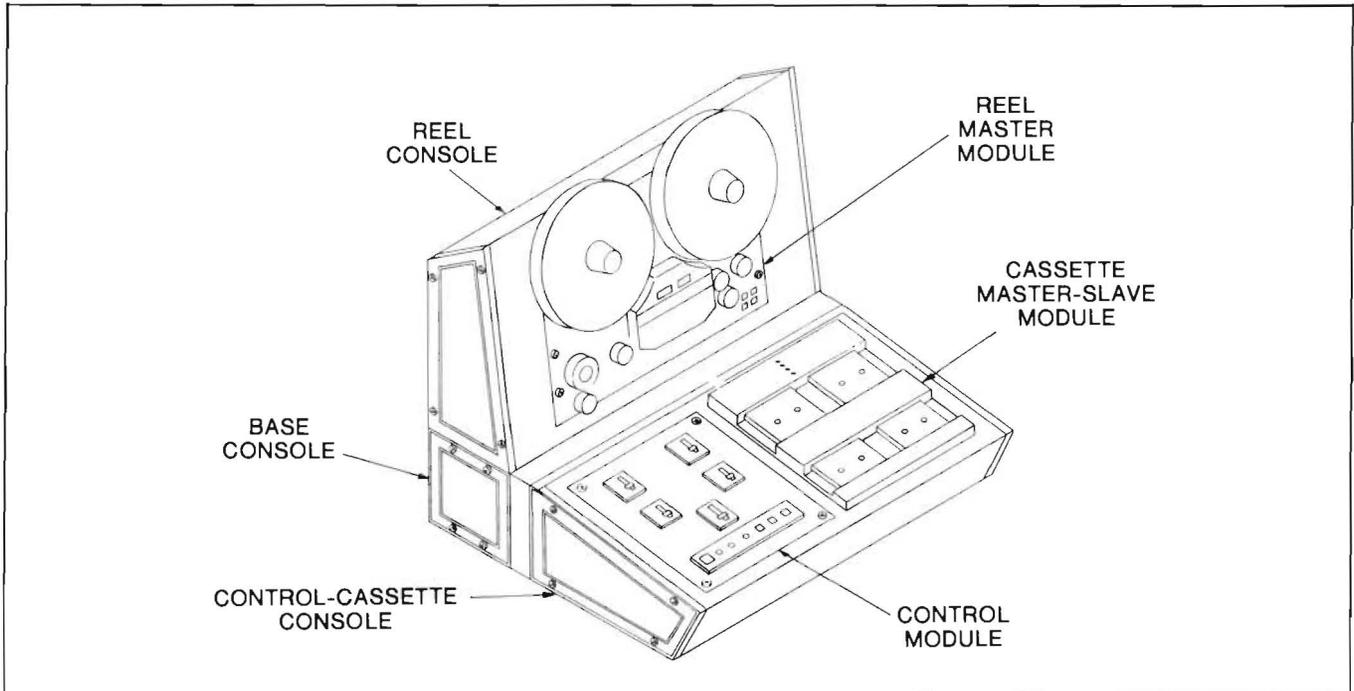


Figure 6. Typical Module Configuration

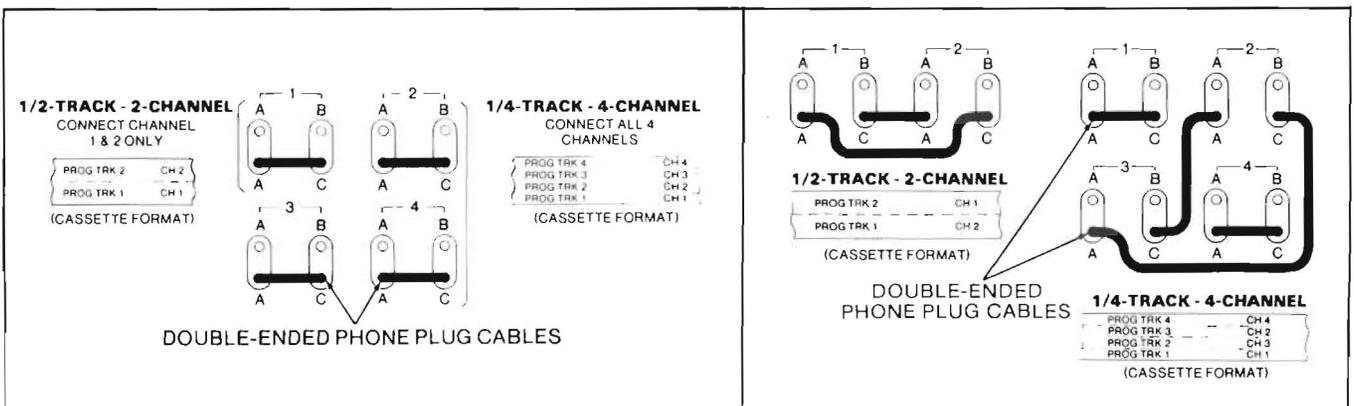


Figure 7a. Standard Track Configuration

Figure 7b. Reverse Track Configuration

# EXPANSION SYSTEMS

## (See Figure 8)

Telex 6120 Tape Duplicating Expansion Systems are installed in much the same way as more basic systems (discussed previously), but they require an expansion module as an extension of the control module.

### EXPANSION MODULE

To install the expansion module in the expanded system:

1. Mount and fasten the expansion module in a control/cassette console using the four number 10 black nylon countersunk finishing washers and four number 10-32 x 1/2-inch flat head screws that are supplied.
2. Arrange system consoles (containing modules) per Figure 8 to centralize the position of the expansion module.

#### NOTE

In the configuration illustrated, two Telex extension cables (part number 93796-000) are required to join the ribbon cables of the two reel slave modules on the far right to the expansion

module. Each 40-inch ribbon extension cable has a 16-position male connector on one end and a 16-position female connector on the other end. (Cables of this type are also commercially available.)

3. Route ac cords and flat ribbon cables from cassette and/or reel slave modules to the rear of the expansion module, and plug into CASS (cassette) COPY (slave) or REEL COPY (slave) receptacles as appropriate.
4. Route the expansion cable (supplied with the expansion module) from the expansion module to the control module after making the 26-pin connection at the EXPANSION receptacle. Plug the 10-pin connector into a control module CASSETTE COPY (slave) receptacle and the 16-pin connector into a control module REEL COPY (slave) receptacle.
5. Route the ac cord of the expansion module to a 10-ampere, 110 Vac, 50/60 Hz or 220 Vac, 50/60 Hz power outlet as applicable.
6. Complete installation by making a final inspection of plug-in connections at the expansion and control modules, and attaching any console rear covers not previously assembled.

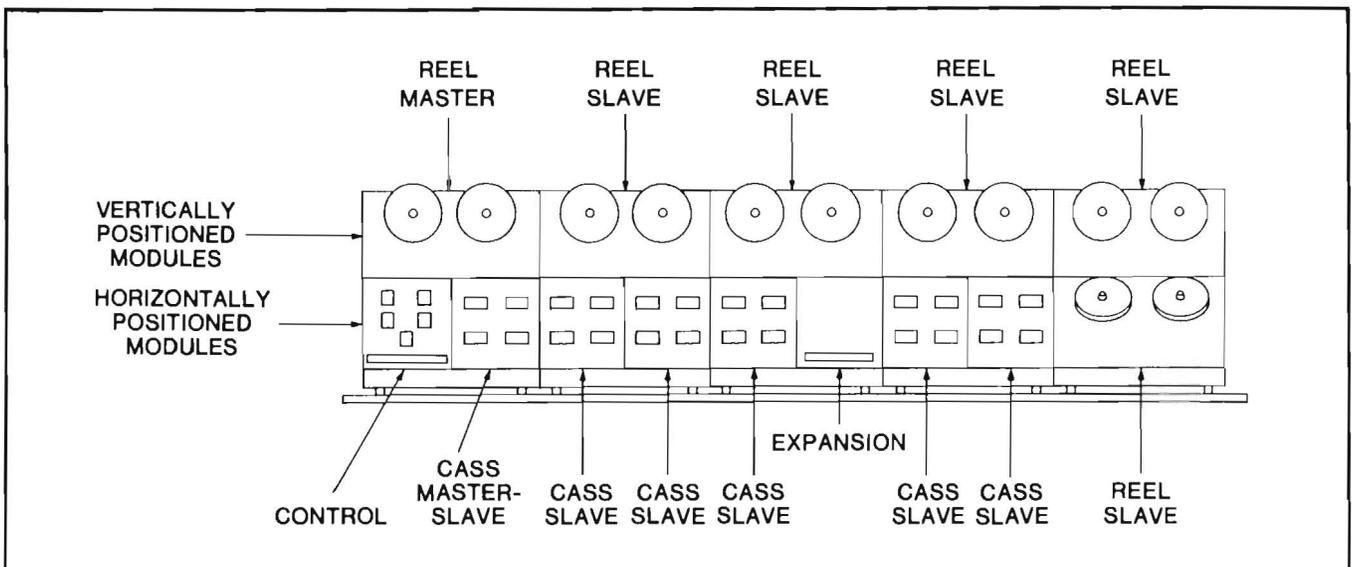


Figure 8. Typical Expansion System - Recommended Configuration

#### NOTE

Retain these installation instructions as a record of console part numbers and as a reminder of the disassembly/assembly sequence in the event of future console parts replacement and/or system configuration modifications. For further information regarding this installation or Telex 6120 Tape Duplicating System maintenance in general, contact the Telex Service Department.

# **SERVICE MANUAL**

## **MODEL 6120 TAPE DUPLICATING SYSTEM**

**TELEX<sup>®</sup>**

TELEX COMMUNICATIONS, INC.

9600 Aldrich Ave. So., Minneapolis, MN 55420 U.S.A.

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## REPLACEMENT PARTS

Authorized Telex Service Centers stock commonly needed replacement items. Parts not available locally may be ordered from our Parts Department. When ordering, please include the Model and Serial numbers, Part Description and Part Number and mail to:

Parts Department  
Telex Communications, Inc.  
9600 Aldrich Avenue South  
Minneapolis, Minnesota 55420 U.S.A.

## REVISION STATUS

Periodically this manual will be reprinted to reflect current design and manufacturing. During the interim, production design modifications shall be disseminated by issuance of temporary information in the form of Service Bulletins, Addenda, or revised insert pages. Upon receipt of such information, insert the material in the manual and enter the issue date and initials in the Record of Revisions.

When the manual is reprinted in its entirety all previously released temporary information shall be incorporated in the current printing and recorded in the Record of Revisions.

## RECORD OF REVISIONS

REVISION NUMBER	ISSUE DATE	EFFECTIVE PAGES	PURPOSE OF REVISION	BY
A	April 1984	All	Update exploded views, schematic diagrams and parts lists.  Add reel slave, expansion and rewind modules.	Telex
B	May 1985	All	General update to reflect current production.	Telex
C	July 1986	All	General update to reflect current production.	Telex
D	July 1987	All	General update to reflect current production.  Added XL & XLP versions.	Telex
E	August 1988	4-4, 4-5, 4-6, 4-8	Revised electrical alignment procedures for open reel modules.	Telex

## PREFACE

This Service Manual is for the use of service representatives and technical personnel engaged in servicing and maintaining the Telex Model 6120 Tape Duplicating System. Every effort is to be made to keep this manual current by issuing addenda pages reflecting design changes in the device.

## INTRODUCTION

This Service Manual is divided into four major sections. Section I, GENERAL INFORMATION, contains a system description and specifications. Section II, THEORY OF OPERATION, provides the necessary information to support both mechanical and electrical operation of the system. This information includes principles of operation, and circuit functional descriptions. Section III, MECHANICAL MAINTENANCE, presents general preventive techniques (cleaning and lubrication). This section also provides information on repair and replacement of mechanical components, testing procedures and illustrated parts breakdowns of the various mechanical assemblies. Section IV, ELECTRICAL MAINTENANCE, provides information to support the electrical operation of the unit. This data includes test and alignment procedures and the schematic diagrams.

In order to clarify the text and enable the reader to readily separate that information applicable only to the Record module or the Reproduce module, parenthetical reference to both units may be made and shall indicate the following: a. (S) Slave - material being discussed is applicable to the Record module only. b. (M) Master - material being discussed is applicable to the Reproduce module only. When ordering replacement parts, particular attention must be given to the information appearing after the part description. This information shall indicate the model and/or version that this particular part is used on. The absence of such information indicates an interchangeable part.

## SERVICE AND REPAIR

All equipment returned for repair must be accompanied with documentation stating your return address and telephone number along with information regarding the nature of the problem. In lieu of this, you may obtain a Return Authorization Form by writing to:

Customer Service Department  
Telex Communications, Inc.  
9600 Aldrich Avenue South  
Minneapolis, Minnesota 55420 U.S.A.  
Telephone: (612)884-4061  
(Collect calls not accepted)

Do not return equipment to above address, but to the address listed below.

**Warranty** - If in warranty, no charge will be made for the repairs; however, proof of date of purchase must accompany the returned equipment. Equipment being returned for in-warranty repair must be sent prepaid and will be returned prepaid.

**Non-Warranty** - Equipment that is not under warranty must be sent to the Telex plant prepaid. If requested, an estimated cost will be issued prior to service. Once your approval for repair, and repair of equipment is completed, the equipment will be returned on a collect basis.

Return equipment to:

Service Department  
Telex Communications, Inc.  
West First Street  
Blue Earth, Minnesota 56013 U.S.A.

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Minneapolis, Minnesota 55420 U.S.A. August 1983

# SECTION I

## GENERAL INFORMATION

### 1.1 GENERAL DESCRIPTION

#### 1.1.1 SYSTEM

The Telex 6120 Tape Duplicating System consists of modular components designed to meet a variety of audio tape duplication needs. By interconnecting modules in various ways, it is possible to create the following tape duplicating options: reel master to reel copy, reel master to cassette copy, and cassette master to cassette copy. The modular system design also offers flexibility of system size. With the addition of expansion modules, a system may be expanded to meet virtually any users needs.

Modules are available in either two-channel monaural, or four-channel stereo format for operation with either 110V, 60 Hz or 220V, 50 Hz ac power sources. In addition, three versions of the system, utilizing different tape heads and duplicating speeds are available. The standard version copies at a 16 to 1 speed ratio (60 Hz ac power) or 13.3 to 1 speed ratio (50 Hz power), offering good quality reproductions at high production speeds. The XL version copies at the same speed as the standard version, but the XL cassette modules utilize special, long-life tape heads which offer somewhat better audio response characteristics and last up to 10 times longer than normal heads. The XLP version cassette modules also use special, long-life tape heads. In addition, the entire XLP system operates at an 8 to 1 speed ratio (60 Hz ac power) or 6.7 to 1 speed ratio (50 Hz ac power) for improved frequency response with less distortion and cross talk.

**NOTE:** Lower speed ratios are obtained in the XLP system in two ways: The XLP cassette modules operate at half the speed of the standard and XL cassette modules; the XLP reel modules operate at the same speed as the standard and XL reel modules, but the XLP reel master module is designed to use master tapes recorded at twice the speed of the standard and XL masters.

Module types and usage are summarized in Table 1.1.

#### 1.1.2 MODULE DESCRIPTIONS

##### 1.1.2.1 Control Module

The control module is the central component of the system. It contains the system operating controls, logic circuitry to activate/deactivate tape modules in the proper sequence during copying, audio and bias controls with associated level meters, input/output and power connectors for tape duplicating modules, and a track assignment patch panel. The control module can support one cassette master/slave module, one reel master module and either two cassette slave and two reel slave modules, or one cassette slave and one reel slave module plus one expansion module.

All controls are located on the front panel of the control module. The power switch controls power to the control module and the ac outlets on the rear panel. The copy and master toggle switches select the type of copy and master tapes to be used. The rewind toggle switch affects only the master pocket of the cassette master/slave module. It selects either manual or automatic rewind of the cassette master after copying. (Off/recue switches on reel modules must be set to the recue position for automatic rewind of reel tapes.) The rewind, stop and copy push buttons control all connected reel and cassette modules, and LED's indicate the current mode of operation. The audio record level controls and indicators provide a level setting capability for each channel of all copy pockets. The bias level control and indicator provides a master adjustment of bias to all copy pockets.

All connections are made on the rear panel of the control module. The switched ac power outlets supply power for reel and cassette modules. (Expansion modules are not powered from the control module, but should be plugged into a separate ac outlet.) Ribbon cable connectors are provided for connection of reel and cassette modules. (An expansion module is connected using one reel slave and one cassette slave connector.) The patch panel is used to assign each track of the master tape to the desired track of the copy tapes. The "A" receptacles are master track

**Table 1.1 Module Types and Usage**

CAT. NO.	DESCRIPTION	SYSTEM USAGE		
		STD	XL	XLP
<b>CONTROL MODULES</b>				
94628-000	110V, 4-Channel	X		
94628-001	220V, 4-Channel	X		
94628-002	110V, 2-Channel	X		
94628-003	220V, 2-Channel	X		
94628-100	110V, 4-Channel		X	
94628-101	220V, 4-Channel		X	
94628-102	110V, 2-Channel		X	
94628-103	220V, 2-Channel		X	
94628-200	110V, 4-Channel			X
94628-201	220V, 4-Channel			X
94628-202	110V, 2-Channel			X
94628-203	220V, 2-Channel			X
<b>REEL MASTER MODULES</b>				
92774-000	110V, 4-Channel	X	X	
92774-001	220V, 4-Channel	X	X	
92774-002	110V, 2-Channel	X	X	
92774-003	220V, 2-Channel	X	X	
92774-200	110V, 4-Channel			X
92774-201	220V, 4-Channel			X
92774-202	110V, 2-Channel			X
92774-203	220V, 2-Channel			X
<b>REEL SLAVE MODULES</b>				
92774-004	110V, 4-Channel	X	X	
92774-005	220V, 4-Channel	X	X	
92774-006	110V, 2-Channel	X	X	
92774-007	220V, 2-Channel	X	X	
92774-204	110V, 4-Channel			X
92774-205	220V, 4-Channel			X
92774-206	110V, 2-Channel			X
92774-207	220V, 2-Channel			X
<b>REWIND MODULES</b>				
94639-000	Four-Position, 110V	X	X	X
94639-001	Four-Position, 220V	X	X	X

CAT. NO.	DESCRIPTION	SYSTEM USAGE		
		STD	XL	XLP
<b>CASSETTE MASTER/SLAVE MODULES</b>				
94629-000	110V, 4-Channel	X		
94629-001	220V, 4-Channel	X		
94629-002	110V, 2-Channel	X		
94629-003	220V, 2-Channel	X		
94629-100	110V, 4-Channel		X	
94629-101	220V, 4-Channel		X	
94629-102	110V, 2-Channel		X	
94629-103	220V, 2-Channel		X	
94629-200	110V, 4-Channel			X
94629-201	220V, 4-Channel			X
94629-202	110V, 2-Channel			X
94629-203	220V, 2-Channel			X
<b>CASSETTE SLAVE MODULES</b>				
94629-004	110V, 4-Channel	X		
94629-005	220V, 4-Channel	X		
94629-006	110V, 2-Channel	X		
94629-007	220V, 2-Channel	X		
94629-104	110V, 4-Channel		X	
94629-105	220V, 4-Channel		X	
94629-106	110V, 2-Channel		X	
94629-107	220V, 2-Channel		X	
94629-204	110V, 4-Channel			X
94629-205	220V, 4-Channel			X
94629-206	110V, 2-Channel			X
94629-207	220V, 2-Channel			X
<b>EXPANSION MODULES</b>				
94649-000	110V, 4-Channel	X	X	
94649-001	220V, 4-Channel	X	X	
94649-002	110V, 2-Channel	X	X	
94649-003	220V, 2-Channel	X	X	
94649-200	110V, 4-Channel			X
94649-201	220V, 4-Channel			X
94649-202	110V, 2-Channel			X
94649-203	220V, 2-Channel			X

outputs, the "B" and "C" receptacles are copy track inputs. For normal applications where one track output is assigned to a single track input, the "C" inputs are used. For special applications where one track output is assigned to two track inputs, each "A" output is connected to the "B" input of the desired track.

**1.1.2.2 Reel Master Module**

The reel master module is designed for reel master tape playback. It is equipped with a two-position tape speed switch to accommodate reel master tapes recorded at either 3.75 ips (9.5 cm/s) or 7.5 ips (19 cm/s) for standard and XL systems (7.5 ips [19 cm/s] or 15 ips [38 cm/s] for XLP systems). (See Table 1.2 for tape speed settings.) A two-position reel size switch sets reel tensions as needed to

accommodate either 7-inch (178 mm) or 10.5-inch (267 mm) reels. A complete set of operating controls provide stop, play, fast rewind, and fast forward functions. An off/recue switch selects automatic rewind at end of playback in the recue position, or no rewind after playback in the off position.

In addition to playing back the master tape, the reel master module originates control signals which tell the control module to activate/deactivate slave modules. These signals are generated by the transitions from clear leader to opaque recording tape at the beginning and end of the master tape. An optical sensor in the tape path senses these transitions and then generates the control signal. Long clear leaders are used at the beginning and end of the master tape so that the reel master module can get up to normal copying speed before actually starting to play back, and also to allow

**Table 1.2 Tape Speed Switch Setting for Desired Copy Tape Speed**

**(Standard and XL Systems)**

Master Tape Speed	Desired Copy Tape Speed	Master TAPE SPEED Switch	Copy TAPE SPEED Switch
<b>REEL MASTER TAPE TO REEL COPY TAPES</b>			
7.5 ips (19 cm/s)	7.5 ips (19 cm/s)	FAST	FAST
7.5 ips (19 cm/s)	3.75 ips (9.5 cm/s)	FAST	SLOW
3.75 ips (9.5 cm/s)	3.75 ips (9.5 cm/s)	SLOW	SLOW
3.75 ips (9.5 cm/s)	7.5 ips (19 cm/s)	SLOW	FAST
<b>REEL MASTER TAPE TO CASSETTE COPY TAPES</b>			
7.5 ips (19 cm/s)	1.875 ips (4.75 cm/s)	FAST	NA
3.75 ips (9.5 cm/s)	1.875 ips (4.75 cm/s)	SLOW	NA
3.75 ips (9.5 cm/s)	.9375 ips (2.38 cm/s)	FAST	NA
<b>CASSETTE MASTER TAPE TO REEL COPY TAPES</b>			
NA	3.75 ips (9.5 cm/s)	NA	SLOW
NA	7.5 ips (19 cm/s)	NA	FAST

**(XLP System)**

Master Tape Speed	Desired Copy Tape Speed	Master TAPE SPEED Switch	Copy TAPE SPEED Switch
<b>REEL MASTER TAPE TO REEL COPY TAPES</b>			
15 ips (38 cm/s)	15 ips (38 cm/s)	FAST	FAST
15 ips (38 cm/s)	7.5 ips (19 cm/s)	FAST	SLOW
7.5 ips (19 cm/s)	7.5 ips (19 cm/s)	SLOW	SLOW
7.5 ips (19 cm/s)	15 ips (38 cm/s)	SLOW	FAST
<b>REEL MASTER TAPE TO CASSETTE COPY TAPES</b>			
15 ips (38 cm/s)	1.875 ips (4.75 cm/s)	FAST	NA
7.5 ips (19 cm/s)	1.875 ips (4.75 cm/s)	SLOW	NA
7.5 ips (19 cm/s)	.9375 ips (2.38 cm/s)	FAST	NA
<b>CASSETTE MASTER TAPE TO REEL COPY TAPES</b>			
NA	7.5 ips (19 cm/s)	NA	SLOW
NA	15 ips (38 cm/s)	NA	FAST

sufficient braking time at the end of the copy cycle so that the master tape does not unthread from the machine.

The reel master module also features an automatic tape cleaner which dispenses cleaning tape at a uniform speed to remove any loose dirt or oxide from the master tape surface before it passes over the playback head.

**1.1.2.3 Cassette Master/Slave Module**

The cassette master/slave module contains a single cassette master playback deck and three cassette copy record decks. The module is equipped with front panel track select switches which allow the user to choose tracks to be recorded without affecting information on other tracks. Each copy position is equipped with a red LED indicator which instantly illuminates if the tape in that pocket jams, breaks or stops during copying before the master tape ends.

The cassette master/slave module originates only an end-of-tape control signal. This signal is generated by an end-of-tape (EOT) sensing circuit in the master pocket which detects when the spindles stop rotating. This signal tells the control module that playback is completed.

**1.1.2.4 Reel and Cassette Slave Modules**

The reel and cassette slave modules are "record only" machines. The reel slave module can provide one copy at either of two speeds on 7- or 10.5-inch reels. The cassette slave can provide four cassette copies. Slave module controls and indicators are similar to those of the master modules.

**1.1.2.5 Expansion Module**

The expansion module makes it possible to add slave modules beyond the capacity of the control module. Each expansion module permits the addition of either three reel slave and three cassette slave modules, or two of each slave module and another expansion module.

**1.1.2.6 Rewind Module**

The rewind module is designed to rewind copy cassettes, since the cassette modules do not perform this function.

## 1.1.3 ACCESSORIES

### 1.1.3.1 Cables

Reel Master to Control Module (See Figure 4.12A parts list, J705)	
Reel Slave to Control Module (See Figure 4.32 parts list, J808)	
Reel Slave Module Extension .....	93796-000
Cassette Master/Slave to Control Module (See Figure 4.20 parts list, J6)	
Cassette Slave to Control Module (See Figure 4.28 parts list, J7)	
Expansion to Control Module .....	94493-011
Control Module Patch Cord, 6-inch .....	50628-008

### 1.1.3.2 Cabinets

Control/Cassette Module Console .....	94630-000
Reel Module Console .....	94630-001
Base Console .....	93785-000
Base Console Extender .....	93785-001
Rewind Module Console .....	94634-000

### 1.1.3.3 Miscellaneous

Dust Cover (lower unit only) .....	93792-000
Dust Cover (upper and lower) .....	93792-001
Reel Module Cleaner Tape (single roll) .....	93780-000
Reel Module Cleaner Tape (48-roll case) .....	93780-001
Clear Reel Leader Tape, 1200-ft (366 m) roll .....	51814-026

## 1.2 SPECIFICATIONS

### 1.2.1 STANDARD 6120 SYSTEM

#### Frequency Response ( $\pm 3$ dB):

- Reel to Cassette and Cassette to Cassette: 50 Hz to 10 kHz
- Reel to Reel with 7½ ips (19 cm/s) tapes: 30 Hz to 15 kHz
- Reel to Reel with 3¾ ips (9.5 cm/s) tapes: 30 Hz to 12 kHz

#### Bias Frequency:

- Reel: 800 kHz
- Cassette: 600 kHz

#### Bias Control:

- Slide-type with preset position optimized for Maxell Communicator Series cassette tape or equivalent, and 3M 176 reel tape or equivalent

#### Bias Range:

- 4 dB to +6 dB from present position

#### Bias Indicator:

- 8-digit LED type with present indicator

#### Audio Level Controls:

- Slide-type with preset positions, one per channel

#### Audio Level Indicators:

- 9-digit, Peak reading, LED type

#### Record Level:

- Within 2 dB of master at 1 kHz with level control in preset positions

#### Distortion:

- Less than 1% kHz at nominal record level.

#### Signal to Noise:

- Less than 3 dB degradation from master tapes

#### Crosstalk

- Tracks 1 and 2-50 dB or greater at 1 kHz
- Tracks 2 and 3-50 dB or greater at 1 kHz

#### Equalization:

- Reel, NAB: Automatically set for 7½ ips (19 cm/s) in fast mode, 3¾ ips (9.5 cm/s) in slow
- Cassette: 1590/120  $\mu$ sec

#### Tape Speed (60 Hz line input):

- Reel: 60 ips (152 cm/s)/120 ips (305 cm/s)
- Cassette: 30 ips (76 cm/s)

#### Tape Speed (50 Hz line input):

- Reel: 50 ips (127 cm/s)/100 ips (254 cm/s)
- Cassette: 25 ips (65 cm/s)

#### Speed Accuracy:

- Reel: 0.5%
- Cassette: 0.8%

#### Flutter/Wow:

- Reel: 0.15% DIN weighted contributed or less
- Cassette: 0.2% DIN weighted contributed or less

#### Forward/Rewind Time:

- Reel, 7 in. (178 mm) with 1200 ft. (366 m) of tape:  
80 sec or less
- Reel, 10½ in. (267 mm) with 2400 ft. (732 m) of tape: 90 sec or less
- Master Cassette C-60 (rewind): 45 sec

#### Reel Size:

- 7 in. (178 mm) and 10½ in. (267 mm)

## SPECIFICATIONS (Cont)

### STANDARD 6120 SYSTEM

**Reel Tape Size:**

Width: 0.250 in. (6.35 mm)  
Thickness: 1.5 mils (.0381 mm) 1 mil (.0254 mm)  
.75 mils (.0191 mm)

**Reel, Clear Leader Tape Size:**

(Recommended) 40 ft. (12.2 m) by 1.5 mils  
.0381 mm) thick

**Reel Spooling Motors:**

Two, 6-pole torque motors

**Capstan Motors:**

Reel: Two speed hysteresis  
synchronous direct drive.  
Cassette: Single speed hysteresis synchronous

**Tape Cleaner Motor Drive:**

0.5 rpm

**End-of-Tape Sensing:**

Reel: Infrared optical switch with tape break/tape  
run-out switch  
Cassette: Motion sensing

**Power Requirements:**

Reel Modules: 105-125V, 50/60 Hz, 180W max or  
210-250V, 50/60 Hz, 180W max  
Cassette Modules: 105-125V, 50/60 Hz, 90W max  
or 210-250V, 50/60 Hz, 90W max

**Shipping Weight:**

Control Module: 24 lbs. (11 kg)  
Reel Module: 35 lbs. (16 kg)  
Cassette Module: 32 lbs. (14 kg)  
Consoles: 20 lbs. (9 kg)  
Expansion Module: 24 lbs. (11 kg)

### 1.2.2 6120XL SYSTEM

**Frequency Response ( $\pm 3$  dB):**

Reel to Cassette and Cassette to Cassette: 50  
Hz to 10 kHz  
Reel to Reel with 7½ ips (19 cm/s) tapes: 30 Hz  
to 15 kHz  
Reel to Reel with 3¾ ips (9.5 cm/s) tapes: 30 Hz  
to 12 kHz

**Bias Frequency:**

Reel: 800 kHz  
Cassette: 600 kHz

**Bias Control:**

Slide-type with preset position optimized for Max-  
ell Communicator Series cassette tape or  
equivalent, and 3M 176 reel tape or equivalent

**Bias Range:**

-4 dB to +6 dB from present position

**Bias Indicator:**

8-digit LED type with present indicator

**Audio Level Controls:**

Slide-type with preset positions, one per channel

**Audio Level Indicators:**

9-digit, Peak reading, LED type

**Record Level:**

Within 2 dB of master at 1 kHz with level control  
in preset positions

**Distortion:**

Less than 1% kHz at nominal record level. Note:  
This series will have lower overall bandwidth  
distortion than std. series.

**Signal to Noise:**

Less than 3% degradation from master tapes

**Crosstalk**

Tracks 1 and 2-50 dB or greater at 1 kHz  
Tracks 2 and 3-52 dB or greater at 1 kHz

**Equalization:**

Reel, NAB: Automatically set for 7½ ips (19  
cm/s) in fast mode, 3¾ ips (9.5 cm/s) in slow  
Cassette: 3180/120  $\mu$ sec

**Tape Speed (60 Hz line input):**

Reel: 60 ips (152 cm/s)/120 ips (305 cm/s)  
Cassette: 30 ips (76 cm/s)

**Tape Speed (50 Hz line input):**

Reel: 50 ips (127 cm/s)/100 ips (254 cm/s)  
Cassette: 25 ips (65 cm/s)

**Speed Accuracy:**

Reel: 0.5  
Cassette: 0.8%

**Flutter/Wow:**

Reel: 0.15 DIN weighted contributed or less  
Cassette: 0.2% DIN weighted contributed or less

**Forward/Rewind Time:**

Reel, 7 in. (178 mm) with 1200 ft.  
(366 m) of tape: 80 sec or less  
Reel, 10½ in. (267 mm) with 2400 ft.  
(732 m) of tape: 90 sec or less  
Master Cassette C-60 (rewind): 45 sec

**Reel Size:**

7 in. (178 mm) and 10½ in. (267 mm)

**Reel Tape Size:**

Width: 0.250 in. (6.35 mm)  
Thickness: 1.5 mils (.0381 mm) 1 mil (.0254 mm)  
.75 mils (.0191 mm)

**Reel, Clear Leader Tape Size:**

(Recommended) 40 ft. (12.2 m) by 1.5 mils (.0381  
mm) thick

**Reel Spooling Motors:**

Two, 6-pole torque motors

**Capstan Motors:**

Reel: Two speed hysteresis  
synchronous direct drive.  
Cassette: Single speed hysteresis synchronous

**Tape Cleaner Motor Drive:**

0.5 rpm

**End-of-Tape Sensing:**

Reel: Infrared optical switch with tape break/tape  
run-out switch  
Cassette: Motion sensing

**Power Requirements:**

Reel Modules: 105-125V, 50/60 Hz, 180W max or  
210-250V, 50/60 Hz, 180W max  
Cassette Modules: 105-125V, 50/60 Hz, 90W max  
or 210-250V, 50/60 Hz, 90W max

**Shipping Weight:**

Control Module: 24 lbs. (11 kg)  
Reel Module: 35 lbs. (16 kg)  
Cassette Module: 32 lbs. (14 kg)  
Consoles: 20 lbs. (9 kg)  
Expansion Module: 24 lbs. (11 kg)

## SPECIFICATIONS (Cont)

### 1.2.3 6120XLP SYSTEM

#### Frequency Response ( $\pm 3$ dB):

Reel to Cassette and Cassette to Cassette: 50 Hz to 13 kHz  
Reel to Reel with 15 ips (38 cm/s) tapes: 30 Hz to 15 kHz  
Reel to Reel with 7.5 ips (19 cm/s) tapes: 30 Hz to 15 kHz

#### Bias Frequency:

Reel: 800 kHz  
Cassette: 600 kHz

#### Bias Control:

Slide-type with preset position optimized for Maxell Communicator Series cassette tape or equivalent, and 3M 176 reel tape or equivalent

#### Bias Range:

-4 dB to +6 dB from present position

#### Bias Indicator:

8-digit LED type with present indicator

#### Audio Level Controls:

Slide-type with preset positions, one per channel

#### Audio Level Indicators:

9-digit, Peak reading, LED type

#### Record Level:

Within 2 dB of master at 1 kHz with level control in preset positions

#### Distortion:

Less than 1% kHz at nominal record level. This series will have lower overall bandwidth distortion than std. series.

#### Signal to Noise:

Less than 3 dB degradation from master tapes

#### Crosstalk

Tracks 1 and 2-50 dB or greater at 1 kHz  
Tracks 2 and 3-52 dB or greater at 1 kHz

#### Equalization:

Reel, NAB: Automatically set for 7½ ips (19 cm/s) in fast mode, 3¾ ips (9.5 cm/s) in slow  
Cassette: 3180/120  $\mu$ sec

#### Tape Speed (60 Hz line input):

Reel: 60 ips (152 cm/s)/120 ips (305 cm/s)  
Cassette: 15 ips (38 cm/s)

#### Tape Speed (50 Hz line input):

Reel: 50 ips (127 cm/s)/100 ips (254 cm/s)  
Cassette: 12.5 ips (32 cm/s)

#### Speed Accuracy:

Reel: 0.5%  
Cassette: 0.8%

#### Flutter/Wow:

Reel: 0.15% DIN weighted contributed or less  
Cassette: 0.17% DIN weighted contributed or less

#### Forward/Rewind Time:

Reel, 7 in. (178 mm) with 1200 ft. (366 m) of tape: 80 sec or less  
Reel, 10½ in. (267 mm) with 2400 ft. (732 m) of tape: 90 sec or less  
Master Cassette C-60 (rewind): 45 sec

#### Reel Size:

7 in. (178 mm) and 10½ in. (267 mm)

#### Reel Tape Size:

Width: 0.250 in. (6.35 mm)  
Thickness: 1.5 mils (.0381 mm) 1 mil (.0254 mm)  
.75 mils (.0191 mm)

#### Reel, Clear Leader Tape Size:

(Recommended) 40 ft. (12.2 m) by 1.5 mils (.0381 mm) thick

#### Reel Spooling Motors:

Two, 6-pole torque motors

#### Capstan Motors:

Reel: Two speed hysteresis synchronous direct drive.

Cassette: Single speed hysteresis synchronous

#### Tape Cleaner Motor Drive:

0.5 rpm

#### End-of-Tape Sensing:

Reel: Infrared optical switch with tape break/tape run-out switch

Cassette: Motion sensing

#### Power Requirements:

Reel Modules: 105-125V, 50/60 Hz, 180W max or 210-250V, 50/60 Hz, 180W max  
Cassette Modules: 105-125V, 50/60 Hz, 90W max or 210-250V, 50/60 Hz, 90W max

#### Shipping Weight:

Control Module: 24 lbs. (11 kg)  
Reel Module: 35 lbs. (16 kg)  
Cassette Module: 32 lbs. (14 kg)  
Consoles: 20 lbs. (9 kg)  
Expansion Module: 24 lbs. (11 kg)

# SECTION II

## THEORY OF OPERATION

### 2.1 INTRODUCTION

The following paragraphs describe the mechanical and electrical principles of operation. All electronic functions described in this section are based upon the schematic diagrams provided in Section IV of this manual. Component reference designators, U1, Q1, R1, C1 and so forth, used in the following text are keyed to both the relevant schematic diagram and associated parts list. If it should become necessary to adjust, realign or repair either a mechanical or electrical malfunction, refer to Sections III and IV of this manual for corrective action.

### 2.2 DETAILED DESCRIPTION - MECHANICAL

#### 2.2.1 CONTROL MODULE

The control module is the central operating component of the system. All controls required for system operation are located on the control module.

The rear of the control module provides receptacles for ac power plugs and ribbon cable connectors from the master tape module and slave tape modules. The rear of the module also has a patch panel that allows various combinations of recording tracks on 1/2 track and 1/4 track tapes.

There are no moving mechanical parts in the control module.

#### 2.2.2 OPEN-REEL MODULE

The open-reel tape transport utilizes a staked subplate assembly as the basic structure upon which are mounted most of the mechanical and some of the electrical components. These components are necessary for the movement and control of the magnetic tape across the head assembly. The function of the major components of the tape transport are described in the following paragraphs.

##### 2.2.2.1 Direct Drive Capstan

The capstan drive utilizes a two-speed hysteresis synchronous motor. The capstan drive motor is mounted on bushings which are staked to the front panel acting as a single assembly, so that flutter

inducing vibrations are virtually eliminated.

The capstan is 1 1/4 inch dia (31.7 mm) and is made from non-magnetic stainless steel. The capstan is ground after being assembled to the motor shaft. The drive system runs only when tape is threaded and the tape break switch (S600) is closed. The tape is brought into contact with the capstan shaft by the pressure roller.

##### 2.2.2.2 Tape Speed Stability

Tape speed stability, essential for low flutter, is accomplished through the use of three stabilizer roller assemblies in addition to the capstan.

##### 2.2.2.3 Reel Drive

The take up and supply reels mount on the shafts of two split-phase capacitor torque motors. Spooling power is ample for large metal reels. Torque for either 7" or 10.5" reel sizes is selected by a front panel switch. Each reel is held in place against a reel rest assembly by a push on type reel hold down. Hold down for both 7 inch (178 mm) and 10.5 inch (267 mm) reels are provided with the equipment.

### CAUTION

**IT IS IMPERATIVE THAT THE SAME SIZE REEL BE USED FOR BOTH SUPPLY AND TAKE-UP, OTHERWISE THE BALANCE OF THE BRAKING SYSTEM IS UPSET. THIS RESULTS IN SLACKNESS OR EXCESSIVE TAPE TENSION, WHICH COULD AFFECT PROPER OPERATION OR DAMAGE THE TAPE.**

When operating in Copy mode, the take up motor supplies sufficient forward torque to transport the tape efficiently. In the Rewind mode, it generates reverse torque to prevent tape over-run. The supply motor applies reverse torque in Copy mode and reels the tape in when operating in Rewind mode. Reverse and forward torque are fixed and require no adjustment.

#### 2.2.2.4 Pressure Roller

The pressure roller is polyurethane rimmed and has a porous bronze oilite bearing. The roller is dc solenoid positioned and brings the tape into contact with the capstan shaft when the solenoid is energized. This method of operation assures that the tape will contact the capstan shaft only during Copy mode.

#### 2.2.2.5 Brakes

Electro-mechanical brakes provide fail-safe differential braking without danger of tape damage in the event of power failure. A band type brake assembly on each spooling motor is actuated by a dc solenoid. The brake band contacts a brake lining on both the take up and supply brake drum when the relevant brake solenoid is de-energized. The brake solenoid is energized during Copy mode, releasing the brakes.

#### 2.2.2.6 Stabilizer Arm Assemblies

The stabilizer arm assemblies act as mechanical filters to remove tape speed variations introduced by the take up and supply reels. This helps to reduce flutter.

The right stabilizer arm has a specific operating range beyond which it will trip the tape brake microswitch, shutting off the transport. During Copy mode, the tape brake switch (S600) is "closed". When the tape end comes off the reel, or the tape breaks, the stabilizer arm opens the tape brake switch, shutting off the tape transport.

#### 2.2.2.7 Magnetic Heads

The open-reel transport is available in either 1/2 track 2 channel or 1/4 track 4 channel in line head configurations. The snap-on head cover contains a mu metal shield to isolate the heads from external electro-magnetic or RF fields.

The individual magnetic heads are factory positioned and secured in a bracket assembly which, in turn, is located and attached to the head plate by screws and compression springs.

All heads, switch and sensor leads are terminated in a connector block. Only four screws secure the entire head block assembly. This pre-aligned plug-in head block assembly concept allows for complete head block replacement without mechanically re-aligning the heads.

### 2.2.3 CASSETTE MODULE

The cassette module's four-position tape drive deck

assembly is the major structure upon which are mounted all the mechanical and electrical components. The tape deck is designed to transfer tape at a constant high rate of speed, while introducing a minimum of wow and flutter. Tape drive is both solenoid and EOT sensor controlled. The function of the major components of the tape deck are described in the following paragraphs.

#### 2.2.3.1 Capstan Drive System

The capstan drive system consists of a single-speed hysteresis synchronous motor which maintains a constant tape speed of 1800 rpm at 60 Hz (1500 rpm at 50 Hz).

The four capstans are driven independent of each other via separate belts. These round belts couple the flywheels to the motor pulley which is secured to the motor shaft by two hex cup set screws. Positioning of these belts is critical and illustrated in Figure 3.4.

#### 2.2.3.2 Spindle Drive

The high speed tape take-up drive for copy operation is achieved by using the flywheel to drive the take-up spindle. The take-up spindle has a felt clutch attached to it for smooth take-up operation. This clutch is driven by a rubber belt from the capstan-flywheel assembly.

When ac power is applied the take-up spindle will rotate, while the supply spindle is held stationary by its' brake. When a cassette is loaded, the take-up spindle pulls the tape taut against the braked supply spindle. The clutch will then slip keeping the tape taut until the unit is put into copy mode. This prevents tape spillage when copy mode is executed.

#### 2.2.3.3 Tape Drive

When the copy button on the control module is pressed, excitation voltage energizes copy solenoids forcing the head slide plate forward. This forward movement brings the head into contact with tape, and allows the pressure roller to press the tape firmly against the rotating capstan and releases the supply spindle brake. The capstan then pulls the tape from the cassette supply reel past the head and feeds it to the cassette take-up reel. Uniform tape tension required for even tape take-up is provided by the clutch in the take-up pulley which regulates the spindle rotation.

### 2.2.3.4 End-Of-Tape Sensor

The end-of-tape (EOT) sensor is designed to sense when tape motion stops and then disengage the tape drive.

On each supply spindle is attached a mirrored surface. Supply spindle rotation is monitored by reflecting an infrared light from the emitter to a matched spectrum IR detector. When a stable state is detected, the copy solenoid is de-energized, retracting the head slide plate. This applies the supply spindle brake and disengages the pressure roller from the capstan.

## 2.3 DETAILED DESCRIPTION - ELECTRICAL

The following paragraphs describe the circuitry used to supply power throughout the Telex Model 6120 Tape Duplicator. Also included is a description of the electrical and logic functions of the various circuit card assemblies.

### 2.3.1 POWER CIRCUITS

#### 2.3.1.1 Control Module

Figure 4.5

The Model 6120 Tape Duplicator is ac line operated. Application of a 90 to 240 volt, 50 or 60 Hz primary source through the external power plug is applied to the primary of the power transformer and the auxiliary ac outlet receptacles.

Filtered dc is maintained at 34 volts by transistor 1Q5 and zener diode 1VR1 to maintain a constant voltage output.

As shown in the Audio Board Schematic diagram (Figure 4.7), this regulated output is applied to bias voltage regulator 1U6, and 24 volt dc supply regulator 1U7. Regulator 1U8 provides 12 volts dc supply for the logic circuitry.

Bias voltage regulator 1U6 in conjunction with transistors 1Q1, 1Q3, and 1Q2, 1Q4, supply the required dc bias control voltage to the cassette slave and reel slave modules respectively (reference paragraph 2.5.1).

Positive 19 volts dc from the power transformer center tap, and associated circuitry, is applied to the input of regulator 1U5. Regulated 5 volts dc is applied to the audio and bias level indicator circuitry from the output of 1U5.

#### 2.3.1.2 Open-Reel Module

Figure 4.15

Secondary number one of T1 is connected by means of connector PJ203 to the motor control board assembly.

Filtered dc is maintained at 24 volts by transistors Q203, Q205 and zener diode VR201 to maintain a constant voltage output which supplies the necessary supply voltage to the reproduce amplifier and motor interface card.

Positive 16 volts dc from the power transformer center tap, and associated circuitry, is applied to the input of regulator U202. Regulated 8 volts dc is applied to the logic circuitry from the output of U202 through connector PJ204.

The four solenoids L601 (take up brake), L602 (supply brake), L603 (pressure roller), and L604 (motor brake) as shown in Main Chassis Wiring Diagram (Figure 4.12) receive their 15 Vdc excitation voltage supply from the transformer circuit through CR206. Momentary voltage boost, approximately 28 Vdc, for solenoid pull-in is provided by transistors Q202 and Q204. Control of the take up and supply brake solenoids is provided by transistor Q207. Control of the play motor brake solenoid and pressure roller is provided by transistor Q206.

Secondary number two of T1 is connected by means of connector PJ106 to the Motor Interface Assembly.

As shown in Motor Interface Schematic Diagram (Figure 4.16), 120 Vac from pin 1 of P106 is connected to pin 3 (P104). Reel switch S1 shorts out R114 for 10.5 inch reel size. Ac then goes to P108 for Hi Wind control.

Reel switch S1 selects either 70 Vac (P106, Pin 3) or 50 Vac (P106, Pin 4) for connection to Play common circuit (P108, Pin 3). The 10.5 inch position of S1 selects 70 Vac; 7.0 inch position of S1 selects 50 Vac.

Secondary number two common (P106, Pin 5) is connected to the neutral side of both windings in the take up and supply torque motors.

Activation of the appropriate torque motor is controlled by the motor control board assembly together with the logic control board assembly through P108, Pin 4 or 5. The play drag circuit (P108, Pin 1) is selected to apply a lower voltage (17 Vac) to the supply torque motor when operating in the Play mode. This maintains a slight torque opposite to that of the take up motor, which provides constant tape movement.

### 2.3.1.3 Cassette Module

Figures 4.19, 4.21 and 4.25

The power transformer secondary output is connected by means of connectors PJ11 and PJ5 to the Power Supply/Oscillator board assembly.

Filtered dc is maintained at 24 volts by transistor 5Q5 and zener diode 5VR2 to maintain a constant voltage output. This output is also applied to regulator 5VR1 which supplies regulated 12 volts to the logic circuitry.

The four copy solenoids L1, L2, L3 and L4 and rewind solenoid L5, as shown in the Main Chassis Electrical Schematic Figure 4.19 receives their 15 volt dc excitation voltage from the transformer CT through diode 5CR1. Momentary voltage boost, approximately 36 volts dc, for solenoid pull-in is provided by transistors 5Q4 and 5Q3. Control of the copy solenoids is provided by Quad Darlington Switch Array 4U9 (Figure 4.25). Control of the rewind solenoid is provided by section A of AND gate 4U6 and transistor 3Q6 (Figure 4.20). Both 4U9 and 4U6 are located on the Cassette Logic board (reference paragraphs 2.6.2.1 and 2.6.2.4).

## 2.4 AUDIO SIGNAL

The Model 6120 Tape Duplicator utilizes high slew rate, wide band width amplifier circuits for processing both reproduce and record audio signals. Block diagram Figure 2.1 provides a good overall view of the various audio circuits, inter-board connections, and signal directional flow as indicated by the red arrows.

Since this portion of the circuit is of conventional design, the following theory is present in generalized form. Because channels 1 through 4 employ identical circuits, the discussion shall pertain to channel 1 only.

### 2.4.1 AUDIO PLAYBACK AMPLIFIER

#### 2.4.1.1 Cassette Master-Slave

Figure 4.22

The audio program, generated by the passage of a prerecorded cassette tape across the reproduce head, is fed to audio preamplifier 6U1, a type 5534 low noise integrated circuit. Response is determined by a frequency sensitive negative feedback network which includes the equalization potentiometer.

The preamplifier fixed gain audio output is fed to level control 6R25 with its' variable output coupled to

bi-lateral switch 1U2, located on the Control Module Audio board. This circuit path is established through a series of PJ connectors.

#### 2.4.1.2 Open-Reel Master

Figures 4.13 and 4.14

Audio signal is applied to preamplifier U1 in the same manner as the cassette master-slave. The fixed gain output is coupled to the Equalization board by PJ401-Pin 9. This board contains both the high frequency equalization and audio level potentiometers. To compensate for selective speed variations, resistor R417 is switched in or out of the EQ feedback network by the Tape Speed switch. With this switch in SLOW position, R417 is in series between the network and PJ401-Pin 11. With the switch in FAST position, a 15V EQ control voltage is applied to Pin 13 of U5, a type 4066 quad bi-lateral switch. This voltage enables the gating circuit between Pins 1 and 2, thereby switching R417 out of the feedback network (reference paragraph 2.7.1).

The preamplified variable output from audio level potentiometer R701 is coupled to bi-lateral switch 1U1, located on the Control Module Audio board.

### 2.4.2 AUDIO SWITCHING AND METERING

#### 2.4.2.1 CONTROL MODULE

Figure 4.7

Preamplified audio from the Cassette Master-Slave is applied to input Pin 8 of integrated circuit 1U2. Signal coupling is through the Mother board, connectors 3P6-Pin 2 and PJ1-Pin 15.

Preamplified audio from the Reel Master is applied to input Pin 8 of integrated circuit 1U1. Signal coupling is through the Mother board, connectors 3P5-Pin 2 and PJ1-Pin 19.

Both 1U1 and 1U2 are type 4066 quad bi-lateral switches. They either enable or inhibit the passage of audio, dependent upon the logic state present at Pin 5. With the Transport Control MASTER switch in CASS position, an inhibiting input (0 volts dc) is present at 1U1-Pin 5, while input Pin 5 of 1U2 rises to +12 volts dc. This positive going voltages enables the internal gating circuit between input Pin 8 and output Pin 9, thereby allowing the cassette preamplified audio signal to pass. With the switch in REEL position, cassette preamplified audio is muted, and reel preamplified audio is allowed to pass. Integrated circuit 1U3 functions as a buffer amplifier between the bi-lateral switches and the impedance matching patch panel on the rear of the controller.

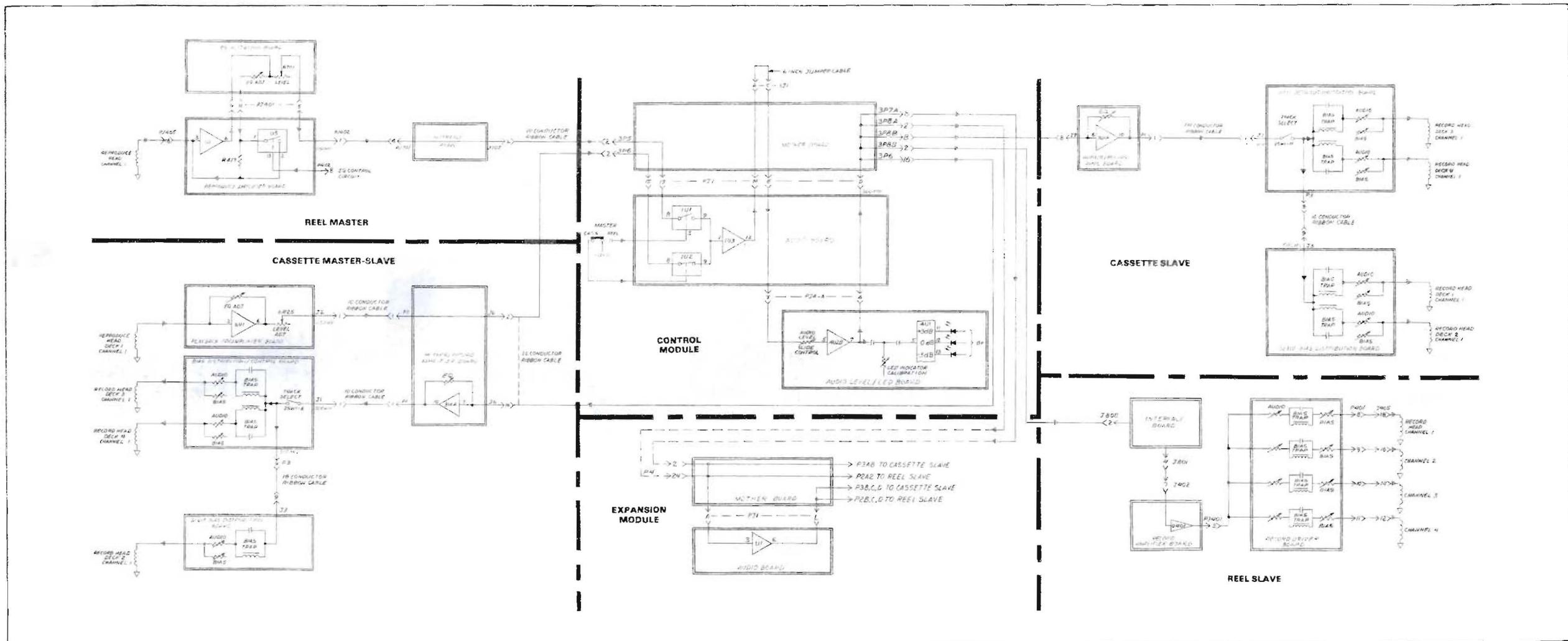


Figure 2.1 Audio Block Diagram  
2-5

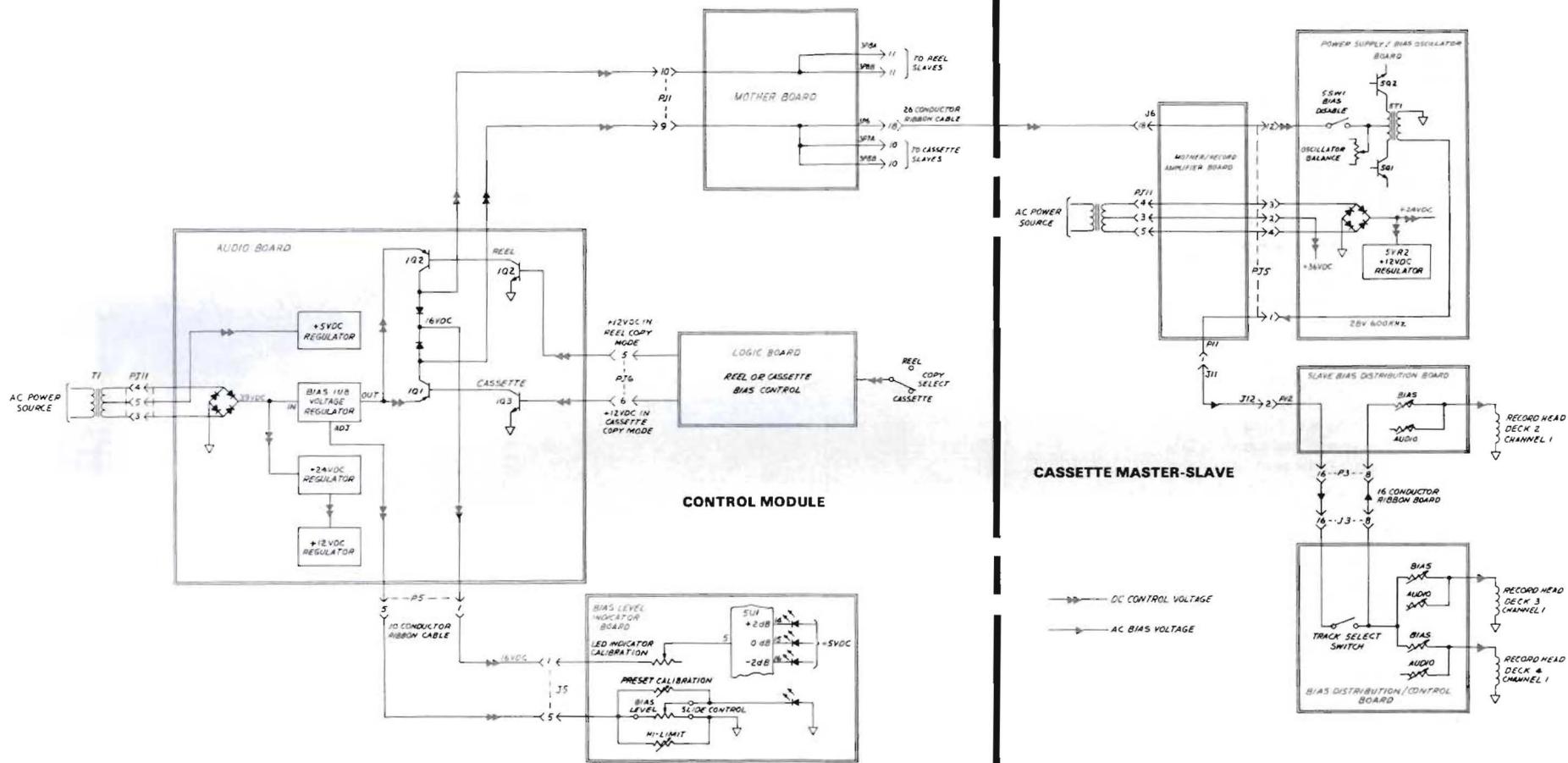


Figure 2.2 Dc Control/Ac Bias Block Diagram

process. Bias voltage is coupled by transformer 5T1 to the Bias Distribution/Control board through the Mother/Record Amplifier board via a series of PJ connectors.

### 2.5.3 BIAS DISTRIBUTION (CASSETTE)

Figure 4.23

The purpose of the Bias Distribution Board(s) is to provide level control and mixing of the bias and audio signals. Record bias, from the bias oscillator, is applied to the track select switch through PJ3, Pin-16. With the switch in the ON position, bias current is fed through bias level potentiometer, mixed with the audio signal, then applied to the record head.

### 2.5.4 BIAS OSCILLATOR (REEL SLAVE)

Figure 4.30

The bias oscillator is a push-pull, multivibrator circuit consisting of Q402, Q403, and associated components, located on the record amplifier board. The oscillator operates at or near 800 kHz. Oscillator frequency adjustment is provided by variable capacitor C439. Potentiometer R450 provides a means of balancing the waveform for symmetry and reduce even harmonic distortion.

The bias oscillator is controlled by and receives power from the system control module. The output of the oscillator is coupled to the record driver board (Figure 4.31). The record board contains the bias traps, coupling circuitry and adjustment potentiometers for the correct bias level. The output of the record driver is coupled to the head block assembly.

## 2.6 LOGIC CONTROL CIRCUITS

The logic control circuits are made up of arrays of logic elements and associated electronic components. Since considerable electronic circuitry is contained in one integrated circuit (IC), you will find similar IC "U" designations as part of more than one functional grouping.

To facilitate control path analysis, functional flow diagrams are presented in Figures 2.3 and 2.4. Logically grouped elements are contained in unique blocks. These diagrams, when used with the group captions of Figures 4.17 and 4.25, provide a more coherent understanding and assists in circuit analysis.

An explanation of the more significant system functional groupings is presented in the following paragraphs, rather than a detailed tracing of "1"'s and "0"'s through each circuit.

### 2.6.1 OPEN-REEL MODULE

Figure 4.17

#### 2.6.1.1 Power Up

The power up circuitry minimizes the stop latch responsiveness to minor momentary power variations. For ease of understanding, the following discussion assumes a theoretical gradual build up of supply voltage.

##### Voltage (B+) Rise

As the supply voltage rises, the base of transistor Q7 is driven positive. This causes Q7 to saturate, which places the collector at ground potential. A resultant logic "0" is impressed on pin 3 of AND gate U4. This places stop quad latch in the stop mode.

As the source voltage continues to rise past four volts or one half the nominal B+, voltage dividers R21 and R24 increase the base voltage of transistor Q6 to 0.6 Vdc. Transistor Q6 is then turned "on" (conducts) and Q7 is taken out of saturation. The potential of collector Q7 rises toward (B+) voltage, with a resultant "1" appearing at pin 3 of U4. The input quad latch is no longer locked in the stop mode.

##### Voltage (B+) Decline

A reduction source voltage causes a reverse sequence of events. The stop mode remains locked out on a power drop until the voltage falls to about the half way point, or 4 Vdc. When the base voltage of Q6 falls below 0.6 Vdc, conduction ceases and transistor Q7 goes to saturation. This places stop quad latch in the stop mode again.

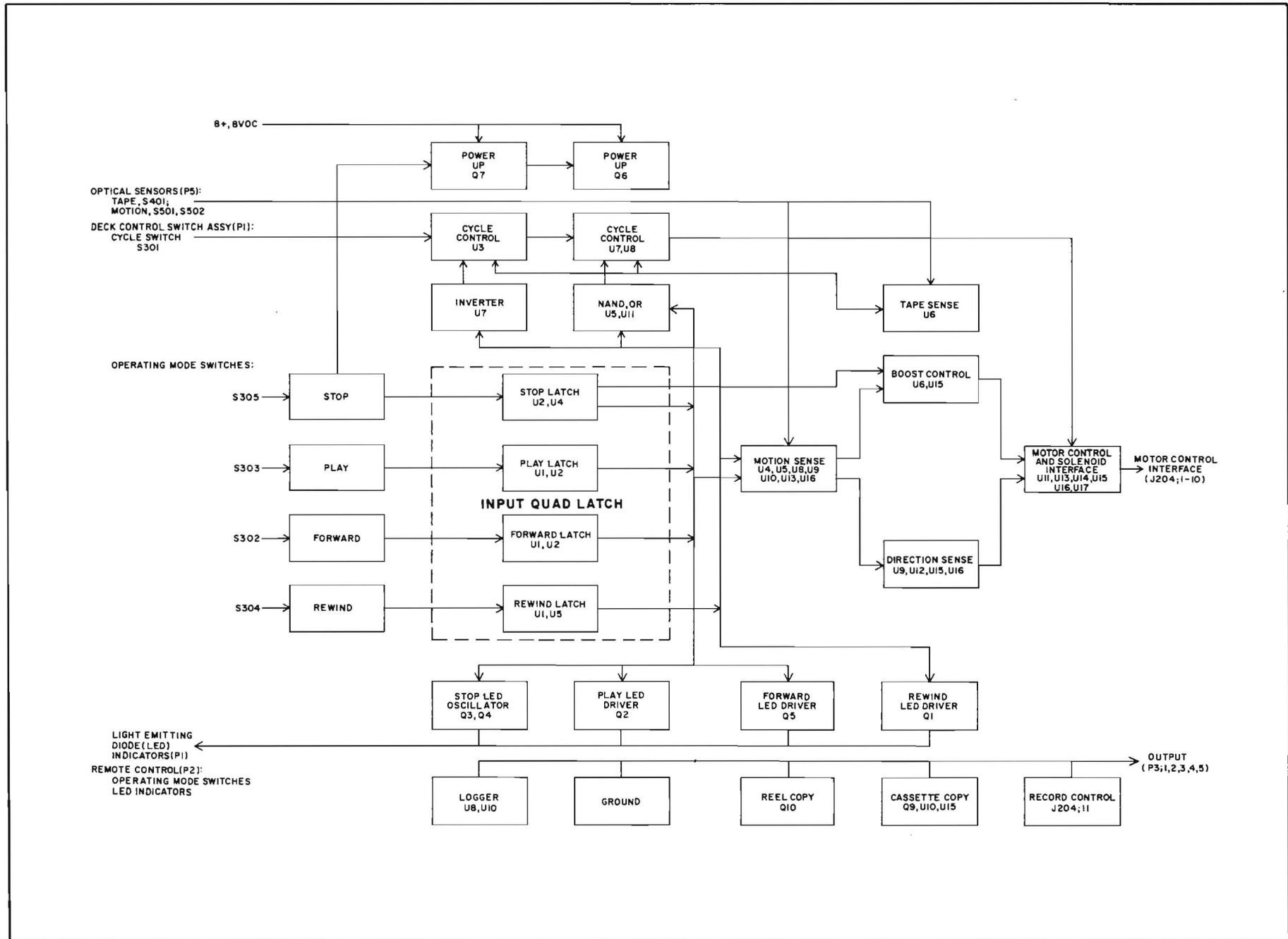
#### 2.6.1.2 Operating Mode Selection

Each operating mode switch, S302 through S305, activates the input quad latch in a similar manner. The switch, by providing a ground, completes the input circuit to a three input "AND" through a coupling diode and resistor. Since the anode side of the diode is connected to 8.0 Vdc (B+) through a "pull up" resistor, a logic "1" is present on this input. A capacitor is also connected to the anode side of each diode, going to ground. This component is used for suppression of transients.

##### Input Quad Latch

The functional configuration of the input quad latch is shown in Figure 2.3. Two logic elements are utilized for each operating mode. The input element is a three input "AND"; the output element is a three input latching "NAND". However, all eight elements are part of a logic circuitry which provides a self canceling switch arrangement. Thus, any function is able to override any other within the latch.

Figure 2.3 Open-Reel Logic Functional Diagram  
2-9



Activation of two or more push buttons simultaneously causes the latch to return to the stop mode. However, advance memory stores the command associated with the last button released. The equipment will respond to this command when the unit resumes operation.

#### LED Driver

Transistors Q1, Q2 and Q5 are drivers for the rewind, play and forward LED indicators on the deck control switch assembly. The base of each transistor is connected to the output of its respective operating mode latch. The activated latch thus turns on its associated transistor resulting in the appropriate LED indicator being illuminated.

#### LED Oscillator

Transistors Q3 and Q4 are arranged in an astable oscillator configuration. With operating mode switch S305 actuated, the output of the stop quad latch is a logic "1". Since the control line is connected from this point to the base of transistor Q4, through resistor R5, Q4 is turned on. When the voltage across capacitor C2 builds up, Q3 turns on and transistor Q4 shuts off.

Since the rc circuit consisting of R6 and C1 has a shorter time constant than the rc circuit consisting of R1 and C2, the stop LED indicator has a longer "on" time than "off" time.

When activation of a switch, other than stop, initiates a mode of operation, the output of stop quad latch, U2 pin 10, is a logic "1". Thus transistor Q4 and the astable oscillator return to quiescent condition.

#### 2.6.1.3 Cycle Selection

Cycle switch S301, a two position slide switch, located on the deck control switch assembly is the input device to the cycle control circuit. The arrangement of logic "1" (+8 Vdc) on terminals one through four of cycle and push button plug P1 determines the operational status of the Reel Transport. This operational status can be either OFF or RECUE, depending on the position of S301.

The logic circuitry controlled by S301 consists of two D flip flops (U3), six NAND gates (U5, U7, U8), one NAND inverter (U7) and one OR gate (U11).

The two D flip flops function as bistable memory devices which automatically advance the transport into the next sequential operating mode. This sequence is determined by the setting of the cycle switch. Interaction of the flip flops with the other logic elements may be seen by examining its inputs and outputs.

In the OFF position, the unit will return to STOP from any active mode at such time when clear leader (or no tape) is present over the photo sensor. In the RECUE position, the unit will transfer into REWIND at the end of the play cycle (clear tape over photo sensor). When the photo sensor is activated by clear leader at the end of the rewind cycle, the transport will stop. This takes approximately 1 second after clear leader is sensed, to apply the brakes and transfer to the stop mode.

#### 2.6.1.4 Boost Control

The boost control supplies additional voltage to the motors and/or the solenoids, as required, to assure proper operation of the reel module.

The boost control enable, to transistor Q202 of the Motor Control Circuit board assembly (Figure 4.15), is coupled by connector J204-P204 terminal 3 from the boost control circuitry of the Logic Control board assembly. This circuitry consists of NAND inverter U6, NAND gate U6, inverter U15 and associated electronics.

Input enable of NAND inverter U6 pins 1 and 2 is coupled by resistor R37, capacitor C21 from pin 3 of motion sense output NOR gate U13. Output of NAND inverter U6 is coupled by diode CR5 to pin 5 of NAND gate U6. Input to pin 6 of U6 is from stop quad latch. Rc networks consisting of R26, C13, and R47 and C21 provide a boost time delay of approximately four seconds. Output of the boost control circuit is from pin 4 of U6 inverted by U15 and connected to terminal 3 of J204. If boost voltage to the take-up motor is lost, the motor will be unable to follow the supply motor.

#### 2.6.1.5 Motion Sense

The tape motion sensing function permits the user to transfer the transport from either hi wind mode to play without first entering and leaving the stop mode.

Optical switch S501 (Figure 4.12) of the direction sensor assembly provides the input to the motion sense circuit through terminal 1 of connector J5-P5. This logic circuit consists of four NAND gates (U5, U8, U9, U16), one AND gate (U4) and four NOR gates (U10-U13) and associated electronic components.

Input logic element U9 functions as a monostable oscillator. It is triggered (pulsed) at input pin 1 with a square wave from S501. The appearance of this waveform for different modes of equipment operation may be seen by reference to Figure 4.18, TP39. Rc network of resistor R42 and capacitor C20 provides

an input time delay. A logic "1" is present at input pin 2 of U9 at all times. The monostable oscillator circuit including, besides U9, diode CR7, capacitor C18 and resistor R34 maintains its output sensing voltage at a constant value.

The output voltage appears at input pin 6 of U9. Logic NAND gates U9 and U16 are cross-connected in a set reset (SR) flip flop configuration. Pin 1 of U16 receives its input level from pin 3 of output, NOR gate U13. Output pin 3 of the SR flip flop is connected to input 13 of NAND gate U8.

Logic NAND gates U5 and U8 are cross-connected in a SR flip flop configuration. Input pins 11 and 12 of U5 connect to the output of the rewind and forward quad latch respectively. These inputs are also paralleled to pin 1 and 2 of AND gate U4.

When the motion sense output of U16 Pin 3 is "1", U8 Pin 13 is also high. Output pin 11 of U8 is high, as is also pin 13 of U5. With either forward (S302) or rewind (S304) push buttons position to place a logic "0" (low) at pin 12 or 11 of U5, the output of U5 at pin 10 is high.

The same output high of U5 appears at the input to logic NOR U10. With play push button S303 positioned to place a logic "0" at pin 9 of U10, the output at pin 10 remains low until the output at U16 Pin 3 goes low, resetting U8 Pin 11 high, causing U5 Pin 10 to go low, thus allowing the play command signal to pass through U10 Pin 10. This "1" voltage level is acted upon by subsequent motion sense logic before controlling the logic elements in the play and rewind circuitry, as well as the mechanical braking circuitry.

#### 2.6.1.6 Tape Sense

Optical switch S401 on the head block assembly detects an end-of-tape condition. The resultant "0" or "1" generated by this tape sensor is input through pin 6 of PJ5 to the tape sensor circuitry.

The logic circuitry consists of a two input NAND (U6) followed by NAND inverter U6. R38 is used as a photo transistor load resistor at input pin 12 of U6. Termination resistor R39 functions to "pull up" input at pin 13 of U6 and allows applied voltage to rise to the source level. Rc network consisting of capacitor R32 and resistor C15 function to delay changes in input to U6 pin 13 due to any erratic actuation of tape sensor S401. Output of the tape sensor from pins 10 and 11 is coupled as inputs to the cycle control circuitry.

#### 2.6.1.7 Direction Sense

The direction sense circuit determines the rotational direction of the supply motor in either the forward or rewind mode of operation. Direction sensing is not necessary in the play mode, since the left hand reel motor, as viewed from the unit's front, is always the supply motor.

The electronic braking is actuated in going from hi wind to play or stop. Mechanical braking is activated also when entering stop mode. No electronic braking takes place in switching between hi wind modes of operation. In such mode changing, only motor torque reversal takes place.

Optical switches S501 and S502 provide the inputs to the direction sense circuit through terminals 1 and 3 of connector PJ5. This logic circuit consists of two NAND inverters (U9), one inverter (U15), two NAND gates (U16) and two flip flops (U12).

Input logic level to U9 pins 8 and 9 is determined by optical switch S501. Input logic level to U9 pins 12 and 13 is determined by optical switch S502. Resistor R44 is a photo transistor load resistor for pins 8 and 9; R45 is a photo transistor load resistor for pins 12 and 13. It is the timing of the outputs from pins 10 and 11 of the two U9 logic elements which determine direction information. These outputs are cross-connected to the data and clock inputs of the two U12 flip flops.

Resetting of the flip flops is accomplished by two U16 NAND gates. One input of each NAND gate is coupled by inverter U15 from pin 4 of motion sense flip flop element U9. The other input of each NAND gate is supplied by the Q output of the opposite flip flop to which U16's output is connected. Resulting output from direction sense flip flop U12 interfaces the reel motor and braking control logic at U14 pins 1 and 3.

#### 2.6.1.8 Logger Output

The logger output assures that the reel slave transport stops simultaneously with the master reel transport. The input signal level is provided by terminal 17 of interface jack PJ705 through pin 1 of output connector PJ3 to the logger circuit. This circuit consists of transistor Q8 and logic NOR element U10, together with associated electronic components.

Input to pin 1 of U10 is from the cycle control circuit. Input to pin 2 of U10 is from the tape sense circuit. Output enable from pin 3 of U10 is coupled by capacitor C17 to the base of Q8, and the resultant pulse turns the transistor on which causes the reel slave to stop.

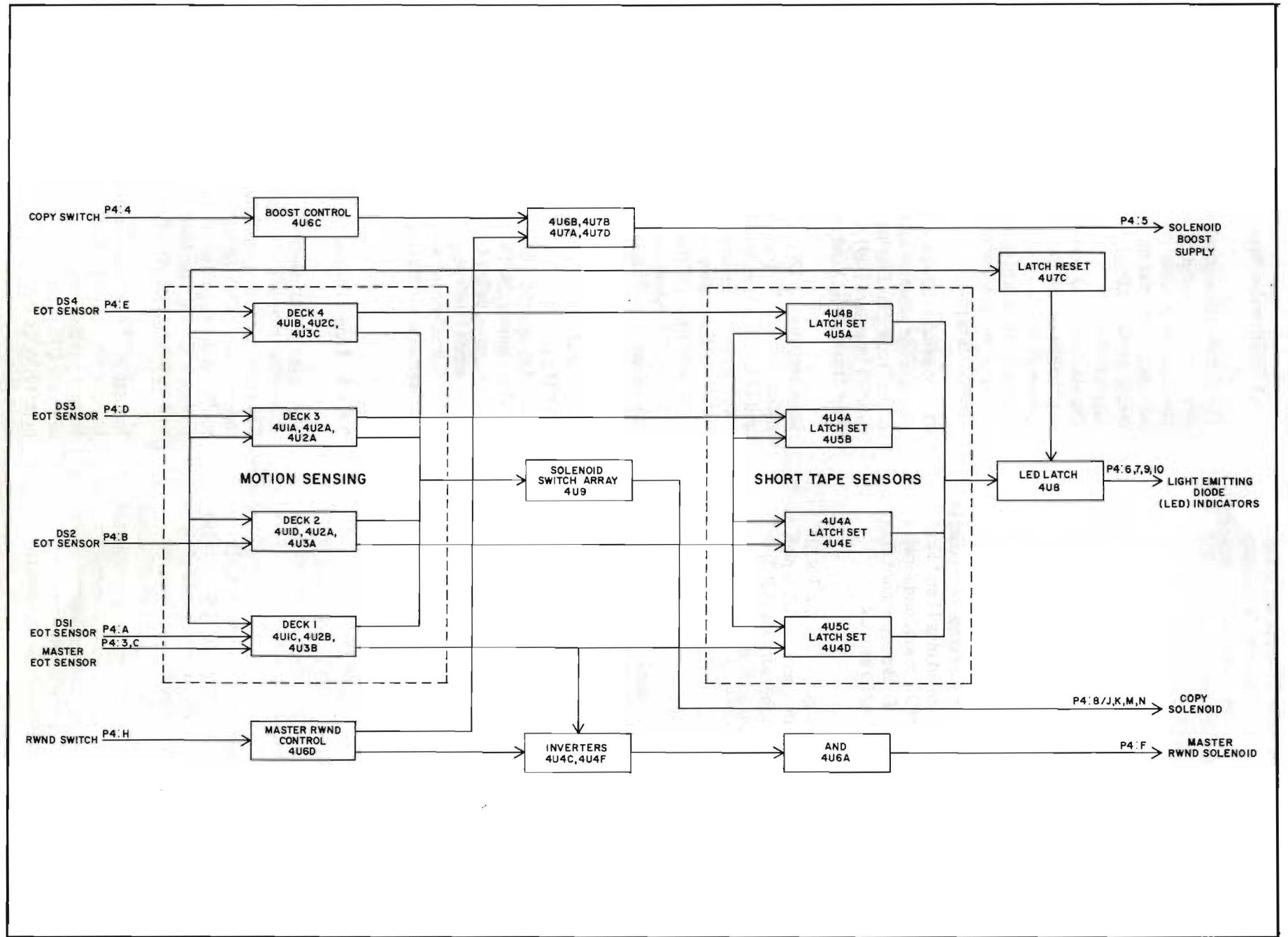


Figure 2.4 Cassette Logic Functional Diagram  
2-12

## 2.6.2 CASSETTE MODULE

Figure 4.25

### 2.6.2.1 Motion Sensing

The tape motion sensing logic circuit disengages the copy solenoid at beginning of tape and detects premature end-of-tape (EOT) conditions. This logic circuit consists of three NOR gates (4U1D, 4U2B, 4U3B) and one section of a Quad Darlington Switch Array (4U9). Since this circuitry is identical for all four decks, the following discussion shall pertain to deck 2 only.

Input to this circuit is from the infrared tape sensor. This sensor produces a logic "0" or logic "1", depending on the position of the reflective mirror attached to the supply spindle. Rotation of the spindle results in a positive (square wave) going pulse at input terminal B of connector PJ4. The appearance of this waveform impresses a similar condition at input Pin 13 of 4U1D, enabling its output Pin 11 to fluctuate at the same rate. This logic voltage level at 4U2A Pin 3 caused by the fluctuating voltage from 4U1D Pin 11 and the time constant formed by 4C6 and 4R10 is acted upon by subsequent motion sensing logic, resulting in pulling input Pin 6 of 4U9 high. With Pin 6 at a logic "1" its corresponding output Pin 8 goes low (ground potential) and is coupled, via a series of PJ connectors, to one lead of copy solenoid L2. With the other lead at B+, the solenoid energizes and will remain in this state as long as forward tape motion is sensed.

When end-of-tape is sensed in the MASTER pocket all copy solenoids will disengage.

### 2.6.2.2 Boost Control

Boost control enable to transistor 5Q4 of the Power Supply Bias Oscillator board assembly (Figure 4.21) is coupled by connector PJ4 terminal 5 from the boost control circuitry of the logic board. This circuitry consists of two AND gates (4U6B, 4U6C) and three NAND inverters (4U7A, 4U7B, 4U7D), and associated electronics.

Input to AND gate 4U6C is initiated by the Control Module COPY switch, and coupled by resistor 4R16 and diode 4CR8 from terminal 4 of connector PJ4. Pins 8 and 9 of 4U6C, normally held high by pull-up resistor 4R16, are enabled by a logic "0". The low output at Pin 10 is direct coupled to input Pin 6 of 4U6B causing output Pin 4 to be forced low. Output Pin 10 of 4U6C is also paralleled as an enabling input to motion sensing NOR gate 4U3A: lamp latch NOR gate 4U5C: and lamp latch reset NAND gate 4U7C.

The logic "0" voltage level at 4U6B-Pin 4 is gated by the remaining boost control circuitry resulting in output Pin 11 of 4U7D going high for approximately one second. This boost time delay is determined by the RC networks consisting of 4R19, 4C12, 4R17 and 4C11.

### 2.6.2.3 Short Tape Sensor

Circuit function is to turn the short tape LED on if the copy cassette stops before the master, and turn the LED off when entering copy mode. Since circuitry is identical for all copy pockets, only deck 2 will be discussed. This circuit consists of one INVERTER (4U4E), one NOR gate (4U5C), one NAND gate (4U7C), and one section of a Quad "NOR" R-S Latch (4U8).

During copy mode, input Pin 13 of 4U4E is held at a logic "0". Input Pin 8 of 4U5C is also at "0" via a common bus. If the copy cassette stops prior to the master tape, Pin 13 goes to a logic "1" with its inverted low output direct coupled to input Pin 9 of 4U5C. Since input Pin 8 is already at logic "0", its output Pin 10 goes high, enabling LED Latch Set input Pin 7 of 4U8. With Pin 7 high, output Pin 9 goes low (ground potential) and is coupled via terminal L of connector PJ4 to the LED, forward biasing it to the on state. The LED will remain on until 4U8 is triggered by LED Latch Reset NAND gate 4U7C.

Input to 4U7C is from AND gate 4U6C. When copy command is initiated, 4U6C output Pin 10 goes low impressing a logic "0" on input Pin 8 of 4U7C, causing a momentary high at its output Pin 10, as determined by the RC time constant of 4R21 and 4C13. With Pin 10 high, 4U8 is reset to the Set Latch condition, pulling output Pin 9 high thereby turning the LED off.

### 2.6.2.4 Master Rewind Control

Rewind control enable to transistor 3Q6 of the Mother/Record Amplifier board (Figure 4.20) is coupled by connector PJ4 terminal F from the rewind control circuit. This circuit consists of two INVERTERS (4U4C, 4U4F), and two AND gates (4U6A, 4U6D).

Input to 4U6D is initiated by the Control Module REWIND circuitry, and coupled by resistor 4R15 and diode 4CR9 from terminal H of connector PJ4. Pins 12 and 13 of 4U6D, normally held high by pull-up resistor 4R13, are enabled by a logic "0". The subsequent low output at Pin 11 is inverted by 4U4, and applied to input Pin 2 of 4U6A. Since Pin 1 of 4U6A is at a logic "1", output Pin 3 goes high causing 3Q6 to conduct which in turn energizes the rewind solenoid.

The solenoid will remain energized until beginning of tape is sensed, or the Control Module STOP button is pressed, either of which will cause Pin 4 of 4U2B to go high. The logic "1" voltage level at output Pin 4 is acted upon by subsequent logic resulting in a logic "0" at input Pin 1 of 4U6A. With output Pin 3 switched low, transistor 3Q6 turns off de-energizing the solenoid.

### 2.6.3 CONTROL MODULE

Figures 4.8 and 4.8.1

The logic board in the control module is the central circuit board through which all system command signals are processed. These command signals establish the mode of operation (stop, copy, rewind); enables and inhibits the slave module bias oscillators; initiates master cassette rewind; and shuts off the slave modules when the master position reaches end-of-tape.

The logic board also contains circuits which are not directly in the path of command signal flow, but are still essential to design performance. These ancillary circuits control master cassette automatic rewind; turn the stop, copy, rewind LEDs on and off; and activates the reel master rewind LED.

Because of the many variable combination of enable/disable conditions selectable by the command switches, a detailed theory of operation for this board is omitted. In its place, a brief Function Outline by stages is presented. The best method for troubleshooting this board is to identify the malfunctioning circuit, using Table 2.1, then substitute the suspected component. The logic diagram truth table (Figures 4.8, 4.8.1) will be very helpful during the fault isolation process.

### 2.6.4 EXPANSION MODULE

Figure 4.35

The logic commands from the control module are fed into a buffer amplifier at the expansion module. This is done to increase the impedance to reduce the loading effect on the control module. The buffer amplifier also keeps the logic signal at the proper level to assure the additional slave modules follow the logic commands.

The circuit board also contains a power down protection circuit. If the expansion module loses power after the copy cycle has started, the control module will not be overloaded from the change in impedance. The copy cycle can then be completed.

**Table 2.1 Controller Logic Function Outline**

LOGIC STAGE	DESCRIPTION
OR Gates 2U1A, 2U1B	These gates supply the copy command signal to the reel or cassette master. They are set by the Tape Transport MASTER switch and enabled by the Copy button.
OR Gates 2U2A,B,C, and 2U3A,B	Reel/cassette control matrix; input from Tape Transport MASTER and COPY switches.
OR Gates 2U3C and 2U4A,B,C,D	Process control signals for the cassette and reel slave modules. Circuit input taken from control matrix, and the master reel transport.
NOR Gate 2U10B, NAND Gates 2U5C, 2U10A, 2U12A; Transistors 2Q6, 2Q7	Couple the control signals from 2U4B and D to the reel slave transports.
NAND Gates 2U14A and C; NAND Inverter 1U14D	Latches the output from the cassette master EOT sensing circuit.
Transistors 2Q1, 2Q2	Assure stop mode is initiated when power is first applied to system.
OR Gate 2U1C, D	Provides the rewind command signal to the reel or cassette master. They are set by the Tape Transport MASTER switch and enabled by the Rewind button.
AND Gates 2U7B, 2U8A,C; NAND Gates 2U9B,C,D	Latch network for cassette modules stop, copy and rewind functions.
J-K Flip-Flop 2U13	Activates cassette master auto-rewind after completion of copy mode.
OR Gates 2U11C,D; NAND Gate 2U5B; NAND inverter 2U12C	Input drivers of J-K Flip-flop 2U13
Transistors 2Q4, 2Q5; OR Gate 2U10C,D	Couples copy and rewind command signals to the cassette master.
Transistors 2Q8, 2Q9, 2Q10; AND Gates 2U7C,D; NAND Gate 2U12B	Control the stop, copy, rewind LEDs on the control module.
NOR Gates 2U6A,B,C,D	Enables/disables the cassette and reel bias oscillators depending upon the positioning of Transport Control COPY switch.



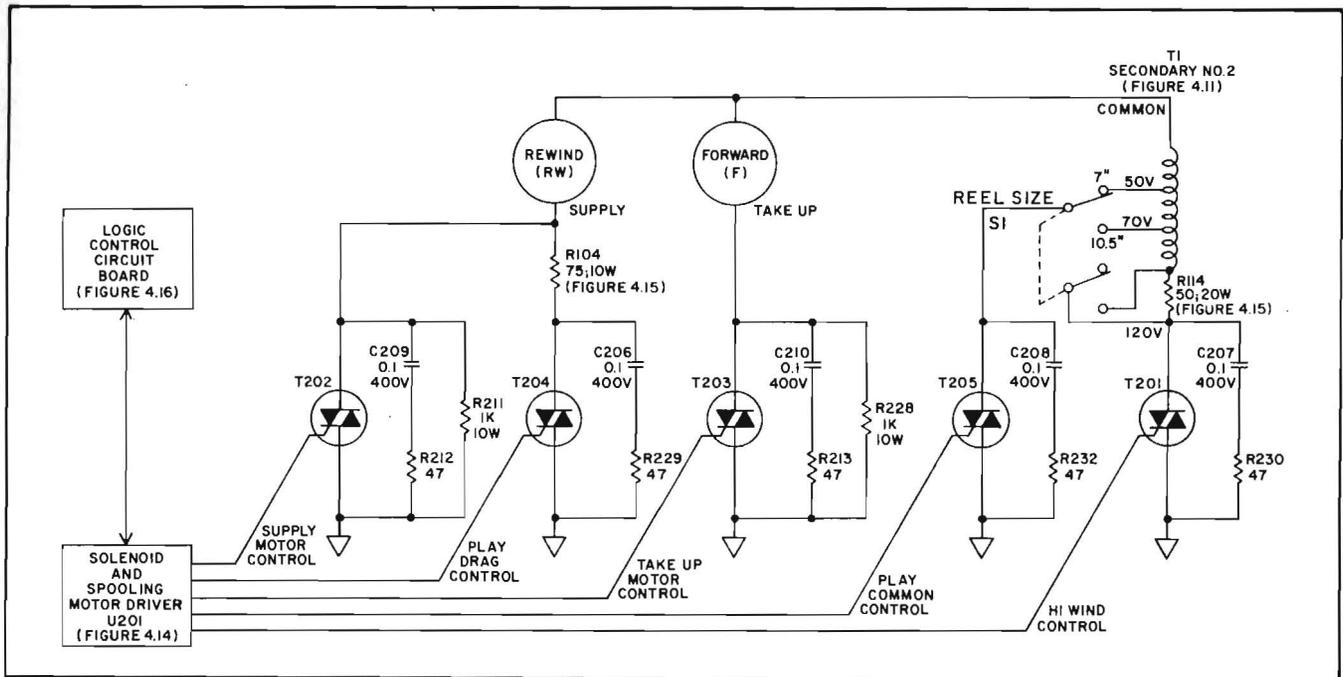


Figure 2.6 Open-Reel Spooling Motor Interface and Control

Resistor R211 provides voltage equalization for the supply motor. This completes the input circuit so the motor can provide a reverse torque or play drag.

Triac T204 turns “on” for play drag control. Series resistor R104 lowers the supply motor voltage to approximately 50 Vac. This triac turns “off” for rewind mode of operation as well as forward.

Table 2.2 Triac Switching Status

Mode of Operation	Control Triac State*				
	T201	T202	T203	T204	T205
Stop	Off	Off	Off	Off	Off
Play (Common)	Off	Off	On	On	On
Rewind	On	On	Off	Off	Off
Forward	On	Off	On	Off	Off
Boost	On**	Off	On**	On**	On**

\* Reference Figure 4.15, Motor Control Electrical Schematic, for Test Point Voltages.

\*\* Increased voltage level occurs momentarily when entering active mode of operation.

### 2.7.2.3 Boost Control

Triac T205, play common control, comes “on” with

logic boost control enable after a time delay. The monostable oscillator, logic NAND element U9 (pins 1, 2 and 3) on the logic control circuit board, provides boost time delay by capacitor R42 and resistor C20.

Triac Q105 on the motor interface board comes on during boost cycle with T204 inhibited. At the end of the cycle the reverse occurs. Triac T203 (take up motor control) stays “on” after initiation from boost mode.

### 2.7.2.4 Hi Wind Control

When triac T201 is turned “on”, 120 Vac from T1 secondary number two is available for hi wind operation. Resistor R106, which is in series with the secondary winding, is in the circuit when reel size switch S1 is in the 7.0 inch position. When S1 is in the 10.5 inch position, R106 is shorted out. This results in application of the full 120 Vac for reel motor operation.

Hi wind control of triac T201 has braking by the supply reel. Resistor R211 or R228 act as a voltage divider with the reel motor in providing reverse torque, as the corresponding triac is “off”. The direction sensor identifies the supply reel.

Pressing the STOP push button activates electrical and mechanical spooling motor brakes.

# SECTION III

## MECHANICAL MAINTENANCE

### 3.1 INTRODUCTION

This section describes preventive (routine) maintenance procedures, and non-routine maintenance and adjustment procedures. This section also includes the complete mechanical parts documentation for all the modules used in the 6120 Tape Duplicating System.

Paragraph 3.2, Preventive Maintenance, is intended for use by 6120 System users as a basis for a regularly scheduled maintenance program. In normal practice, this is the only part of the manual which need be referred to by the user.

Paragraphs 3.3 through 3.6 contain information pertinent to servicers of the 6120 modules. The adjustment procedures in these paragraphs should be considered as non-routine, becoming necessary only when a relevant part has been replaced or removed for servicing.

**Table 3.1 Preventive Maintenance Summary**

PROCEDURE	REEL MODULE	CASSETTE MODULE
Clean heads, capstans and pressure rollers	Daily (minimum)	Daily (minimum)
Demagnetize heads	Daily	Daily
Lubricate pressure roller bearings	500 hours	500 hours
Lubricate capstan bearings (Cassette Module only)	—	240 hours
Lubricate stabilizer roller bearings (Reel Module only)	500 hours	—
<b>NOTE</b>		
Lubrication requires some disassembly, and should be performed by qualified personnel only.		

### 3.2 PREVENTIVE MAINTENANCE

Preventive maintenance consists of periodic inspection, cleaning, demagnetizing and lubrication. In normal use, dust, dirt and tape oxide deposits will accumulate on the tape heads and other exposed parts. Excessive accumulation of tape oxide residue, or other foreign material, can cause wow and flutter, reduced volume and loss of high frequency response. A good guide is to clean unit before each use. Magnetic heads, however, should be cleaned daily as a minimum requirement. The frequency of inspection and cleaning can be adjusted, as necessary, to suit operating conditions. Table 3.1 summarizes the approximate requirements of a preventive maintenance schedule.

#### 3.2.1 CLEANING

##### CAUTION

**NEVER TOUCH TAPE HEADS WITH ANY METALLIC OBJECT. NEVER USE TOOLS OR OTHER METAL OBJECTS WHICH MAY BE MAGNETIZED NEAR THE TAPE HEADS.**

**DO NOT USE EXCESSIVE PRESSURE WHEN CLEANING TAPE HEADS AS THIS MAY MISALIGN THEM.**

**USE ONLY A GOOD COMMERCIAL SOLVENT DESIGNED SPECIFICALLY FOR CLEANING TAPE MACHINES. DO NOT USE ANY FORM OF CLEANING TAPE ON HEADS.**

Isopropyl alcohol works well as a solvent for most cleaning purposes. A cotton swab is an ideal cleaning tool.

### 3.2.1.1 Tape Heads

To clean the tape heads on both the Reel Module and the Cassette Module, dampen a cotton swab with isopropyl alcohol, and gently rub the swab over the entire tape-contacting surface of the head. Repeat this procedure with clean swabs, if necessary, until all deposits are removed.

### 3.2.1.2 Pressure Roller and Capstan - Open-Reel Module

Remove head cover. Remove the supply and takeup reels. Blow all accumulated dust out of the equipment. Inspect and clean all exposed moving parts of any foreign material.

With the transport plugged in, hold the right stabilizer arm assembly far enough to the right, as viewed from the front of the unit, to actuate tape break microswitch S600. Masking tape may be used to hold the arm in this position.

Dampen (do not wet) a clean white cloth with isopropyl alcohol. Depress the play push button (▶). Hold a section of the alcohol-dampened cloth against the pressure roller and capstan shaft to remove oil, dirt and tape residue. Take care that the cloth does not wind around the capstan shaft nor the pressure roller.

Clean the stabilizer pressing assemblies and tape guides as a good preventive maintenance measure.

### 3.2.1.3 Pressure Roller and Capstan - Cassette Module

To clean the capstan and pressure roller in each deck, first defeat the deck's EOT sensor. On newer machines, all the sensors may be defeated by turning the EOT switch OFF (switch located on front panel in lower-right corner under head cover). On older machines, stretch a ¼-inch wide, 1-inch diameter rubber band around the takeup and supply spindles of the deck to be cleaned as shown in Figure 3.1. Also, if a copy deck is being cleaned, place a blank cassette in the master deck.

With the end-of-tape feature defeated by one of the methods just described, press the COPY button on the Control Module. Place a cotton swab dampened with cleaning solution against the pressure roller and capstan to remove deposits. Press the STOP button on the Control Module when finished.

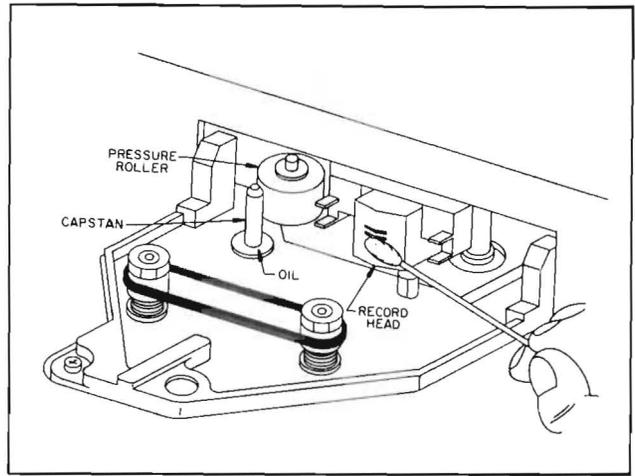


Figure 3.1 Cassette Deck Cleaning, Lubrication

### 3.2.2 DEMAGNETIZING

Occasionally the heads may become magnetized, with the attendant loss of high frequency response and dynamic range. This will also cause an increase in noise. For professional use, the heads should be demagnetized daily. It is also advisable to demagnetize the stabilizer arms (Reel Module), capstan and tape guides from time to time.

#### CAUTION

**TO AVOID DAMAGE TO THE AMPLIFIER, ALWAYS TURN AC POWER OFF BEFORE DEMAGNETIZING TAPE HEADS.**

**USE ONLY DEMAGNETIZING TOOLS HAVING INSULATED TIPS TO PREVENT METAL TO METAL CONTACT WHEN CLEANING TAPE HEADS.**

Use the following procedure when demagnetizing any object:

1. Starting at least 18 inches (approximately ½ meter) away, turn on the demagnetizer and move it SLOWLY toward the object to be demagnetized.
2. SLOWLY pass the demagnetizer as near as possible to, but not in contact with, the object.
3. After a few seconds, SLOWLY remove the demagnetizer to at least the starting distance before turning it off.

### 3.3 OPEN REEL MODULE SERVICE AND ADJUSTMENT

Information contained in this section is intended for use by qualified personnel only. There are no user-oriented procedures in this section.

#### 3.3.1 SPECIAL TEST EQUIPMENT

In order to perform the pressure roller and brake tension measurements of this section, the following special test equipment is required.

Pull spring scale, 0-18 ounces (0-5 N); Telex Part No. 56710-000.

Pull spring scale, 0-72 ounces (0-20 N); Telex Part No. 56710-001.

#### 3.3.2 PRESSURE ROLLER ASSEMBLY

##### 3.3.2.1 Cleaning and Lubrication

###### CAUTION

**WHEN LUBRICATING, CARE MUST BE EXERCISED TO ENSURE THAT BELTS REMAIN FREE FROM OIL AND GREASE. BELT SLIPPAGE AND ERRATIC TAPE MOVEMENT MAY OCCUR FROM CARELESS LUBRICATION. USE OIL SPARINGLY - DO NOT OVER LUBRICATE.**

1. Remove the pressure roller cap (Figure 3.9, 12), grip ring (11), washer (9) and pressure roller (10).
2. Using a clean, lint free cloth, clean the shaft of the pressure roller lever assembly as well as the bronze bearing of the pressure roller.
3. Apply one drop of SAE 30 machine oil to the bronze bearing and to the shaft of the pressure roller lever assembly.
4. Reassemble parts and perform end play adjustment.

##### 3.3.2.2 End Play Adjustment

1. Using a thickness gage, check for 0.005 to 0.010 inches (0.13 to 0.25 mm) of endplay between the back of the pressure roller (Figure 3.9, 10) and the washer (9).

2. Position grip ring to provide the correct end play.

###### NOTE

The intention of this adjustment is that the pressure roller should be as snug on the shaft as possible without binding. If the roller is too loose, tape skewing may result during playback.

##### 3.3.2.3 Tension Adjustment

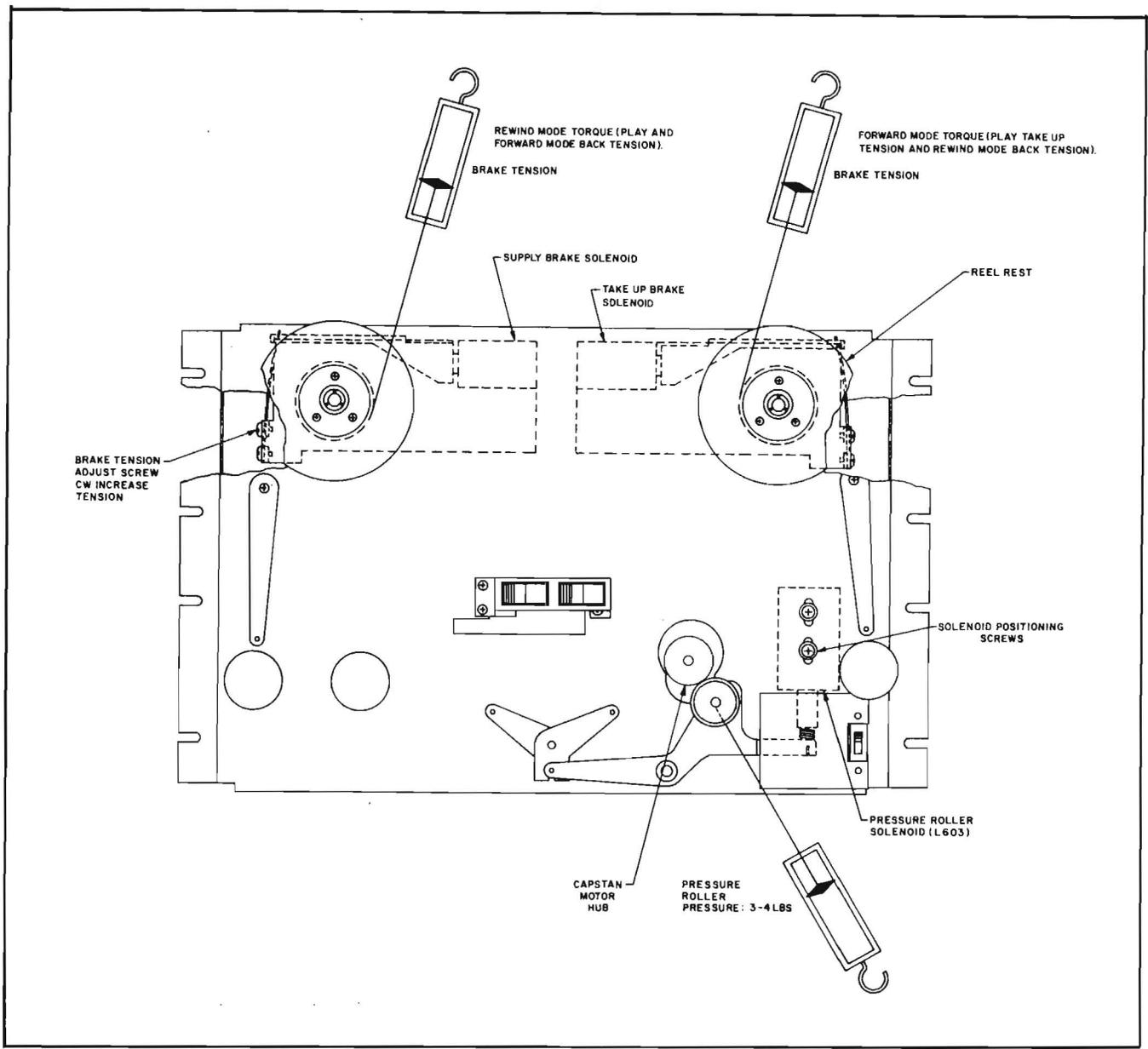
1. Fasten the 0-72 ounce (0-20 N) pull spring scale to the pressure roller as shown in Figure 3.1A.
2. Observe the point where the capstan loses control of the tape. This should occur with a spring scale reading between 3 and 4 pounds (0.8 to 1.1 N).
3. If the measured tension is not within the limits specified in step 2, loosen the two screws (Figure 3.1A) securing the solenoid frame to the deck panel, and reposition the solenoid. Move solenoid up to increase tension, down to decrease.
4. Retighten solenoid mounting screws and recheck the pressure roller tension.

#### 3.3.3 STABILIZER ROLLER ASSEMBLIES

Three stabilizer assemblies are located on the front panel to facilitate and control magnetic tape transfer from supply to take up reel (shown as items 15, 19-23 and 30 in Figure 3.9).

##### 3.3.3.1 Cleaning and Lubrication

1. Loosen the set screw (Figure 3.8, 41) securing the stabilizer assembly to the subplate, and remove the stabilizer assembly.
2. Remove the grip ring (Figure 3.9, 23) and remove all components from the roller shaft — note the order of component disassembly.
3. Clean the roller shaft and the housing and bushing assembly and inspect both for signs of wear. Replace if necessary.
4. Distribute two drops of SAE 30 machine oil onto the stabilizer roller assembly shaft.
5. Reassemble all parts and perform end play adjustment.



**Figure 3.1A Open-Reel Tension Measurements**

**3.3.3.2 End Play Adjustment**

1. Using a thickness gage, check for 0.005 to 0.010 inches (0.13 to 0.25 mm) of end play between housing and bushing assembly (Figure 3.9, 21) and washer (20).
2. Adjust grip ring for correct end play.

**3.3.3.3 Stabilizer Position Adjustment**

1. Reinstall the stabilizer assembly on the

subplate. Position the assembly so that the distance between the back of the roller and the subplate measures 0.325 inches (8.26 mm) as shown in Figure 3.2.

2. Tighten the set screw — do not over tighten as this will ruin the housing and bushing assembly.
3. Recheck the roller position — repeat adjustment if necessary.

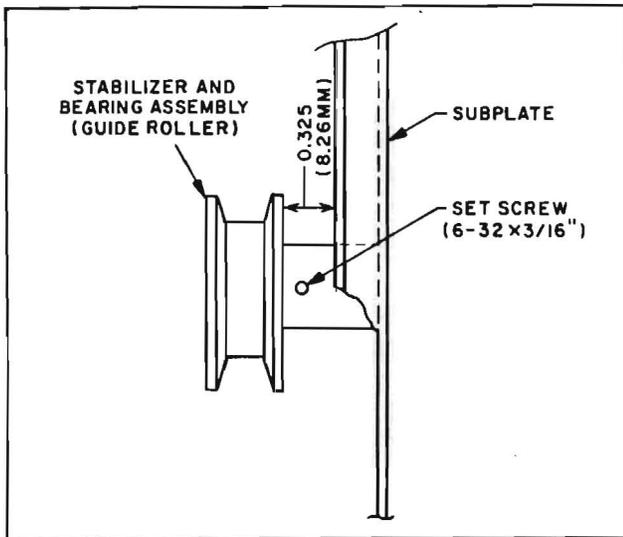


Figure 3.2 Positioning Stabilizer

### 3.3.4 BRAKES

(Supply, Take Up and Capstan)

#### 3.3.4.1 Band Wrap Adjustment

With each brake solenoid activated, the brake band should lie smoothly against the brake stop (Figure 3.10 and 3.11, item 5). There should be no ripples or buckling apparent in the band, and the band should not rub against the brake drum. Adjust the band wrap by loosening the appropriate brake solenoid mounting screws. Reposition the solenoid for proper band wrap.

#### 3.3.4.2 Tension Adjustment

##### A. Supply and Takeup

With a reel hub of, preferably, 1 inch (25.4 mm) radius, a length of fishing line or equivalent, a reel rest assembly and a pull spring scale capable of measuring two pounds, prepare the test setup shown in Figure 3.1A. The reel rest is used to better retain the string around the reel hub.

#### NOTE

If using a reel with a hub other than 1 inch (25.4 mm) radius, tension in inch ounces is determined by multiplying the number of ounces shown on the scale by the radius of the reel hub in inches (from the center of the reel to the point where the string is wound). The product of the two figures is the brake tension.

Conduct the brake tension measurement as outlined following with the transport in the stop mode of operation.

1. Fasten the reel hub to the appropriate motor shaft.
2. Loop the string around the hub several times to provide the direction of rotation required.
3. Attach a pull spring scale to the string end.
4. Pull the scale slowly and smoothly away from the reel until the motor hub begins to rotate.
5. Record the indication on the scale at the point the reel motor starts to move. The proper tension readings in inch ounces are listed in Table 3.2.
6. Adjust brake tension adjust screw of motor assembly under test until the required readings are obtained.

Table 3.2 Reel Motor Braking Tension

REEL MOTOR	ROTATION	TENSION (inch ounces)	(N·m)
Supply	CCW	20-24	0.14-0.17
Supply	CW	10-14	0.07-0.10
Take Up	CW	20-24	0.14-0.17
Take Up	CCW	10-14	0.07-0.10

##### B. Capstan

Manually rotate capstan motor in a CCW direction and compare to tension on supply motor CCW direction. If capstan exhibits greater or less tension than supply motor, adjust brake tension adjust screw until tension of both motors feel approximately the same.

#### 3.3.4.3 Capstan Flywheel Position Adjustment

If the capstan motor has been replaced, the flywheel must be positioned on the new motor shaft for proper braking.

1. With motor and brake stop assembled to Capstan Motor Assembly, install flywheel on motor shaft.

2. Position flywheel so that the side of the flywheel closest to the motor is flush with the side of the brake stop closest to the motor.
3. Tighten set screw. Check brake operation after reassembly and perform band wrap and tension adjustments if necessary.

#### 3.3.4.4 Reel Motor Brake Hub Reassembly

When reassembling the brake hub to the motor shaft on the supply or takeup reel motor assembly:

1. Center the roll pin (Figure 3.11, 35) in the hole in the motor shaft.
2. Orient the slot in the hub so the roll pin slips easily into it during assembly.
3. Assure that only reasonable force is applied when tightening the number 6 screw which secures the hub to the shaft.
4. Rotate the reel motor manually to check clearance between the hub blades and the sensor on take up motor.

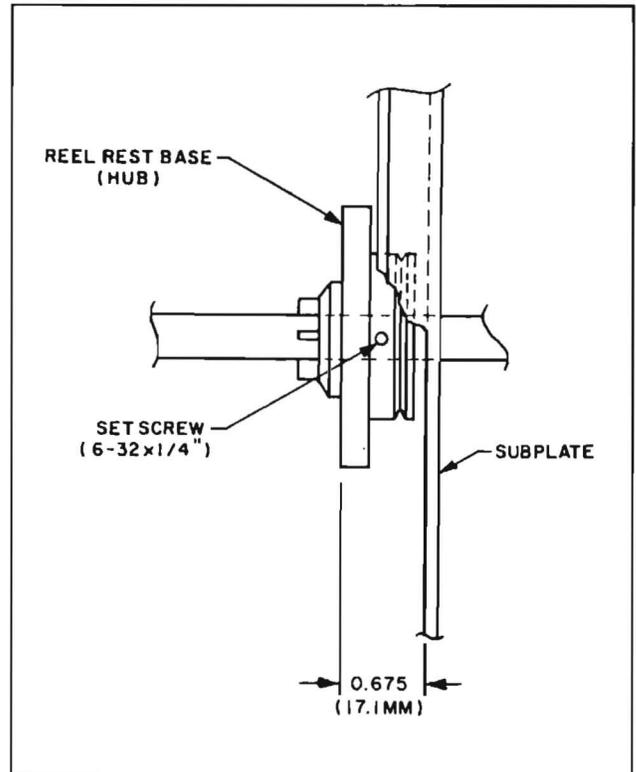


Figure 3.3 Positioning Reel Rest Base

#### 3.3.5 REEL REST BASE POSITION ADJUSTMENT

In the event that service is necessary on the reel motor, which requires its removal from the subplate staking assembly (Figure 3.8, 61), the reel rest base must be removed from the motor shaft. After reassembly of the reel motor to the subplate, adjust the reel rest base as follows:

1. Slide the reel rest base onto the motor shaft and position it so that the distance from its front surface to the front of the staking assembly is 0.675 inches (17.1 mm) as shown in Figure 3.3.
2. Tighten the set screw, making sure that the reel rest base does not shift position on the motor shaft.
3. Verify the measurement in step 1 and repeat adjustment if necessary.

#### 3.3.6 ADJUSTABLE TAPE LIFT GUIDE ADJUSTMENT

An adjustable tape guide assembly is located to the right and slightly above the pressure roller (Figure 3.8, 93). A slotted hole is provided for fastening the adjustable guide to give it a range of positions.

This device prevents magnetic tape contact with the pressure roller during the high wind modes of operation. Access to the adjustment locking screw (Figure 3.8, 90) is obtainable through the front panel to perform the following steps.

1. Apply power to the transport and depress the STOP push button.
2. Verify the clearance between the pressure roller and magnetic tape to be approximately 0.005 inch (0.13 mm) with normal tape tension.
3. Loosen the adjustment locking screw and reposition the adjustable tape guide, if necessary, to obtain the required clearance.

#### 3.3.7 TAPE BREAK SWITCH ADJUSTMENT

The tape break switch (S600), shown as Figure 3.8, item 55, controls main power to the reel module. When properly adjusted, S600 should provide power

to the reel module only when a tape is threaded and held under tension. Adjust as follows:

1. Rotate the right stabilizer arm (Figure 3.9, 6) counterclockwise until an audible click is heard (indicating switch transfer).
2. Slowly return the stabilizer to its maximum clockwise position. There should be an audible click just before this position, indicating that S600 has returned to the off position.
3. Adjust S600 to meet the requirement of step 2 by loosening the two screws (Figure 3.8, 54) and repositioning the switch.

### 3.3.8 TAKEUP AND SUPPLY MOTOR TORQUE MEASUREMENT

Takeup and supply motor torque is non-adjustable; however, should improper performance indicate a malfunction in this area, the tabulation of reel motor operating torque presented in Table 3.3 may be used to verify correct transport response.

Using the appropriate pull spring scale listed in paragraph 3.3.1 Test Equipment, and the measurement method outlined in paragraph 3.3.4.2, record comparative readings to those in Table 3.3.

**Table 3.3 Reel Motor Torque**

Measurements in inch-ounces

MODE OF OPERATION	REEL SIZE	SUPPLY		TAKE UP	
		7.0	10.5	7.0	10.5
REWIND		22-26	32-36	1-2	1.5-2.5
HI FORWARD		1-2	1.5-2.5	22-26	32-36
PLAY		4-6	8-10	5-7	10-12
PLAY BOOST *		2-4	3.5-5.5	22-26	32-36

Metric Equivalents in N·m

MODE OF OPERATION	REEL SIZE	SUPPLY		TAKE UP	
		7.0	10.5	7.0	10.5
REWIND		0.16-0.18	0.23-0.25	0.007-0.01	0.01-0.02
HI FORWARD		0.007-0.01	0.01-0.02	0.16-0.18	0.23-0.25
PLAY		0.03-0.04	0.06-0.07	0.04-0.05	0.07-0.08
PLAY BOOST *		0.01-0.03	0.02-0.04	0.16-0.18	0.23-0.25

\* OCCURS MOMENTARILY AT BEGINNING OF PLAY MODE ALL RECORDING IN INCH OUNCES

## 3.4 CASSETTE MODULE SERVICE AND ADJUSTMENT

Information contained in this section is intended for use by qualified personnel only. There are no user-oriented procedures in this section.

### CAUTION

**UNLESS OTHERWISE NOTED, PROCEDURES IN THE FOLLOWING PARAGRAPHS REQUIRE REMOVAL OF THE CASSETTE MODULE FROM THE CONSOLE. IF MODULE IS PLACED ON ITS FACE (TOP) THE SWITCHES AT THE TOP MAY BE BROKEN OFF. ALSO, DAMAGE TO CIRCUIT BOARDS MAY OCCUR. PLACE THE CASSETTE MODULE ON ITS SIDE WHEN SERVICING.**

#### 3.4.1 SPECIAL TEST EQUIPMENT

1. M-300 head alignment gauge, Telex part number 56626-000.
2. Torque test cassette, local purchase.
3. Scale, spring pull 0-18 oz, Telex part number 56710-000.

#### 3.4.2 PRESSURE ROLLER

##### 3.4.2.1 Cleaning and Lubrication

1. Using a demagnetized Phillips screwdriver, remove the cassette well covers. Each cover is secured by 4 screws - two screws in each well.
2. Remove each pressure roller (Figures 3.16 and 3.17, 12) by first removing the grip ring (10) and washer (8).
3. Using a clean, lint free cloth, clean the shaft of the pressure roller lever assembly (11) as well as the bronze bearing of the pressure roller.
4. Apply one drop of SAE 30 machine oil to the bronze bearing and to the shaft of the pressure roller lever assembly.
5. Reassemble pressure roller and adjust grip ring for minimum end play without binding.

### 3.4.2.2 Tension Adjustment

Pressure roller tension is provided by a torsion spring (Figure 3.15, 11) connected between the pressure roller lever assembly (Figure 3.16, 11) and one of 3 pins cast on the head slide plate. Pressure roller tension may be changed by moving the spring end to one of the other pins.

1. EOT switch is off.
2. Apply ac power. Attach 0-18 oz. spring scale to the pressure roller shaft under retainer ring (Figure 3.16, 10).
3. Activate copy.
4. Pull back on scale until pressure roller loses contact with capstan shaft (stops rotating). Note level on scale. For proper operation, the level will range between 14 and 18 oz.
5. Repeat for all decks.
6. If below the level indicated in step 4, move the spring (Figure 3.15, 11) to another pin.
7. Repeat step 4 to check tension level.

### 3.4.3 CAPSTAN AND CAPSTAN BEARINGS

#### 3.4.3.1 Lubrication

1. Remove bearing locator (Figure 3.13, 25) by removing two phillips head screws (16).
2. Apply a small amount of Beacon grease, or equivalent, to end of capstan shaft.

Reinstall bearing locator. Make sure the 2 locating tabs are seated and the nylon thrust button is centered over the capstan shaft. Tighten the 2 screws (item 16).

3. Apply 1 drop of SAE 30 machine oil to bottom portion of capstan (reference Figure 3.1). Allow time for oil to seep into bearing. Clean excess oil off of capstan.

#### 3.4.3.2 End Play Adjustment

1. Remove drive belts from capstan pulley.
2. Manually move capstan up and down and adjust nylon button (screw) in bearing housing/thrust holder until a deflection (movement) is present. Spin capstan to check for binding (tension). The capstan should be free wheeling when properly adjusted.
3. Reinstall drive belts.

#### 3.4.3.3 Thrust Holder Alignment

1. Loosen the two allen head screws securing the thrust screw holder.
2. Reposition the thrust screw holder so that the thrust screw is centered at the end of the capstan.
3. Retighten the allen head screws.

### 3.4.3.4 Upper Bearing Replacement

1. Remove the screw (Figures 3.16 and 3.17, 14) that holds the retainer (Figure 3.16, 45 and Figure 3.17, 29) to the top of the cassette deck.
2. Pull up on the capstan shaft to start the bearing out of the deck. Grasp the bearing and pull it out.
3. Insert new bearing. The bearing is a slip fit into the bearing sleeve. Add 2 drops of SAE 30 machine oil and replace retainer.

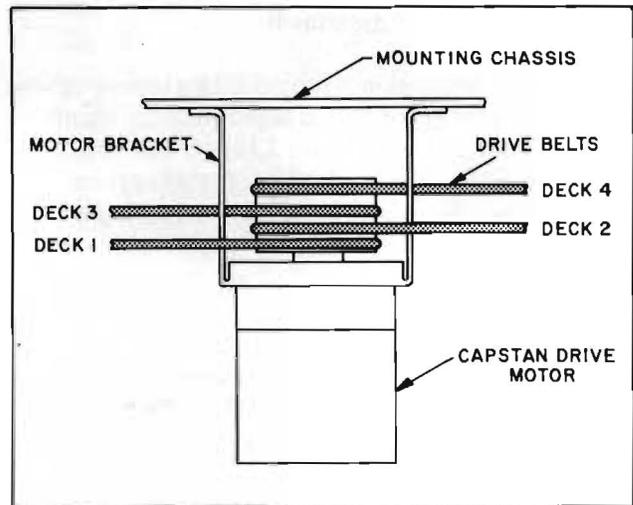


Figure 3.4 Large Drive Belt Placement

### 3.4.4 BELT REPLACEMENT

Figure 3.4 shows the proper positioning of the large drive belts on the motor pulley. Each decks flywheel pulley also has four positions for large belt placement - use the same position on this pulley as is used on the motor pulley.

#### NOTE

Decks are numbered 1-4 as shown in Figure 3.5. On the Master Cassette Module, the master deck is deck 1.

To replace belts, remove the bearing locators (Figure 3.13, 25) by removing the phillips head screws (16). Do not loosen the allen head screws as the thrust screw holder will then have to be realigned. Belts may then be pulled over the end of the capstan assembly for removal.

### 3.4.5 COPY SOLENOID ADJUSTMENT

The copy solenoids are adjusted to insure proper head penetration when solenoid plungers are firmly seated in their housings.

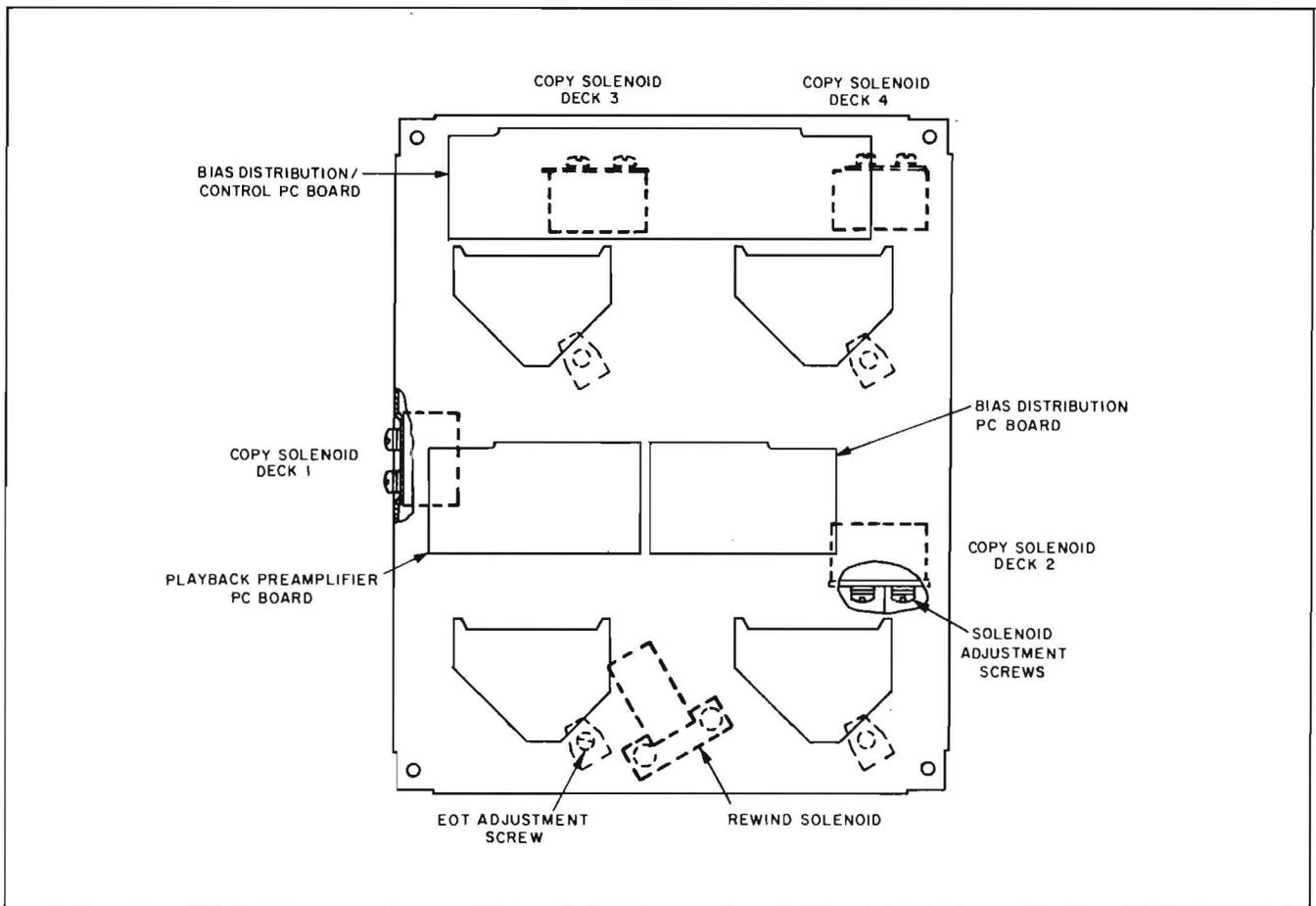
1. Install the M-300 alignment gage in the deck.

2. Manually press the appropriate copy solenoid plunger in until it is firmly seated in its housing.

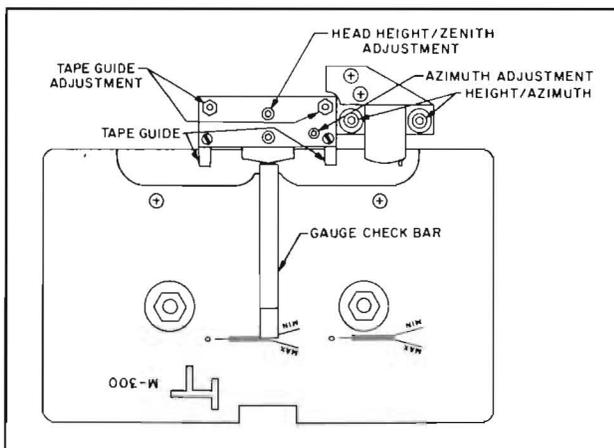
#### NOTE

Avoid pressing on the actuator assembly (connected to the plunger) when performing step 2 as this will upset the following measurement.

3. Place the M-300 gage bar gently against the crown of the tape head (play head - master deck, record head - copy decks).
4. Check that the pointed end of the gage bar falls between the MAX and MIN lines as shown in Figure 3.5A.
5. If the measurement of step 4 is incorrect, loosen the copy solenoid mounting screws (refer to Figure 3.5 for solenoid and screw locations). Shift the solenoid position, tighten the screws, and recheck the head position according to steps 2-4. It may be necessary to repeat the adjustment several times to achieve the proper positioning of the head.



**Figure 3.5 Accessibility of Cassette Electrical Subassemblies**



**Figure 3.5A Copy Solenoid Adjustment**

### 3.4.6 REWIND SOLENOID ADJUSTMENT

When rewind solenoid is activated, takeup roller and bearing assembly (Figure 3.16, 42) must be away from takeup pulley assembly (Figure 3.16, 25). Also, pressure on the rewind feed reel drum must be sufficient so that when supply spindle is held, rewind drum will turn.

1. Turn EOT switch OFF.
2. Loosen the rewind solenoid mounting screws just enough to allow movement of solenoid.
3. Push the solenoid all the way in.
4. Press REWIND on the Control Module, and note that the supply reel does not turn.
5. Gradually pull the solenoid back out. Pull the solenoid evenly so that both adjustment screws are in the same relative positions in their slots.
6. Note the point at which the supply reel begins to turn when pulling out solenoid.
7. Continue pulling until a hissing sound is noted (rewind clutch starting to bind).
8. Return the solenoid to the point midway between the points noted in step 6 and 7, and retighten the adjustment screws.

9. Operate the REWIND and STOP buttons several times to check operation. Rewind a C-90 cassette to check for sufficient torque.
10. Return EOT switch to ON.

### 3.4.7 BRAKE ADJUSTMENT

Each cassette deck has a brake assembly consisting of a brake lever (Figures 3.16 and 3.17, 22) and a rubber bumper (23). The bumper rides on the takeup reel pulley (25) in stop mode, and is separated from it when the deck enters the copy mode due to the lateral movement of the bearing plate assembly (9).

If the brake bumper does not completely separate from the takeup reel pulley in copy mode, slightly increase the amount of bend in the long tab on which the bumper is mounted.

If the brake bumper does not completely separate from the takeup reel in rewind mode (master deck only) when pushed by the rewind lever (Figure 3.16, 34), decrease the amount of bend in the short tab on the brake lever.

#### NOTE

A long, flat-blade screwdriver may be used for these adjustments if some care is exercised.

### 3.4.8 TAKEUP/REWIND SPINDLE TORQUE ADJUSTMENT

1. Insert torque test cassette into deck to be tested.
2. Activate copy mode and note torque level on test cassette. Place in stop mode.
3. Repeat step 2 several times and look for consistent torque levels.
4. The torque levels on the test cassette should range between 50 to 65 gm/cm (takeup) and 70 to 100 gm/cm (rewind, master only).
5. Adjust self-locking nut as required to obtain correct torque. (For takeup, Figure 3.16, 25; for rewind, Figure 3.16, 35).

## 3.5 REWIND MODULE SPINDLE TORQUE ADJUSTMENT

1. Remove rewind module from console.
2. Remove bottom cover (Figure 3.20, 16).
3. Reconnect power cable.
4. Insert torque test cassette (paragraph 3.6.1) into deck to be tested.
5. Apply ac power and note torque reading on test cassette. Repeat several times and look for consistent readings.
6. The torque levels on the test cassette should range between 70 and 100 gm/cm.
7. Adjust, as needed, self-locking nut (Figure 3.20, 2) until levels in step 6 are reached.
8. Use a torque gauge on supply spindle. The level of back tension should range between 5 and 10 gm/cm. Adjust self-locking nut (Figure 3.20, 2) until level is attained.
9. Repeat steps 4 through 8 for balance of decks.

## 3.6 PARTS DOCUMENTATION

Figures 3.6 through 3.20

Figures 3.6 through 3.7 are mechanical exploded view drawings of the control module. Figures 3.8 through 3.12 are mechanical exploded view drawings of the master open reel module. Figures 3.13 through 3.17 are mechanical exploded view drawings of the cassette master-slave and cassette slave modules. Figure 3.18 is the exploded view of the expansion module. Figures 3.19 and 3.20 are views of the rewind module.

Components illustrated on these diagrams are keyed to their associated parts identification lists by item designators. All component parts in the parts identification lists are described by their principal noun plus modifiers as necessary to completely identify the item. Individual components may be located visually on the diagrams, by Telex part number, or by physical description.

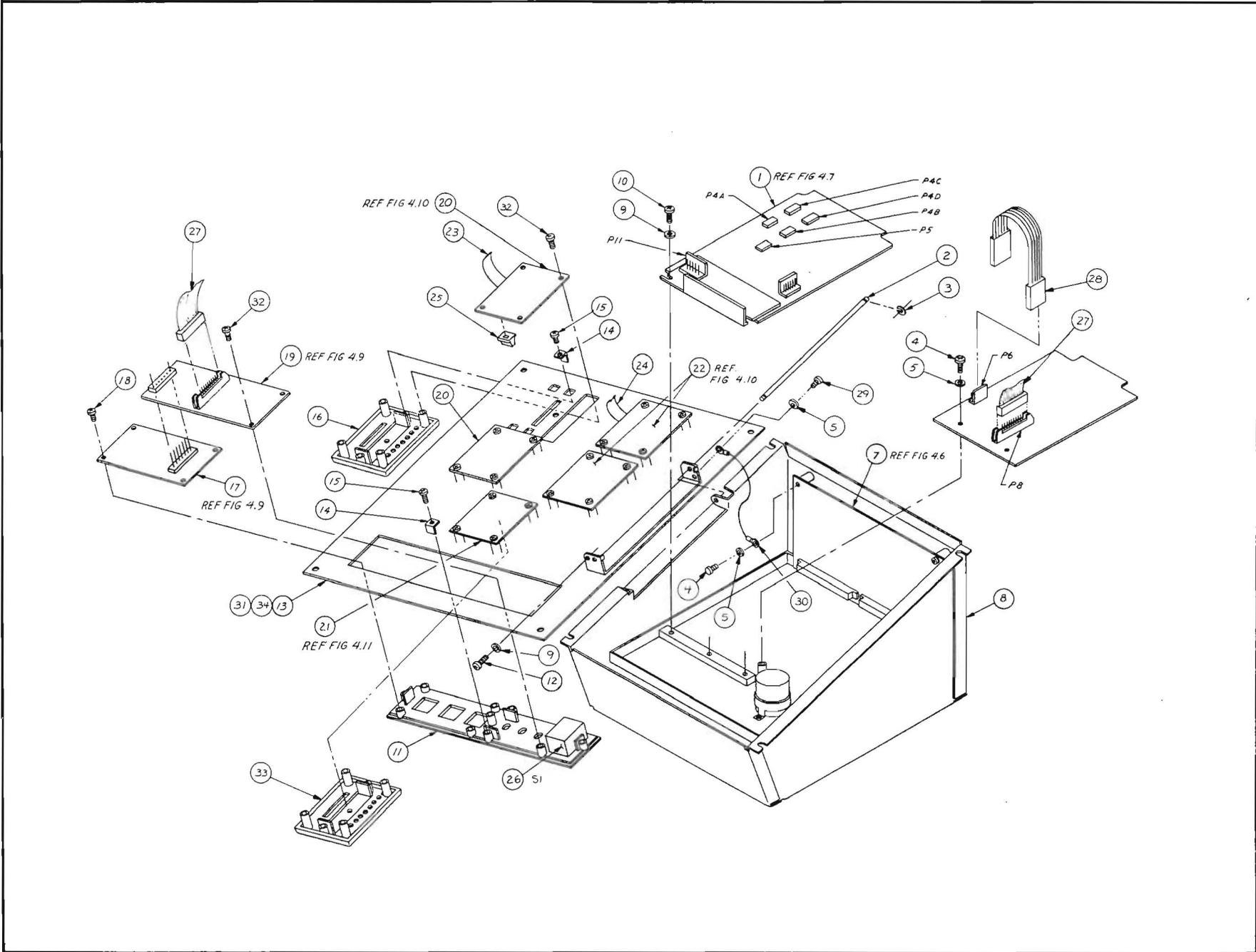


Figure 3.6 Control Module Exploded View - Top

Figure 3.6 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Audio Board Assembly, 2 Channel (Standard & XL)	94508-001
	Audio Board Assembly, 4 Channel (Standard & XL)	94508-000
	Audio Board Assembly, 2 Channel (XLP)	94508-005
	Audio Board Assembly, 4 Channel (XLP)	94508-004
2	Pin, Hinge	92751-000
3	E-Ring	50016-011
4	Screw, No. 4-40 x 1/4" LG	51845-038
5	Lock Washer, Split No. 4	50086-004
6	Logic Board Assembly	94505-000
7	Mother Board Assembly	94502-000
8	Box Subassembly, Control, 110V	92939-000
	Box Subassembly, Control, 220V	92939-001
9	Lock Washer, Split No. 6	50086-001
10	Screw, No. 6-32 x 1/4 LG	51845-074
11	Bezel Switch w/Label	94609-000
12	Screw, No. 6-32 x 1/2 LG	51845-077
13	Deck Panel Assembly, 2 Channel (Standard)	94606-001
	Deck Panel Assembly, 4 Channel (Standard)	94606-000
	Deck Panel Assembly, 2 Channel (XL)	94606-007
	Deck Panel Assembly, 4 Channel (XL)	94606-006
	Deck Panel Assembly, 2 Channel (XLP)	94606-009
	Deck Panel Assembly, 4 Channel (XLP)	94606-008
14	Clamp	92668-001
15	Screw, Plastite, No. 6 x 1/4 LG	51856-007
16	Bezel, Level Indicator	94607-000
17	Pushbutton Board Assembly	94520-000
18	Screw, Plastite, No. 4-20 x 1/4 LG	51856-004
19	Toggle Switch Board Assembly	94517-000
20	Audio Level/LED Board Assembly (Standard & XL)	94511-000
	Audio Level/LED Board Assembly (XLP)	94511-002
21	Bias Level Indicator Board Assembly	94514-000
22	Audio Level/LED PC Board Assembly (Standard & XL)	94511-001
	Audio Level/LED PC Board Assembly (XLP)	94511-003
23	Ribbon Cable, 17" Long	94493-000
24	Ribbon Cable, 11.5" Long	94493-001
25	Knob, Volume/Tone Slide	40503-000
26	Switch, Toggle, DPDT (S1)	57520-000
27	Ribbon Cable, 26 Pin (Logic Board P8 to Toggle SW Board P9)	94493-007
28	Cable Assembly, 6 Wire	94494-000
29	Screw, No. 4-40 x 1/4	51849-011
30	Ground Strap Assembly	83783-007
31	Deck Panel Assembly, 2 Channel (Standard)	94605-001
	Deck Panel Assembly, 4 Channel (Standard)	94605-000
	Deck Panel Assembly, 2 Channel (XL)	94605-007
	Deck Panel Assembly, 4 Channel (XL)	94605-006
	Deck Panel Assembly, 2 Channel (XLP)	94605-009
	Deck Panel Assembly, 4 Channel (XLP)	94605-008
32	Screw, No. 4-40 x 3/8	51856-005
33	Bezel, Bias w/Label	94607-001
34	Control Plate, 2 Channel	92666-005
	Control Plate, 4 Channel	92666-004

92680, Rev M  
 92939, Rev J  
 94606, Rev F  
 94605, Rev C  
 94609, Rev E



Figure 3.7 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Screw, No. 6-32 x ¼ LG	51845-074
2	Lock Washer, Split No. 6	50086-001
3	Cover, Bottom	92667-001
4	Screw, No. 8-32 x ¼ LG	51845-110
5	Lock Washer, No. 8	50086-002
6	Transformer Assembly Power (T1, 110V)	94603-000
	Transformer Assembly Power (T1, 220V)	94603-001
7	Screw, No. 4-40 x ⅜ LG	51845-042
8	Lock Washer, Split No. 4	50086-004
9	Block, Terminal	50099-001
10	Screw, No. 6-32 x 3/16 LG	51845-073
11	Lock Washer, No. 6	50086-001
12	Capacitor, Electrolytic, 2700 µF, 50V (C3)	52688-000
13	Receptacle, Ac	53036-000
14	Relief, Strain	50489-025
15	Fuse Cap (110V Units)	50547-132
	Fuse Cap (220V Units)	57074-007
	Fuse Holder	57074-005
	Fuse, 0.8A, 250V (110V Units)	50547-132
	Fuse, 10.4A, 250V (220V Units)	56676-003
16	Cord, Line	52130-002
17	Screw, No. 6-19 x ⅜ LG	51856-008
18	Hex Nut, No. 8	52188-009
19	Heat Sink	92998-000
20	Not Used	
21	Screw, 8-32 x ⅜ LG	51845-111
22	Screw, No. 10-32 x ¼	51816-146
23	Resistor, 120, ½W (R1, R2)	52154-480
24	Capacitor, Polyester, 0.47, 1000V	50725-007
	Patch Cord (not shown)	50628-008

92680, Rev G  
 92939, Rev J  
 94605, Rev C  
 94606, Rev F  
 94609, Rev E

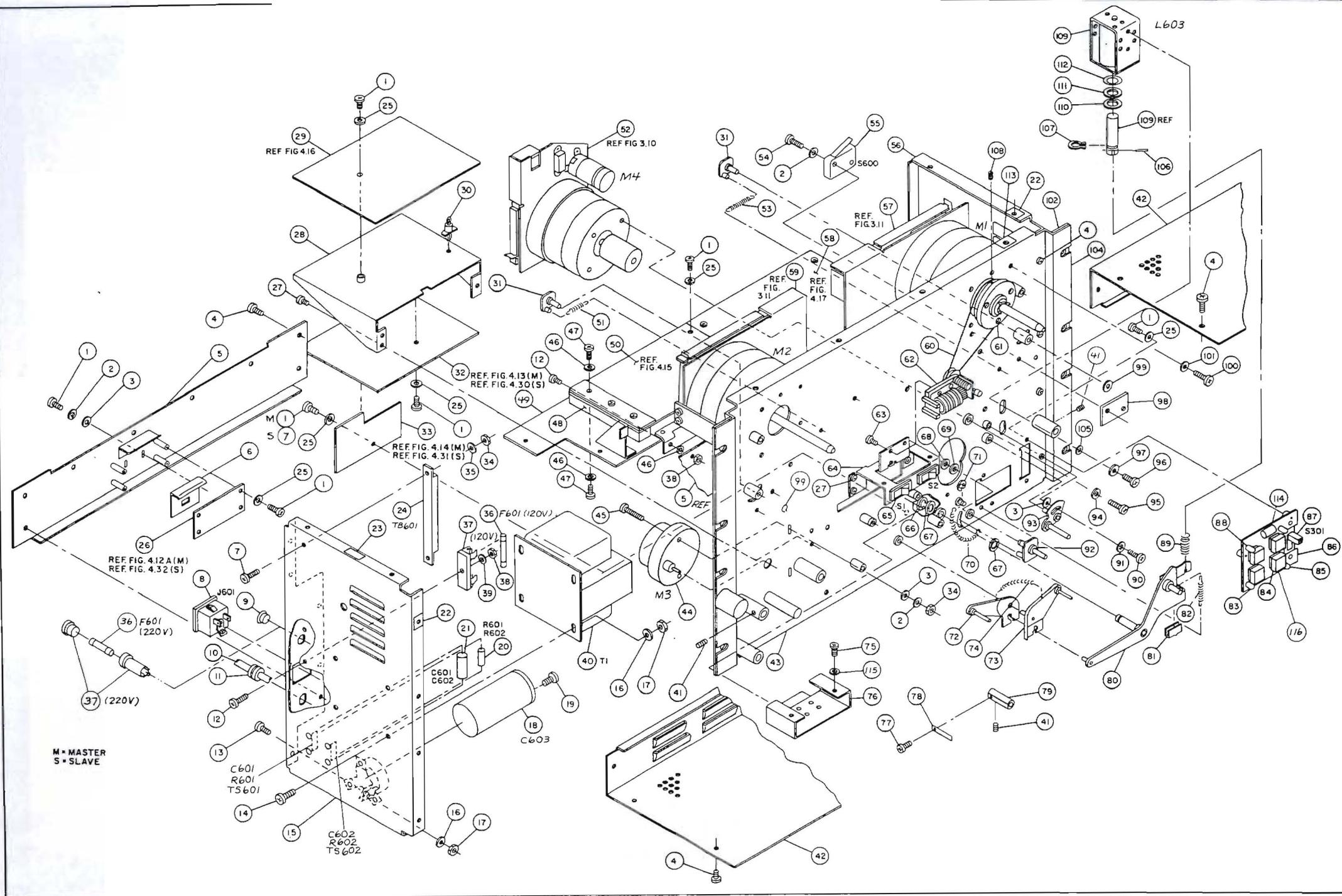


Figure 3.8 Open-Reel Main Chassis Exploded View

Figure 3.8 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Screw, No. 4-40 x 1/4	51845-038
2	Washer, Lock, Split No. 4	50086-004
3	Washer, Flat, No. 4	52186-006
4	Screw, Hex, Washer Head 6-20 x 1/2"	51842-013
5	Riveting Assembly, Remote Panel	93771-000
6	Clamp, Cable	92509-001
7	Screw, Pan Head, 4-40 x 3/8"	51845-039
8	Receptacle, Ac	53036-001
9	Plug, Hole	52185-000
10	Cord, Line	52130-001
11	Strain Relief	50489-007
12	Screw, Pan Head Machine, 6-32 x 3/8"	51845-075
13	Screw, Pan Head, 8-32 x 5/8"	51845-114
14	Screw, Pan Head, 8-32 x 3/8"	51845-111
15	Panel, Left Side	92969-000
16	Washer, Lock, No. 8	50049-002
17	Nut, Hex, 8-32	52188-009
18	Capacitor, 2700, 50V, C3	52688-000
19	Screw, 10-32 x 3/8	51845-147
20	Resistor, 47, 1/2W, R601, R602	85554-009
21	Capacitor, 0.047, 1000V, C601, C602	50725-001
22	Nut, Speed, 6Z	50097-026
23	Pad, Felt	50010-001
24	Connector, Common, 20 Pin, TB1	57684-003
25	Washer, Lock, Int. TH, No. 4	50014-002
26	PC Board Assembly, Interface (Reel Master)	94550-000
	PC Board Assembly, Interface (Reel Slave)	94562-000
27	Screw, Self-tap, No. 6-20 x 3/8	51842-012
28	Bracket	94040-001
29	Motor Interface Board Assembly	94568-000
30	Stand Off, Circuit Board	51855-001
31	Cam & Shaft Assembly, Stabilizer	94064-001
32	Reproduce Amplifier Board Assy, 2 Chan (Master, Standard & XL)	94544-001
	Reproduce Amplifier Board Assy, 4 Chan (Master, Standard & XL)	94544-000
	Reproduce Amplifier Board Assy, 2 Chan (Master, XLP)	56676-001
	Reproduce Amplifier Board Assy, 4 Chan (Master, XLP)	57074-004
	Record Amplifier Board Assy, 2 Chan (Slave)	94556-001
	Record Amplifier Board Assy, 4 Chan (Slave)	94556-000
33	Equalization Board Assy, 2 Chan (Master)	94547-001
	Equalization Board Assy, 4 Chan (Master)	94547-000
	Record Driver Board Assy, 2 Chan (Slave)	94559-001
	Record Driver Board Assy, 4 Chan (Slave)	94559-000
34	Nut, Hex, 4-40	52188-006
35	Washer, Lock, No. 4	50049-003
36	Fuse, Slo-Blo, 1.5A, 250V, (120V)	50547-008
	Fuse, Slo-Blo, 0.8A, 250V, (220V)	56676-001
37	Fuse Holder (120V)	50654-000
	Fuse Holder (220V)	57074-004
38	Nut, Hex, 6-32	52188-008
39	Washer, Lock, No. 6	50086-001
40	Transformer, Power	92970-001

92651, Rev M  
92753, Rev F  
94051, Rev B

92996, Rev K  
94046, Rev D  
94047, Rev B

93776, Rev B  
94068, Rev E  
94552, Rev A

Figure 3.8 Parts List (Continued)

ITEM NO.	DESCRIPTION	PART NO.
41	Screw, Set, 6-32 x 3/16	51843-007
42	Cover, Panel	92827-000
43	Staking Assy, Subplate	94023-001
44	Motor, Tape Scrubber w/Connector	94625-000
45	Screw, No. 4-40 x 1	51845-044
46	Washer, Lock, No. 6	50014-001
47	Screw, No. 6-32 x 1/4"	51845-074
48	Heat Sink	92998-000
49	Plate, Back	92764-000
50	Motor Control Board Assembly	94020-000
51	Spring	54259-001
52	Motor/ Brake Assembly, Capstan	94587-000
53	Spring, Stabilizer Arm	54259-000
54	Screw, No. 4-40 x 3/8"	51845-042
55	Microswitch (Tape Break Switch S600)	57495-000
56	Plate, Right Side	92805-000
57	Motor Brake Assembly, Take-up Reel	94053-000
58	Printed Circuit Board Assembly, Logic	94061-001
59	Motor Brake Assembly, Supply Reel	94053-001
60	Belt, Counter	86631-030
61	Base, Reel Rest	92818-001
62	Counter Assembly	94049-000
63	Screw, Self-tap, No. 4-24 x 1/4	51842-001
64	Bracket	92808-000
65	Switch, DPDT (S1, S2)	57471-003
66	Ring, Grip	50016-005
67	Washer, Flat, Nylon	50013-061
68	Ring, Retaining	50016-003
69	Washer, Flat, Non-Metallic 1/4"	52187-011
70	Spring, Cue Cam	54353-000
71	Ring, Retaining	50016-001
72	Tape Finger Assembly, Left	92840-000
73	Tape Finger Assembly, Right	92840-001
74	Spring	54357-000
75	Screw, Truss Head, No. 4-40 x 1/2	54993-056
76	Cover, Switch Assembly	94075-000
77	Screw, No. 6-32 x 1/8"	51845-072
78	Spring, Take-up	93766-000
79	Spindle	93768-000
80	Lever Assembly, Pressure (Includes item 81)	92833-001
81	Slide, Pressure Lever (Part of item 80)	92966-000
82	Spring, Pressure Lever Release	54354-000
83	LED, Red	53626-001
84	Switch Push Button (Gray)	57474-003
85	LED, Green	53626-002
86	Staking Assembly, Deck Control Board	94033-000
87	Switch, Cycle, DPDT	57500-000
88	LED, Amber	53626-003
89	Spring, Pressure Roller Solenoid	54258-001
90	Screw, No. 4-40 x 1/4"	51845-056
91	Washer, Flat, No. 4	52186-006
92	Cam & Shaft Assembly	92817-001

Figure 3.8 Parts List (Continued)

ITEM NO.	DESCRIPTION	PART NO.
93	Tape Guide Assembly, Adjustable	92959-000
94	Lock Washer, M5	59013-012
95	Screw, M5 x 10 mm	59000-150
96	Screw, No. 8-32 x 5/16 LG	51845-112
97	Washer, Lock, Split No. 8	50086-002
98	Nut Plate	94073-000
99	Ring, Retaining	50057-006
100	Screw, M5 x 10 mm	59000-150
101	Washer, Lock, M5	59013-012
102	Gasket, Rack Mount	94082-000
103	Not Used	
104	Staking Assembly, Subplate	94023-001
105	Washer, Flat, No. 8	52186-009
106	Pin, Spring, 3/32 x 1/2"	50087-001
107	Ring, Retaining	50016-015
108	Set Screw, No. 8-32 x 1/4	51843-014
109	Solenoid Assembly (Pressure Roller, L603)	94087-000
110	Washer, Flat, 1/2	50013-073
111	Washer, Felt, 1/2 x .032	50030-108
112	Washer, Flat, 1/2	50013-107
113	Tinnerman Clip, No. 6-32	50097-025
114	Not Used	
115	Washer, Lock, Split No. 4	50086-104
116	Deck Control Switch PC Board Assembly	94038-000

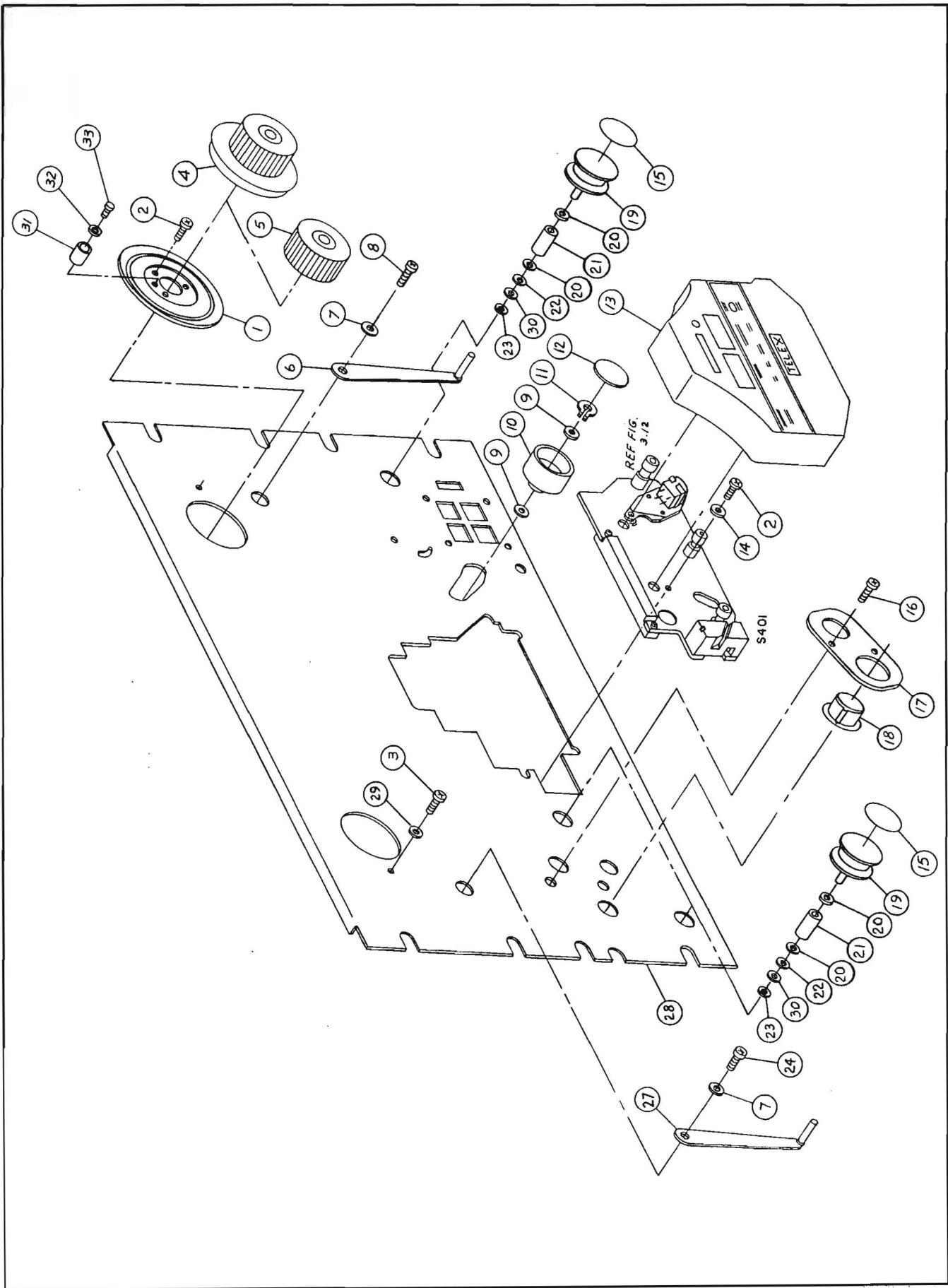


Figure 3.9 Open-Reel Front Panel Exploded View

Figure 3.9 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Rest Assembly, Reel	94057-000
2	Screw, No. 6-32 x $\frac{3}{8}$	54993-093
3	Screw, 6-32 x $\frac{1}{4}$	51845-074
4	Hold Down Assembly, 10" Reel	92982-003
5	Hold Down Assembly, 7" Reel	94598-000
*6	Stabilizer Arm Assembly	92834-002
7	Washer, Lock, No. 4	50049-103
8	Screw, No. 4-40 x $\frac{1}{4}$	54993-056
9	Washer, Fiber, $\frac{1}{4}$ "	50013-052
10	Roller, Pressure	90308-001
11	Ring, Grip	50057-001
12	Cap, Pressure Roller	90309-000
13	Cover Assembly, Head	94025-005
14	Washer, Lock, No. 6	50014-101
15	Disc, Decorative	57978-000
16	Screw, No. 4-40 x $\frac{1}{4}$ Blk	51847-111
17	Pad, Tape Cleaner	93760-000
18	Hub Assembly, Tape Cleaner	93762-000
19	Roller	92968-000
20	Washer, Fiber	86318-003
21	Housing & Bushing Assembly	92999-000
22	Washer, Wave	51439-001
23	Ring, Retaining	50057-008
24	Screw, No. 4-40 x $\frac{1}{4}$ Blk	54993-056
25	Washer, Lock, Split No. 4 Blk	50086-104
26	Washer, Flat, No. 4 Blk	52186-086
*27	Stabilizer Arm Assembly	92834-003
28	Front Panel, Master (Standard & XL)	92835-006
	Front Panel, Master (XLP)	92835-014
	Front Panel, Slave (Standard & XL)	92835-012
	Front Panel, Slave (XLP)	92835-015
29	Washer, Lock, Split No. 6	50086-001
30	Washer, Nylatron, .125 Dia	52187-026
31	Standoff, 0.25 x 0.25	57027-001
32	Washer, Lock, Split No. 6	50086-101
33	Screw, No. 6-32 x $\frac{3}{8}$	51845-093

\* Also replace the cam and shaft assembly (Figure 3.8, item 31) when renewing this part.

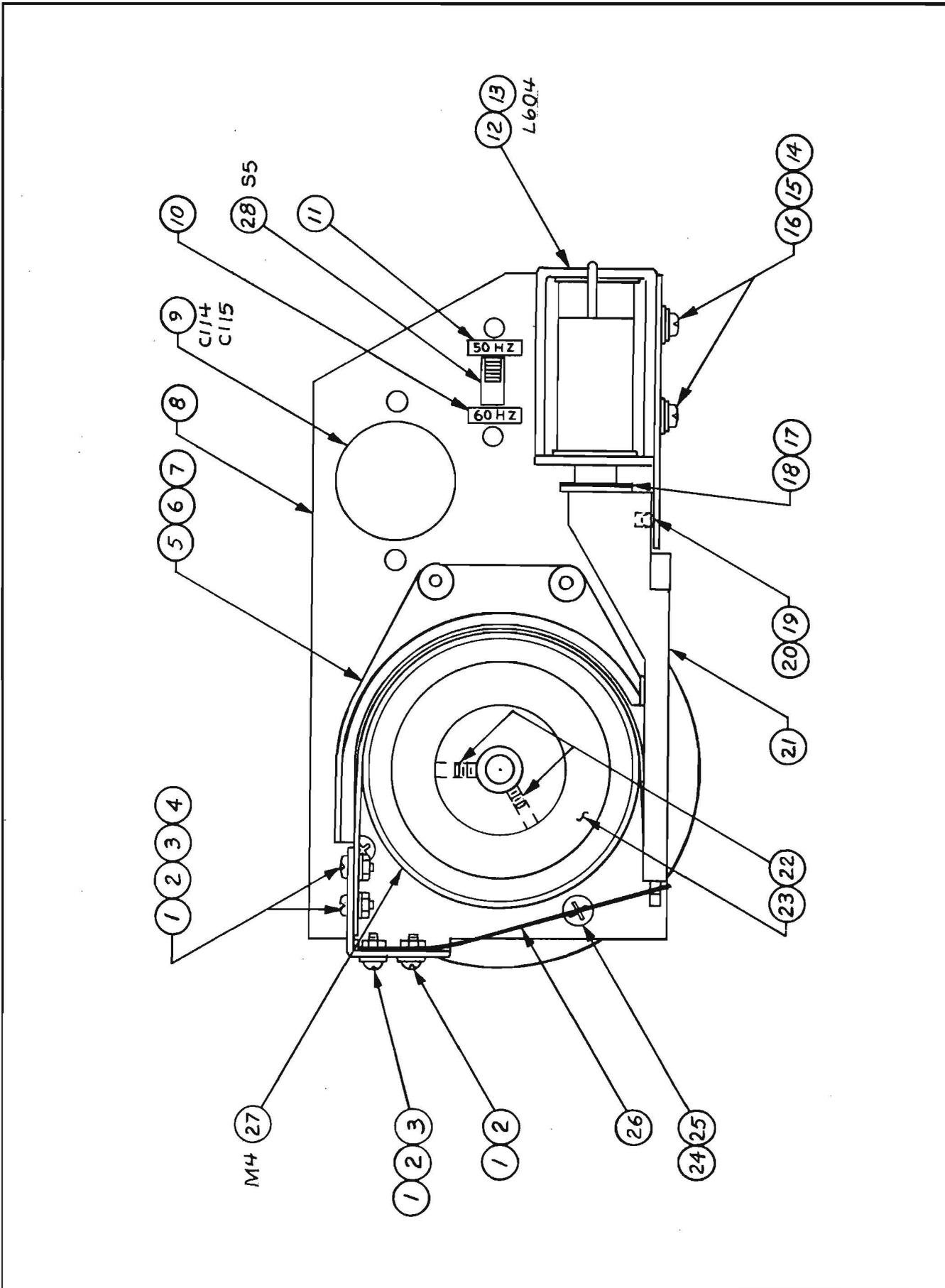


Figure 3.10 Open-Reel Capstan Motor Assembly

Figure 3.10 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Screw, No. 4-40 x 3/8	51845-039
2	Washer, Flat, No. 4	52186-006
3	Washer, Lock, Split No. 4	50086-004
4	Nut - Hex, No. 4-40	52188-006
5	Brake Stop	92841-000
6	Washer, Flat, No. 6	52186-008
7	Screw, Plastite, No. 6-19 x 1/4	51856-007
8	Brake Bracket Riveting Assembly	94588-000
9	Capacitor, Dual, 2.0 & 0.3 mfd (C114, C115)	53790-002
10	Label, 60 Hz	94097-000
11	Label, 50 Hz	94097-001
12	Solenoid (L604)	56042-000
13	Plunger, Solenoid	88017-001
14	Screw, 8-32 x 1/4 51845-110	
15	Washer, Flat, No. 8	52186-009
16	Washer, Lock, Split No. 8	50086-002
17	Washer, Felt	50030-111
18	Washer, Flat, Nylatron	50013-106
19	Steel Ball	50772-006
20	Spring	54352-000
21	Brake Band/Solenoid Link Assembly	94044-001
22	Screw, Set No. 10-32 x 3/8	51843-021
23	Flywheel, Brake Assembly	93765-000
24	Screw, M4 x 10 mm	59000-111
25	Washer, Lock, Split, M4	59013-002
26	Brake Spring Riveting Assembly	94042-000
27	Motor Wiring Assembly, 6120 50/60 Hz (M4)	94624-000
28	Switch, Slide (S5)	35556-000

94587, Rev G

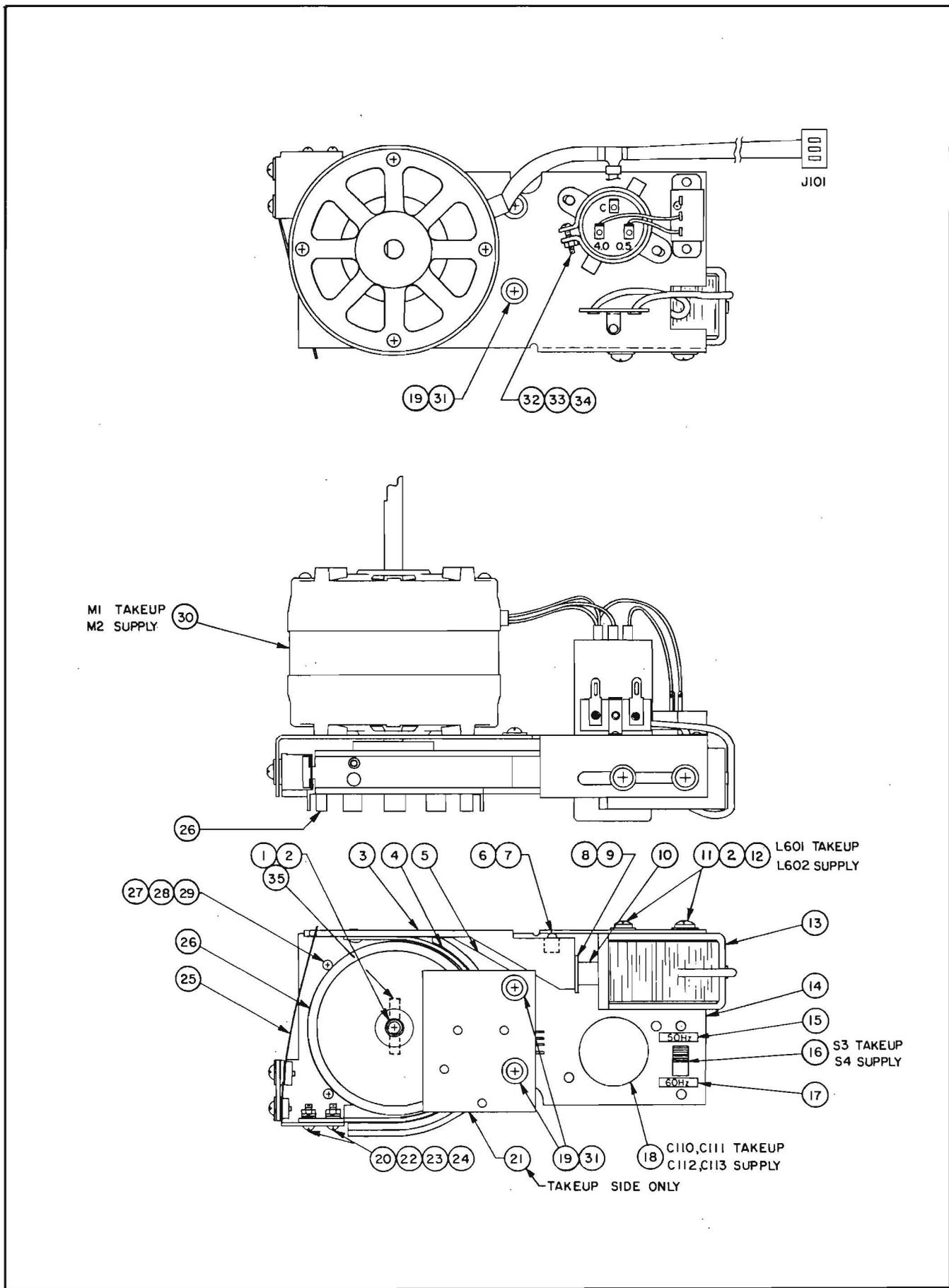


Figure 3.11 Open-Reel Spooling Motor/Brake Assembly

Figure 3.11 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Screw, 8-32 x 1/2	51845-113
2	Washer, Flat, No. 8	52186-009
3	Brake Band, Solenoid Link Assembly	94044-000
4	Felt Strip	94113-000
5	Brake Stop (Take-up)	92841-001
	Brake Stop (Supply)	92841-000
6	Steel Ball	50772-006
7	Spring	54352-000
8	Washer, Felt	50030-111
*9	Washer, Flat, Nylatron, 0.010	50013-106
10	Plunger	88017-001
11	Screw, 8-32 x 1/4	51845-110
12	Washer, Lock, No. 8	50086-002
13	Solenoid (L601, L602)	56042-000
**14	Bracket, Brake Riveting Assembly, Take-up Motor	94048-000
	Bracket, Brake Riveting Assembly, Supply Motor	94048-001
15	Label, 50 Hz	94097-001
16	Switch, Slide (S3, S4)	35556-000
17	Label, 60 Hz	94097-000
18	Capacitor, Dual, 4, 0 and 0.5 mfd, 250 Vac (C110-C113)	53792-002
19	Screw, Plastite, 6-19 x 1/2	51856-008
20	Washer, Flat, No. 4	52186-006
21	Board Assembly, Direction Sensor (Take-up Motor Side Only)	92973-000
22	Screw, 4-40 x 3/8	51845-039
23	Washer, Lock, No. 4	50086-004
24	Nut, Hex, 4-40	52188-006
25	Spring Brake Riveting Assembly	94042-000
26	Brake Drum Assembly (with Lining)	94094-000
	Brake Lining (for item 26)	52324-002
	Double-Sided Tape (to attach Lining)	00043-009
27	Screw, M4 x 10 mm	59000-111
28	Washer, Lock, M4	59013-002
29	Washer, Flat, M4	59002-009
30	Motor Wiring Assembly, Take-up	94045-001
	Motor Wiring Assembly, Supply	94045-000
31	Washer, Flat, No. 6	52186-008
32	Screw, Phms, 4-40 x 1/2	51845-041
33	Washer, Lock, No. 4	50086-004
34	Nut, Hex, 4-40	52188-006
35	Dowel Pin	50088-023

\* Add item 9 as required to prevent solenoid plunger from bottoming.

\*\* Item 14 includes items 16, and 31-34.

94053, Rev L  
 94094, Rev B  
 94048, Rev B

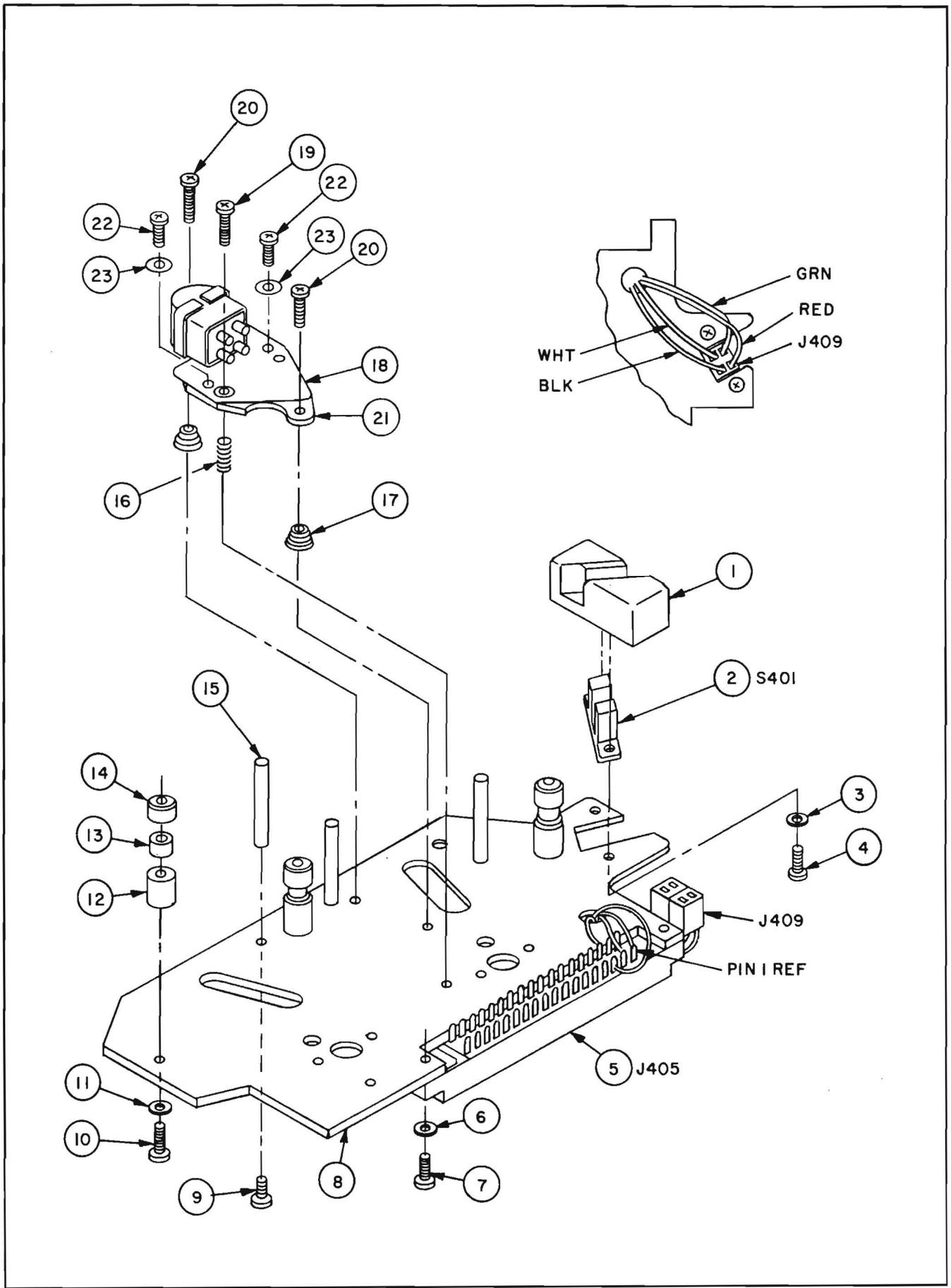


Figure 3.12 Open-Reel Head Plate Exploded View

Figure 3.12 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Cover, Tape Sensor	92804-000
2	Switch, Optical S401	57493-000
3	Washer, Lock, I.T. No. 4	50014-102
4	Screw, No. 4-20 x 3/4 THD Form	51856-024
5	Connector Assembly, Head Plate	95306-004
6	Washer, Lock, I.T. No. 4	50014-002
7	Screw, No. 4-40 x 1/2	51845-041
8	Head Plate Subassembly, Play	94107-001
	Head Plate Subassembly, Record	94107-002
9	Screw, No. 4-40 x 1/4	51845-038
10	Screw, No. 6-32 x 1"	51845-080
11	Washer, Lock, I.T. No. 6	50014-001
12	Tape Guide, Lower	84468-001
13	Tape Guide, Spacer	52464-000
14	Tape Guide, Upper	84470-000
15	Tape Guide, Capstan Relief	82291-003
16	Spring, Azimuth	90240-000
17	Spring, Head Mount	90241-000
*18	Bracket/Head Assembly, Half Track, 2 Ch Play	87620-033
	Bracket/Head Assembly, Quarter Track, 4 Ch Play	87620-032
	Bracket/Head Assembly, Half Track, 2 Ch Record	87620-034
	Bracket/Head Assembly, Quarter Track, 4 Ch Record	87620-035
19	Screw, No. 2-56 x 1/2 (Pan Head)	51845-005
20	Screw, No. 2-56 x 1/2 (Flat Head)	51847-004
	Head Plate Assembly Complete, 2 Track, Play	94028-017
	Head Plate Assembly Complete, 4 Track, Play	94028-016
	Head Plate Assembly Complete, 2 Track, Record	94028-015
	Head Plate Assembly Complete, 4 Track, Record	94028-014
21	Block, Head Mounting	87867-000
22	Screw, No. 2-56 x 3/16	51845-001
23	Washer	52186-044
	Head Plate Assembly Complete, 2 Track, Play	94028-017
	Head Plate Assembly Complete, 4 Track, Play	94028-016
	Head Plate Assembly Complete, 2 Track, Record	94028-015
	Head Plate Assembly Complete, 4 Track, Record	94028-014
24	Head Bracket	87874-000
25	Head, 2 Track, Play	55768-000
	Head, 4 Track, Play	55767-000
	Head, 2 Track, Record	55769-000
	Head, 4 Track, Record	55771-000

\* Item 18 includes items 21-25.

87620, Rev G  
94028, Rev M1

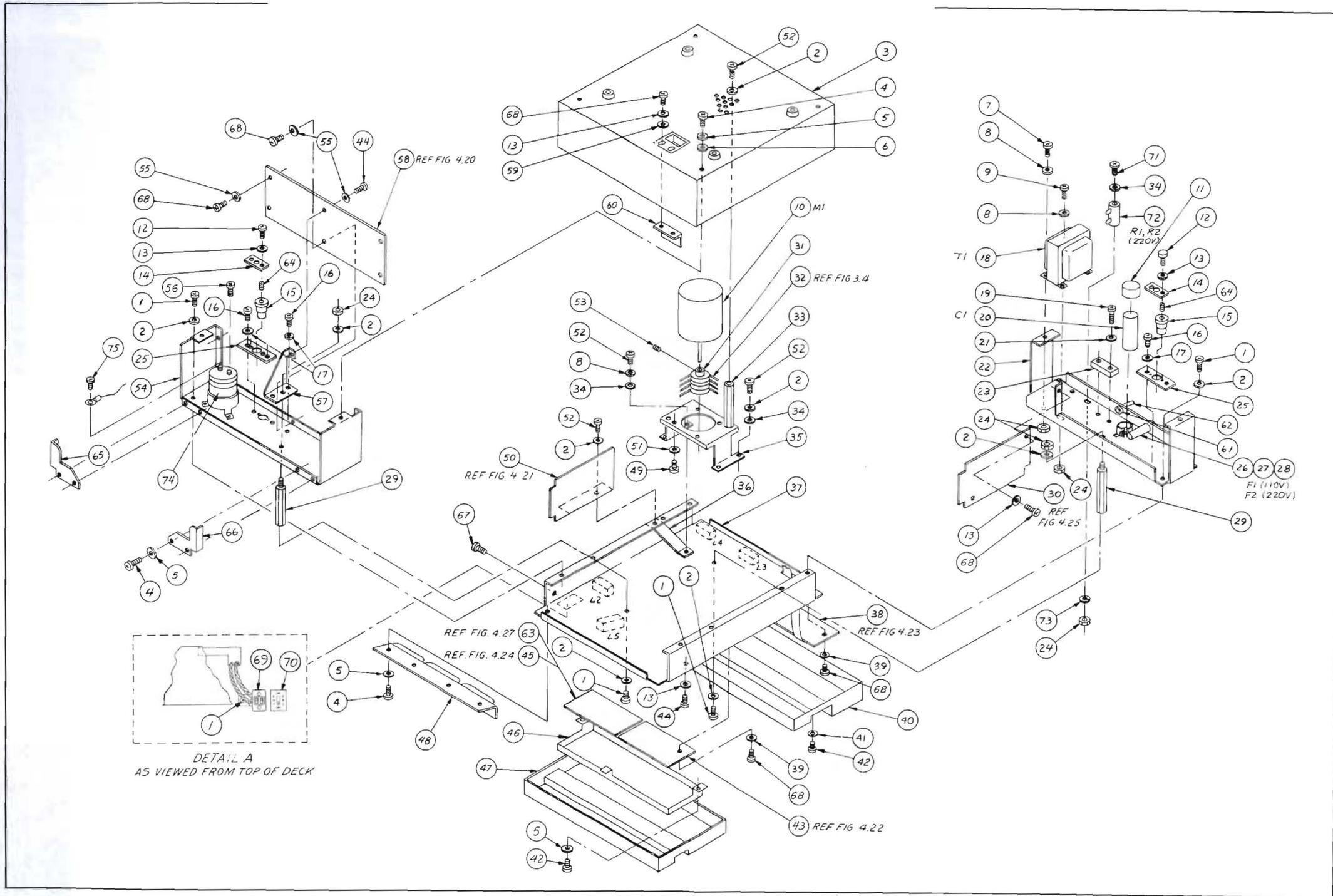


Figure 3.13 Cassette Main Chassis Exploded View

Figure 3.13 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Screw, No. 8-32 x 1/4	51845-128
2	Washer, Lock, No. 8	50086-002
3	Cover Assembly, Bottom	92527-000
4	Screw, No. 6-32 x 3/8	51845-075
5	Washer, Lock, No. 6	50086-101
6	Washer, No. 6	52186-008
7	Screw, No. 8-32 x 1/4 LG	51845-110
8	Washer, Lock, No. 8	50049-002
9	Screw, No. 8-32 x 5/16 LG	51845-112
10	Motor, w/Connector	94621-000
11	Cap, 13/16 Dia	85265-009
12	Allen HD Cap Screw, No. 4-40 x 1/2	51401-033
13	Washer, Lock, No. 4	50086-004
14	Washer Plate Bearing	92653-001
15	Bearing Assembly, Lower (Old Version)	92676-000
*	Holder, Thrust Screw (New Version)	94123-000
16	Screw, No. 6-32 x 1/4 LG	51845-074
17	Washer, Lock, Split No. 6	50086-001
18	Transformer Assembly (110V)	94603-002
	Transformer Assembly (220V)	94603-003
19	Screw, No. 4-40 x 3/8 LG	51845-042
20	Capacitor, 5 μF, Electrolytic	53792-002
21	Washer, Lock, No. 4	50086-004
22	Riveting Assembly, Bracket, Rear	94608-000
23	Terminal Block	50099-001
24	Hex Nut, No. 8-32	52188-009
25	Locator, Bearing	92677-001
26	Fuse Holder	57074-005
27	Fuse Cap (220V)	57074-007
	Fuse Cap (110V)	57074-006
28	Fuse, Metric 0.6A (220V)	56676-005
	Fuse, Slow-Blow 1.25A (110V)	50547-159
29	Support, Standoff	92568-000
30	Logic Board Assembly	94526-000
31	Motor Pulley, Slave (Standard & XL)	92749-000
	Motor Pulley, Master (Standard & XL)	92749-002
	Motor Pulley, Slave (XLP)	96247-000
	Motor Pulley, Master (XLP)	96248-000
32	Drive Belt (Standard & XL)	52571-012
	Drive Belt (XLP)	52571-016
33	Standoff, Motor Mtg Support	92569-000
34	Washer, Flat, No. 8	52186-009
35	Bracket, Motor	92721-001
36	Brace, Motor	92566-000
37	Cassette Deck, Staked (Master)	92725-002
	Cassette Deck, Staked (Slave)	92725-000
38	Distribution/Control Board Assembly, Bias (2 Channel)	94538-001
	Distribution/Control Board Assembly, Bias (4 Channel)	94538-000
39	Washer, Lock, No. 4, Int. Tooth	50014-002
40	Cover, Head (4 Channel)	92823-000
	Cover, Head (2 Channel)	92823-001

\*New Version will have a bearing retainer mounted next to capstan shaft on tape deck.

Figure 3.13 Parts List (Continued)

ITEM NO.	DESCRIPTION	PART NO.
41	Washer, Lock, Int. No. 6	50014-101
42	Screw, No. 6-32 x 3/16 (Black)	51845-091
43	Playback Preamplifier Board Assembly, 2 Channel (Standard)	94532-001
	Playback Preamplifier Board Assembly, 4 Channel (Standard)	94532-000
	Playback Preamplifier Board Assembly, 2 Channel (XL)	94532-003
	Playback Preamplifier Board Assembly, 4 Channel (XL)	94532-002
	Playback Preamplifier Board Assembly, 2 Channel (XLP)	94532-005
	Playback Preamplifier Board Assembly, 2 Channel (XLP)	94532-004
44	Screw, No. 4-40 x 3/8	51845-039
45	Master Bias Distribution Board Assembly (2 Channel)	94541-001
	Master Bias Distribution Board Assembly (4 Channel)	94541-000
46	Shield Assembly	94116-000
47	Cover, Head (Master)	92823-002
	Cover, Head (Slave)	92823-003
48	Bracket Assembly, Cassette Spring	94617-000
49	Screw, No. 10-32 x 3/8	51845-147
50	Power Supply/Oscillator Board Assembly	94529-000
51	Washer, Lock, No. 10	50086-003
52	Screw, No. 8-32 x 3/8 LG	51845-111
53	Set Screw, No. 10-32 x 1/4 LG	51843-020
54	Riveting Assembly, Front PC Bracket	94613-000
55	Washer, Lock, Split No. 4	50086-004
56	Screw, No. 10-32 x 1/4 LG	51845-146
57	PC Bracket	94570-001
58	Master Mother/Record Amplifier Board Assy, 2 Ch (Standard)	94523-001
	Master Mother/Record Amplifier Board Assy, 4 Ch (Standard)	94523-000
	Slave Mother/Record Amplifier Board Assy, 2 Ch (Standard)	94523-003
	Slave Mother/Record Amplifier Board Assy, 4 Ch (Standard)	94523-002
	Master Mother/Record Amplifier Board Assy, 2 Ch (XL)	94523-007
	Master Mother/Record Amplifier Board Assy, 4 Ch (XL)	94523-006
	Slave Mother/Record Amplifier Board Assy, 2 Ch (XL)	94523-011
	Slave Mother/Record Amplifier Board Assy, 4 Ch (XL)	94523-010
	Master Mother/Record Amplifier Board Assy, 2 Ch (XLP)	94523-009
	Master Mother/Record Amplifier Board Assy, 4 Ch (XLP)	94523-008
	Slave Mother/Record Amplifier Board Assy, 2 Ch (XLP)	94523-013
	Slave Mother/Record Amplifier Board Assy, 4 Ch (XLP)	94523-012
59	Washer, Flat, No. 4	52186-006
60	Cable Clamp	92509-001
61	Strain Relief	50489-025
62	Power Cord	52130-002
63	Slave Bias Distribution Board Assembly, 2 Channel	94535-001
	Slave Bias Distribution Board Assembly, 4 Channel	94535-000
64	Screw, Thrust, 1/4-28	51377-001
65	Chassis Bracket	92672-000
66	Chassis Bracket	92672-001
67	Screw, No. 6-32 x 3/8	50959-001
68	Screw, No. 4-40 x 1/4	51845-038
69	Switch & Bracket Assembly	93806-000
70	Label	58138-000
71	Screw, Machine, No. 8-32 x 2 1/4	51845-123
72	Resistor, 20, 20 Watt, ±5% (R1, R2)	50500-310
73	Washer, Lock, Split, No. 8	50014-003
74	Capacitor, Electrolytic, 2700 μF, 50V	52688-000
75	Screw, No. 10-32 x 1/4	51845-146

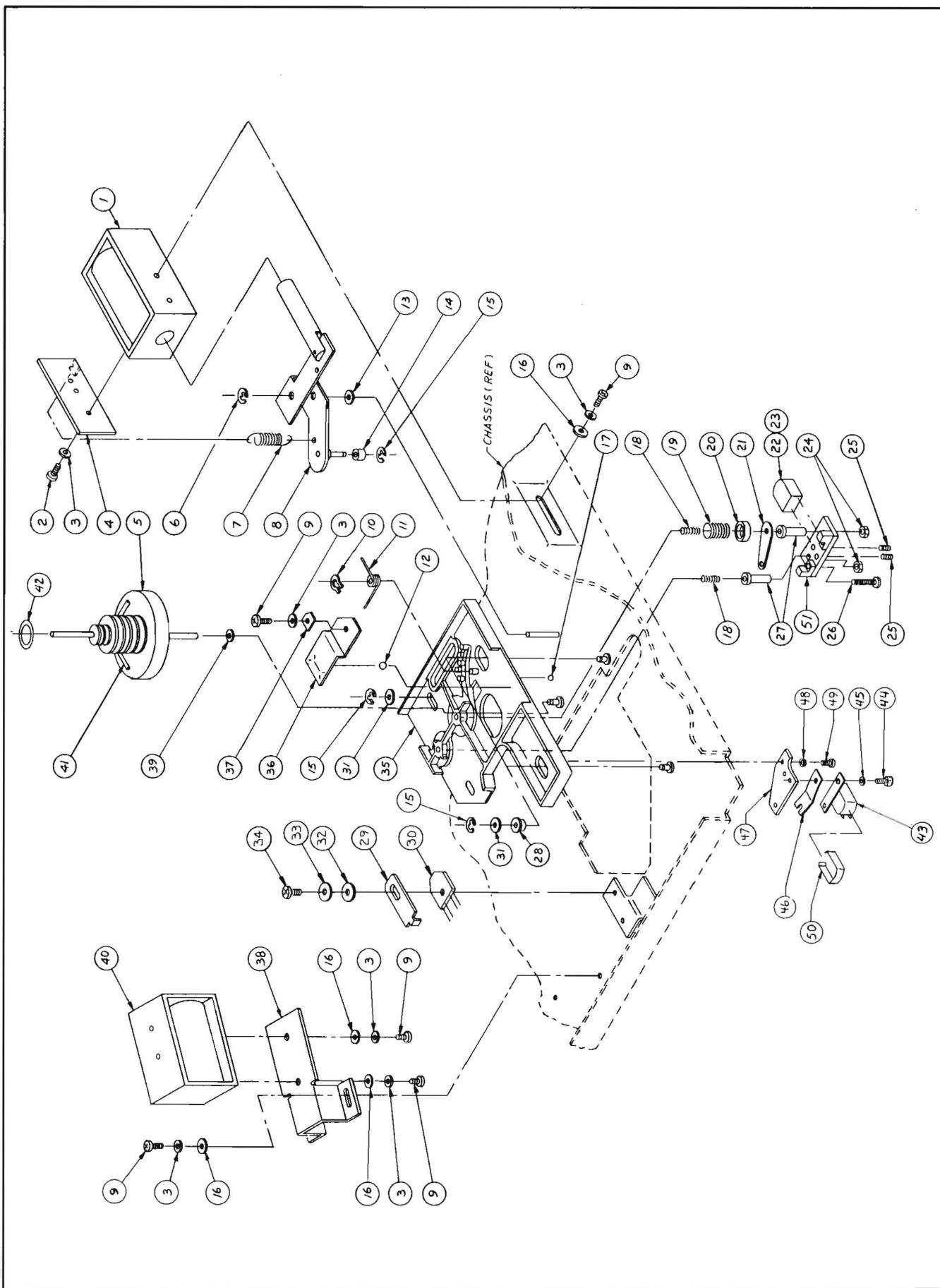


Figure 3.14 Cassette Head Plate Exploded View - Master Position

Figure 3.14 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Solenoid, Copy	93770-003
2	Screw, No. 8-32 x 3/16	51845-109
3	Washer, Lock, No. 8	50049-002
4	Bracket, Spring	94877-001
5	Flywheel Assembly, Capstan	94126-000
6	Retaining Ring, 3/16	86315-004
7	Spring, Head Slide	54362-000
8	Actuator Assembly	92646-001
9	Screw, No. 8-32 x 1/4 (Black)	51845-128
10	Grip Ring, 1/8	50057-008
11	Spring, Pressure Roller	92765-000
12	Ball Bearing, 1/8 Dia	50772-003
13	Washer, Nylon, 3/16	50013-009
14	Roller, Actuator	86341-000
15	Retaining Ring, 3/32	86315-003
16	Washer, Flat, No. 8	52186-009
17	Ball Bearing, 3/32 Dia	50772-002
18	Spring	92744-000
19	Spring	92743-000
20	Spring, Cup	92742-000
21	Head Plate	92188-000
22	Head, 2 Channel, Play (Standard)	92189-002
	Head, 2 Channel, Play (XL & XLP)	55800-000
	Head, 4 Channel, Play (Standard)	92189-007
	Head, 4 Channel, Play (XL)	55802-000
	Head, 4 Channel, Play (XLP)	55805-000
23	Mount, Head	92190-000
24	Nut, Self Locking	86324-000
25	Set Screw	54996-001
26	Screw, Azimuth	51401-045
27	Spring, Compressor	92741-000
28	Roller, Head Plate	86333-000
29	EOT Clip	90689-000
30	EOT Sensor	57515-000
31	Washer, Nylatron, 3/32	50013-040
32	Washer, Flat, No. 4	52186-006
33	Washer, Lock, No. 4	50086-004
34	Screw, No. 4-40 x 3/8	51845-039
35	Head Slide Plate, Staked	92745-000
36	Spring, Hold Down	86308-000
37	Plate Spring Support	86343-000
38	Bracket, Rewind Solenoid	92710-001
39	Washer, Nylon, 1/8"	50013-017
40	Solenoid, Rewind	93770-004
41	Belt, Take-up	52571-008
42	Belt, Drive, Round	52571-006
43	Head, Dummy	55673-000
44	Screw, No. 2-56 x 1/4	51401-061
45	Washer, Flat, No. 2	52186-004
46	Spring	95222-001
47	Plate	94669-000
48	Washer, Lock, No. 2	50086-005
49	Screw, No. 2-56 x 3/16	51845-001
50	Static Shield	88187-000
51	Mount, Head	92190-000

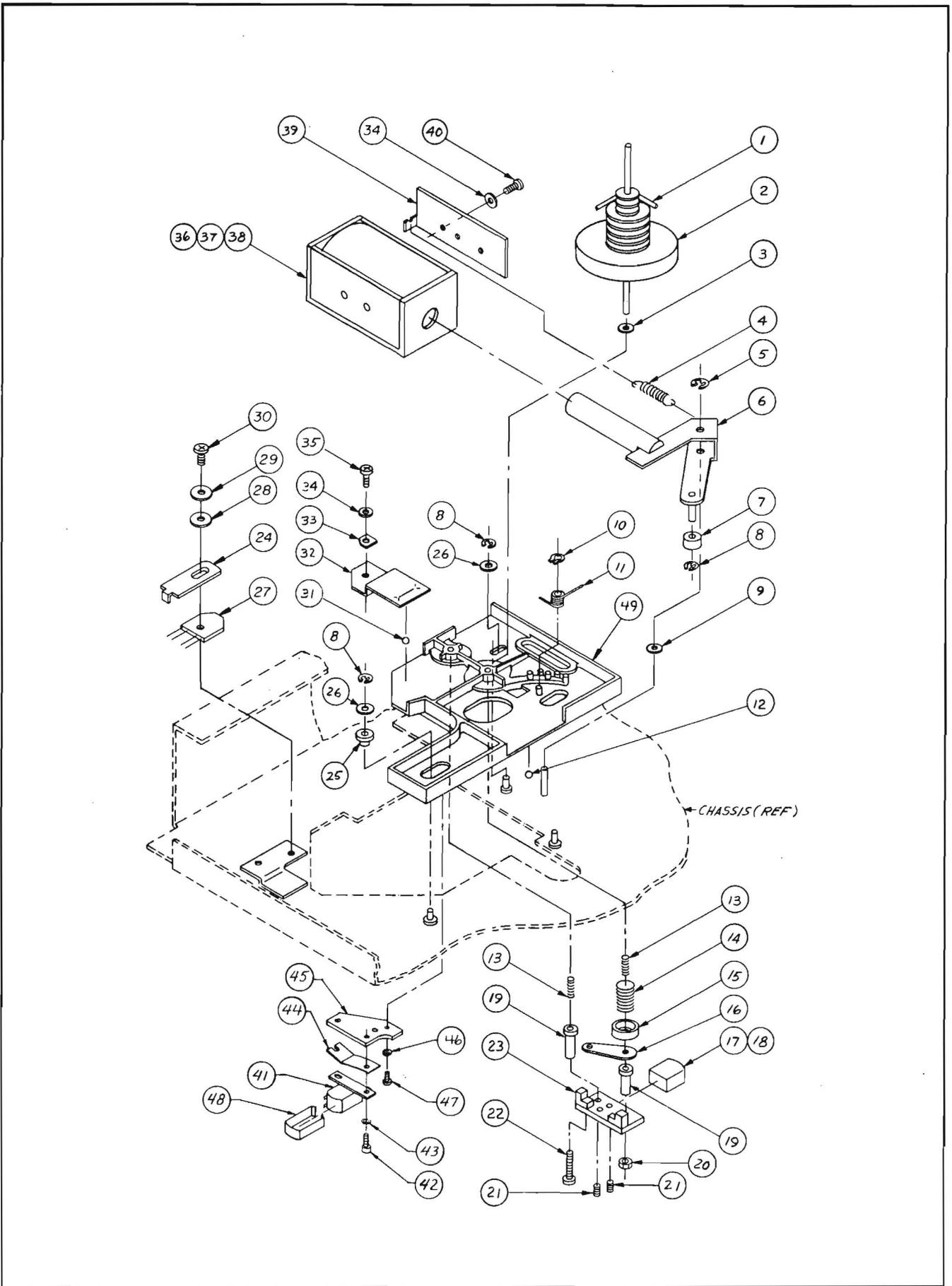


Figure 3.15 Cassette Head Plate Exploded View - Slave Position

Figure 3.15 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Belt, Clutch	52571-009
2	Flywheel Assembly, Capstan	94126-000
3	Washer, Nylon, 1/8	50013-017
4	Spring, Head Slide Plate	54362-000
5	Retaining Ring, 3/16	86315-004
6	Actuator Assembly	92646-000
7	Roller, Actuator	86341-000
8	Retaining Ring, 3/32	86315-003
9	Washer, Nylon, 3/16	50013-009
10	Grip Ring, 1/8	50057-008
11	Spring, Pressure Roller	92765-000
12	Ball Bearing, 3/32 Dia	50772-002
13	Spring	92744-000
14	Spring	92743-000
15	Spring, Cup	92742-000
16	Head Plate	92188-000
17	Head, 2 Channel, Record (Standard)	92189-008
	Head, 2 Channel, Record (XL & XLP)	55801-000
18	Head, 4 Channel, Record (Standard)	92189-005
	Head, 4 Channel, Record (XL & XLP)	55803-000
19	Spring, Compressor	92741-000
20	Nut, Self Locking	86324-000
21	Set Screw	54996-001
22	Screw, Azimuth	51401-045
23	Mount, Head	92190-000
24	EOT Clip	90689-000
25	Roller, Head Plate	86333-000
26	Washer, Nylatron, 3/32	50013-040
27	EOT Sensor	57515-001
28	Washer, Flat, No. 4	52186-006
29	Washer, Lock, No. 4	50086-004
30	Screw, No. 4-40 x 1/8	51845-039
31	Ball Bearing, 1/8 Dia	50772-003
32	Spring, Hold Down	86308-000
33	Plate, Spring Support	86343-000
34	Washer, Lock, No. 8	50086-002
35	Screw, No. 8-32 x 1/4	51845-128
36	Solenoid, Copy (Brn Wire)	93770-000
37	Solenoid, Copy (Red Wire)	93770-001
38	Solenoid, Copy (Orn Wire)	93770-002
39	Bracket, Spring	94877-000
40	Screw, No. 8-32 x 3/16	51845-109
41	Head, Dummy	55673-000
42	Screw, No. 2-56 x 1/4	51401-061
43	Washer, Flat, No. 2	52186-004
44	Spring	95222-001
45	Plate	94669-000
46	Washer, Lock, No. 2	50086-005
47	Screw, No. 2-56 x 3/16	51845-001
48	Static Shield	88187-000
49	Head Slide Plate, Staked	92745-000

92673, Rev AA

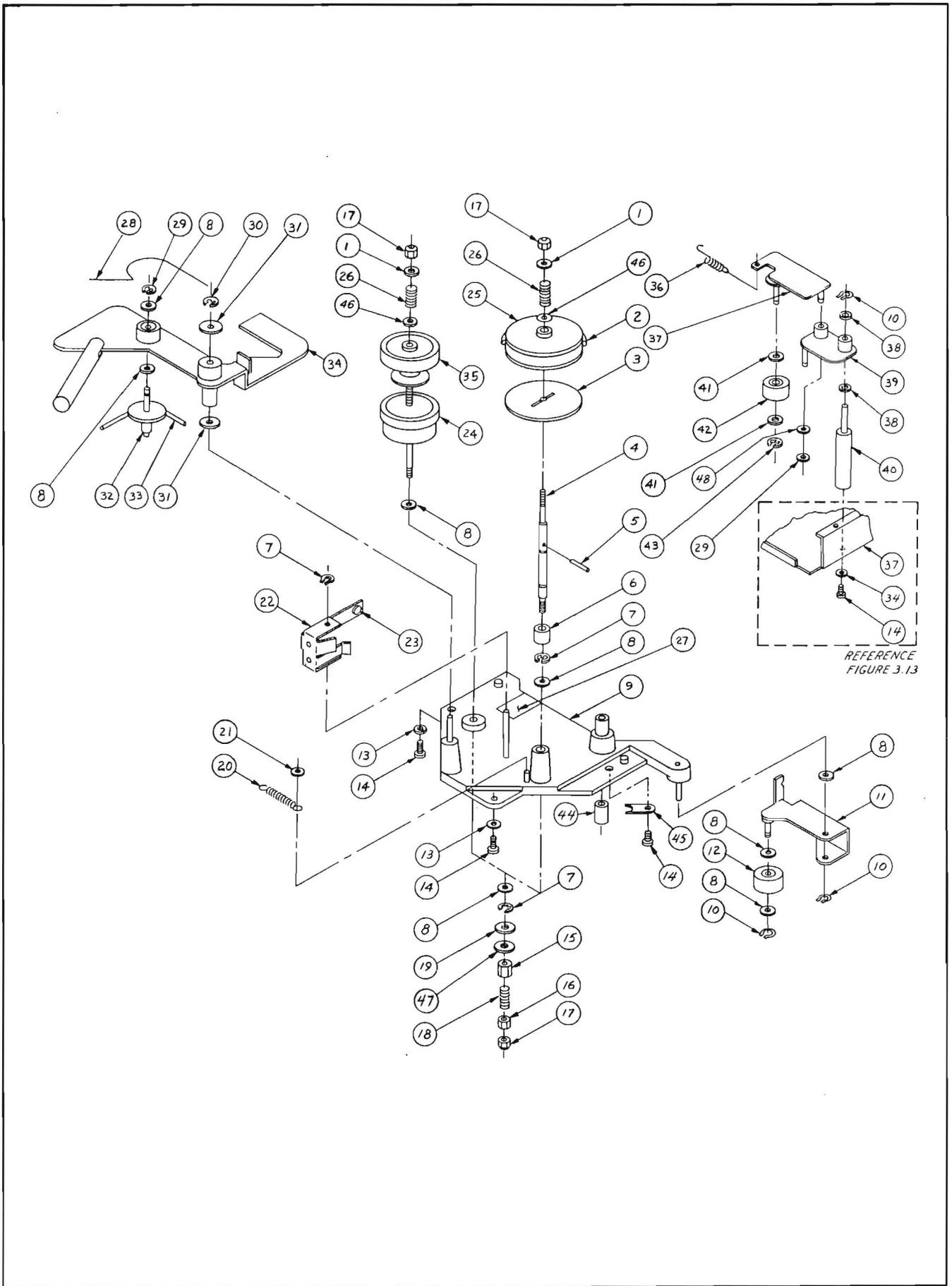


Figure 3.16 Cassette Capstan Bearing Plate Exploded View - Master Position

Figure 3.16 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Washer, Flat, Fishpaper	86318-004
2	Tire, Rewind	52571-007
3	Clutch Disc	86378-000
4	Shaft, Take-up	92757-000
5	Pin	86398-000
6	Spacer, Round	87992-001
7	E-Ring	86315-001
8	Washer, Fiber	86318-003
9	Plate Assembly, Capstan Bearing, Master	92758-002
10	Grip Ring, 1/8 Dia	50057-008
11	Lever Assembly, Pressure Roller	92715-000
12	Bearing Assembly, Pressure Roller	86399-000
13	Washer, Lock, No. 6	50086-101
14	Screw, No. 6-32 x 3/16 (Black)	51845-091
15	Spindle, Drive	86376-000
16	Sleeve	84898-000
17	Nut, Self Locking	86324-000
18	Spring	84932-000
19	Washer, Flat, Metallic	52186-007
20	Spring, Brake Lever	86442-000
21	Push Nut, 3/32	51900-001
22	Lever, Brake	92756-000
23	Bumper	52311-000
24	Feed Reel Drum, Rewind	92746-001
25	Pulley Assembly, Take-up	92730-000
26	Spring, Clutch, Rewind	86420-001
27	Shim	92565-000
28	Spring, Rewind Lever	54361-000
29	E-Ring	86315-001
30	Retaining Ring	86315-002
31	Washer, Nylatron	50013-007
32	Drive Assembly, Rewind (Standard & XL)	92733-000
	Drive Assembly, Rewind (XLP)	92733-001
33	Rewind Beld	52571-008
34	Lever, Rewind	92737-000
35	Pulley & Bushing Assembly	92567-000
36	Spring	86442-000
37	Shaft Assembly, Take-up Arm	94565-000
38	Washer, Nylatron	50013-037
39	Control Arm	94576-000
40	Standoff Assembly, Dowel	93756-000
41	Washer, Nylatron	50013-036
42	Roller & Bearing Assembly	87626-001
43	E-Ring	50016-008
44	Bushing	50001-037
45	Retainer, Bearing	94127-000
46	Washer, Flat, Fishpaper	86318-001
47	Washer, Lock, No. 5, Int. Tooth	50014-013
48	Washer, Fiber	86318-005

92716, Rev R  
92673, Rev AA  
93764, Rev D  
93575, Rev C

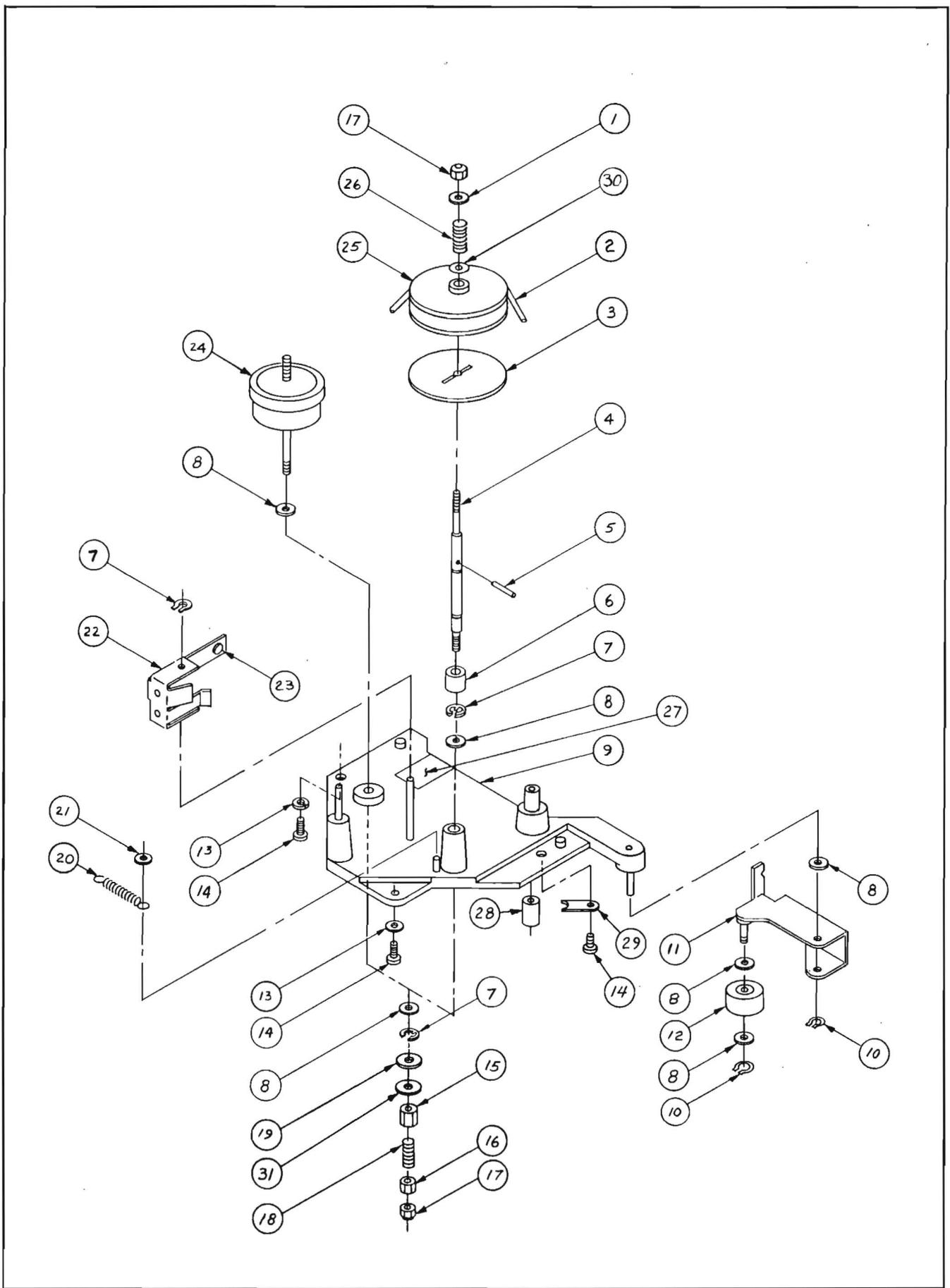


Figure 3.17 Cassette Capstan Bearing Plate Exploded View - Slave Position

Figure 3.17 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Washer, Flat, Fishpaper	86318-004
2	Belt, Clutch	52571-009
3	Disc, Clutch	86378-000
4	Shaft, Take-up	92757-000
5	Pin	86398-000
6	Spacer, Round	87992-001
7	E-Ring	86315-001
8	Washer, Fiber	86318-003
9	Bearing Plate, Capstan	92758-003
10	Grip Ring, 1/8 Dia	50057-008
11	Lever Assembly, Pressure Roller	92715-000
12	Bearing Assembly, Pinch Roller	86399-000
13	Washer, Lock, No. 6	50086-101
14	Screw, No. 6-32 x 3/16 (Black)	51845-091
15	Spindle, Drive	86376-000
16	Sleeve	84898-000
17	Nut, Self Locking	86324-000
18	Spring	84932-000
19	Washer, Flat, Metallic	52186-007
20	Spring, Brake Lever	86442-000
21	Push Nut, 3/32	51900-001
22	Lever, Brake	92756-000
23	Bumper	52311-000
24	Feed Reel Drum	92746-000
25	Pulley Assembly, Take-up	92730-000
26	Spring, Clutch	86420-000
27	Shim	92565-000
28	Bushing, Oil	50001-037
29	Retainer, Bearing	94127-000
30	Washer, Flat, Fishpaper	86318-001
31	Washer, Lock, No. 5, Int. Tooth	50014-013

92716, Rev R  
92673, Rev AA

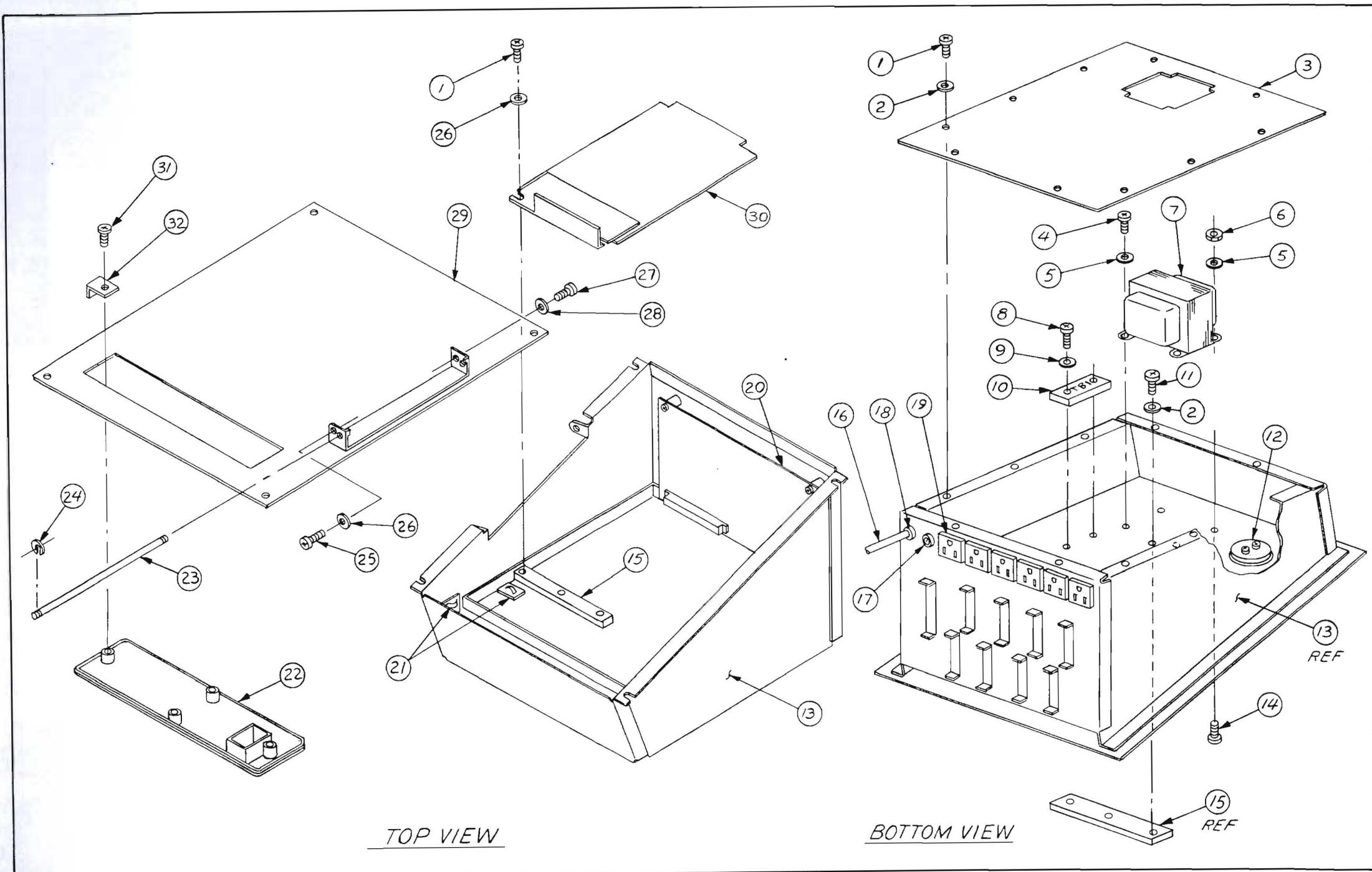


Figure 3.18 Expansion Module Chassis Exploded View

Figure 3.18 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Screw, 6-32 x 1/4	51845-074
2	Lockwasher, Split, No. 6	50086-001
3	Cover, Bottom	92667-001
4	Screw, 8-32 x 1/4	51845-110
5	Lockwasher, No. 8	50086-002
6	Hex Nut, No. 8	52188-009
7	Transformer Assembly (110V)	94603-000
	Transformer Assembly (220V)	94603-001
8	Screw, 4-40 x 5/8	51845-042
9	Lockwasher, Split, No. 4	50086-004
10	Block, Terminal	50099-001
11	Screw, 6-32 x 3/16	51845-073
12	Capacitor, 2700 $\mu$ F, 50V	52688-000
13	Box Subassembly, Expansion (110V)	92939-002
	Box Subassembly, Expansion (220V)	92939-003
14	Screw, 8-32 x 3/8	51845-111
15	Heat Sink	92998-000
16	Cord, Line	52130-002
17	Fuse Cap, Metric	57074-007
	Fuse, 220V, 0.4 A, Metric	56676-003
	Fuse Cap, 110V	57074-006
	Fuse, 110V, 0.8 A	50547-132
	Fuse Holder	57074-005
18	Relief, Strain	50489-025
19	Receptacle, ac	53036-000
20	Mother Board Assembly	94682-000
21	Clip, Cord	52852-004
22	Bezel, Switch w/Label	94609-001
23	Pin, Hinge	92751-000
24	E Ring	50016-011
25	Screw, 6-32 x 1/2	51845-077
26	Lockwasher, Split, No. 6	50086-001
27	Screw, Self-Tap, 4-40 z 1/4	51849-011
28	Lockwasher, Split, No. 4	50086-004
29	Deck Plate	94605-002
30	Audio/Logic Board Assy, 2 Channel	94685-001
	Audio/Logic Board Assy, 4 Channel	94685-000
	Extension Cable, Reel Slave (Not Shown)	94496-000
	Interconnect Cable, Control Mod to Expansion Mod	94493-011
30	Audio/Logic Board Assy, 2 Channel	94685-001
31	Screw, Plastite, No. 6 x 1/4	51856-007
32	Clamp	92668-001
	Audio/Logic Board Assy, 4 Channel	94685-000
	Extension Cable, Reel Slave (Not Shown)	94496-000
	Interconnect Cable, Control Mod to Expansion Mod	94493-011

94605, Rev A

92680, Rev C



Figure 3.19 Parts List

ITEM NO.	DESCRIPTION	PART NO.
1	Staking Assembly, Rewind Deck	93788-000
2	Nut, Self-locking, No. 4-40	86324-000
3	Washer, Flat, Fishpaper	86318-006
4	Spring, Clutch	86420-000
5	Washer, Flat, Fishpaper, Black	86318-002
6	Pulley, Clutch Assembly	94645-000
7	E Ring	86315-001
8	Disc, Clutch	86378-000
9	Pin, Disc Clutch	86398-000
10	Washer, Flat	50013-034
11	Washer, V	86395-000
12	Washer, Flat, Nylon	50013-017
13	Shaft, Take-up	86906-000
14	Label, Fuse	52066-019
15	Label, Serial	52066-018
16	Cover, Bottom Rewind	93787-001
17	Spindle, Drive	86376-000
18	Spring, Compression	86419-000
19	Sleeve, Cartridge	84898-000
20	Washer, Fiber	86318-003
21	Screw, 8-32 x 3/8	51845-129
22	Lockwasher, No. 8	50086-002
23	Screw, 6-32 x 3/16	51845-091
24	Line Cord W/Plug	58338-000
25	Relief, Strain	50489-035
26	Screw, 4-40 x 3/4, Phillips	51845-061
27	Shaft, Supply	86922-000
28	Lockwasher, No. 4	50086-004
29	Nut, No. 4-40	52188-006
30	Switch Assembly	57520-000
31	Spacer, Mounting	51832-003
32	Spacer, Motor	81517-001
33	Screw, 6-32 x 1/4	51845-082
34	Motor Assembly (110V)	94646-000
	Motor Assembly (220V)	94646-001
35	Washer, Internal Tooth, No. 6	50014-001
36	Nut, Hex, 6-32	52188-008
37	Ground Wire Assembly	90009-001
38	Fan Assembly	52310-000
39	Screw, 8-32 x 1.0	51845-134
40	Washer, Flat, No. 8-32	80322-001
41	Lord Mount Assembly	50034-001
42	Plate, Motor Mount	89065-001
43	Belt, Drive	86631-000
44	Pad, Support	86929-000
45	Spring Washer	51439-001
46	Nut, Push	51900-001
47	Bearing and Bushing Assembly	86327-000

# SECTION IV

## ELECTRICAL MAINTENANCE

### 4.1 INTRODUCTION

The following paragraphs present a series of electrical checks and adjustments, thereby permitting the performance of the equipment to be verified. These procedures allow for specific performance malfunctions to be identified, thus expediting the problem location process.

Component designators (C1, J1, R1, S1) used in the text are keyed to the schematic diagrams located at the end of this section. The reference designators are also keyed to the associated parts lists.

If the Model 6120 Tape Duplicating performance parameters are within the required specifications, as outlined in paragraph 1.2, the unit can usually be assumed to be working correctly. If it fails to meet the specifications, the fault may be localized by reference to the test point data presented with major subassemblies schematic diagrams. This analysis may be supplemented, as necessary, by the individual circuit discussion outlined in Section II, Theory of Operation.

If it should become necessary to return the equipment to our factory for repair, reference Service and Repair in the front of this manual for correct handling procedure and address.

### 4.2 SPECIAL TEST EQUIPMENT

On making electronic evaluations of the Model 6120 Tape Duplicator, the test equipment used must be equal in quality to the equipment being tested. Using inferior or inaccurately calibrated equipment produces questionable results. Telex test tapes and some special equipment referred to in the following text may be obtained through Telex Parts Department. Refer to the manual Preface page for the address.

#### NOTE

Only those items with Telex P/N's are available from Telex.

The following items of test equipment are necessary to aid in accomplishing the adjustments and performance measurements outlined in this section.

1. Ac Vtvm - Ballantine Model 300H or equivalent, 1 mV sensitivity  $\pm 2\%$  accuracy, 0-200 kHz frequency response, with low capacitance probe.
2. Ac-Dc Oscilloscope - Triggered, variable horizontal 0.01 second to 1 mSecond.
3. Audio Frequency Oscillator - 20 Hz to 30 kHz, 10 mV to 10 volt.
4. PB10-27 - Special dual input test amplifier Telex P/N 86771-000.
5. PB-160 Preamplifier - Special narrow band, hi gain, tuned to reproduce 160 kHz or 133 kHz. User instruction included. Telex P/N 94694-000.
6. Tape Guide - Head alignment gauge, M-300 or equivalent. Telex P/N 56626-000.
7. Test Tapes
  - Open Reel
    1. Reference, azimuth, and frequency response. Telex P/N 87443-010 (Std, XL), Telex P/N 87443-011 (XLP)
  - Cassette
    2. 10 kHz full track azimuth alignment. Telex P/N 86524-001
    3. Multi-tone frequency response with voice announcements. Telex P/N 86524-006
    4. 333 Hz full track reference level. Telex P/N 86524-014
    5. Bias test cassette with  $\frac{1}{2}$  track 2 channel monitor head, and instructions. Telex P/N 89160-000
    6. Bias test cassette with  $\frac{1}{4}$  track 4 channel monitor head, and instructions. Telex P/N 89160-001
    7. Tape path viewing test cassette. Telex P/N 91749-000

## 4.3 ELECTRICAL ADJUSTMENT - CONTROL MODULE

### WARNING

**THE FOLLOWING ELECTRICAL ADJUSTMENTS CAN BE PERFORMED ONLY WITH AC POWER APPLIED TO THE UNIT. THEREFORE, TO PREVENT THE POSSIBILITY OF ELECTRICAL SHOCK, CAUTION MUST BE EXERCISED WHILE SERVICING.**

#### 4.3.1 AUDIO LEVEL LED INDICATOR ADJUSTMENT

After completing the open reel and master cassette-slave audio level and equalization adjustments, it is advisable to check and adjust, if necessary, the level meters on the control module.

1. Remove double-ended phone plug cables from the rear of the control module.
2. Connect an audio frequency oscillator to jack C, channel 1. Adjust for 16 kHz sine wave 200 millivolts output while plugged into jack C.
3. Set all control module audio and bias LEVEL controls to PRESET.
4. Apply ac power. Observe the LED's illumination which should stop at the "0" dB level. If above or below 0 dB, insert a narrow blade screwdriver into front access hole and adjust potentiometer for a 0 dB LED illumination.
5. Move audio frequency oscillator to jack C for each of the remaining channels and adjust, if necessary, each respective level for a 0 dB illumination.
6. Remove test equipment and reinsert double-ended phone plug cables.
7. Install test tape 7-1 or 7-4 (reference paragraph 4.2) and set up control module switches to correspond with master module being used.
8. Play the reference level section of the test tape and observe readings on level indicators. The LED's illumination should stop at "0" dB. If not, check the master tape module for correct level adjustments (reference paragraphs 4.4.3 and 4.5.4).

#### 4.3.2 BIAS OSCILLATOR ADJUSTMENTS

The system control module produces a dc voltage which is coupled to the bias oscillator circuit located on each slave module. By varying the dc voltage, the high frequency bias voltage is proportionally changed. See Section II, paragraph 2.5, for more detailed theory.

##### 4.3.2.1 Bias Preset Calibration

### NOTE

The following is a factory preset adjustment which, under normal circumstances, should not require re-alignment.

1. Place a blank cassette or reel tape on the master transport. Ac power off.
2. Place control module Transport Control COPY switch in CASS position.
3. Set all audio and bias LEVEL indicators to PRESET positions.
4. Open the system control module by folding the front panel back on its hinges to expose the bias level indicator printed circuit board.
5. Connect a vtvm to pin 5 of J5 on the printed circuit board and ground.
6. Apply ac power; activate copy. The voltage at pin 5 should be approximately 16 Vdc. If not, adjust potentiometer 5R3 until proper voltage is attained.

##### 4.3.2.2 Bias Hi Level Adjustment

Steps 1 through 6, outlined under Bias Preset Calibration, are also required for bias hi level adjust. If bias preset calibration procedure has been completed, it is necessary to perform only the following steps.

1. Move bias level control to the maximum position (top).
2. Voltage at pin 5, J5 should now read 30 Vdc. If not, adjust potentiometer 5R2 until proper voltage is attained.

##### 4.3.2.3 Bias Level Meter Calibration Adjustment

1. Place a blank cassette or reel tape on the master transport. Ac power OFF.
2. Place control module Transport Control COPY switch in CASS position.

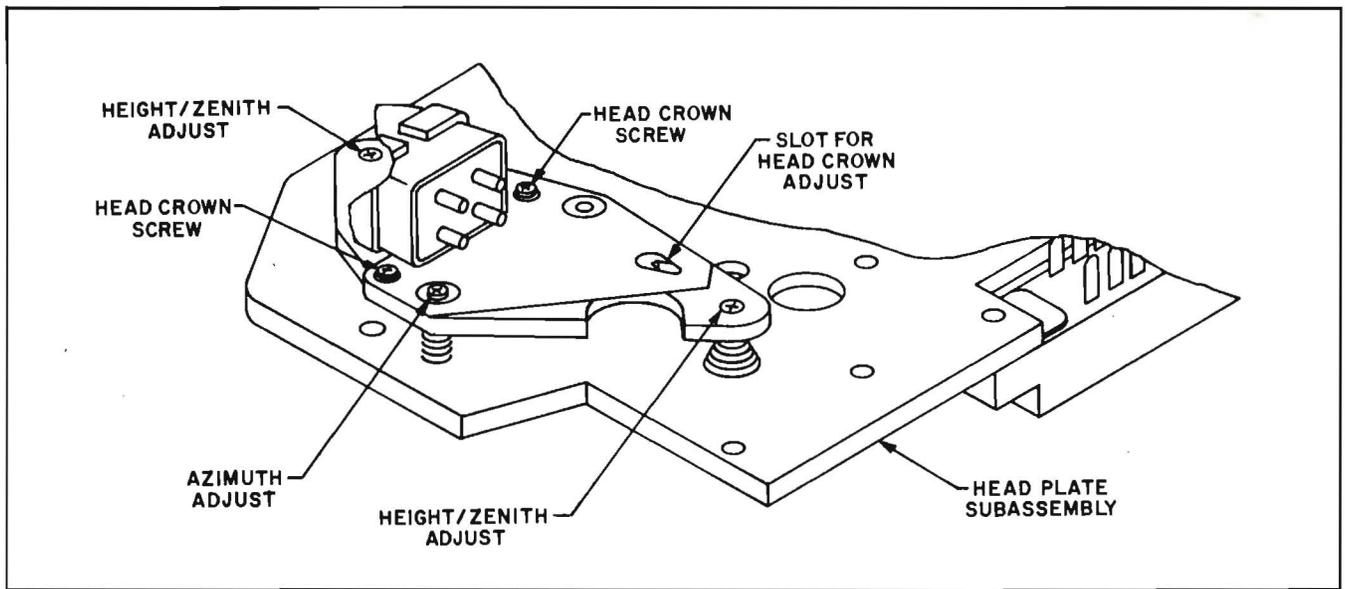


Figure 4.1 Open-Reel Head Block Assembly

3. Set audio and bias LEVEL indicators to PRESET position.
4. Apply ac power; activate copy. The "0" dB LED indicator should illuminate. If not, insert a small bladed screwdriver through the front access hole and adjust potentiometer (5R4) until "0" dB LED illuminates consistently.

#### 4.4 ELECTRICAL ALIGNMENT — OPEN REEL MODULE

##### WARNING

**THE FOLLOWING ELECTRICAL ADJUSTMENTS CAN BE PERFORMED ONLY WITH AC POWER APPLIED TO THE UNIT. THEREFORE, TO PREVENT THE POSSIBILITY OF ELECTRICAL SHOCK, CAUTION MUST BE EXERCISED WHILE SERVICING.**

##### NOTE

It is suggested, while performing the electrical alignment adjustments, that an oscilloscope be used with a vtvm so that noise, wow, flutter, and signal output can all be observed. The meter can only show output level. Also, note when using the scope, the output frequency will be higher than the normal play speed of the tape due to high system speed.

#### 4.4.1 OPERATIONAL ADJUSTMENT

For the purpose of the following discussion, it is assumed that the reel module is connected to the rear panel of the Control Module. The output voltage will be monitored by a vtvm or oscilloscope (reference paragraph 4.2) and connected to the Control Module rear panel unused phono jack A, of channel in question.

#### 4.4.2 HEAD ALIGNMENT

One of the major causes of malfunctions with magnetic equipment is head misalignment. Improper head alignment can cause several problems such as low output, poor high frequency response, cross talk and distortion. The face of the magnetic head must be parallel to the tape, while the head gap must be perpendicular to the edge of the tape and centered on the track location.

Before attempting head alignment, check to see if the head, capstan, pressure roller, tape guides, lifters, etc. have been properly cleaned. Dirty, scratched or magnetized heads may cause some of the same problems as misaligned heads.

##### NOTE

The tape heads on the open reel and cassette modules were factory pre-aligned. Readjustment of the heads **should not** be attempted unless it has definitely been determined that re-alignment is absolutely necessary. **DO NOT** attempt to re-adjust heads that have a groove worn into the face.

## NOTE

Head alignment **should not** be attempted by inexperienced personnel. The nature of these adjustments requires an individual thoroughly qualified in this area.

### 4.4.2.1 Head Alignment

## NOTE

In the event head replacement becomes necessary, **DO NOT** move the audio adjustment potentiometers on the Equalization board. The present position will serve as an audio preset adjustment.

To perform this adjustment procedure, complete the steps outlined following.

#### Height/Zenith

Height and zenith are adjusted using the same two screws, as shown in Figure 4.1.

1. Achieve a balanced height adjustment of the head, bracket and block assembly by alternately adjusting the two height/zenith adjust screws. Physical observation is the criteria in making this measurement.
2. Verify zenith and height position by orientation of pole piece(s) with respect to clear leader tape.
3. Load a standard tape on the transport. Perform any additional setting of height/zenith screws to optimize location of pole piece(s) and head with respect to magnetic tape and tape guides.

#### Head Crown (Master)

This adjustment is provided to obtain maximum head contact of pole piece(s) with magnetic tape.

1. Remove the head cover assembly. Reference Figure 3.9, 13.
2. Clean heads thoroughly with head cleaner, as outlined in paragraph 3.2.
3. Load test tape 7-1 (reference paragraph 4.2) on to the tape transport.
4. Place the transport reel size switch to correspond to the size reel being used.
5. Place the transport tape speed switch to SLOW.

6. Place the master switch on the system control module to REEL, channel 2 audio LEVEL to preset.
7. Connect vtm to the unused jack A of channel 1 (on the rear panel of the control module).
8. Apply ac power; activate copy.
9. Loosen the head crown screws (reference Figure 4.1) slightly and insert a small flat blade screwdriver into the slot provided.
10. While playing the 10 kHz azimuth section of the tape, rotate the head bracket on its pivot to obtain maximum output voltage on the vtm or oscilloscope.
11. Retighten the head crown screws.

#### Azimuth (Master)

Steps 1 through 8, outlined under Head Crown alignment, are also required for azimuth alignment. If the head crown alignment procedure has been completed, it is necessary to perform only the following additional steps.

1. Play test tape 7-1 (reference paragraph 4.2) for azimuth alignment on the tape transport.
2. Using 10 kHz portion, rotate the azimuth adjust screw (reference Figure 4.1) for a maximum indication on the vtm or oscilloscope.

## NOTE

Ensure a false peak is not achieved. Rotate the screw several turns in each direction to obtain the maximum output indication.

#### Azimuth & Head Crown (Slave)

## CAUTION

**ASSURE REEL MASTER IS IN PROPER AZIMUTH PRIOR TO THIS PROCEDURE.**

1. Disconnect cables and position console as shown in Figure 4.2A. Reconnect cables. Install blank tape as shown. Set tape speed to slow. Select correct reel size.
2. Remove jumper cables from jacks A and C on control module.

3. Connect audio frequency oscillator to jack C of channel 1 or 2. Set oscillator at 160 kHz (Std, XL) or 80 kHz (XLP), 20 millivolts as measured on vtvm when connected to load.
4. Connect a vtvm to jack A (same channel) on control module.
5. Set control module controls to reel master, reel copy, and all level indicators to preset.
6. Activate COPY. Rotate the azimuth adjust screw (reference Figure 4.1) for a maximum indication on the vtvm.

**NOTE**

Allow time for the tape to reach the playback head for the level to be indicated on the meter.

**NOTE**

Ensure a false peak is not achieved. Rotate the screw several turns in each direction to obtain the maximum output indication.

**4.4.3 PLAYBACK LEVEL ADJUSTMENT (REEL MASTER)**

**NOTE**

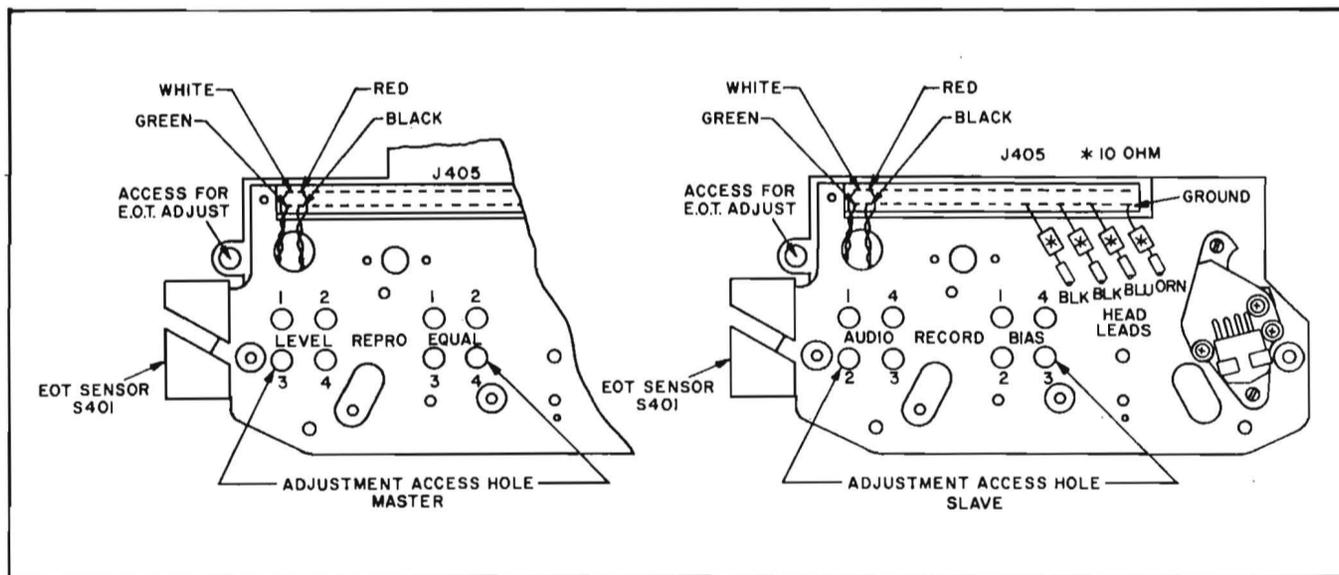
Reproduce head must be properly aligned before proceeding.

1. Remove head cover to gain access to level adjustment potentiometers (Figure 4.2).
2. Clean reproduce head (reference paragraph 3.2).

3. Connect reel master to system Control Module.
4. Set control module Transport Control MASTER switch to REEL.
5. Load test tape 7-1 (reference paragraph 4.2) on reel master.
6. Set Reel Module SPEED switch to SLOW and Reel Size switch to appropriate position.
7. Connect an ac vtvm or oscilloscope to output jack A of channel in question. (Rear panel of system control module.)
8. Set vtvm or oscilloscope for a range of 0-300 millivolts.
9. Apply ac power; activate copy.
10. While playing the reference level portion of the tape, adjust level potentiometer, Figure 4.2, for 200 millivolts.
11. Repeat procedure as necessary for other channels.

**NOTE**

Only the first portion of the tape contains the signal needed for level adjustment. Replay the first portion of tape until all level adjustments have been made.



**Figure 4.2 Accessibility of Open-Reel Adjustments**

#### 4.4.4 EQUALIZATION ADJUSTMENT — REEL MASTER

##### NOTE

Assure that reproduce head is clean and properly aligned before proceeding.

Steps 1 through 9 under Playback Level Adjustment are also required for equalization adjustment.

1. Advance the test tape to 10 kHz portion: reference 20 dB down from 200 mV playback level.
2. Play 10 kHz reference portion, covered in step 2 of Azimuth (Master) section.
3. Locate and play the 1000 Hz reference portion (20 dB down from 200 mV playback level, and note this output level. If 10 kHz output (step 2) was higher than 1000 Hz output, rotate equalization adjustment counterclockwise (Figure 4.2) until 1000 Hz level is obtained. If 1000 Hz was higher, rotate equalization adjustment clockwise until 1000 Hz level is obtained.
4. Replay the 10 kHz and 1000 Hz, -20 dB reference portions and note outputs. When properly adjusted, the two levels should be the same for both signals.
5. Repeat procedure as necessary for other channels.

#### 4.4.5 REEL SLAVE LEVEL AND BIAS CHECK

##### NOTE

The audio levels and bias levels are adjusted for Ampex 631 tape at the factory. The record amplifier and record driver circuitry can be checked for operation by using the following procedure. This is only a check. Adjustment procedures are given in section 4.4.7.

1. Ac power Off on system. Remove head cover.
2. Unsolder head ground leads from their pins on J405, and connect a 10 ohm, 1/8 watt resistor between each channel's pin and ground lead. (Reference Figure 4.2.)
3. Set audio oscillator frequency at 16 kHz (Std, XL) or 8 kHz (XLP), 100 mV. Place a 600 ohm load in series with the positive lead of oscillator output.
4. On control module, disconnect jumper cable from jack C, channel one, and connect oscillator to jack C.
5. Connect oscilloscope across 10 ohm resistor

coming from J405, pin V (channel 1).

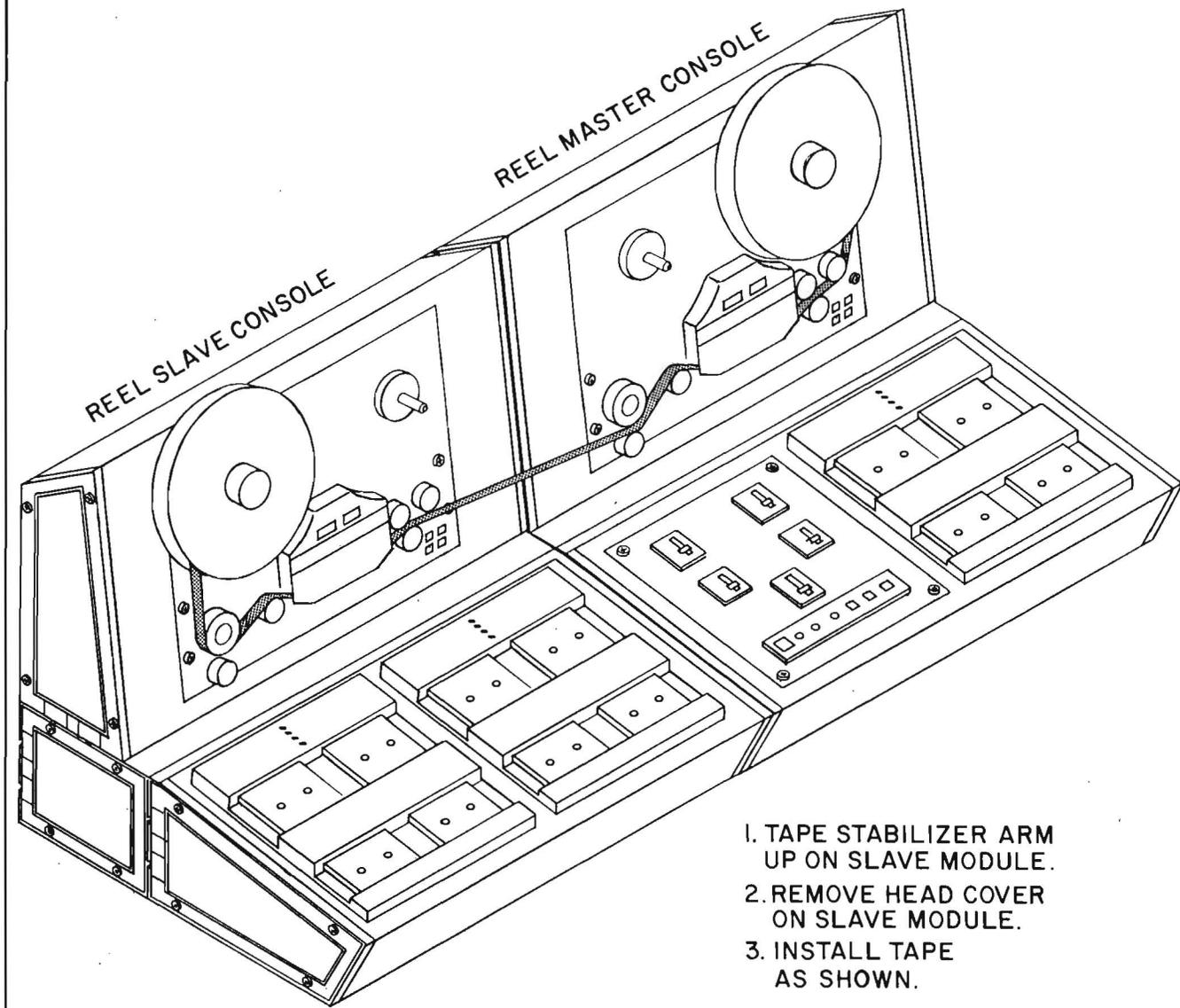
6. Remove any tapes mounted on reel master and slave modules.
7. Set control module for reel master and reel slave.
8. Apply ac power to all equipment. Control module in stop position. An audio waveform should be present on scope.
9. Position the take-up stabilizer arm assembly (Figure 3.9, 6) to the right on both reel modules. Tape in place, place control module in Copy mode. An 800 kHz (nominal) bias signal should now appear on scope.
10. Place control module in stop mode. Move audio oscillator to channel 2, jack C. Move scope to resistor on J405, pin T.
11. Repeat steps 8 and 9 for channel 2. Repeat steps 8, 9 and 10 for channels 3 (R) and 4 (N) for 4 channel modules. The outputs for each channel should be within 10% of each other.
12. If an audio level is missing or very low, refer to record amplifier (Figure 4.30) and then record driver (Figure 4.31).
13. If a bias signal is missing or very low, refer to record drive (Figure 4.31) and then record amplifier (Figure 4.30).
14. If level and bias are okay, proceed to EQ check. Leave 10 ohm resistor in place.

#### 4.4.6 REEL SLAVE EQUALIZATION CIRCUIT CHECK

##### NOTE

The EQ is factory preset and should not need to be adjusted. The circuitry can be checked for proper operation by using the following procedure.

1. Set audio oscillator to 160 kHz. Place a 600 ohm load in series with positive lead of oscillator and connect oscillator to jack C, channel 1 of control module.
2. Connect high impedance vtvm across 10 ohm resistor on J405, pin V (channel 1). (Reference paragraph 4.4.5, 2).
3. Set reel slave speed to slow and note output on meter. Switch to fast speed. Level should drop by approximately one half.
4. Repeat steps 1, 2 and 3 for channels 2 (T), 3 (R) and 4 (N) where appropriate.
5. Leave 10 ohm resistors in place, as they will not affect the operation of the module.



1. TAPE STABILIZER ARM UP ON SLAVE MODULE.
2. REMOVE HEAD COVER ON SLAVE MODULE.
3. INSTALL TAPE AS SHOWN.

Figure 4.2A Console Arrangement for Bias Peaking

#### 4.4.7 PEAKING BIAS AND LEVEL, REEL

##### BIAS PEAKING

1. Disconnect ac power and ribbon cable. Move reel slave console and position as shown in Figure 4.2A. Reconnect power and ribbon cables.
2. Install blank tape as shown in Figure 4.2A. Select reel size. Tape speed - Slow.
3. Remove jumper cables from jacks A and C on control module.
4. Connect audio frequency oscillator to channel 1 jack C on rear panel of control module. Adjust frequency to 16 kHz (Std, XL) or 8 kHz (XLP). Adjust level (while connected to control module) to 200 millivolts.
5. Connect vtvm to channel 1, jack A, on control module.
6. Set all level indicators on control module to preset.
7. Set control module to reel master and reel copy.
8. Apply ac power. Press copy. Adjust channel 1 bias on reel slave for a peak on vtvm. Do not adjust beyond peak. Reference Figure 4.2.
9. Move oscillator from channel 1, jack C to channel 2, jack C. Move vtvm to channel 2, jack A. Adjust bias for peak.
10. Move oscillator and vtvm to channel 3 and adjust for peak bias.
11. Move oscillator and vtvm to channel 4 and adjust for peak bias. Proceed to audio level peaking.

##### AUDIO LEVEL PEAKING

1. Measure output of oscillator to assure 200 millivolts is being introduced to jack C, channel 1. Adjust channel 4 audio on the reel slave for 1.2 volts on vtvm plugged into jack A, reference Figure 4.2.
2. Move oscillator to channel 2, jack C and vtvm to jack A. Adjust audio for 1.2 volts.
3. Move to channel 3 and adjust for 1.2 volts.
4. Move to channel 4 and adjust for 1.2 volts.

#### 4.4.8 END-OF-TAPE SENSING (REEL MODULES)

The end-of-tape sensor (EOT) optical switch located on the left edge of the head plate assembly, requires a sensitivity adjustment to insure proper discrimination between clear leader and opaque tape. A small access hole, located behind the EOT sensor (Figure 4.2), is provided to facilitate adjustment.

Optical switch sensitivity is to be adjusted by completing the following procedure using an oscilloscope or vtvm.

1. Plug the dc oscilloscope (paragraph 4.2), into an ac outlet and place the power switch to the on position. Remove reel transport head cover.

##### NOTE

A high impedance volt ohmmeter may be used as a measuring device instead of the oscilloscope.

2. Set the oscilloscope vertical deflection for 2.0 V/cm or vtvm to a 0-1 volt range.
3. Attach the positive lead of the oscilloscope to pin 1 (white lead) of head block connector J405 (reference Figure 3.12). Connect the negative lead, or ground return, of the oscilloscope to connector J405 pin B (black lead).
4. Plug tape transport ac power cord into appropriate receptacle.

##### NOTE

The utilization of a Control Module is not necessary for this alignment procedure.

5. Position the take-up side stabilizer arm assembly (Figure 3.9, 6) to the right. This is the "power up" position of tape break switch S600. The stabilizer arm may be taped in this position.
6. Insert a short section of clear tape leader in the tape sensor optical slot.
7. Rotate the sensitivity rheostat to a maximum counterclockwise position and observe the indication on the oscilloscope. A reading of 0 to 0.5 Vdc should be observed.

- Slowly rotate the rheostat clockwise, while observing the oscilloscope display. Note that at some point during the rotation the voltage indication begins to rise toward 8 Vdc. STOP! Now rotate the rheostat counterclockwise to the point (but not beyond) where the voltage returns to the original reading obtained in step 7 (0 to 0.5 Vdc).

#### NOTE

Should the tape sensor fail to indicate a voltage increase, leave the rheostat set in the maximum clockwise position.

- Insert a short section of opaque tape in the optical sensor slot. Observe that the voltage indication on the oscilloscope increases to  $+8 \text{ Vdc} \pm 0.5\text{V}$ .

## 4.5 ELECTRICAL ALIGNMENT CASSETTE MODULE

### WARNING

THE FOLLOWING ELECTRICAL ADJUSTMENTS CAN BE PERFORMED ONLY WITH AC POWER APPLIED TO THE UNIT. THEREFORE, TO PREVENT THE POSSIBILITY OF ELECTRICAL SHOCK, CAUTION MUST BE EXERCISED WHILE SERVICING.

#### 4.5.1 TAPE GUIDE ALIGNMENT

- Remove the head cover.
- Place EOT switch to OFF position.
- Place M-300 alignment gauge plate into cassette deck in question.
- Apply ac power; activate copy.
- Place the gauge check bar on the gauge plate as illustrated in Figure 4.3, position A.

#### NOTE

Do not force or bend tape guides.

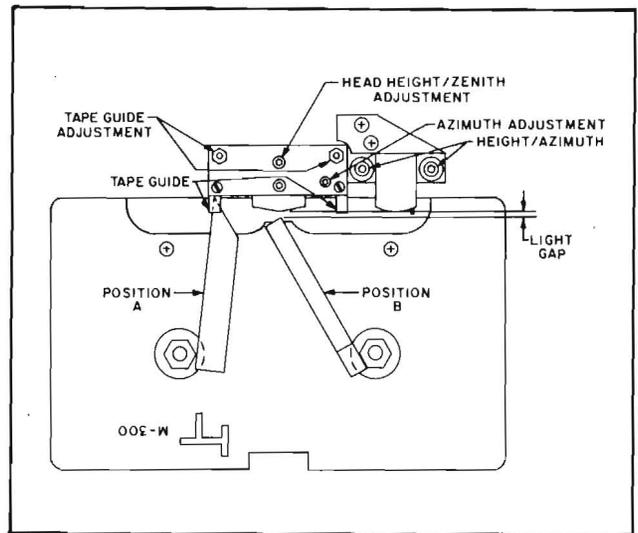


Figure 4.3 Cassette M-300 Gauge Positioning

- The bar should be positioned equidistant between the upper and lower tape guides while remaining flat on the gauge plate.
- If not, adjust the appropriate tape guide adjustment hex nut.

#### 4.5.2 HEAD ALIGNMENT

For the purpose of the following discussion, it is assumed that the cassette module is connected to the rear panel of the control module. The output voltage will be monitored by a vtvm or oscilloscope (reference paragraph 4.2) and connected to unused jack A of channel in question.

Steps 1 through 7, outlined under Tape Guide Alignment, are also required prior to head alignment.

#### NOTE

The tape heads on the Cassette Module were factory pre-aligned. Readjustment of the heads **should not** be attempted unless it has definitely been determined that re-alignment is absolutely necessary.

#### NOTE

Head alignment **should not** be attempted by inexperienced personnel. The nature of these adjustments requires an individual thoroughly qualified in this area. Do not attempt to re-adjust heads that have a groove worn into the face.

In the event head replacement becomes necessary, DO NOT move either the bias or audio adjustment potentiometers on the Bias Distribution boards. Their present position will serve as an audio and bias preset adjustment.

#### 4.5.2.1 Head Zenith

1. Remove the head cover.
2. Place EOT switch to OFF position.
3. Place M-300 alignment gauge plate into cassette deck in question.
4. Apply ac power; activate copy.
5. Place the gauge check bar on the gauge plate as illustrated in Figure 4.3, position B. Leave a narrow light gap between the head and bar (approximately the thickness of a piece of paper).
6. Sight through the light gap. Both the head face and forward edge of the gauge check bar should be parallel to the same degree.
7. If not, adjust the head height/zenith adjustment screws.
8. Recheck the head for proper height and azimuth.

#### 4.5.2.2 Head Height

Prior tape guide alignment and head zenith must be verified before head height is checked.

1. Remove head cover.
2. Place a tape viewing cassette 7-7 (reference paragraph 4.2) in the cassette deck.
3. Apply ac power; activate copy.
4. Achieve a balanced height adjustment of the head by alternately adjusting the two head height/zenith adjustment screws until top and bottom pole pieces of the head are equally covered. Physical observation is the criteria in making this measurement.
5. Verify height position by orientation of pole piece(s) with respect to clear leader tape.
6. Recheck the head for proper zenith and azimuth.

#### 4.5.2.3 Azimuth - Master Deck

Steps 1 through 6, outlined under Head Height are required prior to head azimuth alignment.

1. Remove head cover.
2. Clean head.
3. Place Bias and EOT switches in OFF positions.
4. Place control module Transport Control MASTER switch to CASS.
5. Insert test tape 7-2 (reference paragraph 4.2), in master deck.
6. Apply ac power; activate copy. Adjust azimuth screw for maximum indication (approximately 20 mV rms) on the vtvm or oscilloscope.

#### NOTE

Ensure a false peak is not achieved. Rotate the screw several turns in each direction to obtain the maximum output indication.

#### 4.5.2.4 Azimuth - Slave Deck

##### A. Using Preamp Method

1. Perform steps 1 through 3 as outlined under Azimuth Master Deck.
2. Remove channel 2 head lead jumper plug (located on Bias Distribution board: reference Figure 4.23) and connect input of hi-gain narrow band pass preamplifier (reference paragraph 4.2, item 5) in series with the head.
3. Connect a vtvm or oscilloscope to the preamplifier output.
4. Place all channel TRACK switches to OFF position.
5. Place test tape 7-2 (reference paragraph 4.2) into slave deck.
6. Apply ac power; activate copy. Adjust azimuth screw (Figure 4.3) for peak indication on the vtvm or oscilloscope.

##### B. Using Comparison Method

**NOTE:** Master deck head must be properly aligned before using this method.

1. Place the Control Module Transport Control MASTER switch to CASS, and COPY switch to CASS.
2. Insert test tape 7-2 (reference paragraph 4.2) into master deck.

3. Place blank cassette into slave deck in question.
4. Connect a vtvm or oscilloscope to unused jack A of channel 2 (Control Module rear panel).
5. Apply ac power; activate copy. Copy a portion of the test tape. While doing so, adjust master head azimuth screw (Figure 4.3) for peak indication on vtvm or oscilloscope.
6. Mark position of azimuth screw for reference.
7. Remove test tape from master deck and insert newly recorded duplicate tape. Playback duplicate tape and again adjust azimuth for peak indication on vtvm or oscilloscope. Note direction and distance azimuth screw moved.
8. Adjust azimuth screw on copy deck to compensate for difference (if any) noted between step 6 and 7. Return master azimuth to position as marked in step 6. Bulk erase copy tape and insert into copy deck. Repeat above steps until no difference is noted in step 7.
9. Reinsert original test tape into master deck and blank tape into slave deck.
10. Record a portion of test tape onto copy tape.
11. Rewind copy tape and play back on master deck. Note peak level, it should be same as test tape. If not, repeat steps 7 through 11.

#### 4.5.3 PLAYBACK LEVEL ADJUSTMENT - MASTER DECK

This adjustment should be done after head alignment.

#### NOTE

This procedure can be done with metal shield over master preamplifier circuit board.

1. Clean head.
2. Place audio and bias LEVEL controls on Control Module to PRESET.
3. Place all track (channel) switches in ON position.
4. Load test tape 7-4 (reference paragraph 4.2) into Master deck.
5. Connect a vtvm or oscilloscope to unused jack A, channel 1 (rear panel of control module).

6. Set vtvm or oscilloscope for 0-300 millivolt range (rms).
7. Set Control Module Transport Control MASTER switch to CASS and COPY switch to CASS.
8. Apply ac power; activate copy.
9. Adjust appropriate LVL (level) potentiometer (Figure 4.4) for 200 millivolts output.

#### 4.5.4 EQUALIZATION - MASTER DECK

Playback level adjustments have to be performed before equalization adjustments can be done (reference paragraph 4.5.3). Assure that master head is clean, demagnetized and properly azimuthed.

1. Connect a vtvm or oscilloscope to unused jack A, of channel in question (rear panel of control module).
2. Set vtvm or oscilloscope for 0-30 millivolts range (rms).
3. Insert 10 kHz, -20 dB test tape 7-2, (reference paragraph 4.2) into master deck.
4. Apply ac power; activate copy. Adjust appropriate EQ (equalization) potentiometer (Figure 4.4) for 20 millivolt rms output.
5. Recheck playback level adjustment (200 millivolts). If level has changed by more than 1 dB, re-adjust playback as stated in paragraph 4.5.3, then re-adjust for equalization.

#### 4.5.5 BIAS LEVEL ADJUSTMENTS - SLAVE DECK

1. Insert special test cassette 7-5 or 7-6 (reference paragraph 4.2) into copy deck in question.
2. Remove double-ended phone plug cables from rear of control module.
3. Connect an audio frequency oscillator to jack C of channel in question. Adjust oscillator output to 16 kHz (Std, XL) or 8 kHz (XLP) sine wave, 200 millivolts rms.
4. Place TRACK switch, of channel in question, to ON position.

5. Connect PB10-27 pre-amplifier (reference paragraph 4.2) to special test cassette output leads.
6. Place EOT switch in OFF position and Bias switch to ON.
7. Connect vtvm or oscilloscope to PB10-27 output.
8. Set audio and bias LEVEL indicators to PRESET position.
9. Apply ac power; activate copy. Adjust bias potentiometer (Figure 4.4) for a peak indication on the vtvm or oscilloscope. Continue clockwise rotation until level drops 1/2 dB.

#### 4.5.6 AUDIO LEVEL ADJUSTMENTS - MASTER-SLAVE MODULE

The audio level adjustments are done using the comparison method.

1. Assure both EOT and the Bias switches are ON. All channel switches ON.
2. Place control module audio LEVEL controls to PRESET.
3. Connect vtvm or oscilloscope to unused jack A, channel 1 (rear panel of control module).
4. Insert test tape 7-4 (reference paragraph 4.2) into master deck and a blank tape into slave deck.
5. Apply ac power; activate copy. Copy a portion of the test tape. Note the level on the vtvm or oscilloscope and the control module LEVEL indicator for each channel.
6. Remove test tape from master deck and insert newly recorded duplicate tape.
7. Playback duplicate tape. The level from the duplicate tape should be the same as the test cassette. If the duplicate audio levels are low, rotate AUDIO potentiometer (Figure 4.4) clockwise; if high, rotate counterclockwise.
8. Reinsert test tape into master deck and blank tape into deck being adjusted. Repeat steps 5, 6, and 7 until duplicate and test tape levels are within  $\pm 1$  dB. Repeat for all channels.

#### 4.5.7 FREQUENCY RESPONSE CHECK

1. Clean heads.
2. Insert test tape 7-3 (reference paragraph 4.2) into master deck and blank cassette into copy deck.
3. Connect vtvm or oscilloscope to unused jack A of channel 1 (rear panel of control module).
4. Apply ac power; activate copy. Copy test tape and note playback levels on vtvm or oscilloscope.
5. Replace test tape with newly recorded duplicate tape, rewind, then playback.
6. The level of the duplicate tape should be within  $\pm 3$  dB of test tape.

#### NOTE

Slight adjustment in bias and audio levels may be required to achieve the above results. A decrease in bias will cause an increase in high frequency response while an increase in bias will cause reduction of high frequency response. Do not decrease or increase bias to a point beyond that which produces a drop in 16 kHz level in excess of 1.0 dB.

#### 4.5.8 END-OF-TAPE SENSING

The four sensors used in the cassette module play an important part in the operation of their respective logic circuits. It is therefore of the utmost importance that they are operating properly. Each sensor is made up of an infrared (IR) emitter and detector. The emitters are connected in series with a load resistor to assure the correct voltage drop of 1.2 to 1.7 volts dc across each emitter.

When the emitters fails, it usually opens up. This is indicated by a voltage reading across the emitter equal to the supply voltage.

All detectors are supplied with a +12 Vdc source. The output voltage will vary from 0.6 Vdc (dark) to 11.25 Vdc (light).

The four EOT sensors should provide a logic "0" or logic "1", depending on the position of the spindle mirror, Logic "0" is equal to 0.6 to 1.2 volts dc. Logic "1" is equal to approximately 11.3 volts dc.

The four EOT sensors are supplied as a sealed assembly, and are replaced in the same manner.

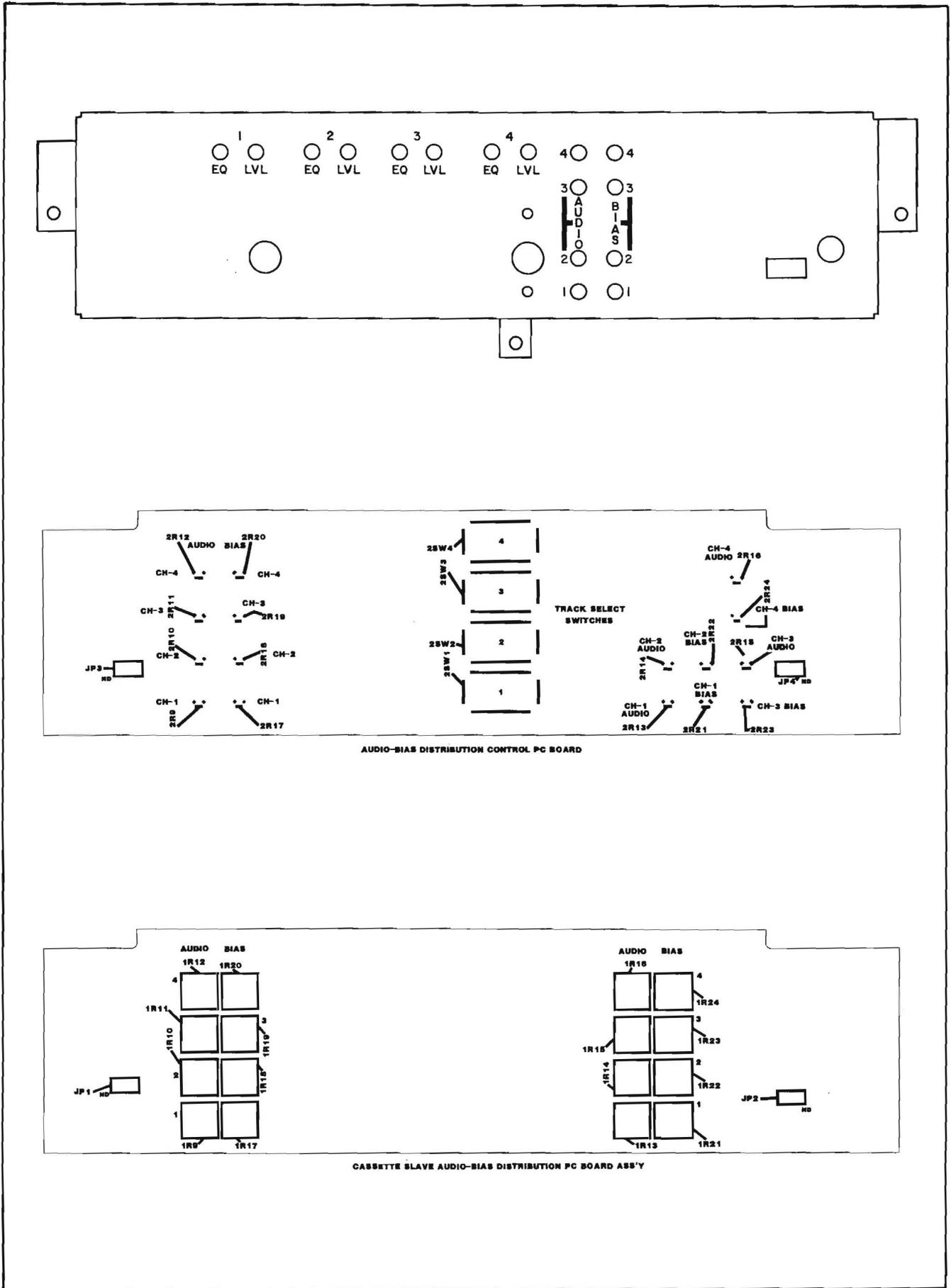


Figure 4.4 Accessibility of Cassette Adjustments

## 4.6 UNITY GAIN - EXPANSION MODULE

1. Connect an audio frequency oscillator to pin A (P1) and ground. Set oscillator at 1 kHz with 250 millivolts output.
2. Using an ac vtvm, measure the input (TP-1) and the output (TP-6) of U1.
3. If the output voltage is less than the input, adjust R21 until voltages are equal.
4. Move oscillator to pin B (P1). Repeat steps 2 and 3 using R22.
5. Move oscillator to pin C (P1). Repeat steps 2 and 3 using R23.
6. Move oscillator to pin D (P1). Repeat steps 2 and 3 using R24.

## 4.7 PARTS DOCUMENTATION AND SCHEMATICS

The following pages present the schematics and electrical parts lists for all modules except the Cassette Rewind Module, which is covered entirely in Section III. The schematics and parts lists are organized into six groups. Each group documents one module, and begins with a wiring diagram of the module followed with a board-by-board breakdown of the module (Table 4.1).

Table 4.1

Module	Figures
Control	4.5-4.11
Open Reel Master	4.12-4.19
Cassette Master-Slave	4.20-4.26
Cassette Slave	4.27-4.29
Open Reel Slave	4.30-4.33
Expansion	4.34-4.37

▷ 3P7A AND 3P8A ARE CONNECTED TO EXPANSION MODULE P4 WHEN EXPANSION MODULE 15 IS USED IN A SYSTEM.

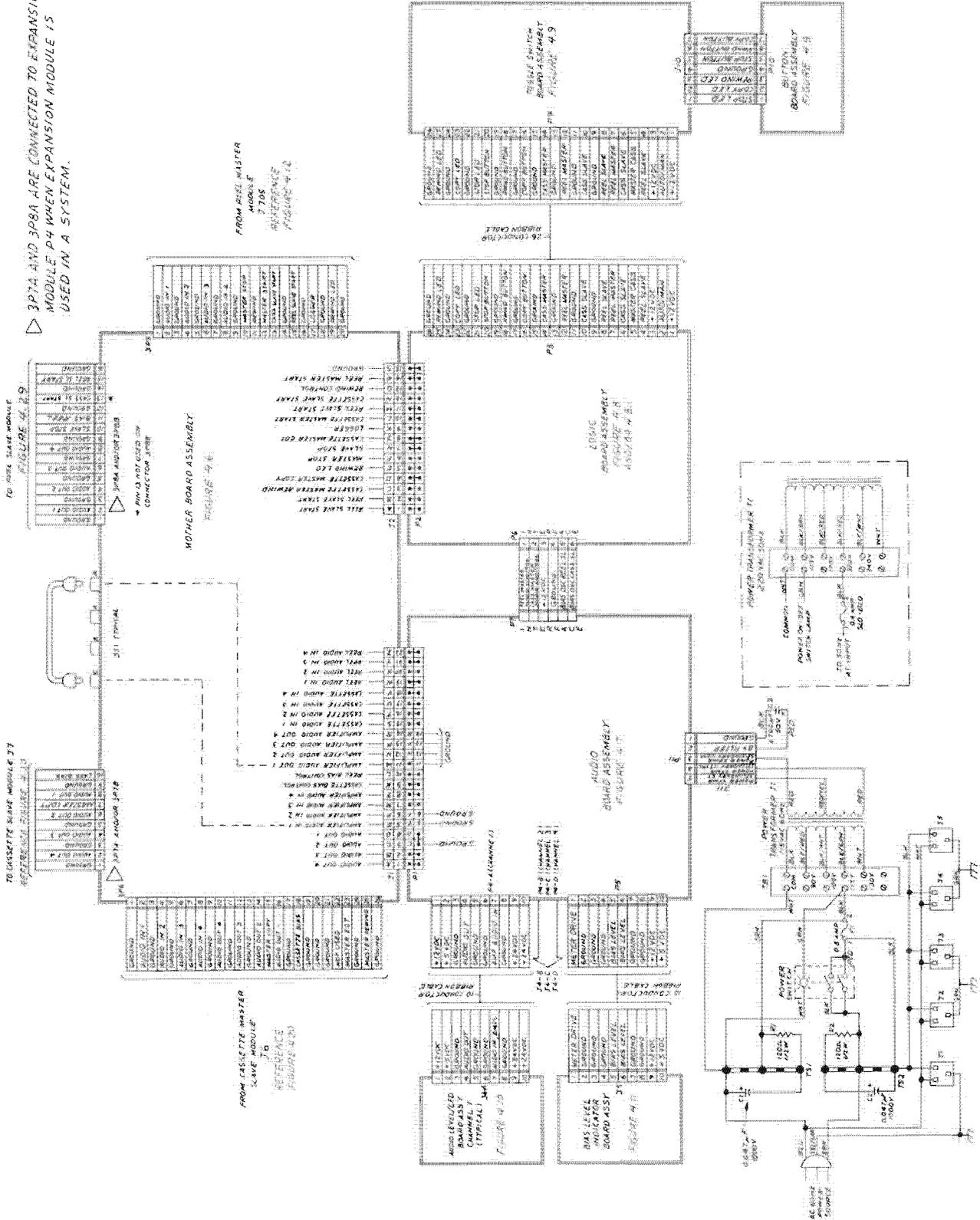


Figure 4.5 Control Module Chassis Wiring Diagram

**Figure 4.8 Parts List**

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, 1/2W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
2C1, 2C4, 2C10-2C13, 2C19, 2C20	Capacitor, .15, Ceramic	52676-014
2C2, 2C3, 2C5-2C9, 2C14-2C18, 2C22-2C28	Capacitor, .02, Disk	52157-252
2C21	Capacitor, 10, 25V	51821-020
2CR1-2CR17	Diode, Silicon	50745-003
P6	Connector, 6 Pin	57721-006
P8	Connector, 26 Pin	57742-016
2Q1-2Q7	Transistor, 2N3416, NPN Silicon	51213-000
2Q8-2Q10	Transistor, 2N5366, PNP Silicon	51820-000
2R1	Resistor, 100	52154-305
2R2, 2R4-2R7, 2R9-2R14, 2R19-2R22, 2R24, 2R28- 2R32, 2R36, 2R37, 2R39, 2R41-2R43, 2R45, 2R47, 2R55-2R60	Resistor, 10K	52154-257
2R3	Resistor, 11K	52154-256
2R8	Resistor, 1.2K	52154-279
2R15-2R18, 2R27, 2R34, 2R35, 2R48, 2R53	Resistor, 100K	52154-233
2R23	Resistor, 560	52154-287
2R25, 2R26	Resistor, 4.7M	52154-193
2R33, 2R52	Resistor, 1M	52154-209
2R38, 2R40, 2R44	Resistor, 3M	52154-198
2R46	Resistor, 1K	52154-281
2R49-2R51	Resistor, 680, 1/2W	52154-462
2U1, 2U4, 2U11	IC, Quad 2 Input OR Gate 4071	53266-031
2U2, 2U3	IC, Triple 3 Input OR Gate 4075	53266-098
2U5	IC, Triple 3 Input NAND Gate 4023	53266-017
2U6, 2U10	IC, Dual 4 Input NOR Gate 4001	53222-000
2U7	IC, Quad 2 Input AND Gate 4081	53266-033
2U8	IC, Triple 3 Input NAND Gate 4073	53266-091
2U9, 2U12	IC, Quad 2 Input NAND Gate 4011	53266-007
2U13	IC, Quad Type D Flip Flop 4013	53266-009
2U14	IC, Quad 2 Input NAND Schmidt Trigger 4093	53266-096
	Socket Integrated Circuit, 14 Pin	53041-000

448891 Rev. 1





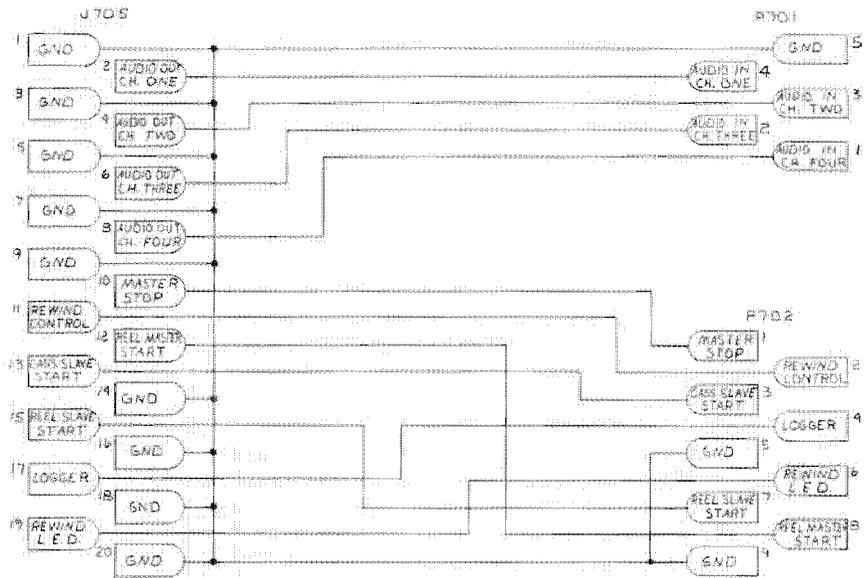


Figure 4.12A Open Reel Master Interface Board Schematic Diagram

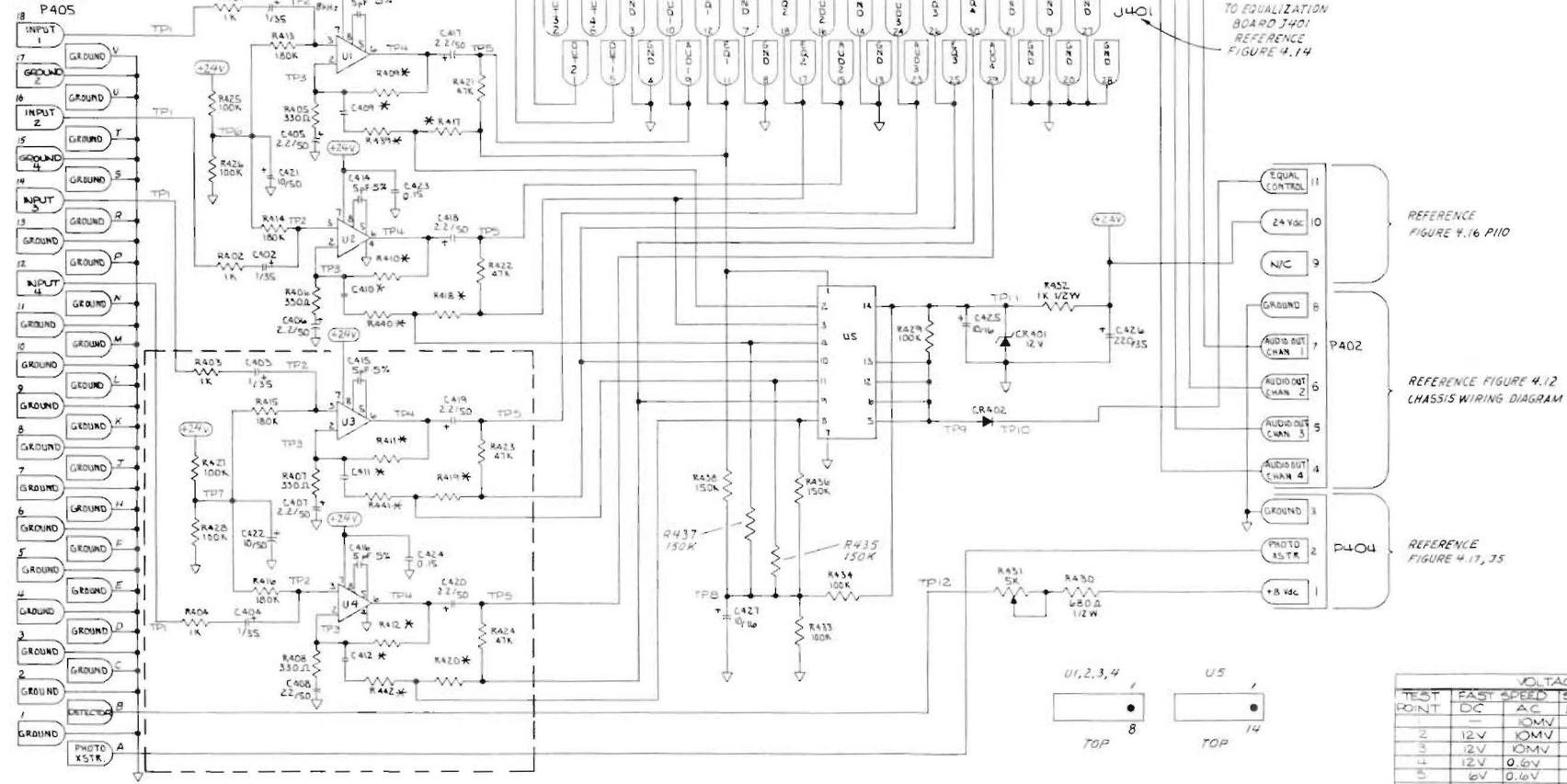
94551, Rev A

Figure 4.12A Parts List

REFERENCE NO.	DESCRIPTION	PART NO.
J705	Cable Assy	94493-008
P701	Connector, 5 pin	57721-005
P702	Connector, 9 pin	57721-009

94551, Rev B

REFERENCE 4.12  
CHASSIS WIRING  
DIAGRAM



\*SEE PARTS LIST FOR COMPONENT VALUE AND USAGE

NOTES:

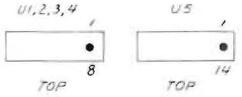
1. ALL RESISTORS IN OHMS, 1/4 WATT, ±5%, CARBON UNLESS NOTED.
2. ALL CAPACITORS IN MICROFARADS UNLESS NOTED
3. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VOM USING GROUND AS REFERENCE.
4. ALL ac VOLTAGES MEASURED WITH A HIGH IMPEDANCE ac VTVM USING GROUND AS REFERENCE.
5. ALL VOLTAGES INDICATED ARE TYPICAL AND MAY VARY SLIGHTLY DUE TO CIRCUIT TOLERANCE.
6. THIS DIAGRAM IS SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN. FIRST RELEASE AUGUST 1983.

TO EQUALIZATION BOARD J401 REFERENCE FIGURE 4.14

REFERENCE FIGURE 4.16 P110

REFERENCE FIGURE 4.12 CHASSIS WIRING DIAGRAM

REFERENCE FIGURE 4.17, 35



TEST POINT	VOLTAGE			
	FAST SPEED DC	FAST SPEED AC	SLOW SPEED DC	SLOW SPEED AC
1	—	10mV	—	10mV
2	12V	10mV	12V	10mV
3	12V	10mV	12V	10mV
4	12V	0.6V	12V	0.7V
5	6V	0.6V	6V	0.7V
6	12V	—	12V	—
7	12V	—	12V	—
8	6V	—	6V	—
9	12V	—	0.6V	—
10	25V	—	0.1V	—
11	12V	—	12V	—
12	1.2V	—	1.2V	—

Figure 4.13 Open-Reel Master Reproduce Amplifier Schematic Diagram

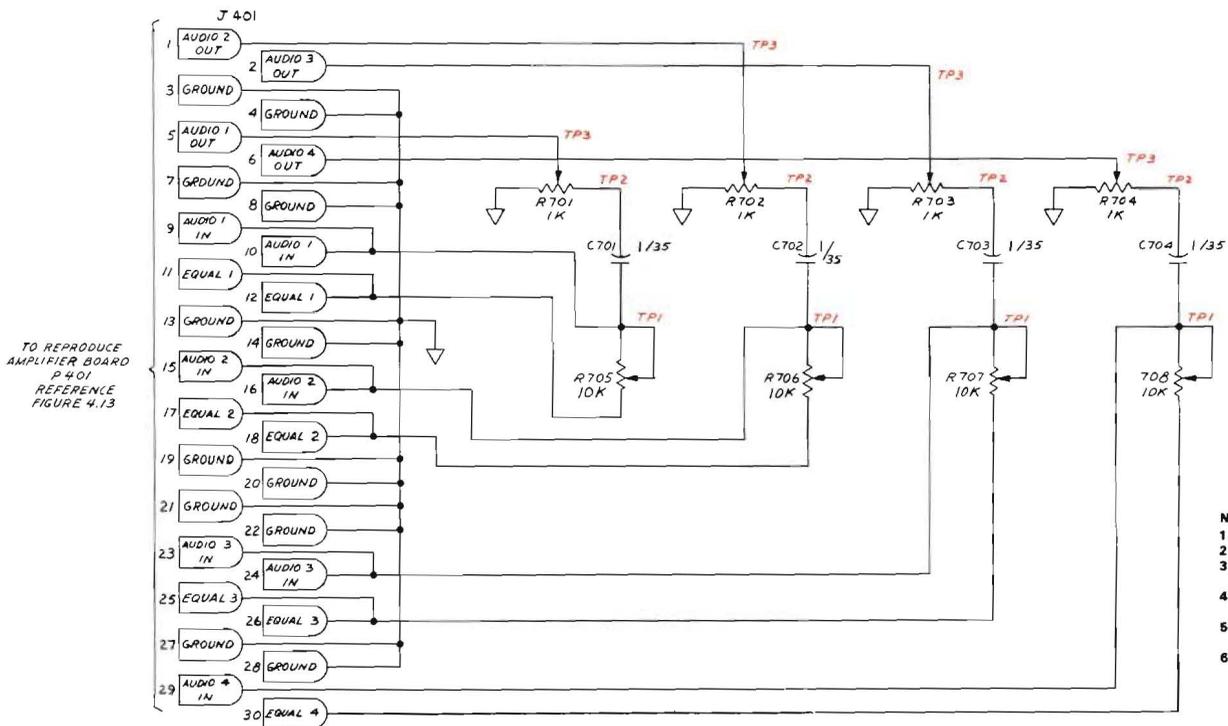
Figure 4.13 Parts List

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, 1/4W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
C401-C404	Capacitor, 1, 35V, Electrolytic	52257-049
C405-C408,C417-C420	Capacitor, 2.2, 50V, Electrolytic (Standard & XL)	52715-043
	Capacitor, 2.2, 25V, Tantalum (XLP)	52257-077
C409-C412	Capacitor, 470 pF, Disk (Standard & XL)	52157-017
	Capacitor, 680 pF, Mica (XLP)	50555-010
C413-C416	Capacitor, 5 pF, Mica	50555-012
C421,C422	Capacitor, 10, 50V	52715-047
C423,C424	Capacitor, 0.15	52676-014
C425,C427	Capacitor, 10, 16V	52715-014
C426	Capacitor, 220, 35V	52160-092
CR401	Diode, Zener, 1N4742, 12V	51302-010
CR402	Diode, Silicon	50745-004
J401	Connector, 15 Pin	57750-003
P402-P404	Socket, 11 Pin	57712-011
R401-R404	Resistor, 1K	52154-281
R405-R408	Resistor, 330	52154-293
R409-R412	Resistor, 270K (Standard & XL)	52154-223
	Resistor, 750K (XLP)	52154-212
R413-R416	Resistor, 180K	52154-227
R417-R420	Resistor, 6.8K (Standard & XL)	52154-261
	Resistor, 1K (XLP)	52154-281
R421-R424	Resistor, 47K	52154-241
R425-R429,R433,R434	Resistor, 100K	52154-233
R430	Resistor, 680, 1/2W	52154-462
R431	Potentiometer, 5K	35278-058
R432	Resistor, 1K, 1/2W	52154-458
R435-R438	Resistor, 150K	52154-229
R439-R442	Resistor, 5.6K (Standard & XL)	52154-263
	Resistor, 3.9K (XLP)	52154-267
U401-U404	IC, 5534	53293-000
U405	IC, 4066	53266-102
	Socket, 8 Pin, IC	53041-002
	Socket, 14 Pin, IC	53041-000

94544, Sh. 1, Rev. M

Figure 4.14 Open-Reel Master Equalization Board Schematic Diagram  
4-31



TABULATION		
TEST POINT	TEST DC	TEST AC
1	6V	0.6V
2	0	0.6V
3	0	0.25V

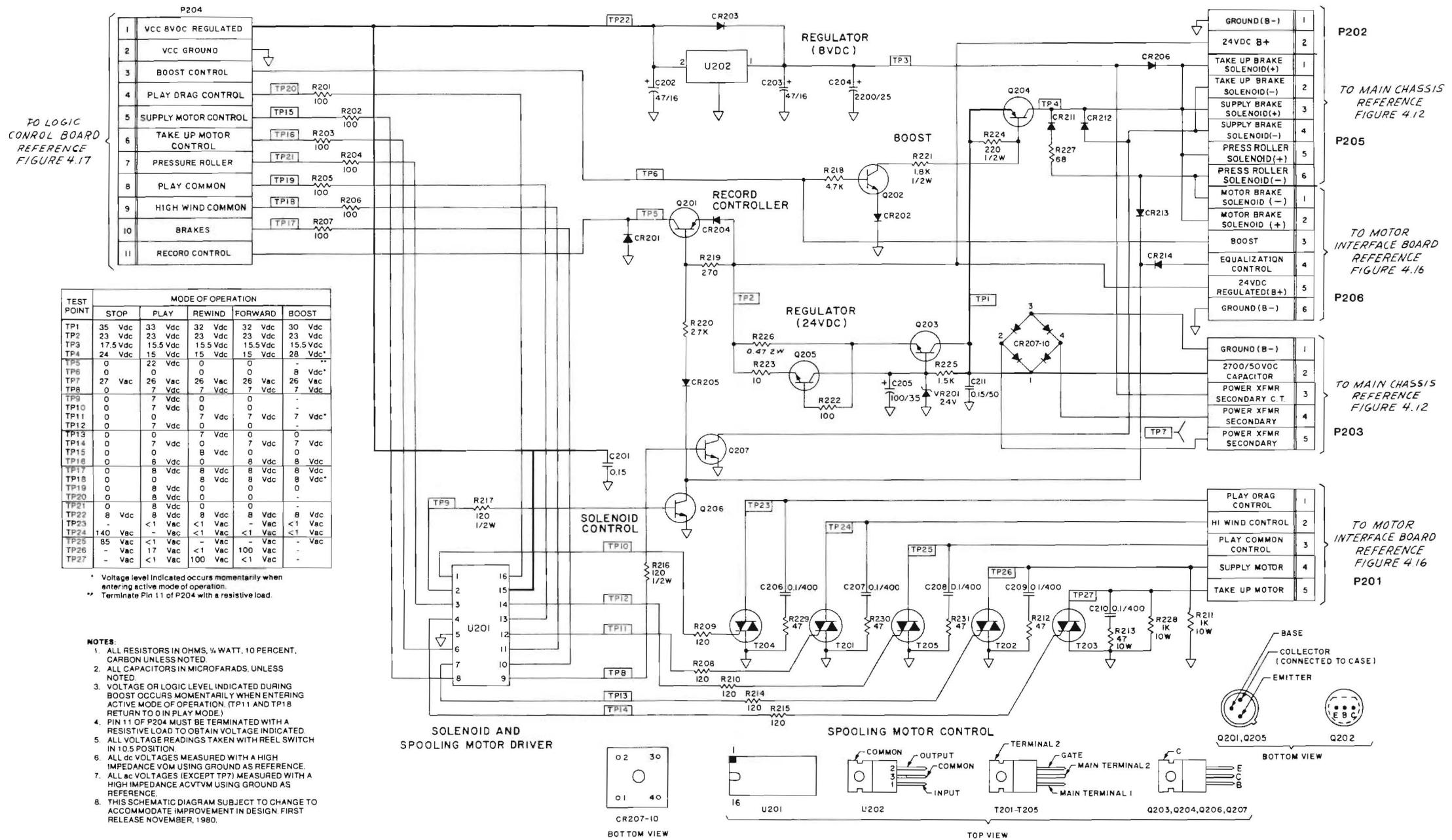
**NOTES:**

1. ALL RESISTORS IN OHMS, 1/4 WATT, ±5%, CARBON UNLESS NOTED.
2. ALL CAPACITORS IN MICROFARADS UNLESS NOTED.
3. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VOM USING GROUND AS REFERENCE.
4. ALL ac VOLTAGES MEASURED WITH A HIGH IMPEDANCE ac VTVM USING GROUND AS REFERENCE.
5. ALL VOLTAGES INDICATED ARE TYPICAL AND MAY VARY SLIGHTLY DUE TO CIRCUIT TOLERANCE.
6. THIS DIAGRAM IS SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN. FIRST RELEASE AUGUST 1983.

**Figure 4.14 Parts List**

All Capacitors are in microfarads unless otherwise specified.  
All resistors are in ohms,  $\frac{1}{4}W$ ,  $\pm 5\%$ , unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
C701,702,703,704	Capacitor, 1, 35V	52257-049
R701,702,703,704	Potentiometer, 1K	57148-026
R705,706,707,708	Potentiometer, 10K	57148-029
	Equalization/Level Board Assembly, 2 Channel	94547-001
	Equalization/Level Board Assembly, 4 Channel	94547-000



TEST POINT	MODE OF OPERATION				
	STOP	PLAY	REWIND	FORWARD	BOOST
TP1	35 Vdc	33 Vdc	32 Vdc	32 Vdc	30 Vdc
TP2	23 Vdc	23 Vdc	23 Vdc	23 Vdc	23 Vdc
TP3	17.5 Vdc	15.5 Vdc	15.5 Vdc	15.5 Vdc	15.5 Vdc
TP4	24 Vdc	15 Vdc	15 Vdc	15 Vdc	28 Vdc*
TP5	0	22 Vdc	0	0	-
TP6	0	0	0	0	8 Vdc*
TP7	27 Vac	26 Vac	26 Vac	26 Vac	26 Vac
TP8	0	7 Vdc	7 Vdc	7 Vdc	7 Vdc
TP9	0	7 Vdc	0	0	-
TP10	0	7 Vdc	0	0	-
TP11	0	0	7 Vdc	7 Vdc	7 Vdc*
TP12	0	7 Vdc	0	0	-
TP13	0	0	7 Vdc	0	0
TP14	0	7 Vdc	0	7 Vdc	7 Vdc
TP15	0	0	0 Vdc	0	0
TP16	0	8 Vdc	0	8 Vdc	8 Vdc
TP17	0	8 Vdc	8 Vdc	8 Vdc	8 Vdc
TP18	0	0	8 Vdc	8 Vdc	8 Vdc*
TP19	0	8 Vdc	0	0	0
TP20	0	8 Vdc	0	0	-
TP21	0	8 Vdc	0	0	-
TP22	8 Vdc	8 Vdc	8 Vdc	8 Vdc	8 Vdc
TP23	-	<1 Vac	<1 Vac	<1 Vac	<1 Vac
TP24	140 Vac	- Vac	<1 Vac	<1 Vac	<1 Vac
TP25	85 Vac	<1 Vac	- Vac	- Vac	- Vac
TP26	- Vac	17 Vac	<1 Vac	100 Vac	- Vac
TP27	- Vac	<1 Vac	100 Vac	<1 Vac	- Vac

\* Voltage level indicated occurs momentarily when entering active mode of operation.  
 \*\* Terminate Pin 11 of P204 with a resistive load.

- NOTES:**
- ALL RESISTORS IN OHMS, 1/2 WATT, 10 PERCENT, CARBON UNLESS NOTED.
  - ALL CAPACITORS IN MICROFARADS, UNLESS NOTED.
  - VOLTAGE OR LOGIC LEVEL INDICATED DURING BOOST OCCURS MOMENTARILY WHEN ENTERING ACTIVE MODE OF OPERATION. (TP11 AND TP18 RETURN TO 0 IN PLAY MODE).
  - PIN 11 OF P204 MUST BE TERMINATED WITH A RESISTIVE LOAD TO OBTAIN VOLTAGE INDICATED.
  - ALL VOLTAGE READINGS TAKEN WITH REEL SWITCH IN 10.5 POSITION.
  - ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VOM USING GROUND AS REFERENCE.
  - ALL ac VOLTAGES (EXCEPT TP7) MEASURED WITH A HIGH IMPEDANCE ACVTVM USING GROUND AS REFERENCE.
  - THIS SCHEMATIC DIAGRAM SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN. FIRST RELEASE NOVEMBER, 1980.

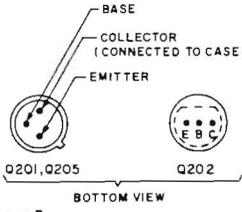
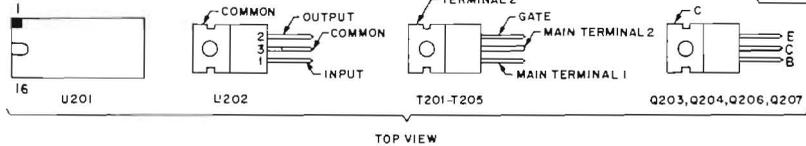
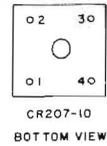


Figure 4.15 Open-Reel Motor Control Board Schematic Diagram, Master/Slave

Figure 4.15 Parts List

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, 1/4W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
C201,C211	Capacitor, .15, 50V	52676-014
C202,C203	Capacitor, 47, 16V, Electrolytic	51821-068
C204	Capacitor, 3300, 35V, Electrolytic	52160-097
C205	Capacitor, 100, 35V, Electrolytic	51821-011
C206-C210	Capacitor, .1, 400V, Mylar	52159-097
CR201-CR205,CR211- CR214	Diode, 1 Amp, Silicon	50745-001
CR206	Diode, 3 Amp, Silicon	56073-000
CR207-CR210	Rectifier, Bridge	52313-000
P201,P203	Connector, 5 Pin	57708-005
P202	Connector, 2 Pin	57708-002
P204	Connector, 11 Pin, Angle	57712-011
P205,P206	Connector, 6 Pin	57708-006
Q201	Transistor, 2N5323	35469-003
Q202	Transistor, 2N3416	51213-001
Q203	Transistor, 2N6386	54650-002
Q204	Transistor, TIP 125	54662-000
Q205	Transistor, 2N5321	35469-002
Q206,Q207	Transistor, 2N5296	51793-001
	Transistor, Pad (not shown)	85301-000
R201-R207,R222	Resistor, 100	52154-305
R208-R210,R214-R217	Resistor, 120, 1/2W	52154-480
R211,R228	Resistor, 1K, 10W	50155-024
R212,R213,R229-R231	Resistor, 47	52154-313
R218	Resistor, 4.7K	52154-265
R219	Resistor, 270	52154-295
R220	Resistor, 2.7K	52154-271
R221	Resistor, 1.8K, 1/2W	52154-452
R223	Resistor, 10	52154-329
R224	Resistor, 220, 1/2W	52154-474
R225	Resistor, 1.5K, 1/2W	52154-454
R226	Resistor, .47, 2W, 0%	51019-011
R227	Resistor, 68	52154-309
T201-T205	Triac, TIC 216D	52120-000
U201	IC, CA3082	53276-000
U202	Voltage Regulator, 78HV08CU	53271-002
VR201	Diode, Zener, 24V	51302-011
	Socket, 16 Pin, IC	53041-001
	Heat Sink	92772-000
	Motor Control Board Assembly	94020-000
	Screw, No. 6-32 x 1/2 (CR207-kCR210 Mtg)	51845-077
	Pad, Transistor (Assemble under Q201)	85301-000
	Nut, Hex, No. 4-40	52188-006
	Washer, Lock, No. 4 Ext. Tooth (T204, Q203, Q204 Mtg)	50049-003
	Screw, No. 4-40 x 1/4 (Triac Mtg)	51845-056
	Washer, Lock, No. 6 Ext. Tooth (Heat Sink Mtg)	50049-001
	Washer, Insulating (Q203, Q204 Mtg)	51858-000
	Screw, No. 4-40 x 3/8 (Q203, Q204 Mtg)	51845-057
	Screw, No. 6-32 x 1/4 (Heat Sink Mtg)	51845-092

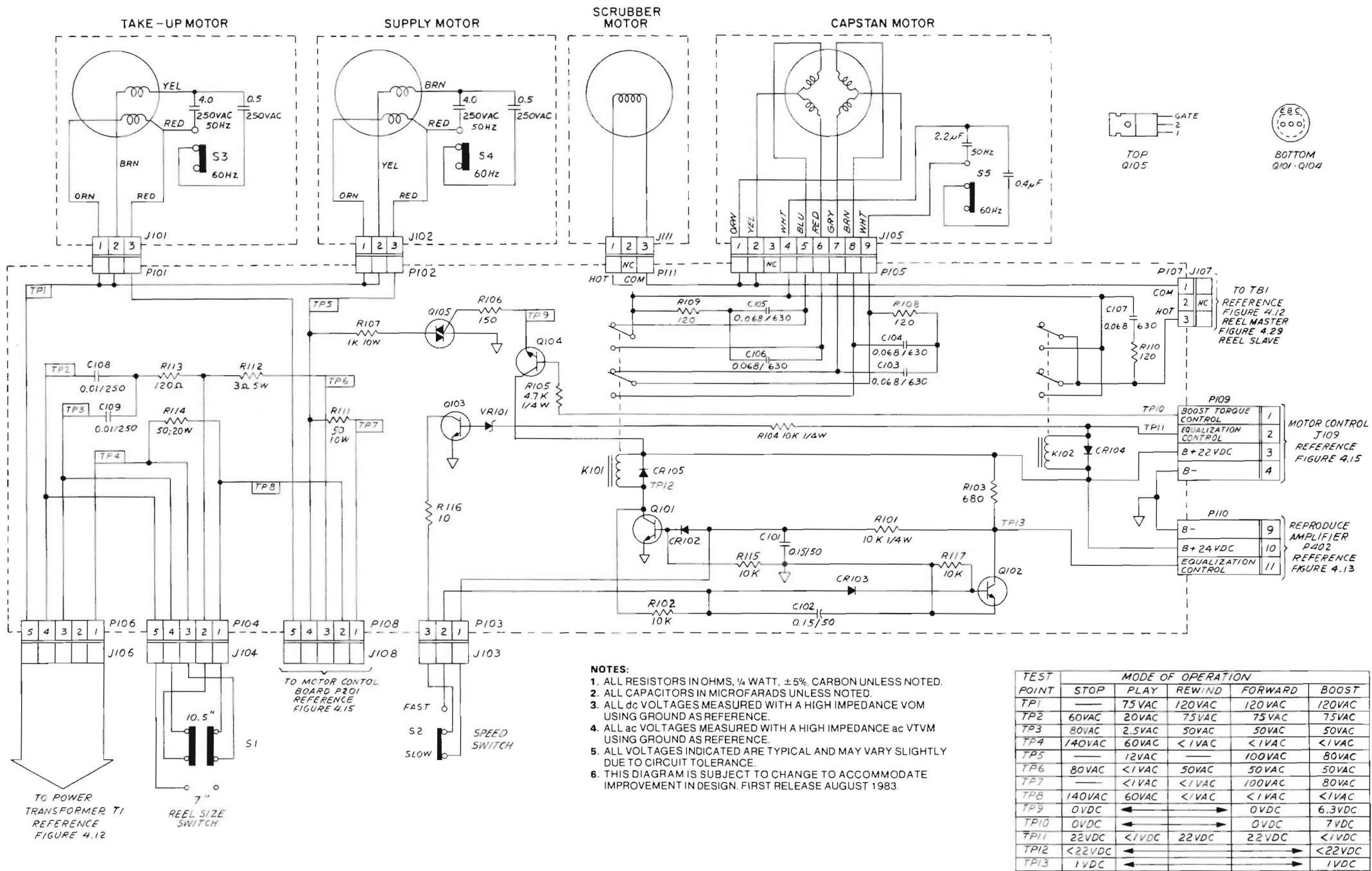


Figure 4.16 Open-Reel Motor Interface Board Schematic Diagram, Master/Slave

**Figure 4.16 Parts List**

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, ¼W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
C101,C102	Capacitor, 0.15, 50V	52676-014
C103-C107	Capacitor, .068, 630V	52708-081
C108,C109	Capacitor, .01, 250V	52712-000
CR102-CR105	Diode, 1 Amp	50745-003
K101,K102	Relay, DPDT	54123-000
P102-P103,P107,P111	Connector, 3 Pin, .156	57708-003
P104,P106,P108	Connector, 5 Pin, .156	57708-005
P105	Connector, 9 Pin, .156	57708-009
P109,P110	Connector, 7 Pin, .156	57708-007
Q101-Q104	Transistor, 2N3416	51213-001
Q105	Triac, C216D	52120-000
R101,R102,R104, R115,R117	Resistor, 10K	52154-257
R103	Resistor, 680, ½W	52154-462
R105	Resistor, 4.7K	52154-265
R106	Resistor, 150, ½W	52154-478
R107	Resistor, 1K, 10W, 10%	50155-024
R108-R110,R113	Resistor, 120, ½W	52154-480
R111	Resistor, 50, 10W, 10%	50155-023
R112	Resistor, 3, 5W, 10%	50155-013
R114	Resistor, 50, 20W	50768-005
R116	Resistor, 10	52154-329
VR101	Diode, Zener, 9.1V	51302-016
	Screw, No. 4-40 x ¼	51845-056
	Washer, Lock, No. 4	50049-003
	Nut, Hex, No. 4-32	52188-006

44508, Rev J

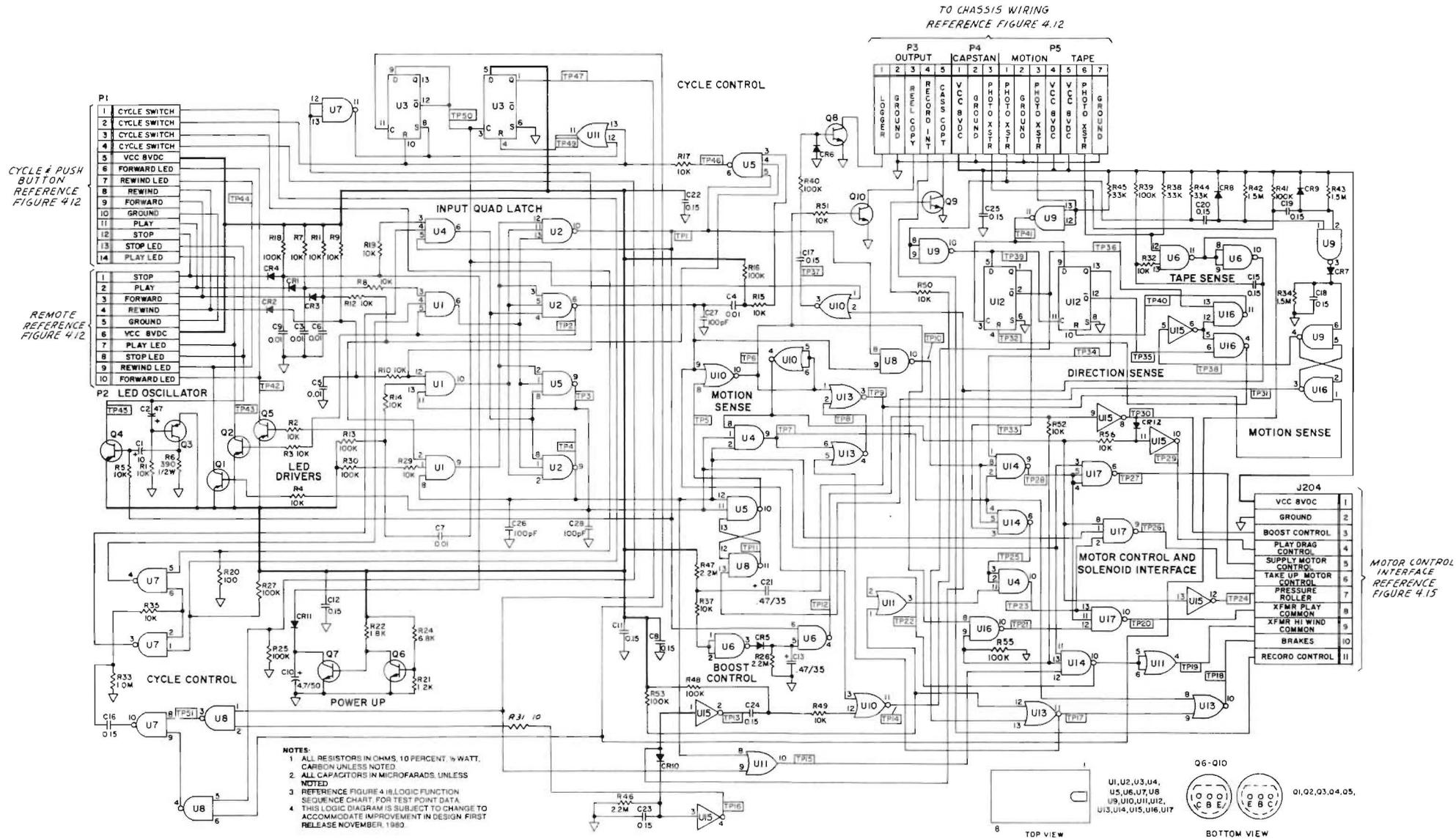
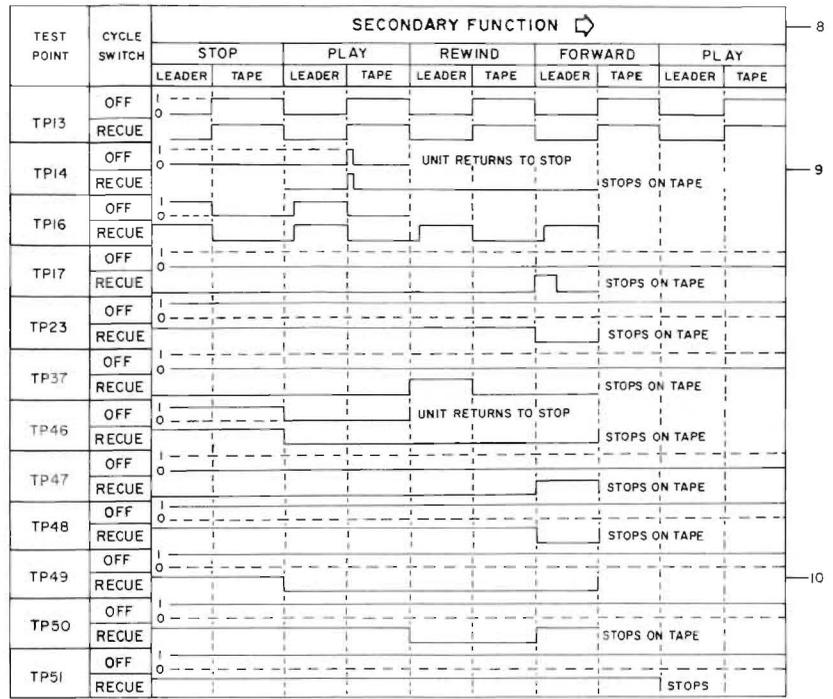
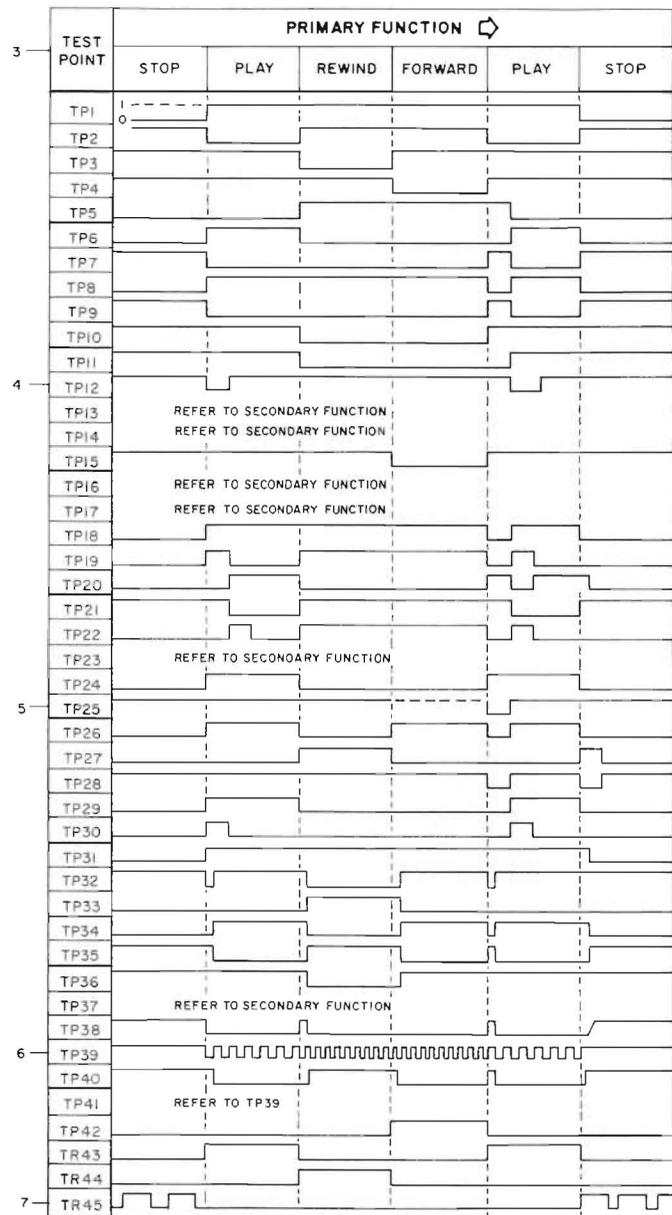


Figure 4.17 Open-Reel Logic Board Diagram, Master/Slave

Figure 4.17 Parts List

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, 1/4W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
C1	Capacitor, 10, 25V, Electrolytic	51821-020
C2	Capacitor, 47, 16V, Electrolytic	51821-068
C3-C9,C14	Capacitor, .01, 50V, Disk	52158-040
C10	Capacitor, 4.7, 50V, Electrolytic	51821-109
C11,C12,C16-C20,C22-C25	Capacitor, 0.15, 50V	52676-014
C13,C15,C21	Capacitor, .47, 35V, Tantalum	52257-069
C26-C28	Capacitor, 100 pF, Disk	52157-008
CR1-CR12	Diode, Silicon	50745-001
J204	Connector, Molex, Right Angle, 11 Pin	57720-011
P1	Connector, 14 Pin, Molex	57721-014
P2	Connector, 10 Pin, Molex	57785-010
P3	Connector, 5 Pin, Molex	57785-005
P5	Connector, 7 Pin, Molex	57785-007
Q1-Q5	Transistor, 2N5366	51820-000
Q6-Q10	Transistor, 2N2925	51547-000
R1-R5,R7-R12,R14,R15, R17,R19,R29,R32,R35, R37,R49-R52,R56	Resistor, 10K	52154-257
R6	Resistor, 390, 1/2W	52154-468
R13,R16,R18,R20,R25, R27,R30,R39-R41, R48,R53,R55	Resistor, 100K	52154-233
R21	Resistor, 1.2K	52154-279
R22	Resistor, 1.8K	52154-275
R24	Resistor, 6.8K	52154-261
R26,R46,R47	Resistor, 2.2 Meg	52154-201
R31	Resistor, 10	52154-329
R33	Resistor, 1 Meg	52154-209
R34,R42,R43	Resistor, 1.5 Meg	52154-205
R38,R44,R45	Resistor, 33K	52154-245
U1,U4	IC, CD4073B	53266-091
U2,U5,U14,U17	IC, CD4023B	53266-093
U3,U12	IC, CD4013B	53266-095
U6	IC, CD4093B	53266-096
U7-U9,U16	IC, CD4011B	53266-092
U10,U13	IC, CD4001B	53266-094
U11	IC, CD4071B	53266-097
U15	IC, CD40106B	53266-088
	Socket, 14 Pin, IC	53041-000
	Logic Board Assembly	94061-001



**NOTES:**

1. REFERENCE FIGURE 4.7, LOGIC CONTROL CARD CIRCUIT DIAGRAM, FOR TEST POINTS.
2. LOGIC 1 > 7Vdc; LOGIC 0 < 0.1Vdc.
3. PULSE TRANSITIONS OCCUR DURING AUTO SEQUENCE OR MANUAL OPERATION AND SHOULD BE MEASURED WHEN ENTERING OR LEAVING THE INDICATED MODE.
4. NEGATIVE PULSE TRANSITION WILL OCCUR WHEN ENTERING ANY MODE FROM STOP.
5. TP25 PULSE SHOWN OCCURS ONLY WHEN ENTERING PLAY OR STOP FROM REWIND.
6. AFFECTED BY RPM OF FORWARD TAKE UP MOTOR.
7. NEGATIVE PULSE TRANSITION MAY NOT RETURN TO ZERO.
8. WAVEFORMS ARE INDICATIVE OF AUTO OPERATION AFTER INITIATION OF SEQUENCE IN PLAY MODE.
9. NEGATIVE PULSE TRANSITION STARTS ON CLEAR LEADER.
10. POSITIVE LEVEL EXCURSIONS WILL OCCUR WHEN THE FORWARD OR REWIND BUTTON IS PRESSED DURING AUTO SEQUENCE.

Figure 4.18 Open-Reel Logic Function Chart, Master/Slave

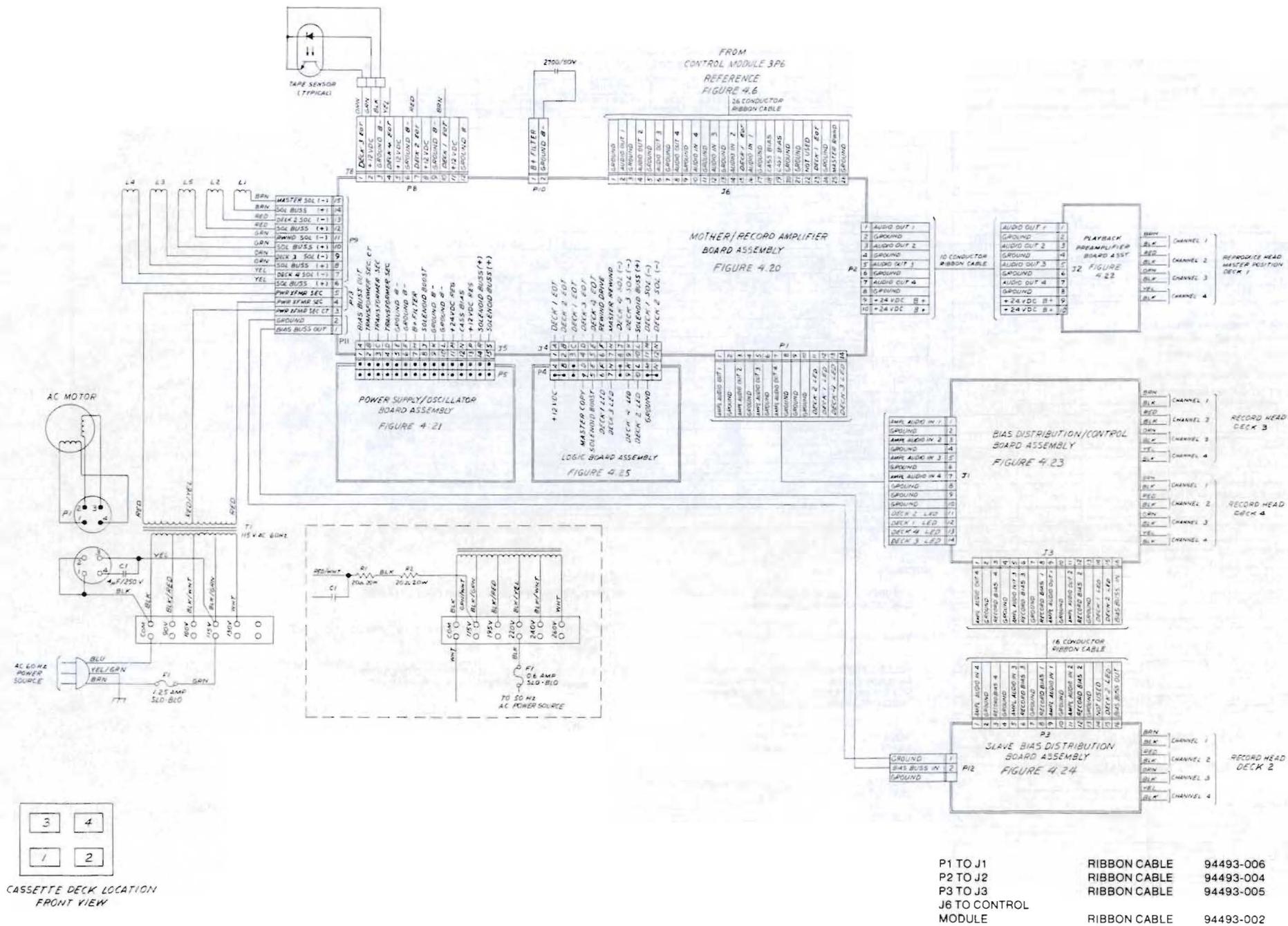


Figure 4.19 Cassette Master-Slave Chassis Wiring Diagram

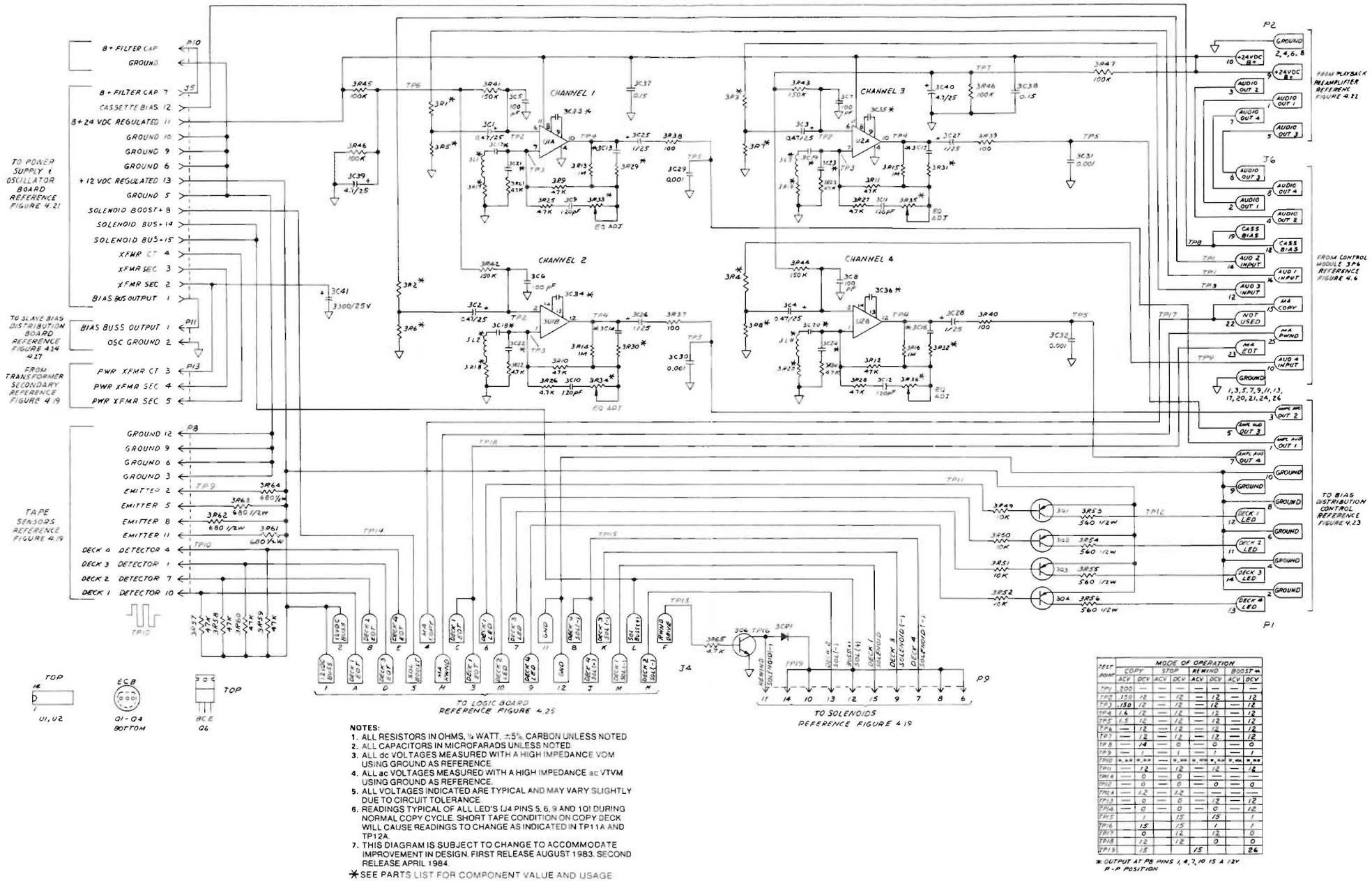


Figure 4.20 Cassette Master-Slave Mother/Record Amplifier Board Schematic Diagram

Figure 4.20 and Figure 4.28 Parts List

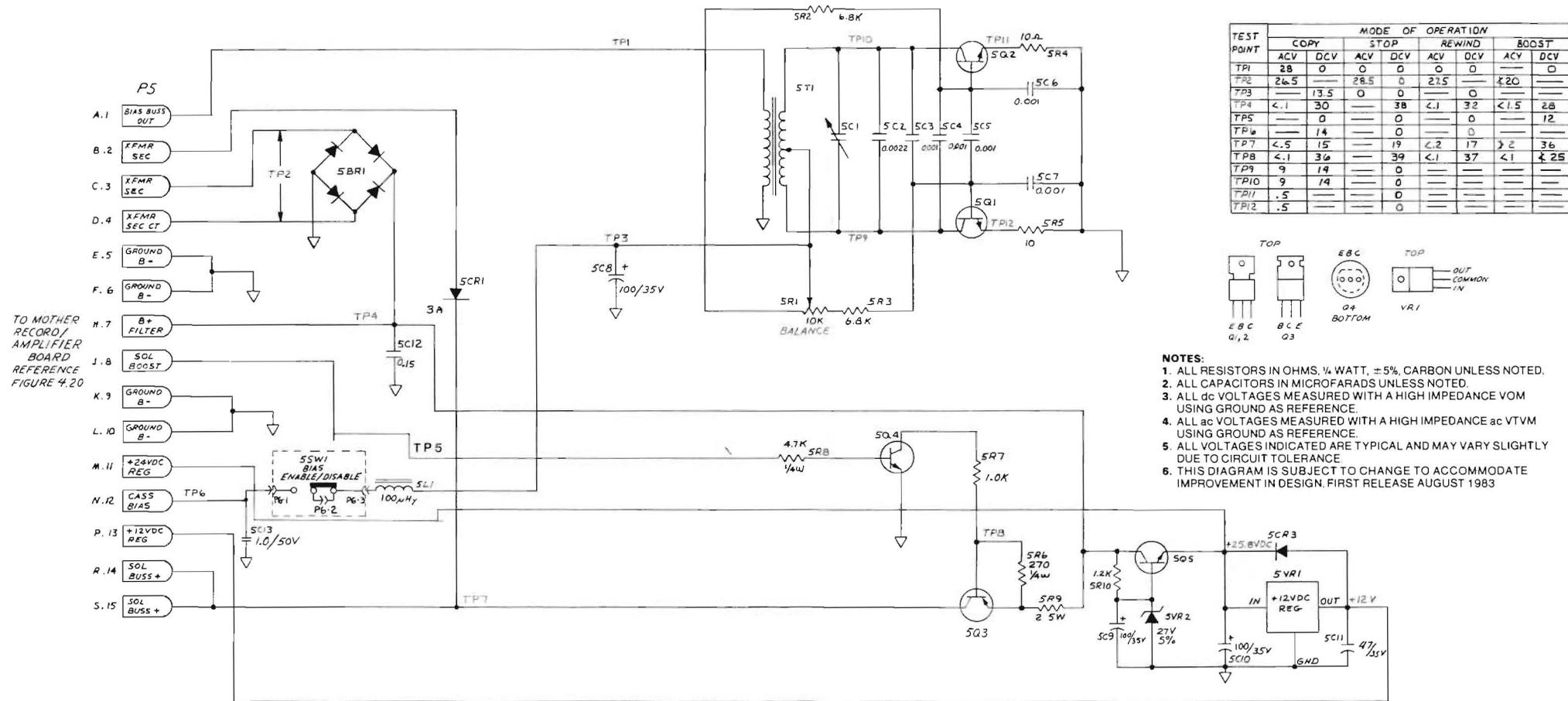
All capacitors are in microfarads unless otherwise specified.  
All resistors are in ohms, 1/4W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
3C1-3C4	Capacitor, .47, 35V (Standard and XL)	52715-039
	Capacitor, .47, 35V, Tantalum (XLP)	52257-069
3C5-3C8	Capacitor, 100 pF, Disk	52157-008
3C9-3C12	Capacitor, 120 pF, Mica	50555-021
3C13-3C16	Capacitor, .0022, Mylar (Standard & XLP)	52708-004
	Capacitor, .0015, Mylar (XL)	52708-002
3C17-3C20	Capacitor, .001, Mylar (Standard)	52708-000
	Capacitor, .0018, Mylar (XL)	52708-003
	Capacitor, .0022, Mylar (XLP)	52708-004
3C21-3C24	Capacitor, .1, Mylar (Standard & XLP)	52708-024
	Capacitor, .068, Mylar (XL)	52708-022
3C25-3C28	Capacitor, .1, 50V, Electrolytic (Standard & XL)	51821-106
	Capacitor, .1, 35V, Tantalum (XLP)	52257-049
3C29-3C32	Capacitor, .001	52157-022
3C33-3C36	Capacitor, 5 pF, Mica (Standard & XL)	50555-012
	Capacitor, 10 pF, Mica (XLP)	50555-020
3C37,3C38	Capacitor, .15, 50V, Disk	52676-014
3C39,3C40	Capacitor, 4.7, 25V, Electrolytic	51821-079
3C41	Capacitor, 3300, 25V, Electrolytic	52160-077
3CR1	Diode, 1 Amp Silicon (Master)	50745-003
J4	Socket, 12 Pin DR	57691-000
J5	Socket, 15 Pin SR	57691-009
J6	Ribbon Cable Assembly (Master)	94493-002
J7	Ribbon Cable Assembly (Slave)	94493-010
3L1-3L4	Choke, 560 μH (Standard & XLP)	51227-011
	Choke, 220 μH (XL)	59216-011
P1	Connector, 14 Pin	57742-004
P2	Connector, 10 Pin (Not used on Std Slave Module)	57742-000
P8	Connector, 12 Pin	57721-012
P9,P11,P13	Connector, 15 Pin	57708-015
P10	Connector, 2 Pin	57705-002
3Q1-3Q4	Transistor, 2N5366	51820-000
3Q6	Transistor, TIP 110 (Master)	54668-000
3R1-3R4	Resistor, 2K (Standard)	52154-274
	Resistor, 3K (XL & XLP)	52154-270
3R5-3R8	Resistor, 3K (Standard)	52154-270
	Resistor, 2K (XL & XLP)	52154-274
3R9-3R12,3R57-3R60	Resistor, 47K	52154-241
3R13-3R16	Resistor, 1M	52154-209
3R17-3R20	Resistor, 390 (Standard & XLP)	52154-291
	Resistor, 240 (XL)	52154-296
3R21-3R24	Resistor, 4.7K	52154-265
3R25-3R28	Resistor, 4.7K (Standard)	52154-265
	Resistor, 2K (XL & XLP)	52154-274
3R29-3R32	Resistor, 18K (Standard & XL)	52154-251
	Resistor, 33K (XLP)	52154-245
3R33-3R36	Potentiometer, 100K (Standard & XL)	57148-033
	Potentiometer, 500K (XLP)	57148-035
3R37-3R40	Resistor, 100	52154-305
3R41-3R44	Resistor, 150K	52154-229
3R45-3R48	Resistor, 100K	52154-233

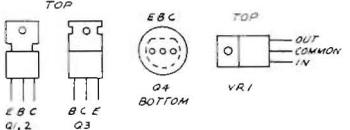
Figure 4.20 and 4.28 Parts List (Continued)

REFERENCE NO.	DESCRIPTION	PART NO.
3R49-3R52	Resistor, 10K	52154-257
3R53-3R56	Resistor, 560, 1/2W	52154-464
3R61-3R64	Resistor, 680, 1/2W	52154-462
3R65	Resistor, 4.7K, 1/2W (Master)	52154-442
3U1,3U2	IC, Dual Low Noise Operational Amplifier NE5533	53311-000
	Nut, Hex, No. 4-40	52188-006
	Washer, Lock, No. 4	50014-002
	Screw, No. 4-40 x 1/4	51845-056
	Socket, 14 Pin, IC	53041-000
	Cable Tie	51709-002

94523, Sht 1, Rev 1



TEST POINT	MODE OF OPERATION							
	COPY		STOP		REWIND		BOOST	
	ACV	DCV	ACV	DCV	ACV	DCV	ACV	DCV
TP1	28	0	0	0	0	0	0	0
TP2	26.5	—	28.5	0	27.5	—	220	—
TP3	—	13.5	0	0	—	0	—	—
TP4	<.1	30	—	38	<.1	32	<1.5	28
TP5	—	0	—	0	—	0	—	12
TP6	—	14	—	0	—	0	—	—
TP7	<.5	15	—	19	<.2	17	>.2	36
TP8	<.1	36	—	39	<.1	37	<.1	25
TP9	9	14	—	0	—	—	—	—
TP10	9	14	—	0	—	—	—	—
TP11	.5	—	—	0	—	—	—	—
TP12	.5	—	—	0	—	—	—	—



- NOTES:**
1. ALL RESISTORS IN OHMS, 1/4 WATT, ±5%, CARBON UNLESS NOTED.
  2. ALL CAPACITORS IN MICROFARADS UNLESS NOTED.
  3. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VOM USING GROUND AS REFERENCE.
  4. ALL ac VOLTAGES MEASURED WITH A HIGH IMPEDANCE ac VTVM USING GROUND AS REFERENCE.
  5. ALL VOLTAGES INDICATED ARE TYPICAL AND MAY VARY SLIGHTLY DUE TO CIRCUIT TOLERANCE.
  6. THIS DIAGRAM IS SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN. FIRST RELEASE AUGUST 1983

Figure 4.21 Cassette Power Supply/Oscillator Board Schematic Diagram

**Figure 4.21 Parts List**

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, 1/2W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
5BR1	Bridge	52313-000
5C1	Capacitor, Adjustable	86452-000
5C2	Capacitor, .0022 Poly	51191-005
5C3,5C4	Capacitor, 1000 pF, Mica	50555-006
5C5-5C7	Capacitor, .001, Disk	52157-022
5C8-5C10	Capacitor, 100, 35V, Electrolytic	51821-011
5C11	Capacitor, 50, 35V, Electrolytic	51821-010
5C12	Capacitor, 1.5	52676-014
5C13	Capacitor, 1, 50V	52676-016
5CR1	Diode, Rectifier, 3 Amp	56073-000
5CR2	Diode, Zener, 27V	51302-014
5CR3-5CR5	Diode, 1 Amp	50745-003
5L1	Choke, 100 mHy	52341-000
P6	Wafer, Friction Lock	57721-003
5Q1,5Q2	Transistor	54672-000
5Q3	Transistor, TIP 125	54662-000
5Q4	Transistor, GE 53416	51213-001
5Q5	Transistor, TIP 110	54668-000
5R1	Potentiometer, 10K	35278-006
5R2,5R3	Resistor, 6.8K	52154-438
5R4,5R5	Resistor, 10	52154-506
5R6	Resistor, 270	52154-295
5R7	Resistor, 1K	52154-458
5R8	Resistor, 4.7K, 1/4W	52154-265
5R9	Resistor, 2, 5W	51236-005
5R10	Resistor, 1.2K	52154-456
5SC1	Shield, Oscillator	95022-000
5T1	Transformer Oscillator	52940-000
5VR1	Regulator, 12V	53231-000
	Insulator, Mica	52008-001
	Heat Sink	94115-000
	Screw, No. 6-32, Nylon	50983-001
	Washer, Lock, Int. Tooth, No. 6	50014-001
	Nut, Hex, No. 4-40, Black	52188-066
	Washer, Lock, No. 4, Black	50049-103
	Screw, No. 4-40 x 3/8	51845-057
	Screw, No. 4-40 x 1/4	51845-056
	Screw, No. 6-32 x 3/8	51845-093

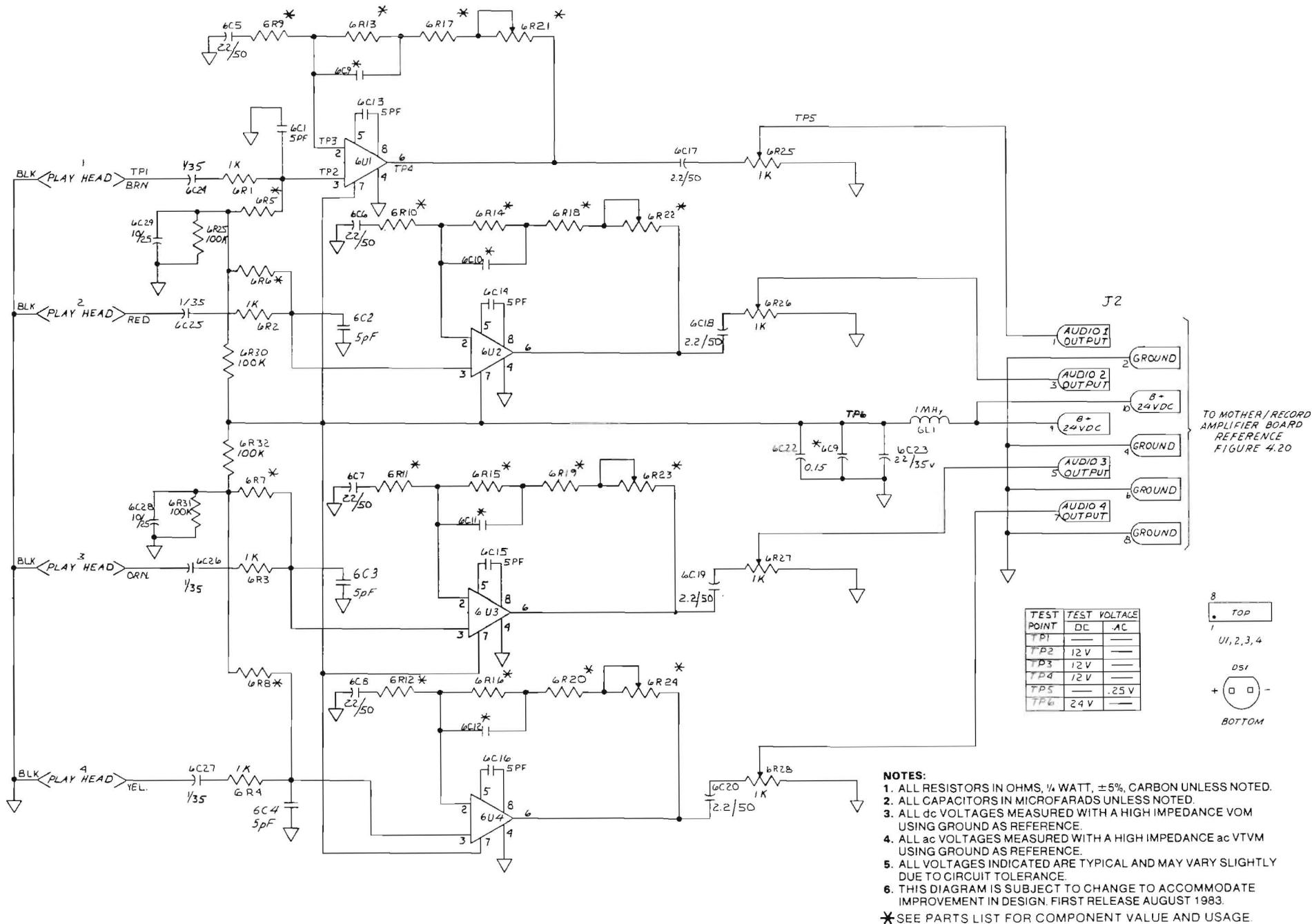


Figure 4.22 Cassette Master-Slave Playback Preamplifier Board Schematic Diagram

**Figure 4.22 Parts List**

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, 1/4W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
6C1-6C4,6C13-6C16	Capacitor, 5 pF, Mica (Standard & XL)	50555-012
	Capacitor, 10 pF, Mica (XLP)	50555-020
6C5-6C8,6C17-6C20	Capacitor, 2.2, 50V, Electrolytic (Standard & XL)	52715-043
	Capacitor, 2.2, 50V, Tantalum (XLP)	52257-077
6C9-6C12	Capacitor, 220 pF, Mica (Standard)	50555-004
	Capacitor, 330 pF, Mica (XL)	50555-017
	Capacitor, 470 pF, Mica (XLP)	50555-055
6C21,6C22	Capacitor, .15	52676-014
6C23	Capacitor, 22, 35V, Electrolytic	52160-087
6C24-6C27	Capacitor, 1, 35V, Tantalum	52257-049
6C28,6C29	Capacitor, 10, 25V, Electrolytic	51821-020
1J2	Ribbon Cable Assembly (not shown)	94493-004
6L1	Choke, 1 mHy	51227-002
6R1-6R4	Resistor, 1K	52154-281
6R5-6R8	Resistor, 330K (Standard)	52154-221
	Resistor, 68K (XL)	52187-237
	Resistor, 100K (XLP)	52154-233
6R9-6R12	Resistor, 360 (All Other Modules)	52154-292
	Resistor, 220 (4Ch, XL & XLP Modules Only)	52154-297
6R13-6R16	Resistor, 680K (Standard)	52154-213
	Resistor, 490K (XL)	52154-217
	Resistor, 750K (XLP)	52154-212
6R17-6R20	Resistor, 15K (Standard & XL)	52154-253
	Resistor, 24K (XLP)	52154-248
6R21-6R24	Potentiometer, 50K (Standard)	57148-032
	Potentiometer, 25K (XL & XLP)	57148-031
6R25-6R28	Potentiometer, 1K	57148-026
6R29-6R32	Resistor, 100K	52154-233
6U1-6U4	IC, 5534	53293-000
	Grommet (not shown)	50058-010
	Head Clips (not shown)	51740-000
	IC, Socket (not shown)	53041-002

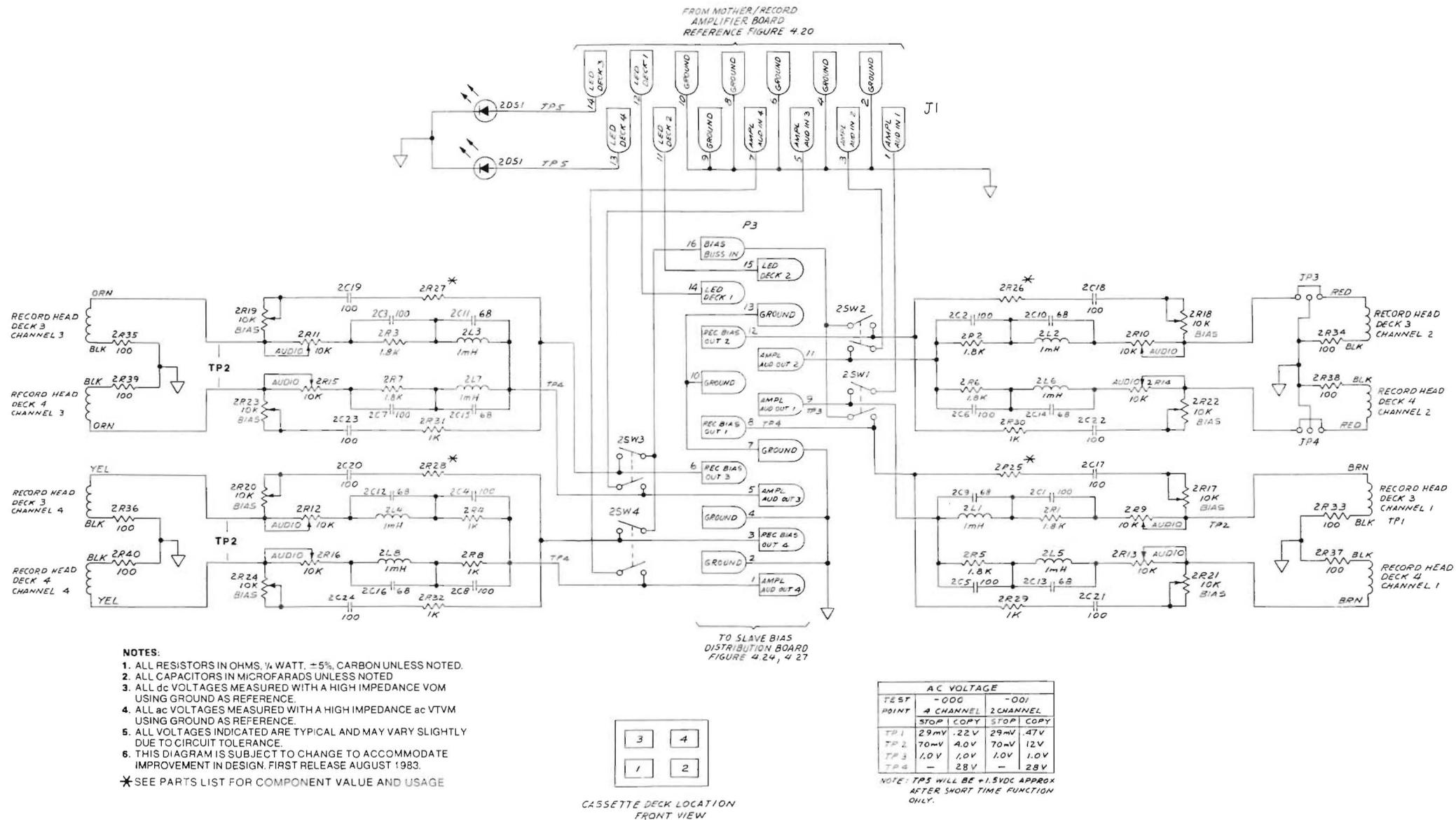


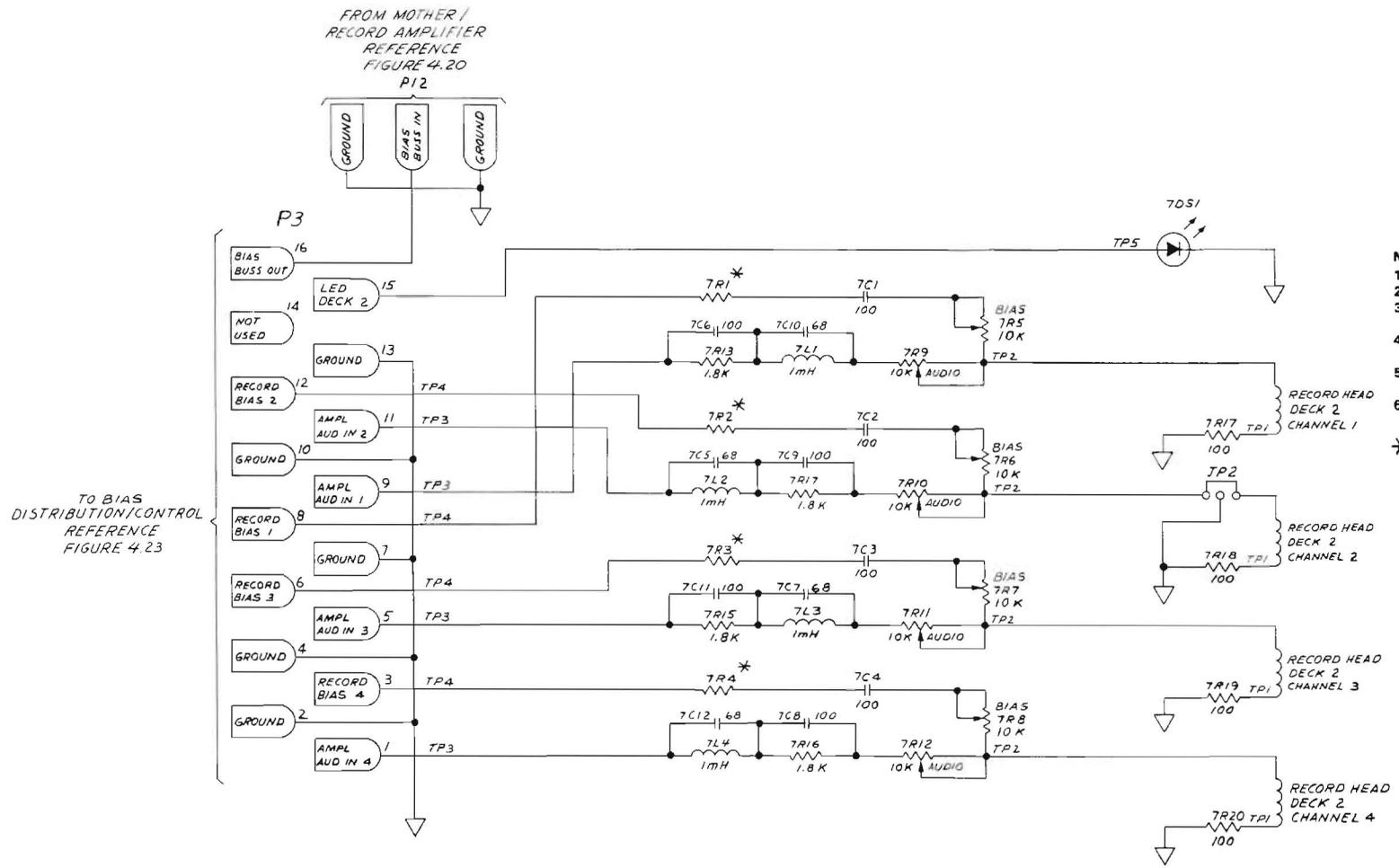
Figure 4.23 Cassette Bias Distribution/Control Board Schematic Diagram

**Figure 4.23 Parts List**

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, 1/4W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
2C1-2C8,2C17-2C24	Capacitor, 100, Disk	52157-008
2C9-2C16	Capacitor, 68, Mica	50555-019
2DS1,2DS2	LED, Red	58680-000
J1	Ribbon Cable Assembly Connector	94493-006 57744-001
J3	Ribbon Cable Assembly Connector	94493-005 57744-003
JP3,JP4	Header	57775-003
JP3,JP4	Jumper Plug, Removable	57775-001
2L1-2L8	Choke, 1 mHy	51227-002
2R1-2R8	Resistor, 1.8K	52154-275
2R9-2R24	Potentiometer, 10K	57148-029
2R25-2R32	Resistor, 1K (4 Channel) Resistor, 220 (2 Channel)	52154-281 52154-297
2R33-2R40	Resistor, 100	52154-305
2SW1-2SW4	Switch, Head Clip, Head Pin (not shown) Grommet (not shown) Switch Bracket (not shown) Screw, No. 4-40 x 1/8	57517-000 51740-000 50058-010 93772-000 51845-036

94538, Sh. 1, Rev. 1

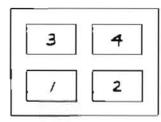


TO BIAS DISTRIBUTION/CONTROL REFERENCE FIGURE 4.23

- NOTES:**
1. ALL RESISTORS IN OHMS, 1/4 WATT, ±5%, CARBON UNLESS NOTED.
  2. ALL CAPACITORS IN MICROFARADS UNLESS NOTED.
  3. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VOM USING GROUND AS REFERENCE.
  4. ALL ac VOLTAGES MEASURED WITH A HIGH IMPEDANCE ac VTVM USING GROUND AS REFERENCE.
  5. ALL VOLTAGES INDICATED ARE TYPICAL AND MAY VARY SLIGHTLY DUE TO CIRCUIT TOLERANCE.
  6. THIS DIAGRAM IS SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN, FIRST RELEASE AUGUST 1983.
- \* SEE PARTS LIST FOR COMPONENT VALUE AND USAGE.

TEST POINT	AC VOLTAGES			
	- 001		- 000	
	2 CHANNEL	4 CHANNEL	2 CHANNEL	4 CHANNEL
TP1	29mV	0.47V	29mV	0.22V
TP2	70mV	12V	70mV	4.0V
TP3	1.0mV	1.0V	1.0mV	1.0V
TP4	-	28V	-	28V
TP5	1.5V *			

\* DURING JAMMED OR PREMATURE END-OF-TAPE MODES ONLY



CASSETTE DECK LOCATION FRONT VIEW

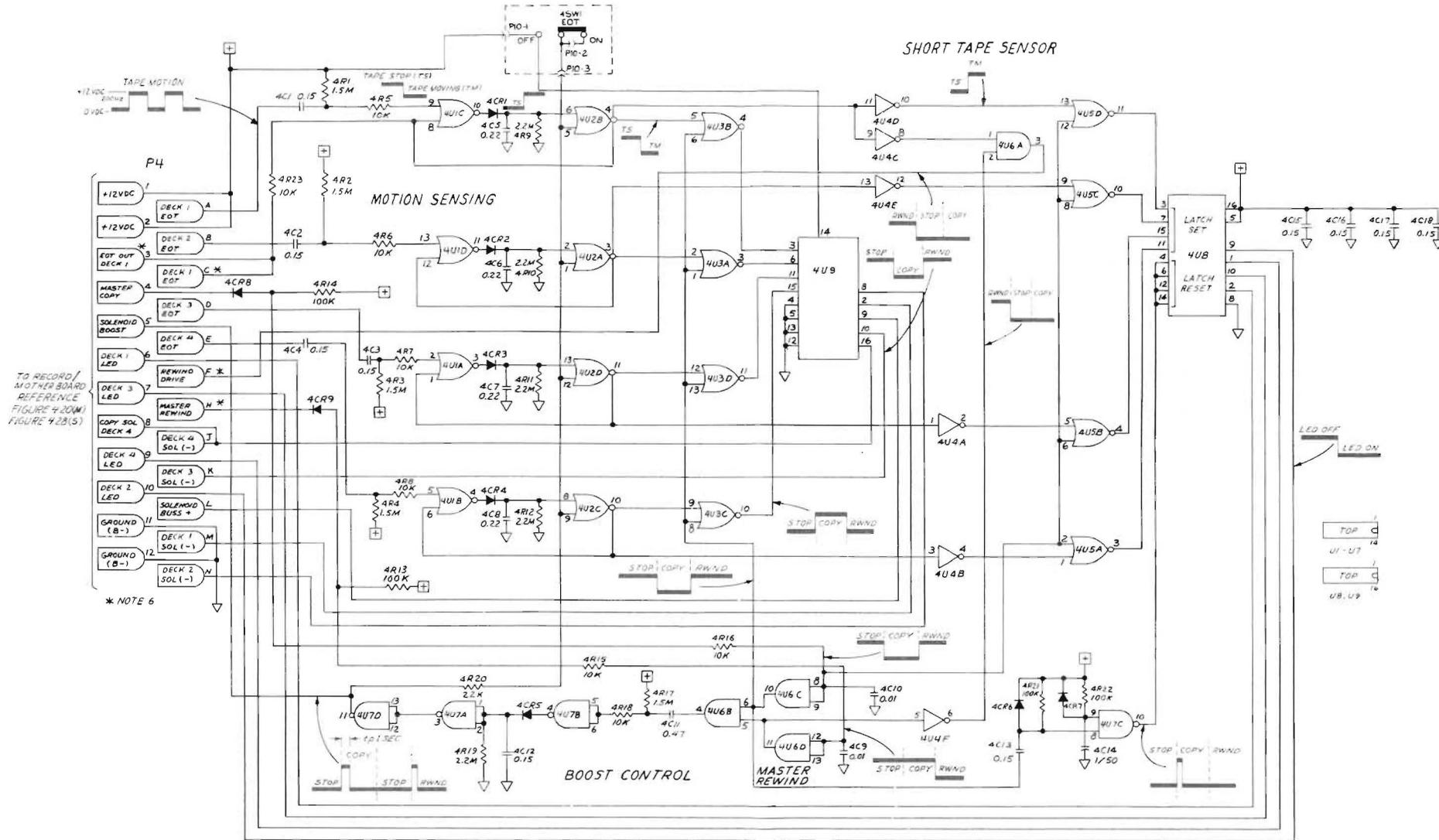
Figure 4.24 Cassette Master-Slave Bias Distribution Board Schematic Diagram

**Figure 4.24 Parts List**

All resistors are in ohms,  $\frac{1}{4}W$ ,  $\pm 5\%$ , carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
7C1-7C4,7C6,7C8-7C11	Capacitor, 100 pF, Disk	52157-008
7C5,7C7,7C10,7C12	Capacitor, 68 pF, Mica	50555-019
7DS1	Diode, Red Light Emitting (LED)	58680-000
7L1-7L4	Choke, 1 mHy	51227-002
JP2	Header	57775-003
JP2	Plug	57775-001
P3	Connector, Right Angle, 16 Pin	57743-008
P12	Connector, 3 Pin	57721-003
7R1-7R4	Resistor, 1K (4 Channel)	52154-281
	Resistor (2 Channel)	52154-297
7R5-7R12	Potentiometer, 10K	57148-029
7R13-7R16	Resistor, 1.8K	52154-275
7R17-7R20	Resistor, 100	52154-305
	Grommet	50058-010

94541, S00 1, Rev E



- NOTES:**
1. ALL RESISTORS IN OHMS, 1/4 WATT, ±5%, CARBON UNLESS NOTED
  2. ALL CAPACITORS IN MICROFARADS UNLESS NOTED
  3. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VOM USING GROUND AS REFERENCE.
  4. ALL ac VOLTAGES MEASURED WITH A HIGH IMPEDANCE ac VTVM USING GROUND AS REFERENCE.
  5. ALL VOLTAGES INDICATED ARE TYPICAL AND MAY VARY SLIGHTLY DUE TO CIRCUIT TOLERANCE.
  6. NOT USED ON SLAVE ONLY MODULE. REFERENCE FIGURE 4.28.
  7. THIS DIAGRAM IS SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN. FIRST RELEASE AUGUST 1983. SECOND RELEASE APRIL 1984.

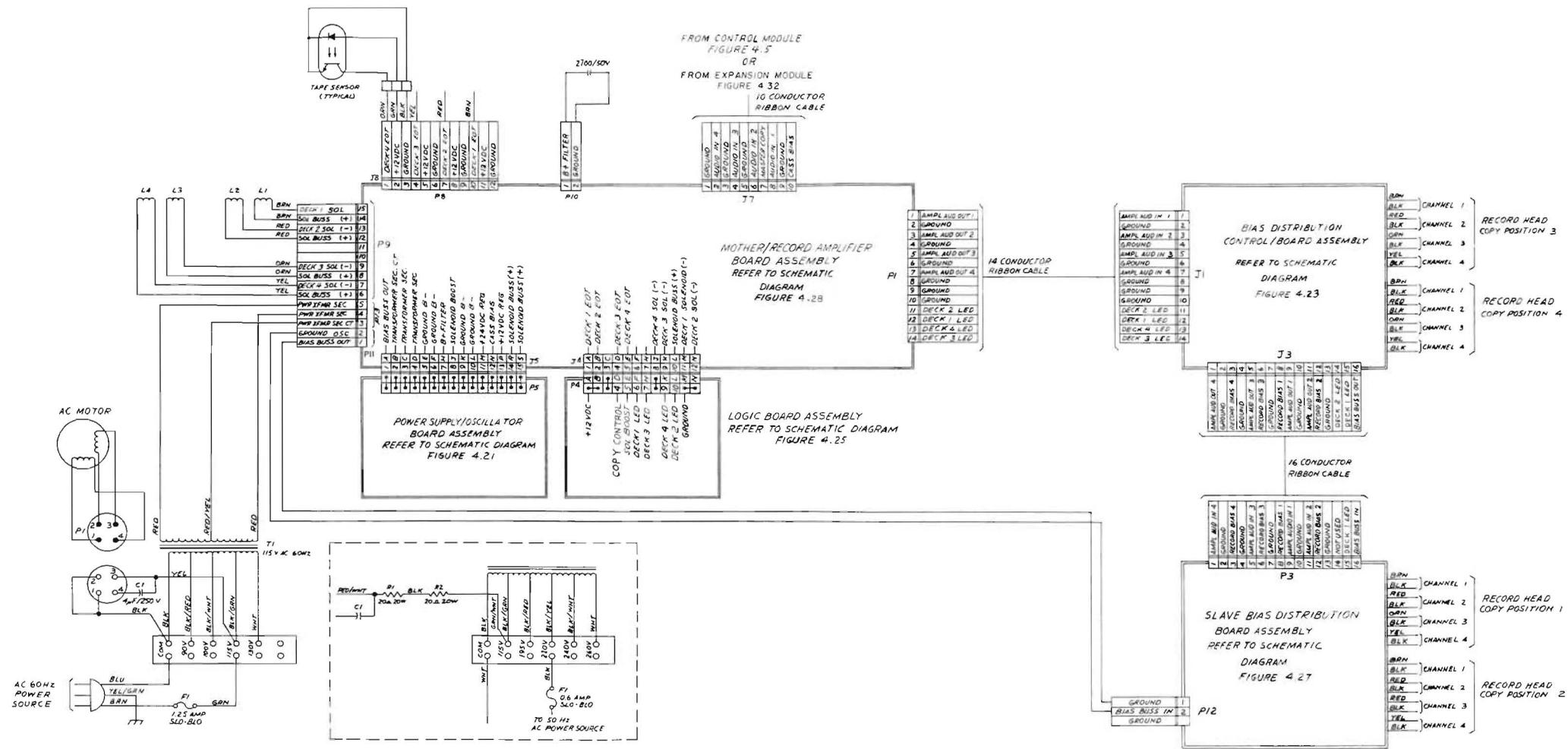
Figure 4.25 Cassette Master-Slave Logic Board Diagram

**Figure 4.25 Parts List**

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms,  $\frac{1}{4}W$ ,  $\pm 5\%$ , carbon unless otherwise specified.

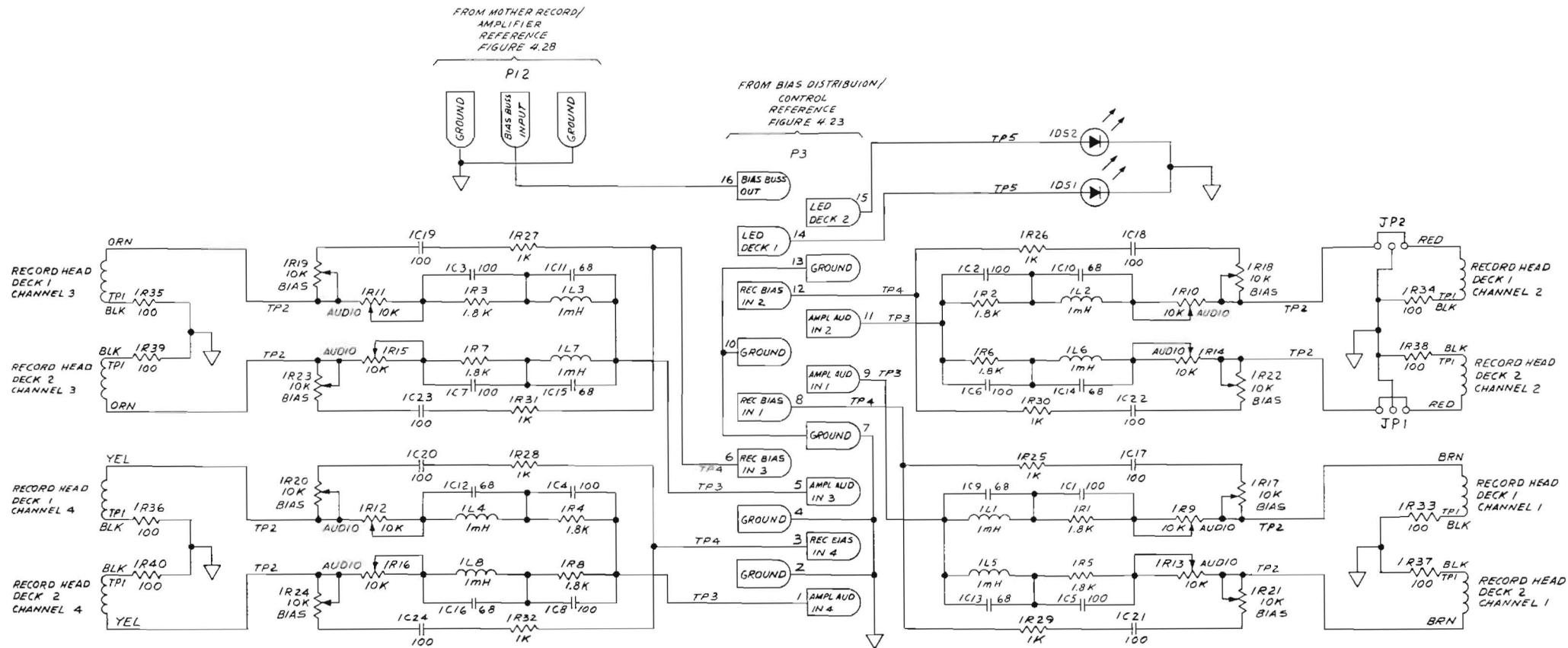
REFERENCE NO.	DESCRIPTION	PART NO.
4C1-4C4,4C12,4C13, 4C15-4C18	Capacitor, .15	52676-014
4C5-4C8	Capacitor, .22	52708-028
4C9,4C10	Capacitor, .01, 50V	52158-040
4C11	Capacitor, .47, 50V	52715-039
4C14	Capacitor, 1, 50V, Electrolytic	51821-106
4CR1-4CR9	Diode, 1 Amp	50745-003
P10	Wafer, Friction Lock	57721-003
4R1-4R4,4R17	Resistor, 1.5M	52154-205
4R5-4R8,4R15,4R16, 4R18,4R23	Resistor, 10K	52154-257
4R9-4R12,4R19	Resistor, 22M	52154-201
4R13,4R14,4R21,4R22	Resistor, 100K	52154-233
4R20	Resistor, 22K	52154-249
4U1-4U3,4U5	IC, 4001	53266-094
4U4	IC, 4069	53266-090
4U6	IC, 4081	53266-033
4U7	IC, 4093	53266-096
4U8	IC, 4043	53266-100
4U9	IC, 2071	53299-000
	IC Socket, 14 Pin	53041-000
	IC Socket, 16 Pin	53041-001

94526, Rev G



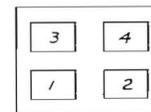
P1 TO J1	RIBBON CABLE	94493-006
P3 TO J3	RIBBON CABLE	94493-005
J7 TO CONTROL MODULE	RIBBON CABLE	94493-010

Figure 4.26 Cassette Slave Chassis Wiring Diagram

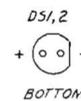


**NOTES:**

1. ALL RESISTORS IN OHMS, 1/4 WATT, ±5%, CARBON UNLESS NOTED.
2. ALL CAPACITORS IN MICROFARADS UNLESS NOTED.
3. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VOM USING GROUND AS REFERENCE.
4. ALL ac VOLTAGES MEASURED WITH A HIGH IMPEDANCE ac VTVM USING GROUND AS REFERENCE.
5. ALL VOLTAGES INDICATED ARE TYPICAL AND MAY VARY SLIGHTLY DUE TO CIRCUIT TOLERANCE.
6. THIS DIAGRAM IS SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN. FIRST RELEASE AUGUST 1983.



CASSETTE DECK LOCATION  
FRONT VIEW



TEST POINT	AC VOLTAGE			
	-000		-001	
	4 CHANNEL	2 CHANNEL	4 CHANNEL	2 CHANNEL
TP1	29mV	.22V	29mV	.47V
TP2	70mV	4.0V	70mV	12V
TP3	1.0V	1.0V	1.0V	1.0V
TP4	-	28V	-	28V
TP5	1.5V*			

\* DURING JAMMED OR PREMATURE END-OF-TAPE MODES ONLY.

Figure 4.27 Cassette Slave Bias Distribution Board Schematic Diagram

**Figure 4.27 Parts List**

All resistors are in ohms, ¼W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
IC1-IC8,IC17-IC24	Capacitor, 100 pF, Disk	52157-008
IC9-IC16	Capacitor, 68 pF, Mica	50555-019
IDS1,IDS2	Diode, Red Light Emitting (LED)	58680-000
JP1,JP2	Header	57775-003
	Plug	57775-001
IL1-IL8	Choke, 1 mHy	51227-002
P3	Connector, Right Angle, 16 Pin	57743-008
P12	Connector, 3 Pin	57721-003
IR1-IR8	Resistor, 1.8K	52154-275
IR9-IR24	Potentiometer, 10K	57148-029
IR25-IR32	Resistor, 1K	52154-281
IR33-IR40	Resistor, 100	52154-305
	Clip, Head Pin	51740-000
	Grommet	50058-010
	Standoff, LED	80660-208

94535, Sht 1, Rev G

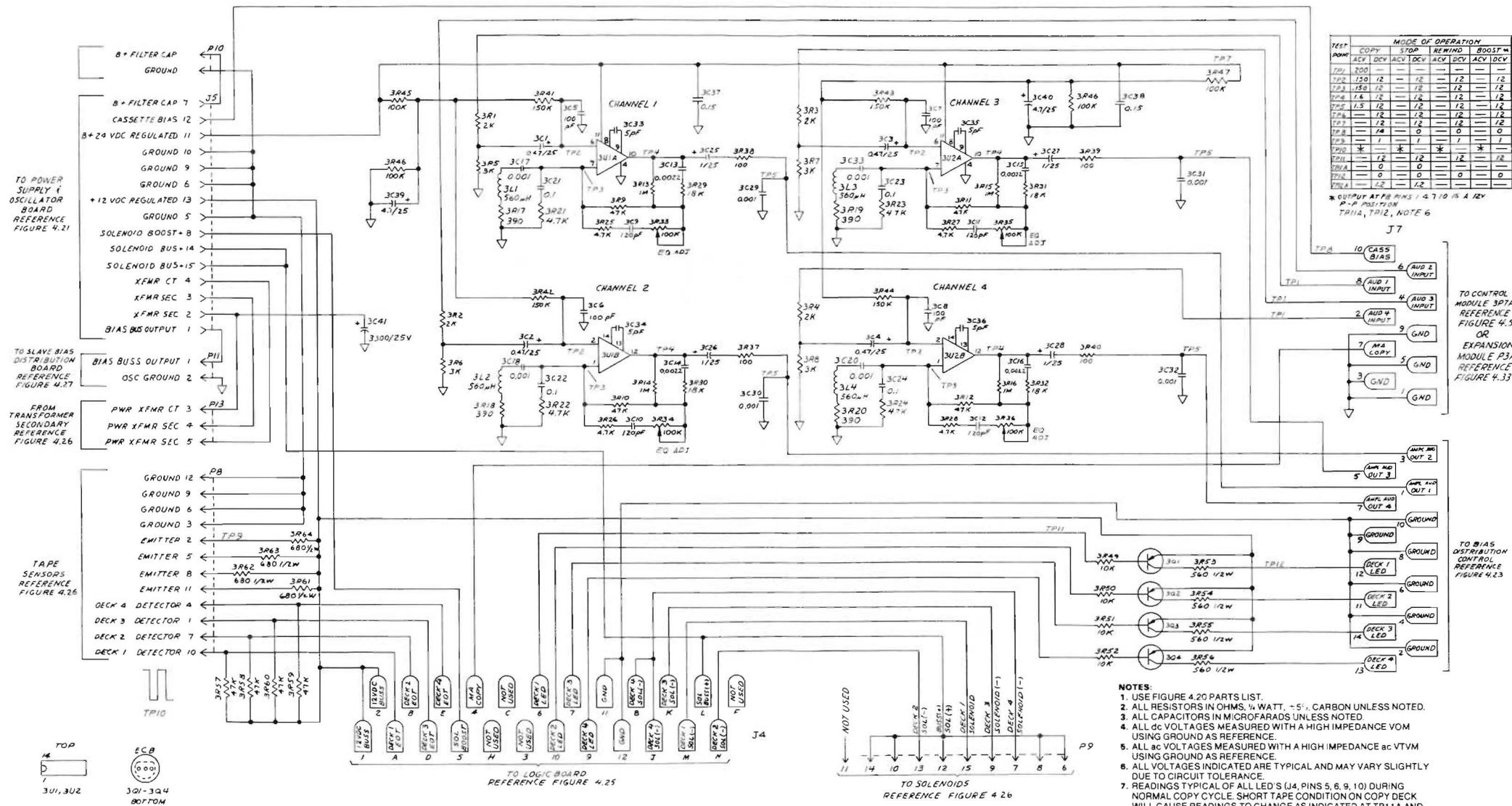


Figure 4.28 Cassette Slave Mother/Record Amplifier Board Schematic Diagram (Reference page 4-42 for parts list)

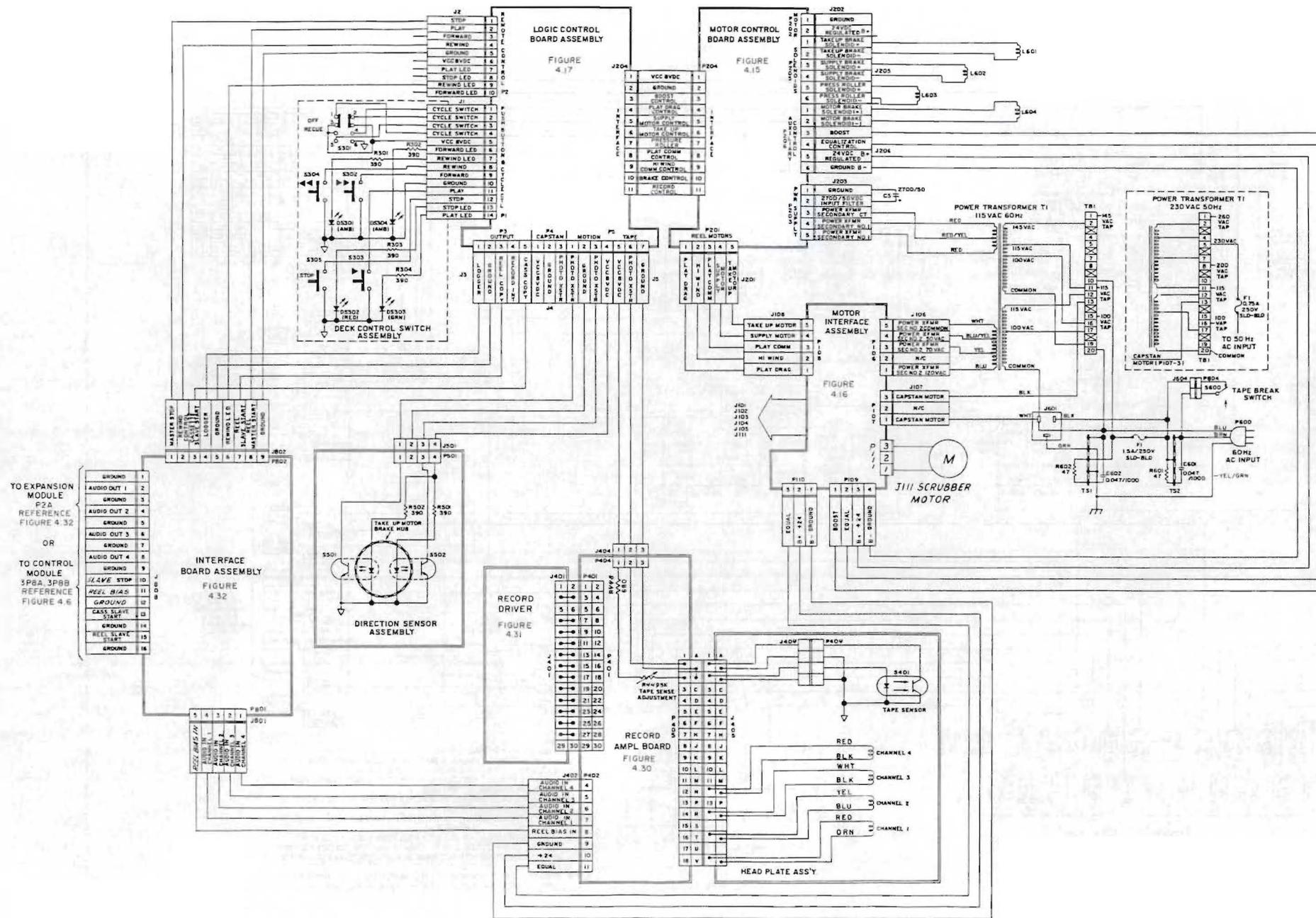
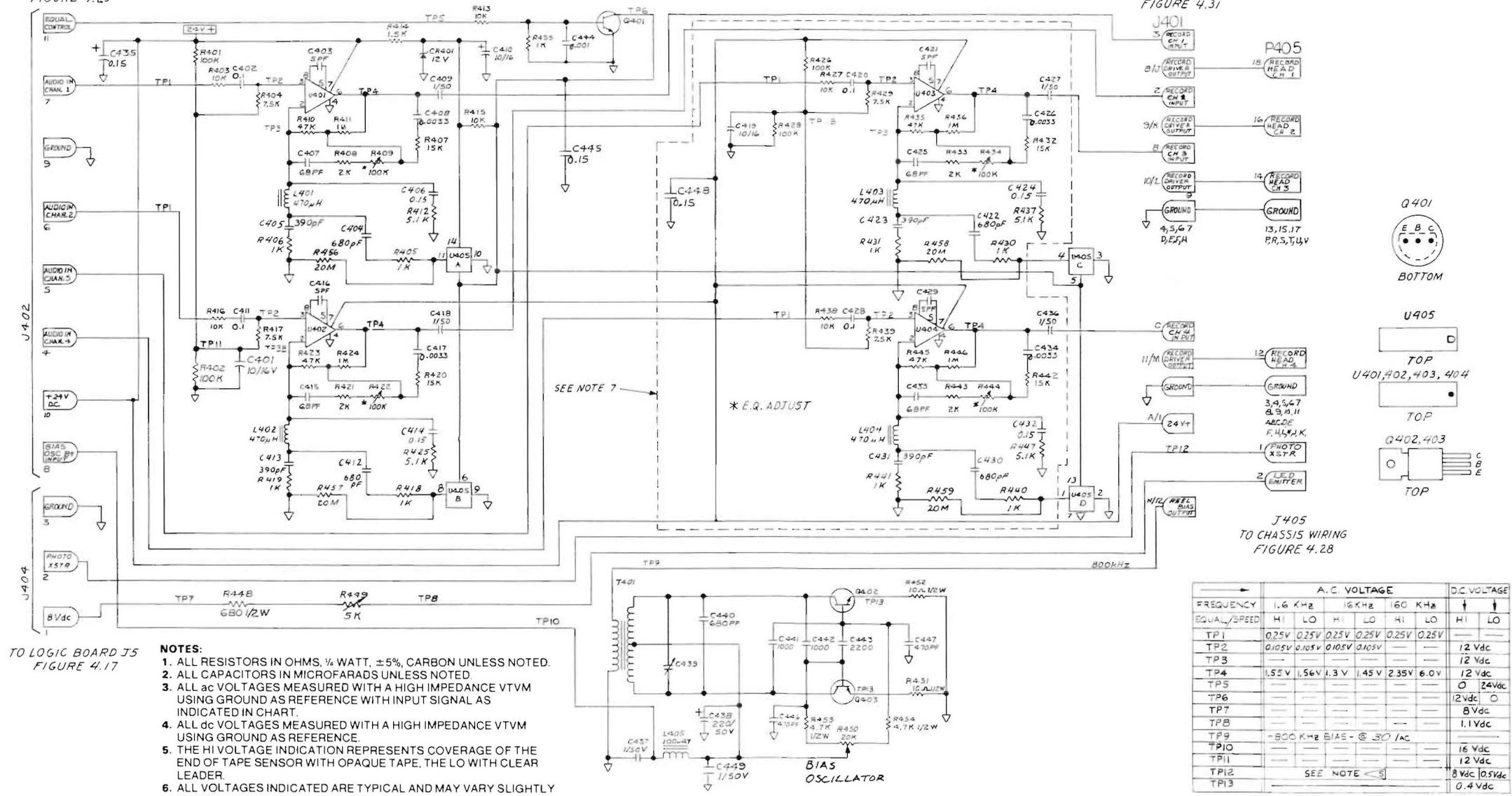


Figure 4.29 Open-Reel Slave Chassis Wiring Diagram

TO CHASSIS WIRING  
J801 REFERENCE  
FIGURE 4.29

TO RECORD  
DRIVER  
FIGURE 4.31



TO LOGIC BOARD J5  
FIGURE 4.17

- NOTES:**
1. ALL RESISTORS IN OHMS, 1/4 WATT, ±5%, CARBON UNLESS NOTED.
  2. ALL CAPACITORS IN MICROFARADS UNLESS NOTED.
  3. ALL ac VOLTAGES MEASURED WITH A HIGH IMPEDANCE VTVM USING GROUND AS REFERENCE WITH INPUT SIGNAL AS INDICATED IN CHART.
  4. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VTVM USING GROUND AS REFERENCE.
  5. THE HI VOLTAGE INDICATION REPRESENTS COVERAGE OF THE END OF TAPE SENSOR WITH OPAQUE TAPE, THE LO WITH CLEAR LEADER.
  6. ALL VOLTAGES INDICATED ARE TYPICAL AND MAY VARY SLIGHTLY DUE TO CIRCUIT TOLERANCE.
  7. COMPONENTS DELETED ON 2 CHANNEL.
  8. THIS DIAGRAM IS SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN. FIRST RELEASE APRIL 1984.

SEE NOTE 7  
\* E.Q. ADJUST

J405  
TO CHASSIS WIRING  
FIGURE 4.28

FREQUENCY	A.C. VOLTAGE				D.C. VOLTAGE				
	1.6 KHz	16 KHz	160 KHz	HI	LO	HI	LO		
EQUAL/SPEED	HI	LO	HI	LO	HI	LO	HI	LO	
TP1	0.25V	0.25V	0.25V	0.25V	0.25V	0.25V	—	—	
TP2	0.105V	0.105V	0.105V	0.105V	—	—	12 Vdc	—	
TP3	—	—	—	—	—	—	12 Vdc	—	
TP4	1.55V	1.56V	1.3V	1.45V	2.35V	6.0V	12 Vdc	—	
TP5	—	—	—	—	—	—	0 24Vdc	—	
TP6	—	—	—	—	—	—	12Vdc	0	
TP7	—	—	—	—	—	—	8Vdc	—	
TP8	—	—	—	—	—	—	1.1Vdc	—	
TP9	-800 KHz BIAS - @ 30 IAC							—	—
TP10	—	—	—	—	—	—	16 Vdc	—	
TP11	—	—	—	—	—	—	12 Vdc	—	
TP12	SEE NOTE 5							8Vdc	10.5Vdc
TP13	—							—	0.4 Vdc

Figure 4.30 Open-Reel Slave Record Amplifier/Bias Oscillator Board Schematic Diagram

Figure 4.30 Parts List

All capacitors are in microfarads unless otherwise specified.  
All resistors are in ohms, 1/4 W, carbon unless otherwise specified.

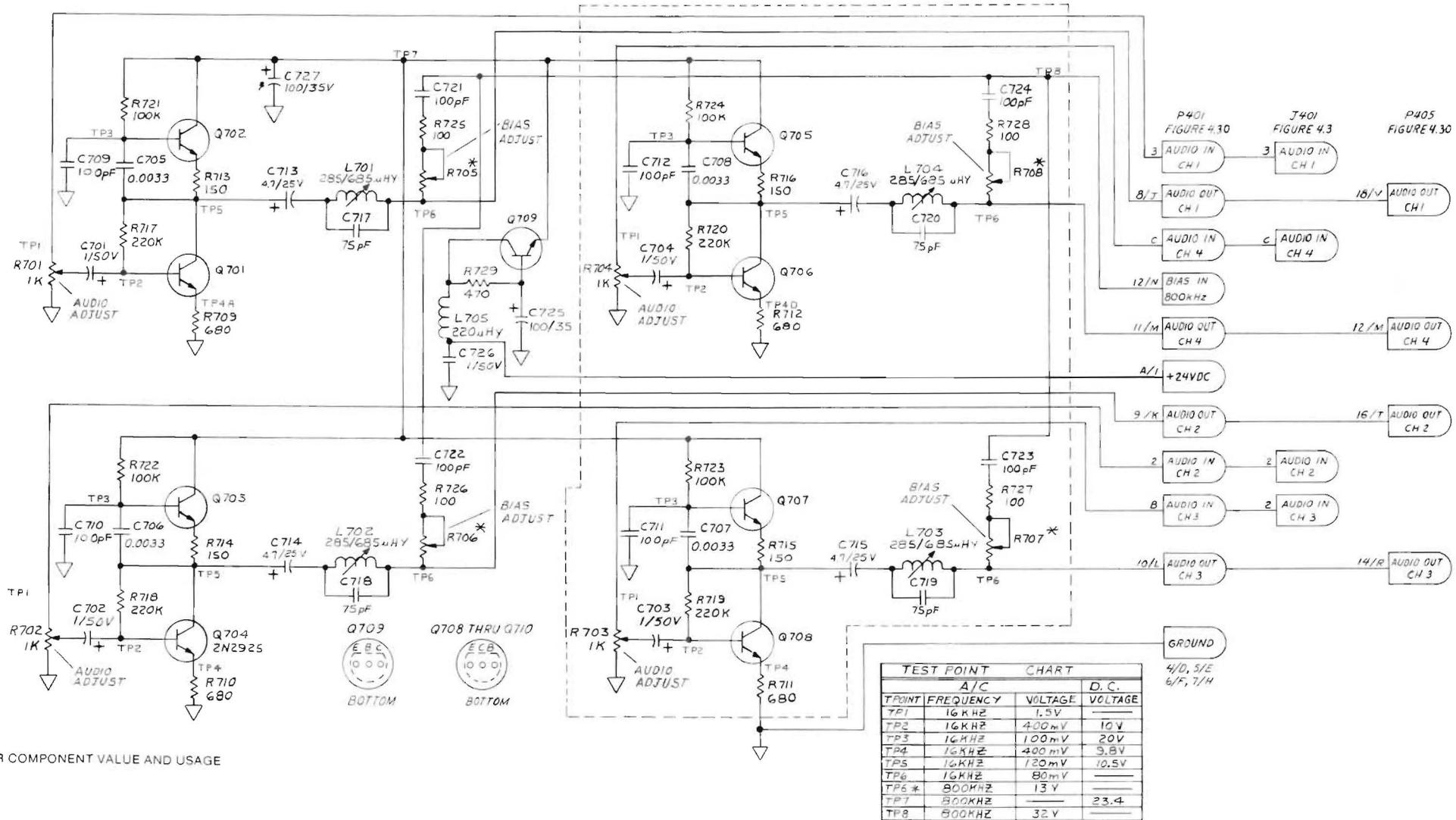
REFERENCE NO.	DESCRIPTION	PART NO.
C401,C410,C419	Capacitor, 10, 16V, Electrolytic	52257-026
C402,C411,C420,C428	Capacitor, 0.1	52708-024
C403,C416,C421,C429	Capacitor, 5 pF, Mica	50555-012
C404,C412,C422,C430	Capacitor, 680 pF, Disk	52157-020
C405,C413,C423,C431	Capacitor, 390 pF, Disk	52157-016
C406,C414,C424,C432	Capacitor, 0.15	52708-026
C407,C415,C425,C533	Capacitor, 68 pF, Mica	50555-019
C408,C417,C426,C434	Capacitor, 0.0033	52708-006
C409,C418,C427,C436	Capacitor, 1, 50V, Electrolytic	52715-041
C435,C445,C448	Capacitor, 0.15	52676-014
C437,C449	Capacitor, 1, 50V, Ceramic	52676-016
C438	Capacitor, 220, 50V, Electrolytic	51821-117
C439	Capacitor, Variable	86452-000
C440	Capacitor, 680 pF, 160V	51191-074
C441,C442	Capacitor, 1000	50555-006
C443	Capacitor, 2200	50555-007
C444	Capacitor, 0.001, Disk	52157-022
C446,C447	Capacitor, 470 pF, Disk	52157-017
CR401	Diode, Zener, 1N4742, 12V	51301-010
J401	Connector, 12 Pin	57691-009
J402	Socket, 11 Pin	57712-011
L401-L404	Choke, 470 μHy	51227-012
L405	Choke, 100 μHy	52341-000
Q401	Transistor, 2N3416	51213-001
Q402,Q403	Transistor	54672-000
R401,R402,R426,R428	Resistor, 100K	52154-233
R403,R413,R415,R416, R427,R438	Resistor, 10K	52154-257
R404,R417,R429,R439	Resistor, 7.5K	52154-260
R405,R406,R418,R419, R430,R431,R440, R441,R455	Resistor, 1K	52154-281
R407,R420,R432,R442	Resistor, 15K	52154-253
R408,R421,R433,R443	Resistor, 2K	52154-274
R409,R422,R434,R444	Potentiometer, 100K	57148-033
R410,R423,R435,R445	Resistor, 47K	52154-241
R411,R424,R436,R446	Resistor, 1 Meg	52154-209
R412,R425,R437,R447	Resistor, 5.1K	52154-264
R414	Resistor, 1.5K	52154-277
R448	Resistor, 680, 1/2 W	52154-462
R449	Potentiometer, 5K	35278-058
R450	Potentiometer, 20K	57148-030
R451,R452	Resistor, 10, 1/2 W	52154-506
R453,R454	Resistor, 4.7K, 1/2 W	52154-442
R456-R459	Resistor, 20 Meg	52154-178
T401	Transformer	52940-000
U401-U404	Integrated Circuit, 5534	53293-000
U405	Integrated Circuit, 4066	53266-099
	IC Socket, 14 Pin	53041-000
	IC Socket, 8 Pin	53041-002

Figure 4.30 Parts List (Continued)

REFERENCE NO.	DESCRIPTION	PART NO.
	Printed Circuit Board Support	93775-000
	Mica Insulator, Transistor	52008-000
	Screw, Nylon, No. 6	50983-001
	Screw, No. 4-24, Hex Head	51842-001

94556, Rev C

- NOTES:**
1. ALL RESISTORS IN OHMS, 1/4 WATT, ±5% CARBON UNLESS NOTED.
  2. ALL CAPACITORS IN MICROFARADS UNLESS NOTED.
  3. COMPONENTS DELETED ON 2 CHANNEL.
  4. ALL ac VOLTAGES MEASURED WITH A HIGH IMPEDANCE VTVM USING GROUND AS REFERENCE WITH AN INPUT SIGNAL OF 16 KHZ.
  5. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VTVM USING GROUND AS REFERENCE.
  6. ALL VOLTAGES INDICATED ARE TYPICAL AND MAY VARY SLIGHTLY DUE TO CIRCUIT TOLERANCE.
  7. THIS DIAGRAM IS SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN FIRST RELEASE APRIL 1984.



\* SEE PARTS LIST FOR COMPONENT VALUE AND USAGE

Figure 4.31 Open-Reel Slave Record Driver Board Schematic Diagram

**Figure 4.31 Parts List**

All capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, ¼W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
C701-C704	Capacitor, 1, 50V, Electrolytic	52715-041
C705-C708	Capacitor, 0.033	52708-018
C709-C712	Capacitor, 100 pF, Disk	52157-008
C713-C716	Capacitor, 4.7, 25V, Electrolytic	52715-024
C717-C720	Capacitor, 75 pF, Mica	50555-016
C721-C724	Capacitor, 100 pF, Disk	52157-008
C725,C727	Capacitor, 100, 35V, Electrolytic	51821-011
C726	Capacitor, 1, 50V, Ceramic	52676-016
L701-L704	Choke, Adjustable, 285-685 μHy	52964-000
L705	Choke, 220 μHy	51227-010
Q701-Q708	Transistor, 2N2925	51547-002
Q709	Transistor, 2N3416	51213-001
R701-R704	Potentiometer, 1K	57148-026
R705-R708	Potentiometer, 10K (2 Channel)	57148-029
	Potentiometer, 5K (4 Channel)	57148-028
R709-R712	Resistor, 680	52154-285
R713-R716	Resistor, 150	52154-301
R717-R720	Resistor, 220K	52154-225
R721-R724	Resistor, 100K	52154-233
R725-R728	Resistor, 100	52154-305
R729	Resistor, 470	52154-289

Figure 4.32 Open-Reel Slave Interface Board Schematic Diagram

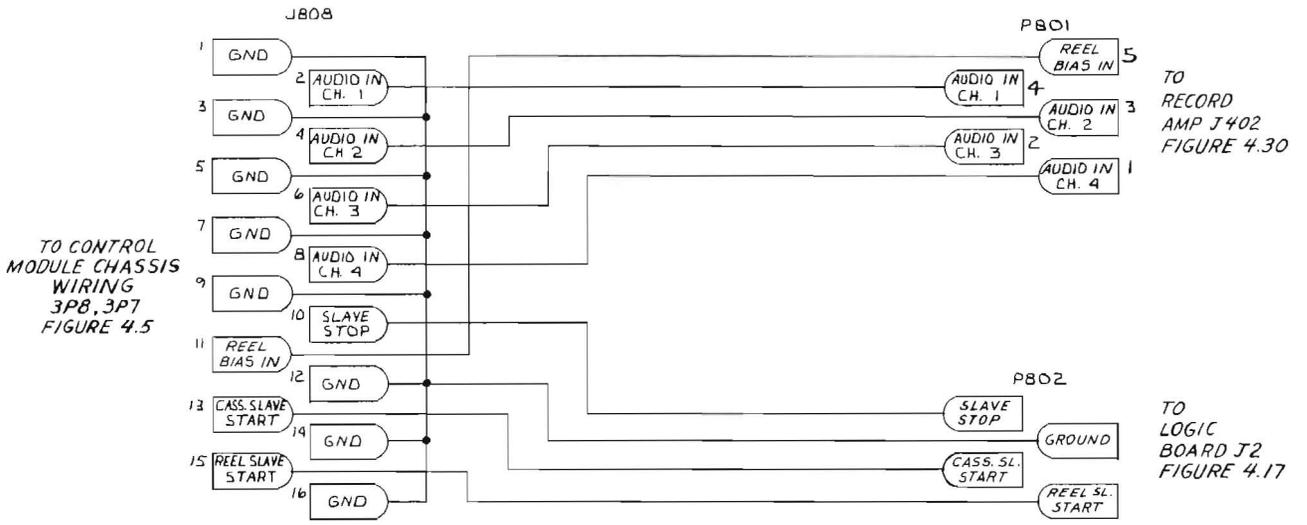


Figure 4.32 Parts List

REFERENCE NO.	DESCRIPTION	PART NO.
J808	Cable Assy	94493-009
P801	Connector, 5 Pin	57721-005
P802	Connector, 4 Pin	57721-004

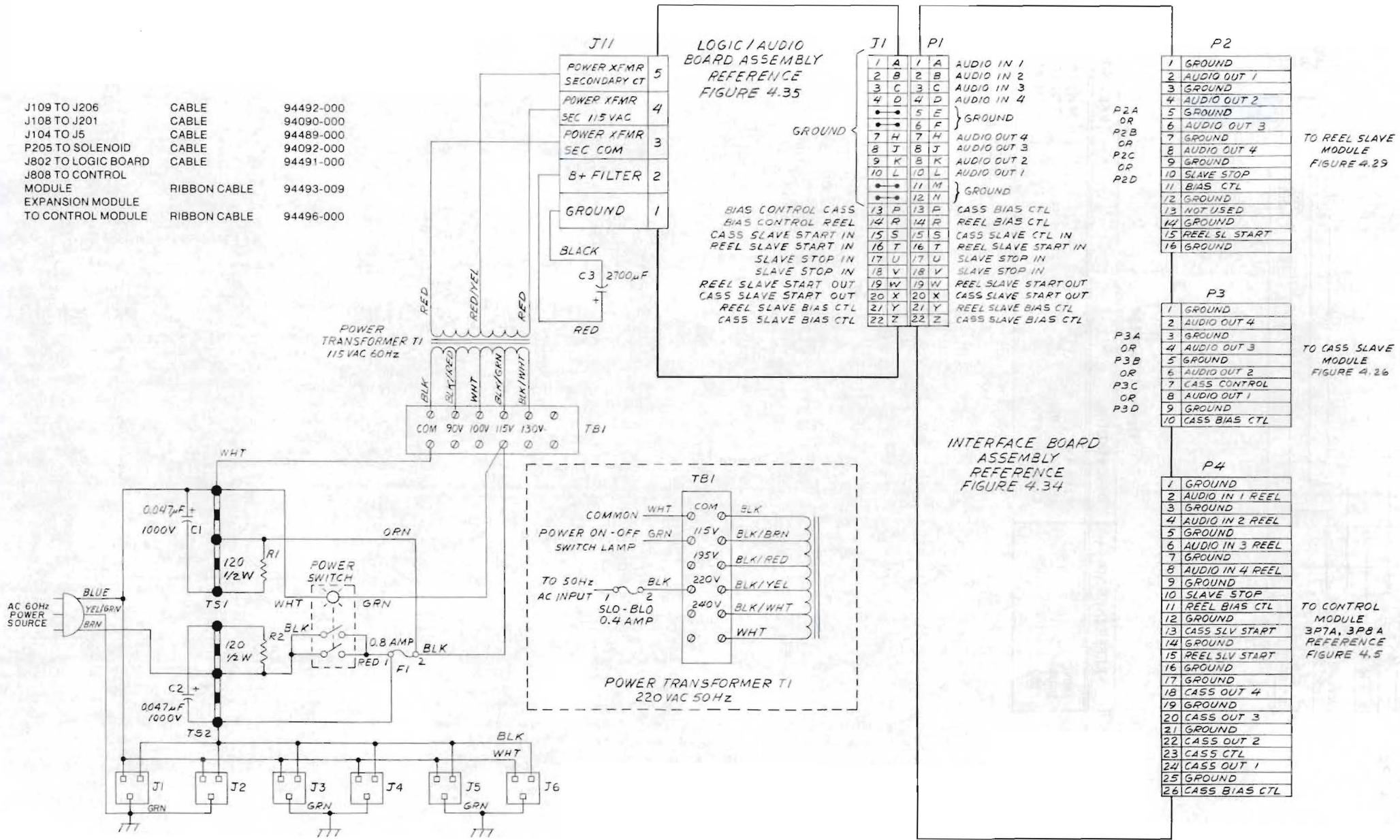
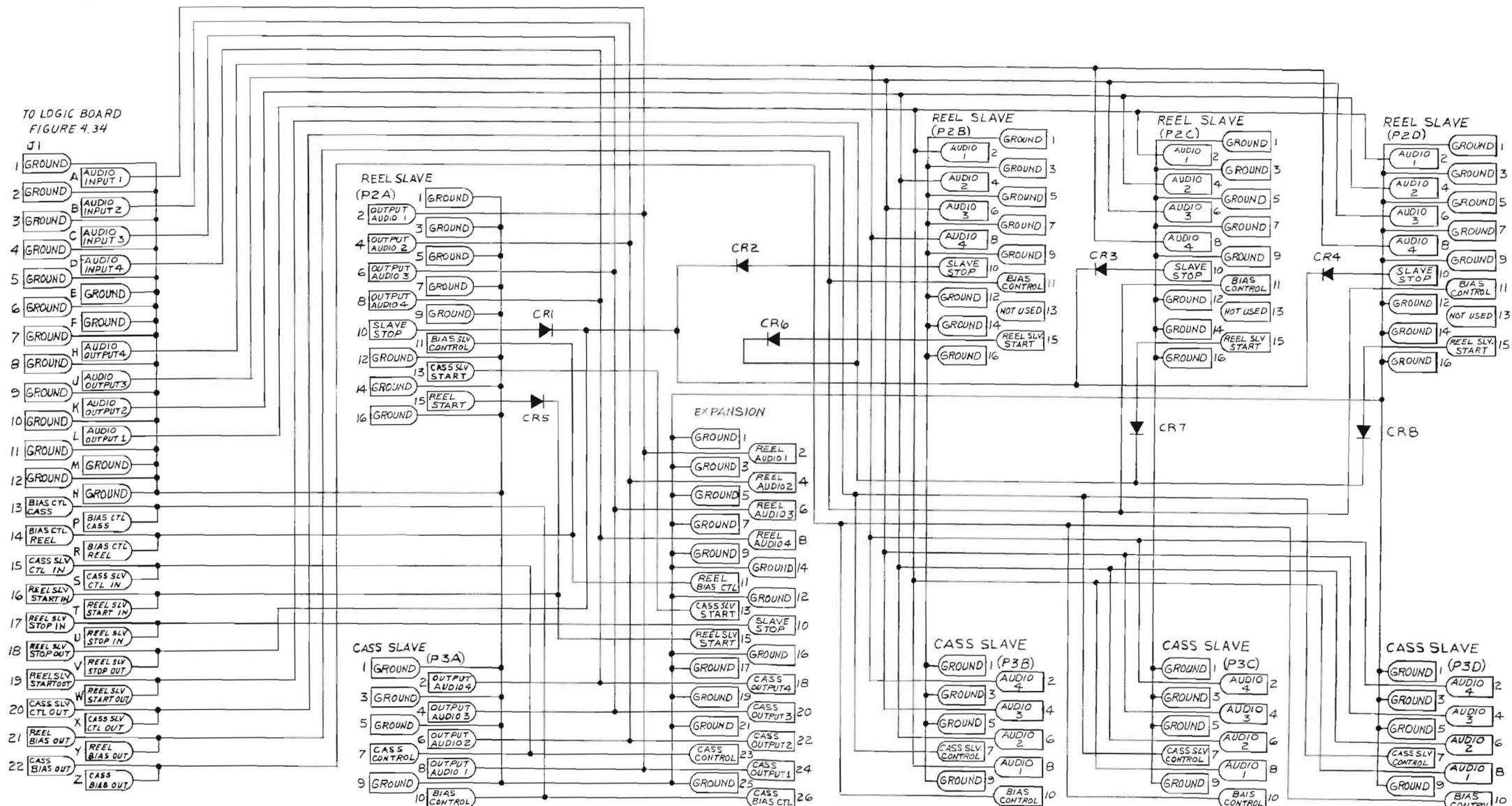


Figure 4.33 Expansion Module Chassis Wiring Diagram

TO LOGIC BOARD  
FIGURE 4.34



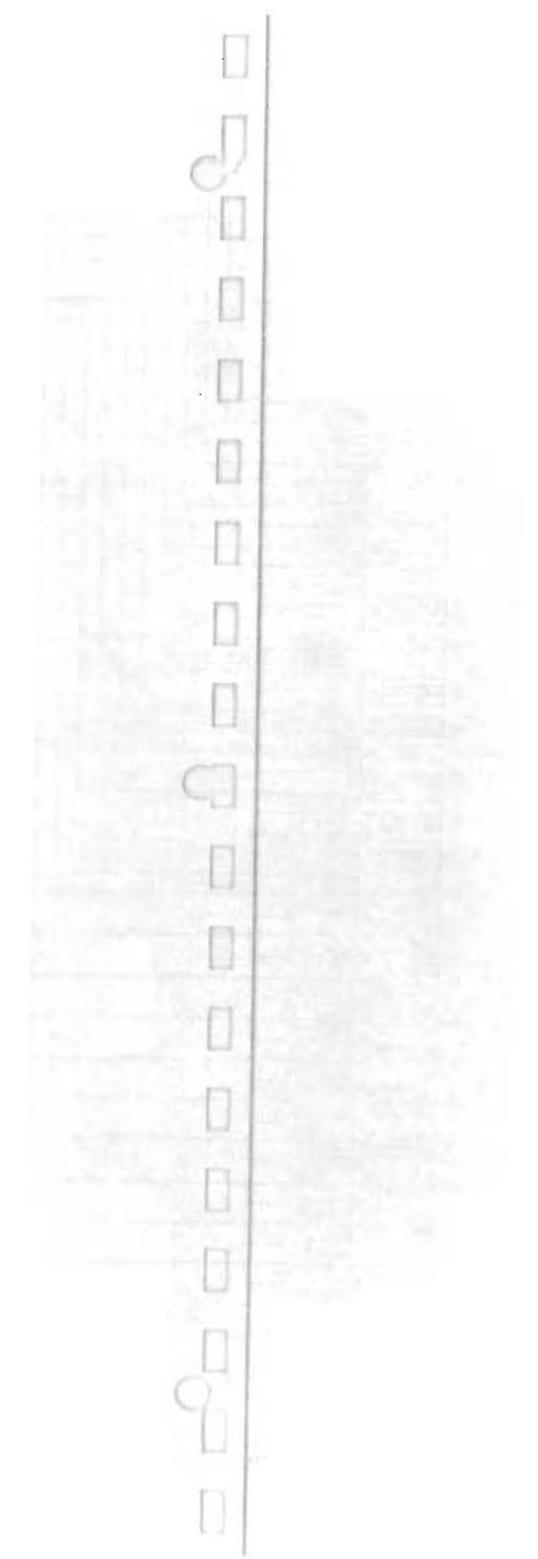
TO CONTROL 3P8  
MODULE 3P7  
FIGURE 4.5

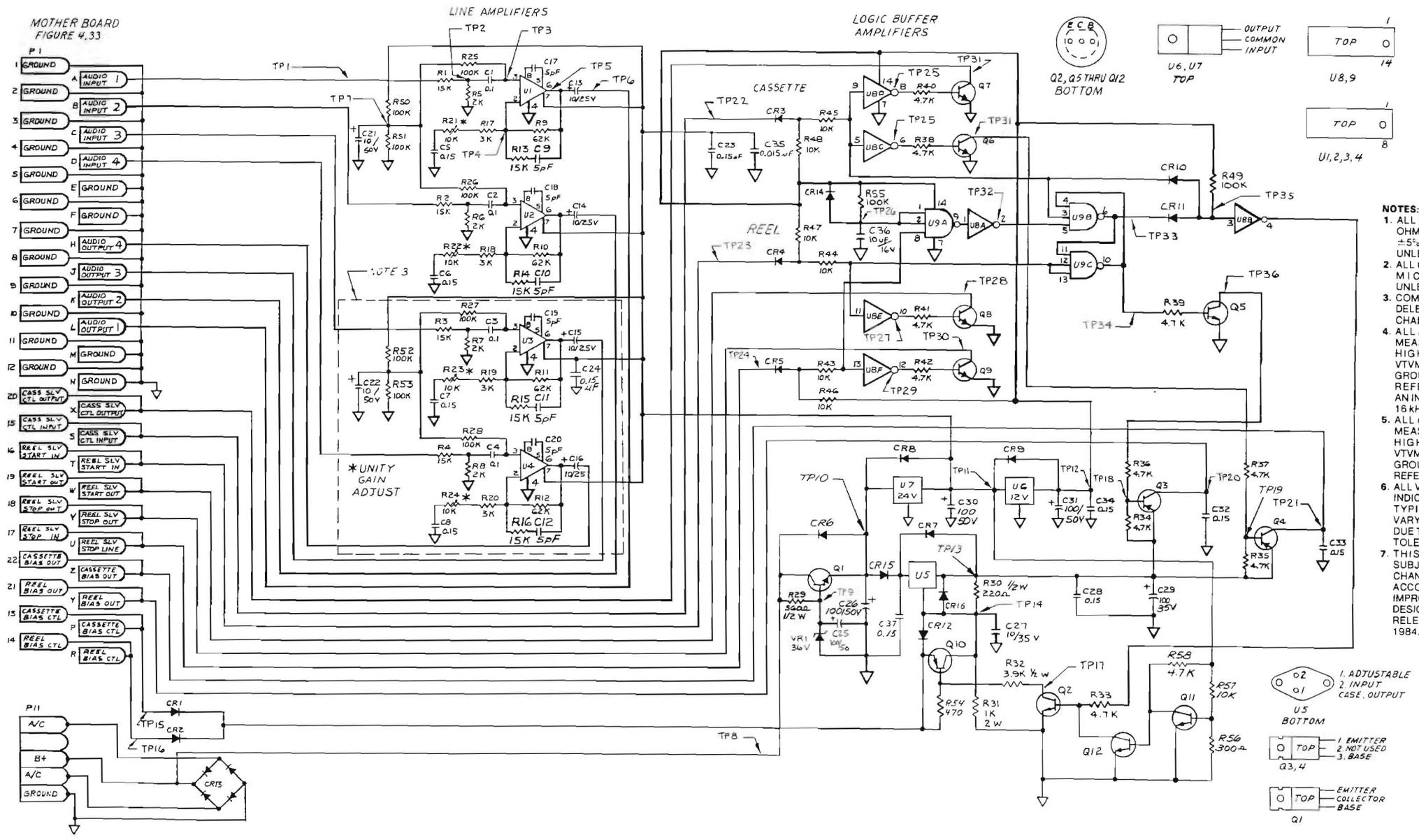
Figure 4.34 Expansion Module Mother Board Schematic Diagram

Figure 4.34 Parts List

REFERENCE NO.	DESCRIPTION	PART NO.
CR1,2,3,4,5,6,7,8	Diode	50745-003
J1	Connector, 22 Pin	57691-013
P2A,2B,2C,2D	Header, 16 Pin	57741-016
P3A,3B,3C,3D	Header, 10 Pin	57741-000
	Header, 26 Pin (Expansion)	57741-032

94682, Rev B





- NOTES:**
1. ALL RESISTORS IN OHMS, 1/4 WATT, ±5% CARBON UNLESS NOTED.
  2. ALL CAPACITORS IN MICROFARADS UNLESS NOTED.
  3. COMPONENTS DELETED ON 2 CHANNEL.
  4. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VTVM USING GROUND AS REFERENCE WITH AN INPUT SIGNAL OF 16 KHZ.
  5. ALL dc VOLTAGES MEASURED WITH A HIGH IMPEDANCE VTVM USING GROUND AS REFERENCE.
  6. ALL VOLTAGES INDICATED ARE TYPICAL AND MAY VARY SLIGHTLY DUE TO CIRCUIT TOLERANCE.
  7. THIS DIAGRAM IS SUBJECT TO CHANGE TO ACCOMMODATE IMPROVEMENT IN DESIGN. FIRST RELEASE APRIL 1984.

Figure 4.35 Expansion Module Audio/Logic Board Schematic Diagram

**Figure 4.35 Parts List**

All Capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, ¼W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
C1,2,3,4	Capacitor, 0.1	52708-024
C5,6,7,8	Capacitor, 0.15	52708-026
C9,10,11,12, 17,18,19,20	Capacitor, 5 pF	50555-012
C13,14,15,16	Capacitor, 10, 25V	52715-026
C21,22	Capacitor, 10, 50V	52715-047
C23,24,28,32, 33,34,35,37	Capacitor, 0.15	52676-014
C25,26,29,30,31	Capacitor, 100, 50V	51821-115
C27	Capacitor, 10, 35V, Tantalum	52257-055
C36	Capacitor, 10, 6V	52715-014
CR1,2,3,4,5,6,7,8,9, 10,11,12,14,16	Diode, 1 Amp, 1N4005	50745-003
CR13	Bridge, Rectifier	52313-000
CR15	Diode, 2 Amp	51483-001
P11	Connector, 5 Pin	57708-000
Q1	Transistor, TIP 110	54668-000
Q2,5,6,7,8,9,11,12	Transistor, 2N3416	51213-002
Q3,4	Transistor, TIP 125	54662-000
Q10	Transistor, 2N5323	35469-003
R1,2,3,4,13,14,15,16	Resistor, 15K	52154-253
R5,6,7,8	Resistor, 2K	52154-274
R9,10,11,12	Resistor, 62K	52154-238
R17,18,19,20	Resistor, 3K	52154-270
R21,22,23,24	Potentiometer, 10K	57148-029
R25,26,27,28,49, 50,51,52,53,55	Resistor, 100K	52154-233
R29	Resistor, 560	52154-464
R30	Resistor, 220, ½W	52154-474
R31	Resistor, 1K, 2 Watt, 10%	51019-017
R32	Resistor, 3.9K, ½W	52154-444
R33,34,34,36,37, 38,39,40,41,42,58	Resistor, 4.7K	52154-265
R43,44,45,46, 47,48,57	Resistor, 10K	52154-257
R54	Resistor, 470	52154-289
R56	Resistor, 300	52154-294
U1,2,3,4	Integrated Circuit, 5534	53293-000
U5	Regulator, Variable	53297-000
U6	Regulator, 12V	53231-000
U7	Regulator, 24V	53231-005
U8	Integrated Circuit, 4069	53266-090
U9	Integrated Circuit, NAND, 4023	53266-093
VR1	Diode, Zener, 36V	51302-008

**Figure 4.35 Parts List (Continued)**

All Capacitors are in microfarads unless otherwise specified.  
 All resistors are in ohms, ¼W, ±5%, carbon unless otherwise specified.

REFERENCE NO.	DESCRIPTION	PART NO.
C201,211	Capacitor, .15, 50V	52676-014
	IC Socket, 14 Pin	53041-000
	IC Socket, 8 Pin	53041-002
	Heat Sink	94114-000
	Screw, 6-32 x 3/8	51845-093
	Lockwasher, No. 6	50014-001
	Nut, No. 6-32	50033-008
	Screw, 4-40 x ¼	51845-056
	Screw, 4-40 x 3/8	51845-057
	Nut, No. 4-40	52188-006
	Lockwasher, Internal Tooth, No. 4	50014-002
	Insulator, TO-220	52008-000
	Insulator, TO-3	50587-000
	Audio/Logic Board Assembly, Complete, 4 Channel	94685-000
	Audio/Logic Board Assembly, Complete, 2 Channel	94685-001
	Mounting Pad, Transistor (Assemble under Q10)	85301-000
	Insulator, TO-3 Type	50587-000
	Insulator, TO-220 Type	52008-000
	Lock Washer, Int. Tooth, No. 4 (Q1,3,4,U6,7 Mtg)	50014-002
	Nut, No. 4-40 (Q1, 3, 4 Mtg)	52188-006
	Screw, No. 4-40 x 3/8	51845-057
	Screw, No. 4-40 x ¼	51845-056
	Nut, No. 6-32	50033-008
	Lock Washer, Int. Tooth, No. 6-32 (CR13, U5 Mtg)	50014-001
	Screw, No. 6-32 x ¼ (CR13, U5 Mtg)	51845-093
	Heat Sink	94114-000
	Connector, 5 Pin (P11)	57708-005
	Socket, 14 pin	53041-000
	Socket, 8 pin	53041-002

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Figure 4.36 Test Data for Audio/Logic Board

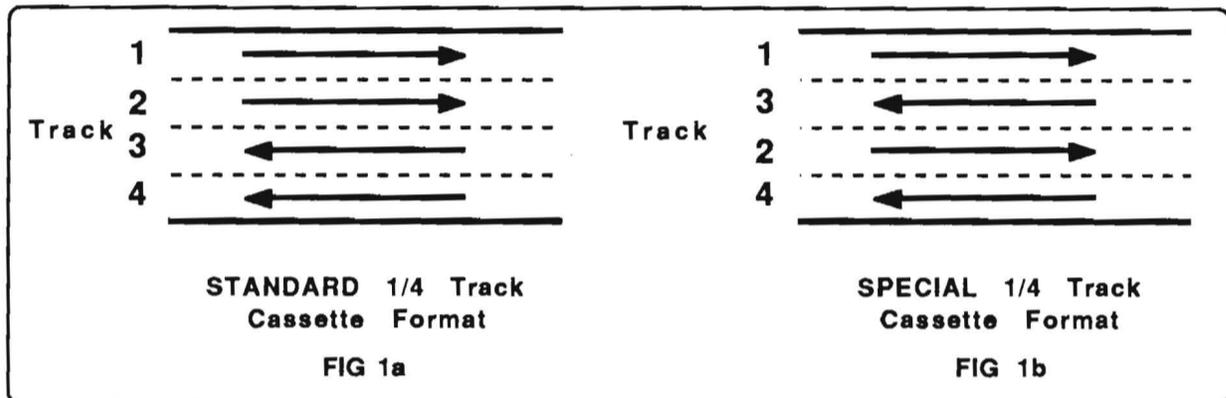
TEST POINT	ANALOG VOLTAGE		TEST POINT	MODE OF OPERATION			TEST POINT	MODE OF OPERATION		
	ACV	DCV		SLAVE STOP	SLAVE CASS	REEL SLAVE		SLAVE STOP	SLAVE CASS	REEL SLAVE
TP1	0.25V	—	TP13	6.1Vdc	16.6Vdc	16.6Vdc	TP25			
TP2	0.03V	—	TP14	5.0Vdc	15.2Vdc	15.2Vdc	TP26			
TP3	0.03V	+12V	TP15		+16Vdc		TP27			
TP4	0.03V	+12V	TP16			16Vdc	TP28	$\overline{7Vdc}$	$\overline{7Vdc}$	
TP5	0.25V	+12V	TP17	$\overline{5Vdc}$			TP29			
TP6	0.25V	—	TP18	6.1Vdc	15.4Vdc	16.6Vdc	TP30		$\overline{7Vdc}$	$\overline{7Vdc}$
TP7	—	+12V	TP19	6.1Vdc	16.6Vdc	15.4Vdc	TP31			6.1Vdc
TP8	—	+39V	TP20		16Vdc		TP32			
TP9	—	36V	TP21			16Vdc	TP33			
TP10	—	34.8V	TP22				TP34			
TP11	—	24V	TP23		$\overline{\quad}$		TP35			
TP12	—	12V	TP24				TP36	$\overline{6.1Vdc}$	$\overline{6.1Vdc}$	

**NOTES:**

1. LOGIC 1 TYPICALLY +12 Vdc LOGIC 0 .5 Vdc.
2. LOGIC LEVEL TRANSITIONS TYPICAL WHEN ENTERING THE INDICATED FUNCTION.
3. LEVEL TRANSITION AT TP26 TYPICAL DURING POWER UP CYCLE.

**SUBJECT: 6120 Track Format Modification Requirements:****Effectivity:** 6120 Reel Modules for Library of Congress & Talking Book Cassettes.

**Statement:** A special tape track format is employed on some cassette players used by the above mentioned organizations. In this situation each of the four tracks is used for an individual mono voice program. Fig 1a shows the standard cassette format and Fig 1b shows the special track format used by the above organizations.



**Solution:** The following paragraphs describe how the Telex 6120 Tape Duplicating System can be used to produce cassettes with this special track format.

**Procedure:**• **Cassette to Cassette**

When producing a cassette copy from a cassette master tape which has been recorded in this format no patching changes or modifications are needed. See Fig 2a for standard patching.

• **Reel to Cassette**Method #1

When producing a cassette copy from a 1/4 track reel master tape, Channels 2 and 3 must be reversed. This can be accomplished by changing the patch cables on the rear panel of the Control Module as shown in Fig 2b.

Method #2

If the 6120 is dedicated to producing cassette copies of this special format the 6120 Reel Master can be modified so that the patching on the rear panel need not be changed. This would eliminate the need of changing the patch cables when alternating between Reel Master and Cassette Master. To modify the Reel Master remove the head cover to expose the head block. Locate the channel 2 head lead wires which connect to pins 16 and T and the channel 3 head lead wires connected to pins 14 and R of connector J405. Unsolder these wires from the connectors and exchange pin 16 with 14 and the T with R. See Fig 3. Control Panel patch cables are then connected as in Fig 2a. below.

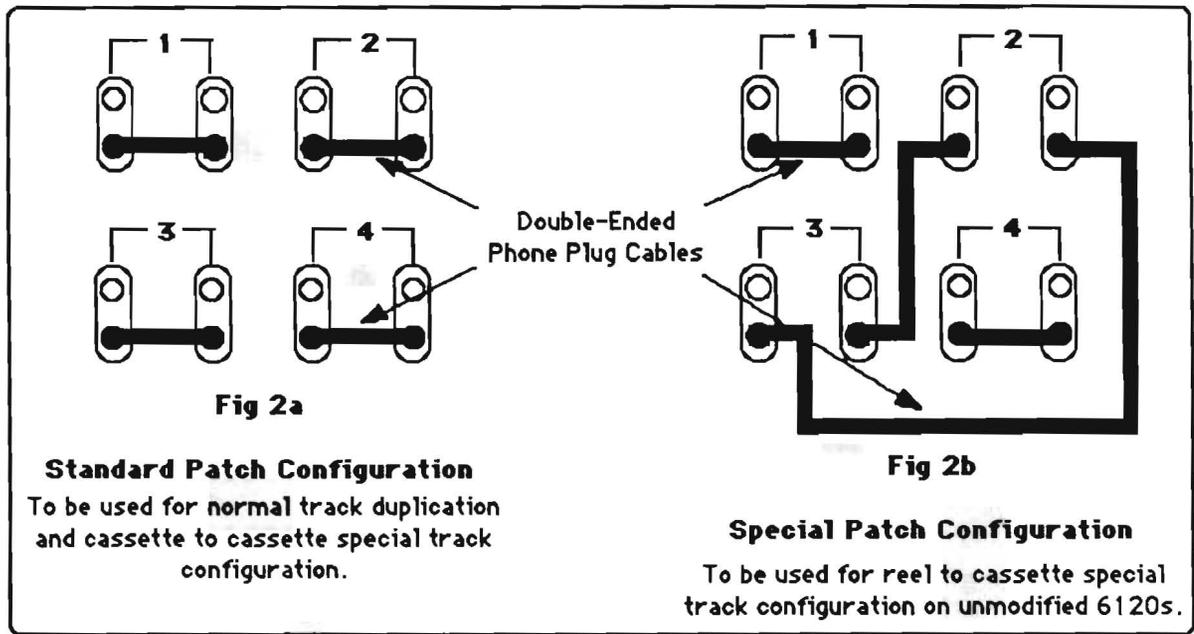


Fig 2: The Patch Panel is located on the rear of the 6120 Control Module ( Ref. Fig 2 of the 6120 Operating Instructions Manual).

