

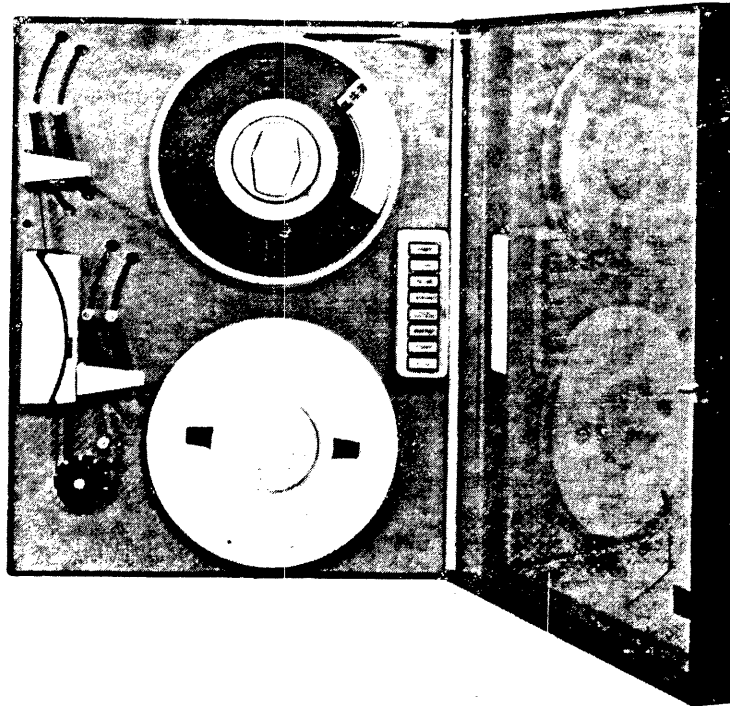
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**Mod 10 PE and PE/NRZI  
Magnetic Tape Transport  
Maintenance Manual**

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Volume 1



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**Mod 10 PE and PE/NRZI  
Magnetic Tape Transport  
Maintenance Manual**

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Volume 1

RECORD OF REVISIONS

Revision	Description	Date
A	<p>Original Publication</p> <p>Formerly, this manual was mostly Section 6 in Volume I of this 2-volume manual. This volume is now revised to provide information that pertains only to maintenance.</p>	8/82

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# SECTION I

## GENERAL DESCRIPTION

### I.1 INTRODUCTION

This manual contains all data essential to maintain optimum performance of the Mod 10 Phase Encoded (PE) and Dual-Density Phase Encoded/Non-Return to Zero (PE/NRZI) Magnetic Tape Transport (MTT) systems, shown in Figure I-1, manufactured by Cipher® Data Products, Inc., Garden Grove Division. The information is presented in two volumes. Volume 1 contains the following five sections:

- Section 1 General Description
- Section 2 Installation and Operation
- Section 3 Interface
- Section 4 Maintenance
- Section 5 Fault Isolation

Volume 2 contains the following five sections:

- Section 1 Introduction
- Section 2 Magnetic Recording Formats
- Section 3 Function Logic
- Section 4 Control Electronics Logic
- Section 5 Data Electronics Logic

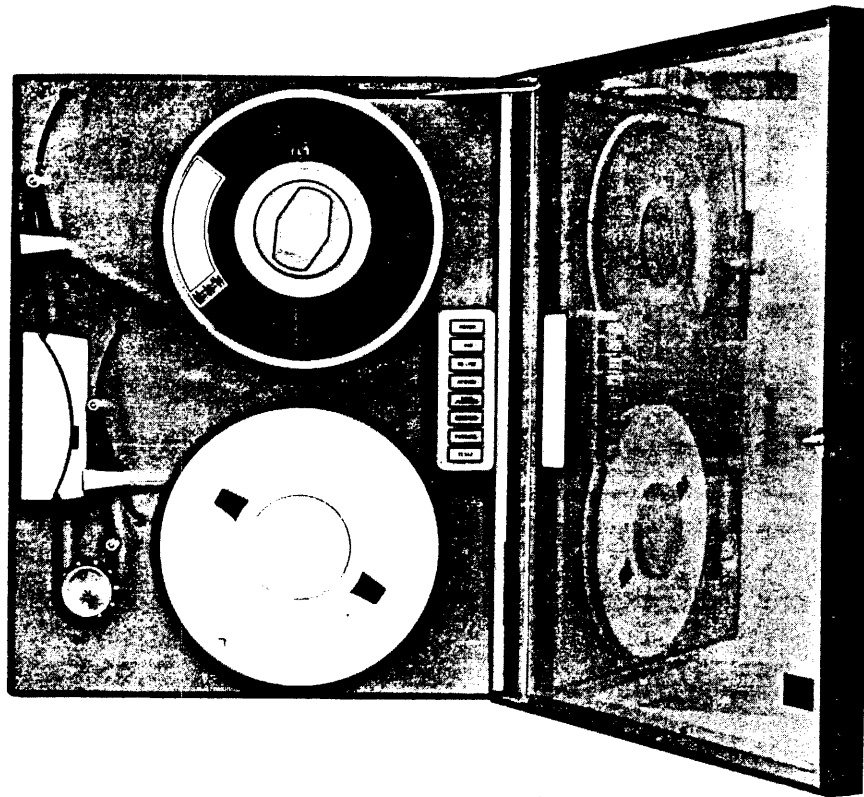
The Engineering Drawing Package contains the following three sections:

- Section 1 Logic Schematics
- Section 2 Assembly Drawings
- Section 3 Master Spare Parts List

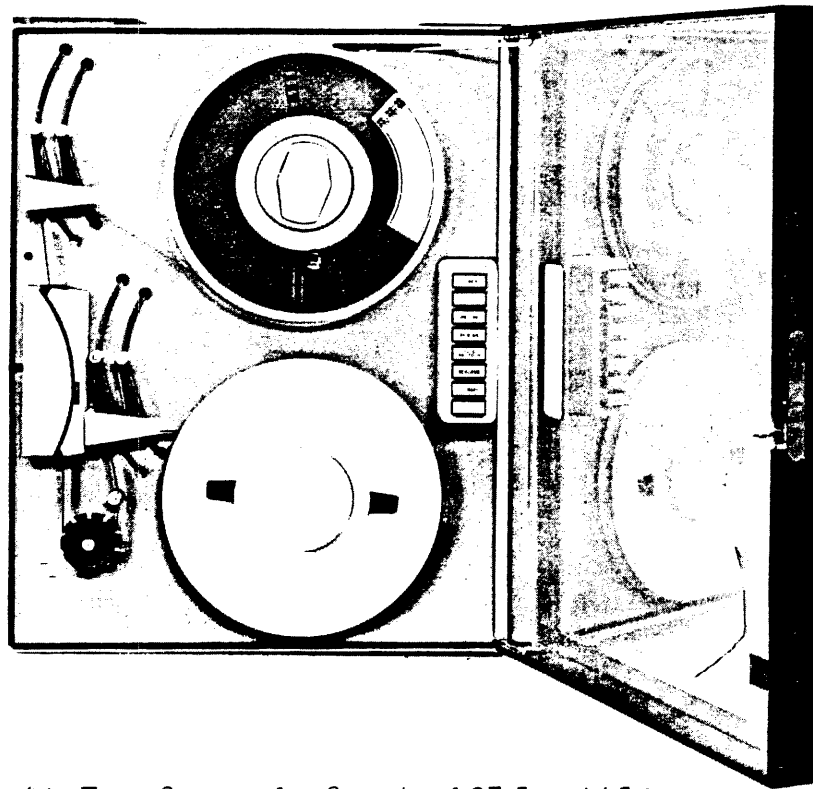
### I.2 RELATED DOCUMENTS

To enhance user knowledge of the Mod 10 PE and PE/NRZI systems, the following related documents are available:

Product Description . . . . .	.202575-001
Theory of Operation (Volume 2) . . . . .	.200951-003
Engineering Drawing Package . . . . .	.200951-002



Tape System for Speeds of 25 ips or Less



(b) Tape System for Speeds of 37.5 and 45 ips

Figure I-1. Mod 10 MTT System, Front View

### 1.3 DESCRIPTION

The Mod 10 MTT provides equipment necessary to provide the following functions:

- a. Move half-inch magnetic tape across a read-after-write head in response to commands from remote equipment or to signals generated from the operator control panel (OCP) located on the MTT.
- b. Read or Write data on magnetic tape and transfer this data between the MTT and the controller.

#### NOTE

Where necessary, metric conversion may be easily accomplished by multiplying or dividing, as applicable, by the factors listed in Table 1-1.

Table 1-1. Metric Conversion Factors

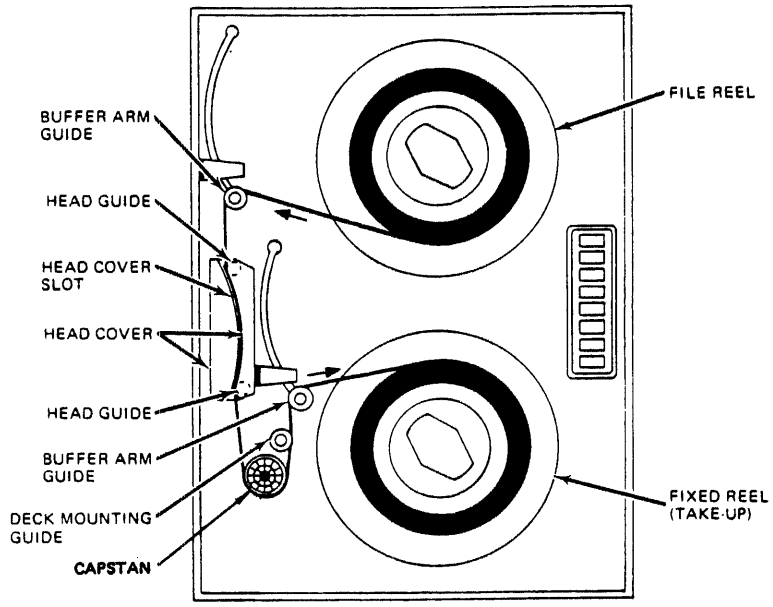
From →	→ To	→ Multiply By
To ←	← From	← Divide By
Inches	Centimeters	2.54
Inches	Millimeters	25.4
Feet	Meters	0.3048
Feet	Centimeters	30.48
Feet	Millimeters	304.8
Ounces	Grams	28.35
Pounds	Kilograms	0.4536

In a computer or other data-processing systems, MTT units are used to store very large amounts of data. Recovery of the data without errors depends on proper installation and maintenance of the tape and MTT's. The Mod 10 has been designed to permit easy operation and simple maintenance; it also has ample safeguards to protect the tape from damage during its use with the MTT. The tape path is shown in Figure 1-2.

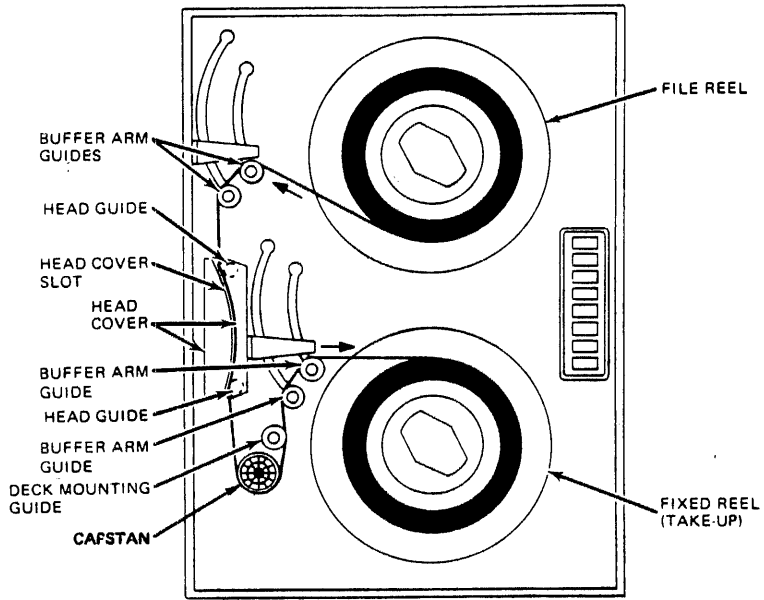
#### 1.3.1 TAPE CHARACTERISTICS

The Mod 10 uses half-inch computer-grade tape on reels up to 10½ inches in diameter. The file or supply reel mounts on a hold-down knob that is the same size as the knobs on IBM units. Data on the tape is written so that it may be read by IBM systems; tapes recorded on IBM equipment may also be read by the Mod 10.





(a) 25 ips or Less System



(b) 37.5 and 45 ips System

Figure I-2. Tape Threading Path

The Phase Encoded (PE) MTT is capable of processing 9-track ANSI- or IBM-compatible data at 1600 cpi. The dual-density MTT is capable of processing 9-track data at 800 cpi (NRZI) or 1600 cpi (PE). The density selection in the dual-density MTT is made via the appropriate command line from the controller interface or via a pushbutton switch on the OCP.

### 1.3.2 TAPE SPEED

Tape speeds on the Mod 10 are 10, 12.5, 18.75, 25, 37.5, and 45 inches per second (ips). With the combination of tape speed and data density considered, data may be transferred into or out of the tape system at rates from 8,000 to 72,000 characters per second.

### 1.3.3 TAPE CONTROL

During normal operation of the MTT with the data system, tape motion and the reading or writing of data is controlled by the system. When the tape system is not under computer control; i.e., when it is off-line, tape motion can be controlled by the operator through pushbuttons on the front of the machine. Indicator lights are also provided to show under which conditions the equipment is operating. Complete details of functions and indications are provided in Section 2.

### 1.3.4 CAPSTAN FUNCTIONS

When the system is operating, the speed and direction of the tape is determined by the rotary momentum of the capstan. As the capstan turns, it pulls the tape past the head assembly so that data may be either written or read. For the tape system to operate efficiently, the tape must be started and brought up to speed as quickly as possible. The inertial mass of the tape on the reels prevents the reels from starting as rapidly as the capstan, so a small length of tape is stored by buffer arms which are either pulled in or released by the tape motion. Changes in the position of these arms cause the reels to either feed tape to the capstan or take up the slack created by the capstan motion.

### 1.3.5 TAPE END MARKERS

Reflective markers at either end of the tape prevent it from being pulled completely from either the file or fixed reels except when the operator wants to change the reel. A sensing post near the read-after-write head assembly illuminates the tape and issues a stop signal when the marker reflects the light into a photocell. Interface status lines for

the beginning and end of the tape are provided to the computer or data-processing system to indicate which end of the tape has been reached.

### 1.3.6 TAPE CLEANER

To provide the greatest assurance that data on the tape is correctly read, the tape is cleaned just before it gets to the head assembly. The tape cleaner has blades which clean the dirt or oxide deposits from the tape. For best system operation, the dirt must be removed from the cleaner periodically as described in Section 3 (covering important operator maintenance functions of head assembly and tape guide cleaning).

## 1.4 SPECIFICATIONS

Specifications for the Mod 10 MTT are listed in Table 1-2.

Table 1-2. Mod 10 MTT Specifications

Parameter	Characteristics
Data Density:	9-Track – 1600 cpi or 800/1600 cpi
Tape Velocity:	10 through 45 ips
Rewind Speed:	150 ips nominal
Total Speed Variation:	$\pm 4\%$ maximum
Start/Stop Distance:	
Start Distance	$0.17 \pm 0.02$ in.
Stop Distance	$0.19 \pm 0.02$ in.
Start/Stop Time:	
	$37.5 \pm 2.5$ milliseconds (ms) at 10 ips
	$30.0 \pm 2.0$ ms at 12.5 ips
	$20.0 \pm 1.3$ ms at 18.75 ips
	$15.0 \pm 1.0$ ms at 25 ips
	$10.0 \pm 0.7$ ms at 37.5 ips
	$8.3 \pm 0.6$ ms at 45 ips
Head:	Dual gap
Number of Tracks:	9 ANSI-compatible
Recording Mode:	NRZI or PE – IBM and ANSI-compatible

Table 1-2. Mod 10 MTT Specifications (continued)

Parameter	Characteristics
Static Skew: Write Read Forward	Electronic skew compensation supplied for NRZI 100 microinches maximum
Dynamic Skew:	75 microinches maximum
Tape Specifications:	Computer grade, 0.5 in. wide, 0.0015 in. thick Mylar® base
Reel Size:	Up to 10.5 in. diameter, IBM hub compatible
Tape Tension:	6.50 ± 0.25 oz
Electronics:	Silicon solid state and 930 series DTL logic
MTT Interface:	DTL logic (low true)
Weight:	100 lbs.
Dimensions: Height Width Depth	24 in. 19 in. 11 in. from mounting surface
Power:	100/115/120 VAC ± 10%, 2.5 A, 48 – 62 Hz 200/208/220/230/240 VAC ± 10%, 1.3A, 48 – 62 Hz
Operating Environment: Temperature Relative Humidity	60° to 90°F (15.5° to 32.2°C) 20 to 80%, noncondensing
Nonoperating Environment: Temperature Relative Humidity	-30° to +140°F (-34° to +60°C) 15 to 95%, noncondensing
Altitude:	0 to 20,000 ft

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## SECTION 2

### INSTALLATION AND OPERATION

#### 2.1 INTRODUCTION

This section provides installation instructions for the Mod 10 MTT system. Procedures and information for unpacking and electrically connecting and checking out the system are included.

#### 2.2 UNPACKING AND INSPECTION

Inspect the shipping container for evidence of in-transit damage. Notify the carrier and a Company representative if damage is evident. Specify nature and extent of damage.

Open shipping container and remove contents. See Figure 2-1. Check removed items against the shipping invoice to verify container contents. Notify a Company representative if a packing shortage is found.

Remove protective padding and covering from the MTT. Verify the serial number of the MTT corresponds with that shown on the shipping invoice.

Visually inspect the exterior of the enclosure for evidence of physical damage that may have occurred in transit.

Check major component assemblies to determine if any assemblies or screws have been loosened. Tighten any loose screws or mounting hardware. Inspect input/output connectors.

#### 2.3 RACK MOUNTING THE MTT

The MTT may be mounted in a standard 19-inch RETMA or Universal equipment rack that has at least 24 inches of vertical panel space and a minimum depth of 11 inches behind the rack mounting surface. To rack mount the MTT, see Figures 2-2 and 2-3, and use the following procedure:

- a. Remove shipping bolt that secures transport deck to frame (located adjacent to deck fastener).
- b. Turn deck fastener 90 degrees. This action allows deck hinge to open.

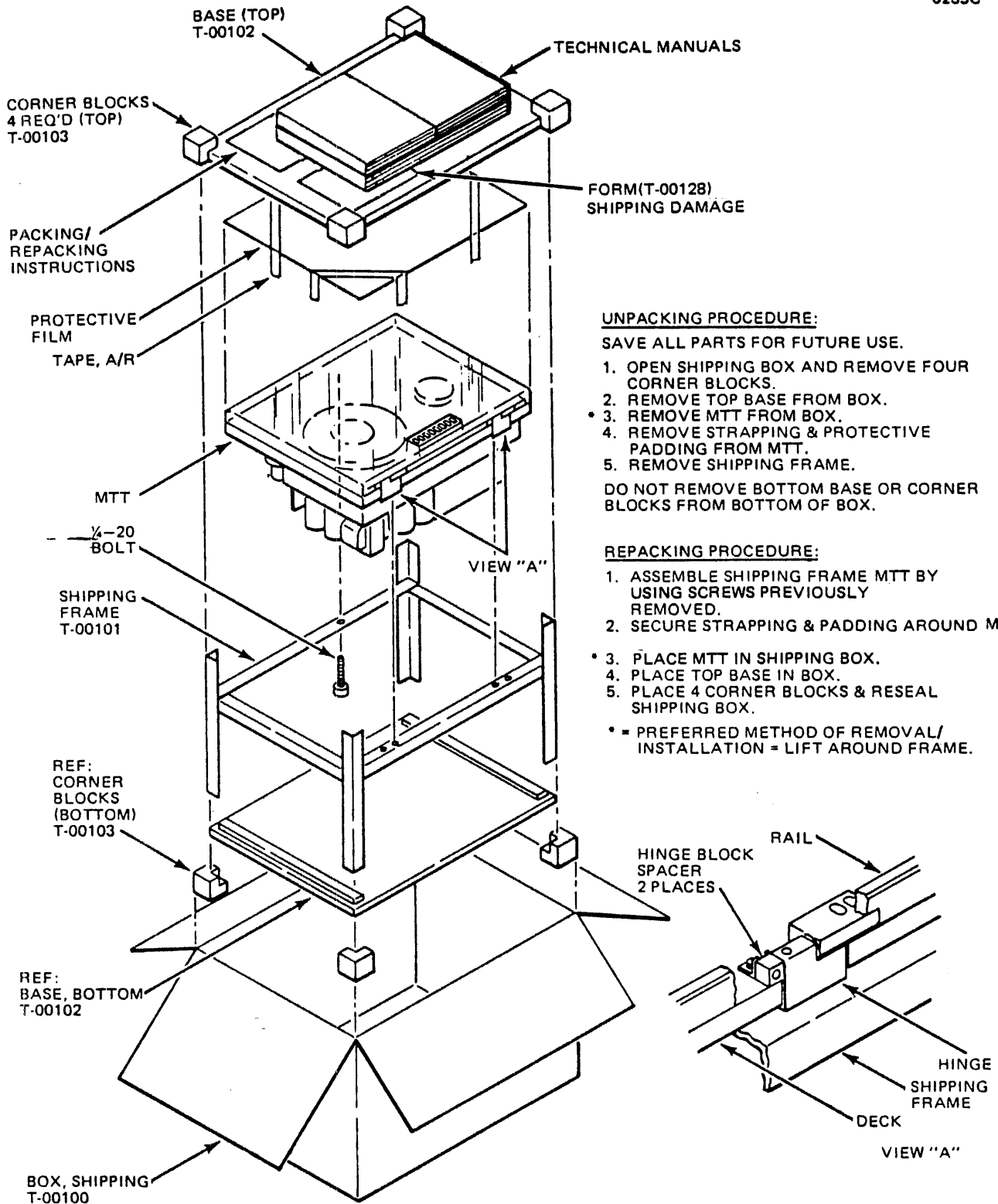


Figure 2-1. Mod 100 MTT Unpacking/Repacking Procedures

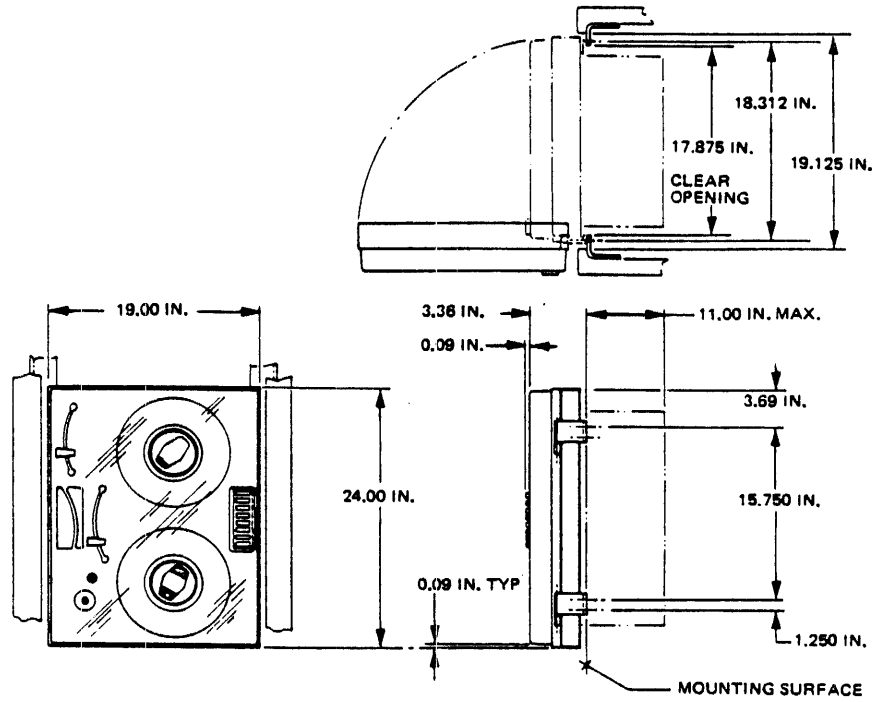


Figure 2-2. MTT System Rack Mounting Dimensions

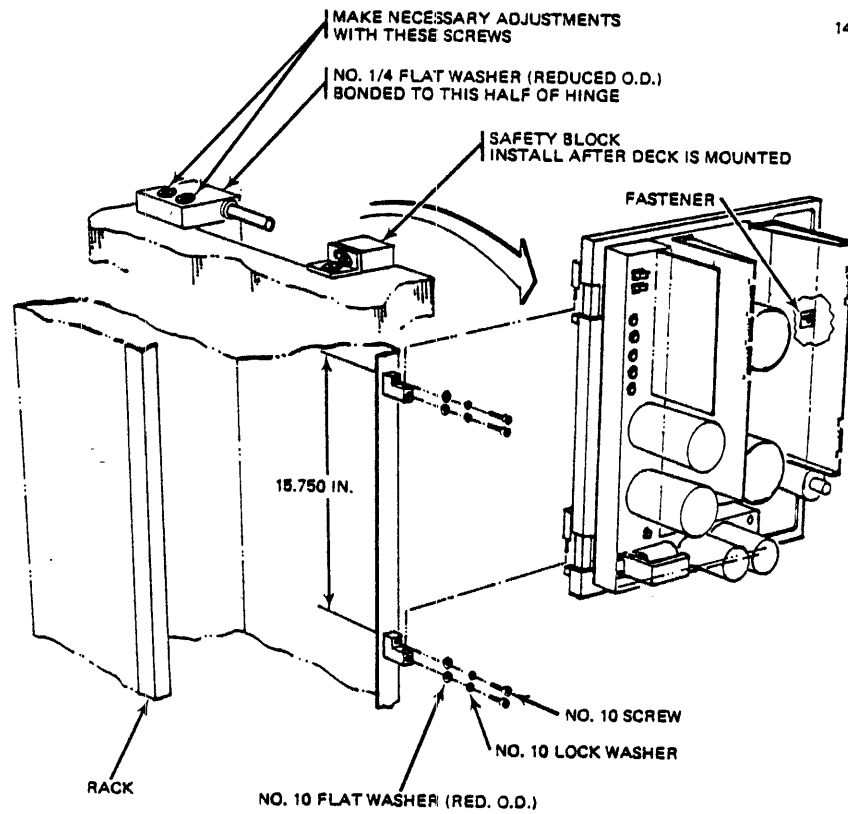


Figure 2-3. MTT System Installation



- c. Remove safety blocks from below hinges then lift MTT off shipping frame.
- d. Remove hinge-half from shipping frame and install same on rack in desired position.
- e. Hang MTT on rack and lock in closed position by tightening catch screw in front of transport deck.
- f. Replace safety blocks.

## 2.4 INITIAL CHECKOUT PROCEDURE

To check the proper operation of the MTT before placing it in the system, use the following procedure:

- a. For applications not using 115 VAC line power, wire required power plug to cord and verify appropriate primary power transformer wiring is correct. This check can be accomplished by swinging out power supply chassis and checking wiring against voltage decal located on deck of MTT. Connect power cord.
- b. Turn MTT power on by setting power switch, located on power supply chassis, to ON position and pressing POWER pushbutton switch located on OCP. At this point, POWER indicator should illuminate.
- c. Load a scratch-pad reel of tape, without a write enable ring, onto MTT and thread tape (see paragraph 2.5.1).
- d. Press LOAD pushbutton to initiate Load sequence. Tape should move forward until it reaches BOT tab (marker). ON LINE indicator should illuminate when BOT tab reaches photosensor. At this point, there is no action when LOAD pushbutton is pressed. To remove system from On-Line mode, press RESET pushbutton. System is then in Off-Line mode. Since write enable ring is not in place, FILE PROTECT indicator should be lit.
- e. With MTT Off-Line (ON-LINE indicator not lit), press FORWARD pushbutton. Run several feet of tape onto fixed reel, then press RESET pushbutton to stop tape. Verify that action of FORWARD pushbutton is inoperative when MTT is On-Line.
- f. Press REVERSE pushbutton. Tape should move backward until BOT tab reaches photosensor. Verify that action of this control is inoperative when MTT is On-Line.
- g. Press FORWARD pushbutton and run several feet of tape onto takeup (fixed) reel. Press REWIND pushbutton to initiate Rewind mode. Tape should

rewind past BOT tab, return to BOT tab, and stop with LOAD indicator lit. If REWIND pushbutton is then pressed, tape rewinds until tape tension is lost. This action is used to unload tape. Supply reel can then be removed (see paragraph 2.5.2).

## 2.5 OPERATION

Operation of the Mod 10 MTT system requires only a few simple procedures. These include tape loading and unloading, manual rewind, power-failure recovery, and possible other special operations required by the data-processing system using the tape equipment.

### 2.5.1 TAPE LOADING

Tape loading is made particularly easy by the toggle-action hold-down knob shown in Figure 2-4. Positive indication is provided by the hold-down knob for installation of the reel and for the locked condition. To prepare the knob for reel installation, press the toggle at the end marked PRESS. It then remains in that position. Place the tape reel on the knob, with the write enable ring or the slot provided for it, toward the MTT. This placement automatically positions the end of the tape on the reel for proper threading. After pressing the reel firmly against the knob, by using the fingertips against the REEL hub only, press the extended end of the toggle tab until it is flush with the face of the hold-down knob. The snap action of the knob by can be distinctly felt, and the knob is then firmly locked. It is not necessary to hold the reel against the knob when the knob is being locked.

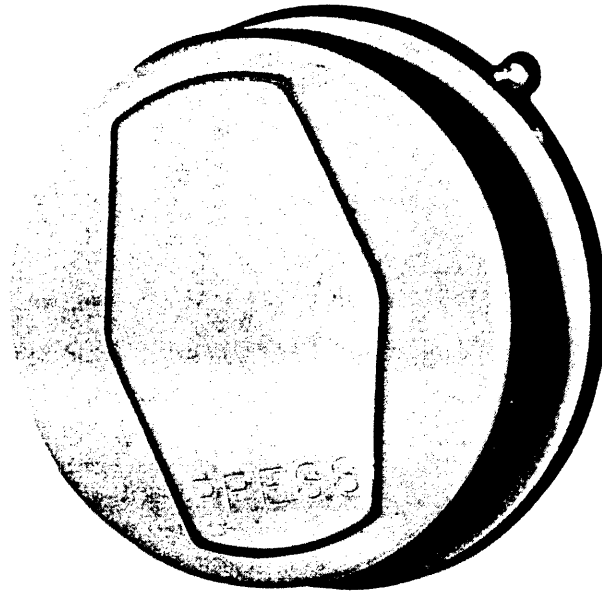
#### **CAUTION**

When loading the tape or locking knob, use care to avoid pressing the reel flanges against the tape pack.

Pressure of the flange against the tape edges can cause two types of damage:

- a. Oxide is dislodged from the film causing potential Read error.
- b. Deformity of the edge of the tape results in misalignment of the tape as it passes the head which increases possibility of errors.

0730



0785



Figure 2-4. File Reel Mounting Hold-Down Knob in Locked (Top) and Unlocked (Bottom) Positions

### 2.5.1.1 Tape Threading

To thread tape on Mod 10 MTT's that have tape speed of 10, 12.5, 18.75 or 25 ips, see Figure 1-2a and use the following procedure:

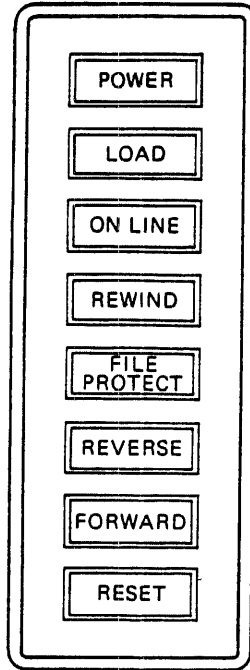
- a. Lead end of tape over buffer arm guide and down through slot guide in head assembly cover. Passage of tape through slot causes small shield over head assembly to move away from head.
- b. At capstan end of head cover slot, lead tape around capstan and over top of other buffer guide.
- c. Pass tape over top of fixed takeup reel.
- d. Press end of tape against hub through one of openings in reel flange.
- e. Hold tape against hub, then turn reel until end of tape is overlapped and secured by next tape layer.
- f. Manually wind three full turns of tape onto fixed (takeup) reel.
- g. If machine power has not been turned on, press POWER switch on OCP. Indicator should illuminate. To complete loading operation, press LOAD pushbutton on OCP shown in Figure 2-5. Both buffer arms then move to their normal operating positions and capstan pulls tape forward until beginning-of-tape (BOT) marker reaches photosense assembly. Control of tape system is then automatically turned over the data system tape controller and ON LINE and LOAD indicators illuminate. No operator is needed to put tape system On-Line.
- h. If On-Line mode is not desired, MTT may be taken Off-Line, for manual control from OCP, by pressing RESET pushbutton.

To thread tape on Mod 10 MTT's that have tape speed of 37.5 or 45 ips, perform the procedure described for low-speed MTT's except lead the tape across both rollers of each buffer arm guide assembly (see paragraph 2.5.1.1 and Figure 1-2b).

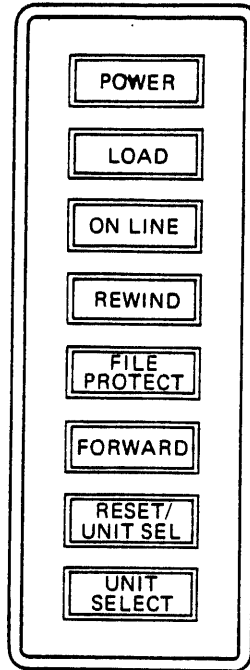
## 2.5.2 TAPE UNLOADING

### 2.5.2.1 Rewinding

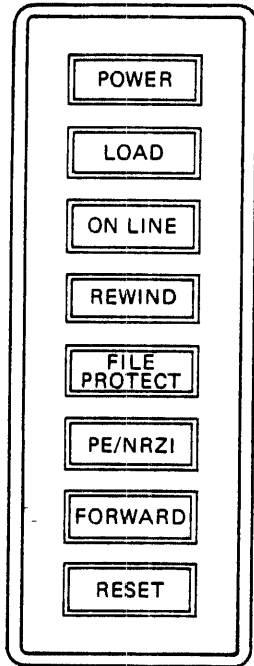
At the conclusion of a tape system operation with the computer or at other times when it is necessary, the tape must be rewound onto the file (supply) reel. Normally, the computer or data-processing system issues a Rewind command without operator participation. Other conditions may sometime require the operator to rewind the tape



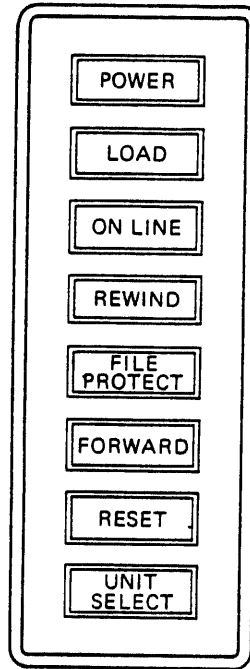
PE (STANDARD)



PE (UNIT SELECT OPTION)



DUAL DENSITY (STANDARD)



DUAL DENSITY (UNIT SELECT OPTION;  
REMOTE MODE SELECTION)

Figure 2-5. Operator Control Panel Configurations

by pressing the REWIND pushbutton on the OCP. This action results in high-speed Reverse operation. When the beginning-of-tape (BOT) marker reaches the photosense unit, the Rewind operation ends, and the MTT advances the tape until the reflective marker is at the photosense head.

#### 2.5.2.2 Tape Reel Removal

The tape may be completely removed from the tape path and put on the file reel by pressing and holding in the REWIND pushbutton. When the reel is full, this operation may be stopped by releasing the REWIND pushbutton. The file tape reel may then be removed from the machine by pressing the hold-down knob toggle to the unlocked position.

#### **CAUTION**

Again, care should be taken to avoid pressing the reel flanges against the sides of the tape. This pressure could cause tape damage.

#### 2.5.3 POWER FAILURE

If a power failure occurs while the system is on line, the buffer arms extend and tension on the tape is relaxed to prevent any possible tape damage. When power has been removed, tape system operations may be resumed by first taking up the tape slack and then pressing the LOAD pushbutton. When the buffer arms have returned to their operating positions, press the RESET pushbutton to stop tape motion; then press the REWIND or ON LINE pushbutton, depending on the requirements of the system with which the Mod 10 is operating.

#### 2.5.4 CONTROL AND INDICATOR FUNCTIONS

Functions of OCP controls and indicators, shown in Figure 2-5, are listed and described in Table 2-1.

Table 2-1. OCP Control/Indicator Functions

Control/ Indicator	Function/Description
POWER	<p>Combination alternate-action pushbutton switch and indicator which controls AC power to the MTT. The indicator illuminates when the regulated voltages are available. For the convenience of the maintenance or customer engineer, a DPST power switch is provided on the power supply chassis at the rear of the machine. This switch is accessible only when the MTT is swung open for service.</p>
LOAD	<p>Combination pushbutton switch and indicator. After threading the tape (see Figure 1-2), press this control indicator to complete the tape-loading operation. Tape is automatically advanced to the load point, or BOT marker, and then the tape system goes On-Line activating the Ready and On-Line status lines. LOAD and ON LINE indicators are lit when the action is completed. The LOAD indicator light is lit any time the tape is positioned at the load point. The LOAD indicator light is extinguished when the tape is advanced from the load point or rewound. After this sequence of operations is completed, the switch becomes functionally disabled and can only be reenabled by loss of tape tension.</p>
ON LINE	<p>Combination pushbutton switch and indicator. The indicator is lit when the system is under control of the computer or data-processing system. If the system is Off-Line, and if control is to be turned over to the computer, press the ON LINE pushbutton. The system is then returned to the Off-Line mode if either of the following conditions exist:</p> <ol style="list-style-type: none"> <li>a. The system interlocks are lost.</li> <li>b. An Off-Line controller command is sensed.</li> <li>c. The RESET pushbutton is pressed.</li> </ol>

Table 2-1. OCP Control/Indicator Functions (continued)

Control/ Indicator	Function/Description
FILE PROTECT	<p>Indicator only. Lit when a write enable ring is not installed on the file reel; protective circuits in the tape system then prevent data from being written on the tape. When a supply reel is put on the machine with the write enable ring properly placed in the slot at the back of the reel, the FILE PROTECT indicator is extinguished, thereby indicating data may be written on the tape.</p>
REWIND	<p>Pushbutton switch. Pressing this pushbutton causes the tape to be rewound with high-speed reverse operation. The operator can stop this reverse motion by pressing the RESET pushbutton. If RESET is not pressed, the tape goes beyond the BOT marker, stops, and then automatically returns to the load point. If the REWIND pushbutton is pressed again, the tape is drawn out of the tape path and the Unload operation is completed. If the MTT is On-Line and under computer control, the REWIND pushbutton is disabled. This safety feature prevents accidental tape damage.</p>
FORWARD	<p>Combination pushbutton switch and indicator. Functions only when the machine is Off-Line. If the ON LINE indicator is lit, pressing the FORWARD pushbutton has no effect. If the ON LINE indicator is extinguished and the FORWARD pushbutton is pressed, the indicator illuminates and the MTT moves the tape in the forward direction at normal tape speed. To stop the machine when it is running in this mode, press the RESET pushbutton.</p>
<p><b>NOTE</b></p> <p>The FORWARD and REVERSE pushbutton switches are electronically interlocked to prevent both switches from being functional at the same time. If one switch is enabled, the other is automatically disabled.</p>	



Table 2-1. OCP Control/Indicator Functions (continued)

Control/ Indicator	Function/Description
REVERSE	<p>Combination pushbutton switch and indicator. Functions only when the machine is Off-Line. If the ON LINE indicator is lit, pressing the REVERSE pushbutton has no effect. If the ON LINE indicator is extinguished and the REVERSE pushbutton is pressed; the indicator illuminates and the MTT moves the tape in the reverse direction at normal tape speed. To stop the machine when it is running in this mode, press the RESET pushbutton.</p>
RESET	<p>Pushbutton switch only. All tape motion, except unload, stops when the RESET pushbutton is pressed. Pressing RESET clears all read, write and control functions. It also removes the MTT from On-Line operation with the computer or data-processing system and turns off the ON LINE indicator.</p>
RESET/UNIT SELECT	<p>Combination pushbutton switch and indicator. It is optional only on Phase Encoding MTT's and replaces the normal RESET switch described above. All tape motion, except unload, regardless of the command that established it, stops when the RESET pushbutton is pressed. Pressing RESET clears all read, write, and control functions and also removes the MTT from On-Line operations with the computer or data-processing system. The ON LINE indicator is extinguished. This switch also houses the Unit Select indicator. This indicator is lit if the MTT has been selected.</p>
UNIT SELECT	<p>Optional four-position (0, 1, 2, 3) thumbwheel switch. If this switch is provided in Phase Encoding MTT's, the REVERSE switch is not installed; if the switch is provided in PE/NRZI switchable MTT's the PE/NRZI mode select switch is not installed (and the mode is selected by the controller). UNIT SELECT is a 4-position switch with which the MTT assignment in a daisy-chain</p>

Table 2-1. OCP Control/Indicator Functions (continued)

Control/ Indicator	Function/Description
UNIT SELECT (cont'd)  PE/NRZI	<p>configuration is selected. A particular MTT among several daisy-chained MTT's is selected if the selector switch position corresponds to the Controller Select line which has been set true.</p> <p>Combination pushbutton switch and indicator that is used only on PE/NRZI MTT's. It conditions the system to operate in PE mode when the indicator is lit. To operate in NRZI mode, the switch must be in the alternate state that corresponds to the indicator being extinguished. The switch is not installed if the PE/NRZI Select input line is used. When the switch is provided, the REVERSE switch is not installed.</p>

### 2.5.5 TAPE HANDLING

Handlers of magnetic tape should remember that the Mylar or polyester base on which the magnetic coating is applied is only 1 or 1.5 thousandths of an inch thick and that the magnetic coating is only a fraction of that thickness. Several things happen when tape is improperly handled. The most serious tape damage occurs when the tape is bent, crimped, twisted, curled, stretched, or otherwise physically deformed so that part of the magnetic coating is dislodged. This deformation results in two possibilities for data errors:

- a. The area from which the magnetic coating has been removed can no longer accept data when it is written in that area, and conversely, data cannot be recovered from that area.
- b. Redepositing of the loose oxide may occur at some other location where it can cause the tape to be lifted from the head while passing over the head. This condition again results in improper writing or reading of the data.

#### 2.5.5.1 Fragility

Because of the tape's fragility, it is important that it be handled as little as possible during tape loading and/or unloading. The tape should never be handled in any area other than that ahead of the BOT marker. Should it be necessary, because of power failure or

some other malfunction, to handle the tape at any other point in its length, use extreme care to ensure the tape edges are not deformed in any way and that no dirt, lint, or other contaminants are deposited on the oxide surface or on the back of the tape. Particles of dust or other material create potential data errors in the same way dislodged surface oxide does: by lifting the tape away from the read and write heads.

#### 2.5.5.2 Contamination Prevention

When handling the tape in any area, including the length used in threading or loading it on the MTT, the tape should not be permitted to touch the floor or other surfaces where dust or dirt may be transferred to it. Only that length of tape actually required to thread the MTT should be removed from the reel in the process of threading. An extra length of tape that dangles or drops from the machine during loading and/or unloading is likely to pick up dust or other contaminants. Care should be taken to prevent grease or skin exudations on the fingers from being transferred to the tape. Foods should never be brought into the area where computer tapes are used.

#### 2.5.5.3 Reel Flanges

When handling the reel upon which the tape is wound, the flanges of the reel should never be pressed against the tape wound on the reel. This mishandling is one of the most common sources of damage to tape. When the reel flanges are pressed against the tape, the tape edges protruding from the tape pack become bent, curled, and deformed so that oxide is dislodged and proper guiding of the tape is prevented. To properly handle the reel, it should be grasped at the outer edges with both hands so that any pressure required to hold the reel is directed toward the center opening. When mounting the reel on the hold-down knob of the MTT, proper seating of the reel can be accomplished by pressing with the fingertips against the area within half an inch of the reel opening. There is a solid ring at this point; no tape is wound in the area and no damage to the tape can result. It is extremely important that the reel not be pressed on the MTT in any way other than that described. If the flexible part of the reel flange is pressed to seat the reel properly, damage to the tape always results.

#### 2.5.5.4 Tape Removal

In removing tape from the tape handler, these same precautions should be observed. After unlocking the hold-down knob, the tape reel should again be grasped at the outer edges and extreme caution must be used to prevent the reel flange being brought forward

to the edge of the tape pack. The tape handler does not discriminate between damage to the front edge or rear edge of the tape. Damage to either edge of the tape results in the same eventual data unreliability.

#### 2.5.6 TAPE CANISTERS

Tape-storage canisters should always be carefully handled with no abrupt motions or hard impacts. After the tape reel is removed from the canister to load on the MTT, the tape canister should immediately be closed and locked so that dust cannot be introduced into the canister while the tape is on the MTT. Broken, chipped, or cracked canisters should be discarded immediately. The cost of a canister is small compared to the value of the data on a reel of magnetic tape.

#### 2.5.7 TAPE RECERTIFICATION

When tape has been in use for a long time and data errors begin to occur frequently, it is possible to have the tape cleaned and recertified for additional use. If recertification does not restore the tape to a satisfactory level of reliability, it should be discarded. Most modern digital magnetic tape gives long and reliable service if properly handled. It does not last indefinitely however, and a regular program of tape recertification can help establish which tapes must be discarded to prevent costly errors and down time of the data-processing system.

#### 2.5.8 TAPE STORAGE

When tape is not in use, it should be stored in canisters under temperature and humidity conditions prescribed by the tape manufacturer. Tape should never be stored or placed near electric motors, transformers or any other device that may be expected to generate strong magnetic fields.



## SECTION 3

### INTERFACE

#### 3.1 CABLING

The interface cables must be twisted pairs with returns grounded. Wire should be 24 or 26 AWG conductor with minimum insulation thickness. Cables should contain approximately 25 twists per foot. Maximum cable lengths should be 20 feet. The ground side of each twisted pair must terminate within a few inches of the line receiver or transmitter ground. Connectors must be Transitron 600-061-18-SL or equivalent. Cables should be wired and strain-relieved. Figure 3-1 shows connector locations.

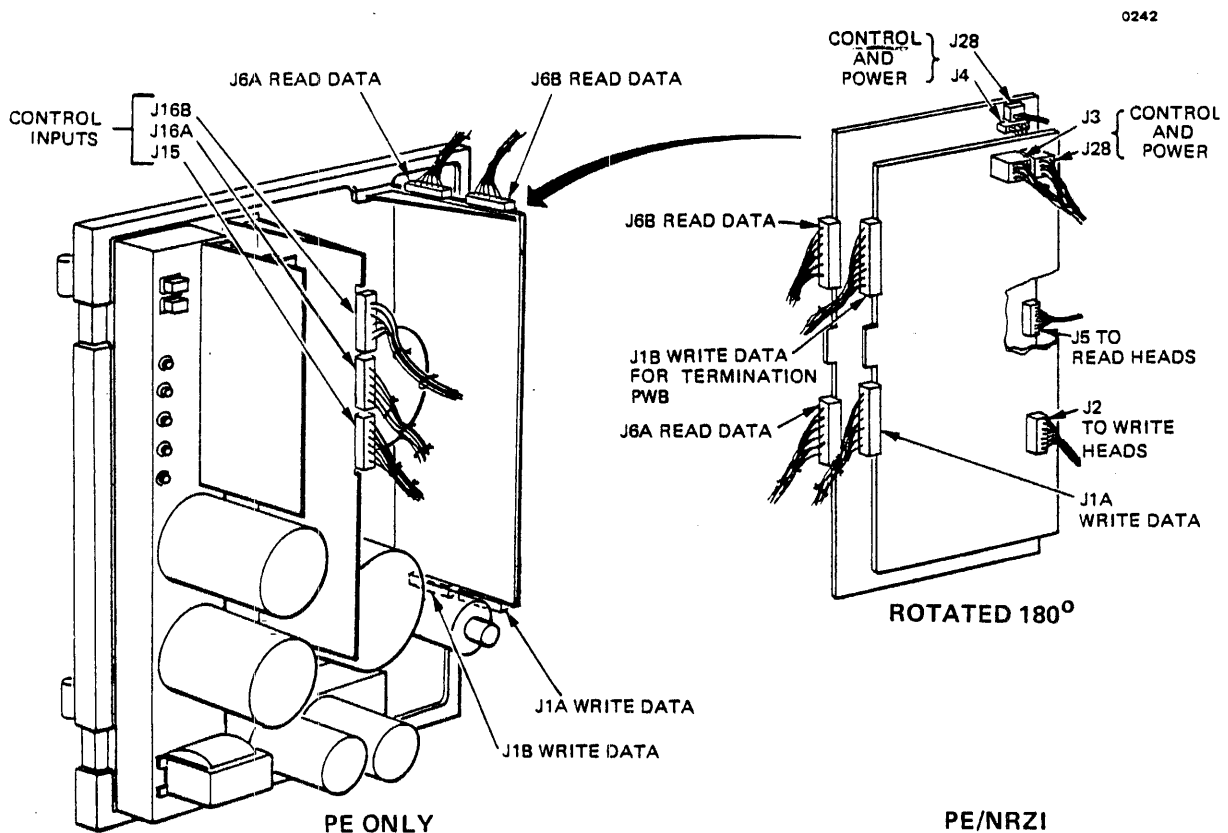


Figure 3-1. MTT System Interface Cable Installation

### 3.2 DAISY CHAINING

Up to four MTT's can be daisy chained on the same bus without any modification to any of the MTT's tied in the daisy-chain configuration. When the Unit Select option is installed, it is feasible to add or delete MTT's from the bus and reassign new MTT addresses. The following features incorporated into the Mod 10 MTT allow daisy chaining to become a simple operation.

- a. Parallel connectors are provided for all interface cables (Control, Write, and Read).
- b. The line terminating resistors, rather than being mounted on the individual MTT's, are packaged on a special terminator PWB assembly. This assembly can be plugged into, or unplugged from, any MTT. A change to a different MTT, when an MTT is added or removed from the daisy chain, is therefore easy. The terminator PWB is supplied with power, regardless of which MTT in the daisy chain is energized.

#### 3.2.1 DAISY CHAINING CABLE CONFIGURATION WITHOUT A UNIT SELECT SWITCH

This method is recommended when daisy chaining without the Unit Select option as shown in Figure 3-2. With this method, the select lines are rotated in the MTT-to-MTT control cable. Pin J of the MTT is always the active select line of the MTT. If an MTT is removed, as shown in Figure 3-3, the address of each MTT succeeding the removed MTT in the daisy chain must be reduced by one. Thus, the address of the MTT is fixed by its physical position. The read cable and the write cable do not require any signal rotation and are therefore 1-to-1 cables.

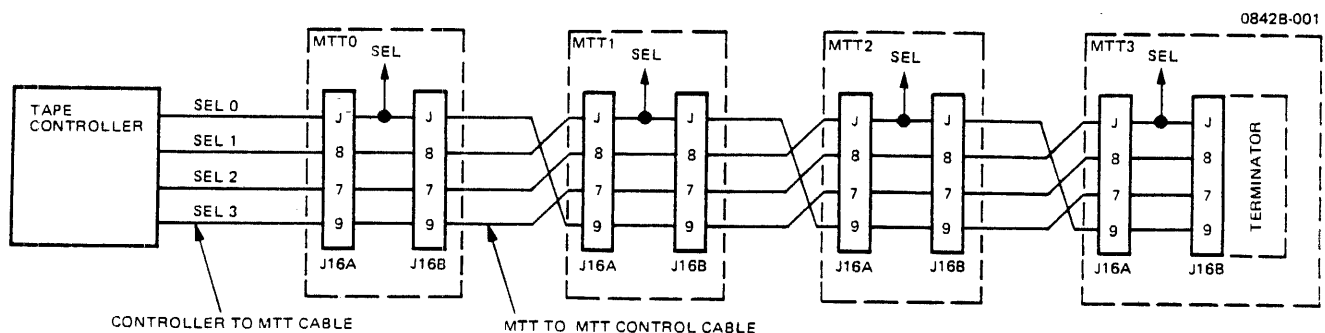


Figure 3-2. Daisy Chaining Without Unit Select Option

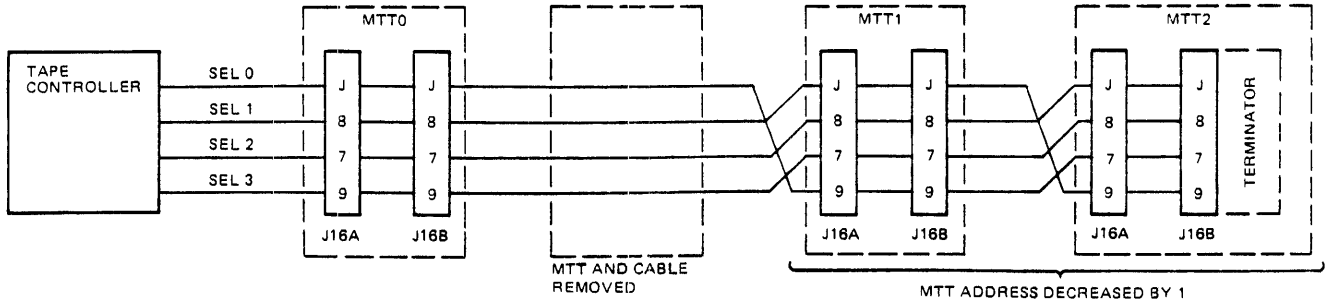


Figure 3-3. Daisy Chaining With MTT and Daisy-Chain Cable Removed

**NOTE**

Any 1-to-1 cable is one with a direct pin-to-pin configuration.

3.2.2 DAISY CHAINING WITH UNIT SELECT SWITCH

This configuration is applicable only to MTT's that contain a Unit Select switch. When daisy chaining in the Unit Select configuration, all the cables (Control, Write, and Read) are 1-to-1 cables as shown in Figure 3-4. The operator has the freedom to give each of the four MTT's in the daisy chain the logical address desired, regardless of its physical position on the bus, but the address for each MTT must be unique; i.e., each select line should select a different MTT.

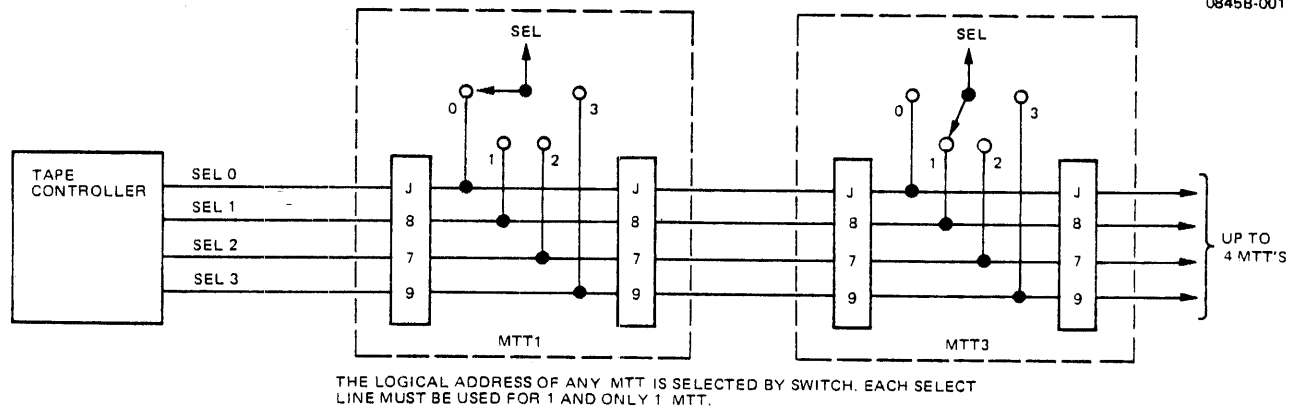


Figure 3-4. Daisy Chaining With Unit Select Option



### 3.2.3 T-CABLES

The parallel connectors on the MTT do not exclude the use of T-cables. (The connections should be as shown in Figures 3-2 and 3-3 when used without the Unit Select option. If the Unit Select option is used, the connection should be as shown in Figure 3-4.

### 3.3 INPUTS

Input voltage requirements are listed in Table 3-1; a diagram of the input termination configuration is shown in Figure 3-5; and input control and data functions are listed in Table 3-2.

The On-Line input signals (see paragraphs 3.3.1 and 3.3.2) control operation of the MTT only after power is on, the On-Line mode has been initiated, Ready status has been established, and the MTT has been selected. Pin connections, required to achieve correct interface with the controller, are listed in Table 3-3.

Table 3-1. Input Level Requirements

Logic State	Voltage	Current
False (Logic 0) True (Logic 1)	+2.5 to +5.5 Volts 0.0 to +0.4 Volt	0 (open collector) 26 mA sink

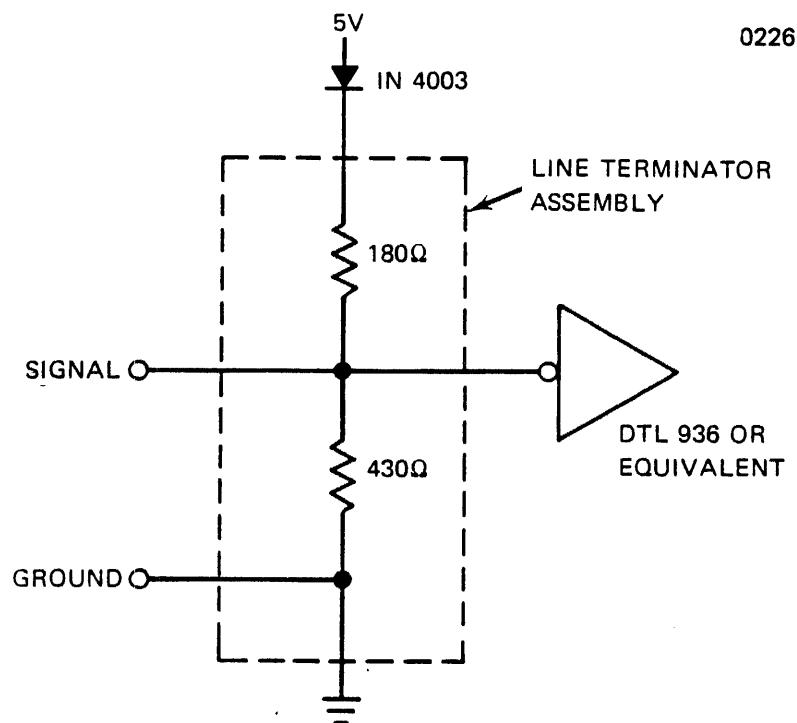


Figure 3-5. Input Termination Configuration

Table 3-2. Input Functions

Input Control Lines			Input Data Lines	
Select 0			Write Data	(9 lines)
Select 1			Write Data Strobe	(1 line)
Select 2	(Option)	(4 lines)	Write Reset	(1 line)
Select 3			Read Threshold	(1 line)
Forward		(1 line)		
Reverse		(1 line)		
Rewind		(1 line)		
Off-Line		(1 line)		
Write Enable		(1 line)		
PE/NRZI Select	(Option)	(1 line)		

Table 3-3. Input/Output Pin Assignments

Connector No. Cipher 100140-001 (or equivalent)	Signal Nomenclature	Signal Pin	Ground Pin
J16	CONTROL INPUTS FROM CUSTOMER		
	PE/NRZI SELECT (Optional)	D	4
	SELECT 0	J	-
	SELECT 1	8	-
	SELECT 2	7	-
	SELECT 3	9	-
	FORWARD/STOP	C	3
	REVERSE/STOP	E	5
	REWIND	H	-
	OFF-LINE	L	10
	WRITE ENABLE	K	-
	STATUS OUTPUTS TO CUSTOMER		
	SPEED STATUS	A	1
	READY STATUS	T	16
	ON-LINE STATUS	M	11
	REWIND STATUS	N	12
	EOT STATUS	U	17
BOT STATUS	R	14	
FILE PROTECT STATUS	P	13	
+5V TERMINATOR POWER	S	-	

Table 3-3. Input/Output Pin Assignments (continued)

Connector No. Cipher 100140-001 (or equivalent)	Signal Nomenclature	Signal Pin	Ground Pin
J1  WRITE DATA INPUT CONNECTOR	LOW READ THRESHOLD WRITE DATA STROBE WRITE RESET WRITE DATA PARITY WRITE DATA 0 WRITE DATA 1 WRITE DATA 2 WRITE DATA 3 WRITE DATA 4 WRITE DATA 5 WRITE DATA 6 WRITE DATA 7 +5V TERMINATOR POWER	F A C L M N P R S T U V 2	6 1 3 10 11 12 13 14 15 16 17 18 -
J6  READ DATA OUTPUT CONNECTOR	READ STROBE (NRZI) READ DATA PARITY READ DATA 0 READ DATA 1 READ DATA 2 READ DATA 3 READ DATA 4 READ DATA 5 READ DATA 6 READ DATA 7 NRZI/PE STATUS (PE/NRZI)	2 1 3 4 8 9 14 15 17 18 10	B A C D J K R S U V L

### 3.3.1 INPUT CONTROL FUNCTIONS

#### 3.3.1.1 Select 0

A true level on this line enables all the write and read circuitry, On-Line MTT control commands, and the status output lines if the Ready status line is true and if the MTT is in the On-Line mode. When the level goes false, these MTT-control command functions are disabled.

#### 3.3.1.2 Unit Select (Option)

Four select lines, are provided so that one of several daisy-chained MTT's is selected if the line which is true corresponds with the Unit Select switch position of that MTT.

#### 3.3.1.3 Forward

A true level on this line causes tape to move forward. When the level goes false, tape motion ceases.

#### 3.3.1.4 Reverse

A true level on this line causes tape to move in the reverse direction. When the level goes false, tape motion ceases.

#### 3.3.1.5 Rewind

A 2-microsecond pulse on this line causes the MTT to drive tape at 150 ips in the reverse direction and stop at the load point. The MTT initiates a Load operation, illuminates the LOAD indicator, and remains in the On-Line mode. If already at load point when the Rewind command is given, the command is ignored. All other motion commands are inhibited until the Rewind operation is complete.

#### 3.3.1.6 Off-Line

The signal on this line is a level or a 2-microsecond minimum pulse that resets the on-line flip-flop to the zero state, thus placing the MTT under operator control. It is gated only by Select in the Transport Control logic which allows an Off-Line command to be issued while a Rewind operation is in progress.

#### 3.3.1.7 Write Enable

The leading edge of this pulse must occur prior to or be coincident with the leading edge of the Forward or Reverse motion command, and the level must remain true at least 20 microseconds after initiation of the motion command for the MTT to be set in the Write mode. This line need not be pulsed if consecutive records are to be written; but merely held true until the Write operation is terminated.

If the Read mode of operation is required, keep this line false for at least 20 microseconds, starting from the leading edge of the motion command. This condition resets the write/read flip-flop, and places the MTT in the Read mode. The Write mode can also be disabled by any of the following conditions:

- a. A Rewind command.
- b. An Off-Line command.

- c. Loss of interlocks.
- d. Manually switching to the Off-Line mode.

### 3.3.1.8 PE/NRZI Select (Option)

This line is used only on dual-density MTT's. A true level on this line conditions the MTT to write and read at a data density of 1600 cpi (PE) and causes the NRZI/PE status line to go false. When this input line is false, the MTT is conditioned to operate at 800 cpi (NRZI).

## 3.3.2 INPUT DATA FUNCTIONS

### 3.3.2.1 Write Data

Depending on which version of the Mod 10 MTT is used, Write Data is processed in the NRZI or PE mode.

- a. For NRZI mode in the dual-density version, one line is required for each bit in a tape character. The Write Data lines establish the controlling condition for the NRZI write register. When true, the state of the corresponding flip-flop changes at the time of the Write Data Strobe pulse. This state changes the direction of the current through the write head which establishes a flux reversal and one (1) is written on the tape. When false, the state of the flip-flop does not change at the time of the Write Data Strobe pulse. This state results in no change in the direction of write head current; thus no flux reversal, and zero (0). These data lines must be held steady through the time interval from 0.2 microsecond before to 0.2 microsecond after the Write Data Strobe pulse. At least one Write Data line must be true for every Write Data Strobe pulse.
- b. For PE mode in the PE-only or dual-density version, the Write Data waveforms at connector J1 are in phase-encoded format. These waveforms are transferred to the write heads in the form of currents at the time that corresponds with the trailing edge of the Write Data Strobe pulse if the MTT has been placed in the Write mode. When these lines are true, the head currents are changed (unless already in the proper state) by the Write Data Strobe pulse such as to magnetize the tape in the direction opposite to the IRG polarity. When these lines are false, the effect is correspondingly reversed. These data lines must be held steady throughout the time interval

consisting of 0.2 microsecond before to 0.2 microsecond after the Write Data Strobe pulse. Since the preamble, postamble, identification burst, and tape (file) mark information are also placed on these lines, the MTT does not distinguish them from normal data.

### 3.3.2.2 Write Data Strobe

Depending on which version of the Mod 10 MTT is used, the Write Data Strobe pulse is processed in the NRZI or PE mode.

- a. NRZI mode, dual-density – A 1-microsecond pulse on this line causes a change in the state of the NRZI write register cell at the time the deskew one-shot times out if the corresponding Write Data line is true. One pulse is required for each character to be recorded. The recording density is determined by the tape speed and the frequency of the pulses. The frequency must remain stable within 0.25 percent.
- b. PE mode – In the dual-density version, a 1-microsecond pulse on this line transfers data from the write bus to tape when the deskew one-shot times out. Since no write deskewing is used on PE-only MTT's, the transfer to tape occurs on the trailing edge of the Write Data Strobe pulse. One Write Data Strobe pulse is required for every flux reversal on the tape, and the frequency of this pulse is twice that of the character transfer rate. Write Data Strobe pulses are required when writing preamble, postamble, identification burst, and tape marks. The frequency must remain stable within 0.25 percent.

### 3.3.2.3 Write Reset

The Write Reset pulse is processed only in the NRZI mode.

NRZI mode, dual-density. A 1-microsecond pulse on this line resets the NRZI write register. This pulse is used to write the longitudinal redundancy check character (LRCC) at the end of each block of data; therefore, the Write Reset pulse creates an even number of flux reversals (1's) in each track of the data block. This pulse occurs 8 character times after the last data character in every block of data.

### 3.3.2.4 Low Read Threshold (RTH2)

A true level on this line selects an extra-low threshold level for the Read signals, thus allowing for the detection of marginal areas of tape. This level is approximately 12

percent in NRZI mode and 7 percent in PE mode. A false level on this line selects the normal Read Threshold signal level which is 24 percent in NRZI mode and 15 percent in PE mode. This level is active only in Read operations since the threshold level for Write operations is fixed at 45 percent in NRZI mode and 28 percent in PE mode.

### 3.4           **OUTPUTS**

Output voltage levels, output current levels, and a list of output control and data functions are listed in Tables 3-4, 3-5 and 3-6 respectively. Figure 3-6 shows output termination.

On-Line output signals, described in paragraphs 3.4.1 and 3.4.2, provide the data functions when the MTT is Ready and Selected. Control status functions are activated when the MTT is On-Line and Selected. Unless otherwise specified, the description of these lines is common to both PE-only and dual-density MTT's (see Table 3-3 for pin connections).

#### 3.4.1.       **OUTPUT CONTROL FUNCTIONS**

##### 3.4.1.1      Ready Status

This line is true when the MTT interlocks are made, the MTT is On-Line and not rewinding, and the initial Load operation is complete.

##### 3.4.1.2      On-Line Status

A true level on this line indicates the on-line flip-flop is set and the MTT is under remote control.

##### 3.4.1.3      Rewinding Status

A true level on this line indicates the MTT is rewinding. The Rewind function is completed when the tape stops at the load point.

##### 3.4.1.4      EOT Status

A true level on this line indicates the MTT is sensing the EOT reflective marker.

Table 3-4. Output Voltage Levels

Logic State	Condition
False (Logic 0)	Open Collector – Terminated as shown in Figure 3-6
True (Logic 1)	0.0 to +0.5V

Table 3-5. Output Current Levels

Level	Output
False	Open Collector
True	40 milliamperes (mA) maximum sink

Table 3-6. Output Functions

Output Control Status Lines		Output Data Lines	
Ready Status	(1 line)	Read Data	(9 lines)
On-Line Status	(1 line)	Read Strobe (NRZI)	(1 line)
Rewind Status	(1 line)	NRZI/PE Status (Dual Density)	(1 line)
EOT Status	(1 line)		
BOT Status	(1 line)		
File Protect Status	(1 line)		
Speed Status	(1 line)		



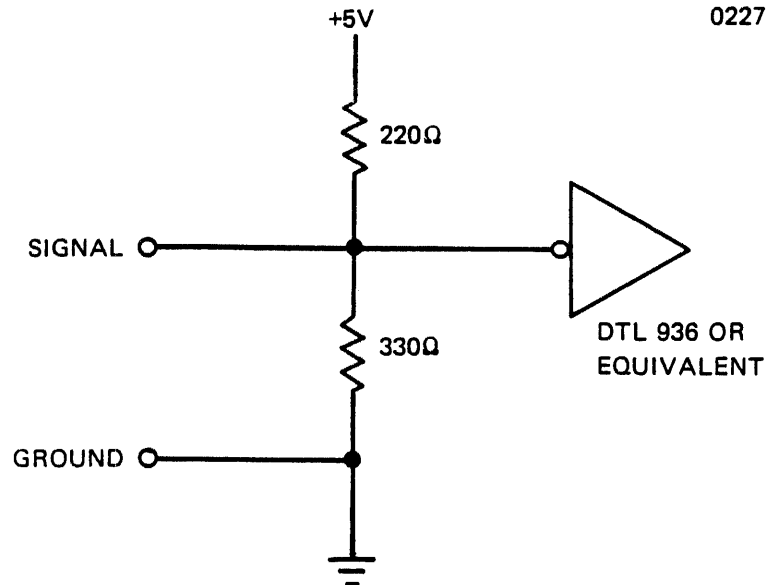


Figure 3-6. Output Termination Configuration

#### 3.4.1.5 BOT Status

A true level on this line indicates the MTT is sensing the BOT reflective marker at the load point.

#### 3.4.1.6 File Protect Status

A true level on this line indicates no write enable ring has been installed on the supply reel.

#### 3.4.1.7 Speed Status

A true level on this line indicates the selected MTT is operating at the lower one of two tape speeds. This line is used when two or more MTT's of different tape speeds are used in a daisy-chain system.

### 3.4.2 OUTPUT DATA FUNCTIONS

#### 3.4.2.1 Read Data

Depending on which version of the Mod 10 MTT is used, Read Data is processed in the NRZI or PE mode.

- a. For NRZI mode in the dual-density version, one line is required for each bit in a tape character. Each output line is at a level which changes to its appropriate state before the trailing edge of the Read Clock pulse appears and remains in that state approximately 500 nanoseconds after the trailing edge of the Read Data signal.
- b. For PE mode in the PE-only or dual-density version, the signals on the Read Data lines are the peak detected outputs individually gated with the outputs of their respective Read-signal envelope detectors. These signals are in the same form as the phase-encoded signals on the write bus. A low (0 Volt) level on these lines represents the level opposite to that of the IRG when moving tape in the forward direction. The opposite polarities occur when tape is moving in the reverse direction.

#### 3.4.2.2 Read Clock Pulse, NRZI Only

The Read Clock line provides a pulse of 2 microseconds duration for each data character read from the tape. The trailing edge of this pulse is used to sample the Read Data lines.

#### 3.4.2.3 NRZI/PE Status, Dual-Density MTT's

A true level on this line indicates the selected MTT is operating in the NRZI mode. A false level on this line indicates the selected MTT is operating in the PE mode. This line is not conditioned with the Ready function.



## SECTION 4

### MAINTENANCE

#### NOTE

The information contained in this manual is not to be used as criteria for equipment acceptance verification. This manual is to be used in making Field Service Adjustments.

#### 4.1 PREVENTIVE MAINTENANCE

Before any Mod 10 MTT leaves the factory, each of its components has been thoroughly tested and all adjustments have been made to ensure reliable operation. Careless handling in transit or the effect of long use may necessitate replacement of some parts or readjustment of some components.

Table 4-1 lists a basic set of maintenance tools and supplies required for regular servicing of the Mod 10. As the table suggests, some supplies should also be available to the operator for daily or shift-end cleaning. Oscilloscopes, probes, and meters must be maintained in calibration to manufacturers specifications.

Table 4-2 offers a suggested schedule for preventive maintenance. Again, some of these functions are the responsibility of the MTT operator; procedures for performing them are described in paragraph 4.1.1. This section describes preventive maintenance tasks that must be performed by a service engineer in conjunction with the repair procedures for any subassembly to which they pertain.

In the pages that follow, instructions are provided for replacements, readjustments, and fault isolation aids that can prove effective while the MTT remains installed in the customer's computer system. As in the preceding sections, the maintenance instructions are organized in terms of subassembly units. Some tasks of repair require test equipment not normally available in the field or special alignment and adjustment tools that are not available to field engineers. Instructions for repairs of this more complex kind are NOT included in this section.

Table 4-1. Maintenance Tools and Supplies

FOR THE OPERATOR	
Lint-free cloth Foam Floss Swabs, P/N TX700(50), TX700B(500), Texwipe, Co., 51 Prospect Pl., P.O. Box 278, Hillsdale, N.J. 07642. IBM Tape Transport Cleaner, P/N 453511	
FOR THE SERVICE ENGINEER	
Equipment	Model or Type
Socket wrench set	For 4-40, 6-32, 8-32, and 10-32 cap screws
Socket wrench set	For 4-40, 6-32, and 10-32 set screws
Open-end wrench	For 7/16-inch bolts
Long-nose pliers	
Screwdriver set	Phillips
Screwdriver set	Standard blade
Soldering aid	
Soldering iron	
Tape Tracking Fixture	Cipher P/N T-00010
Voltmeter	Triplett Model 800 or equivalent
Reel hub alignment fixtures	Cipher P/N T-00002
Oscilloscope	Tektronix 547 or equivalent
Dual trace plug-in	Tektronix 1A1 or equivalent
X10 oscilloscope probes (3)	Tektronix
Guide shims (as required)	Cipher P/N 200203
Master alignment tape	IBM 432640 or 432641 or Cipher P/N 150105
Standard-level output tape	IBM 461108 or 432152 or Cipher P/N 150104
Scratch-pad tape	
Pulse generator or TCU	

Table 4-2. Suggested Schedule for Preventive Maintenance

Maintenance Task		Interval (in operating hours)	Procedure Described in:
PERFORMED BY OPERATOR	Clean Head, Tape Cleaner	8	Section 4
	Face, Head Guides and Head Guide Blocks	(Daily)	
	Clean and Check Roller Guides	8 (Daily)	Section 4
	Clean and Check Capstan	8 (Daily)	Section 4
PERFORMED BY SERVICE ENGINEER	Clean Entire MTT Surface	(Approx. 4 months)	Section 4
	Clean Tape Cleaner Unit	(as required)	Section 4, para. 4.3.5.2
	Check Tape Tracking	2,000	Section 4 para. 4.4.2.3

#### 4.1.1 CLEANING

Proper and regular maintenance of the Mod 10 MTT ensures operation of the high levels of data and mechanical reliability that have been designed into the system. Particularly important are the operator maintenance functions that are intended to keep the system free of dirt and contaminants. At the high densities of data on tapes written or read with the Mod 10, extremely small particles of dust or loose oxide from the tape are capable of causing data errors. Careful attention to the cleaning procedures described in this section can ensure the greatest possibility of trouble-free operation.

Unless otherwise specified, all cleaning functions must be performed after every eight hours of system operation. Table 4-3 lists assemblies and corresponding cleaning agents. Perform the following preliminary steps:

- a. Remove tape from MTT as described in Section 2.
- b. Turn off system power if not required.
- c. Remove head cover by pulling directly away from the front of the MTT. Head cover comes off with application of gentle steady pull.

Table 4-3. Cleaning Agents

Assembly	Cleaning Agent
Head	IBM Transport Cleaner P/N 453511
Guides	IBM Transport Cleaner P/N 453511
Tape Cleaner	IBM Transport Cleaner P/N 453511
Capstan	Water

4.1.1.1 Head Assembly Cleaning

To clean the head assembly, see Figure 4-1 and use the following procedure:

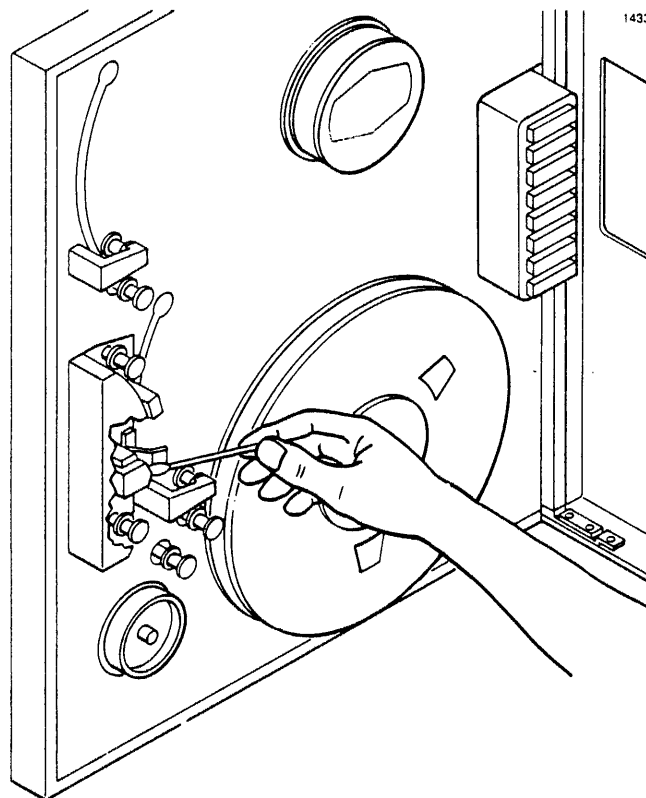


Figure 4-1. Cleaning the Read-After-Write Head Assembly

- a. Moisten a soft, lint-free cloth or applicator\* with IBM Tape Transport Cleaner P/N 453511. After head surfaces, including that of erase head, have been carefully swabbed, dry them with a separate clean and lint-free cloth.
- b. Clean tape cleaner blades by using same procedure as described in step a. Also remove accumulated oxide residue from cavities between blades.

\*See Table 4-1.

- c. Clean head guides and head-guide blocks. Head-guide blocks are immediately in back of head guides. Dry with a separate clean and lint-free cloth.
- d. Replace previously removed head cover by aligning holes in cover with mounting pins on MTT and pressing firmly into place.

**CAUTION**

Care must be taken to ensure the head assembly wires are not pinched upon installation of the cover.

#### 4.1.1.2 Tape Guide Cleaning

The roller guides shown in Figure 4-2 must be cleaned while rotating them to ensure that all surfaces have been treated. Dry each cleaned roller guide with a separate clean and lint-free cloth.

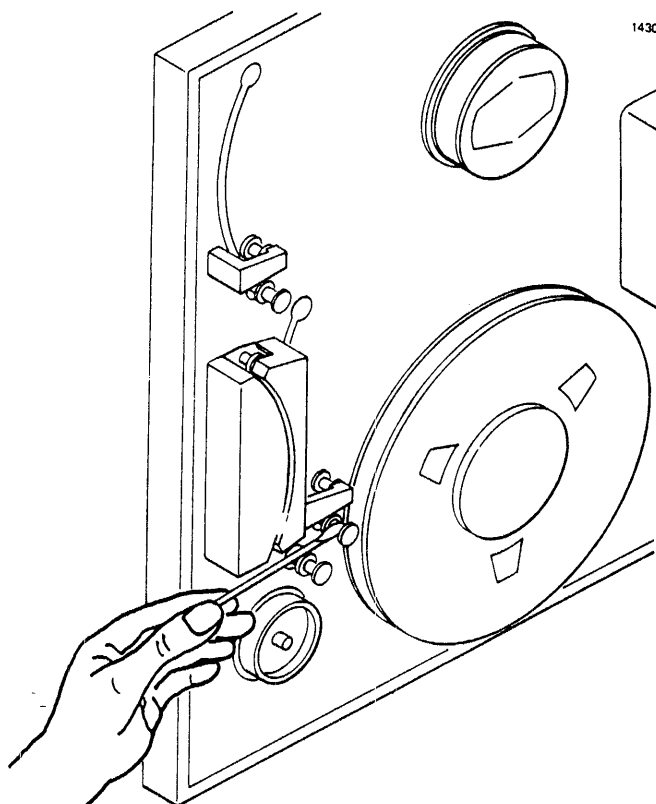


Figure 4-2. Cleaning the Roller Guides

#### 4.1.1.3 Capstan Cleaning

To clean the capstan, use the following procedure:



- a. Moisten clean, lint-free cloth with water.
- b. Rotate capstan slowly with one hand without touching rubber surface, and simultaneously clean surface of capstan with moistened cloth.
- c. Visually inspect capstan surface for abrasion or polish; if defects are observed, consult service engineer.
- d. Dry capstan with a separate clean, lint-free cloth.

#### 4.1.1.4 Periodic Cleaning Requirements

Additional cleaning requirements are carried out at longer intervals. Every four months, the entire surface of the MTT should be cleaned to be certain that accumulations of dust around the hold-down knobs and in the head are removed. The head cover should be removed and cleaned on the inside and outside. Verify that all deposits of dust and other possible tape contaminants are removed.

Any periodic maintenance functions beyond those described here should be performed by customer maintenance engineers.

## 4.2 POWER SUPPLY

The opening of the power supply is necessary when troubleshooting and component replacement is required in this area. It is also required when it is desired to access terminal board TBI to change power transformer taps. Use the following procedure:

- a. Turn off power with toggle switch on power supply and disconnect power cord from AC outlet.
- b. Swing out transport deck.
- c. Remove four Phillips screws that fasten power supply assembly to transport deck. These screws are shown flagged in Figure 4-3.
- d. Swing power supply assembly open.

### 4.2.1 CHECKING UNREGULATED POWER SUPPLY

A check may be made of the unregulated power supply by testing with a voltmeter at test points provided on the TEB. Table 4-4 lists the voltages and corresponding test points. The voltages should be within  $\pm 20$  percent of the specified nominal value. Test point locations are shown on Drawing 200632 in the Engineering Drawing Package, Sections 1 and 2.

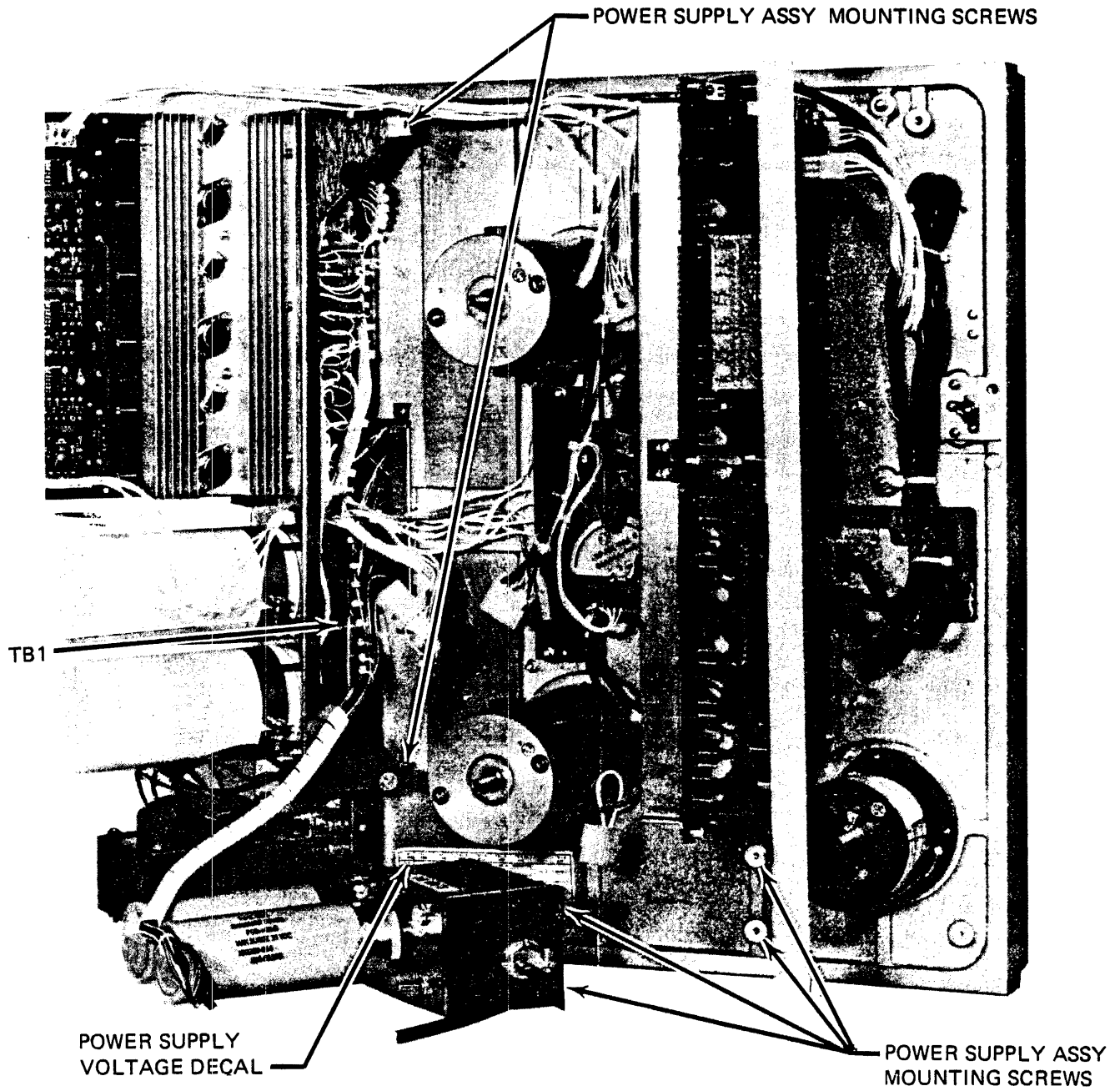


Figure 4-3. How to Open Power Supply

Table 4-4. Unregulated Power Supply Voltages

Voltage	Test Point
+19V	TP419
-19V	TP422
+13V	TP420
-13V	TP421

#### 4.2.2 CIRCUIT BREAKER RESET

If a malfunction occurs, an automatic circuit breaker (CBI) provides protection against damage from severe overload conditions (caused, for example, by improper connection of the transformer primary taps). The circuit breaker Reset button is located adjacent to the power switch on the power supply chassis. The button is in the OUT position after an automatic circuit break has occurred. Pushing in the button restores the circuit.

#### 4.2.3 FUSES

Five fuses, in the unregulated power supply lines, are located on the power supply subassembly. F1 is a 5 Ampere fuse in the +19-Volt line. F2 is a 10 Ampere fuse in the -19-Volt line. F3 is a 10 Ampere fuse in the +13-Volt line that supplies all loads except the +5-Volt regulator. F4 is a 4 Ampere fuse in the +13-Volt line that supplies current to only the +5-Volt regulator. F5 is a 10 Ampere fuse in the -13-Volt line. All fuses are fast-blow types.

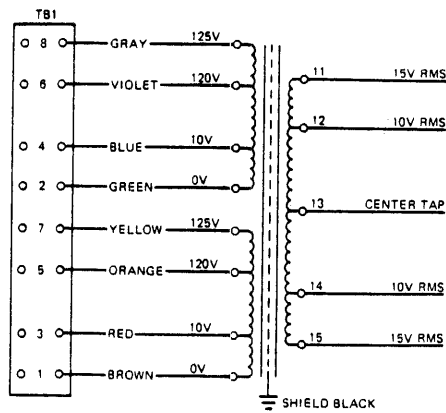
### CAUTION

Never replace defective fuse with slo-blow type or with fuse that has a higher rating than specified.

Before replacing a defective fuse, evaluate and correct the condition that caused it to open; then, unscrew the fuse holder and withdraw the fuse. Replace the fuse with one of identical rating and type; then reinstall the fuse and fuse cap.

#### 4.2.4 TRANSFORMER TAPS

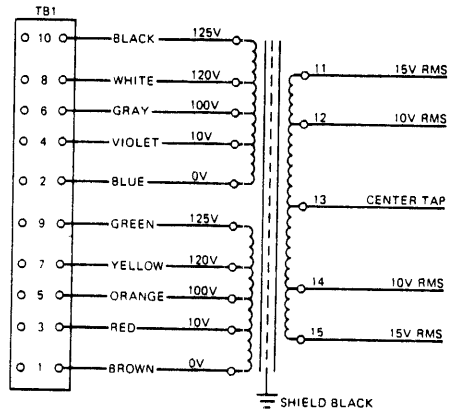
The Mod 10 MTT can accept power from sources of varying voltage, depending on the power transformer primary connection chosen. Figure 4-4 shows the color coding of the transformer primary wires attached to terminal board TBI under the power supply chassis.



STANDARD P/N 200011 FOR 25 IPS AND BELOW, 200487 FOR 37.5 IPS AND ABOVE,  
 \*110V ON OPTIONAL P/N 201067 FOR 25 IPS AND BELOW

LINE VOLTAGE	TB1-1 BRN	TB1-2 GRN	TB1-3 RED	TB1-4 BLU	TB1-5 ORN	TB1-6 VIO	TB1-7 YEL	TB1-8 GRY
110			LINE B	JUMPER TO 3	LINE A	JUMPER TO 5		
115			LINE B	JUMPER TO 3			LINE A	JUMPER TO 7
120	LINE B	JUMPER TO 1			LINE A	JUMPER TO 5		
125	LINE B	JUMPER TO 1					LINE A	JUMPER TO 7
220			LINE B	JUMPER TO 5		LINE A		
230			LINE B	JUMPER TO 7				LINE A
240	LINE B	JUMPER TO 5				LINE A		
250	LINE B	JUMPER TO 7						LINE A

**WARNING:** DO NOT REMOVE UNMARKED WIRES ON TERMINALS 3 AND 7. THESE WIRES CARRY 115V TO THE RETRACT MOTOR.



OPTION P/N 200116 FOR 37.5 IPS AND ABOVE

LINE VOLTAGE	TB1-1 BRN	TB1-2 BLU	TB1-3 RED	TB1-4 VIO	TB1-5 ORN	TB1-6 GRY	TB1-7 YEL	TB1-8 WHT	TB1-9 GRN	TB1-10 BLK
90			LINE B	JUMPER TO 3	LINE A	JUMPER TO 5				
100	LINE B	JUMPER TO 1			LINE A	JUMPER TO 5				
110			LINE B	JUMPER TO 3			LINE A	JUMPER TO 7		
115			LINE B	JUMPER TO 3					LINE A	JUMPER TO 9
120	LINE B	JUMPER TO 1					LINE A	JUMPER TO 7		
125	LINE B	JUMPER TO 1							LINE A	JUMPER TO 9
180			LINE B	JUMPER TO 5		LINE A				
200	LINE B	JUMPER TO 5				LINE A				
210		JUMPER TO 7	LINE B			LINE A				
220			LINE B	JUMPER TO 7				LINE A		
230			LINE B	JUMPER TO 9					LINE A	
240	LINE B	JUMPER TO 7						LINE A		LINE A
250	LINE B	JUMPER TO 9								LINE A

**WARNING:** DO NOT REMOVE UNMARKED WIRES ON TERMINALS 3 AND 9. THESE WIRES CARRY 115V TO THE RETRACT MOTOR.

Figure 4-4. Mod 10 MTT Power Transformer Connection

For example: parallel connection to standard 115-Volt  $\pm$  10 percent power is made by connecting the gray and yellow wires to one side of the line voltage and the blue and red wires to the other side. Side connection to a 220-Volt power source is made by connecting the violet wire to one side of the line voltage, connecting the blue to the orange wire on terminal board TBI, and connecting the red wire to the other side of the line. Unused wires should be left attached to the terminal strip.

### 4.3 REMOVAL AND REPLACEMENT PROCEDURES

The following paragraphs describe the procedures required for removal of assemblies and subassemblies for servicing or replacement in the Mod 10 MTT. To reinstall an assembly or subassembly, simply reverse the order of the steps in the removal procedure.

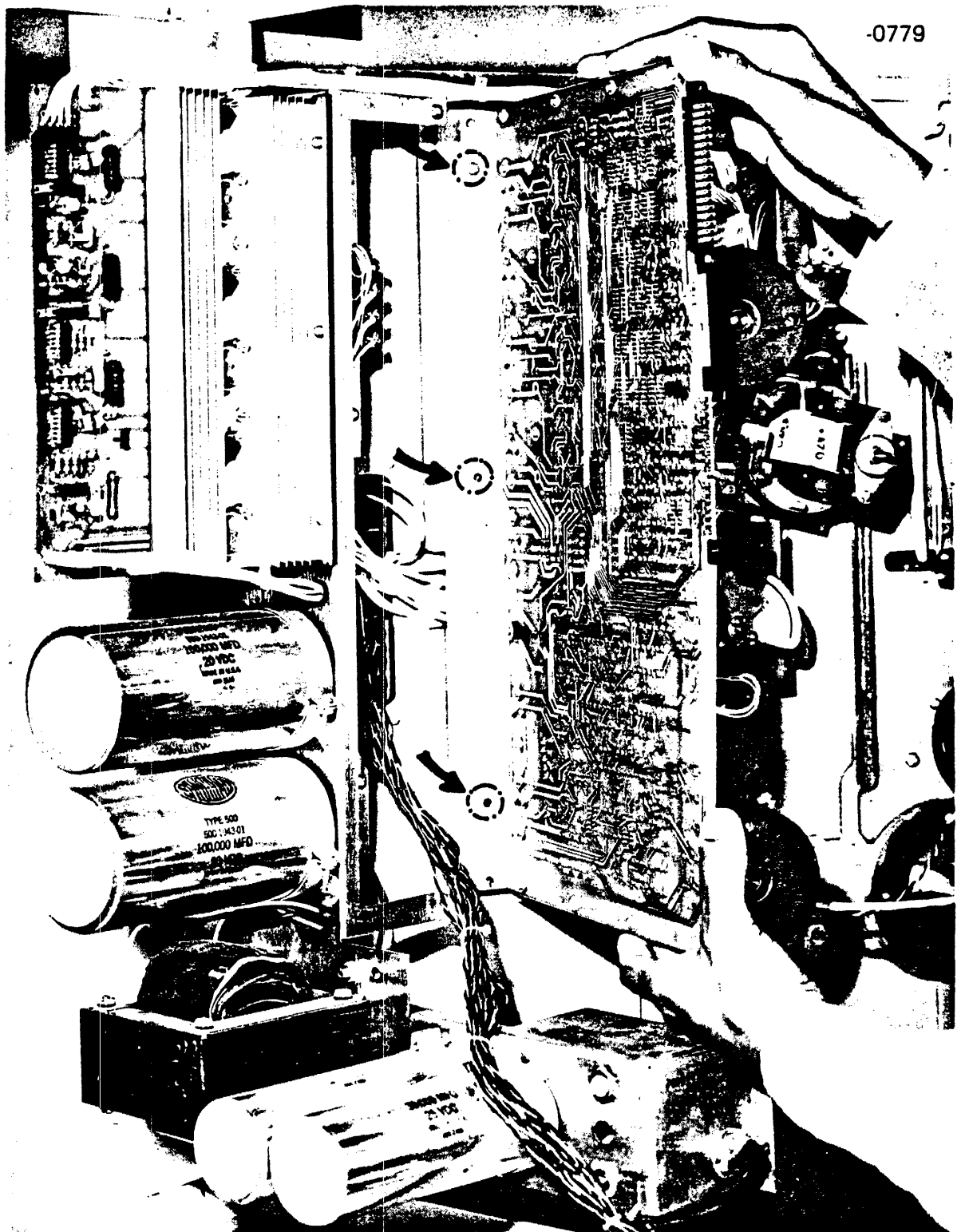
#### CAUTION

Keyed shakeproof connectors are used on all interconnecting cables. To unplug a connector, force must be applied only to the connector body. Pulling on wires attached to a connector can result in damage to wires and/or connector pins. When connecting a plug to a connector, ensure that keying is aligned properly.

#### 4.3.1 TRANSPORT ELECTRONICS PWB

To remove the Transport Electronics PWB (TEB) which houses all the servo and control logic electronics, use the following procedure:

- a. Turn off power to MTT with toggle switch on power supply and disconnect power cord from AC outlet.
- b. Remove all connectors from TEB. Use care to avoid damaging connector pins on TEB.
- c. Open power supply assembly as described in paragraph 4.2.
- d. Remove three screws from heatsink which fasten TEB to transport deck. These screws are shown in Figure 4-5. Be sure to support assembly to prevent damage when screws are removed. TEB is then free to be removed.
- e. After installation of new TEB, perform TEB adjustments described in paragraph 4.4.5.



○ TRANSPORT ELECTRONICS PWB ASSY.  
MOUNTING HOLES.

Figure 4-5. Transport Electronics PWB Removal

### 4.3.2 DATA ELECTRONICS PWB

In the PE-only MTT, the Data Electronics PWB (DEB) contains both the read data and write data electronics. In the dual-density PE/NRZI MTT, the Read Data Electronics PWB contains the read data circuitry, and the Write Data Electronics PWB contains the write data circuitry.

#### 4.3.2.1 PE-Only System

To remove DEB which houses both the read and write electronics, use the following procedure:

- a. Turn main power off, either at OCP or at switch S1 on power supply chassis.
- b. Remove all connectors from DEB.

#### **CAUTION**

Use an appropriate size screwdriver on the jackscrew fasteners. Loosen the connectors evenly, alternating turns on each screw. Attempting to loosen one side at a time can cause the connectors to bind and possibly bend the pins. Use of fingers instead of screwdriver risks the possibility of breaking wires on the connectors.

- c. While supporting DEB to prevent damage, remove four Phillips screws that hold DEB mounting brackets to transport deck. Location of bracket screws are shown in Figure 4-6.
- d. After replacement with a new DEB, perform adjustments described in paragraph 4.4.6.

#### 4.3.2.2 Dual-Density PE/NRZI System

The Write Data Electronics PWB must be removed before the Read Data Electronics can be removed.

4.3.2.2.1 Write Data Electronics PWB. To remove the Write Data Electronics PWB, see Figure 4-7 and use the following procedure:

- a. Turn main power off at the OCP and at switch S1 on the power supply chassis.
- b. Remove connectors P3, P28, P1A and P1B from PWB.
- c. Remove Winchester write-head cable connector P2 from PWB.

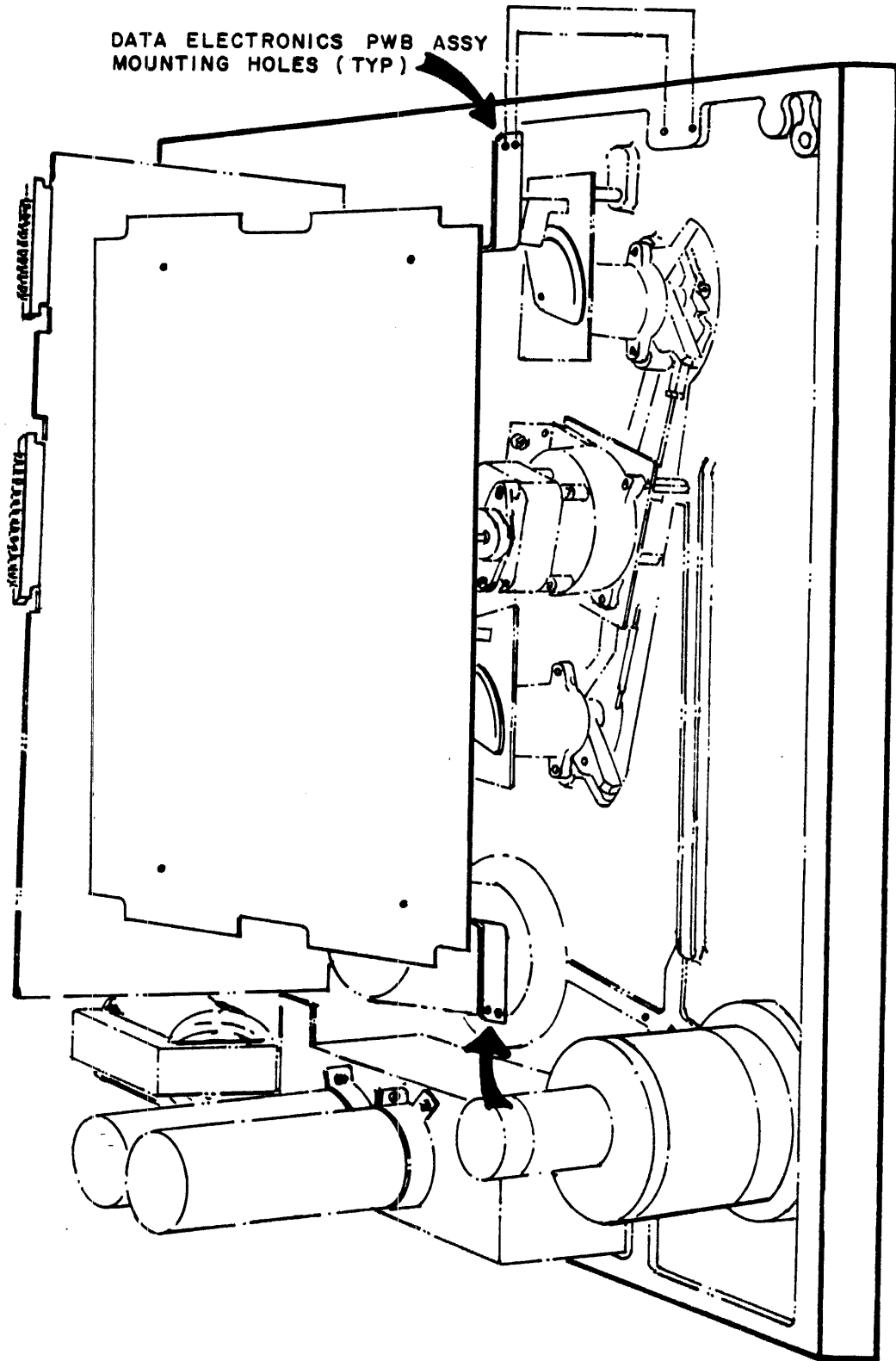


Figure 4-6. Data Electronics PWB Removal, PE-Only System



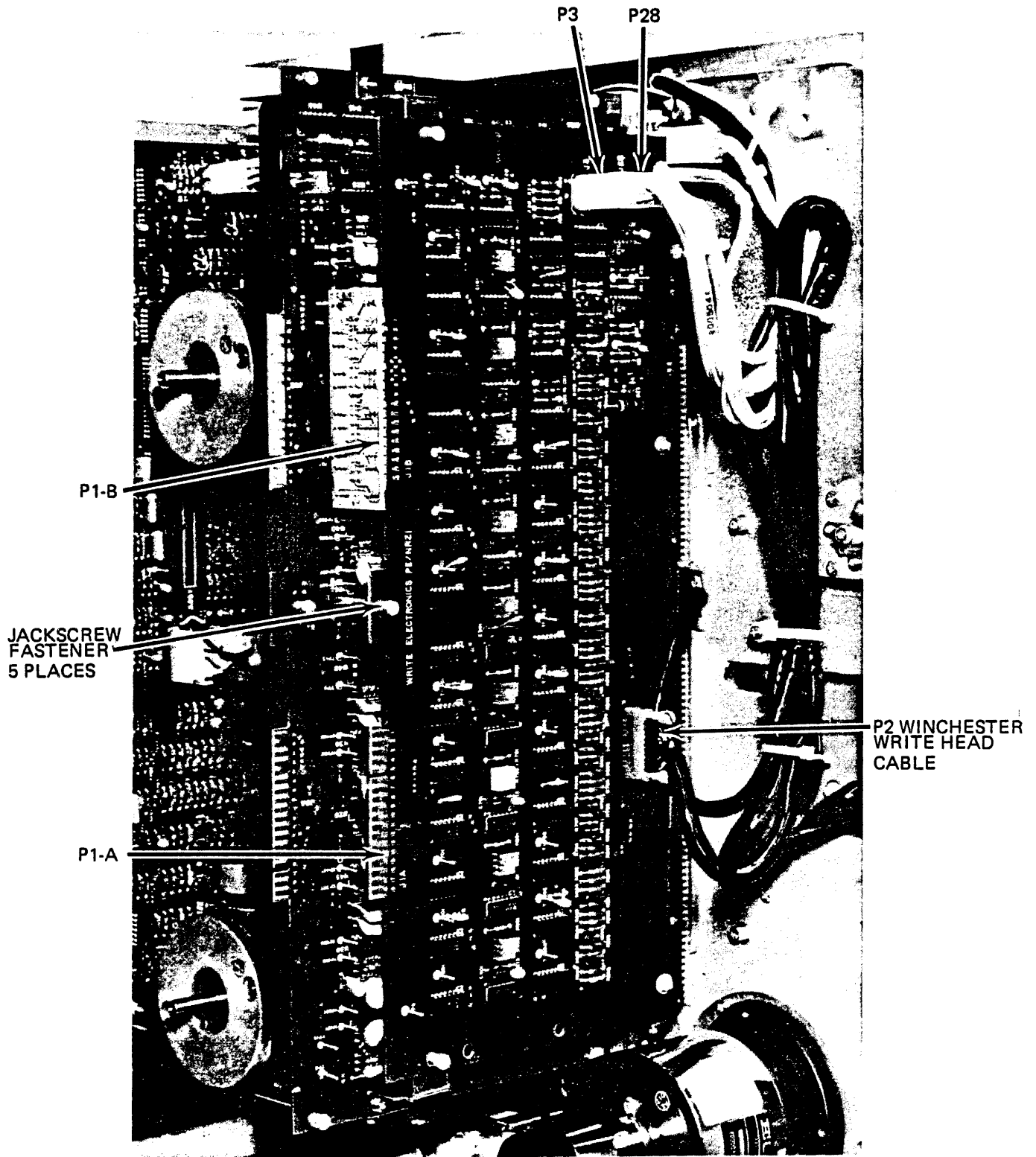


Figure 4-7. Write Data Electronics PWB Removal, Dual-Density System

**CAUTION**

Use an appropriate size screwdriver on the jackscrew fasteners. Loosen the connectors evenly, alternating turns on each screw. Attempting to loosen one side at a time can cause the connectors to bind and possibly bend the pins. Use of fingers instead of screwdriver risks the possibility of breaking wires on the connectors.

- d. Loosen four captive screws which hold PWB to spacers or brackets; then, slide PWB support bracket along slider guide and off end as shown in Figure 4-7.
- e. After PWB replacement, perform adjustments described in paragraph 4.4.7.

4.3.2.2.2 Read Data Electronics PWB. To remove the Read Data Electronics PWB, see Figure 4-8 and use the following procedure:

- a. Turn main power off at OCP and at switch S1 on power supply chassis.
- b. Remove Write Data Electronics PWB first as described in paragraph 4.3.2.2.1.
- c. Remove connectors P4, P28, P6A, and P6B from PWB.
- d. Remove Winchester read-head cable connector P5 from PWB.

**CAUTION**

Use an appropriate size screwdriver on the jackscrew fasteners. Loosen the connectors evenly, alternating turns on each screw. Attempting to loosen one side at a time can cause the connectors to bind and possibly bend the pins. Use of fingers instead of screwdriver risks the possibility of breaking wires on the connectors.

- e. While supporting PWB to prevent damage, loosen five captive screws that hold PWB to stand-offs.
- f. After PWB replacement, perform adjustments described in paragraph 4.4.7.

### 4.3.3 OCP SWITCH

The pushbutton switches on the OCP are sealed assemblies. If either the switch or the indicator fails, the entire sealed unit for the particular assembly must be replaced. See Figure 4-9 and use the following procedure:

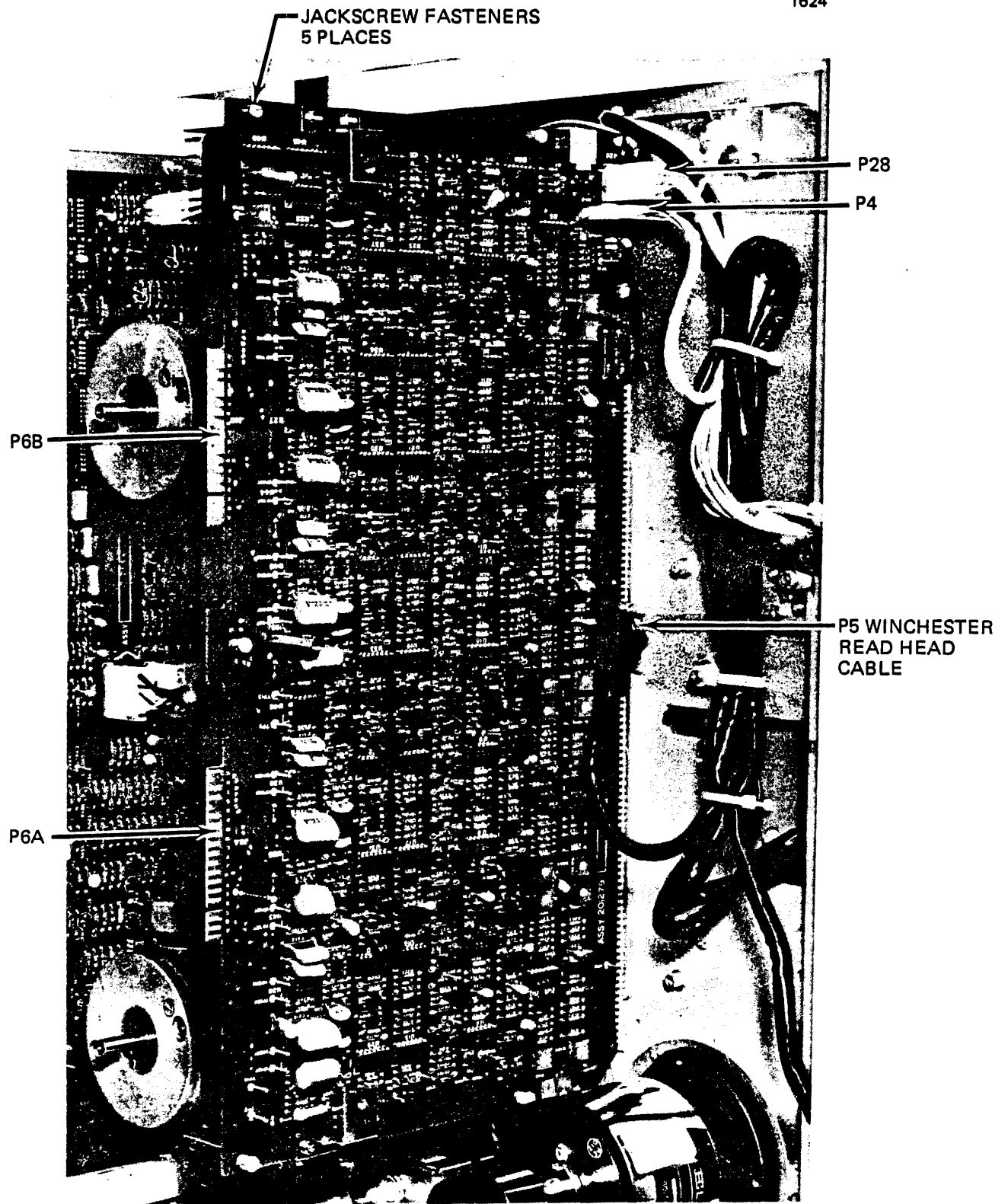


Figure 4-8. Read Data Electronics PWB Removal, Dual-Density System

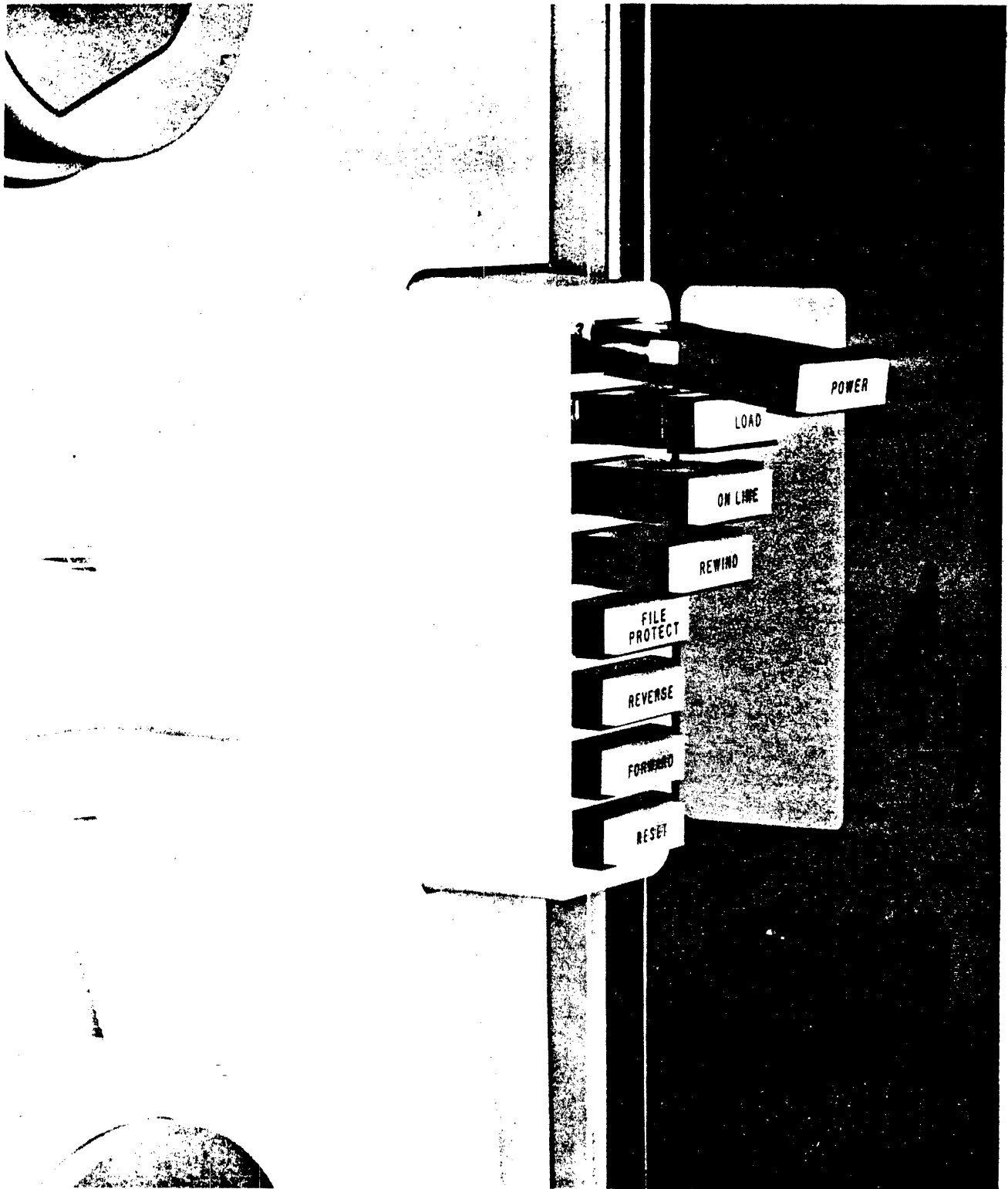


Figure 4-9. OCP Switch Removal

- a. Set utility power switch S1 at back of power supply chassis to OFF position.
- b. Grasp pushbutton at either side and pull it directly away from transport deck by rocking it gently from side to side. Use care that attached wires are not damaged.
- c. Identify position of push-on lugs attached to switch terminals, then remove push-on lugs.
- d. Connect push-on lugs to replacement switch in proper positions.
- e. Push replacement switch firmly into position.

#### 4.3.4 ARM SENSE LAMP AND PHOTOCELL

The lamp and holder assembly is a plug-in unit. To replace, plug in new assembly.

To replace the photocell, it is required to remove the Arm Sense PWB before replacing the photocell. Use the following procedure:

- a. Loosen Allen screw on collect clamp and rotate cam and clamp assembly until it is free of shaft.
- b. Cut cable-harness tie wraps to separate cable from rest of harness.
- c. Remove three Phillips screws that secure Arm Sense PWB to main frame.
- d. Remove connector at end of PWB cable located on TEB. This connector is P12 for the file side, or P13 for the fixed side.
- e. Unsolder photocell from Arm Sense PWB and install replacement photocell on PWB.
- f. Perform Arm Sense PWB adjustments in paragraph 4.4.4 after replacement is completed.

#### 4.3.5 HEAD ASSEMBLY

Read-after-write head assemblies may be removed and replaced in the field. See Figure 4-10 and use the following procedure:

**WARNING**

SYSTEM POWER MUST BE TURNED OFF  
BEFORE DISCONNECTING OR CONNECTING  
THE HEAD ASSEMBLY.

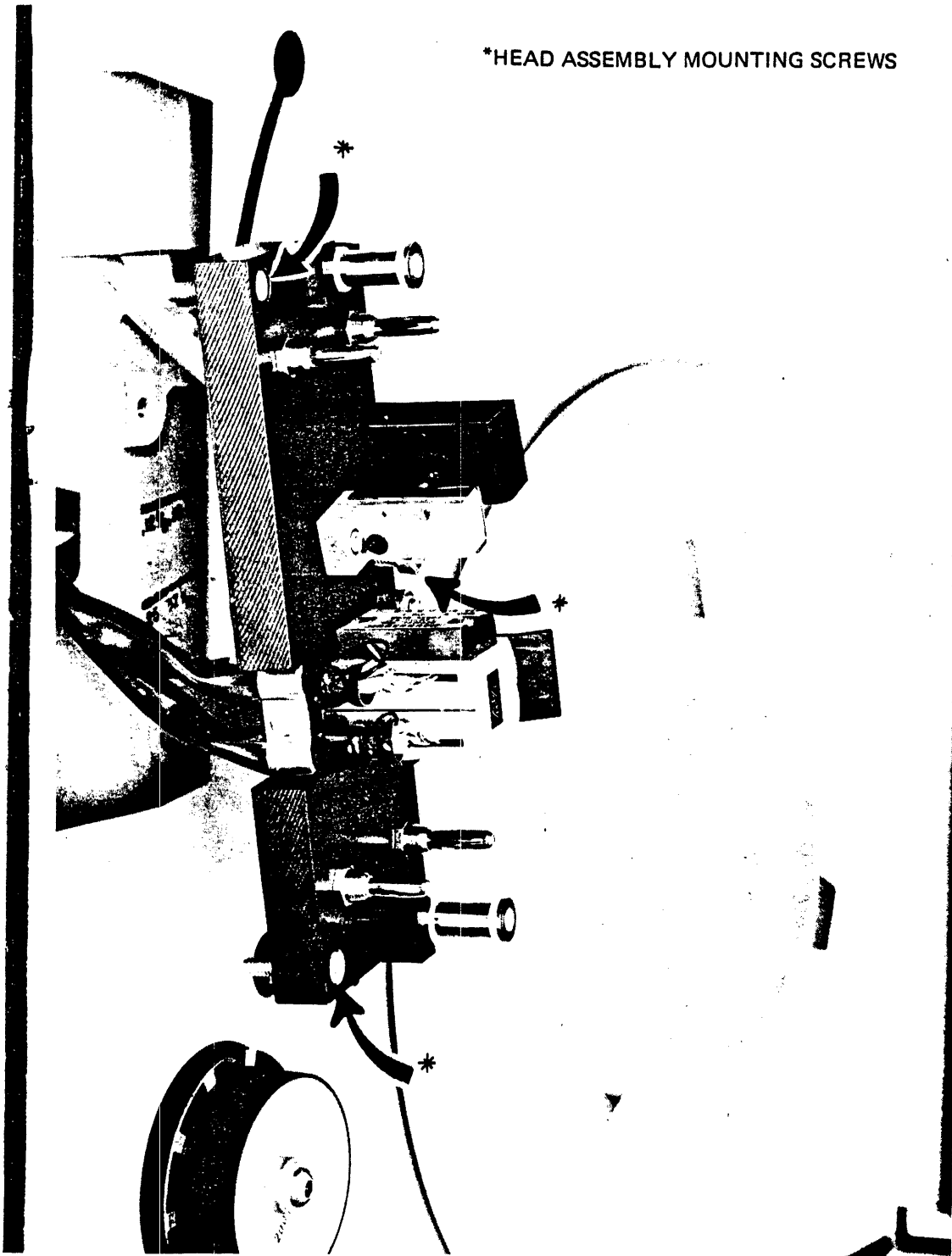


Figure 4-10. Head Assembly Removal

- a. Remove head connectors from DEB or Write and Read Data Electronics PWB's located at rear of MTT by using an appropriate size slot screwdriver. To preclude possibility of connector wire damage, do not use fingers for this purpose.
- b. Remove both pieces of head cover, then remove three large Allen screws that fasten head plate assembly to transport deck.
- c. Since it is not desirable to replace photosense assembly due to its cable dressing configuration, disconnect this subassembly from baseplate by removing two Phillips screws at rear of base plate.
- d. Remove head assembly.
- e. Follow this procedure in reverse and install new head assembly.
- f. Perform Tape Tracking check described in paragraph 4.4.2.
- g. Perform DEB alignments described in paragraphs 4.4.6 and 4.4.7..

#### 4.3.5.1 Photosense Unit

The EOT/BOT photosense unit is a sealed component. If either lamp or photocell fails, the unit must be replaced in its entirety. Use the following procedure:

- a. Perform steps a and b of paragraph 4.3.5.
- b. Remove both screws that hold photosense unit to read-after-write head assembly base plate, then move photosense unit to rear of deck. Cut cable harness ties to free this cable. Disconnect connector P11 from TEB.
- c. Replace photosense unit and reinstall read-after-write head assembly. Adjust potentiometer R215 as described in paragraph 4.4.5.1 to ensure proper operation of photosense unit.

#### 4.3.5.2 Tape Cleaner Servicing

To clean the tape cleaner, use the following procedure:

- a. Remove plastic head-assembly covers (both sides).
- b. Shield head assembly by inserting a piece of paper or cloth between tape cleaner and head assembly.
- c. Brush away loose particles.
- d. Clean blade surface with IBM cleaner P/N 453511 by using a lint-free applicator.
- e. Replace head covers.

#### 4.3.6 DECK OVERLAY

Removal and replacement of many components requires removal of the deck overlay. See Figures 4-11 and 4-12, and use the following procedure:

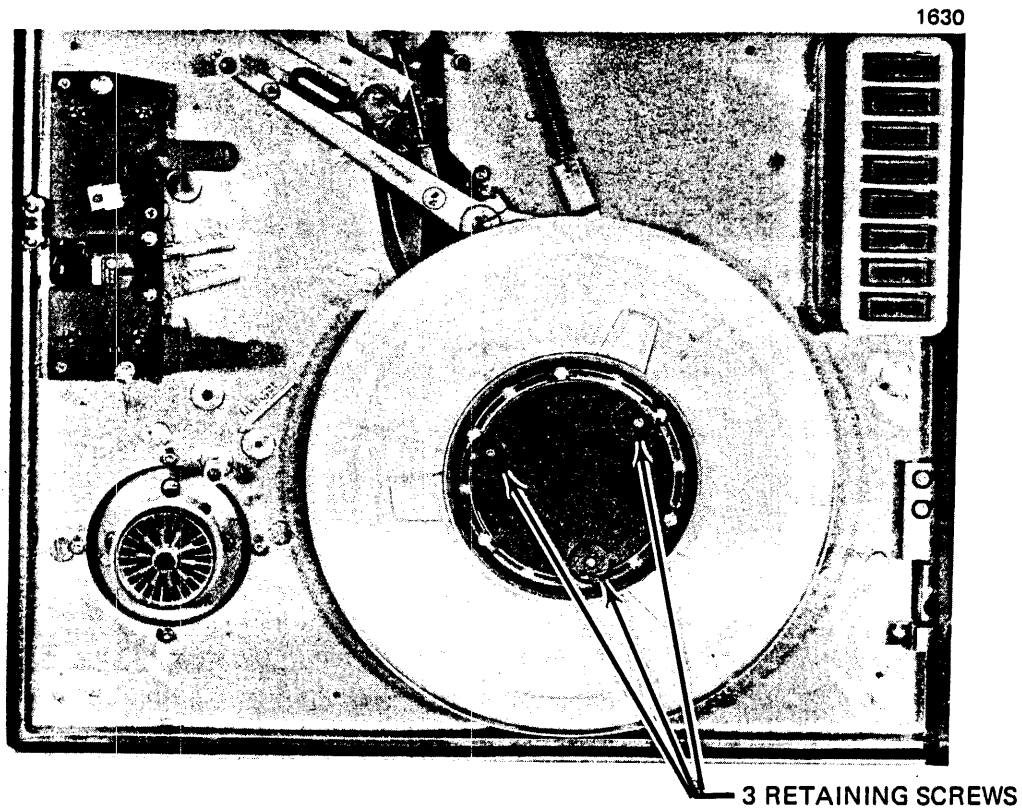


Figure 4-11. Fixed Reel Removal

- a. Remove fixed reel by removing three screws through cover that hold reel in place, then remove reel.

#### CAUTION

Before removing guide post assemblies, identify top and bottom assemblies so they may be returned to their correct location when reassembled. Remove each guide post by unscrewing two Phillips screws accessible from rear of transport deck. Under no circumstances should small set screw that holds roller guide assembly be removed. Removal of this screw destroys an adjusted setting and necessitates laboratory or factory retracking.



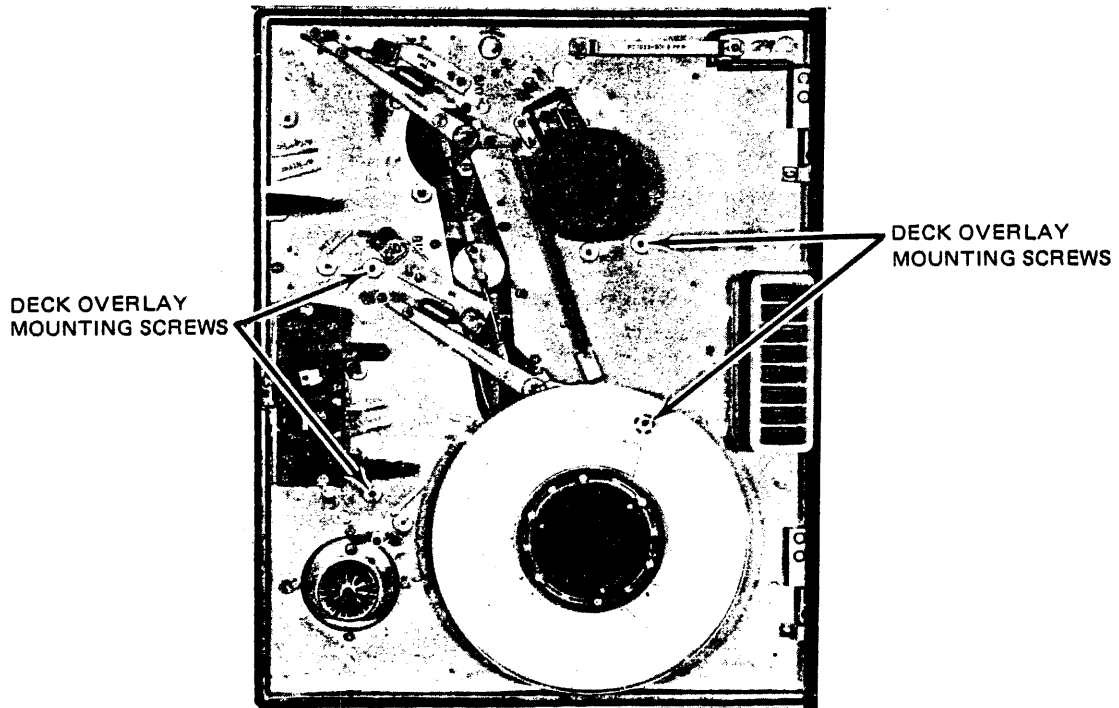
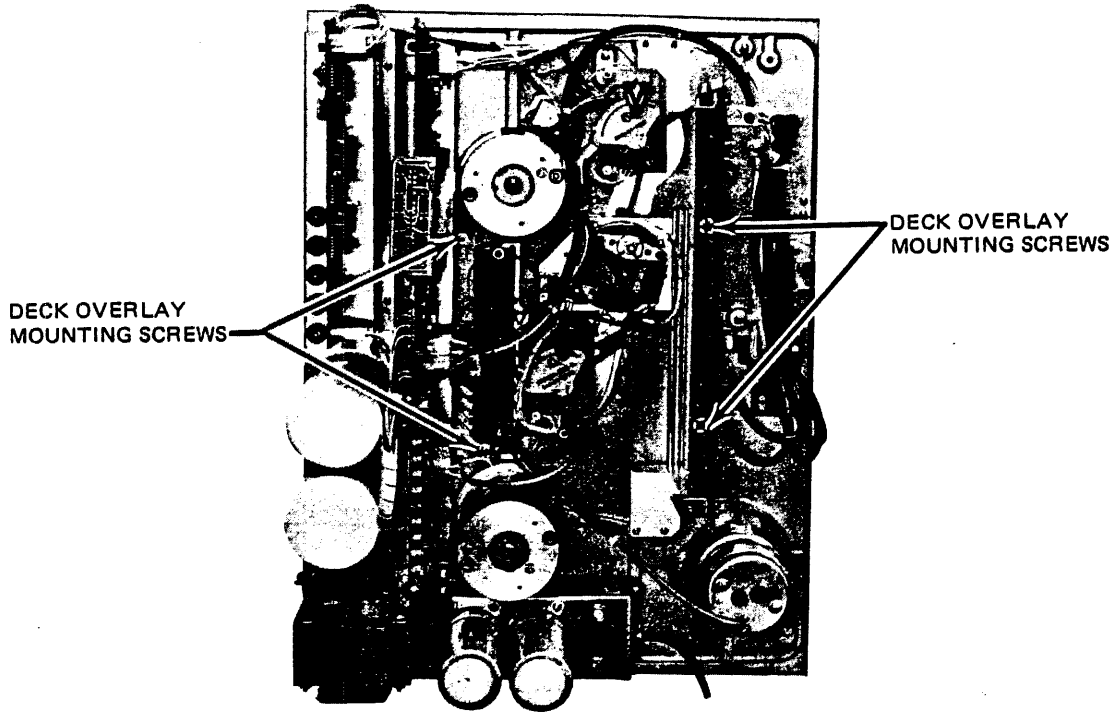


Figure 4-12. Deck Overlay Removal

- b. Remove covers from read-after-write head assembly by pulling in direction that is perpendicular to head plate.
- c. Loosen, but do not remove, four overlay screws that are accessible from front of machine. These screws are shown marked by arrows in Figure 4-12.
- d. Lift off deck overlay.
- e. To replace deck overlay, reverse this procedure.

#### 4.3.7 CAPSTAN AND CAPSTAN MOTOR

##### 4.3.7.1 Capstan Only

The capstan can be removed and replaced by releasing the Allen screw on the top of the capstan motor shaft while holding the shaft by the flats provided. Capstan speed adjustments are specified in paragraphs 4.4.5.2.2 and 4.4.5.2.3.

**CAUTION**

Observe and record the orientation of the capstan before removing it, and ensure that it is replaced in the same position.

##### 4.3.7.2 Capstan Drive Assembly

Replacement of the entire capstan drive assembly (capstan and capstan motor) should be done in accordance with the following procedure:

- a. Remove capstan (see paragraph 4.3.7.1).
- b. Remove motor and tachometer leads from rear terminal board.
- c. Remove four screws that hold motor to transport deck.
- d. Replace capstan drive assembly.
- e. Replace capstan (see paragraph 4.3.7.1).
- f. Perform adjustments for speed and start/stop ramps as described in paragraphs 4.4.5.2.2 through 4.4.5.2.4.
- g. Check tape tracking as described in paragraph 4.4.2.

##### 4.3.7.3 Calculating Capstan Speed Error

The 50/60 Hz strobe disk is inserted into each capstan. The inner strobe pattern is for 60 Hz and is so marked. It is to be viewed with a corresponding AC light (such as fluorescent). The 50 Hz pattern operates with a 100 Hz source, and the 60 Hz pattern

requires a 120 Hz source. The pattern image should appear stationary at 12.5, 25, and 37.5 ips. The error from nominal for the mentioned speeds is derived from the following equation:

$$\text{ips } E = \frac{624}{T \times S} \%$$

where S is nominal tape speed in ips, and T is the time in seconds for the image to drift one revolution. If the error exceeds 1 percent, readjust speed as instructed in paragraph 4.4.5.2.

#### 4.3.7.4 Capstan Motor Brushes

The capstan motor brushes are obtainable by removal of the two (one on each side) slot-head caps (black) located at the end of the capstan housing nearest the transport deck casting. When the cap is unthreaded, the worn brush can be removed, the new brush can be installed, then the cap can be refastened.

#### 4.3.8 REEL MOTOR

Use the following procedure:

- a. Remove deck overlay (see paragraph 4.3.6).
- b. Remove hub of motor to be replaced (two set screws).

#### NOTE

If Cipher fixture P/N T-00002 is not available, measure and record the distance from the reference boss to the hub outer flange before removal.

- c. Remove motor leads from terminal board at rear.
- d. Remove four screws that hold motor to transport deck.
- e. Install new motor with four screws removed in step d.
- f. Replace motor hub by using reel-hub alignment fixture (Cipher P/N T-00010) which sets position of outer flange to a distance 0.727-inch above adjacent reference boss. If fixture is not available, reposition hub to distance measured in step b. Tighten two setscrews against flats on motor shaft.
- g. Replace deck overlay.

#### 4.3.8.1 Reel Motor Brushes

The reel motor brushes are obtainable by removal of two (one on each side) slot-head caps (black) located at the end of the reel motor housing furthest from the transport deck casting. When the cap is unthreaded, the worn brush can be removed, the new brush can be installed, then the cap can be refastened.

#### 4.3.9 ROLLER GUIDE BEARING

Roller guide bearings, except those on the file reel swing-arm which control tape motion to the head, can be replaced without destroying preset tracking adjustment if appropriate care is exercised. See Figure 4-13 (a,b,c) and Table 4-5, and use the following procedure:

- a. Note position of roller guide with respect to its shaft. Roller guide must be replaced with same flange nearest overlay panel as when it was originally assembled.
- b. Remove retaining ring at shaft end, then remove roller guide.
- c. Insert new bearing(s).
- d. Replace roller guide.
- e. Replace retaining ring.

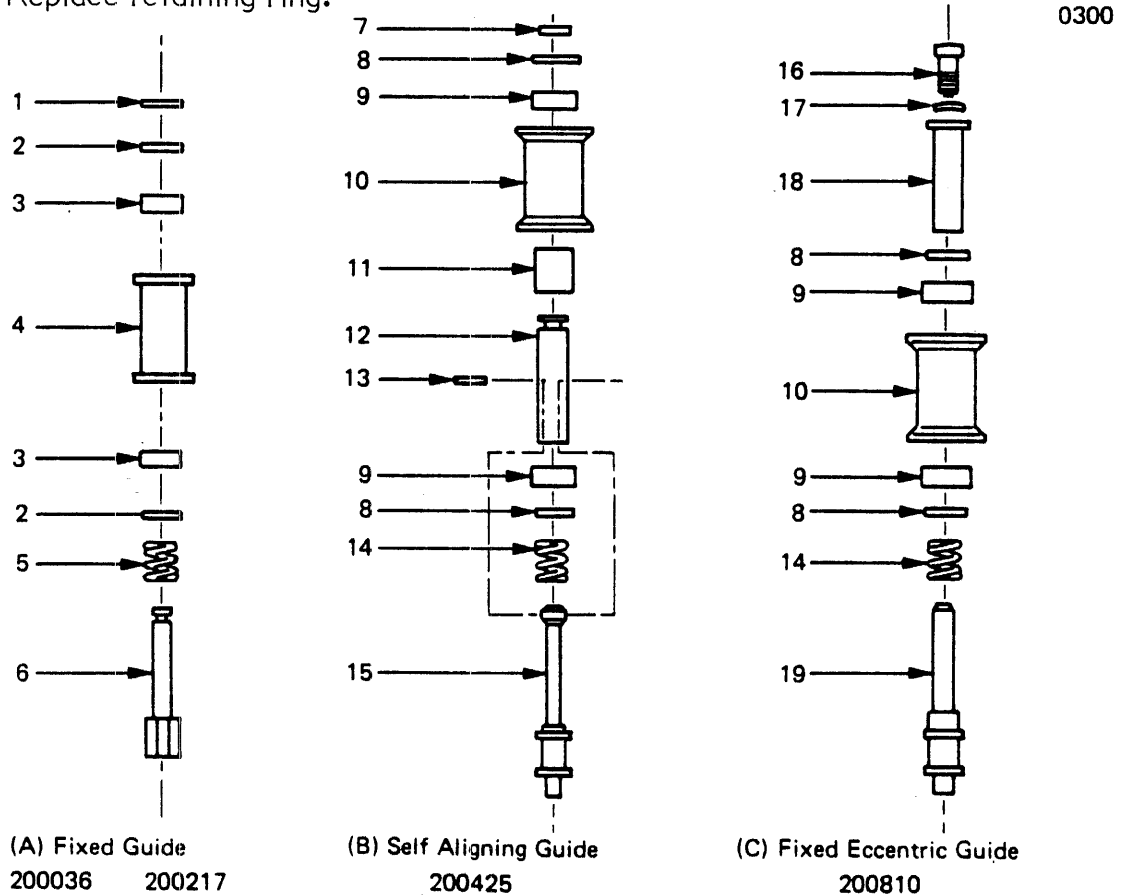


Figure 4-13. Roller Guide Bearing Replacement

Table 4-5. Roller Guide Bearing Parts Identification

Item No.	Description	Part No.
1	Ring, Retaining Ext.	100132-001
2	Washer, Shim	200077-001
3	Bearing, Roller	100006-001
4	Drum	200023
5	Spring	200156
6	Shaft	200037
7	Ring, Retaining Ext.	100132-002
8	Washer, Shim	200077-003
9	Bearing, Roller	100006-002
10	Drum	200419
11	Sleeve, Pin Retaining	200423
12	Sleeve, Bearing	200420
13	Pin	200422
14	Spring	200421
15	Shaft	200418
16	Screw, Button Hd 2-56 x 3/16	100039-903
17	Washer, Belleville	100256
18	Sleeve, Bearing	200752
19	Shaft	200766

Replacement of file reel swing-arm roller guide bearings requires each roller guide to be reset as described in paragraph 4.4.2.1.1. The bearings are changed by removing the locking screw and withdrawing the eccentric guide assembly from the shaft (see Figure 4-13).

#### 4.4 ALIGNMENT AND ADJUSTMENT PROCEDURES

This subsection describes procedures for all alignments and adjustments that can be performed at the installation site. The procedures are presented in the sequence to be followed if an alignment/adjustment is intended.

All maintenance/test equipment specified in these procedures is listed in Table 4-1.

The removal and replacement procedures, described in subsection 4.3 should be reviewed before performing these procedures.

##### 4.4.1 HEAD ASSEMBLY AZIMUTH MEASUREMENT AND CORRECTION

This measurement and adjustment is required only when the read-after-write head assembly has been replaced. Its purpose is to ensure that the head stack is perpendicular to the tape path. This adjustment is a mechanical adjustment and is accomplished by shimming either (but only one) of the two guides mounted on the head assembly base

plate. The shims are mounted by removing the guide, inserting a shim on the guide shaft, and reassembling the guide on the base plate. The shims are 0.0002-inch thick and one shim corrects for 15 microinches of skew. Before performing the procedures described in paragraphs 4.4.1.1 and 4.4.1.2, set oscilloscope controls to the following positions:

- a. Mode – Chop
- b. Sensitivity – as required to get good resolution of peak time displacement
- c. Trigger – internal (–), plug-in mode
- d. Sweep time – sufficient resolution so that peak displacement between traces can be accurately measured.

#### 4.4.1.1 Write Stack Adjustment for PE-Only MTT

This measure and adjustment applies to PE-only MTT's and is set such that the write stack is perpendicular to the tape path (for head assembly adjustment on dual-density MTT's, see paragraph 4.4.1.2). See Figure Figure 4-14 and use for following procedure:

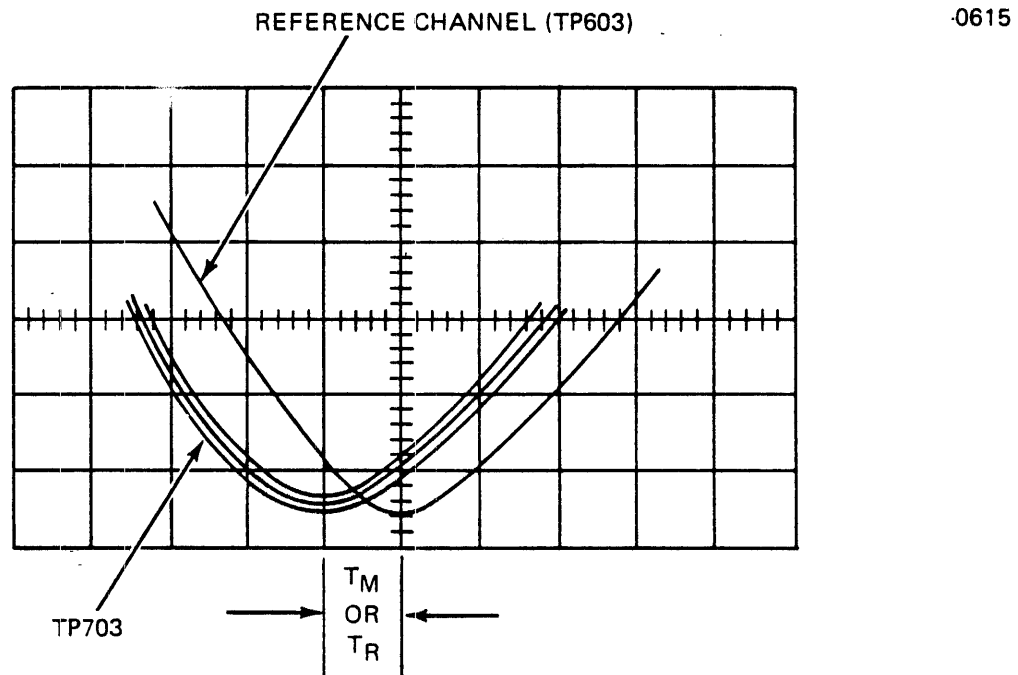


Figure 4-14. Read Head Signal Peaks for PE-Only System

- a. Place channel 1 oscilloscope probe on test point that corresponds with head-edge track located nearest to transport deck. This test point is TP603. Place

channel 2 oscilloscope probe on test point TP703 which corresponds with head-edge track furthest from transport deck.

- b. Verify write enable ring is on and load a scratch-pad tape. Place controller in the Write mode and observe time displacement and phase between peaks. Record time and call it TM. (TM = Read Azimuth and Write Azimuth). If crossfeed during Write process makes accurate measurements difficult, first write a sufficient length of tape, then rewind to load point (BOT). Take MTT off-line and manually initiate forward motion from OCP. Observe and record time and phase measurements.
- c. Verify write enable ring is removed, then load MTT with an IBM master skew alignment tape. Initiate forward motion from OCP. Observe and record time and phase measurements. Call this measurement TR (Time Read Azimuth).
- d. To get write stack azimuth correction, TM and TR which were obtained in steps b and c, are used. Depending on phase relations between TM and TR, to determine TW, which is write stack azimuth, the following formulas apply:

TW = TM – TR, if TM and TR phase relationships are same.

TW = TM + TR, if TM and TR phase relationships are opposed.

- e. If TW corresponds with a distance less than 25 microinches; i.e., 1 microsecond at 25 ips, no shimming is required:

Distance (microinch) = TW (microsecond X tape speed in ips)

If TW corresponds to a distance greater than 25 microinches, number of shims to be inserted can be found in either Table 4-6, for standard tape speeds, or calculated from the following equation where N represents number of shims:

$$N = \frac{TW \text{ (tape speed in ips)}}{15}$$

If more than 14 shims are required, it is probable that MTT requires retracking; therefore, paragraph 4.4.2.3 of this section should be performed before proceeding.

Table 4-6. Shims Required for Standard Tape Speeds

Number of Shims	Time Displacement for Speed Indicated (us)			
	12.5 ips	25 ips	37.5 ips	45 ips
1	0.7 - 1.8	0.4 - 0.9	0.3 - 0.6	0.2 - 0.5
2	1.9 - 3.0	1.0 - 1.5	0.7 - 1.0	0.6 - 0.9
3	3.1 - 4.2	1.6 - 2.1	1.1 - 1.4	1.0 - 1.2
4	4.3 - 5.4	2.2 - 2.7	1.5 - 1.8	1.3 - 1.5
5	5.5 - 6.6	2.8 - 3.3	1.9 - 2.2	1.6 - 1.8
6	6.7 - 7.8	3.4 - 3.9	2.3 - 2.6	1.9 - 2.2
7	7.9 - 9.0	4.0 - 4.5	2.7 - 3.0	2.3 - 2.5
8	9.1 - 10.2	4.6 - 5.1	3.1 - 3.4	2.6 - 2.8

- f. To establish which of two head guides must be shimmed, see shim location guide in Figure 4-15. Matching data, collected in steps c and d, with the parameters of columns 1 through 4, can establish applicable guide in column 5.
- g. Repeat step d to ensure that the new TM and TR from steps b and c have same time and phase measurements when master skew alignment tape is run.

#### 4.4.1.2 Read Stack Adjustment for PE/NRZI MTT

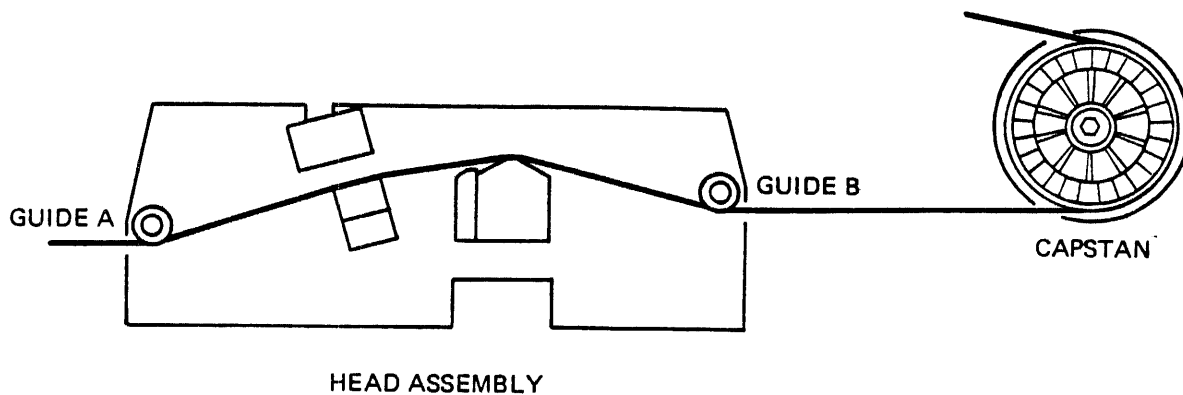
This measurement and adjustment applies to dual-density MTT's only. Its purpose is to ensure that the read stack is perpendicular to the tape path (for (PE-only MTT's, see paragraph 4.4.1.1). See Figure 4-16 and Table 4-6, and use the following procedure:

- a. Place Channel 1 oscilloscope probe on test point that corresponds with head-edge track located nearest to transport deck. This test point is TP603 on Read Data Electronics PWB.
- b. Place Channel 2 oscilloscope probe on test point that corresponds with head-edge track located furthest from transport deck. This test point is TP703 on Read Data Electronics PWB.
- c. Verify write enable ring is removed and load a master skew alignment tape. Place controller in Read mode and observe time displacement between Read signal peaks. If time displacement corresponds with a distance less than 25 microinches; i.e., 1.0 microsecond at 25 ips, no shimming is required:

$$\text{Distance (microinch)} = T (\text{microsecond} \times \text{tape speed in ips})$$

If signal on Channel 2 lags reference channel, and if time displacement corresponds with a distance greater than 25 microinches, guide on file reel side (guide A) of head assembly must be shimmed. Number of shims can be calculated from the following equation where N represents number of shims:





	REFERENCE CHANNEL (TP603) PHASE TM MEASUREMENT	REFERENCE CHANNEL (TP603) PHASE TR MEASUREMENT	TM > TR	TM < TR	SHIM	
					GUIDE A	GUIDE B
1	LAGS	LEADS	—	—	X	
2	LEADS	LAGS	—	—		X
3	LEADS	LEADS	YES	—		X
4	LAGS	LAGS	YES	—	X	
5	LEADS	LEADS	—	YES	X	
6	LAGS	LAGS	—	YES		X

Figure 4-15. Shim Location Guide

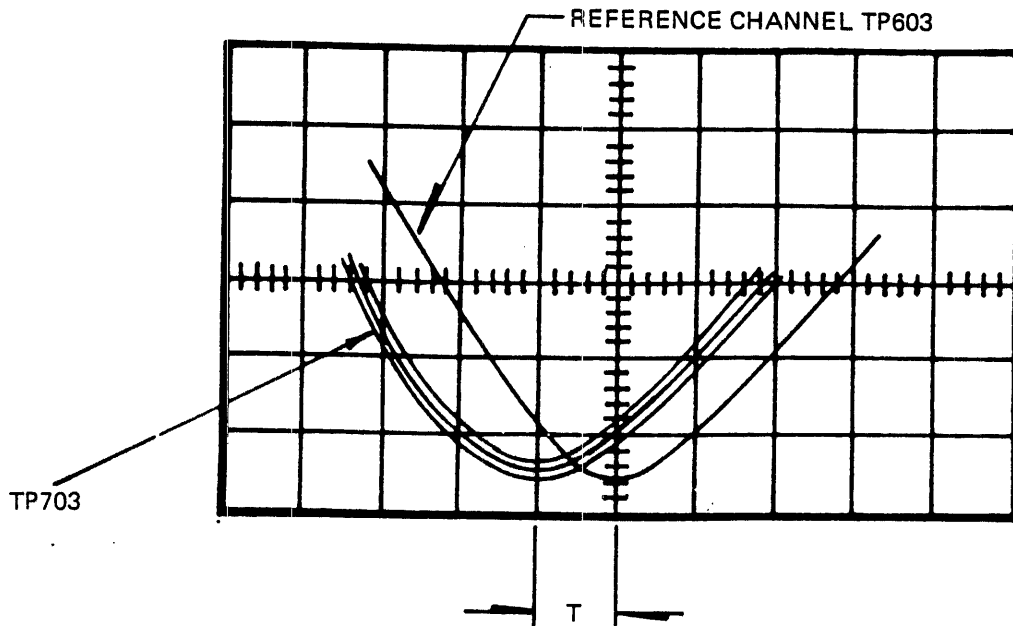


Figure 4-16. Read Head Signal Peaks for Dual-Density System

$$N = \frac{(\text{Tape Speed in ips}) (\text{Time})}{15}$$

- d. If signal on channel 2 leads reference channel, tape guide on capstan side (guide B) of head assembly must be shimmed as described in step c.
- e. After appropriate guide is shimmed, verify that time displacement between outside head-edge tracks corresponds with a distance less than 25 microinches.
- f. If shims are added to guide a, it is necessary to recheck tape tracking as described in paragraph 4.4.2.3.
- g. Measure and record Static Data Staircase by using master skew alignment tape in accordance with method described in paragraph 4.4.7.6. This data is used later to compare with results of paragraph 4.4.7.6.

#### 4.4.2 TAPE TRACKING ALIGNMENT

Accurate tape tracking depends on the mechanical adjustment of elements in the tape path which contribute to the static and dynamic skew of the tape over the read-after-write head and the proper alignment of the tape edges between the file and fixed reels

consistent with proper tape handling; i.e., without damaging the tape. If retracking is required, it is necessary to check the Write Stack Azimuth alignment per the procedure described in paragraph 4.4.1.

Forward tape tracking is controlled by guiding elements between the file reel and the capstan. Reverse tape tracking is controlled by guiding elements between the fixed reel and the capstan. A tape guide diagram is shown in Figure 4-17.

The following tracking procedure assumes there is no gross misalignment of guiding elements which would cause tape edge damage. Initially, the inner guiding edge of each roller guide should be set to 0.837-inch from the transport deck component-mounting surface.

#### 4.4.2.1 Forward Tape Tracking

In forward tape tracking, the file reel swing arm roller guide and file reel fixed roller guide may require alignment.

4.4.2.1.1 File Reel Swing Arm Roller Guide. Basic mechanical alignment of this guide is simplified through the use of a special tool, Tool P/N T-00010, the use of which is shown in Figure 4-18. Use the following procedure:

- a. Remove deck overlay (see paragraph 4.3.6).
- b. Remove all shims from head guides and then fasten alignment tool to head guides; verify outer surface of the tool is against outer edges of fixed guide.
- c. Adjust position of swing arm at supporting shaft (No. 8 screw) such that roller guide trough mates with alignment tool.
- d. Adjust tilt of roller guide until width of drum is parallel to alignment tool. This adjustment is accomplished by slackening roller-guide locking screw  $\frac{1}{2}$  turn and rotating eccentric guide by means of hexagon as shown in Figure 4-19. During this adjustment, drum should be presented to alignment tool by pressing against roller guide. This pressure simulates effect of tape tension on arm.
- e. Replace shims as required in accordance with method described in paragraph 4.4.1.1.

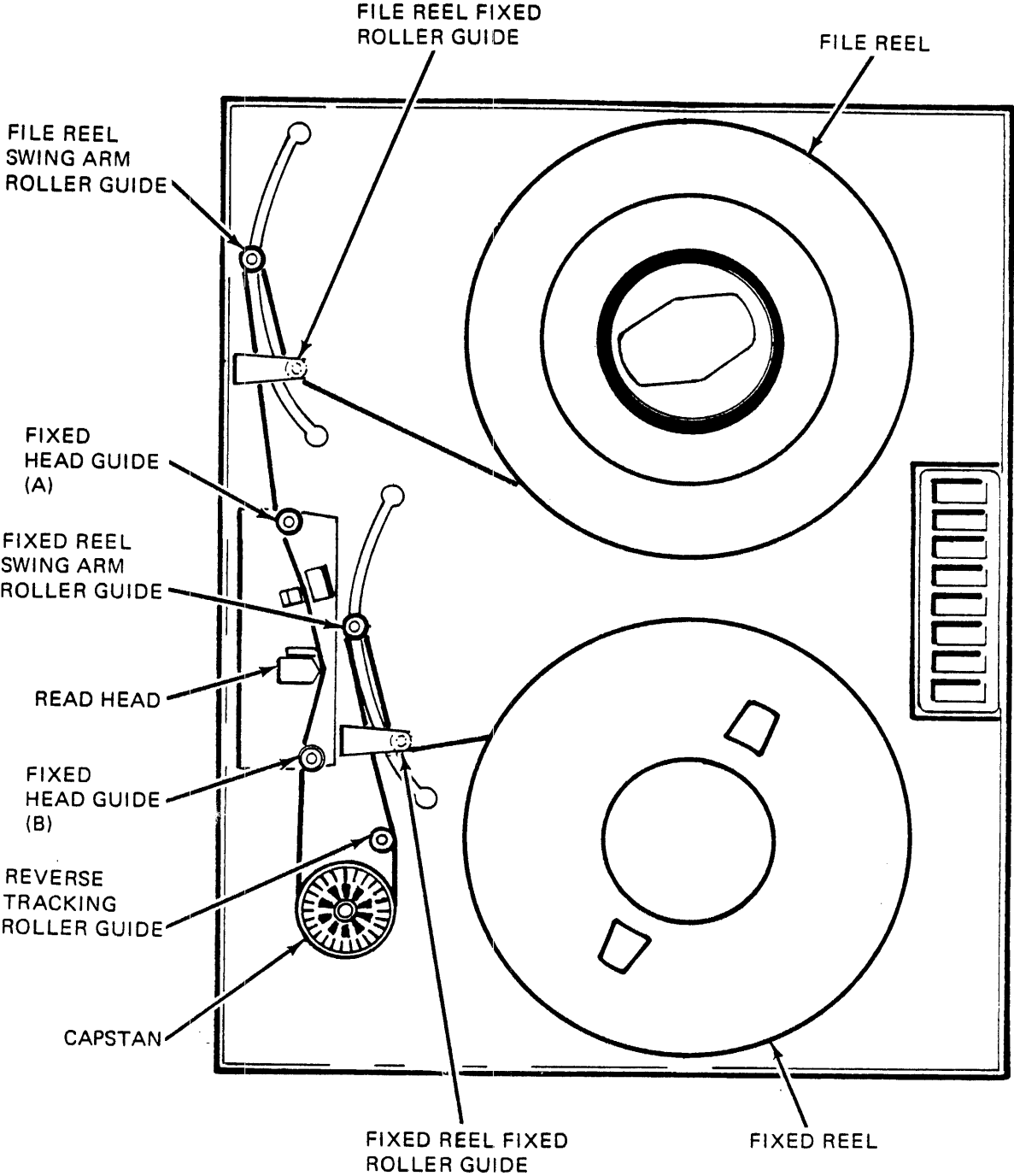


Figure 4-17. Tape Guide Diagram

TOOL PART NO. T-00010

NO. 8 SCREW

0313

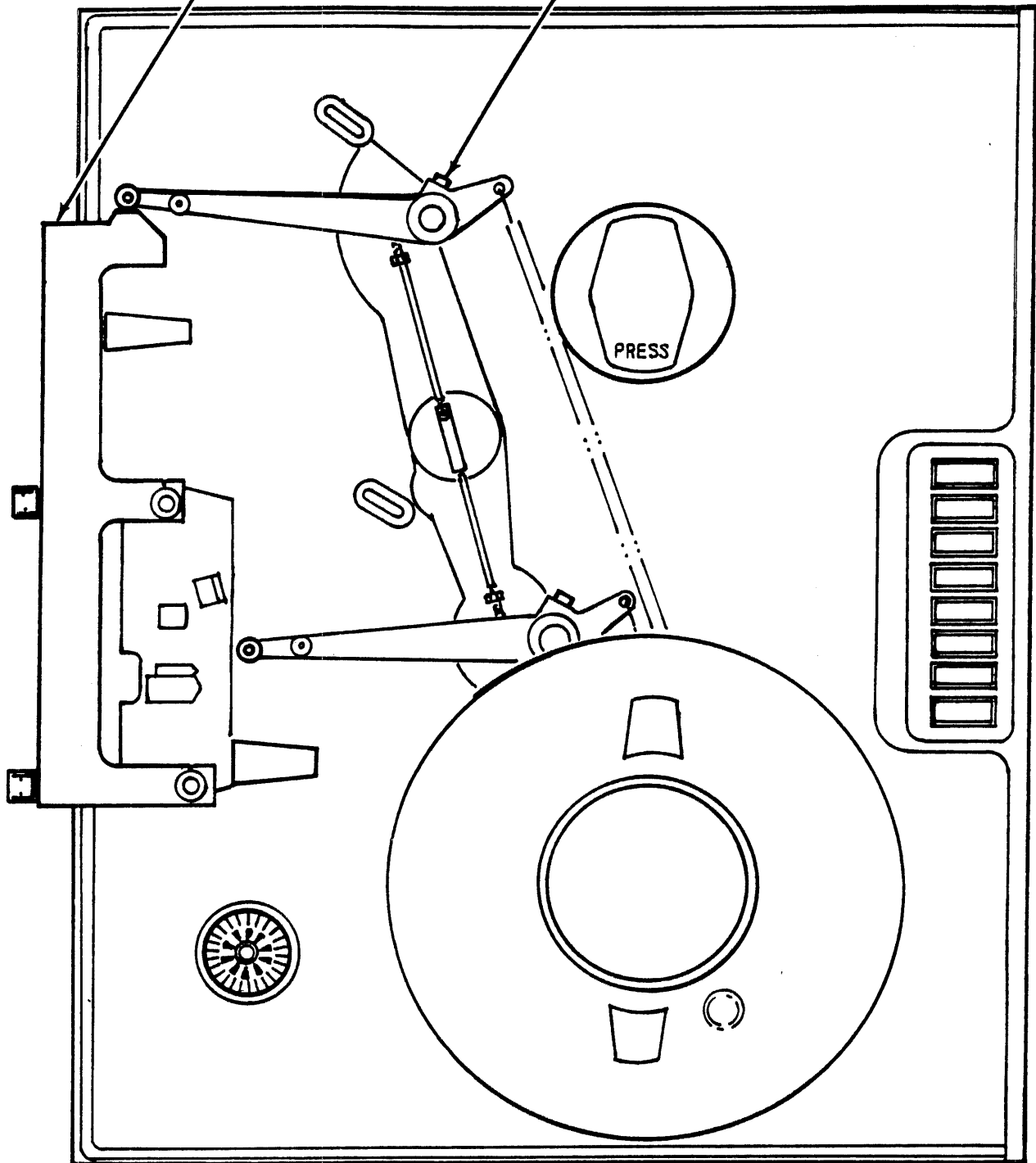


Figure 4-18. File Reel Arm Guide Alignment

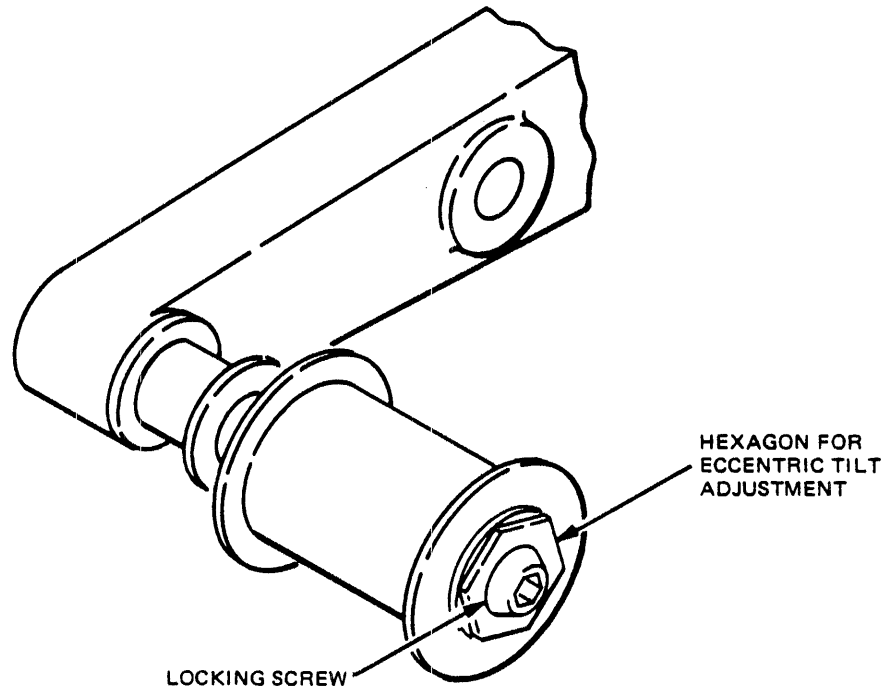


Figure 4-19. Tilt Adjustment for File Reel Arm Guide

4.4.2.1.2 File Reel Fixed Roller Guide. This guide must be visually aligned to the buffer arm roller guide by rotating the file reel counterclockwise (ccw) against the servo. Use old tape tension until the file reel buffer arm reaches a point where the tape disengages the file reel fixed roller guide as shown in Figure 4-20. At this point, any misalignment between the rollers is seen as a curling or scuffing of the tape edge against one of the flanges on the file reel fixed roller guide. This condition may be corrected by adjusting the screw at the side of the support for the file reel fixed roller guide.

#### 4.4.2.2 Reverse Tape Tracking

To align the reverse-tracking roller guide, use the following procedure:

- a. Remove reverse-tracking roller guide by means of screw at side of guide support.
- b. Run tape forward and observe lateral position of tape on capstan, then run tape in reverse direction and verify there is no "tape walk".
- c. If "tape walk" is observed, adjust position of fixed-reel buffer arm at its pivot (no. 8 screw) and align adjacent fixed roller guide to buffer arm roller guide. This procedure is same as that for file reel fixed guide. Capstan "tape

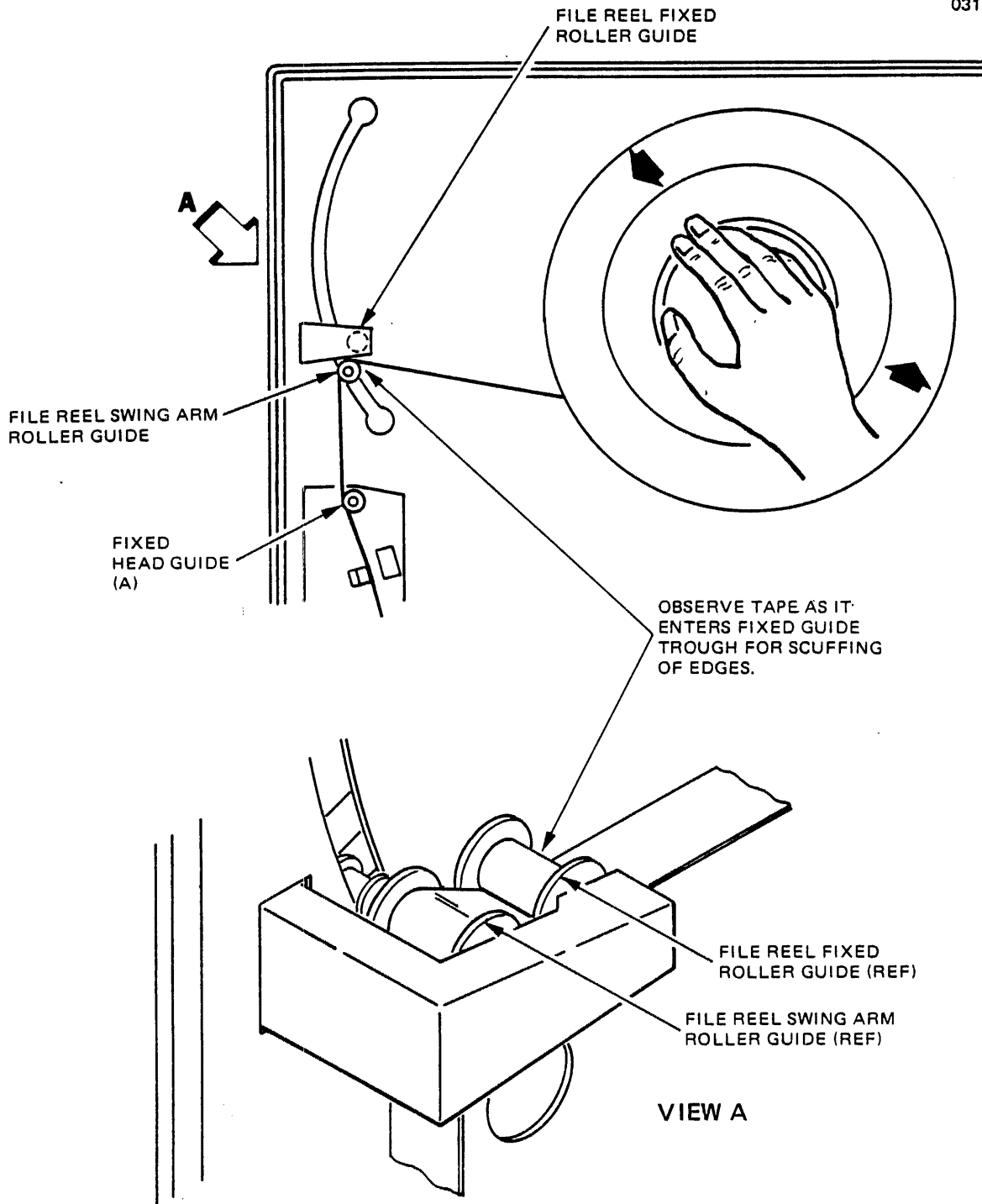


Figure 4-20. File Reel Fixed Guide Adjustment

walk" between forward and reverse motion should be not greater than 0.01-inch with reverse-tracking roller guide removed.

- d. Replace reverse-tracking roller guide, then adjust forward/reverse "tape walk" as near to zero as possible by means of this guide only.
- e. When all alignments are complete, check results by following procedure in paragraph 4.4.2.3.

#### 4.4.2.3 Free Tracking

This procedure should be used only if the capstan or capstan motor have been replaced. To accomplish free track alignment, see Figure 4-21 and use the following procedure:

- a. Remove all shims from under head guides and between capstan motor and transport deck casting.
- b. Use file reel buffer arm roller guide alignment tool T-00010 to set file arm roller guide perpendicular to tape path and outer guiding edge of tape and parallel to inner face of outer head guide ceramic washers.
- c. Remove head guides and reinstall guide body and cap only (see Figure 4-21).
- d. Remove reverse tracking roller guide, and loosen set screws that hold file and fixed reel fixed roller guides (see Figure 4-18).

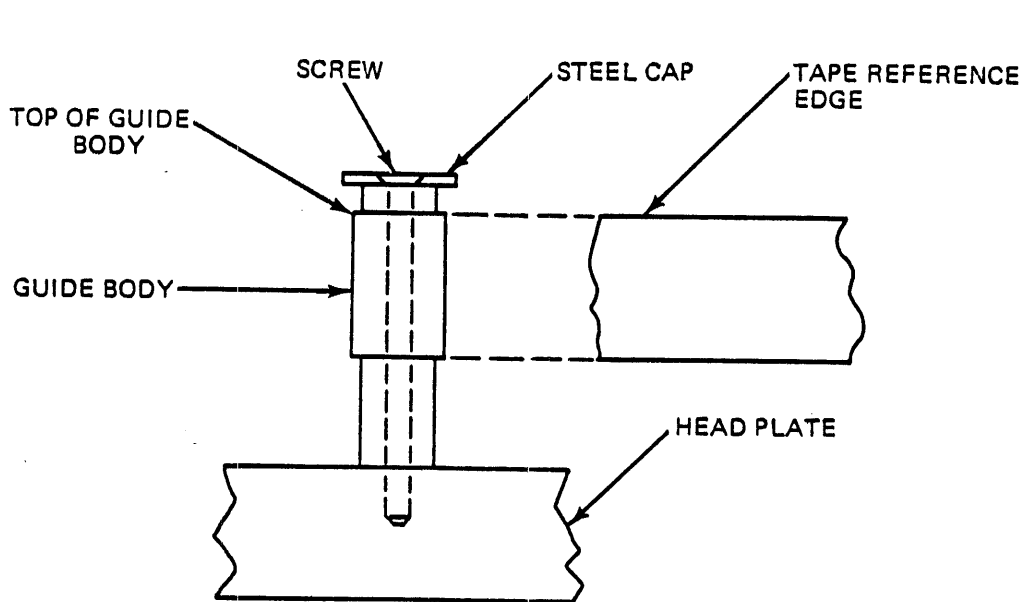


Figure 4-21. Head Guide With Ceramic Washers Removed



1. Loosen set screws 1/8 turn or less to maintain set screw points on flats of guide shaft but sufficiently loose so that guides can self-align when tape is run in forward or reverse directions.
  2. Each time file or fixed reel buffer arm is adjusted, its respective fixed roller guide requires an adjustment for parallelism of guide flanges (see Figure 4-20).
- e. Load scratch tape and run in forward direction. Observe reference (outer) edge of tape as it passes over guide A (see Figure 4-17). Make "in" and "out" adjustment to file reel buffer arm so that tape reference edge and top of guide body are in line.
  - f. Observe reference edge of tape as it passes over guide B. If tape is running high (beyond top of guide B), shim between capstan motor and lowest transport deck casting boss by using 201032-001 or -002 shims (as required). If tape is running low (below top of guide B), shim between capstan motor and uppermost transport deck casting boss.
  - g. Run tape in reverse direction and adjust fixed reel buffer arm in/out position so that tape reference edge is in line with top of both A and B guides. Align fixed roller guides each time buffer arm in/out position is changed.
  - h. Center capstan to tape by shimming between capstan support plate and shoulder on capstan motor shaft with 100316-002 shims (or equivalent) at each boss with 201032-003 shims between capstan motor and deck casting.
  - i. If tape cannot be centered on capstan in forward and reverse tape motion, and tape reference edge cannot be kept in line with outer edges of guides A and B, replace capstan and/or capstan motor.
  - j. Reassemble guides A and B with ceramic washers and springs. Verify polished surface of ceramic washers faces tape.
  - k. Mount a skew tape, and by using a dual-trace oscilloscope, place channel 1 and sync probes on test point TP602 (9-channel systems) or test point TP102 (7-channel systems). Place channel 2 probe on test point TP702 (9-channel systems) or test point TP902 (7-channel systems). Set oscilloscope controls for chop AC mode, sync external (+) AC trigger mode, and 5 milliseconds sweep time.
  - l. Observe analog signals of outer channels while running forward-check skew change as function of file reel buffer arm position. This function is done by reducing or increasing speed of file reel by hand so that file reel buffer arm

is forced to close to its short and long loop extremes. Adjust file reel buffer arm for an in/out position that limits arm position skew shift as listed in Table 4-7. If this requirement is not met, reset file arm roller guide squareness to fixture T-00010 and repeat steps e through l. If squaring guide does not help, replace entire buffer arm assembly and repeat steps b through l.

Table 4-7. Tape Tracking Alignment Limits

Parameter	Tape Speed (ips)				
	10	12.5	25	37.5	45
File Arm Skew Change (us)	3.0	2.4	1.2	0.8	0.7
FWD-REV REV Skew Shift (us)	7.5	6.0	3.0	2.0	1.7
Capstan Tape Walk (us)	1.8	1.4	0.7	0.5	0.4

- m. After skew shift from arm position in forward direction is met, run tape in reverse direction. Make fixed arm in/out adjustment so reverse analog signal peak distance from triggered track is equal to forward peak distance but on opposite side of triggered track (see Table 4-6 for maximum allowable limit).

When this symmetrical condition is met with no tape walk, the MTT is basically tracked and ready for head azimuth error correction. This correction is accomplished by shimming one of the head guides with up to a maximum of 10 P/N 200203-001 shims.

For NRZI MTT's, read head azimuth is to be zeroed to skew tape by shimming appropriate head guide and making analog peaks of outer channels coincident in forward and reverse directions. Verify that forward-to-reverse skew shift is still within limits (see Table 4-6).

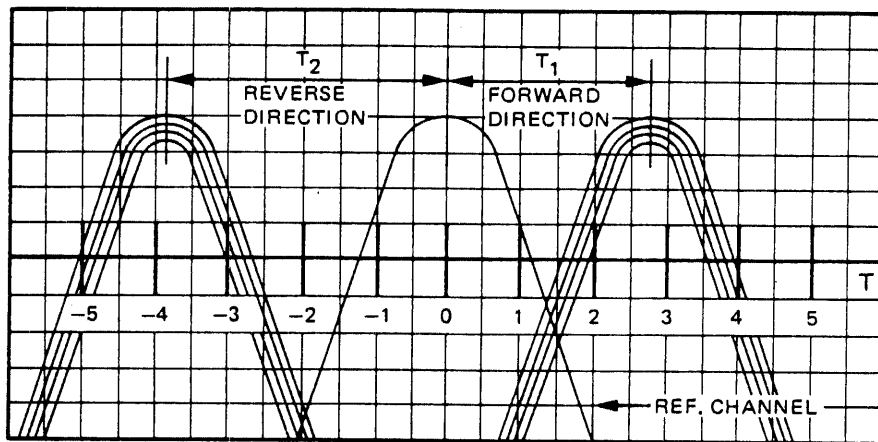
After stated conditions have been satisfied, set screws for guides of both reels may be tightened, and reverse tracking roller guide may be replaced. As each setscrew is tightened, check that its flange alignment to tape edges and either forward or reverse skew does not change.

- n. Check for, and replace if necessary, noisy roller guide or guides with damaged flanges. Check and realign reels for proper tape packing. Pack should be centered between flanges, and tape must not scuff flanges when winding or unwinding.

#### 4.4.2.4 Checking Tape Tracking

This procedure provides an electrical check to verify that tape is tracking in the reverse direction, with respect to the forward direction, within acceptable limits. It compares the time displacements of the analog signal peaks on the channels of the two outside head tracks (while running tape forward) with the time displacement of these peaks (while running in tape in reverse). If the MTT is perfectly tracked, the time displacements in both directions should be the same, but the phase relationship between the two peaks should be opposed. Since accuracy of tape tracking is directly dependent on mechanical alignments and mechanical tolerance buildups, perfect tracking is usually not achieved; however, limits are established to guarantee reliable operation in both directions.

Equipment required includes an oscilloscope, a dual-trace plug-in, three 10X probes, and a scratch-pad tape that has 800 frpi recorded on the outside channels. See Figure 4-22 and use the following procedure:



0318

Figure 4-22. Checking Tape Tracking, Desired Waveform

- a. Set oscilloscope controls to the following positions:
  1. Mode – AC
  2. Sensitivity – as required to get good resolution of peak time displacement
  3. Trigger – external (+), AC, trigger mode
  4. Sweep time – 5 microseconds/centimeter

- b. Place channel 1 oscilloscope probe and trigger probe on test point that corresponds with head-edge track nearest to transport deck. This test point is TP603.
- c. Place channel 2 oscilloscope probe on test point that corresponds with head-edge track farthest from transport deck. This test point is TP703.
- d. Load scratch-pad tape and run tape in forward direction under manual control. Record T1 in microseconds. Run tape in the reverse direction and record T2 (see Figure 4-22). Since read-head azimuth angle can be in either direction, actual phase relation between reference channel and other outside channel may be opposite to that depicted (see Figure 4-22).
- e. Value of  $T_2$  should be related to  $T_1$  by the following equation:

$$T_2 = -T_1 \pm \frac{75}{S \text{ in ips}} \text{ microsecond}$$

where S represents MTT tape speed. If this condition is not met, then either there is "tape walk" on capstan or file-reel buffer-arm guide is improperly set. Retrack MTT per procedure described in paragraphs 4.4.2.1 and 4.4.2.2.

#### 4.4.3 REGULATED POWER SUPPLY ADJUSTMENTS

Three potentiometer adjustments are required to adjust the power supply regulators to the proper operating voltage levels. These potentiometers are located on the Regulator PWB subassembly (see dwg. 200495 in Engineering Drawing Package, Sections 1 and 2). A voltmeter that has an accuracy of at least 2 percent should be used to make the adjustments. Each adjustment should be made to the voltage values listed in Table 4-8.

Table 4-8. Regulated Power Supply Output Voltage Adjustments

Adjust Voltage To:	By Potentiometer	Connect Meter Between Test Points
+5 Volts	R2	TP1 (+) and TP4 (-)
+12 Volts	R14	TP2 (+) and TP4 (-)
-12 Volts	R21	TP3 (-) and TP4 (+)

#### 4.4.4 ARM SENSE PWB ADJUSTMENT

Correct adjustment of the Arm Sense PWB position, cam position, and two potentiometers is necessary to ensure the correct operation of each servo buffer arm.

The adjustments must be made in the sequence in which they are specified in paragraphs 4.4.4.1 and 4.4.4.2 (either arm may be adjusted first).

Before starting the adjustment procedure, the power must be ON and the MTT must be RESET at the OCP. No tape should be loaded on the machine.

#### 4.4.4.1 Fixed Reel Adjustments

See dwg. 200632 in Engineering Drawing Package, Sections 1 and 2, and use the following procedure:

- a. Mechanically position buffer arm in center of its normal operating arc and verify that center of cam arc lines up with photoscell and lamp housing. If cam is improperly positioned, reposition cam as specified in paragraph 4.3.4.
- b. Connect a voltmeter between test point TP424 and ground on TEB.
- c. Loosen three screws that secure Arm Sense PWB to main frame and adjust position of PWB on slotted holes until voltmeter reads  $0.0 \pm 0.2$  Volt, then tighten previously loosened three mounting screws to lock Arm Sense PWB in place.
- d. Adjust fixed-reel servo gain potentiometer R462 and buffer-arm position potentiometer R465 as instructed in paragraph 4.4.5.3.

#### 4.4.4.2 File Reel Adjustments

See dwg. 200632 in Engineering Drawing Package, Sections 1 and 2, and use the following procedure:

- a. Perform step a in paragraph 4.4.4.1.
- b. Connect a voltmeter between test point TP425 and ground on TEB.
- c. Perform step c in paragraph 4.4.4.1.
- d. Adjust file reel servo gain potentiometer R503 and buffer arm-position potentiometer R508 as instructed in paragraph 4.4.5.3.

#### 4.4.5 TRANSPORT ELECTRONICS PWB ADJUSTMENTS

The TEB has provisions for adjusting the EOT/BOT photosense, capstan servo, and reel servo.

#### 4.4.5.1 EOT/BOT Photosense Adjustmnet

See dwg. 200632 in Engineering Drawing Package, Sections 1 and 2, and use the following procedure:

- a. Connect a voltmeter between test point TP201 and ground.
- b. Adjust potentiometer R202 until voltmeter reads  $0.00\text{ V} \pm 0.15\text{ V}$  while tape is loaded on MTT but while neither photosense marker is being sensed.

#### 4.4.5.2 Capstan Servo Adjustment

Five adjustments are required to ensure correct operation of the capstan drive. The sequence in which these adjustments are given in the succeeding paragraphs must be carefully followed since there is interrelationship between some adjustments. Adjustments should be performed with tape loaded on the MTT. Ramp adjustments requires the MTT to be under program control so that the tape repeatedly starts and stops (see dwg. 200632 in Engineering Drawing Package, Sections 1 and 2, for potentiometer and test point locations).

##### 4.4.5.2.1 Offset. To adjust offset, use the following procedure:

- a. Press RESET pushbutton on OCP.
- b. Connect a voltmeter between test point TP408 and ground.
- c. Adjust potentiometer R438 for zero Volt,  $\pm 100$  millivolts.

4.4.5.2.2 Forward Motor Speed. The strobe disk is mounted on the front of the capstan and has two patterns. The inner pattern is used for 60Hz MTT's and the outer pattern is used for 50Hz MTT's. To adjust forward capstan motor speed, use one of the following required procedures as applicable:

- a. For MTT's that contain a strobe disk, use exerciser to run MTT in forward direction under manual control. Illuminate capstan with corresponding AC light (such as fluorescent), and adjust potentiometer R415 until a stationary pattern appears on the strobe disk.
- b. For all other speeds, load an 800 cpi tape (Cipher P/N 201763 or equivalent). Connect a frequency counter to test point TP404 of DEB (see dwg. 200692) for PE-only MTT's or to test point TP403 of Read Data Electronics PWB (see dwg. 201279) for PE/NRZI MTT's. Adjust potentiometer R415 for a frequency count of  $400 \times$  tape speed (ips) while running tape in continuous forward direction.

4.4.5.2.3 Reverse Motor Speed. To adjust reverse capstan motor speed, use one of the following required procedures as applicable:

- a. Repeat procedure of step a in paragraph 4.4.5.2.2 while running tape in reverse direction and adjusting potentiometer R411.
- b. Duplicate procedure of step b in paragraph 4.4.5.2.2 while running tape in reverse direction and adjusting potentiometer R411.

4.4.5.2.4 Start/Stop Ramp Time. The Start/Stop ramp times can be properly adjusted only after the forward/reverse speeds have been set up. Only the forward and reverse stop ramps need be adjusted since adjusting the stop ramp for one direction also adjusts the start ramp for the opposite direction. The stop ramp times can be observed at the capstan tachometer output.

- a. To adjust forward stop ramp time, see dwg. 200632 in Engineering Drawing Package, Sections 1 and 2, and Figure 4-23; and use the following procedure:

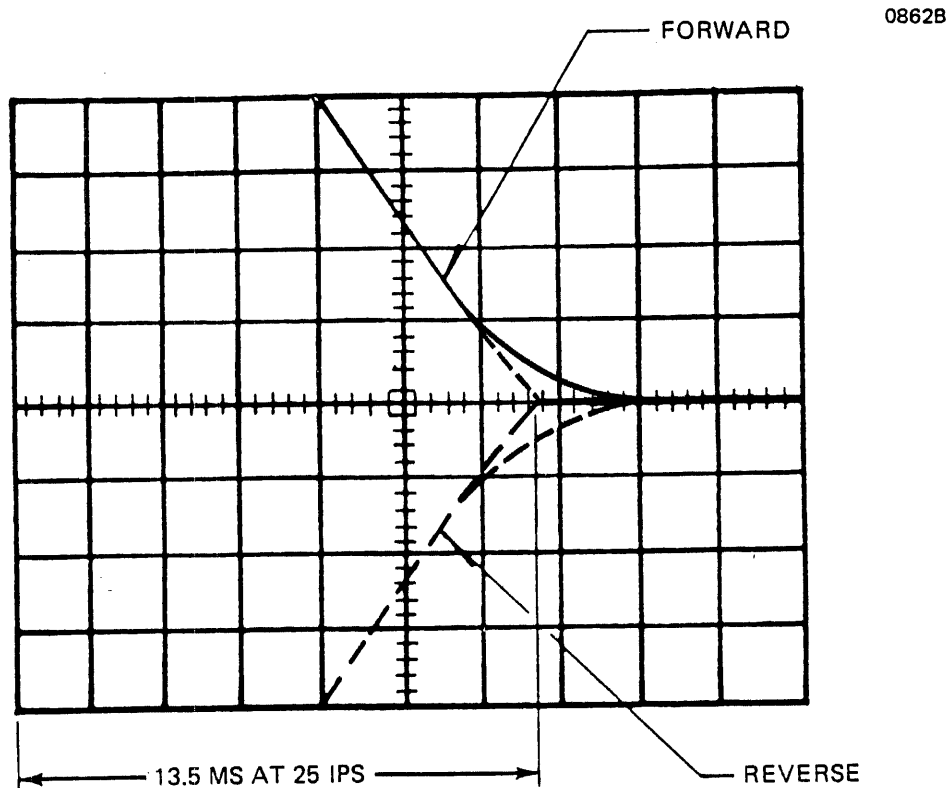


Figure 4-23. Stop Ramp Time

1. Initiate a Start/Stop Forward motion program.
2. Trigger oscilloscope sweep on external negative at Motion test point TP204 on TEB and observe tachometer output signal for capstan motor at test point TP406. To maintain a clean tachometer output signal, connect oscilloscope probe ground to test point TP403. Use sufficient vertical sensitivity on oscilloscope to cleanly measure where signal reaches zero axis.
3. Adjust potentiometer R423 such that the time for the extension of the straight-line portion of the tachometer signal to reach zero is in accordance with the following equation:

$$\text{ips } T = \frac{340}{S} = \text{milliseconds}$$

where T is stop ramp time in milliseconds and S is operating speed of MTT in ips; e.g., a 25 ips MTT would have the following stop ramp time:

$$T = \frac{340}{25 \text{ ips}} = 13.6 \text{ milliseconds}$$

Table 4-9 lists forward stop ramp times for standard tape speeds.

Table 4-9. Forward Stop Ramp Times for Standard Tape Speeds

S (ips)	T(ms)
10	34.0
12.5	27.2
18.75	18.1
25	13.6
37.5	9.1
45	7.6

- b. To adjust reverse stop ramp time, see dwg. 200632 in Engineering Drawing Package, Sections 1 and 2, and use the following procedure:
  1. Initiate a Start/Stop Reverse motion program.
  2. Use same procedure as outlined in step a(2) of forward stop ramp time procedure (paragraph 4.4.5.2.4), and adjust potentiometer R426 for same stop ramp time established in step a(3) of that procedure.



#### 4.4.5.3 Reel Servo Adjustments

Two potentiometer adjustments are required in each reel servo to provide proper servo gain and buffer arm operating position. These adjustments vary depending upon the MTT operating speed and are specified in paragraphs 4.4.5.3.1 and 4.4.5.3.2.

4.4.5.3.1 Gain. To adjust gain, see dwg. 200632 in Engineering Drawing Package, Sections 1 and 2, and use the following procedure:

- a. Mark off four inches of arc along path traveled by tip of buffer arm.
- b. Connect an oscilloscope to Servo Amplifier output test point TP418 for file reel or test point TP410 for fixed reel.

#### **CAUTION**

If the buffer arm is used, handle only the arm. Never touch the roller guide at the end of the arm or the skew may go out of adjustment and damage the tape edges.

- c. With tape loaded and holding tension, move tip of buffer arm back and forth between end points of four-inch arc marked off in step a (this can be most easily accomplished by rotating reel back and forth by hand rather than by using buffer arm).
- d. Adjust reel servo gain potentiometers until four-inch arm movement in step c produces a total voltage change on oscilloscope as specified below. Potentiometer R503 adjusts file reel servo gain and potentiometer R462 adjusts fixed reel servo gain.
  1. For 45 ips machines, adjust for a total voltage change of 6.0 Volts.
  2. For 37.5 ips machines, adjust for a total voltage change of 5.0 Volts.
  3. For 25 ips and slower machines, adjust for a total voltage change of 3.5 Volts.

4.4.5.3.2 Buffer Arm Position. The buffer arm position must be adjusted with tape loaded and with the MTT operating at proper tape speed. Both file and fixed reel arm positions must be adjusted with minimum pack; i.e., less than 1/16-inch of tape on the reels. The file reel arm position is adjusted by potentiometer R508 while running

in forward direction, and the fixed reel arm position is adjusted by potentiometer R465 while running in reverse direction. The following dimensions are the correct arm positions for operating at each tape speed:

- a. Machine operating at 45 and 37.5 ips should have buffer arm adjusted to where center of outermost roller guide on buffer arm is vertically positioned 3/16-inch from top edge of fixed roller guide support bracket.
- b. Machines operating at 25 ips or slower should have buffer arm position adjusted to conform with distance listed in Table 4-10. Distances given in this table are measured vertically from center of buffer arm roller guide to top edge of fixed roller guide support bracket.

Table 4-10. Buffer Arm Position

Machine Speed in ips	Buffer Arm Position Above Fixed Guide Bracket in Inches
25	0.5
18.75	1.0
12.5	1.5

#### 4.4.6 DATA ELECTRONICS PWB ADJUSTMENTS FOR PE-ONLY SYSTEM

All alignments are made at the factory before the equipment is shipped. Verify alignments if DEB or heads seem to malfunction. If the DEB has been replaced, perform the procedure in paragraph 4.4.6.2 only. If the head assembly has been replaced, perform all adjustments. Before performing the adjustments, verify that oscilloscope probes, plug-in unit, and time base are calibrated.

All potentiometer and test point locations are identified by a silk-screened designator adjacent to the component on the DEB (see dwg 200692 in Engineering Drawing Package, Section 2 for the physical PWB location of test points and adjustments).

**WARNING**

SYSTEM POWER MUST BE TURNED OFF BEFORE DISCONNECTING OR CONNECTING EITHER THE DATA ELECTRONICS PWB OR THE HEAD ASSEMBLY.

#### 4.4.6.1 Adjustment Sequence

MTT and power supply adjustments must be verified before performing the DEB adjustments. Because of the interrelationship among the circuits, the adjustments must be made in the following sequence:

- a. Read amplifier and differentiator gain adjustment.
- b. Crossfeed shield.

#### 4.4.6.2 Read Amplifier and Differentiator Gain

To adjust Read Amplifier and Differentiator gain on the PE-only MTT, use the following procedure:

- a. Set oscilloscope controls to the following positions:
  1. Mode – Channel; AC
  2. Sensitivity – 0.1 V/cm (for 10X probe)
  3. Probes – Internal, automatic stability
- b. Load standard-level output tape on MTT and set controller for a continuous Write mode at a frequency that corresponds with 1600 cpi and 1"s written on all channels (tracks).
- c. Connect channel 1 oscilloscope probe to test point TP104; then, adjust potentiometer R112 until analog signal has a 6.40-Volt peak-to-peak amplitude as shown in Figure 4-24.
- d. Repeat for all channels. Table 4-11 lists correct potentiometers and test points.

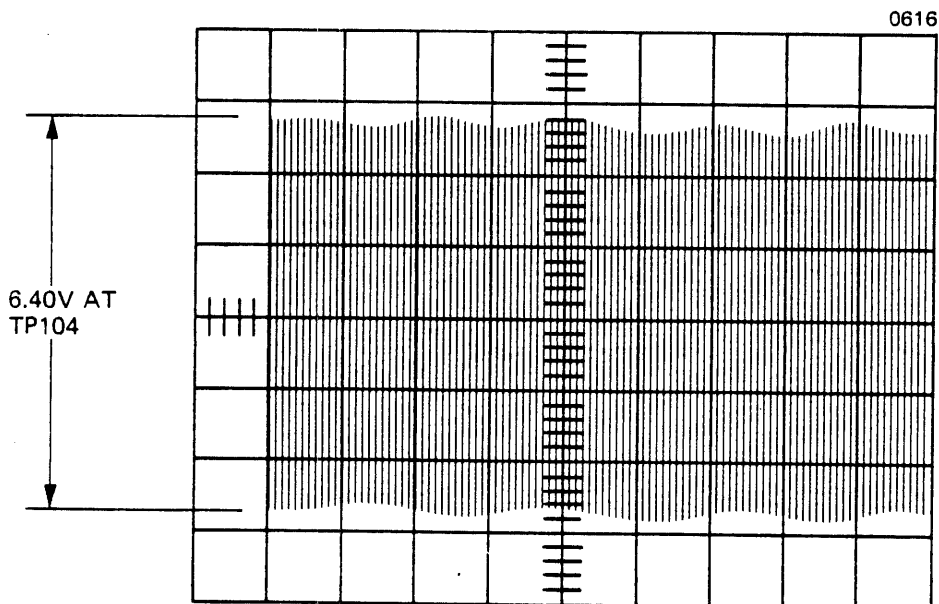


Figure 4-24. Read Amplifier and Differentiator Gain Adjustment

Table 4-11. Data Electronics PWB Adjustment Test Points for PE-Only System

Channel	Read Amplifier and Differentiator Gain	
	Test Point	Pot. No.
P	TP104	R112
0	TP204	R212
1	TP304	R312
2	TP404	R412
3	TP504	R512
4	TP604	R612
5	TP704	R712
6	TP804	R812
7	TP904	R912

#### 4.4.6.3 Crossfeed Shield

This adjustment is a mechanical alignment on the head gate assembly that is necessary to minimize the Write-to-Read crossfeed signal. Use the following procedure:

- a. Connect channel 1 oscilloscope probe to test point TP604 and channel 2 oscilloscope probe to test point TP704. With oscilloscope plug-in mode switch set to alternate, set vertical gain on each oscilloscope channel to 0.2 V/cm (for 10X probes).
- b. Remove tape from capstan to prevent tape movement when a Run (motion) command is given. This tape removal is done by threading tape so as to wrap guide, adjacent to capstan, onto fixed-reel buffer arm.
- c. Set controller for a continuous Write operation, all 1's on all channels, in PE mode. Run MTT and observe crossfeed on channels that correspond with two head-edge tracks. Crossfeed manifests itself as amplitude modulation of Read Data. This crossfeed can be seen by lifting head-shield cover and observing an increase in amplitude modulation.
- d. Loosen two head-gate screws and reposition gate by moving it in plane shown in Figure 4-25 until minimum amount of modulation is observed on both channels. Edge of ferrite should be approximately opposite write gap. Verify that shield housing is resting on head block at both front and back.

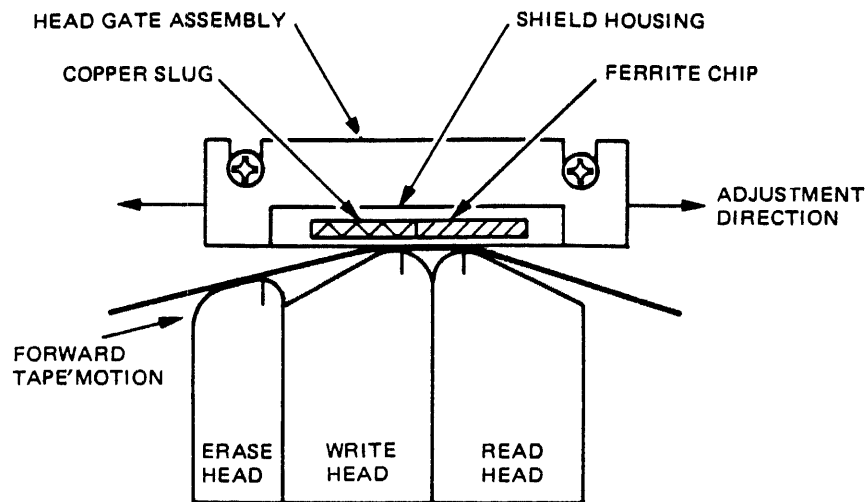


Figure 4-25. Head Gate Adjustment for PE-Only System

#### 4.4.7 DATA ELECTRONICS ADJUSTMENTS FOR PE/NRZI SYSTEM

All alignments are made at the factory before the equipment is shipped. Verify alignments if either of the Read or Write Data Electronics PWB or the heads have been replaced, or if either of these items appear to malfunction. Before performing the adjustments, verify that oscilloscope probes, plug-in unit, and time base are calibrated.

All potentiometer and test point locations are identified by a silk-screened designator adjacent to the component on the PWB (see dwgs. 201276 and 201279 in Engineering Drawing Package, Section 2 for the physical location of test points and adjustments).

### WARNING

SYSTEM POWER MUST BE TURNED OFF  
BEFORE DISCONNECTING OR CONNECTING  
EITHER THE DATA ELECTRONICS PWB OR  
THE HEAD ASSEMBLY.

#### 4.4.7.1 Adjustment Sequence for PE/NRZI

MTT and power supply adjustments must be verified before performing the Data Electronics adjustments. Because of the interrelationship among the circuits, the adjustments must be made in the following sequence:

- a. Read amplifier gain adjustments.
  1. PE mode
  2. NRZI mode
- b. Crossfeed shield
- c. Read strobe delay adjustment
- d. Write stack deskew
  1. Read stack profile measurement
  2. Write deskew one-shot adjustment
- e. Verification via staircase measurement.

#### 4.4.7.2 Read Amplifier Gain

Two gain adjustments are necessary; one each for PE and NRZI operating modes. Because the PE gain adjustment affects the NRZI gain adjustment, the PE adjustment must be made first. Any subsequent readjustment of PE mode gain on a given channel requires the NRZI mode gain to be readjusted also for that channel. These adjustments are performed on the Read Data Electronics PWB.

4.4.7.2.1 PE Gain. To adjust read amplifier gain for PE mode, use the following procedure:

- a. Set oscilloscope controls to the following positions:
  1. Mode – channel: AC
  2. Sensitivity – 0.1 V/cm (for 10X probe)
  3. Probes – internal, automatic stability
- b. Load standard-level output tape on MTT and set controller and MTT for PE operation with continuous Write mode at frequency that corresponds with 1600 cpi with all 1's written on all channels.
- c. Connect oscilloscope channel 1 probe to test point TP104 and run tape forward. Adjust potentiometer R109 until analog signal has a 6.40 Volts peak-to-peak amplitude as shown in Figure 4-26.
- d. Repeat for all channels. Table 4-12 lists correct potentiometers and test points.

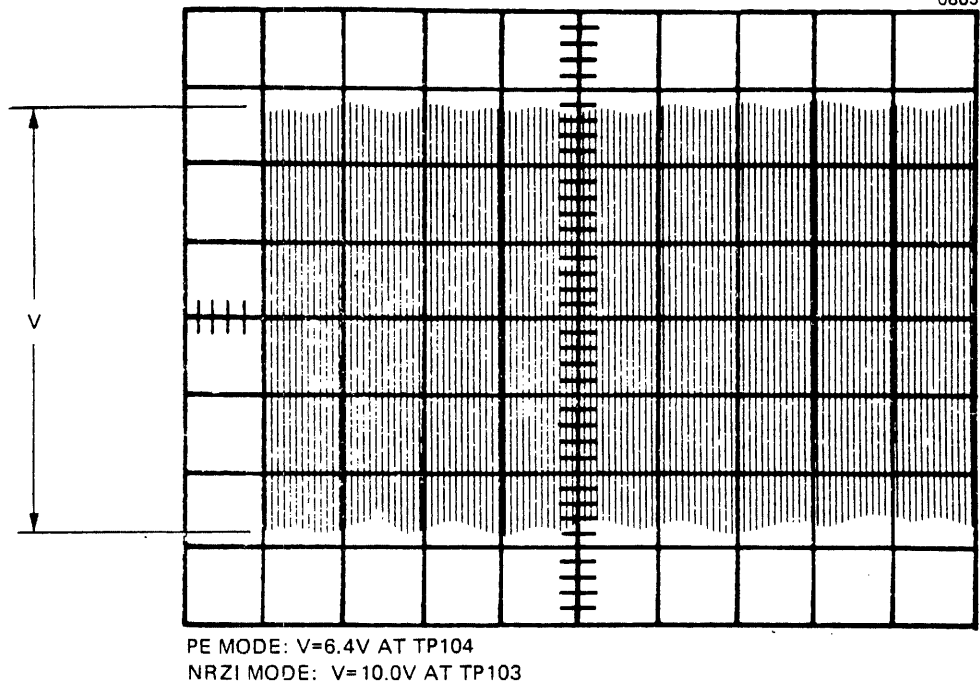


Figure 4-26. Read Amplifier Gain Adjustments for Dual-Density Systems

Table 4-12. Data Electronics Adjustment Test Points for Dual-Density Systems

Channel	Adjustment					
	PE Read Amplifier		NRZI Read Amplifier		Write Deskew	
	Test Point	Pot Point	Test No.	Pot Point	Test No.	Pot Point
P	TP104	R109	TP103	R110	TP107	R102
0	TP204	R209	TP203	R210	TP207	R202
1	TP304	R309	TP303	R310	TP307	R302
2	TP404	R409	TP403	R410	TP407	R402
3	TP504	R509	TP503	R510	TP507	R502
4	TP604	R609	TP603	R610	TP607	R602
5	TP704	R709	TP703	R710	TP707	R702
6	TP804	R809	TP803	R810	TP807	R802
7	TP904	R909	TP903	R910	TP907	R902

4.4.7.2.2 NRZI Gain. To adjust read amplifier gain for NRZI mode, use the following procedure:

- a. Set oscilloscope controls to same positions as for paragraph 4.4.7.2.1, step a.
- b. Load standard-level output tape on MTT, then set controller and MTT for NRZI operation with continuous Write mode at a frequency that corresponds with 800 cpi with all I's written on all channels.
- c. Connect oscilloscope channel 1 probe to test point TP103 and run tape forward. Adjust potentiometer R110 until analog signal has a 10 Volts peak-to-peak amplitude (see Figure 4-26).
- d. Repeat for all channels (see Table 4-12 for location of potentiometers and test points).

#### 4.4.7.3 Crossfeed Shield (PE/NRZI)

This adjustment is a mechanical alignment on the head gate assembly that is necessary to minimize the Write-to-Read crossfeed signal. See dwg 201279 in Engineering Drawing Package, Sections 1 and 2, and use the following procedure:

- a. Connect Channel 1 oscilloscope probe to test point TP603 and channel 2 oscilloscope probe to test point TP703. With oscilloscope plug-in mode switch set to alternate, set both oscilloscope vertical gain on channels 1 and 2 to 0.2 V/cm.
- b. Set controller and MTT for continuous Write operation with all I's on all channels in NRZI mode. Run MTT and observe crossfeed on channels that correspond with two head-edge tracks. Crossfeed manifests itself as amplitude modulation of Read Data. This crossfeed can be seen by lifting head-shield cover and observing an increase in amplitude modulation.
- c. Loosen two head-gate screws and reposition gate by moving it in plane shown in Figure 4-27 until a minimum amount of modulation voltage is observed on both channels. Edge of ferrite should be approximately opposite write gap. Verify that shield housing is resting on head block at both front and back.



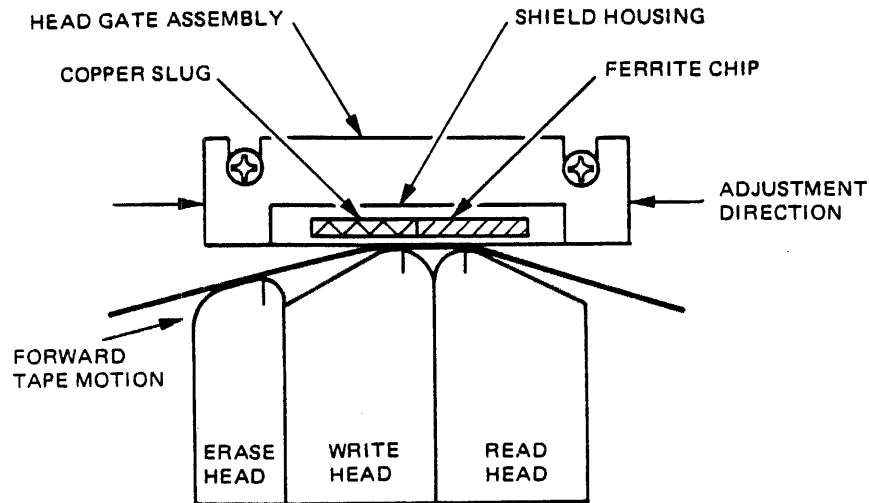


Figure 4-27. Head Gate Adjustment for Dual-Density Systems

#### 4.4.7.4 Read Strobe Delay

To adjust read strobe delay, see dwg 201279 in Engineering Drawing Package, Sections 1 and 2, and use the following procedure:

- a. Set oscilloscope controls to the following positions:
  1. Mode – channel 1, DC
  2. Sensitivity – 0.1 V/cm
  3. Trigger – Internal (+) trigger mode.
- b. Connect channel 1 oscilloscope probe to test point TP13.
- c. Verify MTT is selected for NRZI operation and Write all 1's as described in paragraph 4.4.7.3, step b.
- d. A positive pulse should be observed at test point TP13 as shown in Figure 4-28. Adjust potentiometer R12 for a pulse width of approximately one-half frame time. At 25 ips, this time should be 25 microseconds. Frame time is defined as  $\frac{1}{SD}$ ; where S is MTT tape speed in ips, and D is operating data density. Table 4-13 lists ½ frame time standard tape speeds.

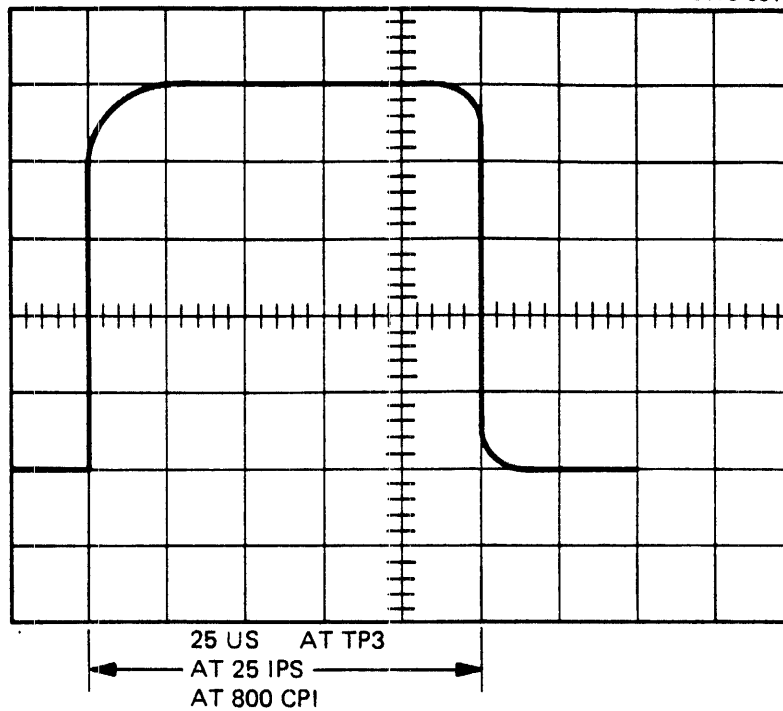


Figure 4-28. Read Strobe Delay Adjustment for Dual-Density Systems

Table 4-13. Half-Frame Times for Standard Tape Speeds

S (ips)	D (cpi)	½-Frame Time (microseconds)
10	800	62.5
12.5	800	50
18.75	800	33.3
25	800	25
37.5	800	16.7
45	800	13.9

#### 4.4.7.5 Write Stack Deskew

The method used to ensure proper write head deskewing is to first plot scatter of the read stack gap in the forward direction while referencing each track to the leading track by using an IBM Master Skew Alignment Tape. The gap-scatter plot is then duplicated by adjusting the potentiometers of the write deskew one-shots while writing all 1's on a scratch-pad tape.

4.4.7.5.1 Read Head Stack Profile. The method used to measure and record the gap scatter is to first locate the leading track and then to measure the time displacement of each of the other tracks with respect to the leading track.

The leading track is located by comparing all the tracks to each other. The digital data compared is only that which corresponds to the negative peaks of the analog signals observed at test points TP103 through TP903. By taking this precaution, error due to the effect of the pulse-pairing phenomenon is eliminated. To locate the leading track, see dwg 201279 in Engineering Drawing Package, Sections 1 and 2, and use the following procedure:

- a. Set oscilloscope controls to the following positions:
  1. Mode – Chop
  2. Sensitivity – 0.2V/cm, DC, both channels
  3. Trigger – External (+), AC mode
- b. Use IBM Master Skew Alignment Tape, and run MTT in forward direction in On-Line NRZI mode.
- c. Set channel 1 oscilloscope probe and external trigger probe on test point TP107 (Read Data Electronics PWB) and set Channel 2 oscilloscope probe on test point TP103. Set oscilloscope sweep for sufficient resolution to accurately measure the time between leading edge of each trace. One of patterns shown in Figure 4-29 can then be observed on oscilloscope screen.
- d. If display shown in Figure 4-29a is observed, proceed to step e, since this display indicates that correct triggering of alternate bits (generated by negative analog signal peaks) has been achieved.

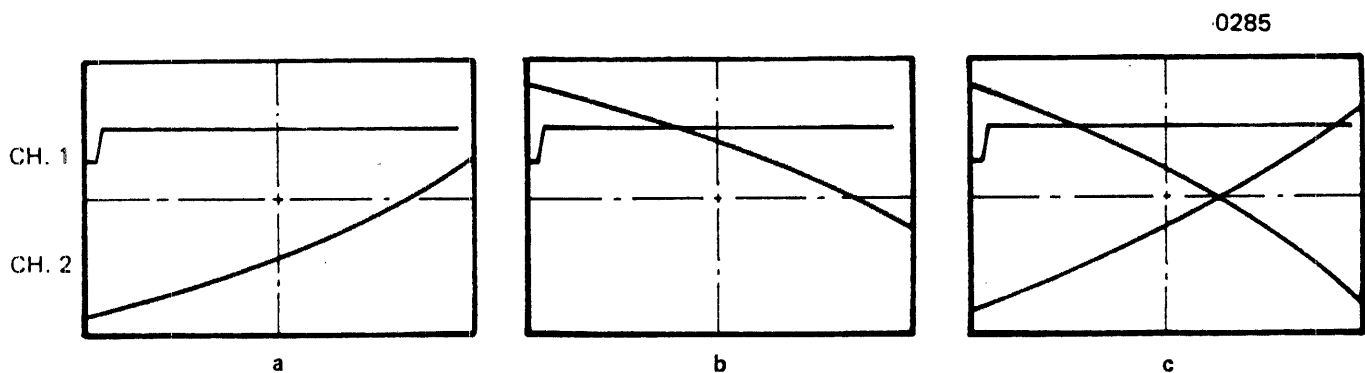


Figure 4-29. Triggering Method

1. If display shown in Figure 4-29b is observed, triggering is on alternate bits but created by wrong polarity analog signal peak. To correct triggering, switch time base up one position then back. Normally, after one or two tries, triggering switches to correct polarity.
  2. If display shown in Figure 4-29c is observed, triggering is again incorrect because it is occurring on every bit. To correct this condition, change to a faster or slower oscilloscope sweep time.
  3. Once display shown in Figure 4-29a is obtained, do not change sweep time for remainder of procedure. If greater sweep time resolution is required, use horizontal magnifier. Correct triggering must be verified during all testing. Align start of sweep with a reference on graticule.
- e. Move channel I oscilloscope probe to test point TP207.
1. If it is observed that positive-going pulse at test point TP207 follows trigger pulse, move channel I oscilloscope probe to test point TP307 since test point TP107 is leading of two tracks, and it is required to maintain trigger probe on leading track. Repeat process until signal on Channel I is not observed.
  2. If signal at test point TP207 is not observed on oscilloscope screen, it is leading track. Move trigger probe to test point TP207. Since trigger probe has thus changed location, verify that triggering is still correct by following method described in step d.
- f. Repeat process described in step e until all tracks have been scanned. Verify correct triggering is maintained every time trigger probe is moved to newly found leading track.
- g. To verify that leading track has truly been located, keep trigger probe fixed on that track and scan remainder of tracks with channel I oscilloscope probe. Leading edge of positive pulse must be observed at all test points.
- h. After completing step g, keep trigger probe on read register test point that corresponds with leading track, and use channel I oscilloscope probe on test points TP107 through TP907 to make a read profile plot. Record time displacement between leading edges of both pulses for each track. Verify proper triggering method is used.

4.4.7.5.2 Write One-Shot Deskew. While the MTT is loaded with a scratch-pad tape for writing all 1's on all tracks at 800 cpi, use the following adjustment procedure:

- a. While running MTT continuously, display test track on channel 1 while triggering on reference track. Set reference track potentiometer to approximately one-third turn from ccw position. Adjust corresponding write deskew potentiometer so that read profile of paragraph 4.4.7.5.1 is duplicated. Verify proper triggering method is used.
- b. Repeat for all tracks (see Table 4-12 for correct test points and potentiometers).
- c. Scan all write deskew one-shot outputs at test points TP101 through TP901 to ensure that positive-going pulse width (P) does not exceed value defined by the following equation:

$$P = \frac{300}{S \text{ in ips}} - 0.2 \text{ microsecond}$$

where S is the tape speed. Table 4-14 lists maximum values for P at standard tape speeds as derived by this equation. If P is within limit provided by this equation, deskewing adjustment operation is complete.

- d. If the conditions defined in step c are not met, record pulse width of each output.
- e. Adjust corresponding write deskew potentiometer until pulse width of longest one-shot output is reduced to limit imposed by Table 4-14.
- f. Reduce pulse width of remaining one-shot outputs by same amount established in step e. This operation maintains deskewing integrity and simultaneously satisfies requirement of step c.

Table 4-14. Maximum Positive-Going Pulse Width

S (ips)	P (microseconds)
10	29.8
12.5	23.8
18.75	15.9
25	11.8
37.5	7.8
45	6.5

#### 4.4.7.6 Verification By Staircase Measurement

A quick verification of all the foregoing adjustments can be made by checking the width of the data staircase when the MTT is running in the forward direction. See dwg. 201279 in Engineering Drawing Package, Sections 1 and 2, and use the following procedure:

- a. Set oscilloscope controls to the following positions:
  1. Mode – channel 1, DC
  2. Sensitivity – 0.1 V/cm
  3. Trigger – External (+), AC, trigger mode.
- b. Connect oscilloscope trigger probe to test point TPI3 and connect channel 1 oscilloscope probe to test point TPI5.
- c. While writing continuous I's, observed waveform should resemble that shown in Figure 4-30. Time T should approximate results described in paragraph 4.4.2.4, step d and should not differ more than value established by the following equation:

$$T = \frac{30}{\text{Tape Speed (ips)}} \quad \text{microseconds}$$

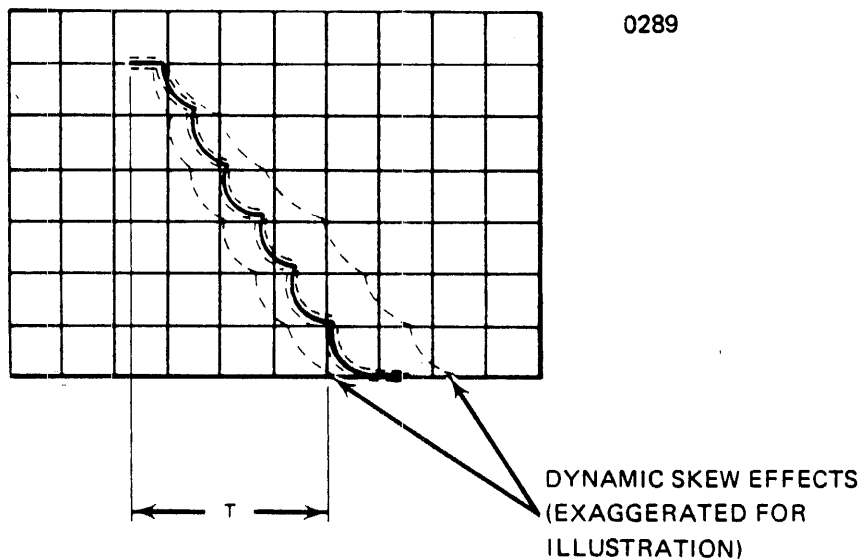


Figure 4-30. Staircase Waveform for Dual-Density Systems

Table 4-15 lists maximum T for standard tape speeds derived from this equation.

Table 4-15. Maximum T Difference

Tape Speed (ips)	T (microseconds)
10	3.0
12.5	2.4
18.75	1.6
25	1.2
37.5	0.8
45	0.67

Time (T) must not include the effects of dynamic skew and should not exceed the value expressed by the following equation:

$$T = \frac{100}{\text{Tape speed in ips}} = T \text{ in microseconds}$$

Table 4-16 lists maximum T for standard tape speeds derived from this equation.

Table 4-16. Maximum T at Standard Tape Speeds Without Dynamic Skew Effects

Tape Speed (ips)	T (microseconds)
10	10
12.5	8
18.75	5.33
25	4
37.5	2.67
45	2.22

- d. If this condition is not met, repeat procedures specified in paragraph 4.4.7.5.

## SECTION 5

### FAULT ISOLATION

#### 5.1 GUIDES

Tables 5-1, 5-2, and 5-3 are System Fault Isolation Guides that should be used as a diagnostic aid for the isolation of faults within the MTT system. They list possible symptoms, probable causes for the malfunction, and corrective actions. A reference column cites the text or drawing, relevant to any particular event, which should be consulted for further information and verification. Figures 5-1 and 5-2 identify assemblies and subassemblies and aid in their location in the MTT.

Table 5-1. Fault Isolation Guide for Mod 10 PE-Only and PE/NRZI Configurations

Symptom	Probable Cause	Remedy	Reference
POWER indicator light does not work when switch is pressed on OCP.	SI power switch in OFF position.	Switch SI to ON position located on lower left corner of power supply chassis	Figure 5-1
	+5 Volts missing.	Check +5 Volts at test point TPI on Regulator PWB which is mounted on the power supply.	Section 4 Para. 4.4.3
	CBI circuit breaker open.	Push in circuit breaker button located by AC cord input.	Figure 5-1
	Power Indicator Lamp burnt out.	Check the lamp terminals for lamp continuity. Replace the switch from the front of the MTT.	Section 4 Para. 4.3.3
	No AC voltage to MTT.	Check outlet with Voltmeter for the proper AC voltage.	
When the LOAD pushbutton is pressed, buffer arms do not move.	Electromechanical retract assembly.	SI6 microswitch open on cam retract assembly.	Dwg. 200119



Table 5-1. Fault Isolation Guide for Mod 10 PE-Only and PE/NRZI Configurations (continued)

Symptom	Probable Cause	Remedy	Reference
When the LOAD pushbutton is pressed, buffer arms do not move. (cont'd)	+13V unregulated is missing.	Check J19 Pin 2 for +13V unregulated.	Dwg. 200498
	P19 connector not seated.	Check connection.	Dwg. 200498
	K2 relay coil open.	Pullout relay and measure for continuity between pins 1 and 4.	Dwg. 200119
When the LOAD pushbutton is pressed, the buffer arms travel to their upper limits and retract to the load position.	Tape threaded incorrectly.	Check threading diagram.	Figures 1-2 and 4-17 Dwg. 200119
	Electromechanical retract assembly not working.	S14 microswitch not closing during a Load operation.	
	K1 power relay not picking.	Check J19 Pin 2 for +13V.	Dwg. 200498
	+13 Volts missing. -13 Volts missing.	Check test point TP420 Check test point TP421	Section 4 Para. 4.2.1
When the LOAD pushbutton is pressed, tape tensions and moves forward at a fast speed.	Tape not threaded correctly.  Fixed reel amplifier defective.	Check threading diagram.  Remove tape, press LOAD pushbutton when buffer arms reach their upper limit, turn power OFF and ON. Then the buffer arms can be cycled by hand and the voltages can be checked.	Figures 1-2 and 4-17  Section 4 Para. 4.4.5.3

Table 5-1. Fault Isolation Guide for Mod 10 PE-Only and PE/NRZI Configurations (continued)

Symptom	Probable Cause	Remedy	Reference
When the LOAD pushbutton is pressed, tape tensions and travels at a fast reverse speed.	Tape not threaded correctly.  File reel amplifier defective.	Check threading diagram.  Remove tape, press LOAD pushbutton when buffer arms reach their upper limit, turn power OFF and ON. Then the buffer arms can be cycled by hand and the plus and minus voltages at test points TP425 and TP418 can be measured.	Figures 1-2 and 4-17  Section 4 Para. 4.4.5.3
When the LOAD pushbutton is pressed, tape tensions, but tape does not move forward.	No forward motion (FORWARD lamp not lit).  Ramp generator circuit not working.  Capstan amplifier not working.	Check test point TP402 for +5 Volts.  Check test point TP404 for voltage output.  Check test point TP408 for voltage output.	Dwg. 200632  Dwg. 200632  Dwg. 200632
When the LOAD pushbutton is pressed, tape tensions and the tape moves forward but does not stop at the BOT marker.	BOT tab dirty or tarnished.  Photosense lamp burnt out.	Clean with IBM Tape Transport Cleaner P/N 453511.  Remove head cover and check.	Section 4 Para. 4.1.1  Section 4 Para. 4.3.4
Buffer arms continually cycle up and down after unloading the tape.	Photosense assembly not adjusted correctly.  Microswitch S15 on cam retract not opening.	With tape loaded and not at BOT, test point TP201 should be zero Volt.  Remove overlay and check S15 microswitch by pressing LOAD pushbutton and visually watching for make and break action.	Section 4 Para. 4.4.5.1  Dwg. 200119

Table 5-1. Fault Isolation Guide for Mod 10 PE-Only and PE/NRZI Configurations (continued)

Symptom	Probable Cause	Remedy	Reference
Buffer arms continually cycle up and down after unloading the tape. (cont'd)	Detective microswitch.	Test microswitch with power OFF by using an ohmmeter.	Dwg. 200119
Tape does not respond to a Forward or Reverse command in the On-Line mode.	No Ready status from MTT.	Check Ready status at connector pin J16-T for zero Volt (low true interface).	Dwgs. 200632 and 200728
	Interface cable fault.	Check at controller cable-mating with connector pin J16-T for Ready Status zero-Volt level input.	Dwgs. 200632 and 200738.
	No Forward input command.	Check forward level at connector pin J16-C for zero Volt input.	Dwgs. 200632 and 200738
	No Select command.	Check connector pin J16-J for zero Volt input. Check S and T jumper for +5 Volts.	Dwgs. 200632 and 200738
Write command given but no data being recorded.	File Protect logic not working.	Remove tape. Turn Power OFF. Turn Power ON and push in solenoid plunger; it should stay in. Press LOAD pushbutton. The plunger should then come out.	Dwg. 200738 and Figure 4-30.
	No Write power.	Check test point TP6 for +12V. (Dual gap)	Dwg. 202063
		Check test point TP3 for +5V (Single gap)	Dwg. 201276
	No Write Enable command.	Check test point TP207 for +5 Volts.	Dwg. 200632

Table 5-1. Fault Isolation Guide for Mod 10 PE-Only and PE/NRZI Configurations (continued)

Symptom	Probable Cause	Remedy	Reference
Write command given but no data being recorded. (cont'd)	Missing Write Clock pulse.	Check connector pin J1-A for negative-going clock.	Dwgs. 200692 and 201276
	Heads not plugged in correctly.	Check J2 connector.	Dwgs. 200692 and 201276
Written data is not correct.	Failure of one Write logic circuit.	Write all 1's and check test point TP101 through TP901 (PE-only) or TP102 through TP902 (PE/NRZI) for Write signals.	Dwgs. 200692 and 201276
	Intermittent Write power, motion, or Write reset signals.	Monitor Write signal test point TP2 (PE/NRZI) or J3-1 (PE-only) and Write reset signal at connector pin J1-C. Look for level changes.	Dwgs. 200692 and 201276.
Correct written data cannot be read.	One of the Read channels is dead.	Read all 1's and check test points TP103 – TP903 for proper analog waveforms. Check test points TP107 – TP907 for proper PE digital waveforms or TP108 – TP908 for NRZI data.	Dwgs. 200692 and 201276
	Read amplifier gains are incorrectly adjusted.	Check Read amplifier gains.	Section 4 Para. 4.4.6.2
	Head and guides need cleaning.	Clean head and guides.	Section 4 Para. 4.1.1
	Head cable not plugged in.	Plug in head cable.	Dwg. 200692 and 201276.
	Tape cleaner dirty.	Clean tape cleaner.	Section 4, Para. 4.3.5.2

Table 5-2. Fault Isolation Guide for Mod 10 PE-Only Configuration

Symptom	Probable Cause	Remedy	Reference
Read command issued but doesn't appear to read correctly.	Head cable not plugged in.	Plug in head cable P5.	Dwg. 200692
	Head guides or tape cleaner dirty.	Clean tape path.	Section 4 Para. 4.1.1
	Select and Read signal not true.	Test point TP7 on DEB must be at +5 Volts.	Dwg. 200692
	One of the read channels is dead.	Check test points TP104 through TP904 for proper analog waveforms. Check test points TP106 through TP906 for proper digital waveforms.	Dwg. 200692 Section 4 Para. 4.4.6.2
	Read amplifier gains incorrectly adjusted.	Check read amplifier.	Dwg. 200692 Section 4 Para. 4.4.6.2
	Threshold levels incorrect.	Check test point TP4 voltage. Should be as described in the Theory of Operation (Read Data Flow)	Dwg. 200692
Write command issued but not being written.	One of the envelope detectors is inoperative.	Check test points TP107 through TP907. The voltage level should be approximately +4 Volts.	Dwg. 200692
	Head not plugged in.	Plug in head cable P2.	Dwg. 200692
	Write interface cable not plugged in.	Plug in write cable P1.	Dwg. 200692
	File Protect logic not working.	Remove tape. Turn Power ON and push in the solenoid plunger; it should stay in. Press the LOAD push-button. The plunger should then come out.	Dwg. 200692 and Figure 4-29

Table 5-2. Fault Isolation Guide for Mod 10 PE-Only Configuration (continued)

Symptom	Probable Cause	Remedy	Reference
Write command issued but not being written. (cont'd)	No Write power.	Check connector pin J3-1 for +5 Volts. Check jumper A - B for -5 Volts.	Dwg. 200692
	No Write Enable signal.	Check connector pin J3-9 for +5 Volts.	Dwg. 200692
	Select and Ready signal not true.	Check test point TP7 for +5 Volts.	Dwg. 200692
	Missing Write Clock pulse.	Check connector pin J1-A for negative clock pulses going from +3 Volts to zero Volt.	Dwg. 200692
Written data not correct.	Failure of Write logic circuits.	Write all 1's and check test points TP101 - TP102 and through TP901 - TP902.	Dwg. 200692

Table 5-3. Fault Isolation Guide for Mod 10 PE/NRZI Configuration

Symptom	Probable Cause	Remedy	Reference
Read command issued but doesn't appear to read correctly.	Head cable not plugged in.	Plug in head cable P5 on Read Data Electronics PWB.	Dwg. 201279
	Head, guides, or tape cleaner dirty.	Clean tape path.	Section 4 Para. 4.1.1
	Select and Ready signal not true.	Connector pin J28-3 on Read Data Electronics PWB must be at zero Volt.	Dwg. 201279
PE Read failure.	PE Select line not true.	On Write Data Electronics PWB, check the voltage at connector pin J3-6, it should be at zero Volt.	Dwg. 201276

Table 5-3. Fault Isolation Guide for Mod 10 PE/NRZI Configuration (continued)

Symptom	Probable Cause	Remedy	Reference
PE Read failure. (cont'd)	One of the Read channels is dead.	On Read Data Electronics PWB, check test points TP104 through TP904 for proper analog waveforms. Check test points TP106 through TP906 for proper digital waveforms.	Dwg. 201279 Section 4 Para. 4.4.7.2.1
	Read amplifier gains incorrectly adjusted.	Check Read amplifier signal level.	Dwg. 201279 Section 4 Para. 4.4.7.2.1
	Threshold levels incorrect.	On Write Data Electronics PWB, check voltage at test point TP5. Should be as described in Theory of Operation (Phase Encoded Signal Path)	Dwg. 201276
	One of the envelope detectors is	On Read Data Electronics PWB, check points TP108 inoperativethrough TP908. The voltage level should be around +4 Volts.	Dwg. 201279
NRZI Read failure	NRZI select line not true.	On Write Data Electronics PWB check the voltage at connector Pin J3-6 for +5 Volts.	Dwg. 201276

Table 5-3. Fault Isolation Guide for Mod 10 PE/NRZI Configuration (continued)

Symptom	Probable Cause	Remedy	Reference
NRZI Read failure (cont'd)	One of the Read channels is dead.	On Read Data Electronics PWB, check test points TP103 through TP903 for proper analog waveforms. Check test points TP107 through TP907 for proper digital waveforms.	Dwg. 201279 Section 4 Para. 4.4.7.2.2
	Read amplifier gains incorrectly adjusted.	On Read Data Electronics PWB, check Read amplifier signal level.	Dwg. 201279 Section 4 Para. 4.4.7.2.2
	Read Strobe delay incorrectly adjusted.	Check adjustment at test point TP14 of Read Data Electronics PWB.	Dwg. 201279 Section 4 Para. 4.4.7.4
	Threshold levels incorrect.	On Write Data Electronics PWB, check voltage at test point TP4. Should be as described in Theory of Operation (Phase Encoded Signal Path, Equalizer).	Dwg. 201279
Write command issued but not being written.	Head not plugged in.	Plug in head cable P2 on Write Data Electronics PWB.	Dwg. 201276
	Write Interface cable not plugged in.	Plug in Write Interface cable P1 on Write Data Electronics PWB.	Dwg. 201276
	File Protect logic not working.	Remove tape. Turn Power OFF. Turn Power ON and push in the solenoid plunger; it should stay in. Press LOAD pushbutton. The plunger should then come out.	Dwg. 200692 and Fig. 4-30



Table 5-3. Fault Isolation Guide for Mod 10 PE/NRZI Configuration (continued)

Symptom	Probable Cause	Remedy	Reference
Write command issued but not being written (cont'd)	No write power.	On Write Data Electronics PWB, check test point TP2 for +12 Volts.	Dwg. 201276
	No Write Enable signal.	On Write Data Electronics PWB, check connector pin J3-4 for +5 Volts.	Dwg. 201276
	Select and Ready signal not true.	On Write Data Electronics PWB, check J3-3 for +5 Volts.	Dwg. 201276
	Missing Write clock pulse.	On Write Data Electronics PWB, check test point TP1 for positive-going clock pulses between zero and 3 Volts.	Dwg. 201276
Written data not correct.	Failure of Write logic circuits.	Write all 1's and check test points TP101 through TP901 for proper signals at output of one-shots.  Check test points TP102 through TP902 at output of write registers.	Dwg. 201276

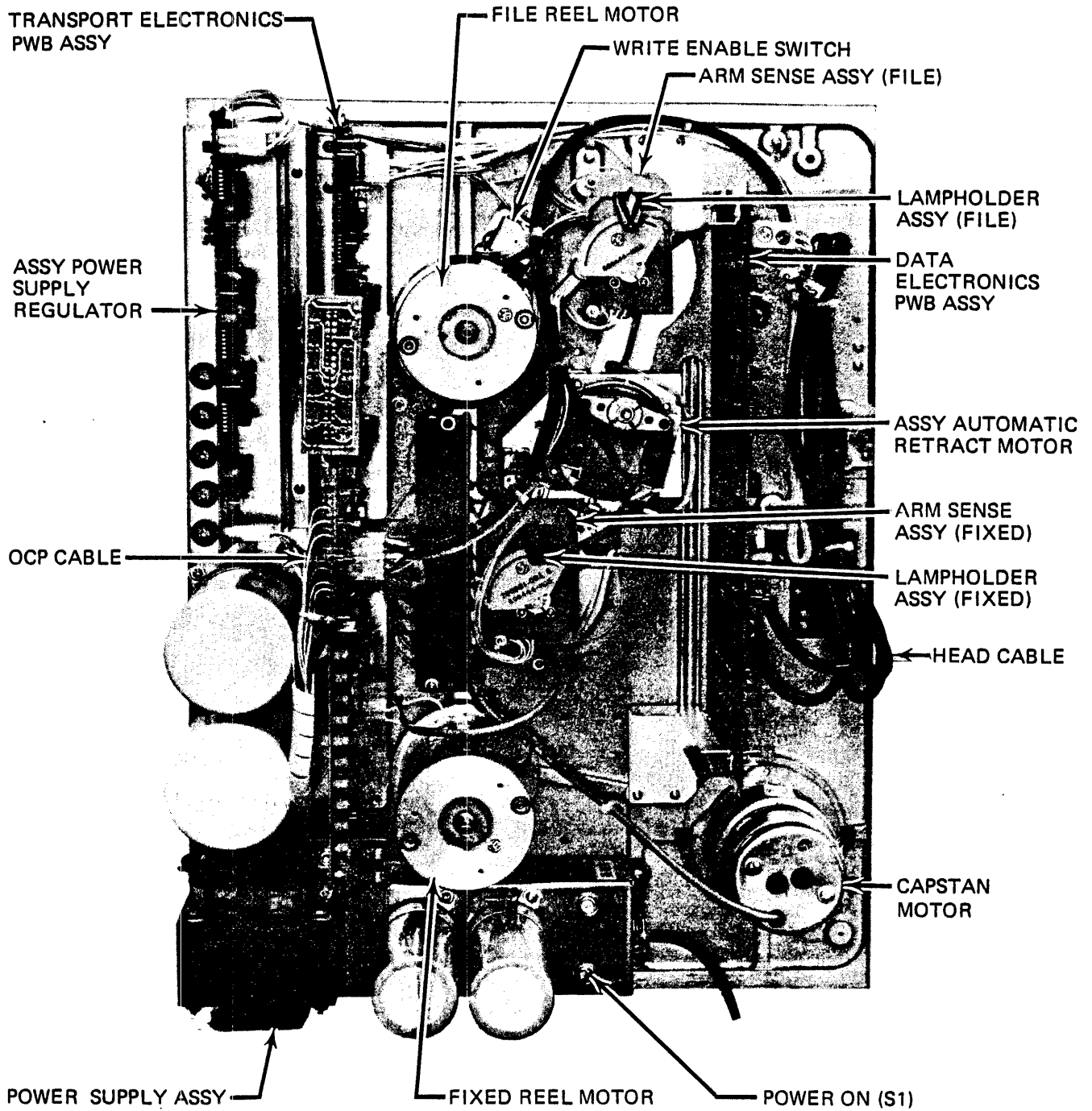


Figure 5-1. Mod 10 MTT System, Rear View

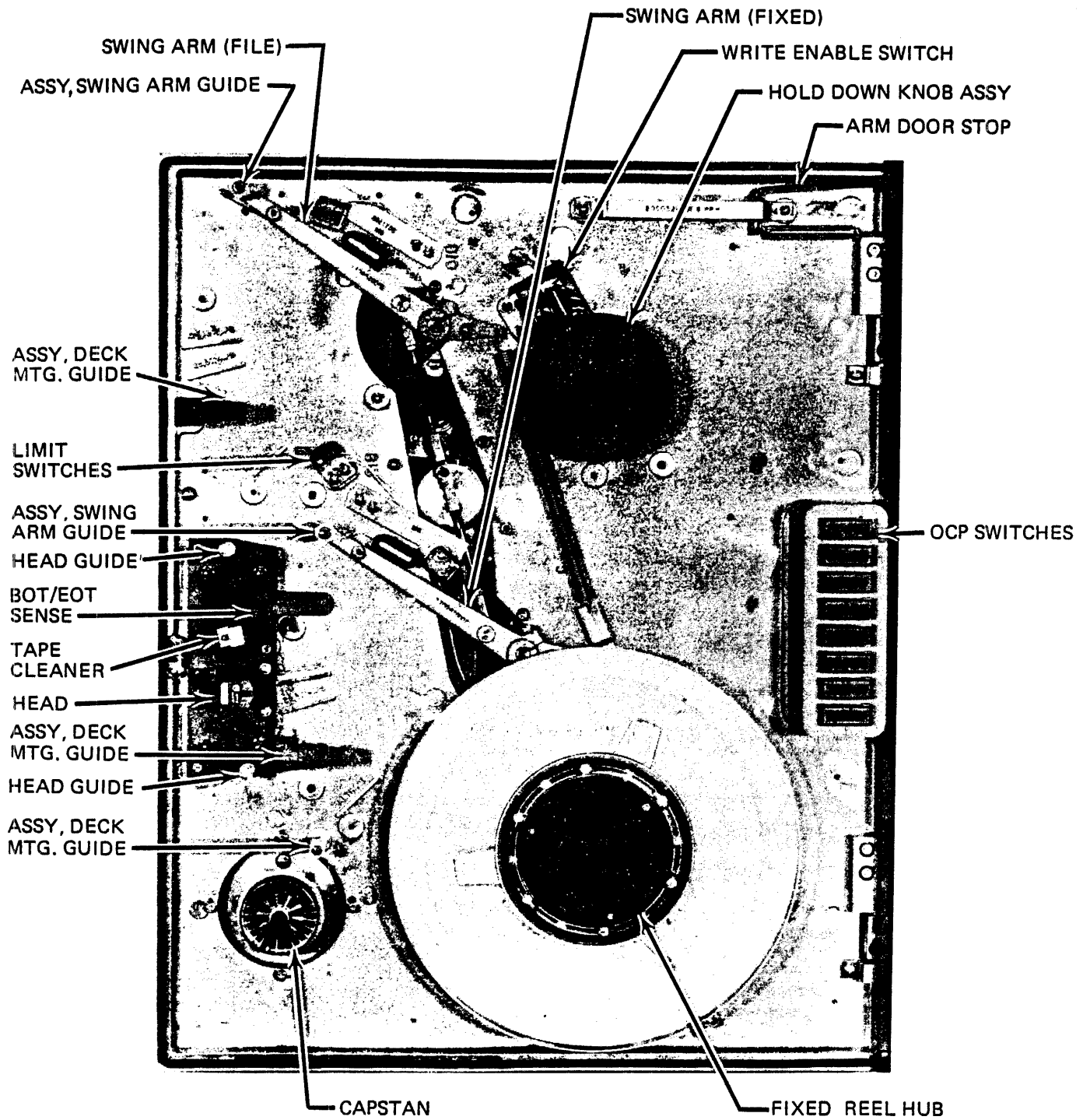


Figure 5-2. Front View With Deck Overlay Removed

USABLE REVISION									
VERSION 200666-001	H								
BASIC ASSY. 200488-030	CC								
PROCESS BD. 200494-001	S								
SCHEMATIC 200666-001	H								
TEST PROCEDURE									
CR/O & INSP. DATE	8612								

ASSY. TRANSPORT ELECTRONICS PWB TYPE P 45 IPS D/G 7CH	PERKIN-ELMER Memory Products Division	H
	200666-001	SHEET 2 OF 83

		USABLE REVISION							
VERSION 200666-002	H								
BASIC ASSY. 200488-006	CC								
PROCESS BD. 200494-001	S								
SCHEMATIC 200666-001	H								
TEST PROCEDURE									
CR/O & INSP. DATE	8/12								

**PERKIN-ELMER**  
**Memory Products Division**

ASSY. TRANSPORT ELECTRONICS  
PWB. TYPE 'P' 45IPS.D/G. 7CH

H

200666-002

SHEET

4 OF 8

# PERKIN-ELMER

## Memory Products Division

LIST

ML

DRAWING NO.

200666-002

REV.

H

ASSY. TRANSPORT ELECTRONICS  
PWB TYPE 'P' 45IPS D/G 9CH

MODEL NO. 10

DATE 8/17/71 SHEET 3 OF 8

DRAWING NO. 200666-002 REV. H

ITEM NO.	DRAWING TITLE	DWG. NO.	NO. REQ.	REMARKS ON CKT. DESIG.
	USE MATERIAL LIST 200488-000 & 200488-006			
	EXCEPT: -			
53	Resistor, 5%, 1/4W 220	100156-221	11	Delete
53	Resistor, " " 220	100156-221	5	Add. R204, 235, 239, 269, 273.
55	Resistor, 5%, 1/4W 330	100156-331	9	Delete
55	Resistor, " " 330	100156-331	3	Add. R205, 218, 219.
144	Resistor, 5%, 1/4W 5.1K	100156-512	1	Add. R280A(See sheet 6).
145	Diode, Rectifier 1N4003	100127-001	1	Add. CR212A across jumper points MM and NN. Cathode on NN.
146	Wire, Solid Insulated	100248-024	A/R	Jumper L to TTT
74	Resistor, 5%, 1/4W	100156-512	21	Delete
74	Resistor 5%, 1/4W	100156-512	20	Add R230, 236, 253, 254, 259, 262, 263, 264, 267, 272, 279, 407, 409, R413, 414, 424, 425, 428, 464, 505
28	Capacitor, Ceramic .001uf	100073-102	2	Delete
28	Capacitor, Ceramic .001uf	100073-102	1	Add C217

MODULAR COMPUTER SYSTEMS

CODE

T120

ASSEMBLY  
PART NUMBER

REV.

200739-001

E2

PERKIN-ELMER  
Memory Products Division

**MATERIAL LIST**

ASSY. DATA ELECTRONICS PWB.

TITLE 40-45 IPS, DG, TYPE P MODEL 10 DATE 5-2-77 SHEET 1 OF 6

ASSEMBLY PART NUMBER  
200739-001

*Handwritten:*  
S/P  
2/2/77

ITEM	REQD	PART NO.	DESCRIPTION	REMARKS
1	1	200167-001	Board, Processed	
2	2	200016-001	Bracket, Mounting	
3	5	100084-001	I.C. HEX. Inverter 836	U1,2,8,9,31
4	6	100085-001	I.C. Quad. 2 Input Nand. 846	U3,4,5,6,7,15
5	3	100086-001	I.C. Quad. 2 Input Power 858	U26,27,28
6	1	100087-001	I.C. 10 Input Nand. 1804	U29
7	10	100088-001	I.C. Dual Flip Flop 853	U10,11,12,13,14,21,22,23 U24,25
8	5	100089-001	I.C. Op. Amplifier 7739	U16,17,18,19,20
9	1	100090-001	I.C. Mono. Multivibrator 9601	U30
10	63	100080-001	Transistor, NPN. 2N4123	Q1,2,5,8,9,11,13,14,15 Q101-901, Q102-902, Q103-903 Q106-906, Q107-907, Q109-909
11	14	100081-001	Transistor, PNP. 2N4125	Q4,6,7,10,12 Q108-908
12	9	100082-001	Transistor, Dual NPN, TD-101	Q104-904
13	1	100083-001	Transistor, PNP. MPS-U51	Q3
14	9	151000-001	Transistor, NPN. 2N708	Q105-905
15	46	100091-001	Diode, Signal 1N914	CR1, CR101-901, CR102-902 CR103-903, CR104-904 CR105-905
16	9	100073-330	Capacitor, Ceramic 33pf	C109-909
17	1	100243-680	Capacitor, Mica 68pf	C36
18	9	100073-101	Capacitor, Ceramic 100pf	C102-902
19	9	100073-331	Capacitor, Ceramic 330pf	C105-905
20	9	100073-332	Capacitor, Ceramic .0033uf	C103-903
21	1	100077-152	Capacitor, Poly .0015uf	C35
22	1	-472	Capacitor, Poly .0047uf	C34
23	9	-102	Capacitor, Poly .001uf	C101-901
24	1	100225-152	Capacitor, Poly .0015uf	C41

MODULAR COMPUTER SYSTEMS

CODE  
T12C

PERKIN-ELMER  
Memory Products Division

**MATERIAL LIST**

ASSEMBLY  
PART NUMBER  
200739-001

REV.  
E2

ASSY. DATA ELECTRONICS PWB.  
40-45 IPS, DG, TYPE P

MODEL 10

DATE 5-2-77 SHEET 2 OF 6

ASSEMBLY PART NUMBER

200739-001

ITEM	REQD	PART NO.	DESCRIPTION	REMARKS
25	9	100128-154	Capacitor, Poly .15uf	C108-908
26				
27	41	100070-106	Capacitor, Tantalum 10uf	C1,2,3,4,5,6,7,9,10,11,12 C13,14,15,16,17,18,19,20 C21,22,23,24,28,29,30,31 C32,37,38,39,40, C104-904
28	1	100070-476	Capacitor, Tantalum 47uf	C27
29	18	100136-224	Capacitor, Tantalum .22uf	C106-906,C107-907
30	1	100069-500	Resistor, Variable 50	R27
31	9	100069-502	Resistor, " 5K	R118-918
32	10	100069-203	Resistor, " 20K	R49, R104-904
33				
34	9	101156-100	Resistor, 5%, 1/4W 10	R131-931
35	18	100155-173	Resistor, 1%, " 61.9	R121-921, R122-922
36	9	-181	Resistor, " " 75	R125-925
37	9	101156-121	Resistor, 5%, " 120	R117-917
38	1	100067-121	Resistor, " 1W 120	R20
39	1	100155-213	Resistor, 1%, 1/4W 162	R29
40	3	101156-221	Resistor, 5%, " 220	R5,9,51
41	10	100142-221	Resistor, 2%, 1W 220	R26, R112-912
42	1	100155-234	Resistor, 1%, 1/4W 267	R73
43	1	100067-271	Resistor, 5%, 1W 270	R18
44	6	101156-331	Resistor, " 1/4W 330	R6,10,13,31,33,35
45	1	100064-391	Resistor, 5%, 1/2W 390	R28
46	5	101156-471	Resistor, " 1/4W 470	R15,19,40,47,52
47	3	100155-261	Resistor, 1%, " 511	R38,41,72
48	19	101156-561	Resistor, 5%, " 560	R74, R108-908, R109-909
49	1	100155-270	Resistor, 1%, " 634	R39
50				
51	37	101156-122	Resistor, 5%, 1/4W 1.2K	R17,22,25,30,32,44,53,57 R70,71, R103-903, R106-906
				R107-907
52				



MODULAR COMPUTER SYSTEMS

CODICE

T1210

REV.

E22

ASSEMBLY PART NUMBER

200739-001

PERKIN-ELMER  
Memory Products Division

MATERIAL LIST

ASSY. DATA ELECTRONICS PWB.  
40-45 IPS, DG, TYPE P

MODEL 10

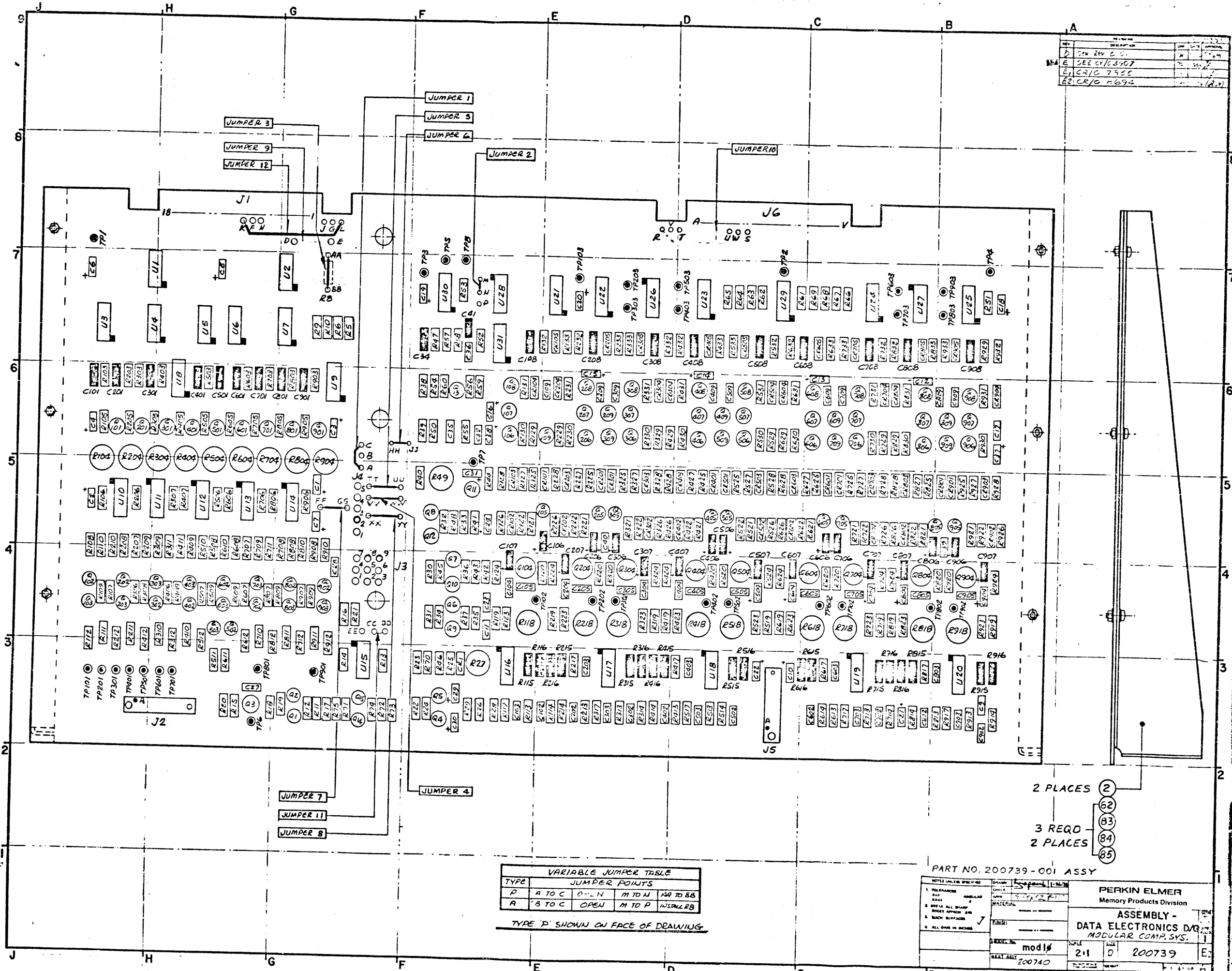
DATE 5-2-77 SHEET 3 OF 65

REV. L2  
ASSEMBLY PART NUMBER  
200739-001

ITEM	REQD	PART NO.	DESCRIPTION	REMARKS
53				
54	20	100155-317	Resistor, 1%, 1/4W 1.96K	R42,55, R120-920,R123-923
55	33	101156-242	Resistor, 5%, " 2.4K	R11,12,14,16,21,45 R105-905,R119-919,R124-924
56	1	100155-336	Resistor, 1%, 1/4W 3.09K	R43
57	41	101156-332	Resistor, 5%, " 3.3K	R24,54,56,60,75, R113-913 R114-914,R129-929,R133-933
58				
59	2	101156-472	Resistor, 5%, 1/4W 4.7K	R34,58
60	2	-512	Resistor, " " 5.1K	R48,50
61	20	-682	Resistor, " " 6.8K	R46,59,R110-910,R11-911
62	1	-822	Resistor, " " 8.2K	R23
63	18	-103	Resistor, " " 10K	R126-926, R127-927
64				
65	1	101156-183	Resistor, " " 18K	R36
66	9	-393	Resistor, " " 39K	R130-930
67	10	-683	Resistor, " " 68K	R37, R132-932
68	9	-104	Resistor, " " 100K	R61,62,63,64,65,66,67,68, , R69
69	9	101156-224	Resistor, " " 220K	R128-928
70	18	101156-334	Resistor, " " 330K	R115-915, R116-916
71	A/R	100248-924	Wire, Solid - Insulated	Jumper J1 A to C J2 M to N J3 AA to BB J4 VV to WW J5 TT to UU J6 HH to JJ J7 FF to GG J8 XX to YY J9 Not Used J10 Not Used J11 CC to DD J12 K to L



REV	DATE	BY	CHKD
D	04 24 64		
E	SEE CR 103407		
F	CR 10 7525		
G	CR 10 7694		



VARIABLE JUMPER TABLE

TYPE	A TO C	D - N	M TO N	N TO 88
P	A TO C	D - N	M TO N	N TO 88
A	B TO C	OPEN	M TO P	W/SMALL RB

TYPE 'P' SHOWN ON FACE OF DRAWING

- 2 PLACES (2)
- (62)
- 3 REQD (83)
- (84)
- 2 PLACES (85)

PART NO. 200739-001 ASSY

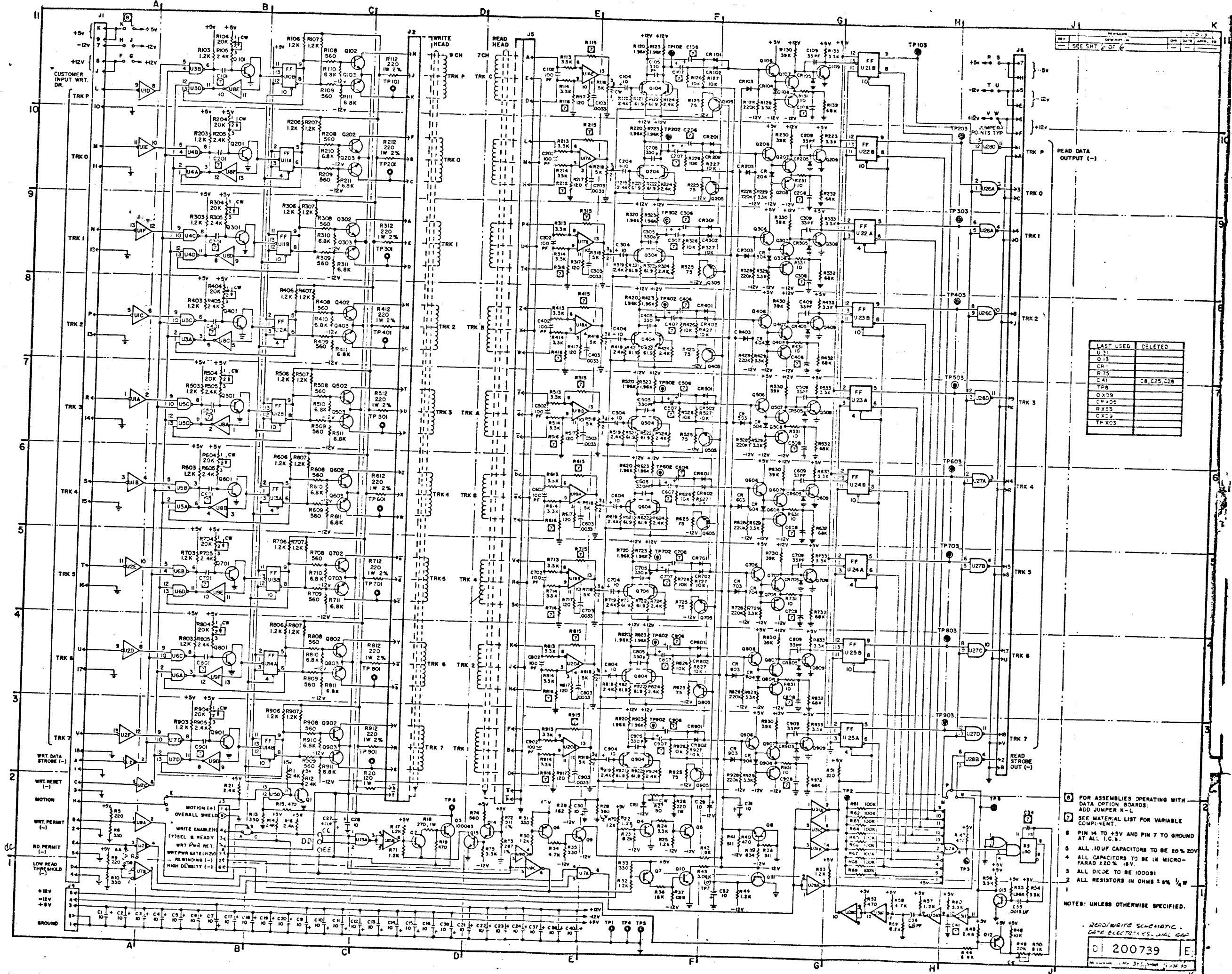
NOTES UNLESS SPECIFIED	DRIVER	CHILL	1-567
1. TOLERANCES	AREA	AREA	AREA
2. BRIDGE ALL SHOWN	BRIDGE APPROX 80%	BRIDGE APPROX 80%	BRIDGE APPROX 80%
3. BACK SURFACE			
4. ALL DIMS IN INCHES			

PERKIN ELMER  
Memory Products Division

ASSEMBLY -  
DATA ELECTRONICS DIV  
MODULAR COMP. SYS.

modif 2:1  
SCALE 2:1  
PART NO. 200739  
NEXT ASSY 200740

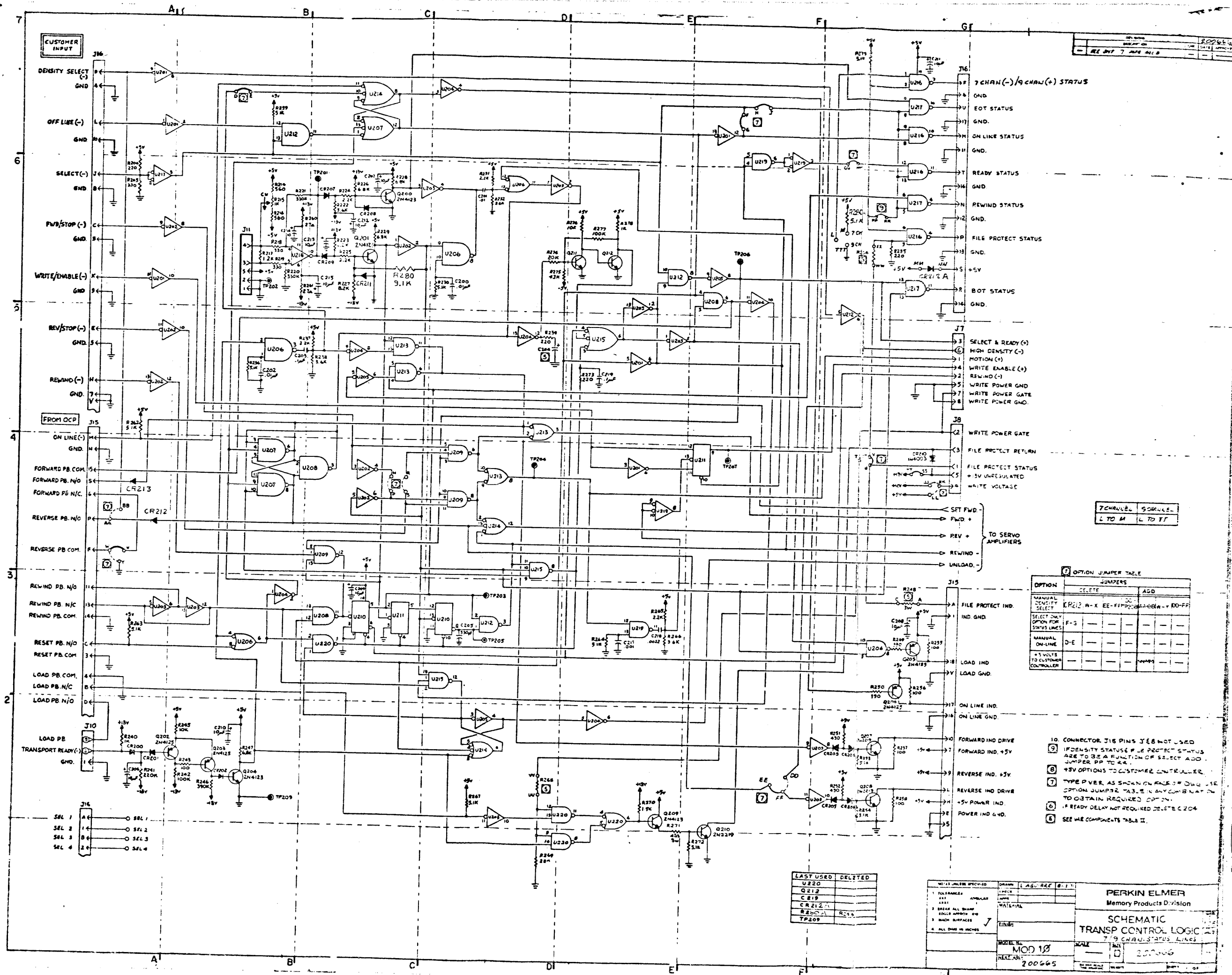
SIMILAR TO 200581



LAST USED	DELETED
U 31	
Q 13	
CR 1	
R 75	
C 41	CB, C25, C26
TP 8	
Q 209	
CR 205	
C 232	
TP 203	

- 1 FOR ASSEMBLIES OPERATING WITH DATA OPTION BOARDS: ADD JUMPER K-L
  - 2 SEE MATERIAL LIST FOR VARIABLE COMPONENT.
  - 3 PIN 14 TO +5V AND PIN 7 TO GROUND AT ALL I.C.'S
  - 4 ALL .10UF CAPACITORS TO BE 20% 20V
  - 5 ALL CAPACITORS TO BE IN MICRO-FARAD ±20% 18V.
  - 6 ALL DIODES TO BE 1000P1
  - 7 ALL RESISTORS IN OHMS ±5% 1/4W
- NOTES: UNLESS OTHERWISE SPECIFIED.

SCHEMATIC TRANS CONTROL LOGIC



7 CHANNEL SCHEMATIC  
L TO M L TO T

OPTION JUMPER TABLE

OPTION	DELETE	ADD
MANUAL DENSITY SELECT	CR212 W-X	EE-FFFF
SELECT ONLY OPTION FOR STATUS LINES	F-5	
MANUAL ON-LINE	D-E	
+5V TO CUSTOMER CONTROLLER		W-W-W-W

- 10 CONNECTOR J16 PINS J & B NOT USED
- 9 IF DENSITY STATUS & FILE PROTECT STATUS ARE TO BE A FUNCTION OF SELECT ADD JUMPER PP TO R4.
- 8 +5V OPTIONS TO CUSTOMER CONTROLLER.
- 7 TYPE POWER AS SHOWN ON FACE OF DWG. USE OPTION JUMPER TABLE IN ANY COMBINATION TO OBTAIN REQUIRED OPTION.
- 6 IF READY DELAY NOT REQUIRED DELETE C204
- 5 SEE THE COMPONENTS TABLE II.

LAST USED DELETED

U220	
Q212	
CR212	
CR213	
R201	
R215	
TP209	

NO. 13 JUMPER SPEC'D

1. DIMENSIONS  
2. BREAK ALL DIMS  
3. MACH SURFACES  
4. ALL DIMS IN INCHES

DRAWN: L. A. G. 222  
DATE: 8-71

PERKIN ELMER  
Memory Products Division

SCHEMATIC  
TRANS CONTROL LOGIC  
7/9 CHAN. STATUS LINES

MODIFIED: MOD 108  
RELEASED: 200665

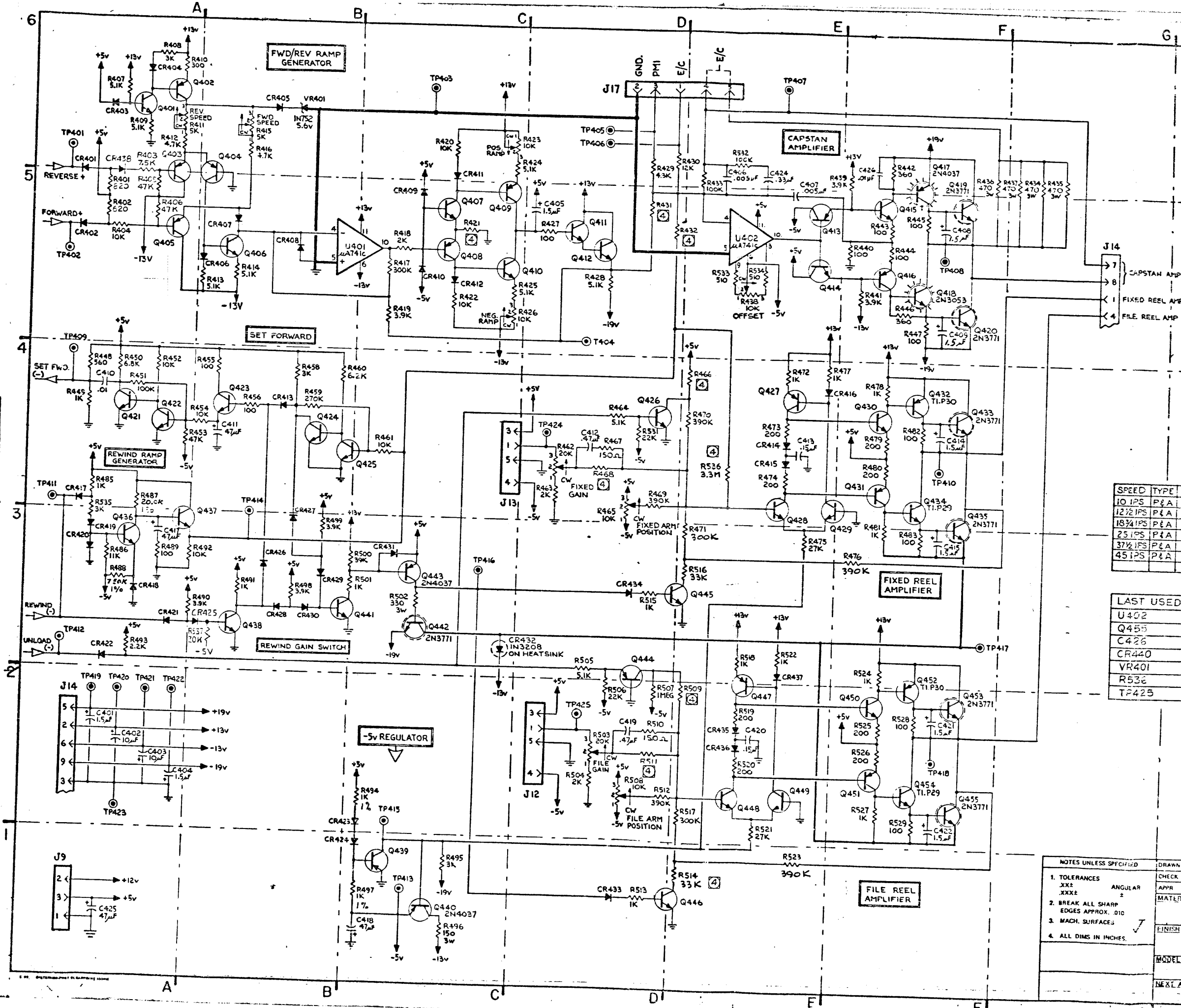
PERKIN ELMER  
Memory Products Division

SCHEMATIC  
TRANS CONTROL LOGIC  
7/9 CHAN. STATUS LINES

MODIFIED: MOD 108  
RELEASED: 200665



REV.	DESCRIPTION	CHK.	DATE	APPROVE
1	SEE SMT 7 (A/FG FELD)		1/27/70	



VARIABLE COMPONENTS TABLE I

SPEED	TYPE	R421	R431	R432	R465	R509	R536	R468	R511
10 IPS	P4A	33K	120K	2K	680K	1.5M	3.3M	390K	390K
12 1/2 IPS	P4A	27K	100K	12K	680K	1.5M	3.3M	390K	390K
18 1/4 IPS	P4A	18K	68K	13K	680K	1.5M	3.3M	390K	390K
25 IPS	P4A	15K	51K	13K	680K	1.5M	3.3M	390K	390K
37 1/2 IPS	P4A	10K	33K	15K	300K	680K	OMIT	390K	390K
45 IPS	P4A	9.1K	27K	15K	300K	680K	3.3K	390K	390K

LAST USED	DELETED
U402	
Q455	
C426	C416, 423
CR440	CR433, 440
VR401	
R536	R457, 484, 530
TP425	

- 4 SEE VARIABLE COMPONENTS TABLE I.  
 2. ALL DIODES ARE IN914  
 2. ALL PNP TRANSISTORS ARE 2N4125  
 1. ALL NPN TRANSISTORS ARE 2N4123

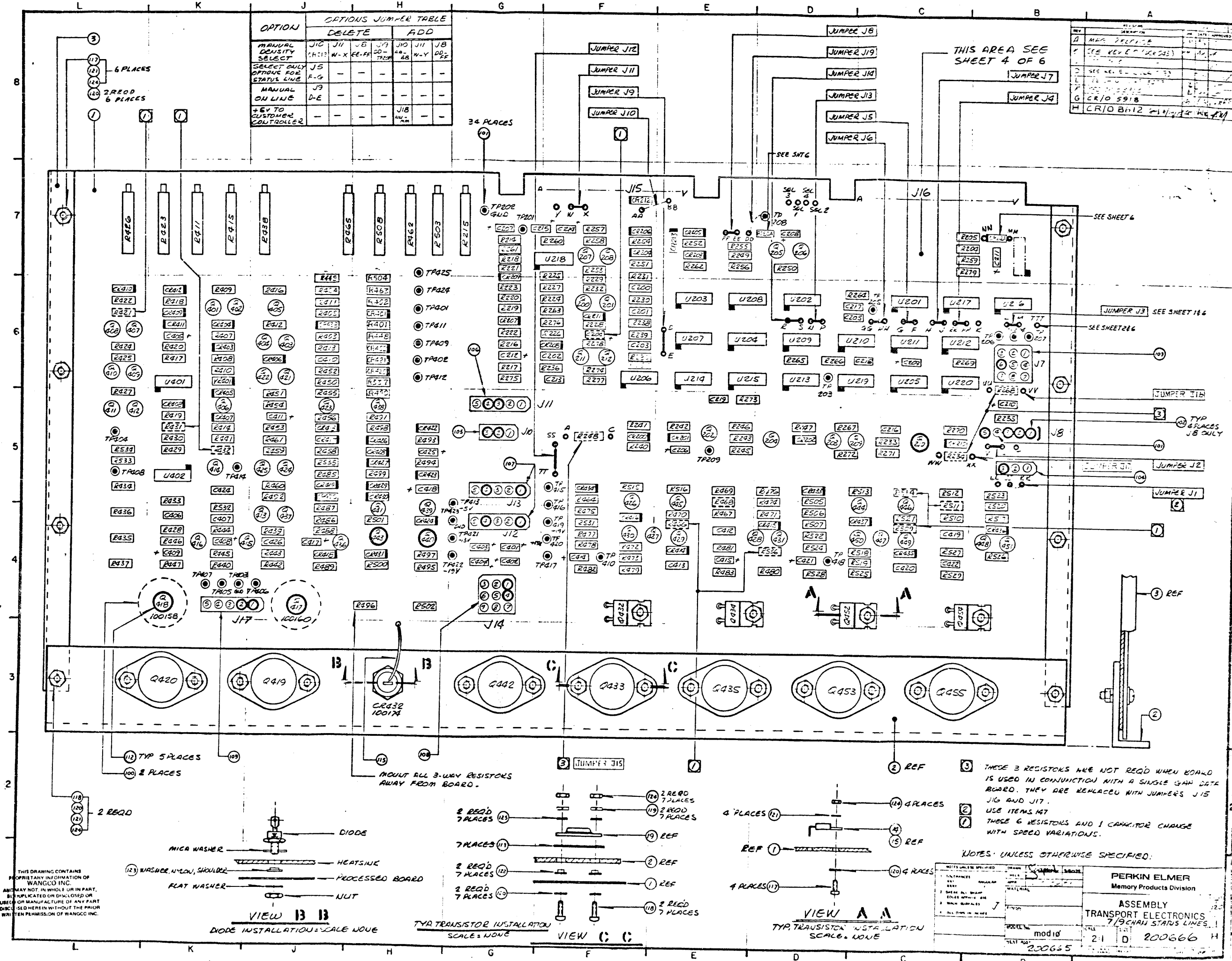
NOTES: UNLESS OTHERWISE SPECIFIED

NOTES UNLESS SPECIFIED 1. TOLERANCES XXXX ANGULAR ± 2. BREAK ALL SHARP EDGES APPROX. .010 3. MACH. SURFACES 4. ALL DIMS IN INCHES.	DRAWN: MORGAN D. 7/22/70 CHECK: [Signature] 1/27/70 APPR: [Signature] 8/11/70 MATERIAL: FINISH:	<b>PERKIN-ELMER</b> Memory Products Division ASSY. TRANS. ELECT. PWB. SCHEMATIC, SERVO AMPLIFIER 7/9 CHANNEL STATUS LINES MODEL No. 10 NEXT ASSY. 200665	SCALE: D SIZE: 200666 SHEET: 1 OF 1
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ASSY. TRANS. PORT ELECTRONICS

OPTION	OPTIONAL JUMPER TABLE							
	DELETE				ADD			
MANUAL DENSITY SELECT	J10	J11	J8	J9	J10	J11	J8	J9
SELECT ONLY OPTION FOR STATUS LINE	CR10	W-X	EE-FF	TP200	AA-BB	MM-NN	DD-EE	FF
MANUAL ON LINE	J9							
+5V TO CUSTOMER CONTROLLER					J18			

REV	DESCRIPTION	DATE	APPROVED
A	MANUFACTURING		
B	SEE KEY (CR10)		
C	SEE KEY (W-X)		
D	SEE KEY (EE-FF)		
E	SEE KEY (TP200)		
F	SEE KEY (AA-BB)		
G	CR10 5918		
H	CR10 B-12		



THIS AREA SEE SHEET 4 OF 6

JUMPER J3 SEE SHEET 166

SEE SHEET 266

JUMPER J16

TYP 6 PLACES JB ONLY

JUMPER J8

JUMPER J2

JUMPER J1

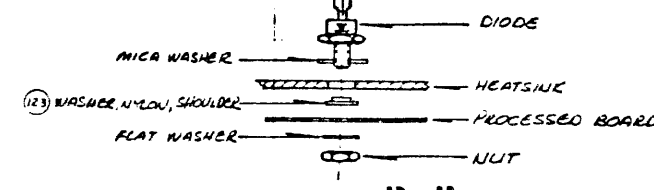
REF

3 THESE 3 RESISTORS ARE NOT REQD WHEN BOARD IS USED IN CONJUNCTION WITH A SINGLE CHAN DATA BOARD. THEY ARE REPLACED WITH JUMPER J15 J16 AND J17.

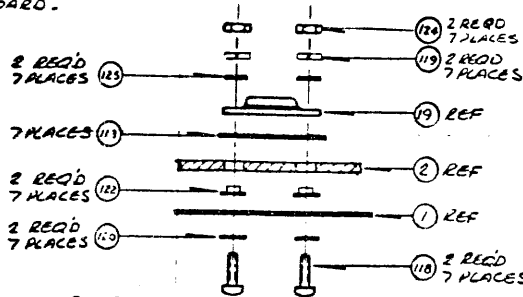
2 USE ITEMS 147

7 THESE 6 RESISTORS AND 1 CAPACITOR CHANGE WITH SPEED VARIATIONS.

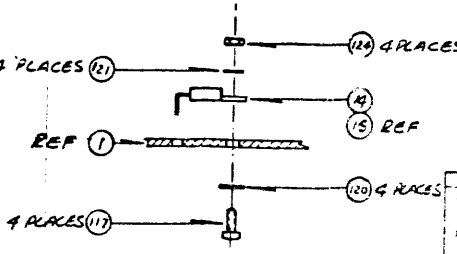
NOTES - UNLESS OTHERWISE SPECIFIED:



VIEW B B DIODE INSTALLATION SCALE NONE



VIEW C C TYP TRANSISTOR INSTALLATION SCALE NONE



VIEW A A TYP TRANSISTOR INSTALLATION SCALE NONE

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PERKIN ELMER  
Memory Products Division

ASSEMBLY  
TRANSPORT ELECTRONICS  
7/9 CHANN STATUS LINES

mod 10  
21 D 200666 H  
200665



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