DATA DISC

OPERATION AND MAINTENANCE MANUAL
FOR
BRIGHT MODEL 2750
MAGNETIC TAPE UNIT

MANUAL NO. 9580061-00

END-ITEM MODEL NO. ______

END-ITEM PART NO. ______

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OPERATION AND MAINTENANCE MANUAL FOR

BRIGHT MODEL 2750 MAGNETIC TAPE UNIT

DATA DISC

686 WEST MAUDE AVENUE

SUNNYVALE, CALIFORNIA 94086

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INTRODUCTION

This manual describes the Bright Model 2750 Magnetic Tape Unit manufactured by Data Disc Inc., 686 West Maude Avenue, Sunnyvale, California. The Model 2750 is a 10½-inch reel, dual vacuum column, digital magnetic tape unit that reads and writes ANSI and IBM compatible formats using either NRZI or phase encoded (PE) methods.

The manual is divided into six chapters as follows:

Chapter 1 – General Information
Chapter 2 – Installation
Chapter 3 – Operation
Chapter 4 – Principles of Operation
Chapter 5 – Maintenance
Chapter 6 – Drawings and Parts Lists

Refer to the introduction of each chapter for a detailed description of the contents of the specific chapter.

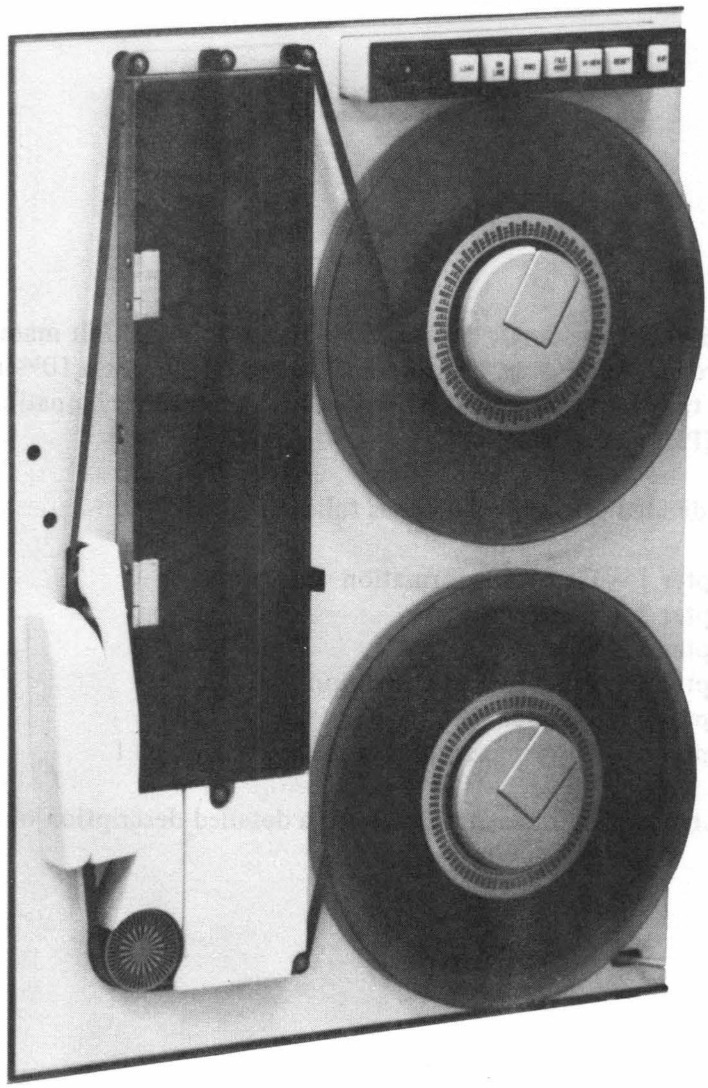


Figure 1-1. Model 2750 Magnetic Tape Unit

Chapter 1
GENERAL INFORMATION

1-1 INTRODUCTION

This chapter contains a description of the Bright Model 2750 Magnetic Tape Unit, its internal components and the optional equipment, interface configurations and accessories available on the unit. The Bright Model 2750 is manufactured by Data Disc, Incorporated, Sunnyvale, California. Performance specifications and equipment characteristics pertaining to the Model 2750 are listed at the end of the chapter.

1-2 GENERAL DESCRIPTION

The Bright Model 2750 is a highly reliable, dual vacuum column, digital magnetic tape drive. See figure 1-1. The Model 2750 reads and writes data in ANSI and IBM compatible formats using either NRZI or phase encoded (PE) methods. Data is recorded on either 7-track or 9-track tapes at various tape speeds in the range of 25 to 75 inches per second (ips). Dual speed tape units are also available in this range. Magnetic tape recorded on the Model 2750 can be read on any other ANSI or IBM compatible tape unit. Also, the Model 2750 can read 7-track or 9-track tapes recorded on any other ANSI or IBM compatible tape unit. The tape unit uses maximum 10½-inch diameter tape reels.

The Model 2750 Magnetic Tape Unit uses either a single gap read/write head, or dual gap, simultaneous read and write heads. A separate erase head is always mounted ahead of the write head. A wide choice of other standard options pertaining to bit densities and other features are available on the Model 2750. Options are described in paragraph 1-4.

The tape unit is designed specifically for remote control of the read, write, forward, reverse, rewind, and packing density select functions. Up to four Model 2750 Tape Units can be daisy-chained and individually addressed by the same external controller.

1-3 PHYSICAL DESCRIPTION

The components of the Model 2750 Magnetic Tape Unit are mounted on a precision machined tape unit baseplate. All tape handling components, the heads and the operator controls are located on the front of the baseplate. A dust cover, mounted on the front of the baseplate, protects the tape and tape handling components from contaminants during operation. All operator controls are accessible through the front of the dust cover. The capstan motor, reel servo motors, vacuum components, and all other mechanical and electromechanical components are mounted on the back of the tape unit baseplate. Refer to figures 1-2 and 1-3.

The control and data electronics are mounted on circuit boards attached to a frame that is hinged to the back of the tape unit baseplate. Figure 1-2 shows a single or dual-density (NRZI) tape unit and figure 1-3 shows a quad-density tape unit. All external control and signal cables connect directly to the edge

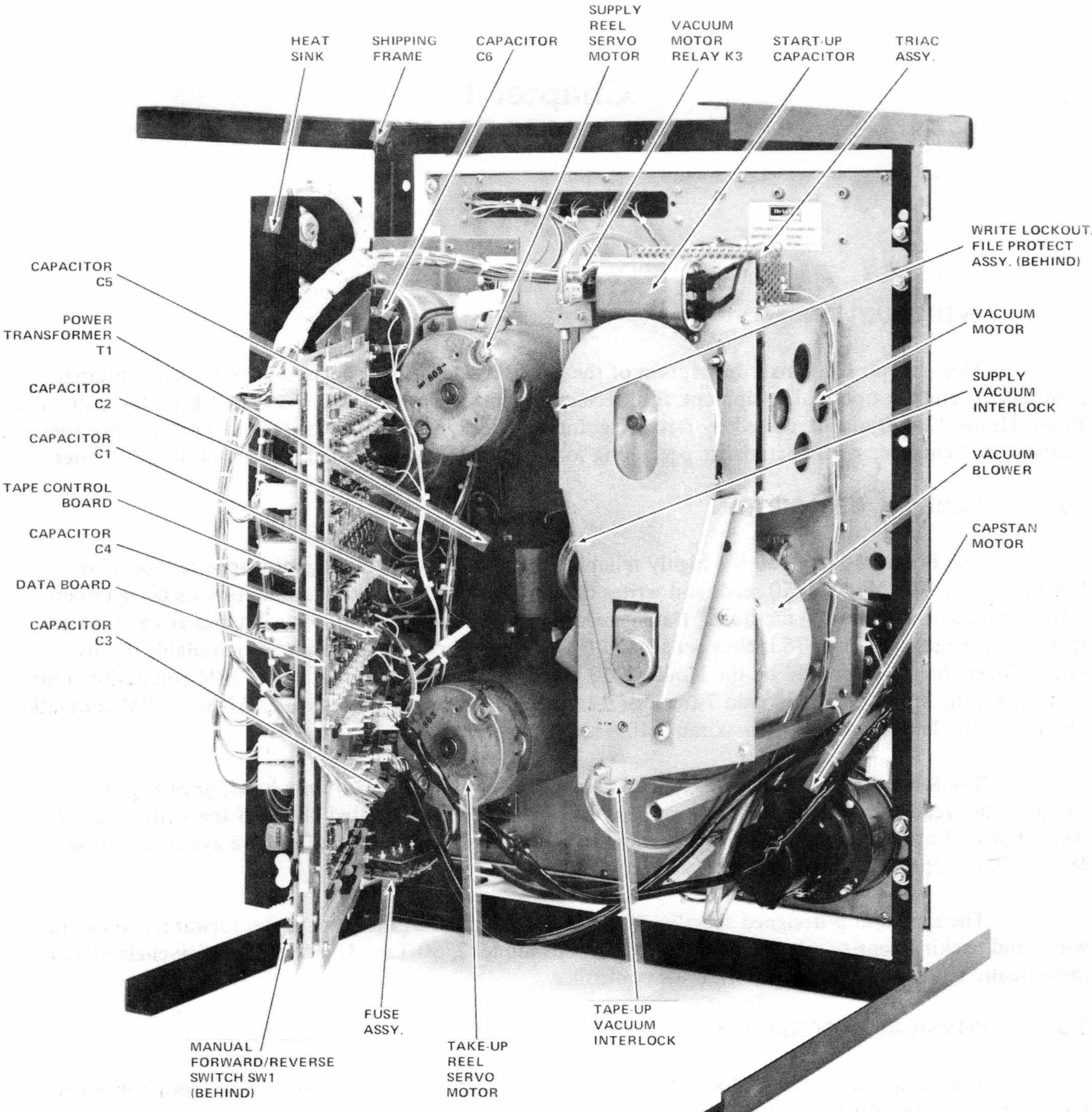


Figure 1-2. Open View of Model 2750 Magnetic Tape Unit with Single Data Board

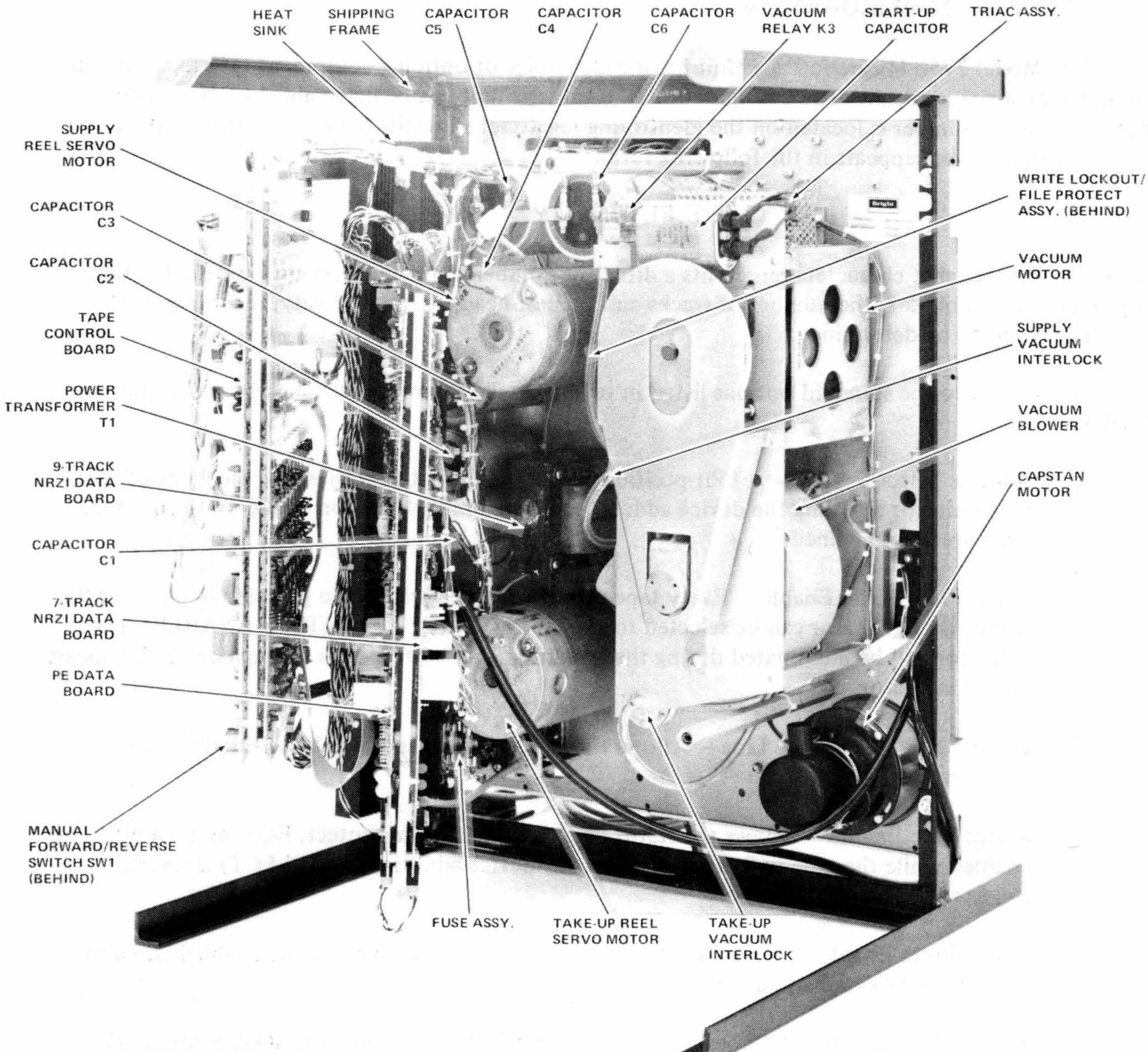


Figure 1-3. Open View of Quad-Density Model 2750 Magnetic Tape Unit (Three Data Boards)

connectors of the two circuit baords. The control and data electronics are described in Chapter 4, Principles of Operation. Cables are discussed in Chapter 2, Installation.

1-4 OPTIONAL CONFIGURATIONS

The Model 2750 Magnetic Tape Unit has a wide choice of optional equipment interface configurations and accessories available. The configuration of each tape unit can be determined by the model number. The model number is located on the identifying tag attached to the back of the tape unit baseplate. The model number appears in the following form:

MODEL 275W-XYZ

where each of the alphabet characters represents a different number. The numbers are identified in table 1-1. By referring to table 1-1, the number of tracks and type of head, packing density, recording method and tape speeds can all be determined.

In addition to the standard options listed in table 1-1, the following options and accessories are also available:

1. Address Select Switch – A four-position thumbwheel switch, located on the front of the tape unit, for selecting the device address of a tape unit installation where up to four tape units are daisy-chained.

2. File Protect/Write Enable -- Every tape unit is equipped with write protect circuits, but the front panel indicator can be selected to read FILE PROTECT or WRITE ENABLE. The indicator will be illuminated during the condition that corresponds to the name that appears on the indicator.

3. Density Select Interface Line – Allows the bit density or speed to be selected via the interface.

4. Status Line Enable – Allows the status lines (rewinding, file protect, BOT, and ready) to be enabled while the tape unit is off-line, but the device address line (SELECT) is asserted (selected).

5. Status Lines Enable – Allows all status lines from the data boards to be enabled when the tape unit is selected and off-line.

6. Status Lines Enable –Allows the status lines (rewinding, file protect, BOT, ready, EOT, high density, and on-line) to be enabled when the tape unit is not selected or on-line.

7. Rewind Status Output – Outputs a signal indicating the tape unit is rewinding while the tape unit is on-line but not selected.

8. EOT Status (EOTS) – An interface line that is asserted when the EOT tab passes the tab sensor. This line remains asserted until the tape is rewound or passes the EOT tab in reverse.

9. Single or Double Load – Two different tape loading modes. In tape units equipped with single load circuits, the tape is tensioned and advanced to BOT marker all in one continuous

TABLE 1-1. OPTIONAL CONFIGURATION IDENTIFICATION LIST

The Model Number 275W-XYZ designates equipment configuration as shown here	
W – NUMBER OF TRACKS	X – HEAD CONFIGURATION
7 seven-track head 8 seven-track/nine-track read-read head 9 nine-track head	1 dual-track head 2 single track head
	Y – PACKING DENSITY AND RECORDING METHOD
	Single Density 8 800 BPI (NRZI, 7- or 9-track) 6 1600 BPI (PE, 9-track) **Dual Density** 7 800/1600 BPI (NRZI and PE, 9-track) 5 800/556 BPI (NRZI, 7-track) 4 556/200 BPI (NRZI, 7-track) 3 800/200 BPI (NRZI, 7-track) **Quad Density** 3 1600/800 BPI (PE and NRZI, 9-track) 800/556 BPI (NRZI, 7-track) 2 1600/800 BPI (PE and NRZI, 9-track) 800/200 BPI (NRZI, 7-track) 1 1600/800 BPI (PE and NRZI, 9-track) 556/200 BPI (NRZI, 7-track)
	Z – TAPE SPEEDS*
	1 75 ips 2 75/37.5 ips 3 75/45 ips 4 75/56¼ ips

*Tape units are available for both single speed and dual-speed in the range of 25 to 75 ips.

sequence. With double load circuits, tape is tensioned first, then the operator must press a control switch to cause the tape to advance to BOT. The double load sequence allows the operator to verify that the tape has been threaded and seated in tape guides properly, before the tape is advanced to BOT.

10. Automatic Load/On Line – An optional circuit that automatically places the tape unit on line after the tape unit has been loaded (single or double load) and the tape reaches the BOT marker, provided that a rewind operation has not been initiated.

11. Unload – Allows a tape unloading sequence to be initiated from a remote controller.

There are numerous other detail configurations of interfacing, control, and data signals that can be specified for different applications.

TABLE 1-2. PERFORMANCE SPECIFICATIONS AND EQUIPMENT CHARACTERISTICS

CHARACTERISTIC	VALUE
Type of Tape Storage	Vacuum Chamber – Linear servo driven.
Recording Mode	NRZI or Phase Encoded – IBM and ANSI compatible.
Number of Tracks	7 or 9
Head Configuration	Single or Dual Stack
Bit Density	200, 556, 800, 1600 BPI
Tape Speed	Various speeds in range of 25 to 75 ips.
Rewind Speed	250 ips
Data Transfer Rate	120,000 characters per second, maximum.
Speed Variation: Instantaneous Average	±3% ±1%
Start/Stop Time (milliseconds)	375/tape speed (ips)
Start/Stop Displacement	0.190 (±0.02) inches
Skew: Write (NRZI) Read Dynamic	Electronically compensated 100 μinches, maximum 75 μinches, maximum
Tape Tension	8.0 (±0.5) ounces
Reel Size	10.5 inches, maximum
Tape Type (IBM P/N 457892 or equivalent): Width Thickness	Computer Grade 0.5 inch 1.5 mil
Beginning of Tape (BOT) and End of Tape (EOT) Detectors	Photoelectric, IBM compatible spacing.
Tape Cleaner	Perforated Plate type
Read Thresholds	NRZ: 12%, 25%, and 45% selectable remotely. PE: 5%, 15%, and 30% selectable remotely.
Input Signal Parameters: Asserted (True) Not Asserted (False)	0.0 to +0.4 volt +2.5 to +5.0 volts
Output Signal Parameters: Asserted (True) Not Asserted (False)	 40 mA maximum current sink Open collector
Power Requirements: Line Frequency Line Voltage	48 to 62 Hz 95–125 Vac ± 10% (in 5 steps) 190–250 Vac ± 10% (in 10 steps)
Power Consumption	800 watts maximum

TABLE 1-2. PERFORMANCE SPECIFICATIONS AND EQUIPMENT CHARACTERISTICS (continued)

CHARACTERISTIC	VALUE
Environment:	
Temperature, Operating	30°F to 122°F
Storage	–50°F to 160°F
Humidity	15% to 95% without condensation
Altitude	0 to 10,000 feet
Dimensions:	
Height	24 inches
Width	19 inches
Depth, overall	15.4 inches
Depth, from mounting surface	12 inches
Weight	120 pounds, maximum
Daisy-Chaining	Built-in provision

Chapter 2
INSTALLATION

2-1 INTRODUCTION

This chapter contains information pertaining to the installation of the Model 2750 Magnetic Tape Unit. Included are the instructions and data necessary to plan and complete the installation of the tape unit up to the point at which the tape unit has been checked out and is ready for normal operation.

2-2 INSTALLATION PLANNING

2-3 Equipment Location

The Model 2750 Magnetic Tape Unit may be located adjacent to any other electronic data processing equipment provided the temperature, humidity, and other environmental characteristics are within specified limits. Refer to table 1-2, Performance Standards and Equipment Characteristics, for the environmental characteristics of the tape unit. The tape unit should not be located in a strong magnetic field because the recording head assemblies and other components can become magnetized causing interference with the read/write operation. To obtain optimum performance from the tape unit the ambient temperature fluctuation should be kept as small as possible and a reasonably clean and dust-free environment should be provided. It is also important that a free flow of air is allowed around the tape unit and through the rack in which the tape unit is mounted.

The magnetic tape unit is designed to be mounted in a standard 19-inch electronic equipment rack cabinet. The tape unit requires 24 inches of vertical rack space. When the tape unit is mounted, the rack should be located on a firm, vibration-free surface. See figure 2-1 for mounting dimensions on the Model 2750.

2-4 Cabling Considerations

The Model 2750 Magnetic Tape Unit is shipped with all internal interconnect cabling completed. All external data and control interface signal cabling, and primary AC power connections must be completed in the field at the time of installation. Refer to figures 2-2, 2-3, and 2-4 for typical cabling diagrams. No external grounding straps or other ground devices are required in addition to the ground lead in the primary AC power input cable.

The data and control cables connecting the tape unit and the external formatter must be fabricated. Instructions for fabricating these cables are contained in paragraph 2-7. Two data cables, one input and one output, and one control cable must be fabricated. The total length of the fabricated data and control cables must not exceed 20 feet.

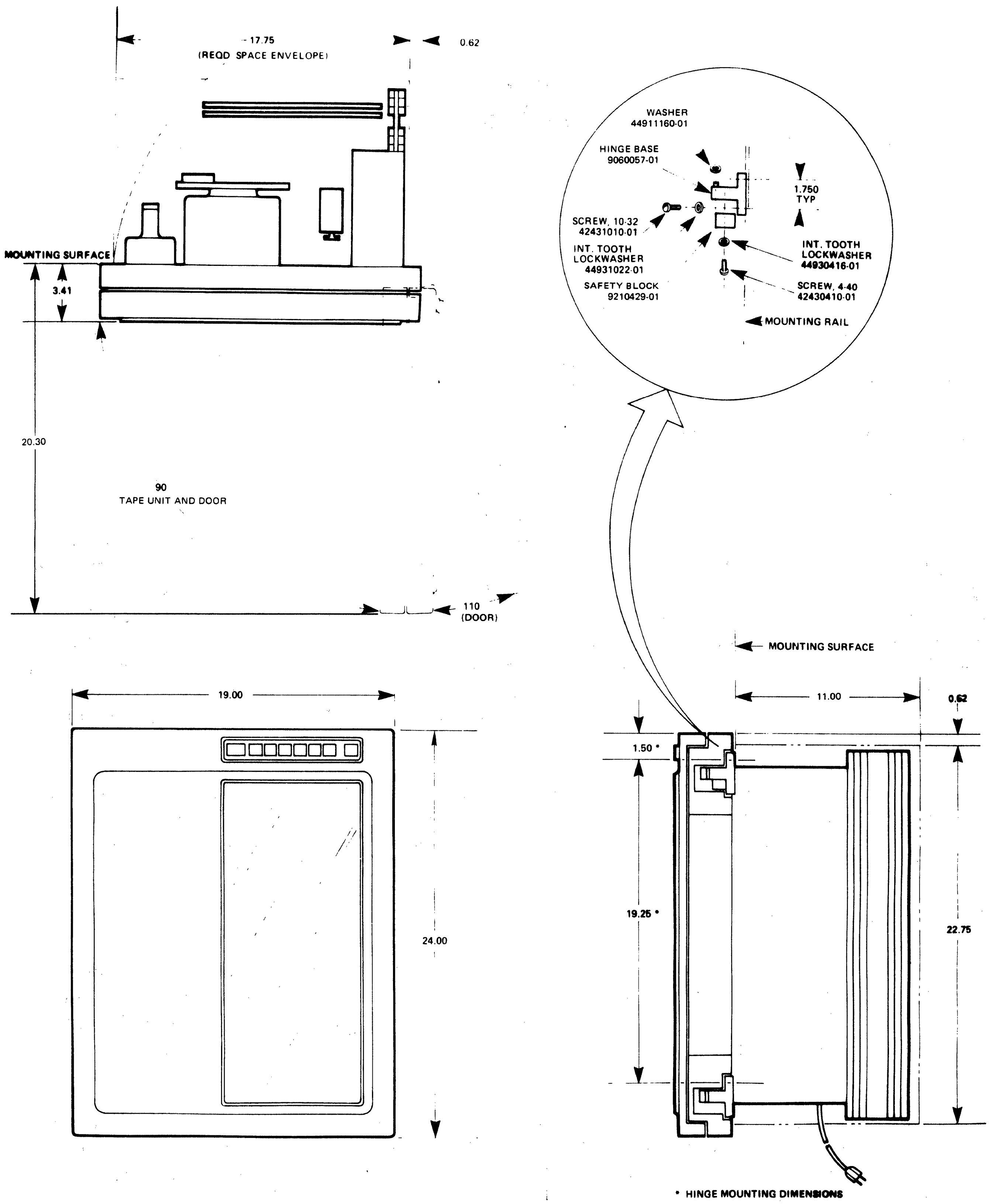


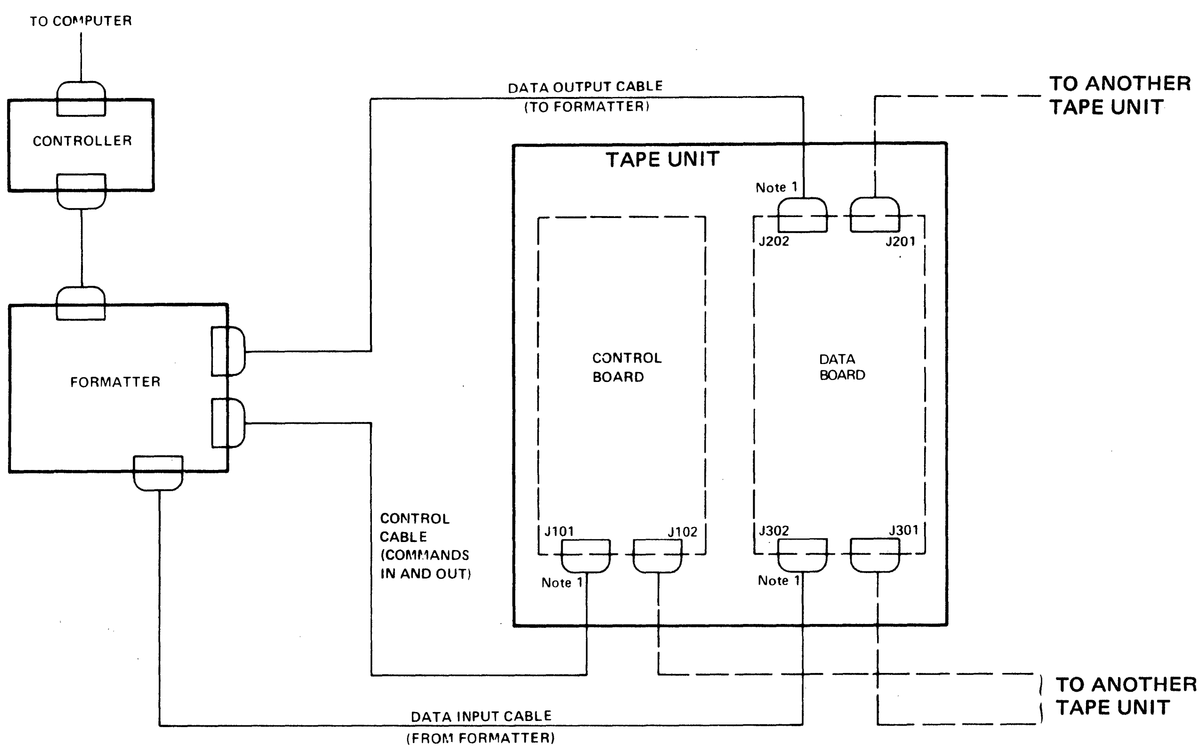
Figure 2-1. Installation Mounting Dimensions for the Model 2750 Magnetic Tape Unit

Data input and output lines connect to edge connectors J302 and J202, respectively, on the data electronics circuit board. Refer to figure 2-2. The data electronics circuit board may be accessed by swinging the electronic card rack out from the tape unit. A single quarter-turn fastener at the lower right corner of the card rack secures the card rack to the tape unit baseplate. The control cable connects to edge connector J101 on the bottom of the tape control logic electronic circuit board. The tape control logic electronic circuit card is mounted on the outside of the electronic card rack.

Figure 2-3 shows a typical cabling diagram for a PE/NRZI dual density tape unit. In addition to the control board, this unit uses one PE data board and one NRZI data board. Figure 2-4 shows a typical cabling diagram for a quad density tape unit. In addition to the control board and PE data board on this unit, two NRZI data boards are used.

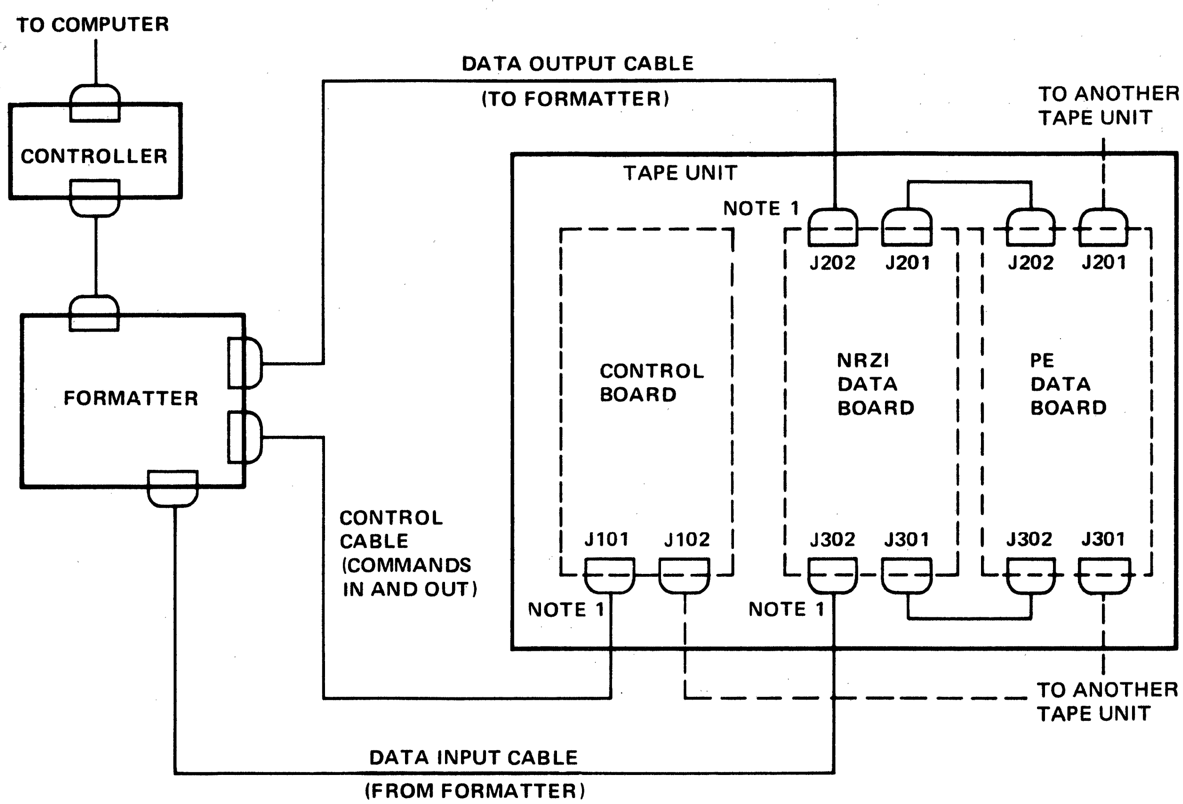
2-5 Cabling for Daisy-Chained Configurations

If several tape units are to be connected in a daisy-chain configuration, the cabling is to be as shown in figure 2-5. The additional circuit card edge connectors must be ordered and cables must be fabricated. The total length of all sets of data or control cables cannot exceed 20 feet. All tape units have the auxiliary data and control signal output connectors, so that no equipment modifications have to be performed. However, the signal line terminating resistors normally installed on all units at the factory must be removed on all except the last unit in the daisy-chain. These resistor networks are 220/330 DIP type and their location is shown in figure 2-5. Figure 2-6 shows a schematic of the resistor networks.



Note 1: Mating Connector ELCO 00-6007-036-980-002 (Supplied)

Figure 2-2. Typical Cabling Diagram (Single Density)



NOTE 1: MATING CONNECTOR ELCO 00-6007-036-980-002 (SUPPLIED)

Figure 2-3. Typical Cabling Diagram (PE/NRZI Dual Density)

2-6 Interface Circuits

The tape unit data board drivers and receivers are shown in figure 2-6. The interface must be compatible with these circuits in order for the tape unit to function correctly.

Logic Levels are:	Asserted (True)	0.0 to +0.4 Vdc
	Not Asserted (False)	+2.5 to +5.0 Vdc

2-7 Cable Fabrication

The interface is designed for twisted pair cables with returns grounded. The wire should be 26 AWG with thin insulation and twisted about 30 turns/foot. The maximum length can be 20 feet. The twisted pairs should be grounded within a few inches of the driver and receiver.

The mating connector is ELCO 00-6007-036-980-002 or equivalent. All connector pin assignments are contained in tables 2-1, 2-2, and 2-3.

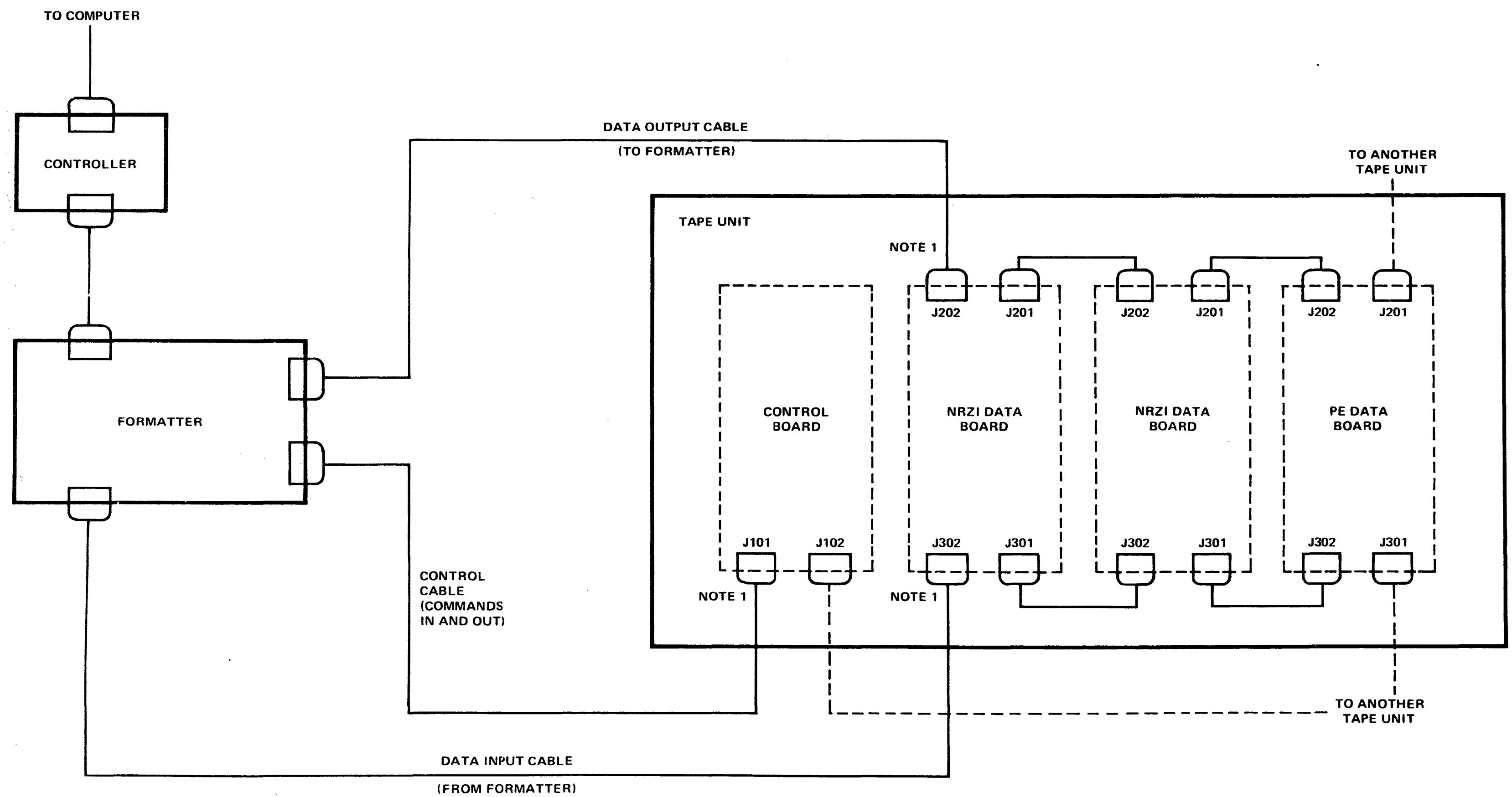
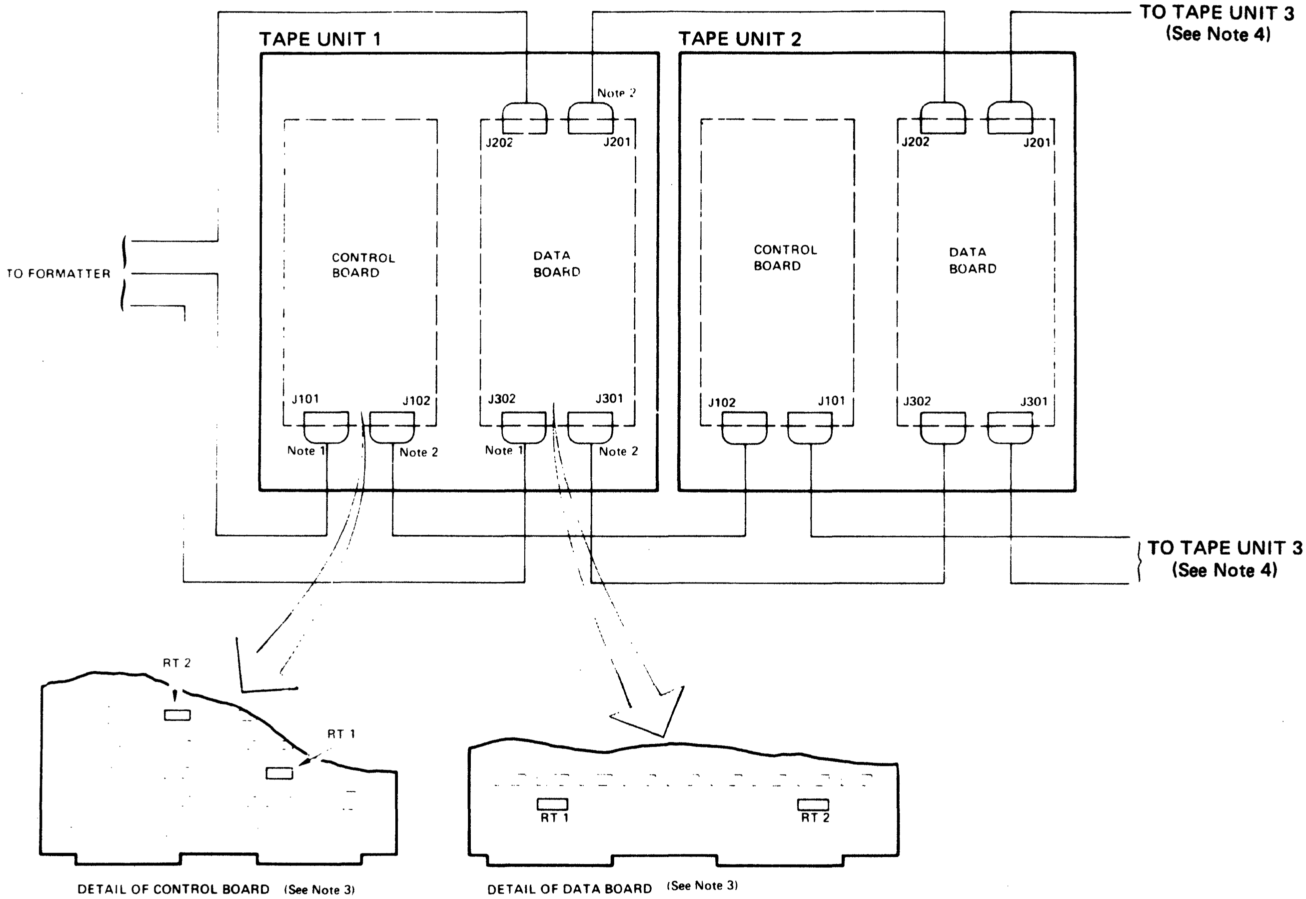


Figure 2-4. Typical Cabling Diagram (Quad Density)



Note 1:	*Same as on Figure 2-2*
Note 2:	*Mating Connector - same as Note 1, but not supplied*
Note 3:	*Terminating resistor (Part No. 04600001 - 02) networks are to be removed from all except the last tape unit in the daisy-chain*
Note 4:	*Up to four tape units may be daisy-chained*

Figure 2-5. Typical Cabling Diagram for Daisy-Chained Installations

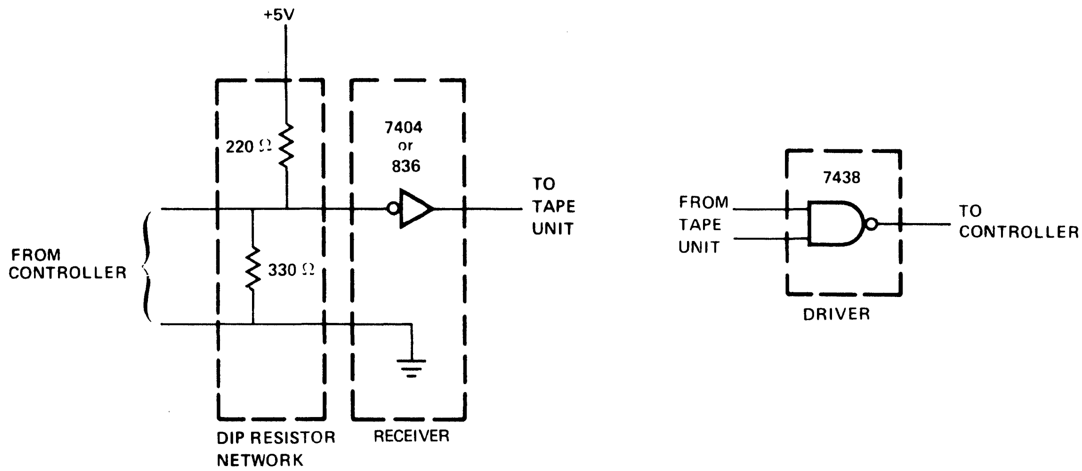


Figure 2-6. Tape Unit Interface Circuits

TABLE 2-1. TAPE UNIT CONTROL AND STATUS CONNECTIONS (J101, J102)

SIGNAL CONNECTOR PIN	GROUND CONNECTOR PIN	SIGNAL NOMENCLATURE
	COMMAND INPUTS	
J	8	ISELECT 0
A	8	ISELECT 1
18	8	ISELECT 2
V	8	ISELECT 3
C	3	ISFC (Forward)
E	5	ISRC (Reverse)
H	7	IREW (Rewind)
L	10	IOFFL (Off Line)
K	9	ISWRT (Set Write)
B	2	IOVW (Overwrite)
D	4	*IDDS (Density Select)
	COMMAND OUTPUTS	
T	16	IRDY (Ready)
M	11	IONL (On Line)
N	12	IRWD (Rewinding)

*Indicates tape unit option.

TABLE 2-1. TAPE UNIT CONTROL AND STATUS CONNECTIONS (J101, J102) (continued)

SIGNAL CONNECTOR PIN	GROUND CONNECTOR PIN	SIGNAL NOMENCLATURE
COMMAND OUTPUTS (continued)		
U	17	IEOT (EOT)
R	14	IBOT (BOT)
P	13	IFPT (File Protect)
F	6	IDDI (High Density)

TABLE 2-2. TAPE UNIT DATA INPUT/OUTPUT CONNECTIONS (J201, J202)

SIGNAL CONNECTOR PIN	GROUND CONNECTOR PIN	SIGNAL NOMENCLATURE
DATA OUTPUTS		
2	B	Read Data Strobe
1	A	Read Data Parity
3	C	Read Data 0
4	D	Read Data 1
8	J	Read Data 2
9	K	Read Data 3
14	R	Read Data 4
15	S	Read Data 5
17	U	Read Data 6
18	V	Read Data 7
11	M	Seven-Track
12	N	Single Stack
10	L	NRZ
13	P	Speed

NOTE: Read Data 0 and 1 are not used on seven-track tape unit.

TABLE 2-3. TAPE UNIT DATA INPUT/OUTPUT CONNECTIONS (J301, J302)

SIGNAL CONNECTOR PIN	GROUND CONNECTOR PIN	SIGNAL NOMENCLATURE
	DATA INPUTS	
E	5	Read Threshold 1
F	6	Read Threshold 2
A	1	Data Ready
C	3	LRC Strobe
L	10	Write Data Parity
M	11	Write Data 0
N	12	Write Data 1
P	13	Write Data 2
R	14	Write Data 3
S	15	Write Data 4
T	16	Write Data 5
U	17	Write Data 6
V	18	Write Data 7

NOTE: Write Data 0 and 1 are not used on seven-track tape units.

2-8 INSTALLATION

2-9 Unpacking and Inspection

The tape unit is shipped in a special double packing case, which should be saved if reshipment of the equipment is planned. Within the packing case the tape transport is attached to a shipping frame with three bolts. The shipping frame will hold the tape unit upright when the unit is removed from the packing case and placed on a level surface. There is also a separate shipping kit contained in the packing case. The shipping kit contains the rack mounting hardware for the tape transport and other necessary parts.

As the equipment is unpacked, care should be exercised to prevent damage to the finished surfaces of the tape unit and all parts should be inspected for evidence of damage during shipment. If the packing case or any tape unit parts are damaged, advise Data Disc, Incorporated, and file a claim with the transfer company. The crated weight of the tape unit is approximately 150 pounds. The following procedures should be followed for unpacking and inspecting the tape unit.

a. Inspect the packing case for evidence of in-transit damage. Contact the transfer company and Data Disc if damage is evident. Specify nature and extent of damage.

CAUTION

The tape unit weighs over 100 pounds, and should be lifted by at least two persons.

b. Open the outer and inner packing case and remove the contents. Check items removed from the shipping list to verify packing case contents. Contact Data Disc in the event of a packing shortage.

c. Remove any additional packing material and verify that the serial number of the unit corresponds to that shown on the shipping invoice.

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

e. Check major component assemblies to determine if any assemblies or screws have been loosened. Tighten any loose screws or mounting hardware. Inspect all Molex connectors.

2-10 Mounting and Checkout

Installation of the tape unit consists of mounting it in a rack cabinet, performing a preliminary operational check and interconnecting the cables in accordance with figures 2-2, 2-3, 2-4, or 2-5. To mount the tape unit, refer to figure 2-1 and proceed as follows:

a. Place the tape unit on a level surface face up and remove the 3 screws that hold the unit to the shipping frame.

b. Remove the two hinge bases from the shipping kit and mount them onto the rack cabinet, 19.25 inches apart. Refer to figure 2-1.

c. Lift the tape unit and set it on the hinges in the 90° open position (see figure 2-1). The tape unit is now mounted in place and can be swung in its closed position and latched.

NOTE

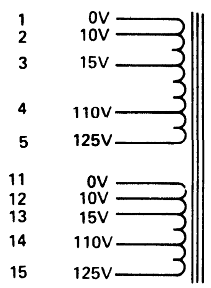
The safety blocks should be installed only if the tape unit and the rack cabinet are to be tipped over on side or back. The safety blocks keep the tape unit from slipping off the hinge bases.

d. After the tape unit is installed in place, check again for any damage and missing or loose components. Check also for the following items:

(1) Loose relays (two on control board and one near center of base plate).

(2) Loose connectors or terminal connections on circuit boards and other assemblies.

e. Check that the input power transformer (see figure 1-2) is connected correctly to supply the primary power voltage from which the tape unit is to be operated. Refer to figure 2-7.



IF THE INPUT VOLTS (RMS) IS	CONNECT INPUT POWER TO TERMINALS	and	JUMPER BETWEEN	and	JUMPER BETWEEN
95	3 and 4		3 and 13		4 and 14
100	2 and 4		2 and 12		4 and 14
110	1 and 4		1 and 11		4 and 14
115	2 and 5		2 and 12		5 and 15
125	1 and 5		1 and 11		5 and 15
190	3 and 14		4 and 13		-
200	2 and 14		4 and 12		-
210	2 and 14		4 and 11		-
215	2 and 15		4 and 12		-
220	1 and 14		4 and 11		-
225	1 and 15		4 and 12		-
230	2 and 15		5 and 12		-
235	1 and 15		4 and 11		-
240	2 and 15		5 and 11		-
250	1 and 15		5 and 11		

Figure 2-7. Diagram of Primary Winding of the Input Power Transformer

f. Check the five fuses located at the lower left corner on the back of the tape unit. These fuses are identified in figure 2-8.

g. Refer to Chapter 3 to familiarize yourself with all tape unit controls and operating procedures before applying power to the tape unit.

h. Plug in the primary power cable and turn on equipment power with the ON/OFF switch on the front of the tape unit. Verify that tape unit power comes on.

i. Load a reel of tape on the tape unit according to the procedures in Chapter 3. This will verify that the tape unit can move tape and can execute the loading sequence properly.

j. Use the Forward/Reverse toggle switch on the tape control logic board to move the tape first in the forward and then in the reverse directions. This will verify that the tape unit operates properly in both directions. (The Forward/Reverse toggle switch is described in table 3-1 and illustrated in figure 1-2).

k. Press the RWD pushbutton to verify that the tape properly rewinds (at 250 ips) and stops at the BOT marker.

l. Press the RWD pushbutton again to verify that the tape unit unloads tape properly.

The magnetic tape unit is now ready for normal operation. Refer to Chapter 3 for information pertaining to the operation of the tape unit.

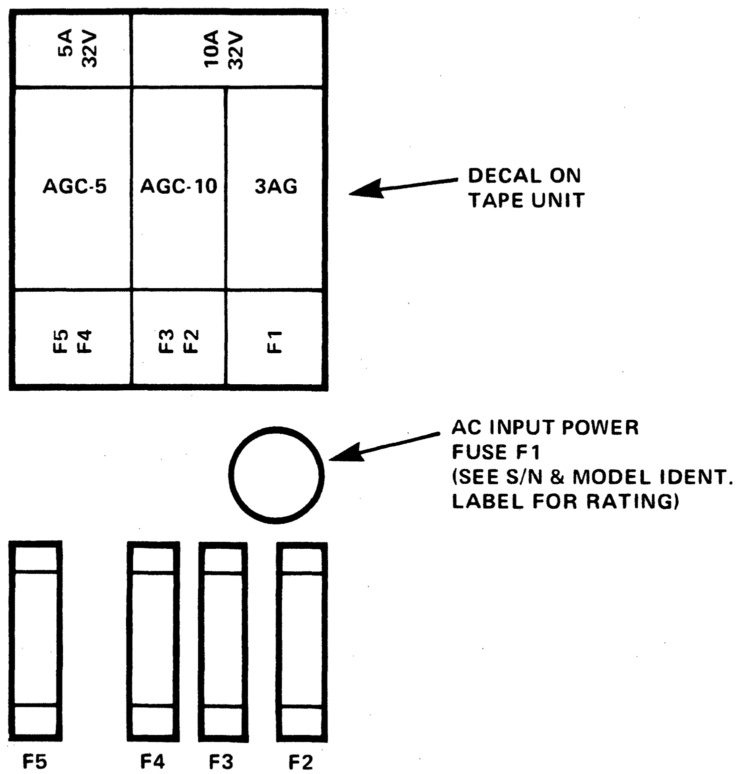


Figure 2-8. Tape Unit Fuses

Chapter 3
OPERATION

3-1 INTRODUCTION

This chapter describes all operator accessible controls and indicators, and also includes operating instructions for the tape unit. Once the tape unit is placed on line, all essential operation is transferred to an external controller, under software control, and it is necessary to take the tape unit off line only to change tape.

3-2 CONTROLS AND INDICATORS

The basic operating controls and indicators of the tape unit are located on the front of the unit, accessible through an opening in the cover door. It is important to note that several of these controls operate in conjunction with the interface command lines. That is, the function of a front panel control or indicator may be affected by the status of a command line on the interface between the tape unit and the computer.

The front panel controls are described in table 3-1 and shown in figure 3-1; table 3-1 also includes a Forward/Reverse switch located on the control board.

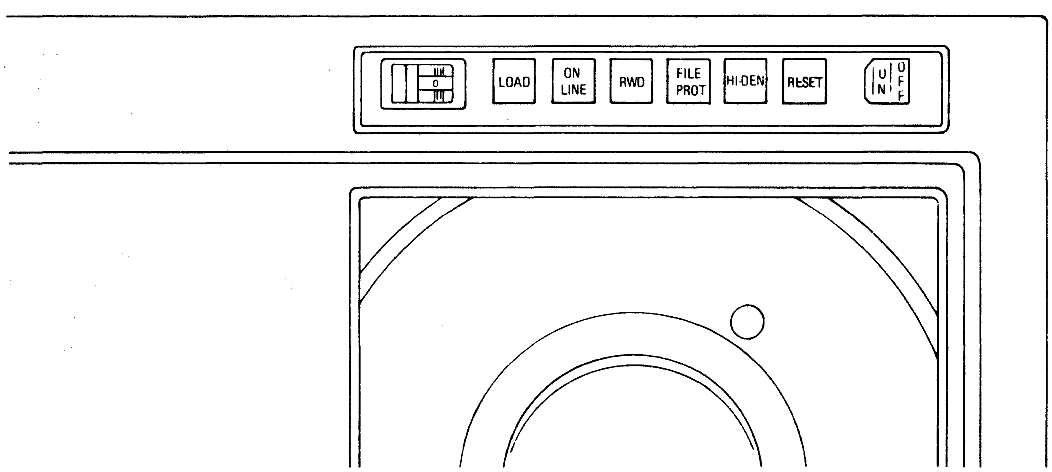


Figure 3-1. Tape Unit Front Panel Controls and Indicators

TABLE 3-1. CONTROLS AND INDICATORS

NAME	FUNCTION
RWD	A pushbutton that is operative only when the tape unit is off line and then is used to initiate a tape rewind operation. The tape will rewind past the BOT tab, then reverse and advance to the BOT tab and stop. If the tape is at the BOT tab and the RWD button is pressed, the tape will rewind slowly off of the take-up reel.
RESET	A backlighted pushbutton that functions to: (1) stop tape motion if the tape unit is in the forward, reverse, or rewind mode, and (2) place the unit off line, if it is on line. The indicator light is on whenever the tape unit is selected by the computer (the proper ISELECT line is asserted). Optionally, the indicator light can be wired so that it is on only when the tape unit is selected and on line.
FILE PROTECT	An indicator that lights to indicate that a write protected file reel is installed on the tape unit. This light is meaningful only after the tape has been tensioned.
HI-DEN	An alternate action indicator switch pressed to select packing density. When the switch is lighted the higher density is selected. The switch is functional in the dual density NRZI tape units or dual density NRZI/PE tape units which are dual speed tape units, and operates in parallel with the IDDS command input line from the controller. This switch is not operational in the single density versions of the tape unit.
1600 BPI (optional)	On the optional NRZI and PE combination tape unit, this alternate action indicator switch replaces the HI-DEN switch. This switch is illuminated when 1600 bpi Phase Encoded operation is selected.
9-TRACK (optional)	An alternate action indicator switch used with quad density and combination 7- and 9-track, single speed, 800 bpi NRZI tape units. The switch is normally in the 7-track position with the switch lamp extinguished. When the switch is pressed, the lamp illuminates, and the switch is positioned to the 9-track position.
FORWARD/REVERSE	A three-position toggle switch mounted on the tape control board (accessible when the tape deck is swung out). In the off line mode this switch can be used to move tape in the forward and reverse directions; in the on line mode it has no function. It will move tape only between the BOT and EOT tabs. Switch positions: up = forward; down = reverse; center = off.
ON/OFF	A pivot switch that controls power to the tape unit. Press the ON side to turn power on, the OFF side to turn power off. The switch is lighted in the ON position by the +5-volt regulator.

TABLE 3-1. CONTROLS AND INDICATORS (continued)

NAME	FUNCTION
LOAD	A backlighted pushbutton that is used during loading of tape. After the tape is threaded, press LOAD pushbutton to apply tension to the tape and/or advance the tape to the BOT tab. (Paragraph 3-6 describes operation of LOAD pushbutton in single-load and double-load versions of the tape unit.) The pushbutton lights to indicate that the tape is properly tensioned and has been advanced to the BOT tab. Light will go out whenever the BOT tab moves off the sensor.
ADDRESS SELECT	A rotary thumbswitch whose first four positions (0, 1, 2, and 3) are used to select the active address for the tape unit. This switch operates in conjunction with the ISELECT 0–3 command input lines from the controller. If the tape unit is not equipped with this switch, its address (select code) is zero. Switch position should only be changed while the tape unit is off line.
ON LINE	A backlighted pushbutton that is used to place the tape unit under remote control (on line). It can also be used to place the tape unit under control of pushbuttons on the tape unit (off line), but in this respect it operates in parallel both with the RESET pushbutton and the IOFFL interface command line; either can place the tape unit off line and extinguish the pushbutton light, but cannot place the tape unit on line. The ON LINE pushbutton is lighted to indicate that the tape unit is on line. Note, however, that it can be depressed and lighted also when the tape unit is not selected (RESET pushbutton indicator not lit); in this case the tape unit is on line, but is not under remote control until selected.

3-3 OPERATING PROCEDURES

3-4 General Operating Precautions

To ensure proper operation of the tape unit, the following precautions should be observed:

a. Clean the tape unit daily as described in paragraph 3-5, Operator's Preventive Maintenance.

b. Keep the dust cover closed whenever tape is not actually being loaded or unloaded. This prevents the occurrence of data dropouts and contaminants from impairing the operation of the unit.

c. Check that the tape is correctly positioned on the guides before tensioning, or damage to the tape may result.

d. To prolong the life of the tape, avoid touching the tape except at the end of the reels.

e. Do not touch any of the moving tape unit components, tape, or electronic parts while the tape is in motion, or the tape unit is on line.

f. Do not bring magnetized objects in contact with or in the vicinity of the tape unit, in order to ensure maximum data reliability.

3-5 Operators Preventive Maintenance

The tapes handling components should be cleaned each day. Tape oxide or dust buildup on the heads, guides, capstan, or tape cleaner may result in poor data reliability.

To clean these components use a clean, lint-free cloth or cotton swap moistened in isopropyl alcohol. Avoid soaking the guides with excessive solvent. If the solvent seeps into the bearings the bearing lubricant could break down. To clean the vacuum chamber, open the chamber door and wipe the surfaces which contact the tape. Visually check that the air holes are clear.

3-6 Loading Tape

To load tape, proceed as follows:

a. Turn on power to tape unit by pressing the ON side of the ON/OFF switch. The indicator should light. Other indicators that may be on are: RESET, if the tape unit is selected by the computer; HI-DEN and FILE PROTECT. No other indicators should be on.

b. Install a reel with tape on the upper reel hub by lifting the reel hub loading latch, placing the reel onto the hub and pushing it on until it seats; then lower the loading latch.

c. Install an empty reel on the lower reel hub in the same manner.

d. Notice the tape threading diagram inside the cover door, or refer to figure 3-2, and thread the tape as shown. Secure the tape end to the takeup reel by holding the tape end with a finger through the hole in the reel flange and rotating the takeup reel in the *clockwise* direction. Continue turning the takeup reel a few turns in the clockwise direction until you are sure that the tape is on securely and there is enough tape to tension the tape.

e. Turn the supply reel to tension the tape, then press the LOAD pushbutton. The vacuum chambers will activate and tape will be tensioned. If the tape unit is equipped with double-load option, the tape will now remain stationary and you should proceed with step f. If the tape unit is equipped with the single-load option, the tape will immediately be automatically advanced to the BOT tab, where it will stop and the LOAD pushbutton will light; proceed to step g.

f. Check that the tape is properly positioned on the guides, then press the LOAD switch again. The tape will advance to the BOT tab and stop. The LOAD indicator will light and remain lit until the tape is moved forward to BOT (either manually with Forward/Reverse switch or by a remote command after the tape unit is placed on line).

g. Verify that the Address Select thumbwheel is set to the address which will be used to select the tape unit.

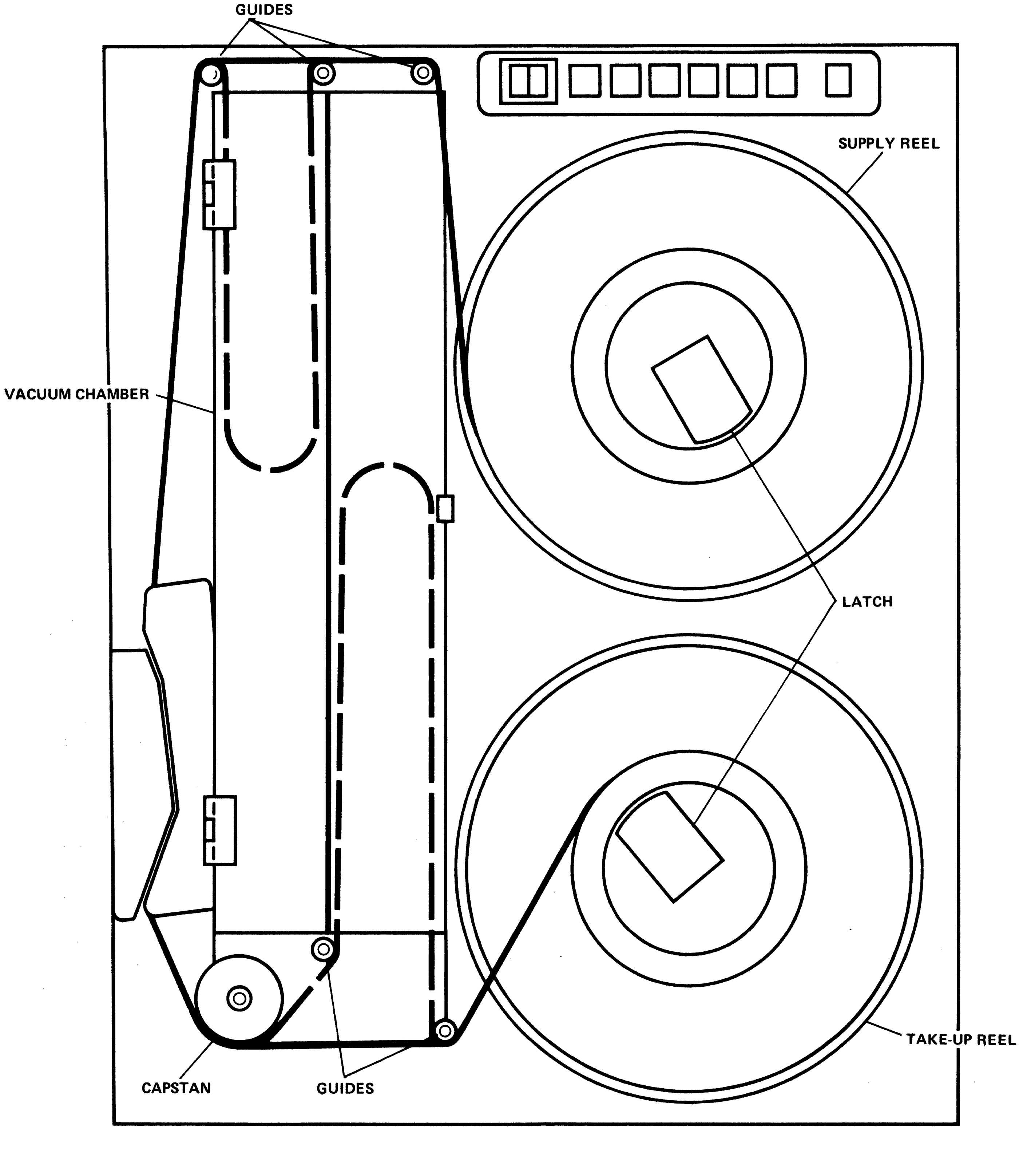


Figure 3-2. Diagram of Tape Threading Path

h. Press ON LINE switch to enable the controller to assume control. Whenever the controller asserts the ISELECT address line the tape unit is under remote control. (As soon as the tape unit is on line, the operator should not interfere with its operation, except to press the RESET pushbutton when ready to go off line.)

3-7 Unloading Tape

To unload tape proceed as follows:

a. Press RESET or ON LINE pushbutton to select off line operation.

b. If the tape is at BOT, press RWD. The tape will start low speed reverse operation until it is wound off the lower reel onto the upper reel and then will stop.

c. If the tape is forward of BOT, press RWD to rewind the tape to BOT. Tape motion will stop automatically and RWD must be pressed again to thread the remaining tape onto the upper reel.

d. Remove the file reel from the upper reel hub by lifting the reel hub loading latch, removing the tape reel, then lowering the loading latch.

3-8 Quad Density Operation

When the tape unit being used is a quad density tape unit, operation can be in any one of four different bit density modes. These include the 9-track 1600 bpi phase encoded mode, the 9-track 800 bpi NRZI mode, the 7-track 800 or 556 bpi NRZI mode, and the 7-track 556 or 200 bpi NRZI mode. Perform operation as follows:

a. When operating in 9-track phase encoded mode or 9-track NRZI mode, press 9-TRACK switch to place switch in 9-track position. Switch will illuminate in this position. If tape unit is being operated without external density selection from a controller, press HI DEN switch when operating in 1600 bpi phase encoded mode. Switch will illuminate in this position. If external density selection is being used, do not press HI DEN switch (leave switch in extinguished condition). Density selection will be performed by the controller.

b. When operating in 7-track NRZI mode, release 9-TRACK switch to return it to extinguished condition. This is the 7-track position of the switch. If tape unit is being operated without external density selection from a controller, press HI DEN switch to select high density when operating at 800 bpi. Leave HI DEN switch in extinguished condition (low density position) when operating at 556 or 200 bpi. If external density selection is being used, do not press HI DEN switch (leave switch in extinguished condition). Density selection will be performed by the controller.

3-9 TAPE TRACK LAYOUT AND DATA FORMATS

3-10 Tape Track Layout

Depending on the exact equipment configuration, the Model 2750 Tape Unit can read and write standard 9-track or 7-track tapes. Figure 3-3 shows the orientation and layout dimensions of tape tracks

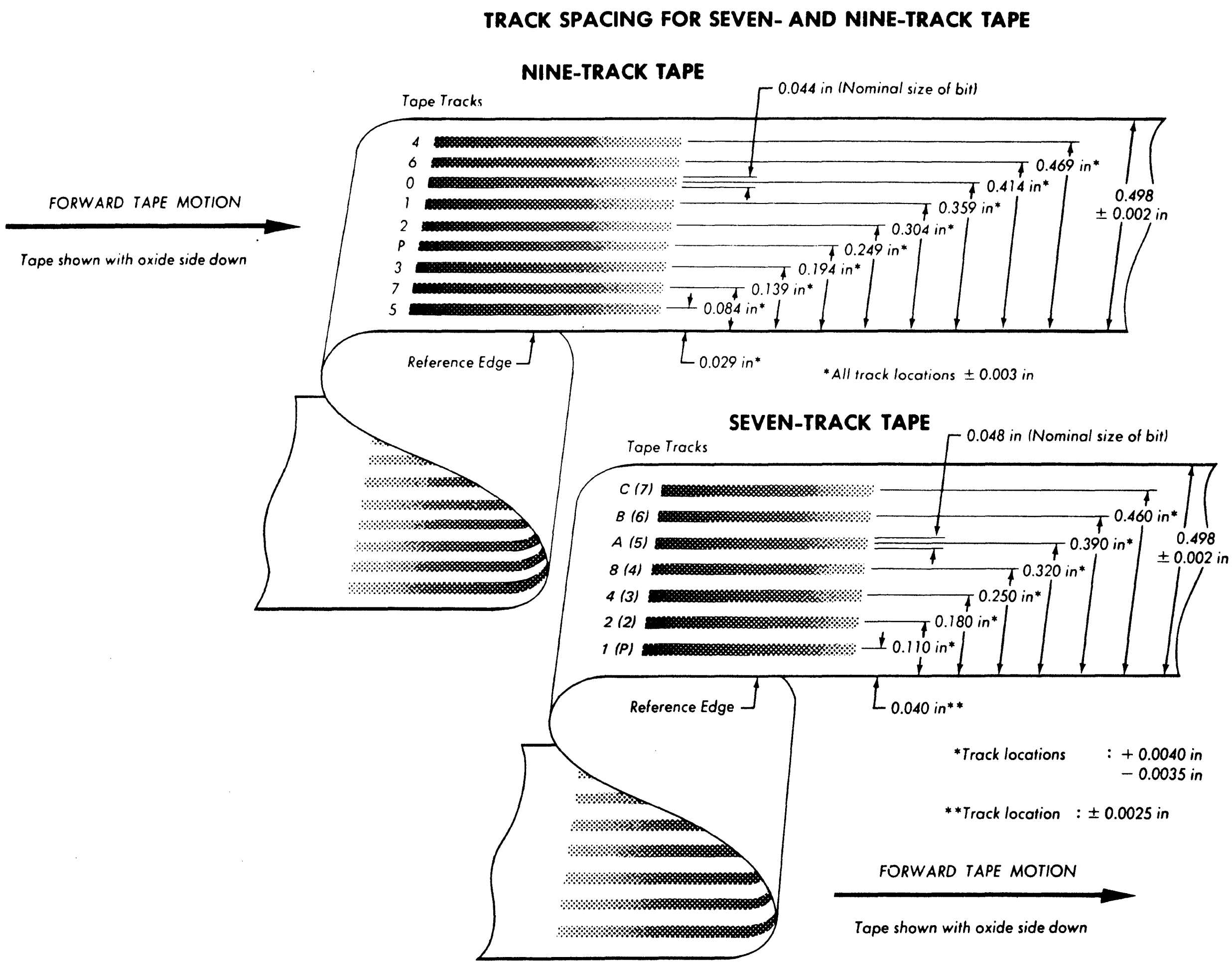


Figure 3-3. Tape Track Layouts

for both formats. Note that 9-track tape is used both for PE recording or NRZI, whereas 7-track tape is used only for NRZI.

3-11 Beginning and End of Tape Formats

In order to assure maximum reliability in the storage of data, an erased area must be recorded in the vicinity of the beginning-of-tape (BOT) marker that is affixed near the reference edge at the start of every tape and an unrecorded area must be left in the vicinity of the end-of-tape (EOT) marker affixed at the trailing end of a tape reel. These unrecorded areas are identified and specified in figure 3-4.

The first recorded data after a BOT marker starts in a different manner, depending on whether it is NRZI or PE data. On NRZI recorded tapes, the first data record begins after a delay of approximately 6 inches. On PE recorded tapes, there is first a PE Identifying Burst, consisting of all logic 1 bits on channel P, all others being erased. Then, there is a space, after which the first data record starts. Minimum spacing between data records is 0.6 inch.

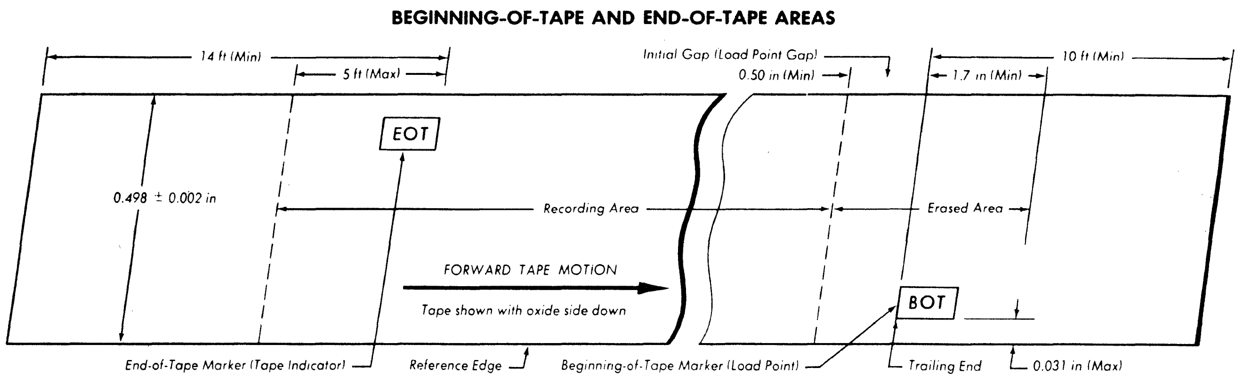


Figure 3-4. BOT and EOT Erase Formats

3-12 NRZI Data Recording Format

When using NRZI coding, a logic 1 bit appears on the interface lines as a low voltage level and a logic 0 as a high voltage level. However, on the tape, a logic 1 bit is recorded as a flux change and a logic 0 bit as no change. The direction of the change is immaterial. Refer to figure 3-5.

The data is formatted and recorded on the tape in blocks referred to as records. The exact configuration of a record depends on whether the tape is in 7- or 9-track format. On 9-track tape, each record consists of the data, a cyclic redundancy check (CRC) character, and a longitudinal redundancy (LRC) character. The CRC character must occur four character times after the final data character, and the LRC character must occur four character times after the CRC. A minimum spacing of 0.5 inch is required between records. The end of a record is shown in figure 3-6.

On 7-track tape, each record consists of data, followed by an LRC character only, as shown in figure 3-6. Minimum spacing between data records is 0.6 inch.

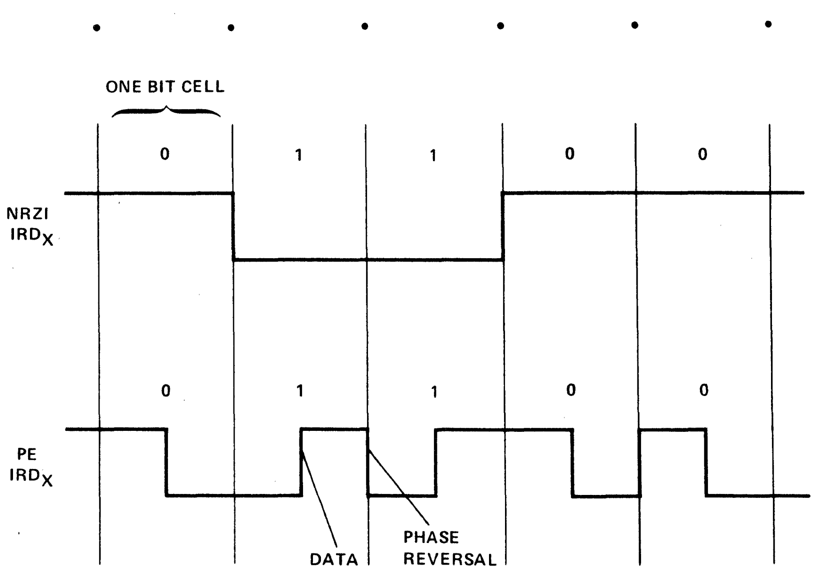


Figure 3-5. NRZI and Phase Encoded Data Formats

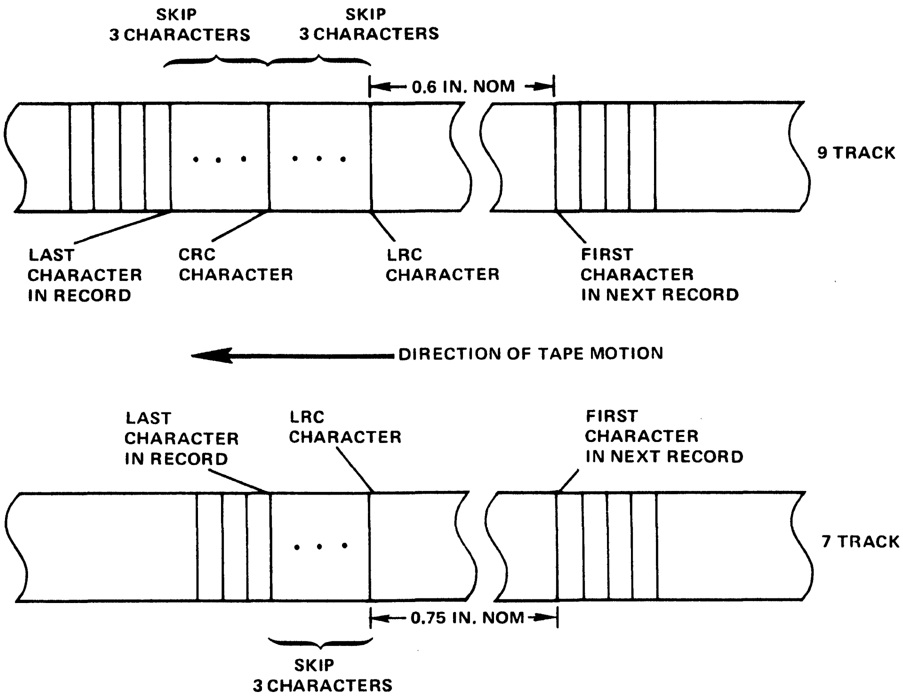


Figure 3-6. End-of-Record Mark Formats for 7- and 9-Track NRZI Tapes

3-13 Phase Encoded Data Recording Format

On the interface a low-to-high transition in the middle of the bit cell time is defined as a logic 1 and a high-to-low transition is a logic 0. Refer to figure 3-5. A phase reversal occurs between successive one bits or successive zero bits to establish proper transition relationships for the data. Consequently, two data strobes (Data Ready) are used by each PE data bit. On the tape a logic 1 bit is a flux change in one direction and a logic 0 as a flux change in the opposite direction. On the output lines the data is self-clocked and does not require an output clock (Read Strobe).

The data is formatted on the tape in records, with each record consisting of a preamble, the data, and a postamble. See figure 3-7. The preamble consists of 40 characters of all logic 0's and one character of all logic 1's. The postamble is a mirror image of the preamble, and consists of one character of all logic 1's and 40 characters of all logic 0's. A minimum spacing of 0.5 inch is required between records. (PE data is always recorded on 9-track tape.)

3-14 RECORD AND FILE MARKS

Standard end-of-record and end-of-file mark formats that are used for NRZI recordings are shown in figures 3-6 and 3-8, respectively. The corresponding preamble and postamble for PE recording is described in paragraph 3-12 above. The end-of-file mark for PE recording is shown in figure 3-9.

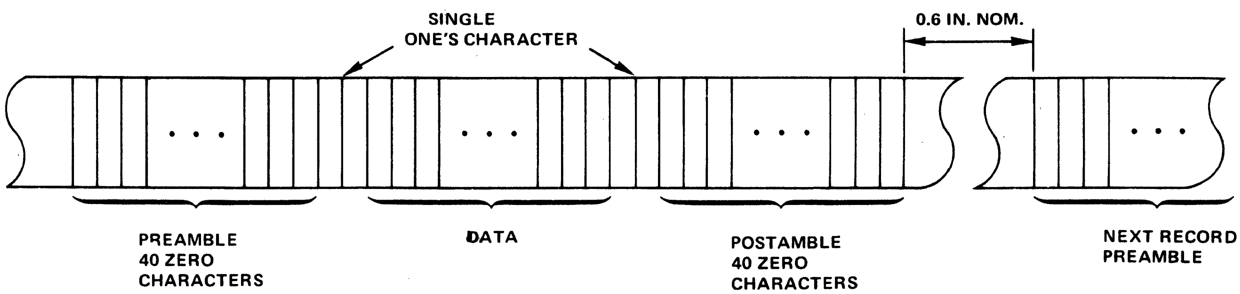


Figure 3-7. PE Record Data Formats

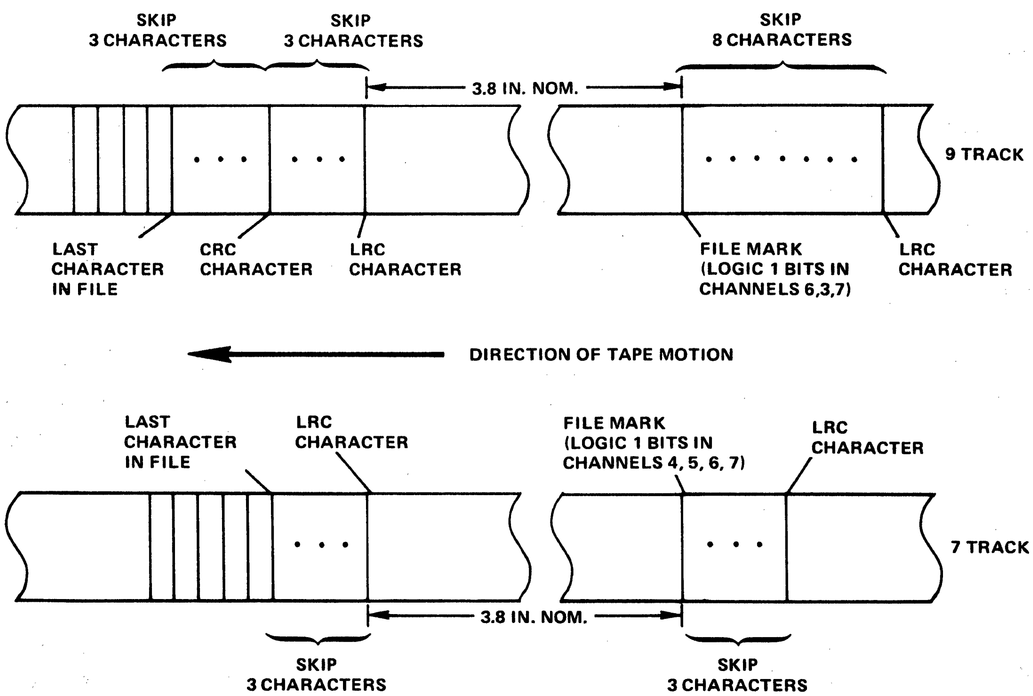


Figure 3-8. End-of-File Mark Formats for 7- and 9-Track NRZI Tapes

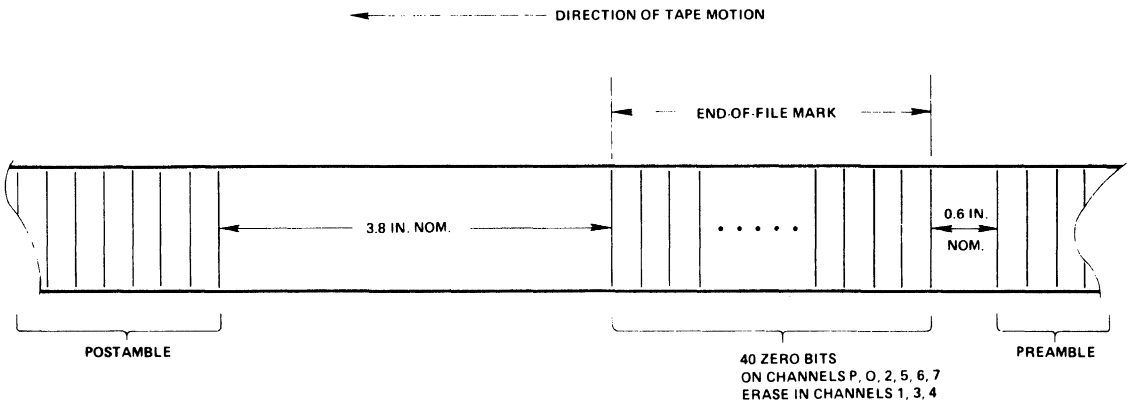


Figure 3-9. End-of-File Mark for PE Tapes

3-15 PROGRAMMING INFORMATION

The tape unit has four categories of input and output lines. These are:

1. Data Inputs – the data and parity lines, data ready line, and LRC strobe;
2. Data Outputs – data and parity lines, data strobe line, and several status lines;
3. Command Inputs – lines that select the tape unit, initiate tape motion, enable a read or write operation, and generally control operation of the tape unit; and
4. Command Outputs – lines that generally indicate the status of the tape unit, the position of the tape (at BOT or EOT), and other similar information.

Descriptions of the functions and typical examples of use of these lines are in tables 3-2 through 3-5 and the following paragraphs. All logic levels are negative true; that is, when a signal line is asserted, its logic level is 0 to 0.4V, and when it is not asserted (cleared) the logic level is 2.5 to 5.0V. It is also important to note that several of the input/output lines operate in parallel with, or in some other way interact with, the front panel controls and indicators of the tape unit.

3-16 Data Inputs

The data input lines are used for entry of data into the tape unit from the formatter, as well as for determining the read threshold voltages. Figure 3-10 shows typical timing interrelationships between these lines.

TABLE 3-2. TAPE UNIT DATA INPUT LINES

<table>
<tr><th>NAME</th><th>FUNCTION</th></tr>
<tr><td>DATA READY</td><td>This line must be asserted for a minimum of 1 microsecond during the time a data or CRC character is recorded. The tape speed and the frequency of these pulses determines the record density. For NRZI the frequency is equal to the data rate, but for PE the frequency of data ready pulses is twice the data rate. The frequency stability should be 0.25%. The write data lines should not change for 0.5 microsecond before or after DATA READY.</td></tr>
<tr><td>WRITE DATA
(7 or 9 Lines)</td><td>For recording NRZI data, any of these lines must be asserted each time a logic 1 bit is to be recorded on that track. The leading edge of the DATA READY pulse transfers the data into the tape unit write register.

For recording PE data the WRITE DATA lines must present data in the format described in paragraph 3-12. The data will be transferred into the write register on the trailing edge of DATA READY.</td></tr>
<tr><td>LRC STROBE</td><td>This signal must be asserted for a minimum of 1 microsecond at the end of a record or file of NRZI data. The pulse must occur four character times after the last data ready in each record of data.

The signal is not used during recording PE data, except during an overwrite operation, the pulse must occur after the last DATA READY to clear the overwrite function in the tape unit.</td></tr>
<tr><td>IRDT, 1, 2
(Read Threshold
1 and 2)</td><td>The status of these lines defines the read amplifier output voltage level which is recognized as a logic level change. For example, if 25% of the maximum voltage change is recognized as a change from one level to the other, the read threshold is 25%. The function of these lines depends on the configuration of the tape unit. For a tape unit with a single gap head:

<table>
<tr><th>IRDT 1</th><th>IRDT 2</th><th>READ THRESHOLD (NRZI)</th><th>READ THRESHOLD (PE)</th></tr>
<tr><td>false</td><td>false</td><td>25%</td><td>15%</td></tr>
<tr><td>true</td><td>false</td><td>45%</td><td>30%</td></tr>
<tr><td>false</td><td>true</td><td>12%</td><td>5%</td></tr>
</table>

For tape units with a dual-gap head, the high threshold (45% or 30%) is selected automatically whenever the tape unit is in write mode. The middle threshold (25% or 15%) is selected automatically during read, but the assertion of IRDT2 line will select the low threshold (12% or 5%) instead.</td></tr>
</table>

3-17 Data Outputs

The data output lines are used for supplying data and data format information from the tape unit to the formatter.

TABLE 3-3. TAPE UNIT DATA OUTPUT LINES

NAME	FUNCTION
READ DATA 9 or 7 Lines (NRZI)	On these lines the read character is output in parallel form. Each bit is at the correct logic level at the trailing edge of the READ DATA STROBE. These lines are active whenever the ISFC or ISRC command lines have been asserted.
READ DATA 9 Lines (PE)	The signals on these lines are the outputs of each peak detector, gated by the envelope detector associated with that channel. These signals are replicas of the write data input signals. These lines are active whenever the ISFC or ISRC command lines have been asserted.
READ DATA STROBE (NRZI)	Asserted for a minimum of 1 microsecond for each data character, whenever the read data lines are active. NRZI data is to be sampled with the trailing edge of this strobe. The READ STROBE is not used during the reading of PE data.
SEVEN TRACK	A status line asserted to indicate that the tape unit has a seven-track configuration. It is not asserted for a nine-track unit.
SINGLE STACK	A status line asserted for tape units with a single head stack. It is not asserted for dual head stack units.
NRZI	A status line asserted for NRZI tape units; it is not asserted for PE tape units. This line is operative in the optional NRZI and PE combination tape units.
SPEED	This line may be used in installations in which two tape units of different operating speeds are connected to the same formatter. The line is asserted on the tape unit which has the lower of the two tape speeds.

3-18 Command Inputs

Functions of command inputs to the tape unit are listed in table 3-4; except for ISELECT, the command inputs are functional only when the tape unit is on line. Figure 3-10 shows some typical timing interrelationships between these lines.

TABLE 3-4. TAPE UNIT COMMAND INPUT SIGNALS

NAME	FUNCTION
ILOL (Load & On-Line)	An optional line that allows remote restart after power fails (refer to paragraph 3-23).
ISELECT 0–3	Four address select lines that are used for selecting a tape unit. These lines function in conjunction with the front panel Address Select thumbwheel switch so that if the front panel switch is in 0 position and ISELECT 0 line is asserted the tape unit is selected. Likewise, switch position 1 corresponds to ISELECT 1, etc.
ISFC (Forward)	When asserted, will cause the selected unit to accelerate to synchronous speed in the forward direction. The tape unit will automatically begin to read and output data, but tape motion will stop when this line is not asserted.
ISRC (Reverse)	When asserted, will cause the selected unit to accelerate to synchronous speed in the reverse direction and begin to read and output data. The ISRC command is not recognized if the IBOT command output is asserted. The tape unit will stop when this line is not asserted.
IOFFL (Off Line)	Must be asserted for at least 1 μsec to place the unit off line. The tape unit ON LINE indicator will go out. This line operates in parallel with the ON LINE or RESET pushbuttons on the front panel.
ISWRT (Set Write)	Asserted for at least 10 μsec with ISFC to place the tape in write mode. Note that ISWRT must be asserted before the leading edge of ISFC.
IOVW (Over Write)	Asserted for at least 10 μsec with ISFC and ISWRT to overwrite (update) an isolated record. Overwrite is terminated by assertion of the LRC Strobe at the end of the record. Note that the LRC Strobe must be asserted also during PE overwrite.
IDDS (Density Select)	This line is optional on 7-track tape units and is asserted to cause the tape unit to read the higher density data. This functions the same as the HI-DEN switch described in table 3-1, but on any tape unit either the interface line or the switch is functional, but not both. This line may also be used on the optional NRZI and PE combination tape unit and asserted to cause the unit to operate in the 1600 bpi phase encoded mode. The function in this case is the same as the 1600 bpi switch described in table 3-1, but the interface line must be specified. Otherwise, the switch is functional. On dual speed tape units assertion of the IDDS line also causes the tape unit to move tape at the lower of the two speeds.
IREW (Rewind)	When this line is asserted for a minimum of 1 μsec, the tape will be rewound to BOT. When the tape is at BOT, this line is inhibited.

3-19 Command Outputs

The command output lines reflect status of the selected tape unit. The functions are listed in table 3-5 and are available on the interface whenever the tape unit is selected.

TABLE 3-5. TAPE UNIT COMMAND OUTPUT SIGNALS

NAME	FUNCTION
IRDY (Ready)	Asserted to indicate that: 1. Tape is tensioned 2. Tape is at or forward of BOT 3. Tape unit is on line 4. Tape unit is not rewinding. When IRDY is asserted, the tape unit can accept a command.
IONL	Asserted to state that the tape unit is on line (under remote control) with tape under tension. IONL will be cleared by any one of the following: 1. A remote IOFFL assertion. 2. Pressing the tape unit RESET pushbutton. 3. Pressing the ON LINE pushbutton. 4. Loss of tape tension.
IRWD (Rewinding)	Asserted to state that the tape unit is rewinding tape. IRWD is cleared when the tape motion stops and tape is positioned at BOT. As an option, the IRWD line can be enabled for an unselected unit.
IBOT (BOT)	Asserted to state that the tape unit has stopped motion and tape is positioned at the BOT tab.
IEOT (EOT)	Asserted to state that the tape unit has stopped motion and tape is positioned at the EOT tab. Optionally, the tape unit may be wired so that this signal is asserted by the EOT tab and remains on until reset by passing of the EOT tab in reverse direction of tape movement.
IFPT (File Protect)	Asserted to state that the selected tape unit has a write protected tape file mounted on it.
IDDI (High Density)	Asserted to state that the tape unit has been commanded to read the higher of two densities. In the optional NRZI and PE combination tape unit this line is asserted to indicate that the unit is operating in the Phase Encoded mode. On dual speed tape units this also indicates that the tape unit is operating at the lower speed.

3-20 PROGRAM SEQUENCE

The data formats described earlier in this chapter have various gaps preceeding or following the records, end-of-file marks, etc. These gaps serve the purposes of protecting previously recorded data during a write operation and assuring the accuracy of data read from the tape during any possible combined sequence of reading, writing, and editing. The gaps also allow ample time for the tape motion to start and stop.

The implementation of these gaps is the function of the formatter. In the formatter these gaps translate into time delays, between two signal pulses, prior to starting an operation (call pre-delays) and delays after completing an operation (called post-delays). Because the length of the gaps, as measured on tape, are to be maintained constant regardless of tape speed, the pre-delays and post-delays vary in time duration depending on the tape speed. Table 3-6 contains a listing of the essential pre-delays and post-delays for various NRZI and PE tapes. The information in table 3-6 is expressed in terms of distances on tape as well as time.

3-21 Start Unit; Write Record

Figure 3-10 shows control inputs and output timing for the sequence of starting the tape unit, writing and then rewinding the tape to the load point. The sequence is as follows:

a. Assert ISELECT address line (0, 1, 2, or 3).

b. Check the presence of IRDY, IONL, and IBOT signals from the tape unit.

c. Assert ISFC and ISWRT. ISWRT can be cleared after 10 μsec.

d. The tape unit will accelerate to synchronous speed. After a pre-delay programmed by the formatter, data present at the formatter inputs will be gated to the WRITE DATA lines and clocked into the tape unit synchronous with the DATA READY clock.

e. After the last character in the record is written, the formatter will gate the proper CRC, LRC, as they are shown in figures 3-6, 3-8, and 3-9.

f. The formatter will wait for the post-delay and then disable the ISFC signal. The tape unit will stop after the stop distance of 0.190 inch.

g. Assert IREW for at least 1 μsec.

h. Verify that IRWD is asserted until the tape has rewound and is repositioned at BOT (IBOT asserted).

3-22 Start Unit; Read Record

The process for reading data is the same as that for writing data, except ISWRT is not asserted. Data is sampled on the READ DATA lines at the trailing edge of the READ DATA strobe.

TABLE 3-6. PRE-DELAYS AND POST-DELAYS

OPERATION	PRE-DELAYS	
	TYPICAL DELAY (in milliseconds)	TOTAL DELAY (in inches)
Write from BOT	91.00	6.640
Write – Dual Gap Head		
7-channel	7.30	0.365
9-channel	5.65	0.240
Write – Single Gap Head		
7-channel	7.30	0.515
9-channel	7.65	0.390
Write File Mark	50.00	3.565
Read from BOT	18.90	1.607
Read Forward	4.00	0.120
Read Reverse	4.00	0.120
Read Reverse/Edit	4.00	0.120
	POST-DELAYS	
Write	1.00	0.265
Write File Mark	1.00	0.265
Read Forward	0.00	0.190
Read Reverse/Edit		
7-channel	4.30	0.515
9-channel	2.65	0.390
Read Reverse		
7-channel	2.65	0.390
9-channel	1.00	0.265

NOTES:
1. NRZI tapes can be either 7 or 9 tracks; PE tapes are always 9 tracks.
2. Write head to read head distance on dual gap heads = 0.150 inch.
3. Write head to erase head distance = 0.340 inch on all heads.

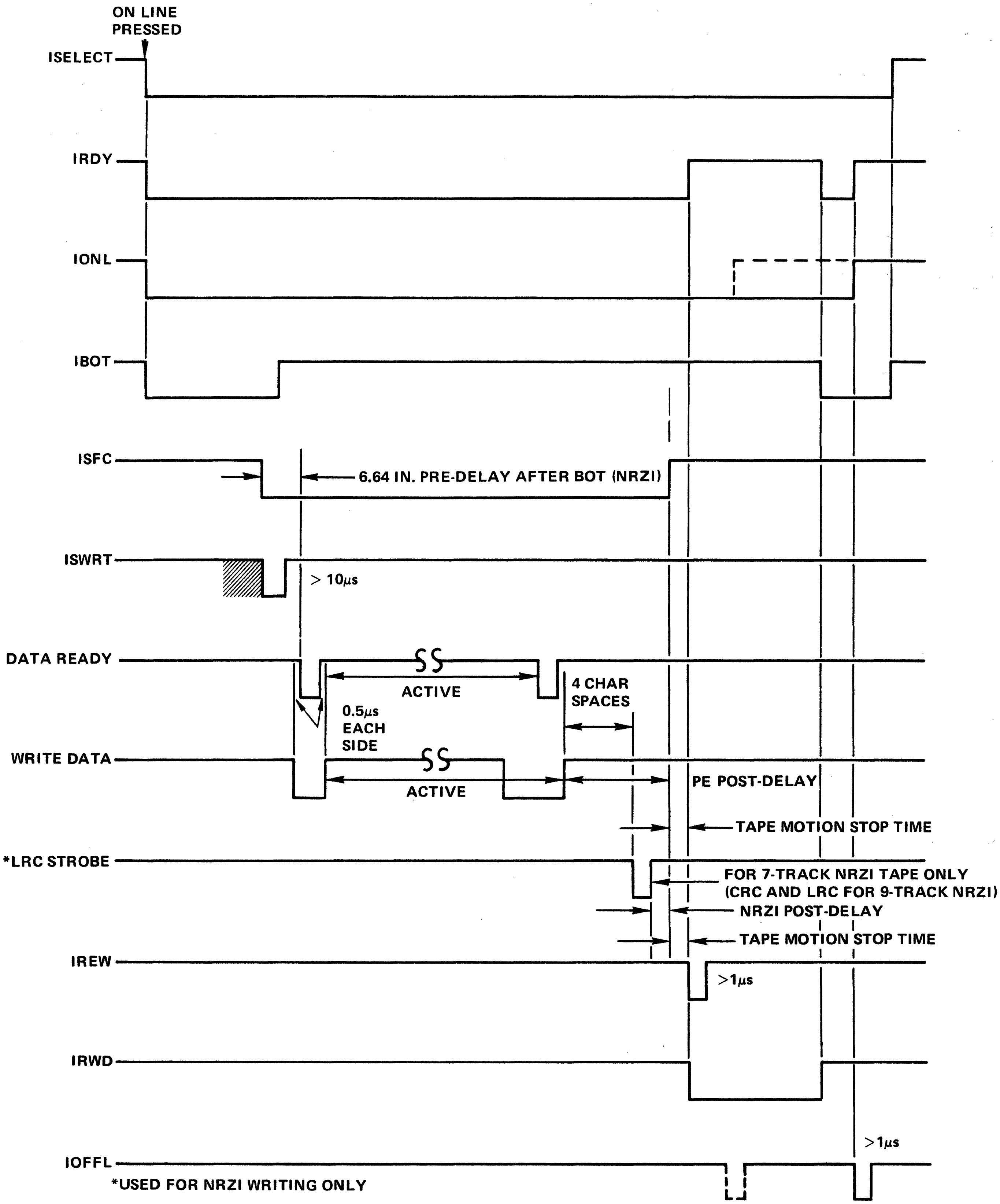


Figure 3-10. Timing Diagram for a Typical Start-Write-Stop Sequence

3-23 Edit/Overwrite Sequence

An individual record within a file can be edited by writing over the same number of characters of existing data. The sequence is as follows: first, the record is read in the forward direction and tape is stopped at the end of the record; next, the record to be edited is read in reverse edit mode (ISRC) and a post-delay, as shown in table 3-6, is inserted by the formatter as the beginning of the record is reached. This post-delay assures that the head is stopped in the proper place in the interrecord gap to start the edit overwrite operation. Then ISWRT, ISFC and IOVW are asserted to perform editing of the next record in the forward direction. The timing is the same as for a normal write operation.

3-24 Restart After Power Fail

On all Model 2750 Magnetic Tape Units an optional command input line, ILOL, can be used to remotely restart the tape unit following power failure. Program the following sequence:

a. Clear all command input lines.

b. Wait one second.

c. Assert SELECT (0, 1, 2, or 3).

d. Assert ILOL for one microsecond.

e. Check IRDY. If not true, the tape is not under tension. The operator must re-thread the tape.

f. Assert IREW.

g. Check IRWD. If true, the unit is rewinding to the BOT tab.

Chapter 4
PRINCIPLES OF OPERATION

4-1 INTRODUCTION

This chapter provides a general functional description of the Bright Model 2750 Magnetic Tape Unit and a more detailed description of the individual electronic circuits contained within the unit. The material in this chapter must be read by maintenance personnel to gain an understanding of the tape unit prior to performing the maintenance described in Chapter 5.

Generally, all logic symbols appearing in the logic diagrams in this manual are drawn in accordance with MIL-STD-806C. All logic elements are identified by a reference designator, such as U2, indicating the integrated circuit package where the element is located. The pin number of the integrated circuit package follows its reference designator: U2-8. The assembly schematic and logic diagrams in Chapter 6 should also be referred to when reading this chapter.

4-2 FUNCTIONAL DESCRIPTION

The Model 2750 Magnetic Tape Unit provides a read and write data operation using either the NRZI or Phase Encoded (PE) methods. The tape unit is designed specifically for remote control of the read/write operation and of tape motion. The Model 2750 Tape Unit uses dual vacuum columns for the tensioning of tape. The following paragraphs provide a functional description of the Model 2750 series Magnetic Tape Unit. Figure 4-1 shows a functional block diagram of the tape units.

4-3 Tape Control Board

Each tape unit contains a Tape Control circuit board and from one to three Data circuit boards. The boards are mounted on a card frame mounted parallel to the tape unit baseplate. The Tape Control board contains the tape control logic, the reel servo amplifiers, ramp generators, capstan servo, BOT/EOT amplifier, and voltage regulators. The power supply assembly that supplies the unregulated ±17 volts and ±32 volts plugs into the Tape Control circuit board. All other deck mounted components, except the read/write head, also plug directly into the Tape Control circuit board. Options can be changed by simply changing jumpers in plugs on the board. Interface signals are connected to the control board by an edge connector.

4-4 Data Board

The Data boards provide the two functions of writing and reading data. Write data signals enter the board by an edge connector on one side of the board. They are buffered by a register which drives the write head. The write and read head connections are made through two connectors in the center of the board. The signals from the read head are amplified, differentiated and compared to a threshold. For PE data boards the signals are driven directly on the interface lines. For NRZI data boards the signals are buffered and strobed out with a read strobe. The read signals are connected to the interface by an edge connector at the other end of the board.

4-5 MECHANICAL DESCRIPTION

The following paragraphs provide a mechanical description of the Model 2750 Dual Vacuum Column Tape Unit. Figures 4-2 and 4-2A show the mechanical assembly of the Model 2750. Detailed mechanical assembly views of the tape unit are contained in Chapter 6.

The Model 2750 Tape Unit uses a dual vacuum column to maintain tape tension. The vacuum columns maintain tape tension at 8 ounces. The position of the tape in the vacuum column is sensed by a transducer covering the length of each column. The transducer is driven by an oscillator and is sensed by an amplifier and a synchronous detector circuit located on the Tape Control board. Since the transducer is the length of the column, the output of the detector is a voltage linearly related to the position of the tape.

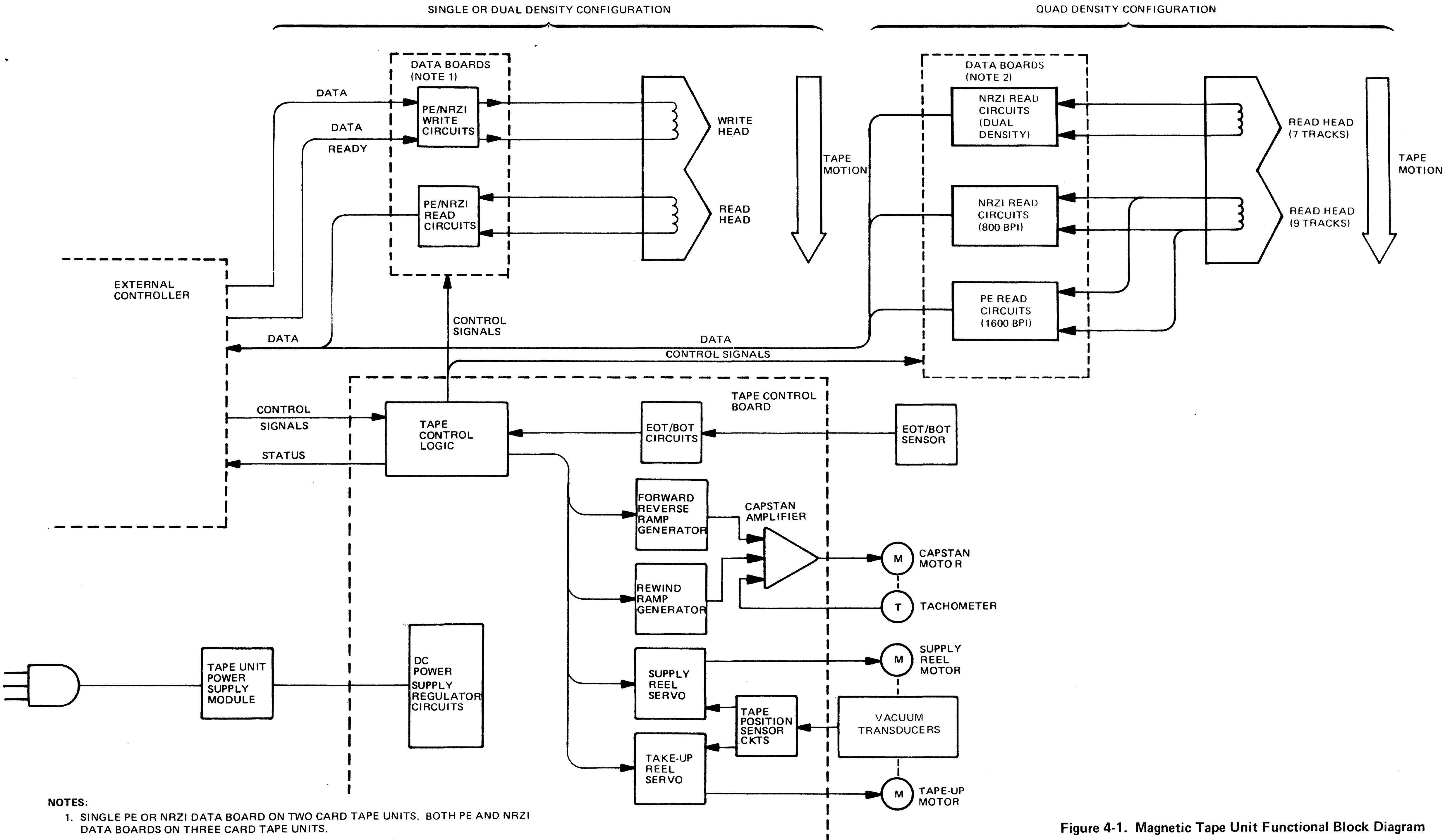
To prevent damage to the tape, two holes located in the vacuum chambers limit the range of the tape loop. When the tape is properly tensioned, the upper hole on the Supply Vacuum Column has atmospheric pressure on it while the lower hole has a vacuum. The two holes are connected through tubing to opposite sides of a pressure switch. The contacts of the pressure switch are closed when the vacuum and atmospheric pressure are across the switch. If, for example, the supply tape loop drops below the lower hole in the vacuum column, the hole no longer has vacuum on it, but is at atmospheric pressure causing the pressure switch contacts to open. Alternately, if the tape loop rises above the upper hole in the vacuum column, the hole no longer has atmospheric pressure on it, but is at a vacuum. When the pressure switch contacts open, the servos are immediately disconnected from the motors, the vacuum motor turns off and write current is removed from the data board. All tape motion stops and the write electronics is prevented from erasing data.

4-6 PRIMARY POWER CIRCUITS

The primary power circuits consist of two parts: (1) a power supply module mounted on the tape unit baseplate (see figure 1-1); and (2) the power supply regulator circuits located on the tape control board. The power supply module (see figure 1-2) contains a power transformer, rectifiers, capacitors, fuses and two power resistors. A heat sink, for mounting the power supply and servo power transistors, is attached to the power supply module. The power transistors on the heat sink are numbered consecutively Q1 through Q11. Power transistor Q1 is located at the top of the heat sink and Q11 is located at the bottom. The power supply regulator circuits consist of the four regulator circuits and a power reset circuit. Figure 4-3 shows a simplified diagram of the primary power circuit. The following paragraphs describe both the power supply module and the power supply regulator circuits.

4-7 Power Supply Module

The power supply module supplies unregulated ±32 volts to the reel servos, and unregulated ±17 volts to the reel servos, the capstan servos and the power supply regulator circuits. Refer to figure 4-3. Primary power is supplied through optional line filter FL1 and front panel ON/OFF switch SW1 to step-down transformer T1. The unregulated ±17-volt outputs are supplied by full-wave rectifier CR1, and the ±32-volt outputs are supplied by half-wave rectifiers CR2 and CR3. Capacitors C1, C2, C3 and C4 are used for filtering the unregulated output of the rectifiers.



NOTES:

1. SINGLE PE OR NRZI DATA BOARD ON TWO CARD TAPE UNITS. BOTH PE AND NRZI DATA BOARDS ON THREE CARD TAPE UNITS.
2. READ ONLY TAPE UNIT, USES THREE SEPARATE DATA BOARDS.

Figure 4-1. Magnetic Tape Unit Functional Block Diagram

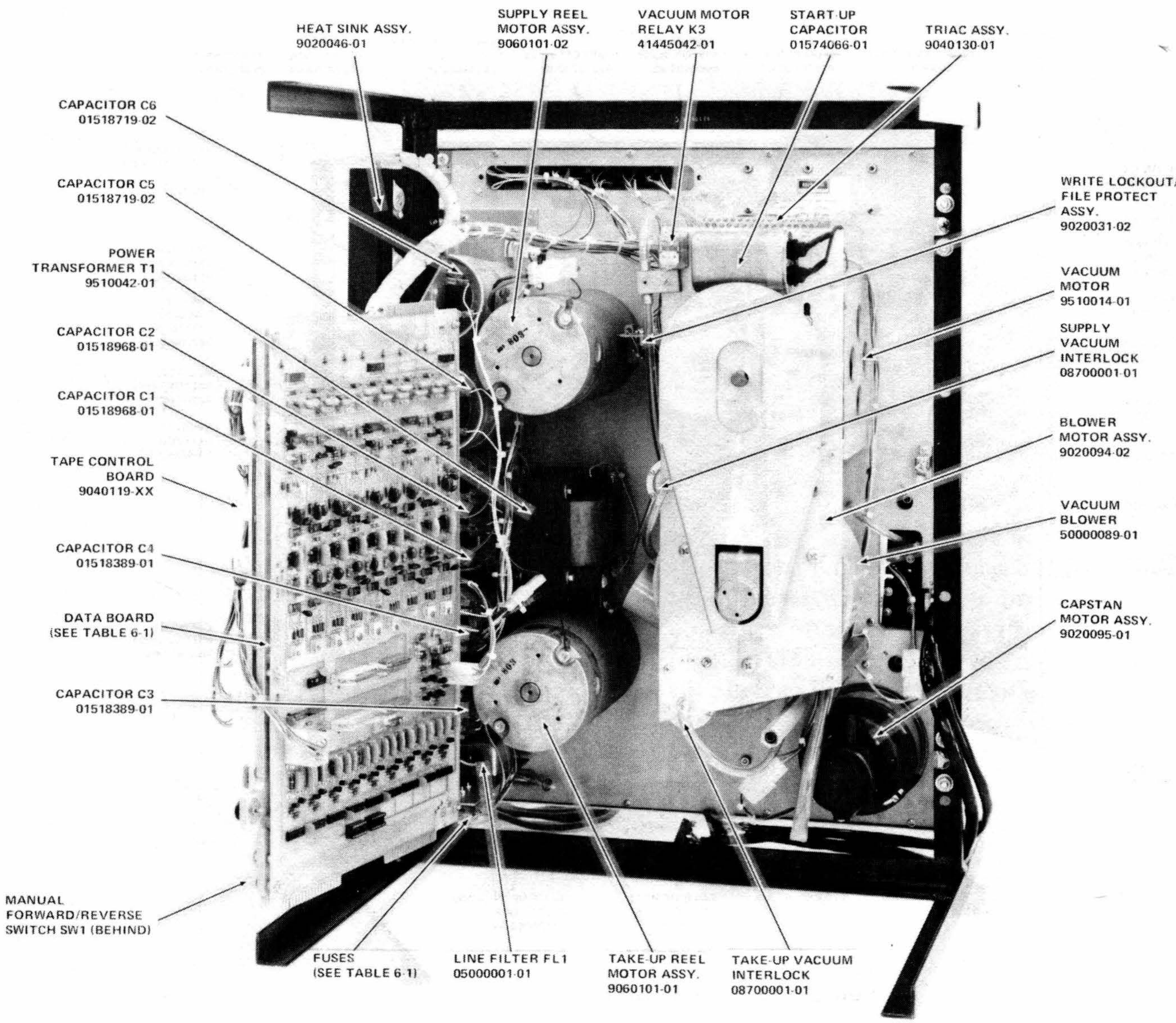
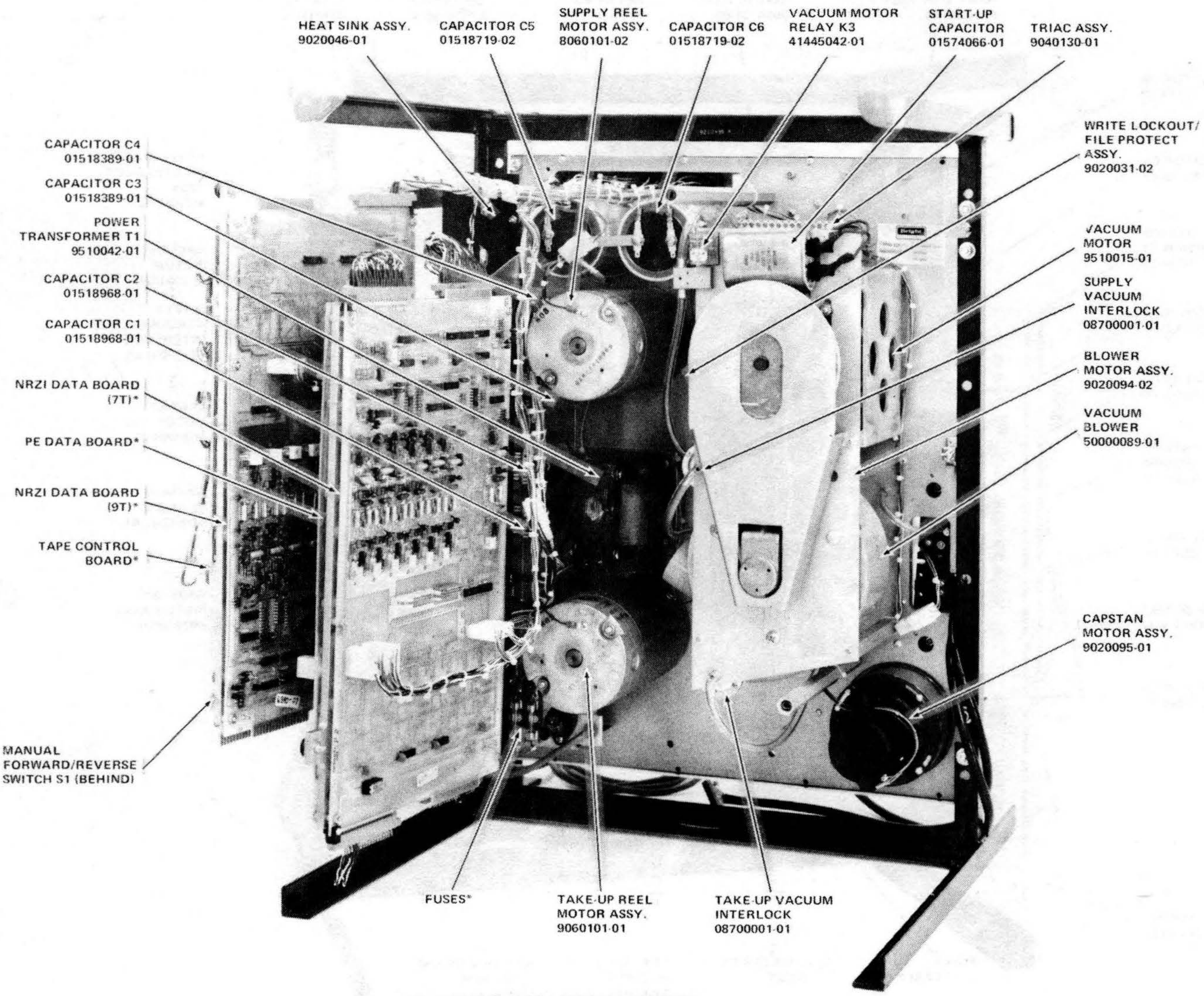


Figure 4-2. Model 2750 Magnetic Tape Unit Mechanical Assembly, Single Data Board Configuration (Single or Dual Density)



*REFERENCE TABLE 6-1 FOR PART NUMBERS.

Figure 4-2A. Model 2750 Magnetic Tape Unit Mechanical Assembly, Three Data Board Configuration (Quad Density)

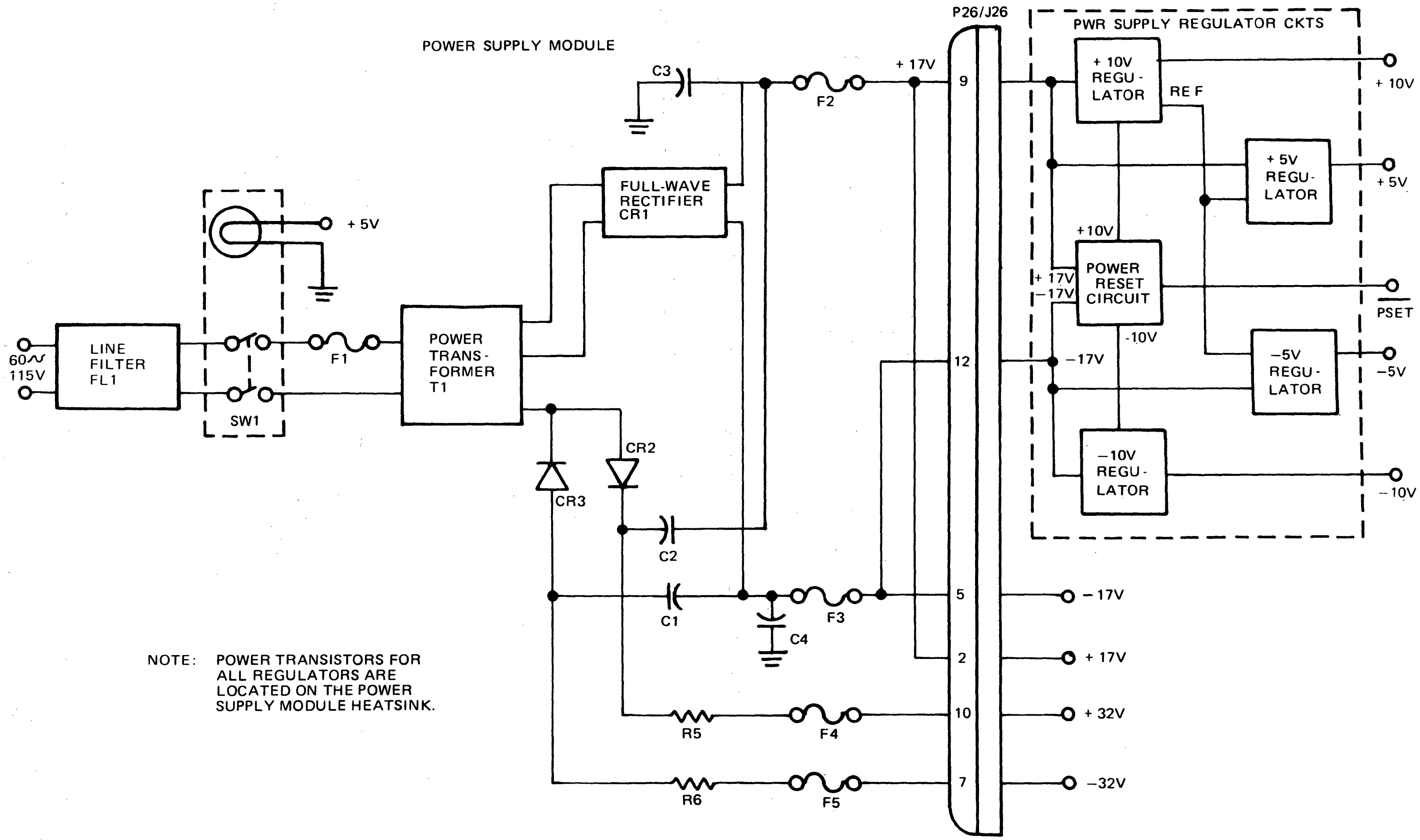


Figure 4-3. Simplified Diagram of Primary Power Circuits

Interconnection between the power supply module and the power supply regulator circuits on the tape control board is provided by a harness that is plugged into tape control board connector J26. Through this connector the unregulated ±17 and ±32-volt outputs are distributed to the other circuits on the tape control board.

4-8 Power Supply Regulator Circuits

The power supply regulator circuits on the tape control board consist of four separate regulator circuits which supply regulated +10 volt, –10 volt, +5 volt and -5 volt outputs. Refer to functional module 1000 on drawing number 9940119 in Chapter 6. In addition, the power supply regulator circuits also provide a reset ($\overline{PSET}$) signal to the tape unit control circuits. The $\overline{PSET}$ signal serves to initialize various logic circuits when power is first turned on, or to disable the servo motors and disconnect the write power from the data boards whenever the ±17 or ±10-volt power supplies malfunction.

4-9 +10 VOLT REGULATOR

The +10 volt regulator consists of a series regulator transistor Q4 mounted on the heat sink, and a voltage sensing network associated with Q1004. See figure 4-4. Unregulated +17 volts is applied to the collector of series regulator transistor Q4 through R1026 and +10 volts is output from the emitter through R1016. The base voltage of Q4 is regulated by the voltage divider network consisting of R1012, R1013 and transistor Q1004. The base of sensing transistor Q1004 is referenced to the +10-volt output across diodes CR1012 through CR1016. CR1015 is a reverse biased 6.2-volt Zener diode. If the regulator output at pin E of functional module 1000 rises above +10 volts, Q1004 conducts more causing the base voltage of Q4 to drop. This causes the output to decrease. Conversely, if the output falls below +10 volts, Q1004 conducts less causing the base potential of Q4 to increase and increases the output. By controlling the base voltage of series regulator Q4 in this manner, an accurate +10-volt output is maintained at pin E. In addition to providing +10 volts at output pin E, CR1015 supplies a reference voltage to the ±5-volt regulator circuits.

Diodes CR1010 and CR1011 provide over-current protection. If the base to emitter voltage of Q4 and the voltage drop across R1016 ever become more than two diode drops below the base voltage, the two diodes will become forward biased and conduct. This causes the base voltage of Q4 to drop. Diode CR1017 prevents power turn-on transients from causing output to go below –0.6 volt.

4-10 –10 VOLT REGULATOR

The –10 volt regulator consists of series regulator transistor Q8 and reference diodes CR1007, CR1004 and CR1005. See figure 4-5. Diode CR1007 is a 10-volt Zener diode. The three diodes set the base voltage of the Q8 to regulate the voltage at the emitter of the series regulator. Diode CR1008 provides over-current protection by always maintaining the –10 volt output at pin F more negative than –9.4 volts. If the voltage at pin F rises above –9.4 volts because of an increase in current flow through R1010, CR1008 will conduct, lowering the base voltage of Q8 and the output. Diode CR1009 prevents power turn-on transients from causing the output at pin F from exceeding +0.6 volt.

4-11 +5 VOLT REGULATOR

The +5-volt regulator circuit is referenced to Zener diode CR1015 in the +10-volt regulator and uses a remote sensing for regulating its output. See figure 4-6. The circuit consists of series regulator transistor Q9 and operational amplifier U46, with associated components.

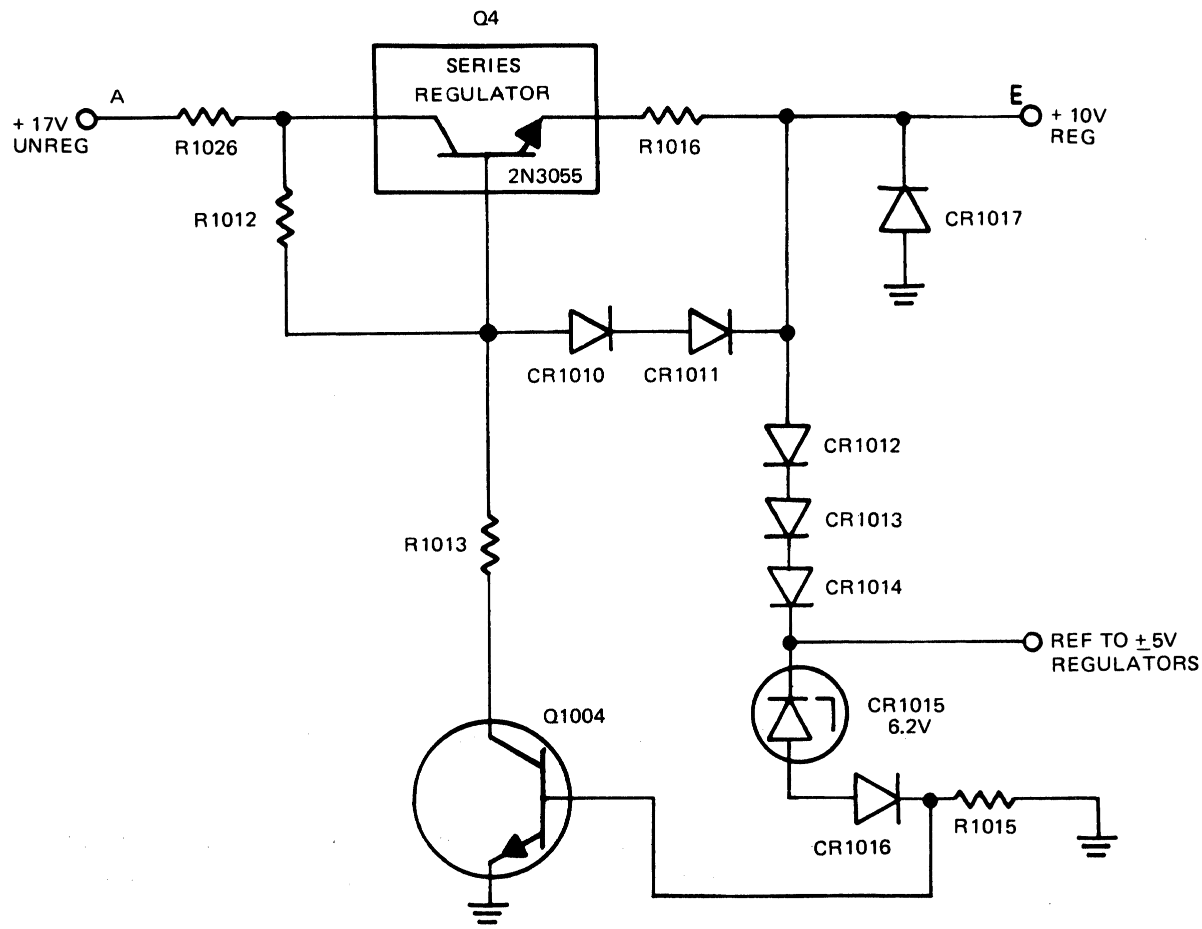


Figure 4-4. +10 Volt Regulator Circuit Simplified Diagram

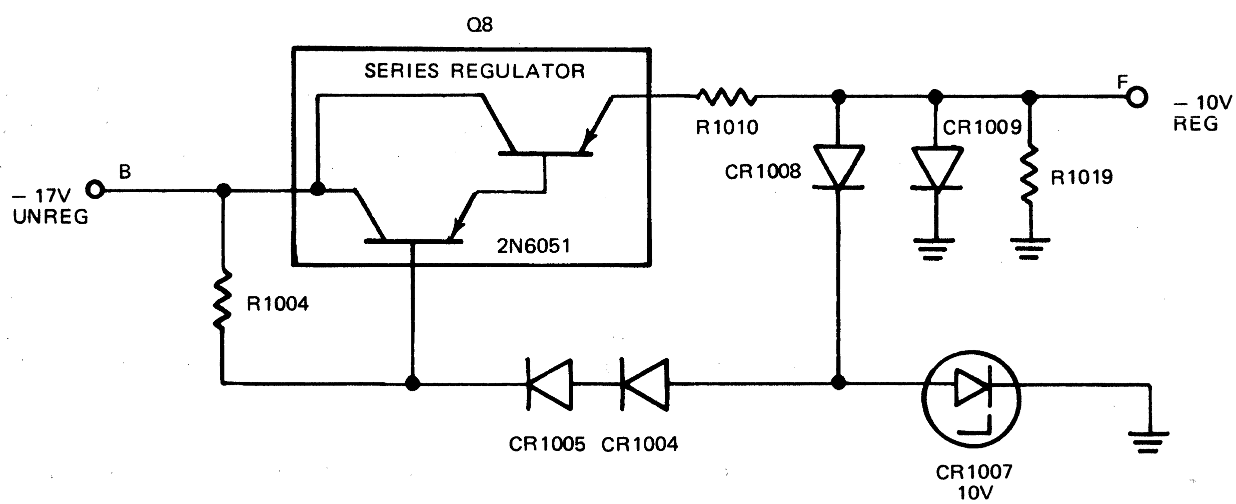


Figure 4-5. –10 Volt Regulator Circuit Simplified Diagram

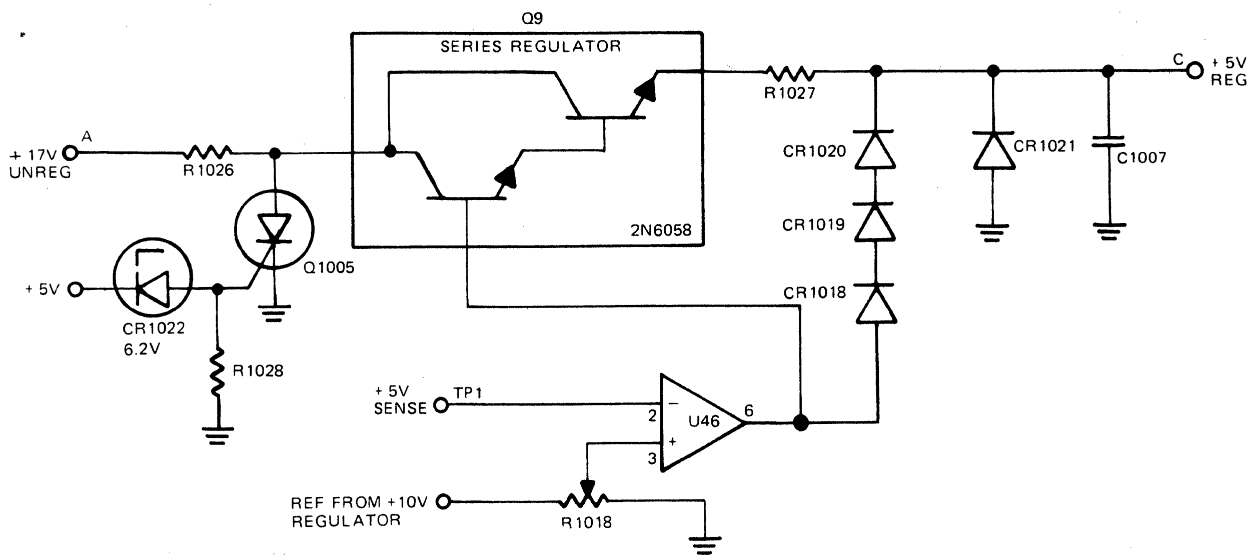


Figure 4-6. +5 Volt Regulator Circuit Simplified Diagram

To maintain +5 volts at the remote location (at TP1 of Forward-Reverse Ramp Generator) the operation amplifier U46 is used to control the base voltage of Q9. One input of amplifier U46 is referenced to Zener diode CR1015 at R1018 and the other input comes from the remote sensing circuit. Potentiometer R1018 is adjusted so that the output of U46 provides the correct base voltage to Q9, needed to maintain the voltage at the remote location at +5 volts. Diodes CR1018, CR1019 and CR1020 provide overcurrent protection, by serving as a current path if output (C) falls more than three diode drops below the output of U46 (base of Q9) because of an increase in voltage drop across R1027. This causes the +5 volts output voltage to be decreased. Diode CR1021 is for protection against transients during power turn-on and keeps output (C) from going below –0.6 volt.

The +5-volt regulator also incorporates an SCR crowbar protection circuit, consisting of Zener diodes CR1022 and SCR Q1005. If the voltage at output (C) rises above 6.2 volts, CR1022 breaks down and conducts, turning on Q1005. This, in turn, provides a shorted path to ground for the +17-volt input (A), causing fuse F2 on the power supply module to burn out.

4-12 –5 VOLT REGULATOR

The –5 volt regulator functions very similar to the +5-volt regulator. See figure 4-7. It is referenced to Zener diode CR1015 and uses an operational amplifier and remotely sensed –5 volts to control the base voltage of series regulator Q11.

One input of operation amplifier U48 is referenced to ground, while the other is taken from a voltage divider R1020, R1021 and R1024. One end of the voltage divider is referenced to the +10-volt Zener diode CR1015 through R1020 and potentiometer R1018 while the other input is connected to the –5 volt remote sensing test point TP2, on the Forward-Reverse Ramp Generator. Potentiometer R1024 is

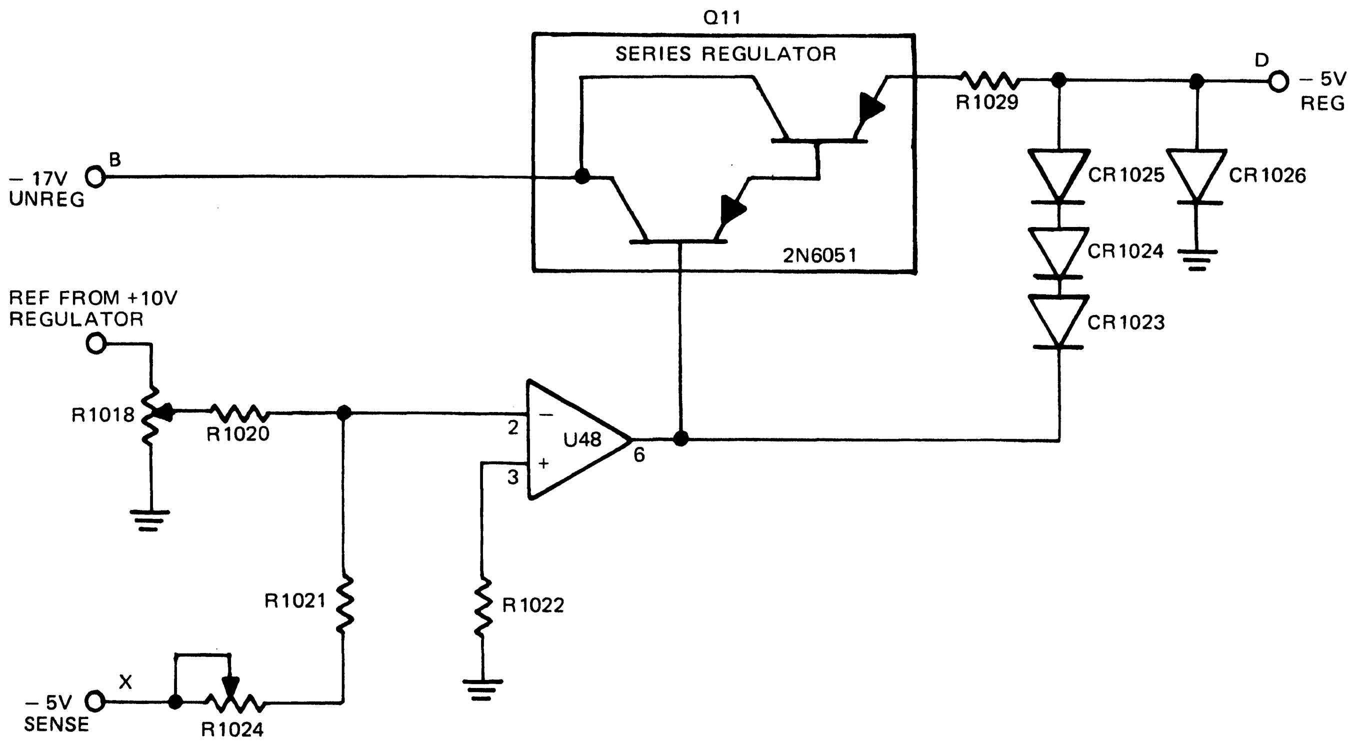


Figure 4-7. –5 Volt Regulator Circuit Simplified Diagram

adjusted so that the output of amplifier U48 maintains the base voltage of Q11 such that the voltage at the remote location is –5 volts.

Diodes CR1023, CR1024 and CR1025 provide over-current protection and diode CR1026 serves as protection against turn-on transients. These diodes function essentially the same as those described for the +5-volt circuit in the preceding paragraphs.

4-13 POWER RESET CIRCUIT

Figure 4-8 shows a simplified diagram of the power reset circuit. The circuit consists of Q1001, Q1002, Q1003 and associated components. The emitter of Q1003 is connected to +17 volts, and the base is connected to +10 volts through R1011. Under these conditions, Q1003 conducts at saturation, causing the collector to be near +17 volts and the voltage on the $\overline{\text{PSET}}$ output (W) at approximately +3 volts (logic high). However, if the +17 volts falls or +10 volts rises, and the V_{be} of Q1003 becomes less than 0.6 volt, transistor Q1003 turns off and $\overline{\text{PSET}}$ becomes a logic low.

The $\overline{\text{PSET}}$ signal can also fall to a low logic level under the control of Q1001 and Q1002. When the –17 volts at (B) and –10 volts at (F) are at their correct levels Q1001 conducts at saturation, conducting current through CR1001 and R1003. This keeps the base of Q1002 at –0.5 volt and Q1002 is shut off. If, however, the –17 volt line rises to near –10 volts, or –10 volts falls to near –17 volts and the V_{be} of Q1001 falls below 0.6 volt, Q1001 stops conducting and the base voltage of Q1002 rises. As Q1002 begins to conduct, $\overline{\text{PSET}}$ will fall to a low logic level.

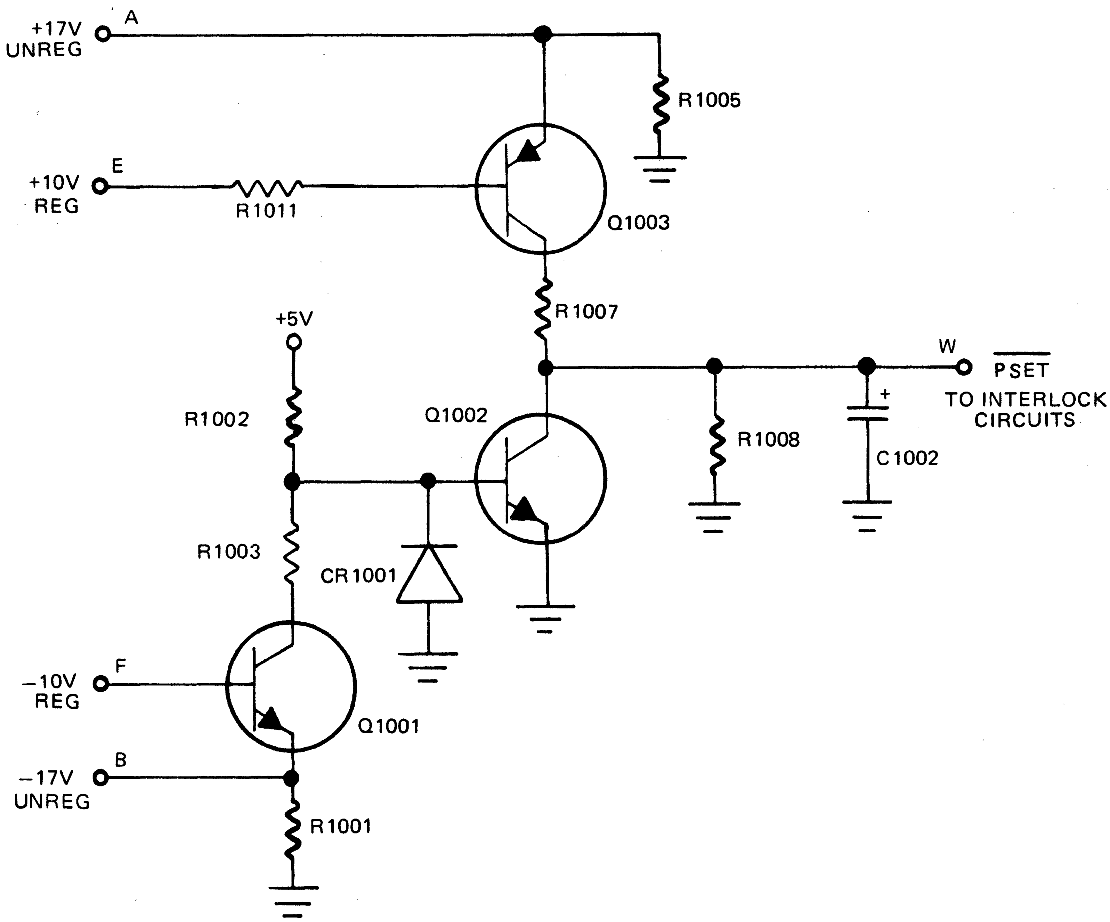


Figure 4-8. Power Reset Circuit Simplified Diagram

When power is first turned on, $\overline{\text{PSET}}$ is always at a logic low. As the power supply voltages reach their nominal levels, $\overline{\text{PSET}}$ remains low for a time period determined by C1002, R1007 and R1008. This temporary logic low signal is used to initialize logic circuits on the control board.

4-14 BLOWER MOTOR CIRCUIT

Figure 4-9 shows a simplified diagram of the blower motor circuit. When relay K3 on the control PWBA is energized during the tape loading sequence, relay K3 contacts 12 and 13 close. This connects the triac output circuit to the gate of triac CR1 through resistor R1. This turns on triac CR1 and allows ac operating voltage from power supply transformer T1 to be applied through the triac to the blower motor M1. When relay K3 is de-energized, triac CR1 turns off and removes the ac operating voltage from the blower motor. The triac assembly is located on top of the blower motor.

4-15 TAPE CONTROL BOARD ELECTRONICS

The following paragraphs describe the operation of the circuits contained on the Tape Control board. These circuits consist of the load logic, reel servo, capstan servo, on-line/off-line logic, addressing logic, and the tape control circuits. A complete schematic diagram of the Tape Control Board circuits (drawing number 9940119) is contained in the attached drawing package. Simplified schematic diagrams

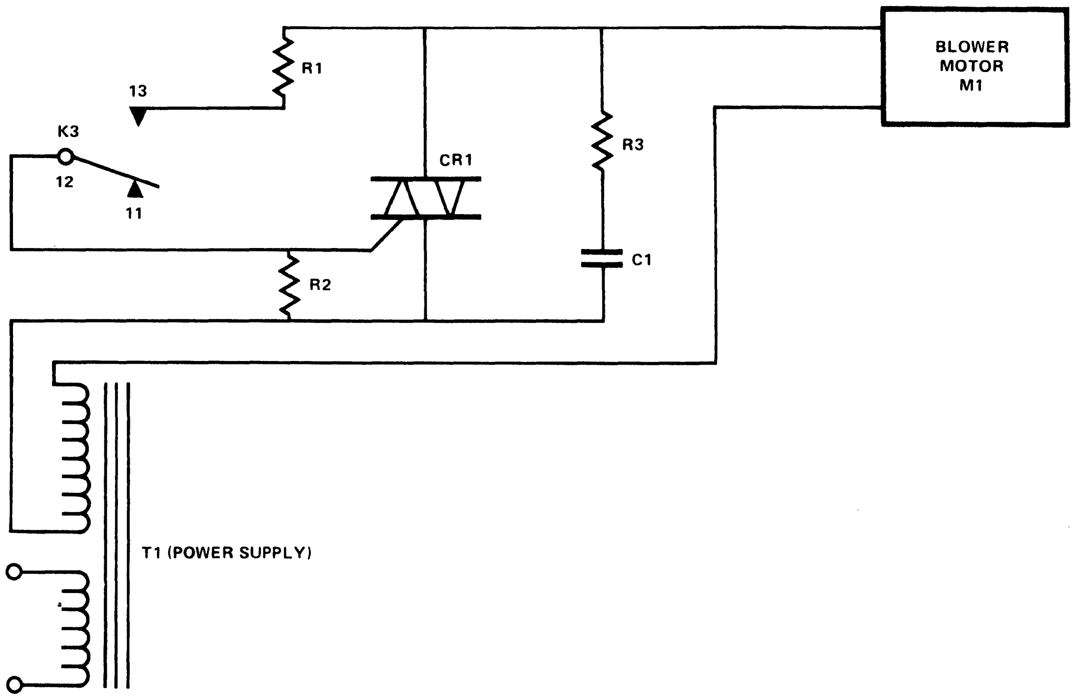


Figure 4-9. Blower Motor Circuit Simplified Diagram

of the various Tape Control Board circuits are contained in the following paragraphs where necessary for clarity of explanation.

4-16 Load Logic Circuits

The load logic circuits have several differences depending on the model of machine, and the load option used. The Model 2750 Dual Vacuum Column machine is available in either a single-load or double-load configuration. For ease in explanation, the following paragraphs make reference to both the single and double-load feature.

Figure 4-10 shows the simplified schematic for a vacuum machine load sequence with the double-load option. Pressing the LOAD switch and releasing it causes a positive pulse output from flip-flop U26-8 which sets flip-flop U27-3 (LDA). LDB flip-flop U27-5 is not set since $\overline{\text{RSTD}}$ is low until INTL goes high. This occurs when the relay K1 is energized.

LDA is connected to gate U43-3 which applies a low at relay driver U38-7. A low at either input to U38 energizes relay K3 and turns on the vacuum motor. LDA is also an input to NAND gate U15-6 with $\overline{\text{INTL}}$ at U15-1 and LDLY at U15-4. $\overline{\text{INTL}}$ is high until relay K1 is energized and LDLY is the output of a load delay circuit.

The input to the load delay circuit is $\overline{\text{LDA}}$. $\overline{\text{LDA}}$ is connected to Q3 through R31 and when $\overline{\text{LDA}}$ is high Q3 conducts at saturation. U1-7 is at ground potential and is less than the voltage at U1-6. The voltage divider of R36 and R37 sets the U1-6 voltage at 3.5 volts. The output of U1 is at –10 volts and is connected to R40. LDLY is clamped by CR5 to approximately –0.5 volt. When LDA is set low, Q3 is turned off. This allows the voltage at U1-7 to increase with the time constant of R35 and C8. When the voltage is increased to greater than 3.5 volts the output of U1 and LDLY goes high and $\overline{LDRDY}$ at U15-6 goes low. $\overline{LDRDY}$ low saturates Q5 and 2N6058 in the reel servo circuits applying –17 volts through a resistor to the reel motors. See figure 4-11. Current through the reel motors creates a torque that allows the tape to enter the vacuum column.

$\overline{LDRDY}$ is also an input to the load fault circuits at U2-12. When $\overline{LDRDY}$ goes low U2-11 allows C48 to charge toward +5 volts at U1-4. The voltage at U1-4 will increase with the time constant of C48 and R74. If the voltage at U1-4 increases above the voltage at U1-5 before the interlock is set, U1-2 and $\overline{LDFLT}$ will go low. This causes $\overline{RST}$ at U35-12 to go low at U31-1, resetting the LDA flip-flop U27 and stopping the load sequence. If the interlock is set before the voltage at U1-4 increases above the voltage at U1-5, $\overline{INTL}$ goes low at U15-1. This causes $\overline{LDRDY}$ to go high and U2-11 goes low causing C48 to discharge through R72. $\overline{LDFLT}$ will remain high allowing the load sequence to complete.

When the tape is in the vacuum columns, the vacuum interlock switches close making VINTL high. With LDA at U33-1 and VINTL at U33-2 high, $\overline{MINTL}$ goes low triggering single shot multivibrator U37 (HOLD). $\overline{MINTL}$ also applies a low at U35-4. Any low at U45 relay driver energized relay K1 connecting the reel and capstan motors to their amplifiers. The tape is now positioned by the reel motors to the center of the vacuum columns. The vacuum interlock switches will stay closed as long as the tape loop stays in the operating range. When relay K1 is energized and the inerlock switches are closed, INTL and INTLA also go high. INTLA at U39-9 is gated with $\overline{PSET}$ at U39-10 causing U39-8 to go low keeping relay K1 energized until $\overline{PSET}$ goes low or either interlock switch is opened.

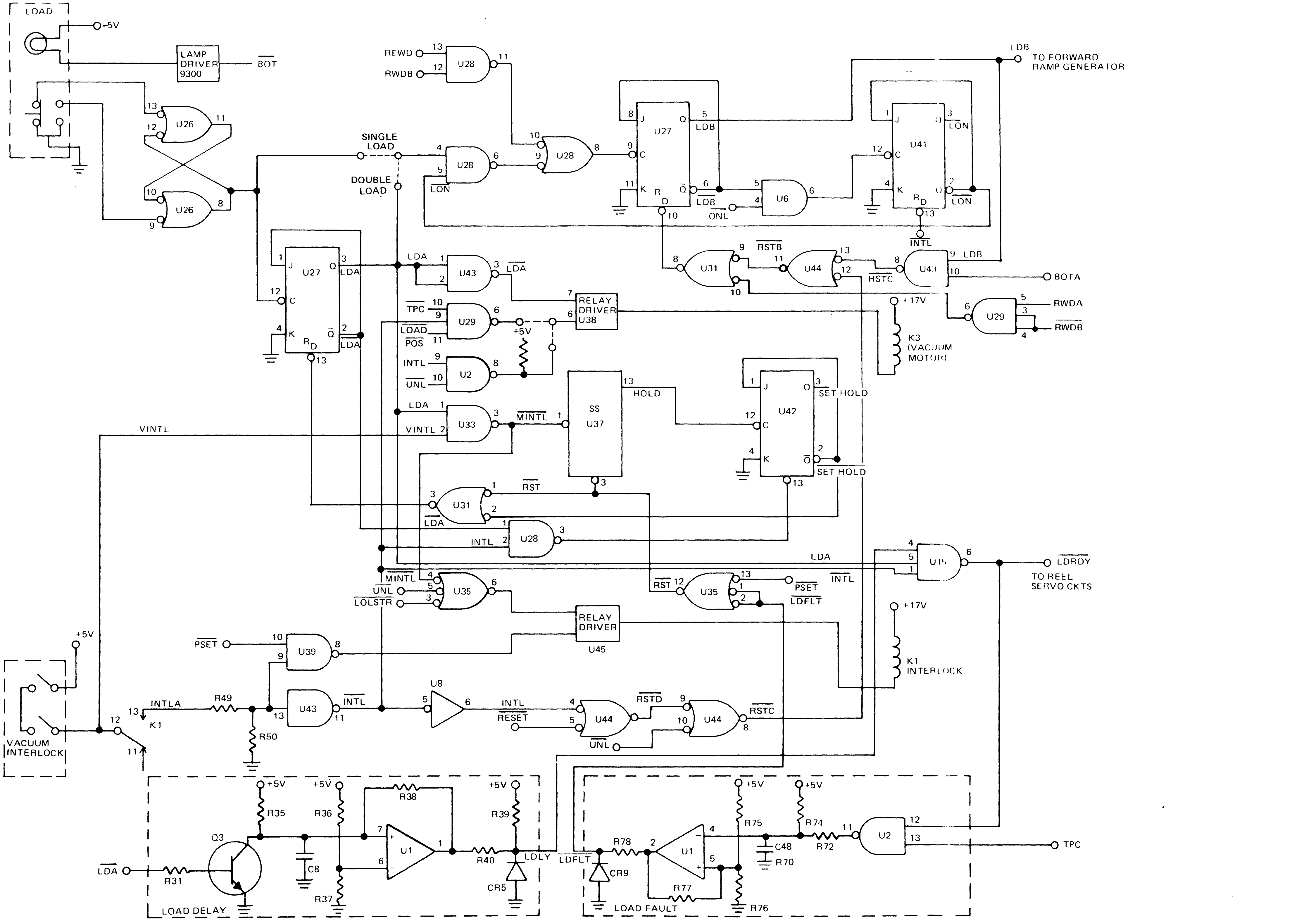
When the HOLD single shot multivibrator U37-13 times out it sets flip-flop U42-3 (SET HOLD). SET HOLD is an input at U31-2 which resets LDA flip-flop U27. Therefore, if the vacuum interlock switches are not closed, relay K1 will be de-energized.

For the single load option LDA at U28-4 is gated with $\overline{LON}$ at U28-5. Since $\overline{LON}$ is high until the tape unit has been loaded, the reset of LDA will cause flip-flop U27-5 (LDB) and flip-flop U41-3 (LON) to be set. LDB is an input to the Forward Ramp Generator which causes the capstan to move the tape forward. When the BOT sensor detects a BOT marker, the BOTA signal at U25-6 goes high. BOTA at U43-10 and LDB at U43-9 are gated at U43-8 applying a low at U44-13. A low input to U44-13 makes $\overline{RSTB}$ to go low at U44-11. $\overline{RSTB}$ is an input to U31-8 which resets LDB at U27-10 stopping tape motion. The tape is now tensioned and stopped at the BOT marker, and the LOAD indicator is lit.

For the double-load option, pressing and releasing of the LOAD switch a second time causes a positive pulse output from U26-8 which is gated with $\overline{LON}$ at gate U28-5. Since $\overline{LON}$ is high until the tape unit has been loaded, the pulse will set flip-flops U27-5 (LDB) and U41-3 (LON). LDB is an input to the Forward Ramp Generator which causes the capstan to move the tape forward. When the BOT sensor detects a BOT marker, the BOTA signal goes high. BOTA at U43-10 and LDB at U43-9 are gated at U43-8, applying a low input at U44-13. A low input at U44-13 makes $\overline{RSTB}$ go low. $\overline{RSTB}$ is an input at U31-9 causing U31-8 to go low, resetting LDB flip-flop U27 and stopping tape motion. The tape is now tensioned and stopped at the BOT marker. The LOAD indicator will be lit.

4-17 Reel Servo Electronics

Figure 4-11 shows a simplified schematic of the Reel Servo electronics. The reel servo electronics consist of two identical circuits: the Supply Reel Servo circuits and the Take-up Reel Servo circuits. Since the operation of both circuits are identical, only the Supply Reel Servo circuit is described.



NOTE: X INDICATES OPEN COLLECTOR GATE.

Figure 4-10. Vacuum Column/Double Load Logic Simplified Diagram

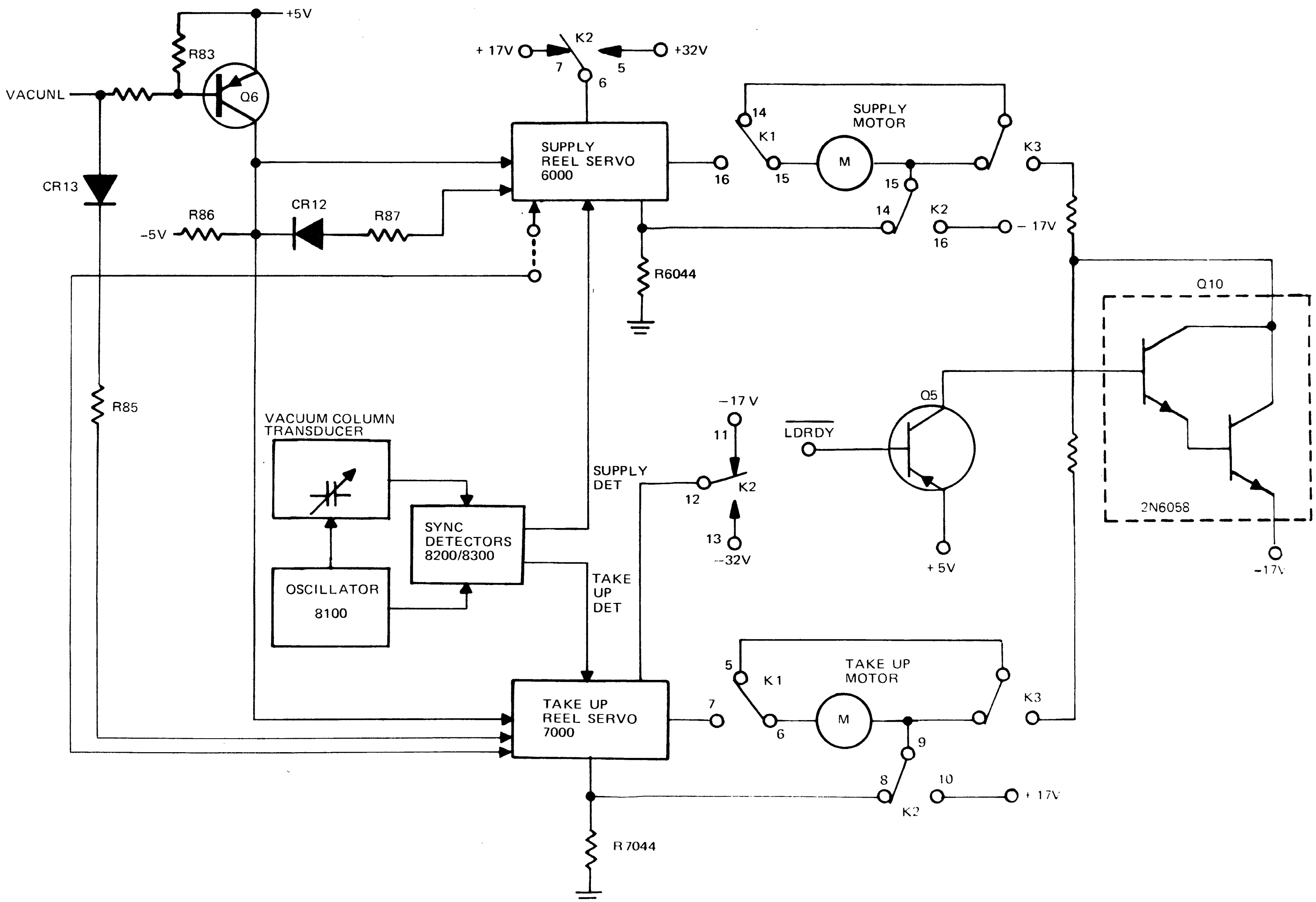


Figure 4-11. Reel Servo Electronics Simplified Diagram

The input to the Reel Servo Amplifier is the tape position sensor. This is a transducer and detector for the Model 2750 Vacuum Column machine. The purpose of the tape position sensor is to provide a voltage that is linearly related to the position of the tape in the operating range.

4-18 VACUUM COLUMN TAPE POSITION SENSOR CIRCUITS

The Model 2750 Dual Vacuum Column machine uses an oscillator that drives the variable capacitor transducer. The output of the capacitor transducer is detected and amplified by a synchronous detector. Figure 4-12 shows a simplified schematic diagram of the vacuum column tape position oscillator and sync detector circuits. The output of the 8100 oscillator is a triangular wave that is determined by the integration of a square wave with R8107, C8101 and U50. For example, when Q8103 and Q8102 are turned on and the output of U50 is at +5 volts, the collector of Q8103 will be at +5 volts and current will flow through R8107, charging capacitor C8101. This will cause the output of U50 to decrease as capacitor C8101 is charged. Capacitor C8101 will charge until the output of U50 reaches –5 volts. At this time, the base of Q8102 will be less than the base voltage of Q8101, turning transistors Q8102 off and Q8101 on. Transistor Q8103 will also be turned off, since R8105 is connected to –5 volts and the output of U50 will increase toward +5 volts. Since the charging rate of C8101 is constant, the output of U50 will have a triangular waveform with a period of 75 microseconds.

The triangular waveform is applied to the vacuum column transducers. The transducers are variable capacitors with a capacitance that varies according to the position of the tape in the vacuum columns. The other plate of the capacitor is connected to an amplifier, one for each column. Since the circuits are also identical, only the Supply Sync Detector (functional module 8300) is described.

The plate of the variable capacitor transducer is connected to pin 2 of amplifier U55. Amplifier U55 has a gain that is the ratio between R8302 and the transducer's capacitive reactance. The amplifier's gain increases at 20 dB per decade. This is the characteristic of a differentiator amplifier. As the capacitance of the transducer varies, the gain of the amplifier will also vary. The output of the amplifier is a square wave since the triangular wave output of the oscillator is differentiated and the amplitude of the square wave will vary according to the transducer's capacitance.

The output of amplifier U55 is connected to a synchronous full wave rectifier composed of U54 and Q8301. A square wave signal from the oscillator is applied to the base of Q8301 through R8305. The negative half of the square wave saturates Q8301, setting pin 3 of U54 at ground potential. At the same time, the output of U55 is also negative and is applied to the inputs, pins 2 and 3, of U54 through R8303 and R8304. Since pin 3 of U54 is grounded, and R8303 and R8306 are equal, the output of U54 is the inverted output of U55 with unity gain.

The positive portion of the oscillator's square wave will turn off Q8301. At this time the output of U55 is also positive. Since the input impedance of U54 is high, very little voltage drop occurs across R8304 and the output of U55 is applied without reduction to pin 3 of U54. The open loop gain of U54 is also very large, so pin 2 of U54 has to also be equal to the output of U55. This will occur only when there is very little voltage drop across R8303 and almost no voltage drop across R8306. This occurs only if the output of U54 is equal to the output of U55. Consequently, the output of U55 is rectified, with the unity gain of U54 applying a positive voltage level output to the Supply Reel Servo circuit.

4-19 REEL SERVO CIRCUITS

The output of the Sync Detector is connected to U6047-2 through a filter network of R6003, C6001, C6002 and R6007. This input network filters out the ripple from the U54 rectifier. Figure 4-13

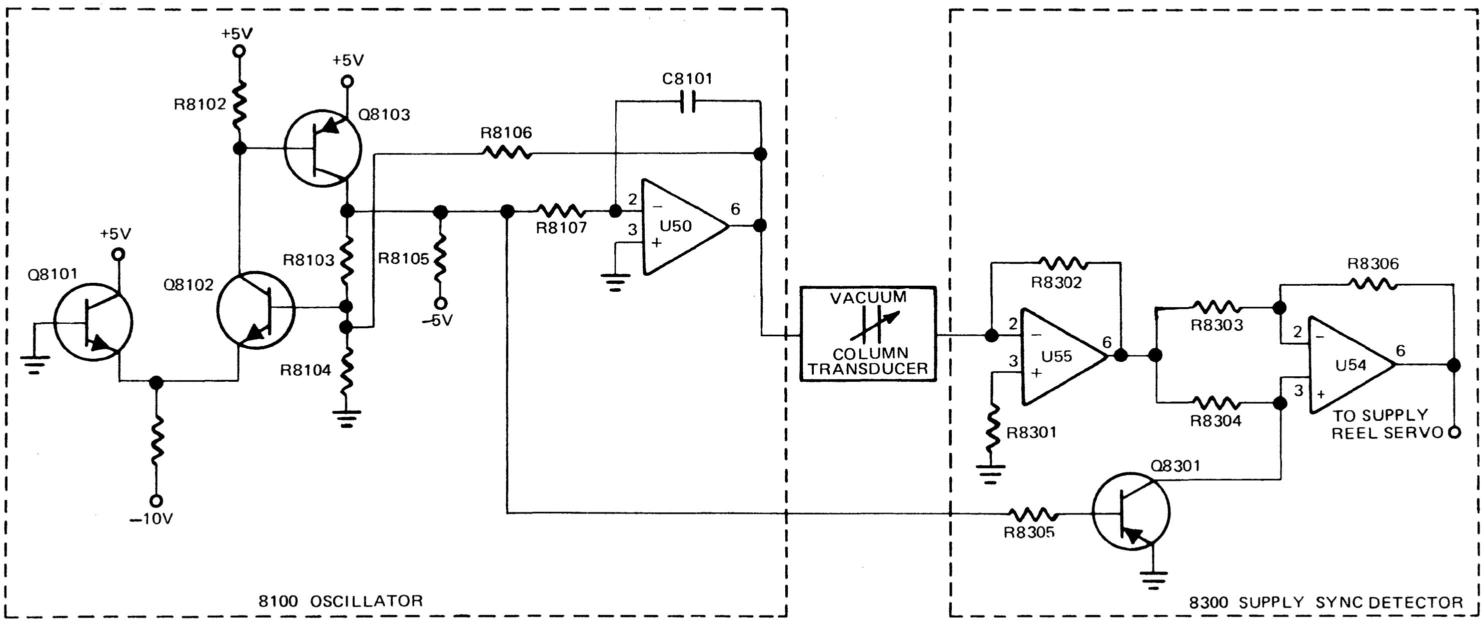


Figure 4-12. Vacuum Column Position Sensor Circuits Simplified Diagram

is a simplified schematic of the reel servo circuits. The feedback around U6047 is the series connection of R6010 and potentiometer R6011. The closed loop gain of U6047 is changed by adjusting potentiometer R6011. Potentiometer R6006 is connected to U6047 through R6008 and is used to adjust the output of U6047 to zero when the tape is positioned in the center of the vacuum column.

U6053, Q6002, Q6003 and 2N6051 and 2N6058 on the heat sink comprise the power amplifier stage of the Reel Servo electronics. R6021 and R6022 are feedback resistors for the amplifier. The output of U6047 is connected to U6053 by either R6015 or R6019 through FET 6004. Since R6019 has a lower resistance than R6015, the gain of the power amplifier stage is about five times greater when R6019 is the input resistor. R6019 is the input resistor when the output of U6047 is greater than ±1.7 volts, or when the tape unit is rewinding. Q4 is turned off when $\overline{\text{RWDC}}$ and $\overline{\text{REWD}}$ are high. This is the case when the tape unit is not rewinding. The collector of Q4 will be at –10 volts as are both sides of R64 since CR8 will be forward biased. This biases the gate of FET Q6001 at –10 volts, turning off Q6001. When $\overline{\text{RWDC}}$ or $\overline{\text{REWD}}$ go low, Q4 will be saturated and its collector will go to +5 volts. The bias voltage at the gate of Q6001 will be increased at a rate determined by the time constant of R64 and C42. When the voltage becomes greater than –0.5 volt, CR6005 will be back biased, turning on FET 6001 and connecting the output of U6047 to R6019. When $\overline{\text{RWDC}}$ and $\overline{\text{REWD}}$ are high again, Q4 is again turned off and C42 is quickly discharged through CR8, turning Q6001 off.

The output of U6047 is also connected to resistor networks R6013/R6014 and R6012/R6017. Since the operation of the networks are identical only the R6012/R6017 network will be described. When there is not current flow through R6019, and since U6053-2 is a virtual ground, the cathode of CR6004 is also ground potential. When the output of U6047 increases to 1.7 volts, CR6004 is forward biased. Any further increase in the output of U6047 will cause the cathode of CR6004 to increase correspondingly. Consequently, R6019 is connected to the output of U6047 whenever the output is greater than 1.7 volts.

Potentiometer R6018 is connected to input of U6053 through R6020 and FET 6004, and is used to adjust the output of the Power Amplifier stage to create a torque in the reel motors to compensate for tape tension, keeping the tape in the center of the range.

During all operations, except unload, FET Q6004 is held in the on condition by the conduction of transistor Q6. During a tape unload sequence, Q6 is turned off when the VACUNL signal goes high. This turns off Q6004 and disconnects the output of U6047 from U6053 (refer to paragraph 4-28).

The output of U6053 is connected to the bases of Q6002 and Q6003. If the output of U6053 increases, Q6002 is turned on, making the collector of Q6002 drop and the base of power transistor 2N6051 will also drop. Power transistor 2N6051 is turned on, causing its collector potential, and the output at TP30 to increase. When the output of U6053 goes negative, Q6003 and power transistor 2N6058 are turned on and the output at TP30 is driven negative.

The output of the reel servo power stage is connected to the reel motor through relay K1. The motor return goes through relay K2 and R6044. The voltage drop across R6044 is connected to U6049 pin 3 by R6039. U6049 and associated components make up a feedback network that prevents motor current from exceeding 14 amps. Closed loop gain of U6049 is set by R6029 and R6040. The output of U6049 is resistor networks R6026/R6025 and R6027/R6028. Since the two networks work the same, only one is described. When the output voltage of U6049 reaches +5.6 volts, CR6007 becomes forward biased. The cathode of U6049 will decrease the output of the power amplifier.

When the tape unit starts to rewind, relay K2 energizes. The 2N6051 transistor in the Supply Reel Servo is connected to +17 volts when K2 is not energized. When K2 is energized, the transistor is

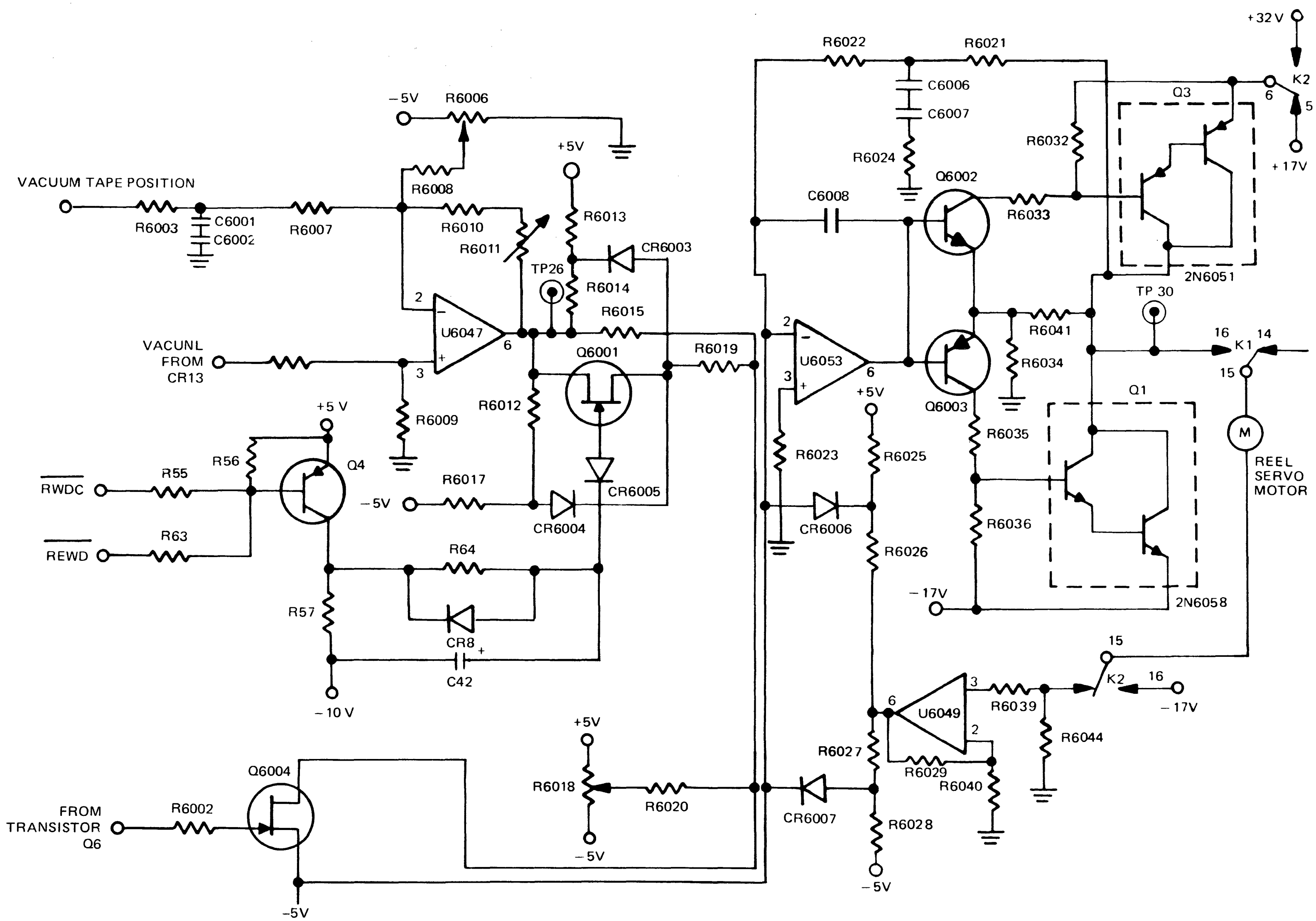


Figure 4-13. Reel Servo Circuits Simplified Diagram

connected to the +32-volt supply. The motor return is normally connected to R6044. However, when K2 is energized, the motor return is connected to –17 volts. Therefore, for the motor to stop, the Supply Reel Servo must have an output of –17 volts, and at the other extreme, the motor can have 49 volts across it. These changes are required so the servo can develop enough voltage to handle the high speed during rewind.

During the unload operation when FET Q6004 is turned off, the VACUNL signal is applied to pin 3 of U6047 from diode CR13. This ensures that Q6004 remains in the turned-off condition.

4-20 Capstan Servo Electronics

The Forward/Reverse Ramp Generator and the Rewind Generator are inputs to the Capstan amplifier. These generators determine the speed, direction and the rise times for the capstan motor and the tape motion. The following paragraphs describe the operation of the two generators and the Capstan Amplifier.

4-21 FORWARD/REVERSE RAMP GENERATOR

The Forward/Reverse Ramp Generator has five inputs, two reverse and three forward. Figure 4-14 shows a simplified schematic of the Forward/Reverse Ramp Generator circuits. These inputs are normally high, and Q5001, Q5002 and Q5003 are turned off. If, for example, $\overline{\text{FORWARD}}$ is set low, Q5001 will conduct at saturation and its collector voltages goes to +5 volts. This biases Q5003 into saturation and the collector of Q5003 goes to –5 volts. Q5003 is connected to pin 3 of U11 through R5011, causing the output of U11 to switch to –10 volts. The –10 volts at U11-6 is connected through R5014 to the cathode CR5002. The cathode of CR5002 is pulled toward –10 volts. However, since the anode of CR5002 is at –5 volts, the voltage at the cathode will be clamped at –5.6 volts. This –5.6 volts is applied across the series connection of R5015 and potentiometer R5020 to U12-2 and to C5001.

Current will flow through R5015 and R5020 and charge C5001 at a constant rate. Since the other plate of C5001 is connected to the output of U12-6 and U12 has a large, open loop gain, the output at U12-6 will increase at a rate determined by R5015, R5020 and C5001. Adjusting R5020 consequently changes the rise time at the output of U12. Feedback resistor R5019 is connected between output of U12 and the input to U11, and is equal to the resistance of R5011. Therefore, when the output of U12 reaches +5 volts, it balances the –5 volts generated by Q5003 at the input of U11-3. Because of the high gain at U11, the output of U11 switches to zero volts and U12-6 is stabilized at +5 volts. Any decrease in output of U12 is regulated by an increase in the output voltage of U11 and charges C5001 back to +5 volts.

The output of U12 is connected through the series connection of R5025 and potentiometer R5026 to the capstan amplifier. Potentiometer R5026 sets the Forward/Reverse capstan speed. When $\overline{\text{FORWARD}}$ goes high, Q5001 and Q5003 are turned off, removing the –5 volts from U11-3. This leaves the feedback resistor R5019 with positive voltage at U11-3 and the output of U11 switches to +10 volts. The anode of CR5001 is clamped to +5.6 volts, causing current flow through R5015 and R5020 to discharge C5001, therefore, decreasing the output of U12. When U12-6 reaches zero volts, the input voltages of U11 are zero and the output of U11 switches to zero volts. The fall time is determined by the discharge rate of C5001 and is equal to the rise time.

The rise/fall ramps and the output of U12 are accurately controlled by the ±5-volt regulators, since the remote voltage sense for these two power supply regulators comes from the Forward/Reverse Ramp Generator circuits.

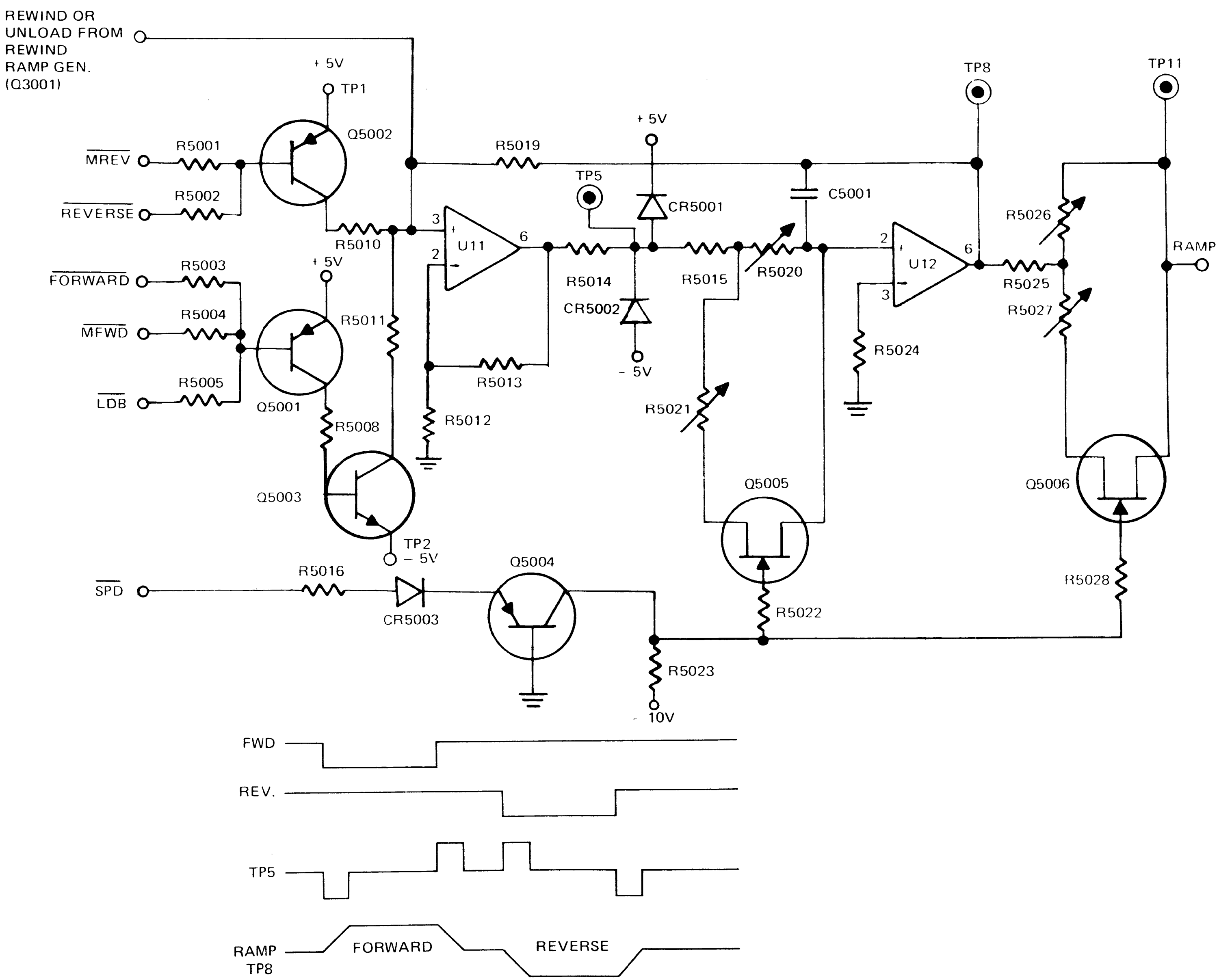


Figure 4-14. Forward/Reverse Ramp Generator Simplified Diagram

For example, if the $\overline{\text{REVERSE}}$ input is set low, Q5002 conducts at saturation, applying +5 volts through R5010 to U11-3. U11-6 switches to +10 volts. Therefore, the operation of the ramp generator is the same as for a forward, except the polarity of the voltages are reversed. The Forward/Reverse Ramp Generator also receives an input from the Rewind Ramp Generator during both rewind and unload operations (refer to paragraph 4-22).

The dual-speed option FET's Q5005 and Q5006 are used to parallel R5020 with R5021 and parallel R5026 with R5027. This will switch to the higher of the two tape speeds. For low-speed operation, SPD is low, back-biasing CR5003 and turning off Q5004. This causes the collector of Q5004 to be pulled to −10 volts through R5023. R5022 and R5028 are also connected to the collector of Q5004 and apply the −10 volts to the gates of Q5005 and Q5006, turning the FET's off and removing potentiometers R5021 and R5027 from the circuit.

To go the higher of the two speeds, $\overline{\text{SPD}}$ is set high, forward-biasing CR5003 and causing Q5004 to conduct. R5002 and R5028 are pulled by Q5004's collector to about 3 volts, turning on FET's Q5005 and Q5006. FET Q5005 parallels R5021 and R5020, increasing the rise/fall times of the ramp generator. Q5006 parallels R5027 and R5026, decreasing the resistance of the input resistor to the capstan amplifier and increasing the speed.

4-22 REWIND RAMP GENERATOR

The second input to the Capstan Amplifier comes from the Rewind Ramp Generator. During rewind operations, the Rewind Ramp Generator is used to generate a negative ramp output to the Capstan Amplifier. It also contains a switching transistor that causes the Forward/Reverse Ramp Generator to generate a negative ramp output during both rewind and unload operations. Figure 4-15 shows a simplified schematic of the rewind ramp generator. Inputs to the ramp generator are the rewind signal $\overline{\text{RWRD}}$ and unload signal $\overline{\text{UNL}}$. These two signals are normally high. Consequently, during normal operation, Q3002 conducts at saturation and Q3003 and Q3001 are turned off, and the REWD output is low.

During a rewind operation, a low input from $\overline{\text{RWRD}}$ sets the anode of CR3003 low, turning off Q3002 and allowing C3001 and C3002 to charge toward −10 volts through R3006. The potential at U30-10 will move toward −10 volts, causing it to go more negative than U30-11. This causes the output of U30 and REWD to switch high. As C3001 and C3002 continue to charge, the base of Q3003 becomes negative, turning on Q3003. As C3001 and C3002 continue to charge, the potential at the emitter of Q3003 will increase at the same rate until Q3003 conducts at saturation, holding the emitter at −5 volts. The input resistors to the Capstan Amplifier are R3008 and potentiometer R3013 which set the rewind speed.

When $\overline{\text{UNL}}$ or $\overline{\text{RWRD}}$ go low, the base of Q3001 becomes negative, causing Q3001 to conduct at saturation. Q3001 then applies +5 volts through resistor R3010 to U11-3 in the Forward/Reverse Ramp Generator. This causes the Forward/Reverse Ramp Generator to generate a negative ramp output to the Capstan Amplifier. When $\overline{\text{RWRD}}$ and $\overline{\text{UNL}}$ both are high, Q3002 turns on, forcing C3001 and C3002 to charge towards +5 volts through R3001. The voltages at the base and emitter of Q3003 move towards +5 volts and when the base reaches ground potential, Q3003 is turned off. U30-10 is then more positive than U30-11 and U30-13 switches to −10 volts. REWD is then clamped low by CR3004.

4-23 CAPSTAN AMPLIFIER

The outputs of the two ramp generators are connected to U20-2. Since pin 2 is the summing junction of the Capstan Amplifier, the adjustment of the ramp generators output potentiometer set the capstan amplifier's output voltage and, consequently, the tape speed. See figure 4-16. Offset potentiometer

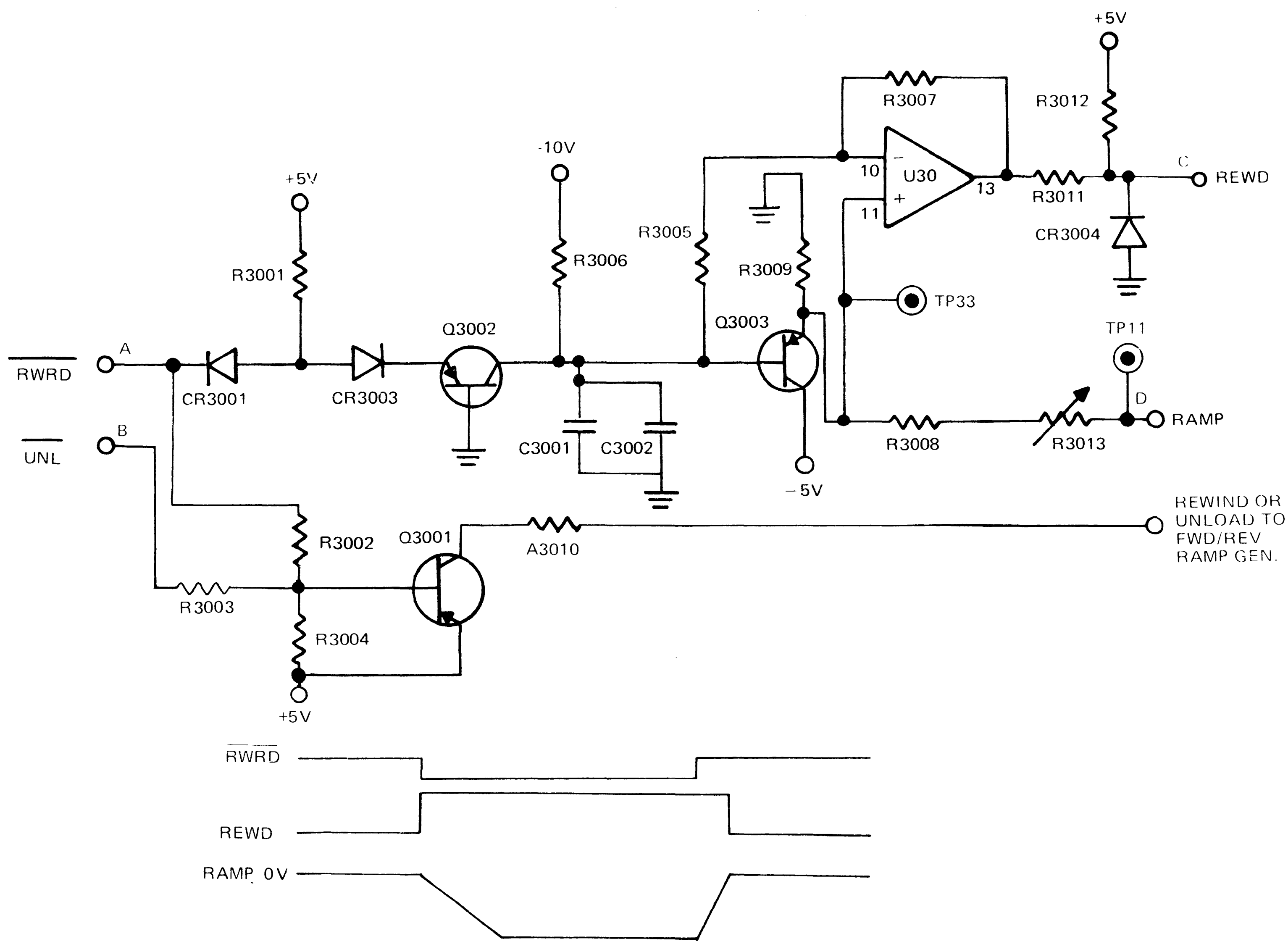


Figure 4-15. Rewind Ramp Generator Circuit Simplified Diagram

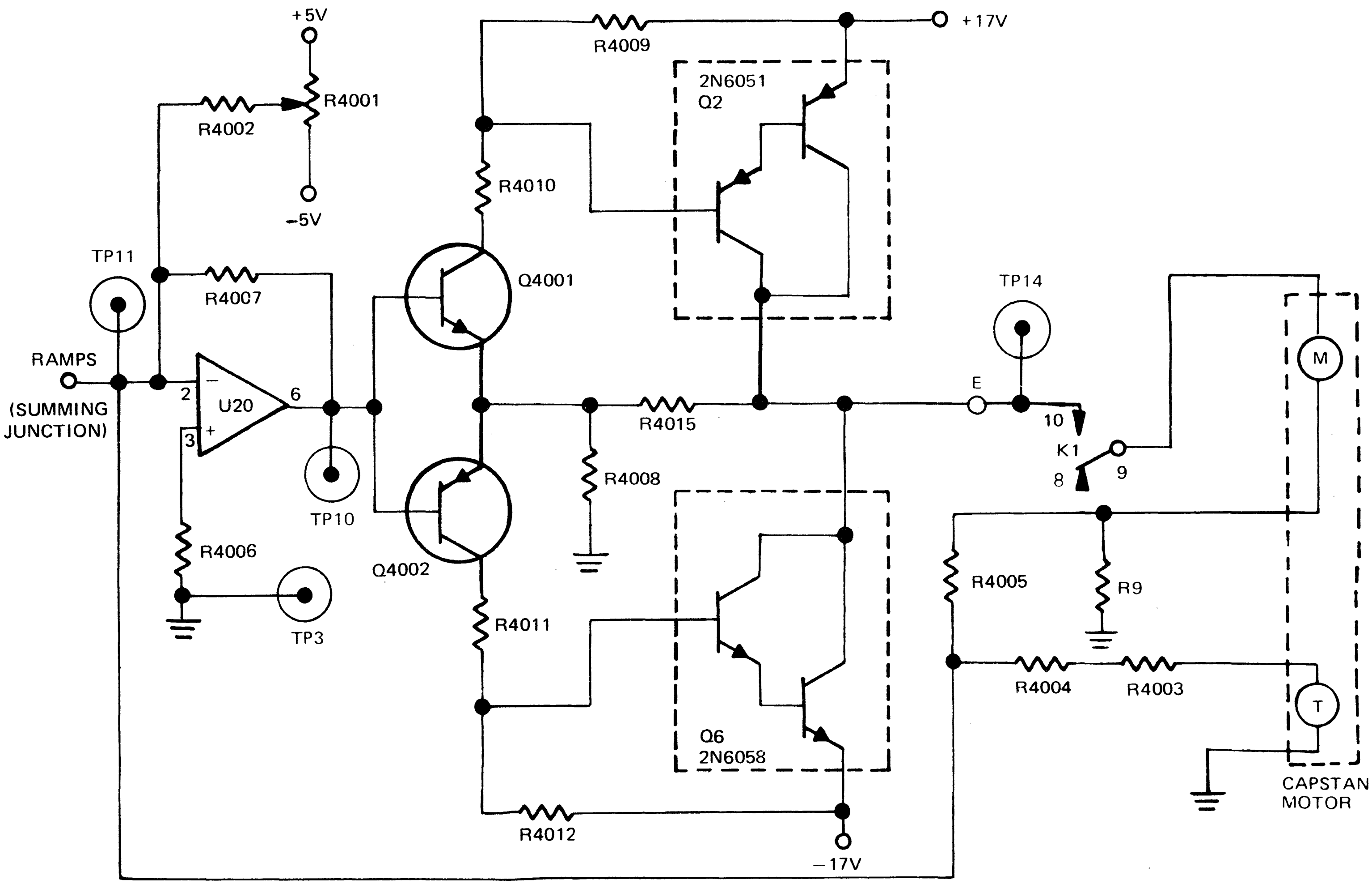


Figure 4-16. Capstan Amplifier Circuit Simplified Diagram

R4001 is connected to U20-2 through R4002. The output of U20-6 is set to zero by R4001, compensating for component variations. Feedback resistor R4007 sets the gain of U20. U20 drives the bases of Q4001 and Q4002, creating a null region since Q4001 and Q4002 are turned on only when the output of U20-6 has reached ±0.6 volt. Since both halves of the power amplifier are identical, only one half will be described.

If, for example, the output of U20-6 is greater than 0.6 volt, Q4001 is turned on. The base of the 2N6051 power transistor is lowered and the collector increases the voltage at the output (E). Consequently, a positive output at U20-6 will cause the output of the Capstan Servo at pin E to be positive.

The output of the Capstan Amplifier is connected through relay K1 to the Capstan Motor. The Capstan Motor return is connected to ground through R9. Current feedback is accomplished by R4005 which senses the voltage drop across R9. A tachometer is attached to the Capstan Motor and the output is connected to the Capstan Amplifier's summing junction through R4003 and R4004. The tachometer allows the Capstan Servo to accurately regulate the Capstan speed.

4-24 On Line/Off Line Logic

Figure 4-17 shows a simplified schematic diagram of the On Line/Off Line circuit. After completion of the load sequence, when LON is set, the tape unit is put on line by momentarily engaging the ON LINE switch. As a result, flip-flop U40-8 produces a negative pulse output which toggles the flip-flop at U41-9 through gate U40-6. Flip-flop U41-5 is set because it was reset during the load sequence by the low $\overline{\text{RSTC}}$ signal at U35-10. The ON LINE lamp driver is driven by a low at U41-6 which turns on the ON LINE indicator. When gate U2 is enabled by the SLTB signal, the output of U2-3 is low, asserting the IONL signal. If the ON LINE switch is pressed again, flip-flop U41-5 will be reset. Flip-flop U41-5 can also be reset by pressing the RESET switch, producing a negative pulse output from U39-3 $\overline{\text{(RESET)}}$. This causes $\overline{\text{RSTD}}$ to go low at U44-6, and $\overline{\text{RSTC}}$ to go low at U44-8 and U35-10. A low input to U35-10 causes U35-8 to go low, resetting U41-5.

The external controller can also set the tape unit off line by asserting the IOFFL signal input through J101-L/J102-L. When IOFFL is asserted, U39-11 goes low, causing U35-8 to go low. The low output of U35-8 is applied to U41-10, resetting flip-flop U41-5.

When the tape unit is equipped with the Auto Load On-Line option, the tape unit is automatically placed on-line after the tape has been loaded on the tape unit. When the tape has been loaded, the LDB flip-flop U27 is set as previously described in the circuit description for the Load Logic circuits. The LDB signal is an input to the Forward Ramp Generator and causes the capstan to move the tape toward the BOT marker. The setting of the LDB flip-flop also produces a high input at U3-1. Since a rewind operation is not taking place, the $\overline{\text{RWDA}}$ signal at U3-2 is also high. This causes the LOLSTR signal at U21-11 to go high. The high LOLSTR signal is applied to U40-1. Since flip-flop U41-9 is not set at this time, the $\overline{\text{ONL}}$ signal at U40-2 is also high. This results in a low output at U40-3 which enables flip-flop U41 with a high input at U41-9. The tape is stopped at the BOT marker when LDB is reset (refer to the circuit description for the Load Logic circuits, paragraph 4-16). LDB low causes the LOLSTR signal to go low, setting flip-flop U41. The low output from U41-6 causes the ON LINE indicator to illuminate. When the STLB signal at U2-2 is high (tape unit address selected or continuous high), the IONL signal to the controller is asserted.

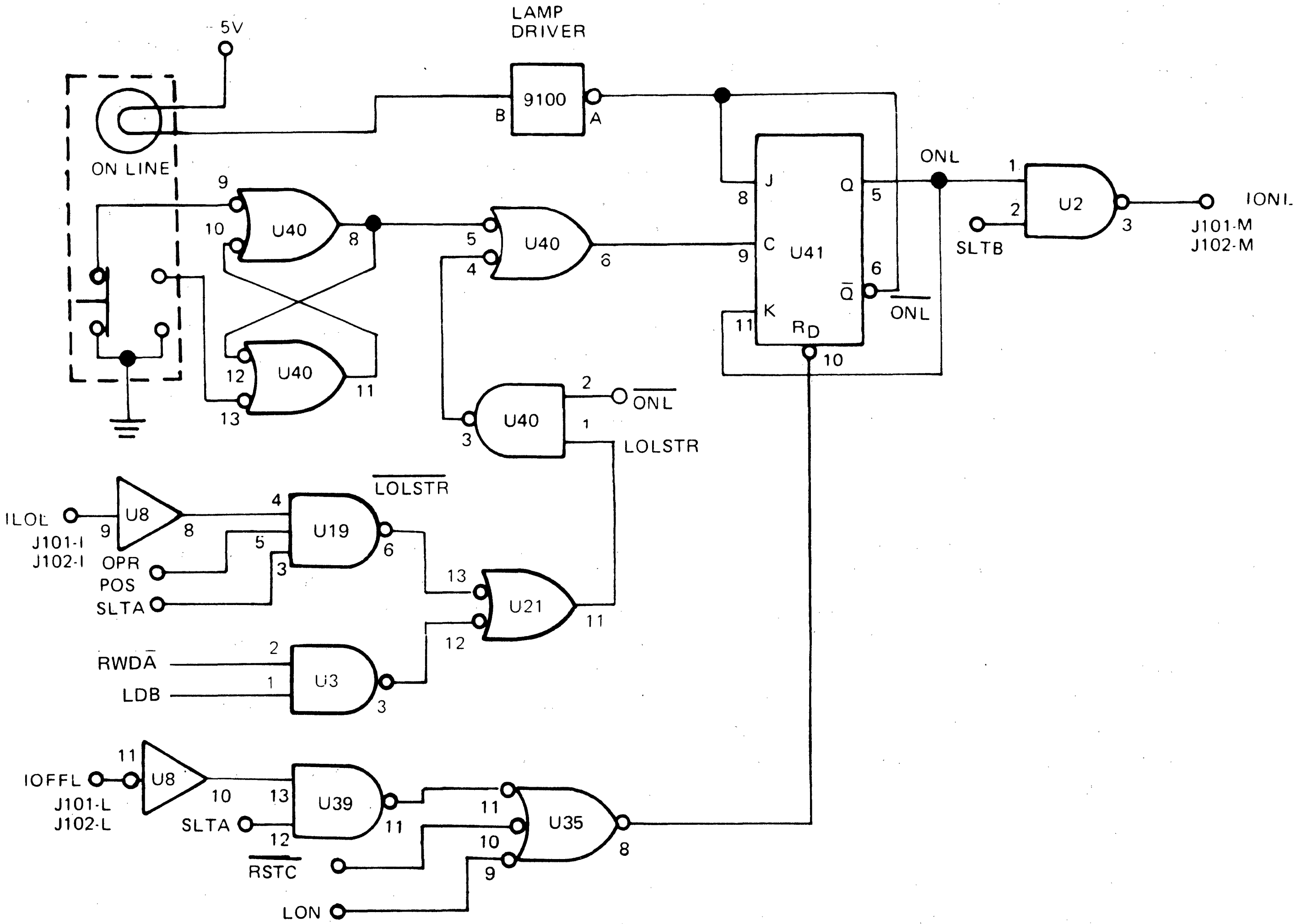


Figure 4-17. On-Line/Off-Line Logic Circuits Simplified Diagram

4-25 Address Logic

Figure 4-18 shows a simplified diagram of the address logic. The address logic circuits, on recognition of the tape unit's address, enables the tape unit to respond to external commands and to drive the interface lines. If only one tape unit is connected, the external controller must still assert the correct ISELECT input. When the tape unit is addressed, the low input is inverted at U5-13, and a high is applied to U13-5. If P8-6 and 3 are connected, the tape unit must be on line with ONL high at U13-4 before U13 can respond to the input. When U13-6 output $\overline{\text{SLTA}}$ goes low, the SELECT output to the Data Electronics at U16-4 goes high, as does the SLTA output to the control electronics at U16-6. $\overline{\text{SLTA}}$ also drives the RESET light, indicating the tape unit is selected. The SLTB output at U16-8 is either continuously high, pins P3-3 and 9 connected, or it is gated high in the same manner as the SLTA output. If pins P3-7 and 1 are connected, the SLTC output from U5-12 is high when the unit is addressed. If pins P3-4 and 1 are connected, the SLTC signal duplicates the SLTB signal at U16-8.

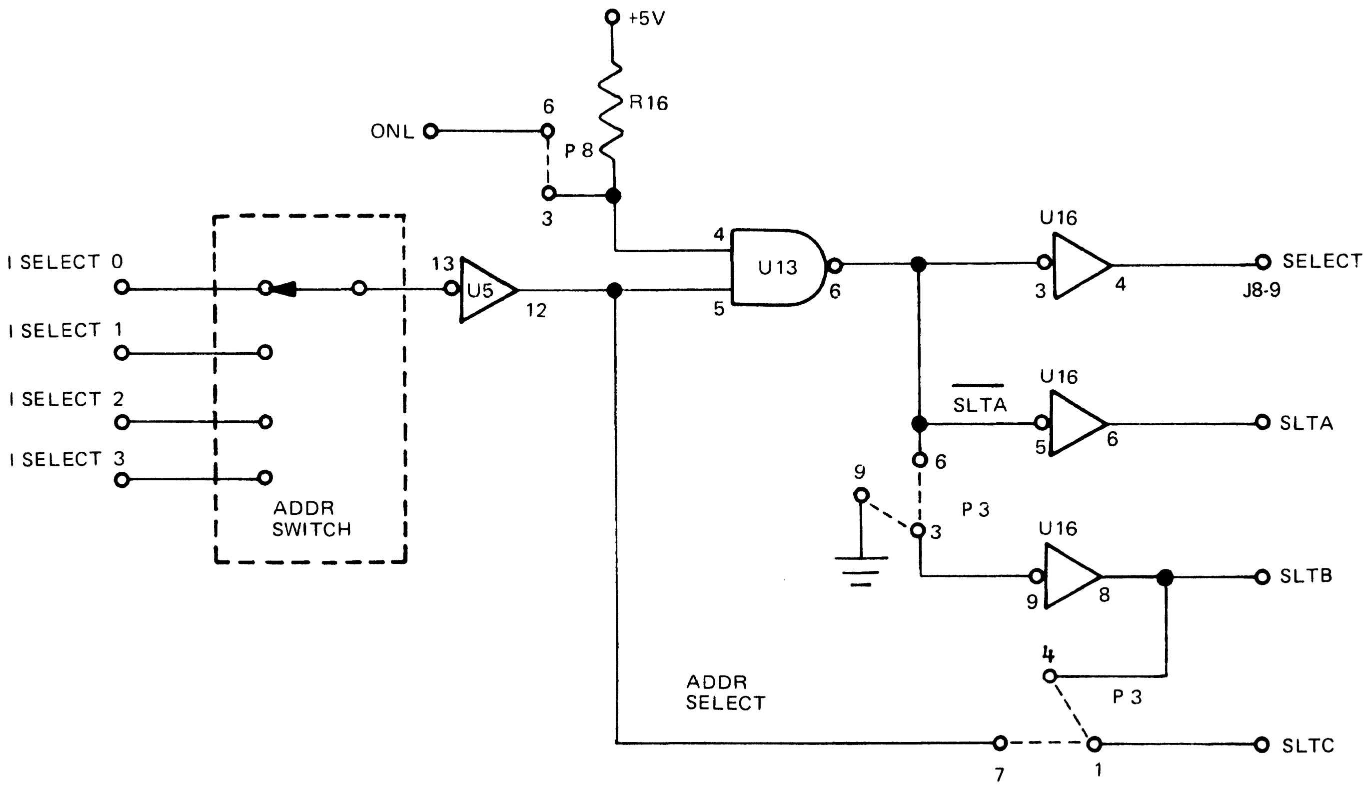


Figure 4-18. Address Logic Circuit Simplified Diagram

4-26 Forward/Reverse Control Circuits

Figure 4-19 shows a simplified schematic diagram of the forward/reverse control citcuits. When the tape unit is on line, selected, not rewinding or loading, and all interlock conditions are set, it is able to respond to external command inputs. At this time the output of U2-6, IRDY is low and ORS is high. When ISFC is asserted by the external controller, gate U3-6 produces a low output that goes to the Forward/Reverse Ramp Generator. As a result, the Forward/Reverse Ramp Generator produces a positive-going ramp output that goes to the Capstan Amplifier. This ramp output will eventually stabilize at some DC voltage suitable for the tape speed requirements of the specific machine.

Tape movement in the reverse direction, at synchronous speed, is initiated when the external controller asserts the ISRC signal. In this instance, the Forward/Reverse Ramp Generator responds by producing a negative-going ramp output, driving the capstan motor in the reverse direction.

When the tape unit is not on line, and RDY is high, RDYNOL at U6-8 is high, enabling gates U4-6 and 8. This enables manual Forward/Reverse control using switch SW1. The manual Forward command is gated with $\overline{\text{EOT}}$ which prevents the tape from being run off the end of the reel. $\overline{\text{BOT}}$ is gated with the manual reverse to prevent the tape from running off the beginning of the reel.

4-27 Write/Overwrite Control Circuit

Figure 4-20 shows a simplified schematic diagram of the write/overwrite control circuit, and figure 4-21 shows the write/overwrite timing diagram. To record data, the ISFC and ISWRT signals must be asserted. When the ISFC signal is asserted, the $\overline{\text{FORWARD}}$ input to U3-9 is low and the output of U3-8 is

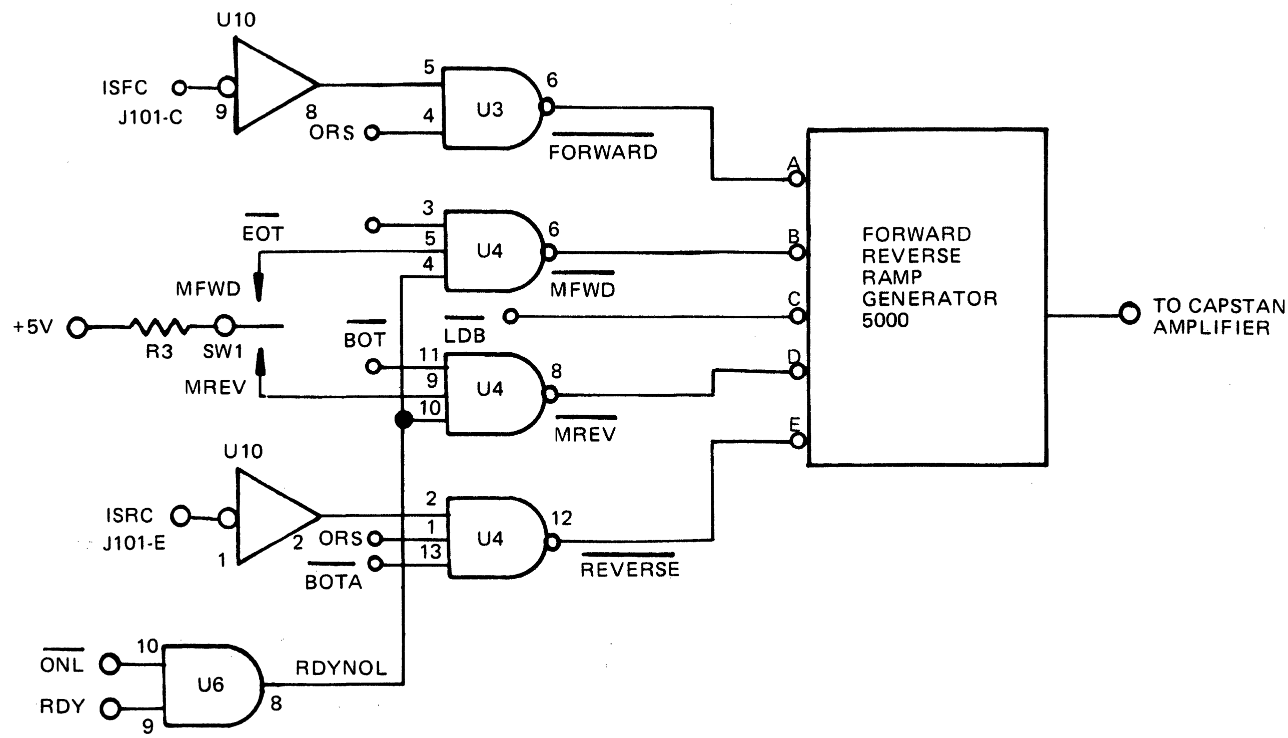


Figure 4-19. Forward/Reverse Control Circuits Simplified Diagram

high, producing a high MOTION signal input to U3-12 and a low $\overline{\text{MOTION}}$ output, via J8-10, to the Data Electronics. The MOTION signal is delayed by the R5 and C1 time constant at U3-13 and differentiated by C2, R66, R67 generating a pulse at TP6 that is used as the clock input to flip-flops at U9-12, U9-9 and U14-1. With the ISWRT input asserted, the SWRT output of U9-3 is clocked high. With the IOVW not asserted, a high is applied to U9-11 which results in the U9-6 output being clocked high. The two high levels are applied to gate U14-4 and 5, forcing the output of U14-6 low. This low is coupled through U14/U22, producing a low $\overline{\text{WRITE ENABLE}}$ output at J8-6 to the Data Electronics.

To perform an overwrite operation, the ISFC, ISWRT, and IOVW inputs must all be asserted (see figure 4-21). When these signals are asserted, flip-flops U9-3, U9-5, and U14-3 are set. Gate U14-6 is inhibited by the $\overline{Q}$ output of U9-6. However, all inputs to gate U15 are high and a $\overline{\text{WRITE ENABLE}}$ output to the Data Electronics is produced. Near the end of a record in which the overwrite sequence is occurring, the $\overline{\text{LRC}}$ input at U14-13 is set low, resetting the U14-3 output low. Consequently, the $\overline{\text{WRITE ENABLE}}$ is set high, ending the overwrite operation.

4-28 Rewind/Unload Control Circuits

Figure 4-22 shows a simplified diagram of the Rewind/Unload Control circuits. A tape rewind operation is initiated when either the external controller asserts the IREW signal or when the REWIND switch/indicator is pressed. If the tape is positioned with the BOT marker at the BOT/EOT sensor and the REWIND switch is momentarily engaged, the tape unit will perform a tape unload sequence.

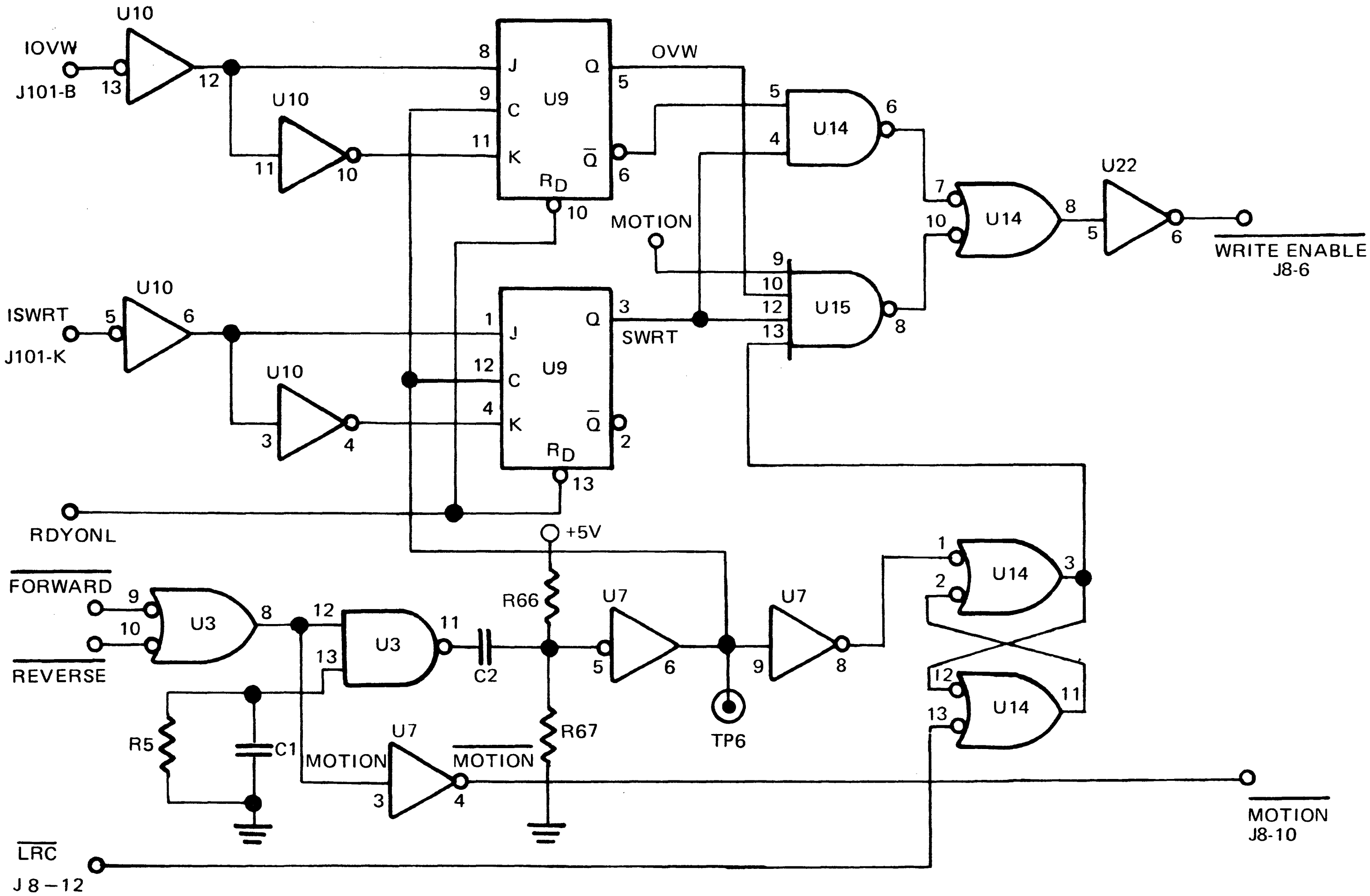


Figure 4-20. Write/Overwrite Control Circuits Simplified Diagram

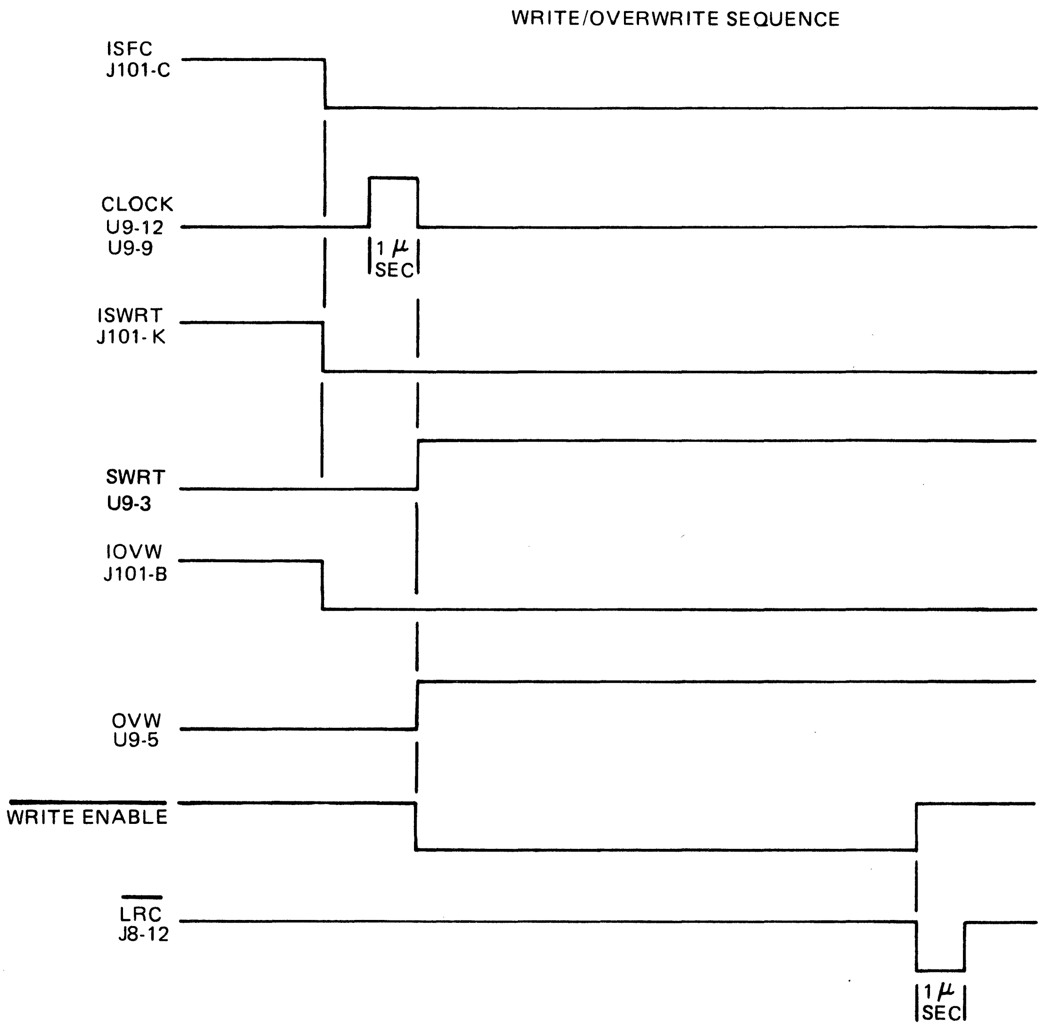


Figure 4-21. Write/Overwrite Timing Diagram

To unload, for example, the REWIND switch is pressed and then released, and U26-3 produces a positive pulse output. When the tape BOT marker is at the BOT/EOT sensor and the $\overline{\text{RWDA}}$ and $\overline{\text{ONL}}$ are high, U29-12 produces a negative pulse output, setting the UNL output U32-6 low. U32-3 (RWDA) is not set because the $\overline{\text{RSTA}}$ signal is low when the tape BOT marker is at the BOT/EOT sensor.

When the $\overline{\text{UNL}}$ signal at U32-6 goes low, $\overline{\text{RSTC}}$ and $\overline{\text{RSTA}}$ are kept low and the $\overline{\text{UNL}}$ input of U2-10 also goes low. This de-energizes relay K3, turning off the vacuum motor. At the same time, the $\overline{\text{UNL}}$ input at U35-5 goes low. This keeps interlock relay K1 energized after the interlock switches have opened. At the same time, the $\overline{\text{UNL}}$ signal at pin B of the Rewind Ramp Generator also goes low and turns on transistor Q3001. The collector of this transistor is connected to the Forward/Reverse Ramp Generator. When Q3001 conducts, it causes the Forward/Reverse Ramp Generator to generate a negative ramp output. As a result, the capstan motor is driven in the reverse direction.

Tape on the take-up reel is pulled off by the capstan, and the interlock switches open. This causes the $\overline{\text{INTL}}$ signal at U31-12 to go high. With high inputs at pins 12 and 13 of U31, the VACUNL signal at pin 11 goes high. This turns off transistor Q6, thereby turning off FETs Q6004 and Q7004 in the

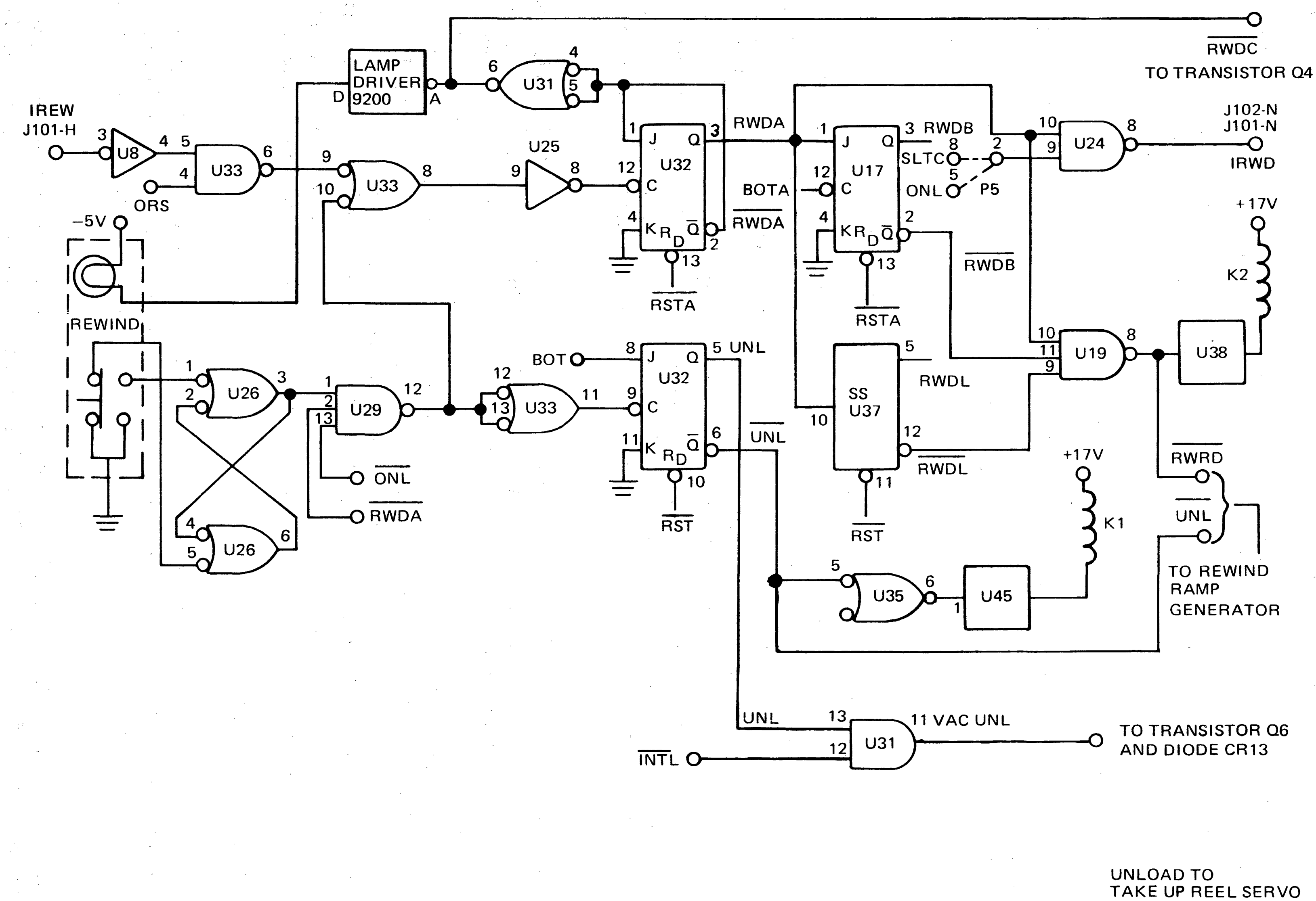


Figure 4-22. Rewind/Unload Control Circuits Simplified Diagram

Supply Reel and Take-up Reel Servos, respectively. The high VACUNL signal applied to the Supply Reel and Take-up Reel Servos from CR13 ensures that Q6004 and Q7004 remain in the turned-off condition.

The supply reel motors keep turning until the tape has been pulled out of the EOT/BOT assembly. When this occurs, the TPC signal at U2-13 goes low and the output at U2-11 goes high. This allows capacitor C48 to charge through resistor R74. When the voltage at U1-4 reaches the voltage at U1-5, the output of U1 switches to –10 volts and $\overline{\text{LDFLT}}$ is clamped low at –0.6 volt by CR9. When $\overline{\text{LDFLT}}$ goes low, it causes the $\overline{\text{RST}}$ signal at U35-12 to go low. This resets flip-flop U32, causing the UNL signal to go low.

When the tape is not positioned at the BOT marker and the external controller asserts the IREW signal or the REWIND switch is pressed, the tape will rewind at 250 ips. When the IREW signal is asserted, the output of U33-6 goes low, setting U32-3. The low $\overline{\text{RWDA}}$ signal at U32-2 causes the REWIND indicator to illuminate and also causes the $\overline{\text{RWDC}}$ signal at U31-6 to go low. The low $\overline{\text{RWDC}}$ signal is applied to transistor Q4 through R55. This causes Q4 to saturate and turn on the high gain FETs Q6001 and Q7001 in the Supply Reel and Take-up Reel Servos, respectively. The RWDA output, now high, asserts the IRWD status signal to the external controller at J101-N/J102-N.

The RWDA signal is also applied to gate U19-10 and single-shot U37-10. The high RWDA signal triggers U37. When single-shot U37-12 has timed out, all inputs to gate U19 are set high. The output of U19-8 goes low and energizes relay driver U38. When relay K2 is energized, ±32 volts is applied to the reel servos instead of the ±17 volts. Relay K2 also changes the motor return voltage. The higher voltage enables the reel servos to be driven at the increased tape speed. Gate U19-8 also applies a rewind command, a low $\overline{\text{RWRD}}$ signal, to the base of transistor Q3001 in the Rewind Ramp Generator. This turns Q3001 on and causes the Forward/Reverse Ramp Generator to generate a negative ramp output in conjunction with the Rewind Ramp Generator. This negative ramp is applied to the Capstan Amplifier and causes the Capstan Amplifier to drive the capstan motor in the reverse direction at the increased speed of 250 ips. The low $\overline{\text{RWRD}}$ signal to the Rewind Ramp Generator also causes the REWD signal from the Rewind Ramp Generator to go high.

When the tape passes the BOT marker, RWDB at U17-3 is set high by the BOTA pulse from U25-6 which sets flip-flop U17. This causes the $\overline{\text{RWRD}}$ signal at U19-8 to go high. When the $\overline{\text{RWRD}}$ signal goes high, transistor Q3001 is turned off, the REWD signal goes low, and the rewind relay K2 is de-energized. The Forward/Reverse Ramp Generator and the Rewind Ramp Generator ramp down until the capstan has stopped. Since the RWDB signal is high, LDB at U27-5 is set high when the REWD signal goes low at U21-1,2 and causes flip-flop U27 to set through NOR gate pin U28-8. The low $\overline{\text{LDB}}$ signal at U27-6 is applied to the Forward/Reverse Ramp Generator and causes the capstan to be moved forward until the BOT marker is detected. When the BOT marker is detected, $\overline{\text{RSTB}}$ goes low, causing $\overline{\text{RSTA}}$ to go low. This resets LDB, RWDA, and RWDB. The tape is positioned at the BOT marker. If the REWIND switch is momentarily pressed again, the tape unloading sequence previously described will be performed by the tape unit.

4-29 EOT/BOT Control Logic

Figure 4-23 shows a simplified schematic diagram of the EOT and BOT control logic. These circuits are used to provide an indication when the tape has passed or is positioned at the EOT or BOT marker. The output of the EOT/BOT circuits are passed through appropriate interface circuits to the external controller.

The output of both the EOT and BOT amplifiers is normally low, going high when active. Since both amplifier circuits are identical, only the EOT amplifier will be described. The output of the EOT amplifier goes high when the EOT marker is in front of the EOT phototransistor.

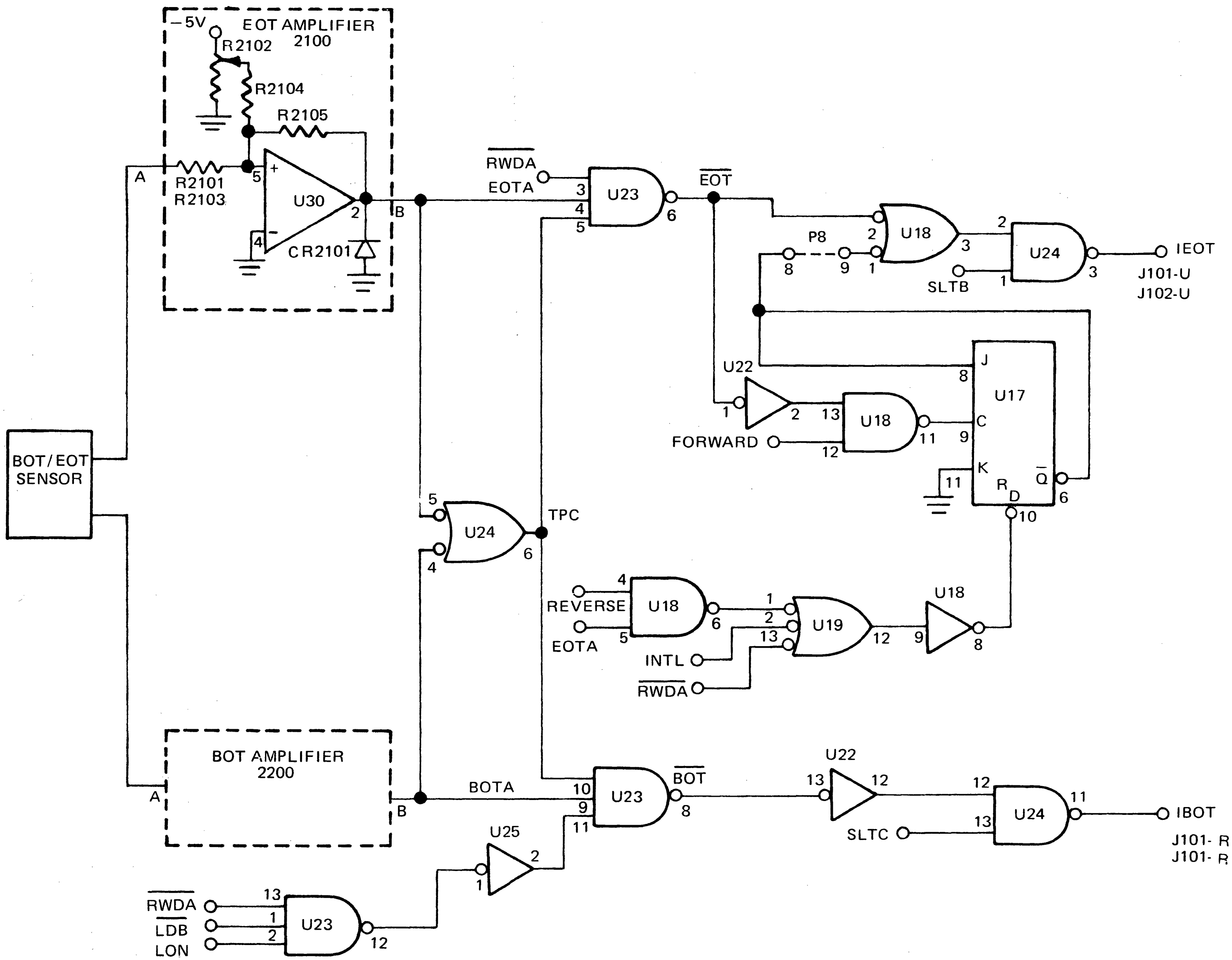


Figure 4-23. EOT/BOT Control Logic Circuit Simplified Diagram

Initially, the current through R2104 is set with blank tape in front of the EOT phototransistor so that the voltage at U30-5 is negative. When U30-5 is more negative than U30-4, the output of U30-2 is negative and pin (B) of functional module 2100 is clamped to –0.6 volt by CR2101. The phototransistor receives an increase of light from the EOT reflective marker, creating an increase of current through R2101 and R2103. The increase in current caused by the EOT marker creates an increase in voltage drop across R2104 so that U30-5 goes positive. The output now switches, high, setting EOTA.

EOTA is applied to NAND gates U23-4 and U24-5. When the tape has been removed from in front of the EOT/BOT assembly, the reflector post in front of the assembly reflects the light, setting both BOT and EOT amplifiers high. Two highs at U24-4 and 5 set TPC at U24-6 low, gating $\overline{\text{EOT}}$ high at U23-6. If the tape unit is rewinding, $\overline{\text{RWDA}}$ at U23-3 is also low, preventing EOT from asserting IEOT through U18-3. EOT through U18-11 sets U17-5 when the FORWARD is asserted at U18-12. If the jumper between pin P8-9 and 8 is connected, the output of U17-6 is connected to U18-1, asserting IEOT at J101-U/J102-U whenever the EOT marker has been passed in the forward direction. U17-5 is reset when the marker has been passed in the reverse direction, a rewind operation is initiated, or the interlock is broken.

BOTA is gated with TPC, $\overline{\text{RWDA}}$, $\overline{\text{LDB}}$ and LON from U23-12 at U23-11. IBOT at J101-R/J102-R is not asserted if the tape unit is loading, rewinding or the tape is not on the tape path.

4-30. Density Select Circuits

Figure 4-24 shows a simplified diagram of the density select circuits. When the density select option is selected, pin P8-1 and 4, and pins P8-2 and 5 are connected. Therefore, when either input at

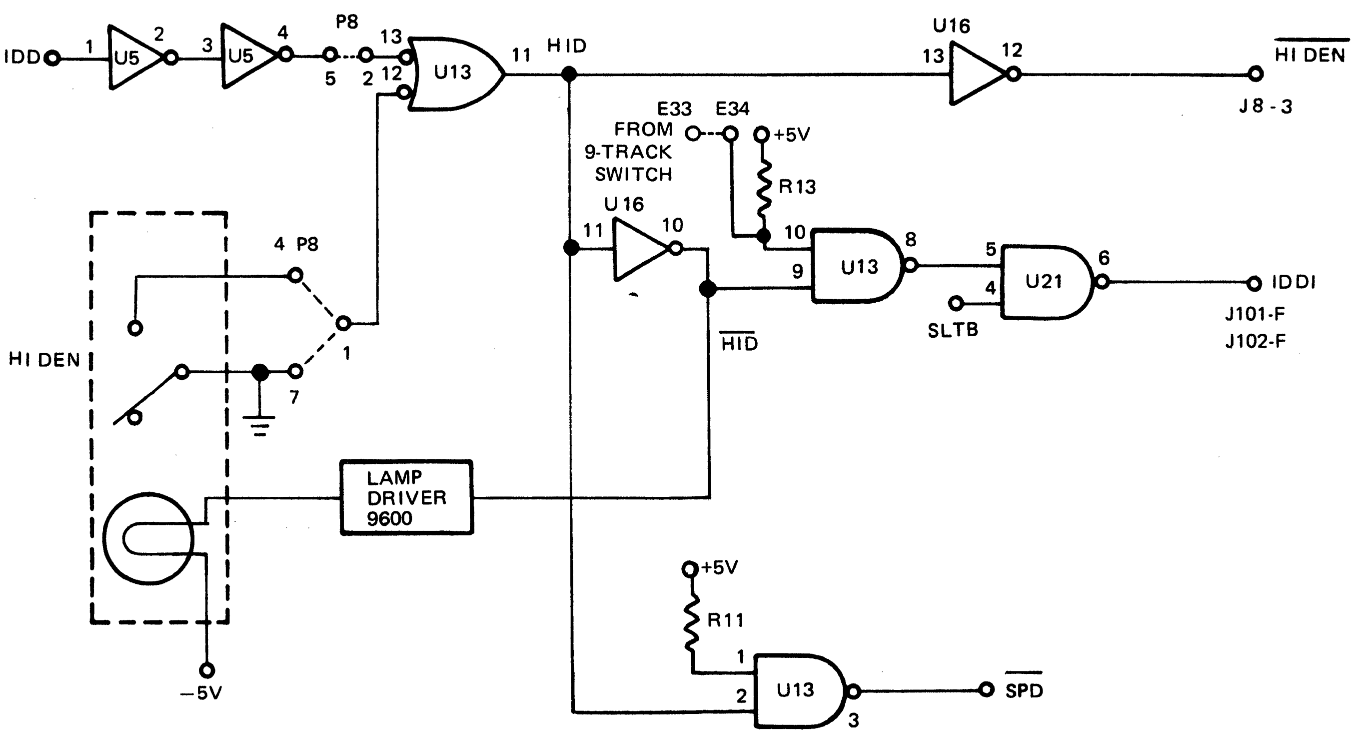


Figure 4-24. Density Select Circuits Simplified Diagram

U13-12 or 13 goes low, the output U13-11 goes high. As a result, the $\overline{HI}$ $\overline{DEN}$ lamp is illuminated and the HI DEN output to the data electronics at J8-3 is set low. In addition, the SLTB signal gates the output of U13-8 through line driver U21-6, setting the IDDI output at J101-F/J102-F low. The IDDI output indicates high density operation to the external controller. When the dual-speed option is used, high density asserted, HID at U13-11 will cause SPD at U13-3 to go low, causing the tape unit to operate at the slower speed.

When the quad density option is used and phase encoded operation is selected, the tape unit will operate at the lower of the two tape unit speeds. The SPD signal for this mode will go low when the IDD signal from the controller goes low. In the 7- and 9-track NRZI modes of operation, the tape unit will operate at the higher speed. The $\overline{SPD}$ signal for these modes is held high, regardless of density selection. High or low density can be selected only for 7-track NRZI operation with the quad density option. The 9-track switch option is used with the quad density option, and when in the 7-track position, causes the IDDI signal to go low when high density is selected. This also causes the 9-track signal to the data electronics to go low, indicating 7-track operation. For both the 9-track NRZI and phase encoded modes of operation, only high density is used. Therefore, the IDDI signal to the controller will go low (indicating high density) for all modes of quad density operation, except 7-track NRZI low density operation.

The dual-speed option is not used for single density operation. The single density for 7-track NRZI operation can be high or low.

4-31 File Protect Circuit

The file protect circuit (see figure 4-25) can be connected as either a file protect circuit or a write enable circuit. When connected as a file protect circuit, the indicator lamp is illuminated when a file reel without a write ring is mounted on the tape unit. This indicates that writing or erasing on the tape is not possible. When connected as a write enable circuit, the indicator lamp is illuminated when a file reel with a write ring is mounted on the tape unit. This indicates that writing or erasing on the tape can be performed.

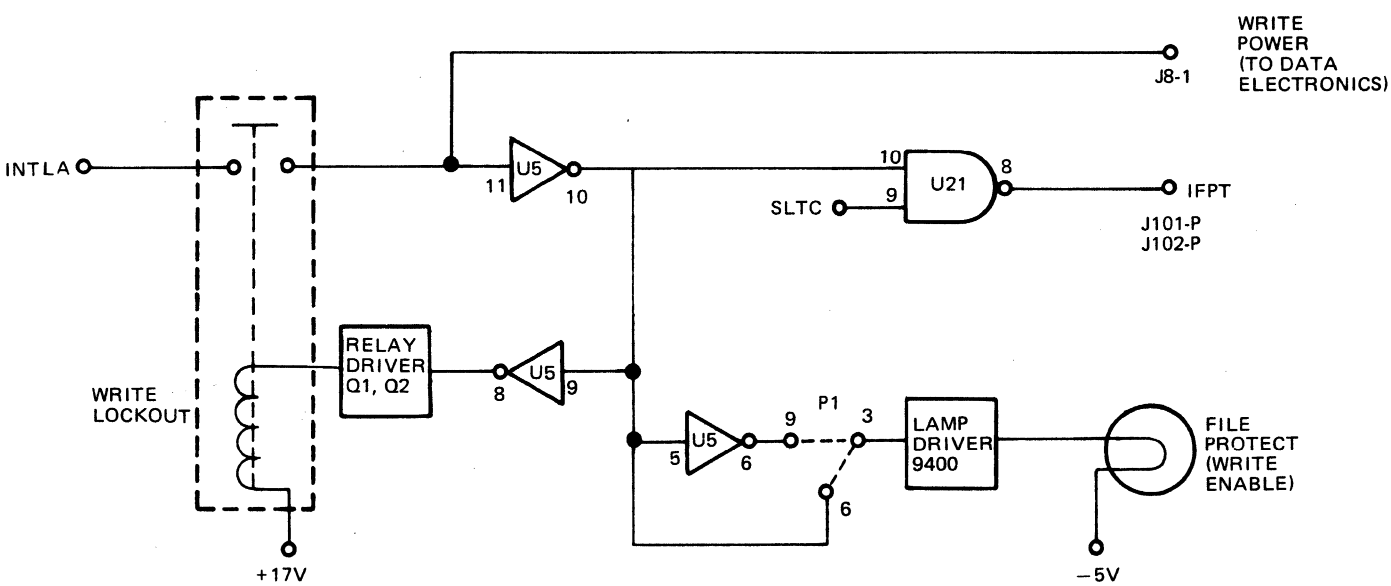


Figure 4-25. File Protect Circuit Simplified Diagram

When a write ring is inserted in the file reel on the tape unit, the high INTLA signal is applied to inverter U5-11. This signal is also applied to the Data Electronics as the WRITE POWER signal at J8-1. The output of U5-10 goes low, setting the IFPT output signal at U21-8 high, indicating to the external controller that the tape is not file protected (a write ring is inserted in the file reel). The high input applied to relay driver Q1/Q2 through inverter U5-8, causes the driver to energize the write lockout solenoid which secures the write lockout assembly. If the circuit is connected as a file protect circuit, the jumper between pins P1-3 and P1-9 is connected, causing the FILE PROTECT lamp to be extinguished. If the circuit is connected as a write enable circuit, the jumper between pins P1-3 and P1-6 is connected, causing the WRITE ENABLE lamp to illuminate.

4-32 9-Track Circuit

Figure 4-26 shows a simplified diagram of the 9-track circuit. The 9-TRACK switch is used with the quad density option and combination 7- and 9-track, single speed, NRZI tape units. When the 9-TRACK switch is used with the quad density option, pins P1-5 and P1-2, E33 and E34, and P1-1 and P1-4 are connected. When the 9-TRACK switch is pressed, a low input is applied to pin A of lamp driver 9500 and to inverter U16-1. This causes the 9-TRACK switch lamp to illuminate and the 9-TRACK signal at J8-2 to go high. The high 9-TRACK signal is applied to the data electronics, indicating 9-track operation. With the 9-TRACK switch in the 9-track position, a low is also applied to U13-10 in the density select circuit. This holds the IDDI signal to the controller low in 9-track operation (indicating high density). The $\overline{SPD}$ signal at U13-3 goes low when the IDD signal goes low for phase encoded operation. This causes the tape unit to operate at the lower speed.

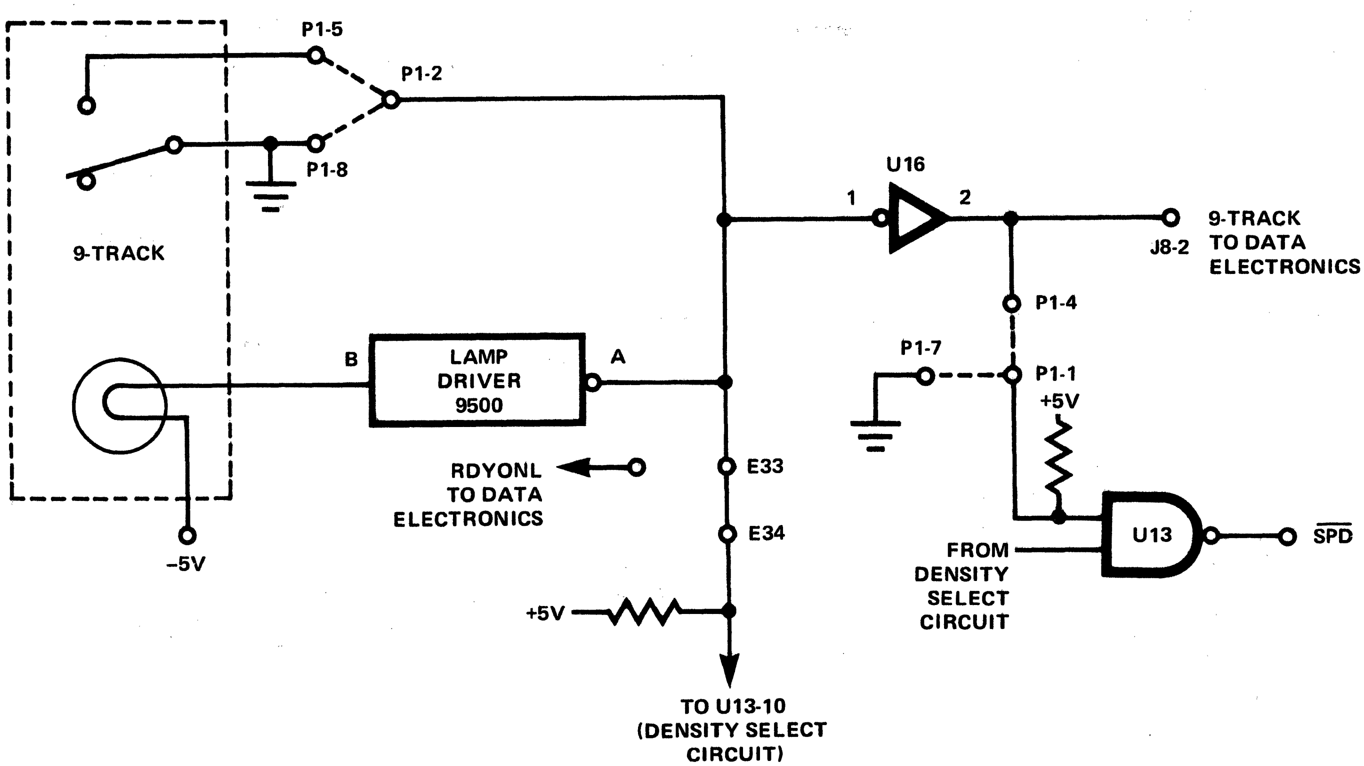


Figure 4-26. 9-Track Circuit Simplified Diagram

When 7-track operation is used in the quad density option, the 9-TRACK switch is released to place the switch in the 7-track position. This applies a high input to 9500-A, U16-1 and NAND gate pin U13-10 in the high density circuit. This causes the 9-TRACK switch lamp to extinguish and the 9-TRACK signal at J8-2 to go low, indicating 7-track operation. The high input to U13-10 enables the IDDI signal for high or low density selection. This allows the IDDI signal to the controller to indicate both high and low density only in the 7-track NRZI mode of operation. In the 7-track position of the 9-TRACK switch, a low is applied to U13-1. This holds the $\overline{\text{SPD}}$ signal high during 7-track operation and causes the tape unit to operate at the higher speed.

The 9-track switch option is also used for combination 7- and 9-track, single speed, 800 bpi NRZI tape units. On these units, the input to U13-1 is held low. This causes the $\overline{\text{SPD}}$ signal to be held high.

The RDYONL signal is used on read only tape units only. This signal is jumpered through pins E32 and E33 to the 9-TRACK switch.

4-33 DATA BOARD ELECTRONICS

The following paragraphs describe the operation of the NRZI and PE Data boards. The data boards perform the functions of reading and writing data on magnetic tape. Complete schematic diagrams for the NRZI and PE Data Board circuits are contained in the attached drawing package. Drawing number 9940116 is for the NRZI Data Board circuits and drawing number 9940121 is for the PE Data Board circuits.

4-34 NRZI Data Board Operation

The NRZI Data Board contains 9 circuits, one for each of the data tracks. For a 7-track head, tracks 0 and 1 are not used. The circuits are divided into two parts, the write and the read circuits. Both the write operation and the read operation are described in the following paragraphs. Since the circuits for the different tracks are identical, only one will be described. Refer to figure 4-27 for a simplified logic diagram of the NRZI Data Board and to figure 4-28 for a timing diagram.

4-35 NRZI WRITE CIRCUITS

The WRT DATA PARITY input (IWDP) is inverted at U29-4 and is gated with DATA READY (I DATA READY), setting U32-10 low if a logic 1 is present on the interface. The low transition through C101 turns off Q101, setting U29-10 low and keeping U32-10 low through 101 to 102. Capacitor C101 is charged through R103 and potentiometer R102 until Q101 is again conducting at saturation, setting flip-flop U33-3 through jumper 103 to 104. For a single stack head, U32-10 is connected directly to U33-12 through jumper 102 to 104. Another DATA READY and logic 1 will reset U33-3. If U33-3 is set when the LRC Strobe occurs, U32-4 will reset U33-3 through Q101.

The outputs at pins 3 and 2 of flip-flop U33 alternately drive Q102 and Q103 so that everytime flip-flop U33 sets or resets a flux change occurs on the tape.

The write current is supplied by the WRITE POWER and WRITE ENABLE signals. If $\overline{\text{WRT ENABLE}}$ is low, Q1 will conduct at saturation, which will cause Q2 and Q3 to conduct at saturation as long as WRITE POWER supplies +5 volts to Q2 emitter. A jumper is installed between 13 and 14 when the High Density (HI DEN) signal controls the operation of the NRZI Data Board when it is used with a PE Data Board. Transistor Q2 supplies current through CR1 for the erase head and for the differential head drivers Q102 and Q103. Transistor Q3 supplies the head current.

4-36 NRZI READ CIRCUITS

Read head signals ranging from 5 to 35 millivolts are amplified by U103. The gain of U103 is determined by series connection of R1115, R118 and potentiometer R117. For a single stack head, a jumper from J3 to J4 is included, as well as diodes CR101, CR102, CR103 and CR104. Refer to the attached drawing package, drawing number 9940116.

The output of U103 at TP101 is connected to diode CR105 and to unity gain inverter U104. The output of U104 is connected to CR106. These output signals are compared to a read threshold voltage at diode CR107.

For normal threshold, about 25% of maximum voltage, Q5 is saturated and Q4 is turned off, setting the voltage at the base of Q6 by voltage divider R13, R15 and R16. The read threshold at the emitter of Q6 is set by the base voltage.

A jumper from 2 to 3 is connected for a dual gap head configuration, setting U30-6 high. If, for example, WRITE ENABLE is high, U28-11 goes low and U26-12 goes high, turning off Q5. U30-11 is set low, turning on Q4. Since R14 has a lower resistance than R13, the read threshold is set high at about 45% of the maximum voltage. If, for example, READ THRESHOLD 2 is asserted, U26-8 goes low, setting U30-11 and U26-11 high and turning off Q4 and Q5. Since R15 has a higher resistance than the parallel combination of R13 and R15, the read threshold is set lower, at about 12% of the maximum voltage.

For single gap heads, a jumper is connected from 1 to 2, setting U28-11 high. If, for example, READ THRESHOLD 1 is set high, U26-8 goes high and U30-6 goes low, and U26-12 goes high, turning off Q5 and saturating Q4. This sets the threshold high. If, for example, READ THRESHOLD 2 is set, U26-12 and U30-11 are set high, turning off Q5 and Q4, setting the threshold low.

Therefore, if the output voltage is higher than the threshold, CR107 is reverse-biased and the signal is not impeded, applying the positive peaks from the amplifier and inverter to differentiator U105.

The gain of U105 is determined by the reactance of C107 and R128, so the gain of U105 increases at 20 dB per decade until U105 is cut off by R128 and C108. Therefore, the peaks of the signals are changed to zero crossings and the amplitude is less dependent upon the data pattern, since the output is related to the rate of change of the input which is constant. When the output of U105 crosses zero and goes negative, comparator U25-2 switches high. As U25-2 goes low, it sets U34-5. Flip-flop U34 is gated with MOTION or READ DATA STROBE at U35-5 to drive the READ READY PARITY line.

Any low input to U18 sets +DL high. This sets U12-2 high, allowing C9 and C10 to charge through R28 and potentiometer R29. When the voltage at TP6 and U3-9 reaches the voltage at U3-8, U3-14 switches high. The voltage at U3-8 is set by the voltage divider formed by R27 and R36, creating a delay that is set equal to 1/2 the data rate. R31, R32 and R33 parallel R36, lowering the voltage at U3-8 and decreases the delay of the circuit during read-after-write and high density read operations.

U12-12 goes high when U3 switches high, allowing C13 to charge through R49. When the voltage at U3-11 reaches the voltage at U3-10, U3-13 switches high, creating a delay of about 1 μsecond. When U3-14 switches high, U28-3 goes low until U3-13 goes high. This 1 μsecond pulse is gated at U3-1 with MOTION to create the READ DATA STROBE.

When U28-3 goes high, all inputs to U26-6 are high which sets U26-6 low, resetting flip-flop U34.

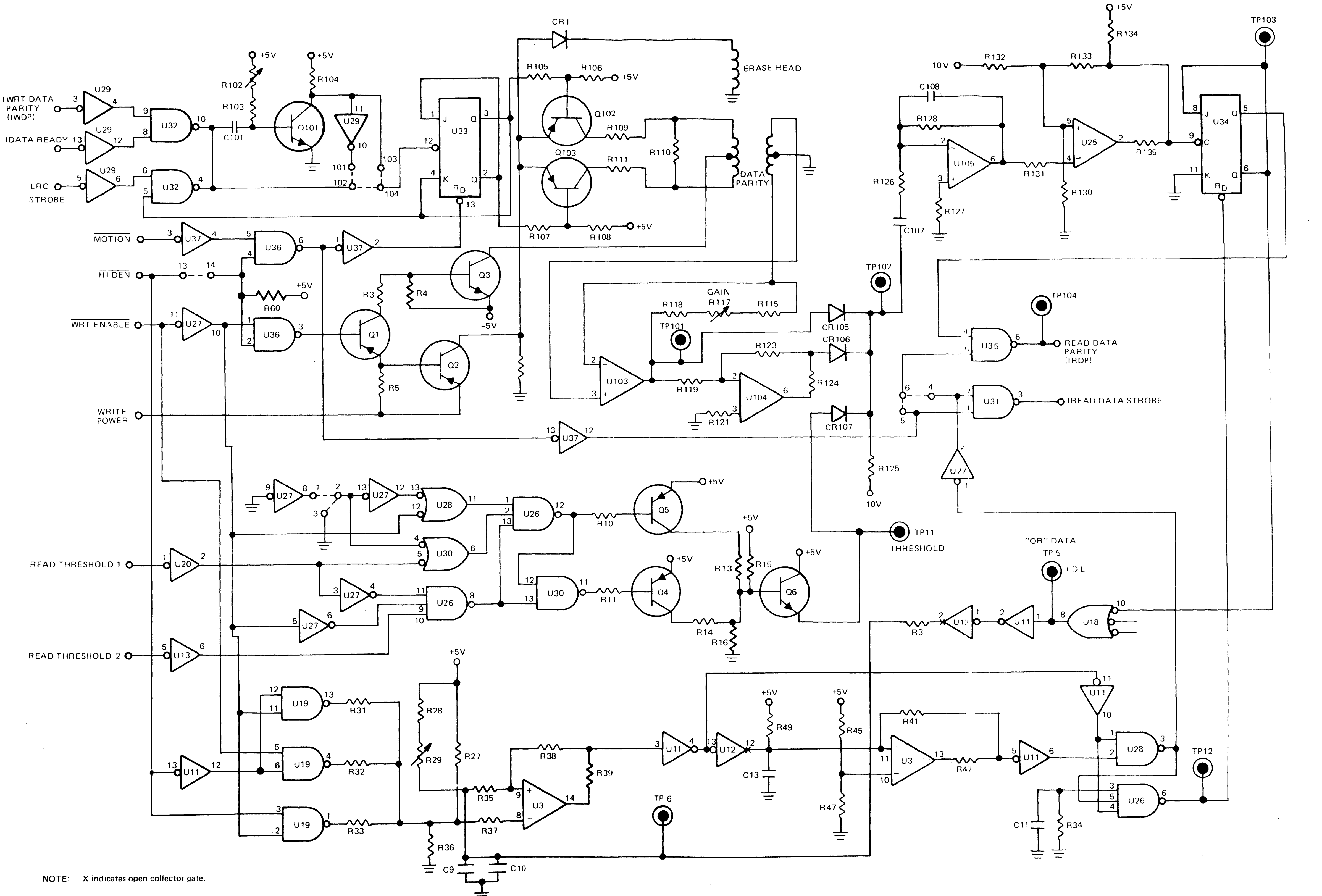


Figure 4-27. NRZI Data Board Simplified Diagram

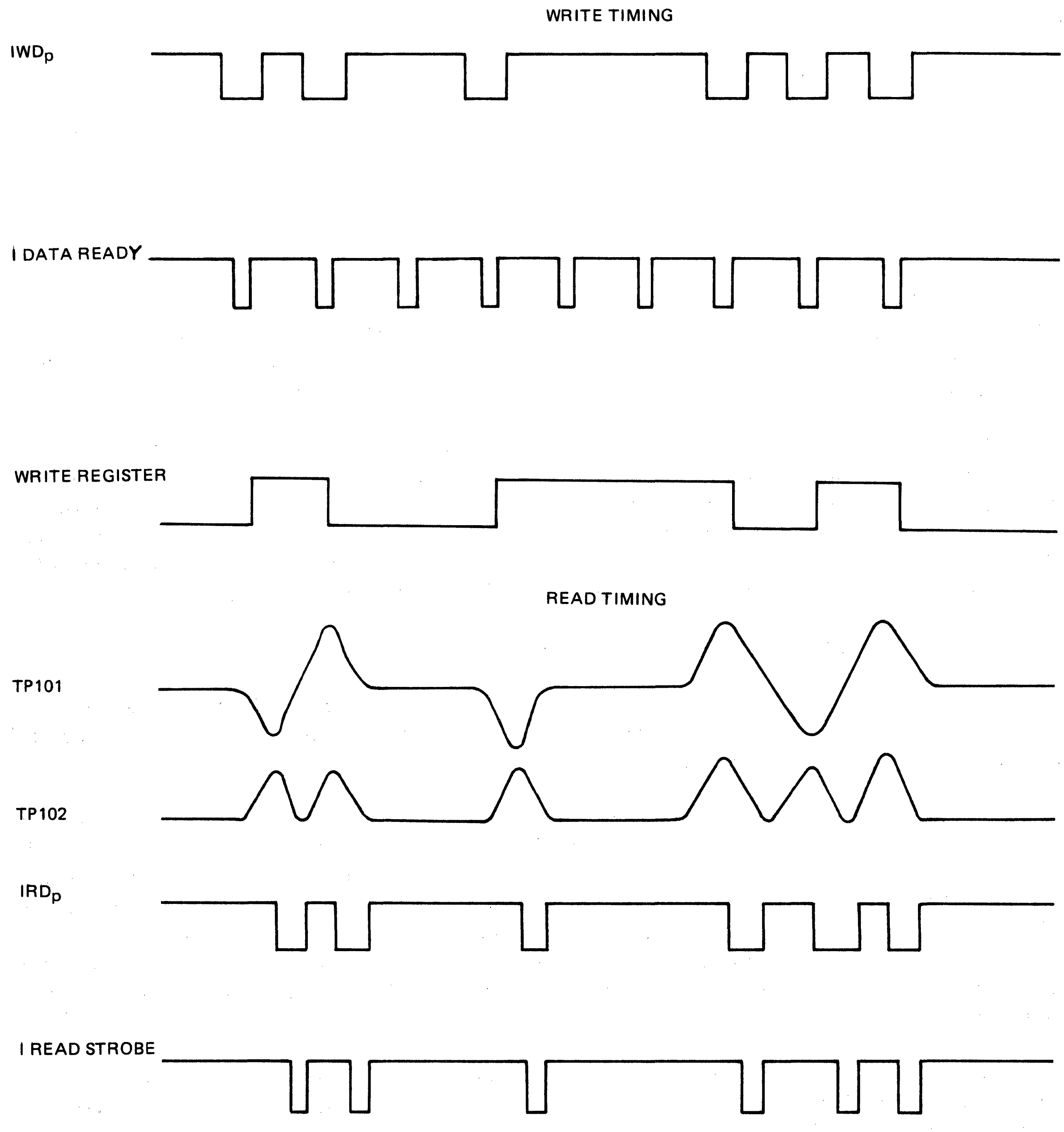


Figure 4-28. NRZI Data Write/Read Timing Diagram

Jumpers on the board determine if 7-track, single stack, and speed are asserted. NRZI is always asserted. All of the read flip-flops are connected to a resistive ladder at TP9 that is useful in determining skew problems.

4-37 PE Data Board Operation

The PE Data board contains nine circuits, one circuit for each of the data tracks. The circuits are divided into the Write and the Read circuits. Both the write operation and read operation is described in the following paragraphs. Since the circuits for different tracks are identical, only one track will be described. Refer to figure 4-29 for a simplified logic diagram of the PE Data Board and to figure 4-30 for a timing diagram.

4-38 PE WRITE CIRCUITS

The WRT DATA PARITY input is inverted at U10 and clocked into flip-flop U11-5 by DATA READY. The outputs of the flip-flop U11-5 and 6 alternately drives Q101 and Q102, creating a flux change on the tape. The head current is determined by R105 and R106. The directions of the flux change are such that whenever U11 is reset in the bit cell time, a logic one is recorded.

The write current for the erase head and for Q101 and Q102 comes from WRT POWER signal when Q1 and Q2 are saturated. A jumper between E7 and E8 is installed when the High Density (HI DEN) signal controls the operation of the PE Data Board when it is used with a NRZI Data Board. In normal operations the jumper is not used. Therefore, when WRITE ENABLE is true, U13-11 will be turning on Q1, Q2 and Q3. Q3 conducts at saturation, supplying the current for the write heads and Q2 supplies the current through CR1 for the erase head and the differential head drivers Q101 and Q102.

4-39 PE READ CIRCUITS

The read head signals ranging from 3 to 18 millivolts are amplified by U101. The gain of U101 is determined by a resistor network consisting of R110, R116 and potentiometer R112. For a single stack head, a jumper from J3 to J4 is included.

U101 is connected to differentiator U102. The gain of U102 is determined by the reactance of C107 and R119, so the gain of U102 increases at 20 dB per decade until cut off by R119, and C114. Therefore, the peaks of the signals are changed to zero crossings and the amplitude is less dependent upon data pattern since the output signal is related to the rate of change of the input, which is constant. The output of U102 is clipped at ±5 volts by CR106 and CR107 and is applied to the comparators at U103-6 and U103-4. U103 detects whenever the differentiator's negative-going output crosses zero, creating a positive output signal at U103-1. The signal is applied to the line driver at U12-1 and gated with the output of the envelope detector.

The envelope detector includes U103-2, Q103 and Q104. U103-2 compares the output of the differentiator with the TP4 read threshold reduced to 1/2 by R136 and R124. (Refer to PE Threshold description.) The thresholds are 30%, 15% and 5%. If the signal is more negative than the threshold, U103-2 switches high, reverse-biasing CR107, allowing C118 to charge through R132. The R132/C118 time constant is such that Q103 is turned on if there are no negative pulses from U103-2 within two data character times. When a negative pulse occurs, Q103 is turned off and C119 is charged up through R133. The emitter of Q104 follows the voltage increase of C119, enabling U12-3 when the emitter voltage reaches approximately 2 volts. The R133/C119 time constant is such that U12-3 is enabled after three character times if Q4 is conducting at saturation, supplying +5 volts to Q104 and R133. Q4 is turned on whenever MOTION is true.

4-40 PE THRESHOLD CIRCUITS

For a normal threshold level of approximately 15% of maximum voltage, Q6 conducts at saturation and Q5 is turned off, setting the voltage at the base of Q7 to the potential at voltage divider R15, R17 and R18. The Read Threshold output at the emitter of Q7 is set by the base voltage.

A jumper from E10 and E9 is connected for a dual gap head configuration, setting U15-11 high. If, for example, WRITE ENABLE is high, U15-8 goes low and U14-6 goes high, turning off Q6. U15-3 is set low, turning on Q5. Since R16 has a lower resistance than R15, the Read Threshold is set high, at approximately 30% of maximum voltage. If, for example, READ THRESHOLD 2 is asserted, U14-8 goes low, setting U15-3 and U14-6 high, turning off Q5 and Q6. Since R17 has a higher resistance than the parallel combination of R15 and R17, the Read Threshold is set lower, at approximately 5% of maximum voltage.

For single gap heads, a jumper is connected from E10 to E11, setting U15-8 high. If, for example, READ THRESHOLD 1 is set high, U14-8 goes high and U15-3 goes low and U14-6 goes high, turning off Q6 and saturating Q5. This sets the Read Threshold to high. If, for example, READ THRESHOLD 2 is set, U14-6 and U15-3 are set high, turning off Q5 and Q6, setting the Read Threshold low.

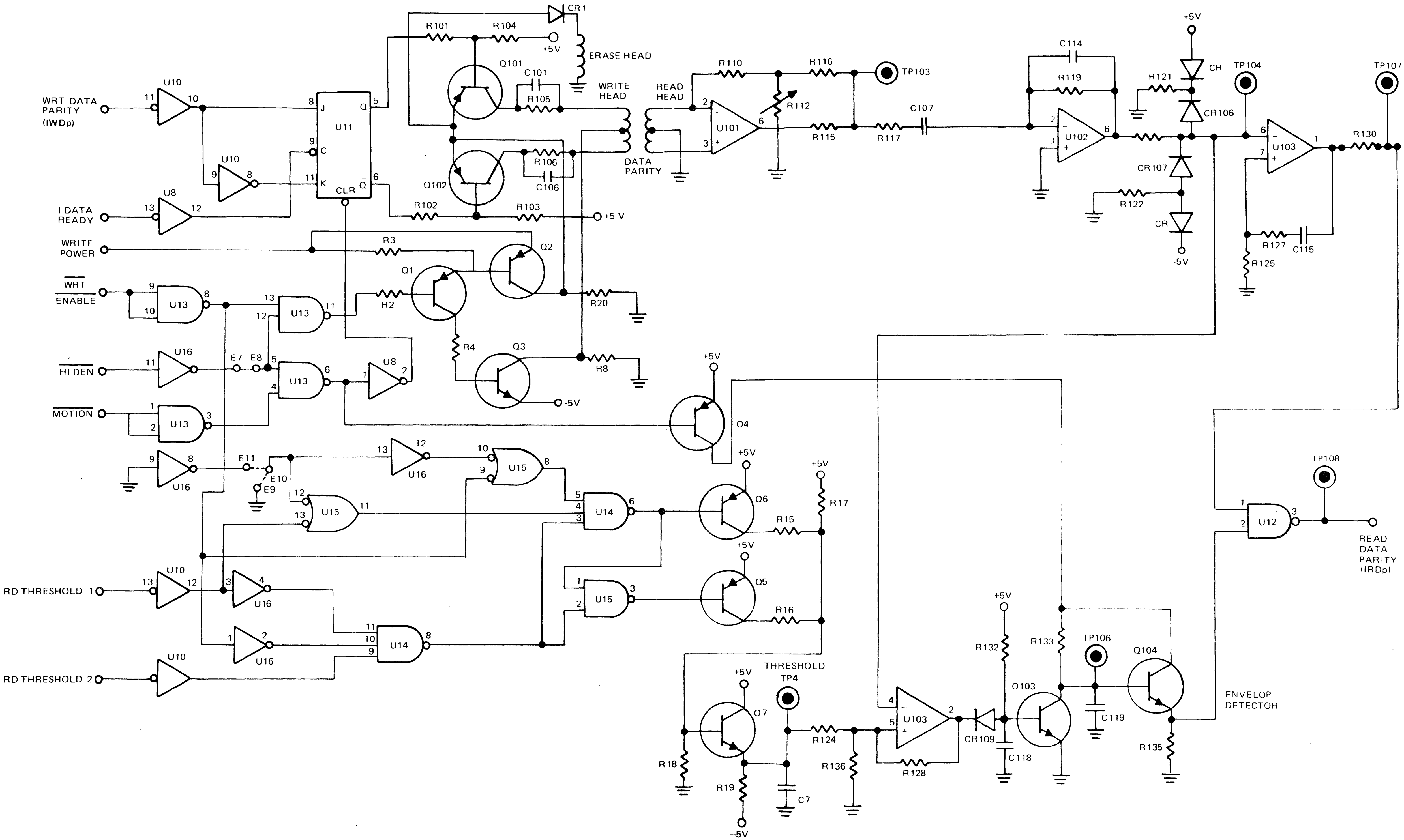
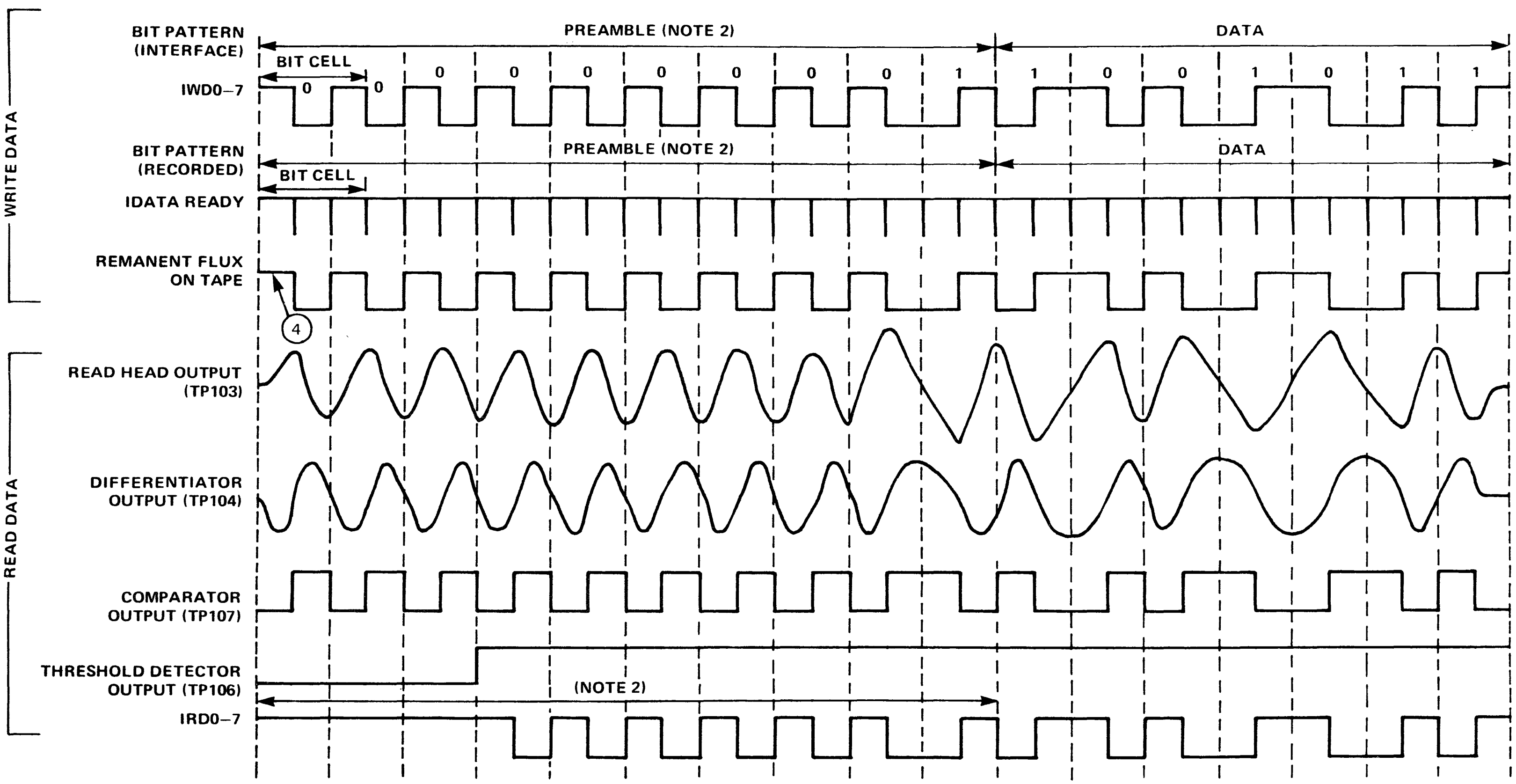


Figure 4-29. PE Data Board Simplified Diagram



NOTES:

1. TAPE UNIT MUST BE SELECTED, READY, AND ON-LINE.
2. PREAMBLE IS SHOWN SHORTENED TO SIMPLIFY DRAWING. PREAMBLE CONSISTS OF 40 ZEROS FOLLOWED BY ONE 1.
3. POSTAMBLE NOT SHOWN. POSTAMBLE CONSISTS OF ONE 1 FOLLOWED BY 40 ZEROS.
4. FLUX POLARITY OF INTERLOCK GAP.

Figure 4-30. PE Data Write/Read Timing Diagram

Chapter 5
MAINTENANCE

5-1 INTRODUCTION

This chapter contains the information required to perform maintenance on the Bright Model 2750 Magnetic Tape Unit. The chapter contains preventive maintenance information, checkout and alignment procedures, component replacement instructions, and troubleshooting procedures to isolate malfunctions. Before using the information in this chapter, the maintenance technician must have a thorough knowledge of the material contained in Chapter 4. One or more of the simplified schematics, logic diagrams and timing diagrams in Chapter 4 may also prove helpful during checkout and alignment, and when troubleshooting the tape unit.

The tape unit is designed to operate at maximum capability with a minimum of maintenance and adjustments. Repair of the tape unit and replacement of parts is planned to be as simple as possible. The use of test equipment is kept to a minimum, and only common tools are required in most cases.

5-2 PREVENTIVE MAINTENANCE

Preventive maintenance on the Model 2750 Magnetic Tape Unit consists of periodic cleaning, checking for alignment and wear of the tape handling components and replacement of worn parts as necessary. Component replacement instructions are presented in paragraph 5-51. To ensure reliable operation of the tape unit at optimum design potential, and to assure high mean-time between failures, a scheduled preventive maintenance program is recommended. For ease of use, this program has been divided into operator preventive maintenance and service engineer preventive maintenance. Table 5-1 lists preventive maintenance which should be performed periodically by the equipment operator and table 5-2 lists preventive maintenance procedures which should only be performed by a qualified engineer or maintenance technician.

5-3 Cleaning the Unit

The tape unit requires cleaning in the following major areas: head and associated guides, roller guides, tape cleaner, and capstan. The following paragraphs present instructions on cleaning the tape components.

To clean the head, head guides, and tape cleaner, use a lint-free cloth or cotton swab moistened in isopropyl alcohol. Wipe the head and tape cleaner carefully to remove all accumulated oxide and dirt.

TABLE 5-1. OPERATOR PREVENTIVE MAINTENANCE SCHEDULE

MAINTENANCE PROCEDURE	HOURS BETWEEN MAINTENANCE	MAINTENANCE TIME (hours)
Clean head, tape guides, tape cleaner face, and capstan surface	8	0.13
Clean vacuum chamber	16	0.1
Check tape guides and capstan	16	0.1
Clean tape cleaner	80	0.1
Clean tape unit surface	3000	0.5

TABLE 5-2. SERVICE ENGINEER PREVENTIVE MAINTENANCE

MAINTENANCE PROCEDURE	HOURS BETWEEN MAINTENANCE	MAINTENANCE TIME (hours)
Check skew, tape tracking, head wear, tape speed, EOT/BOT, and Data Electronics	2000	0.75
Replace reel motor brushes and check tape tension.	5000	0.15
Replace capstan motor	10,000	0.35
Replace reel motors and reel drive belts	15,000	0.35
Replace control switches and lamps	15,000	0.70

CAUTION

Rough or abrasive cloths should not be used to clean the head and head guides. Use only isopropyl alcohol. Other solvents such as carbon tetrachloride, may result in damage to the head lamination adhesive

To clean the capstan, use only a cotton swap moistened with isopropyl alochol to remove accumulated oxide and dirt.

To clean the roller guides, use a lint-free cloth or cotton swap moistened with isopropyl alcohol. Wipe the guide surfaces carefully to remove all accumulated oxide and dirt.

CAUTION

Do not soak the guides with excessive solvent. Excessive solvent may seep into the precision guide bearings, causing contamination and a breakdown of the bearing lubricant.

To clean the vacuum column glass, use a lint-free cloth and any commercial glass cleaner that leaves no residue. Remove any matter which covers the vacuum holes.

5-4 CHECKOUT AND ALIGNMENT

The checkout and alignment procedures can be used to verify that the equipment is operating within specifications, or to check a particular suspected circuit. Test equipment required to perform the maintenance procedures contained in the following paragraphs is listed in table 5-3. Test equipment with equivalent characteristics may be substituted for the equipment listed in table 5-3. Common hand tools are not listed in table 5-3. If abnormal indications are obtained during performance of the following procedures, refer to the troubleshooting procedures in paragraph 5-47. For component location on the circuit boards, refer to the PWBA drawings in the attached drawing package.

5-5 Tape Control Board Electrical Adjustments

Acceptable limits are defined in each adjustment procedure, taking into consideration the assumed accuracy of the test equipment specified in table 5-3. When the measured value of any parameter is within the specified acceptable limits, ***NO ADJUSTMENTS*** should be made. If the measured value falls outside the specified acceptable limits, adjustments should be made in accordance with the relevant procedure.

TABLE 5-3. TOOLS AND TEST EQUIPMENT

COMMON NAME	MANUFACTURER MODEL OR TYPE NUMBER
Bright Vacuum Column Alignment Tool	00326
Micrometer	
IBM Master Skew Tape	432640
Dual Channel Oscilloscope	Tektronix 453
1-pound Gauge	Chatillon DPP-1
15-pound Gauge	Chatillon LP-15
Miscellaneous Shims	(Refer to Spare Parts Lists in Chapter 6)
TX-1000 Tape Transport Exerciser	00295
Digital Multimeter	Weston 4440

NOTE

Some adjustments may require corresponding adjustments in other parameters. Ensure corresponding adjustments are made as specified in the individual procedures. The +5 and –5 regulator voltages must be checked prior to attempting any electrical adjustments.

When any adjustment is made, the value set should be the exact value specified (to the best of the operator's ability) in the procedure. Refer to drawing number 9040119 in the attached drawing package for component location on the Tape Control board.

CAUTION

Primary power should be removed from the unit when rear access is required, except in cases of electrical testing and adjustments.

5-6 ADJUSTMENT OF REGULATED SUPPLIES

The ±10-volt and ±5-volt regulated supplies are located on the Tape Control Board, but only the ±5-volt supplies are adjustable. Adjustments made on one regulator affect the other, so both regulators must be adjusted until the outputs of both are correct. Limits for the ±10-volt and ±5-volt supply are listed below. Any adjustment of the voltage regulators must be followed by a check of the capstan speed, ramps and reel servos. Apply primary power to the tape unit and proceed with the alignment listed in the following paragraphs.

a. +10-volt supply: +10V +1.50, –0.50 vdc
b. –10 volt supply: –10V +1.50, –0.50 vdc
c. +5-volt supply: +5.2V ± 0.05 vdc
d. –5 volt supply: –5.2V ± 0.05 vdc

5-7 +5-VOLT SUPPLY REGULATOR ADJUSTMENT

a. Connect the leads of the digital multimeter between TP1 (+) and TP3 (GND).

b. The digital multimeter's display should indicate +5.2V ± 0.05 vdc. If the display's indication is out of tolerance, adjust potentiometer R1018 (refer to drawing number 9040119) for an indication of +5.2V ± 0.05 vdc.

5-8 –5 VOLT SUPPLY REGULATOR ADJUSTMENT

a. Connect the leads of the digital multimeter between TP2 (+) and TP3 (GND).

b. The digital multimeter's display should indicate –5.2V ± 0.05 vdc. If the multimeter indicates it is out of tolerance, adjust potentiometer R1024 for an indication of –5.2V ± 0.05 vdc.

5-9 Adjustments of EOT/BOT Amplifiers

The EOT/BOT Amplifier circuit is located on the Tape Control Board. Perform the following steps to prepare the tape unit and then continue to the amplifier adjustments.

NOTE

The ±5V regulators must be checked and adjusted, if necessary, prior to checking the EOT/BOT amplifier system.

a. Apply power to the tape unit.

b. Load a reel of tape on the tape unit.

c. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

5-10 BOT AMPLIFIER ADJUSTMENT

a. Remove the head covers. Check and, if necessary, adjust the position of the EOT/BOT tape sensor until it is parallel to the tape path. Refer to figure 5-1.

b. Connect multimeter between TP18 and ground. Replace the head covers.

c. Position the BOT marker in front of the tape sensor and adjust R2202 for BOT marker voltage of +1.5 volts.

d. Position blank tape in front of the tape sensor and verify measured voltage is at least −1.5 volts.

5-11 EOT AMPLIFIER ADJUSTMENT

a. Remove the head covers. Check the position of the EOT/BOT tape sensor and, if necessary, adjust the tape sensor until it is parallel to the tape path. Refer to figure 5-1.

b. Position the tape to the EOT marker.

c. Connect a multimeter between TP17 and ground. Replace the head covers.

d. Adjust R2102 for EOT marker voltage of +1.5 volts.

e. Position blank tape in front of tape sensor and verify measured voltage is at least −1.5 volts.

5-12 Adjustment of Capstan Speed

Only the synchronous forward speed is adjustable. The synchronous reverse function uses the same voltage reference as the synchronous forward and is not adjustable. The following procedures include the capstan amplifier offset adjustment, a coarse speed adjustment and then a fine speed adjustment.

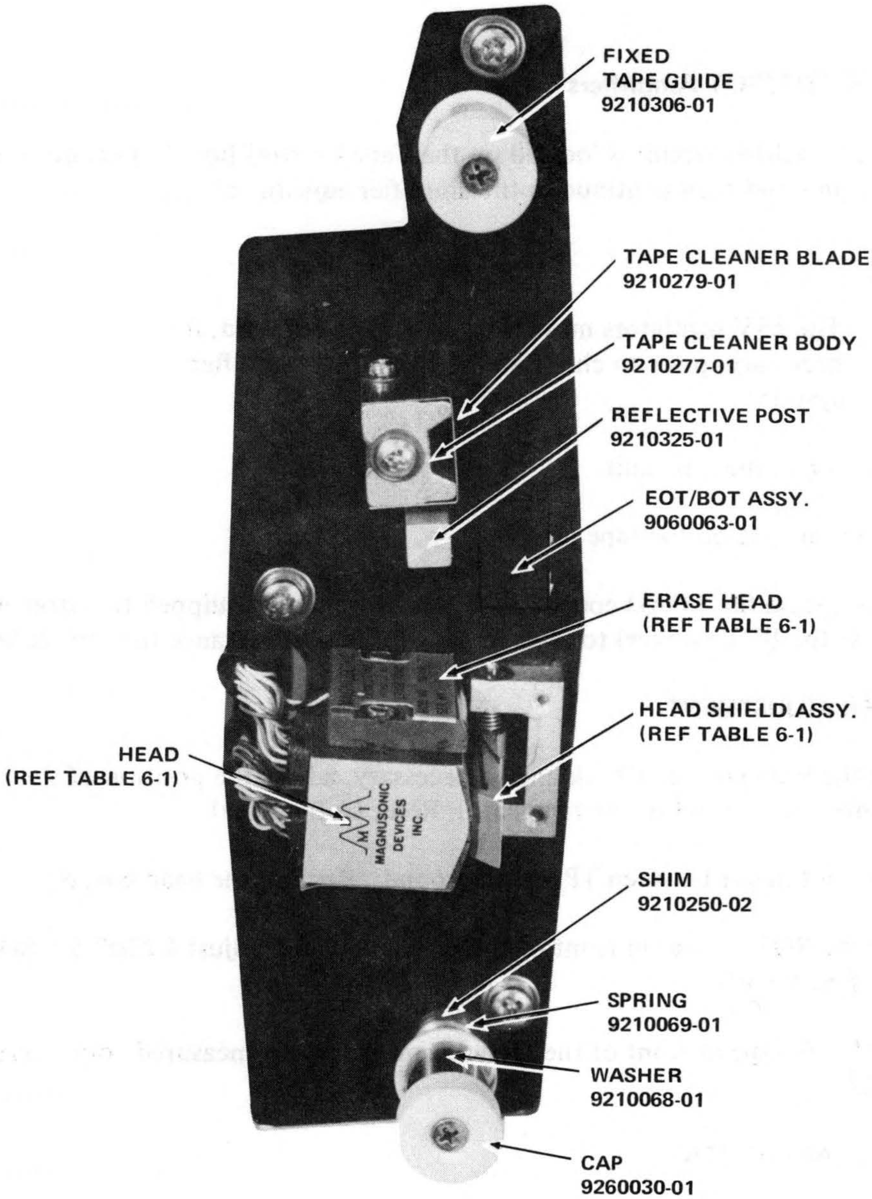


Figure 5-1. Head Assembly

For dual speed units, set the unit to the lower of the two speeds and follow the adjustment procedures as given. After the fine speed adjustment procedure has been completed, the higher speed adjustments can be performed. Set the tape unit to go to the higher speed and repeat the Capstan Speed Coarse Adjustment and the Capstan Speed Fine Adjusment. For the higher speed adjustment, instead of using potentiometer R5026, use potentiometer R5027 for the adjustment.

Peform the following steps to prepare the tape unit for use and then continue to the Capstan Speed Adjustments.

NOTE

The ±5V regulators must be checked and adjusted, if necessary, prior to checking the capstan speed.

a. Apply power to the tape unit.

b. Load a reel of tape.

c. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

5-13 OFFSET ADJUSTMENT

a. Connect the leads of the digital multimeter between TP10 (+) and TP3 (GND).

b. Adjust offset potentiometer R4001 until the voltage displayed on the digital multimeter is between –0.05V and +0.05V.

5-14 CAPSTAN SPEED COARSE ADJUSTMENT

a. Connect the lead of the digital multimeter between TP12 (+) and TP3 (GND).

b. Adjust potentiometer R5026 (R5027) until the digital multimeter's display indicates the voltage appropriate for the speed requirements of the specific machine. The voltage readings for the different speeds are as follows:

SPEED	VOLTAGE
25 ips	0.326 vdc
37.5 ips	0.465 vdc
45 ips	0.587 vdc
75 ips	0.987 vdc

5-15 CAPSTAN SPEED FINE ADJUSTMENT

The 2700 capstan mounted strobe disks are used to perform fine tape speed adjustments of the synchronous speed. Tape speed adjustments made using the strobe disk are accomplished by illuminating the capstan hub from a fluorescent light source and adjusting potentiometer R5026 (R5027) until the disk image, created by the pulsating light source, becomes stationary. The strobe disks have two sets of rings and should be used with the following rules:

1. *Part Number 9210378-04 (12.5/25 ips).* The outer ring is used when the light source is 50 Hz, and the inner ring is used when the light source is 60 Hz.

2. *Part Number 9210378-02 (37.5/75 ips).* The outer ring is used when the light source is 50 Hz, and the inner ring is used when the light source is 60 Hz.

3. *Part Number 9210378-03 (45 ips).* The outer ring is used when the light source is 60 Hz, and the inner ring is used when the light source is 50 Hz.

Perform adjustments as follows:

a. On dual speed units, set HI DEN (high density) switch to high density (for the lower speed first). Adjust potentiometer R5026 until image becomes stationary in reverse direction.

b. On dual speed units, set HI DEN switch to low density (high speed). Adjust potentiometer R5027 until disc image becomes stationary in reverse direction.

c. Set maintenance switch SW1 to forward position, and adjust –5 volt potentiometer R1024 until disc image becomes stationary (for the lower speed on dual speed units).

5-16 ADJUSTMENT OF CAPSTAN REWIND SPEED

Before adjusting the capstan rewind speed, verify that the capstan synchronous speed is correct (refer to preceding procedures). Perform the following steps for the tape unit rewind adjustment.

NOTE

The ±5V regulators must be checked and adjusted, if necessary, prior to checking the capstan rewind speed.

a. Apply power to the tape unit.

b. Load a reel of tape.

c. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

d. Connect the leads of the digital multimeter between TP12 (+) and TP3 (GND).

e. Set the maintenance switch (SW1) on the Tape Control Board to run the tape forward. Record the voltage indicated on the digital multimeter's display.

f. The correct rewind voltage is calculated by using the following formula:

$$\frac{\text{measured voltage}}{\text{tape speed}} \times 250 = \text{rewind voltage}$$

g. After calculating the rewind voltage, initiate a rewind operation. Adjust potentiometer R3013 until that voltage is displayed on the digital multimeter.

5-17 Ramp Timing Adjustment

The four tape acceleration and deceleration ramps (Forward and Reverse, and Start and Stop) are controlled by a single potentiometer adjustment located on the Tape Control Board. For dual speed tape units, set the unit to the lower of the two speeds and follow the adjustments given. After ramp timing has been completed, the higher speed ramp adjustments can be performed. Set the tape unit to the higher speed and repeat the adjustment using potentiometer R5021. Load a reel of tape on the unit and proceed with the following adjustments.

NOTE

The ±5V regulators must be checked and adjusted, if necessary, prior to checking the ramp timing.

a. Connect the oscilloscope input to TP8 and sync the oscilloscope to TP5. Ground oscilloscope at TP3.

b. Initiate a forward-stop tape sequence using either the Tape Transport Exerciser or maintenance switch SW1. Observe the oscilloscope display (see figure 5-2).

c. Adjust potentiometer R5020 (R5021) until the ramp width at the 95% point is equal to the appropriate time for the tape unit speed. See the following list:

TAPE UNIT SPEED (ips)	RAMP TIME (ms)
25	15.0
37.5	10.0
45	8.33
75	5.0

d. For dual speed tape units, set to the higher speed and repeat the preceding steps using potentiometer R5021.

5-18 Vacuum Column Electrical Adjustment

The electrical adjustments for vacuum column machine supply and take-up reel servos are identical. Consequently, the procedure is presented with the take-up reel servo test points and potentiometers indicated in parentheses. Test points and potentiometers not in parentheses are those required for the supply reel servo adjustments. Perform the following steps to prepare for the adjustment procedure.

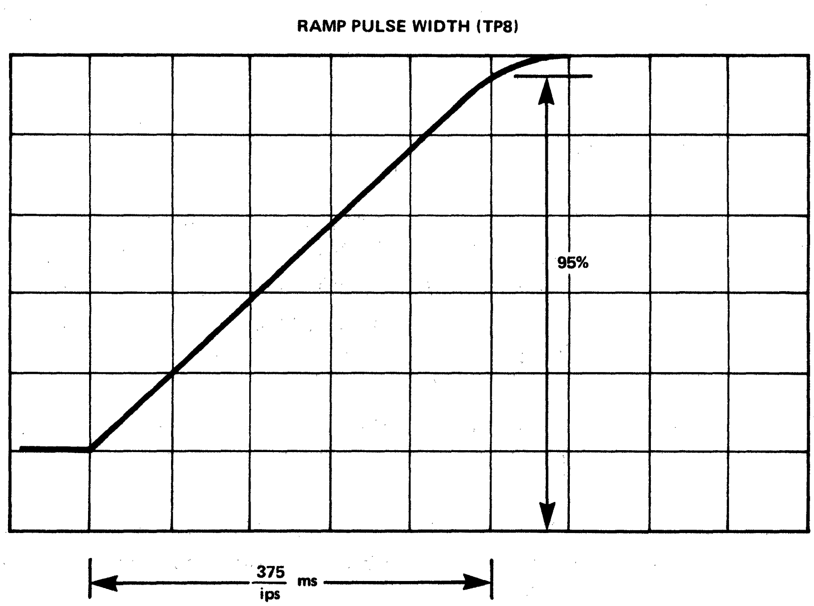


Figure 5-2. Forward Ramp Waveform

NOTE

The ±5V regulators must be checked and adjusted, if necessary, prior to checking the electrical vacuum column adjustment.

a. Apply power to the tape unit.

b. Remove the head covers. Load a loop of tape in the vacuum column as shown in figure 5-3.

c. On dual speed units, set HI DEN switch to low density position for higher of two tape speeds.

d. Momentarily engage the LOAD control.

5-19 VACUUM COLUMN ADJUSTMENT

a. Adjust potentiometer R6011 (R7011) to middle of range.

b. Connect the leads of the digital multimeter between TP26 (TP29) and TP3 (GND).

c. Ensure that the tape loop is in the center of the supply (take-up) column. Adjust potentiometer R6006 (R7006) for an indication of zero volts (±0.05V) on the digital multimeter.

d. Remove the loop of tape from the vacuum column and replace the head covers. Load a full reel of tape on the unit. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker. Advance the tape to the EOT marker when adjusting the take-up reel servo.

e. Adjust potentiometer R6018 (R7018) for indication of zero volts (±0.05V) on the digital multimeter's display.

f. Advance the tape to the EOT marker for supply reel adjustment and to the BOT marker for adjusting the take-up reel servo.

g. Using the maintenance switch SW1, alternately run the tape in the forward and reverse directions. Adjust potentiometer R6006 (R7006) and potentiometer R6011 (R7011) so that the tape travel within the supply (take-up) vacuum column is symmetrical between the two interlock holes. The point where the tape curves away from the vacuum column should approach to within approximately 1 inch of the interlock holes.

h. Advance the tape to the EOT marker for the take-up reel servo and to the BOT marker for adjusting the supply reel servo.

i. Using the maintenance switch SW1, alternately run the tape in the forward and reverse directions. Adjust potentiometer R6018 (R7018) such that the tape travel is symmetrical between the two interlock holes.

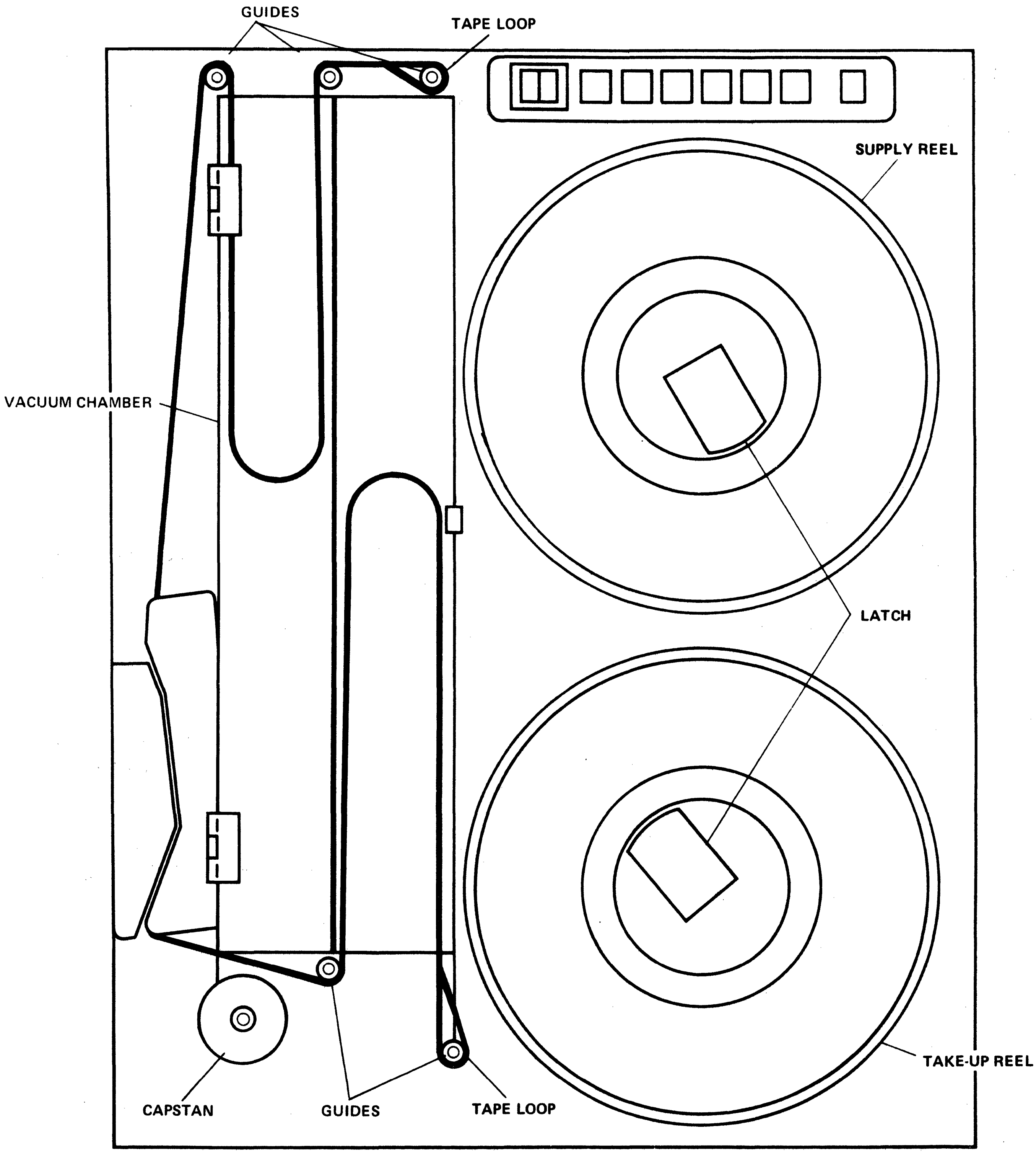


Figure 5-3. Tape Loop for Vacuum Column Servo Adjustment

5-20 NRZI Data Board Electrical Adjustments

The following paragraphs describe the adjustments required for proper operation of the NRZI Data Board. Refer to drawing number 9040116 in the attached drawing package for component location. Acceptable limits are defined in each of the following adjustment procedures for both the dual gap and single gap head assemblies. The following list of adjustment procedures indicate which adjustment procedures are applicable to single gap head assemblies and which are applicable to the dual gap assembly, and the order in which the adjustment should be performed.

1. Read Amplifier gain adjustment procedure: dual and single gap heads.

2. Read head skew measurement and adjustment procedure: dual and single gap heads.

3. Write head deskew: dual gap heads only.

4. Flux gate adjustment: dual gap heads only.

5. Read strobe: dual and single gap heads.

5-21 READ AMPLIFIER GAIN ADJUSTMENT

The gain of each of the read amplifiers located on the NRZI Data Board is independently adjustable. Perform the following steps to prepare the tape unit for the adjustment procedure.

a. Clean the head assembly and tape path as described in paragraph 5-3.

b. Apply power to the tape unit.

c. Load a standard level output tape on the tape unit. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

d. Use the TX-1000 TAPE TRANSPORT EXERCISER to write 800 bpi all ones on all channels. Refer to the TAPE TRANSPORT EXERCISER manual (Part No. 9580062) for equipment interconnect and set-up instruction.

e. After recording all ones on all channels, rewind tape to the BOT marker.

f. Connect oscilloscope to TP101.

g. Run the tape forward in the read mode.

h. Adjust potentiometer R117 until the analog signal displayed on the oscilloscope is 10 volts peak to peak (see figure 5-4).

i. Repeat steps f through h for all channels using TPX01 and potentiometers RX17, X 2 through 9.

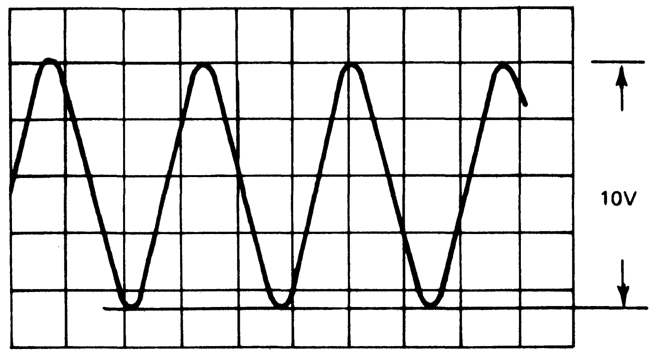


Figure 5-4. Amplifier Waveforms (TP101)

5-22 READ HEAD SKEW MEASUREMENT AND ADJUSTMENT

The read head skew measurement and adjustment procedures should only be required when the read head has been replaced. The adjustment of read skew is accomplished mechanically by shimming one of the head guides. The shims are 0.0005 inch thick and correct for 37.5 microinches of skew. The maximum allowed shims under any one guide is four. Both guides should not be shimmed on the same head plate assembly. The shims can be mounted by removing the guide and placing the shim on the screw that mounts the guide and reassembling the guide on the head plate assembly. Load the IBM Master Skew Tape on the tape unit and perform the following adjustments.

5-23 Skew Measurement and Adjustment

a. Using a dual trace oscilloscope, connect Channel A to TP603 and Channel B to TP703 for nine channel units. For seven channel units, connect Channel A to TP903 and Channel B to TP103.

b. Using the maintenance switch SW1, run the tape forward. Observe the time displacement between the two signals displayed on the oscilloscope (see figure 5-5). Calculate the amount of displacement (refer to table 5-4).

TABLE 5-4. EQUIVALENT DISPLACEMENT TIMES FOR 100 AND 75 MICROINCHES OF SKEW AT VARIOUS TAPE SPEEDS

SPEED (ips)	100 MICROINCHES (microseconds)	75 MICROINCHES (microseconds)
25	4	3
37.5	2.7	2
45	2.2	1.7
75	1.3	1.0

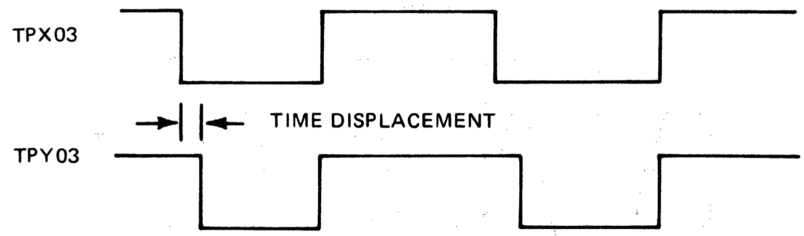


Figure 5-5. Output Waveforms (TP103, TP203, TP603, TP703)

If the displacement is less than 100 microinches, no shiming is required. If the displacement is greater than 100 microinches and TP703 (9-track) or TP103 (7-track) is the leading signal, the guide on the capstan side of the head assembly should be shimmed. The number of shims required can be calculated as follows:

$$\text{Number of Shims} = \frac{(\text{Tape Speed}) \times (\text{Time Displacement})}{37.5 \times 10^{-6}}$$

c. After the guide has been shimmed, verify that the distance displacement is less than 100 microinches.

5-24 WRITE HEAD DESKEW ADJUSTMENT

To ensure proper write head deskewing the read head gap scatter must first be plotted using the IBM Master Skew Tape. This plot is then duplicated while writing on a tape by adjusting the write deskew single-shot potentiometers. Load the IBM Master Skew Tape on the tape unit and perform the following adjustments.

5-25 Read Head Gap Scatter Plot

a. Using a dual trace oscilloscope, connect Channel A to TP103.

b. Use the maintenance switch SW1 to run the tape forward and monitor TP203 through TP903 with Channel B of the oscilloscope. Record the time displacement between Channels A and B of the oscilloscope (see figure 5-5).

5-26 Write Deskew Adjustment

a. Unload the IBM Master Skew Tape from the tape unit and load a reel of tape on the unit.

b. Press and release the LOAD control twice (once for units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

c. Use the TX-1000 TAPE TRANSPORT EXERCISER to write all ones in all channels. Refer to the TAPE TRANSPORT EXERCISER manual (Part No. 9580062) for equipment interconnection and set-up instructions.

d. Connect oscilloscope to TP13.

e. Adjust potentiometer R102 so that the negative pulse displayed on the oscilloscope is 4.25 microseconds at 75 ips, 7.05 microseconds at 45 ips, 8.50 microseconds at 37.5 ips, or 12.75 microseconds at 25 ips (as applicable to tape unit). Set potentiometers R202 through R902 to minimum value (clockwise).

f. Connect Channel A of oscilloscope to TP103. Connect Channel B of oscilloscope to TP203 through TP903 and, while monitoring the signals at these test points, adjust the write de-skew potentiometers (R902 through R902) so that the READ HEAD GAP SCATTER PLOT is duplicated.

5-27 STAIRCASE SKEW MEASUREMENT AND ADJUSTMENT

A quick check of all read/write adjustments can be made by observing the waveform at TP9 (see figure 5-6). The TX-1000 TAPE TRANSPORT EXERCISER (Part No. 00295) should be set-up to write all ones on all channels. The length of time from the first step to the last is the total amount of skew displacement. If the skew is greater than 175 microinches (see table 5-4) and cannot be brought within limits by shimming the fixed guides, the Tape Path Adjustment (paragraph 5-40) should be performed.

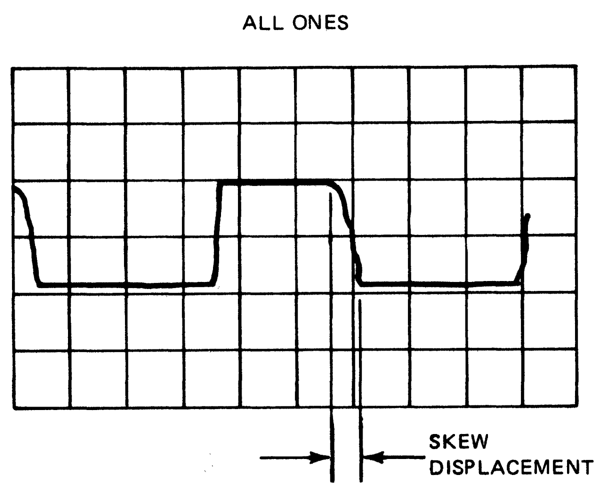


Figure 5-6. Staircase Waveform (TP9)

a. Connect oscilloscope to TP9.

b. Using the maintenance switch, run the tape forward. Measure the skew and verify the static skew is less than 100 microinches and the skew jitter is less than 75 microinches (refer to table 5-4).

c. Run the tape in reverse and measure the amount of skew. The static skew must be less than 100 microinches, and the skew jitter must be less than 75 microinches.

5-28 FLUX GATE ADJUSTMENT

The flux gate adjustment is necessary to minimize the crosstalk between the read and write heads. Perform the following steps to prepare the tape for the adjustment procedure.

a. Apply power to the tape unit.

b. Load a reel of tape on the unit. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

c. Remove the tape from the capstan so that the only signal present at the output of the read amplifier is crosstalk from the write head.

d. Use the TX-1000 TAPE TRANSPORT EXERCISER to write all ones on all channels. Refer to the TAPE TRANSPORT EXERCISER manual (Part No. 9580062) for equipment interconnect and set-up instructions.

5-29 Adjustment of Flux Gate

a. Connect oscilloscope Channel A to TP601 and Channel B to TP701 (9-channel) or Channel A to TP901 and Channel B to TP101 (7-channel).

b. The amplitude of the signal displayed on the oscilloscope should be less than 0.5 volt, with no pronounced peaks.

c. If the signal amplitude is greater than the allowed limit, remove the head cover. Loosen the two screws securing the flux gate (see figure 5-1) and adjust the flux gate until the voltage is within limits. Be careful that the flux gate does not touch the tape.

5-30 READ STROBE ADJUSTMENT

Load a standard level output tape on the tape unit, then use the TX-1000 TAPE TRANSPORT EXERCISER to write 800 bpi, all ones on all channels. Refer to the TAPE TRANSPORT EXERCISER manual (Part No. 9580062) for equipment interconnect and set-up instructions. After recording all ones on all channels, rewind the tape to the BOT marker and proceed to the following adjustment procedures.

a. Connect oscilloscope Channel A to TP5.

b. Run the tape forward in the read mode.

c. Adjust potentiometer R29 such that the positive pulse observed on the oscilloscope is equal to one half of a bit time (refer to table 5-5).

5-31 THRESHOLD MEASUREMENT

The correct threshold voltages are necessary to correctly read data from tape. Perform the following steps to measure the threshold voltages.

TABLE 5-5. ONE-HALF BIT TIME FOR VARIOUS TAPE SPEEDS AND DENSITIES

ONE-HALF BIT TIME (microseconds)

SPEED (ips)	800 bpi	556 bpi	200 bpi
25	25	36	100
37.5	17	24	68
45	14	20	56
75	8.5	12	34

a. Apply power to the tape unit.

b. Load a reel of tape on the tape unit. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape and to advance the tape to the BOT marker.

c. Verify that Read Threshold 1 and Read Threshold 2 are not asserted.

d. Set the tape unit off line. Connect the oscilloscope to test point TP11. The voltage should be 1.3 volts.

e. Set the tape unit on line. Assert Read Threshold 2. The voltage should be 0.7 volt.

f. For dual gap version data boards, use the TX-1000 to write data. Single gap version assert Read Threshold 1. The voltage should 2.1 volts.

5-32 Phase Encoded Data Board Electrical Adjustments

The adjustments contained in this section should be performed whenever a tape head is removed and replaced. The following list indicates the order in which the adjustment procedures should be performed.

1. Read amplifier gain adjustment.
2. Read head skew measurement and adjustment.
3. Flux gate adjustment.

Refer to the PE Data PWBA drawing in the attached PE drawing package, for component location on the Phase Encoded Data Board.

5-33 READ AMPLIFIER GAIN ADJUSTMENT

The gain of each of the read amplifiers located on the Phase Encoded (PE) Data Board is independtly adjustable. Perform the following steps to adjust the PE Data Board read amplifiers.

a. Clean the head assembly and tape path as described in paragraph 5-3.

b. Apply power to the tape unit.

c. Load a standard level output tape on the tape unit. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

d. Use the TX-1000 TAPE TRANSPORT EXERCISER to write all ones on all channels. Refer to the TAPE TRANSPORT EXERCISER manual (Part No. 9580062) for equipment interconnection and set-up instructions.

e. After recording all ones on all channels, rewind the tape to the BOT marker.

f. Connect the oscilloscope to TP104.

g. Run the tape forward in the read mode.

h. Adjust potentiometer R112 until the analog signal displayed on the oscilloscope is 6 volts peak-to-peak. (Refer to figure 5-7.)

i. Repeat step h for all channels using TPX04 and potentiometers RX12 where X is 2 through 9.

5-34 READ HEAD SKEW MEASUREMENT AND ADJUSTMENT

The read head skew measurement and adjustment procedures should only be required when the read head has been replaced. The adjustment of read skew is accomplished mechanically by shimming one of the head guides. The shims are 0.0005 inch thick and correct for 37.5 microinches of skew. The maximum allowed shims under any one guide is four. Both guides should not be shimmed on the same head plate assembly. The shims can be mounted by removing the guide and placing the shim on the screw that mounts the guide, then reassembling the guide on the head plate assembly. Perform the following measurement and adjustment steps.

a. Apply power to the tape unit.

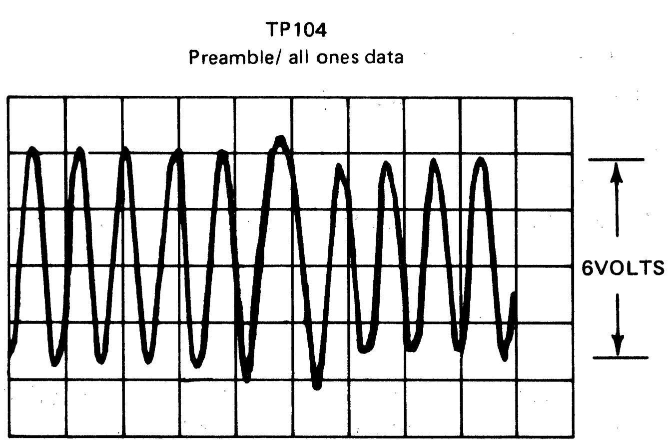


Figure 5-7. Amplifier Waveform (TP104)

b. Load the IBM Master Skew Tape on the tape unit. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

c. Using a dual trace oscilloscope, connect Channel A to TP607 and Channel B to TP707.

d. Using the maintenance switch SW1, run the tape forward. Observe the time displacement between the two signals displayed on the oscilloscope (see figure 5-5). Calculate the amount of displacement (refer to table 5-4). If displacement is less than 100 microinches, no shimming is required. If the displacement is greater than 100 microinches and TP707 is the leading signal, the guide on the capstan side of the head assembly should be shimmed. Otherwise, shim the other guide. The number of shims required can be calculated as follows:

$$\text{Number of Shims} = \frac{(\text{Tape Speed}) \times (\text{Time Displacement})}{37.5 \times 10^{-6}}$$

e. After the guide has been shimmed, verify that the displacement is less than 100 microinches.

5-35 FLUX GATE ADJUSTMENT

a. Apply power to the tape unit.

b. Load a reel of tape on the unit. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

c. Remove the tape from the capstan so that the only signal present at the output of the read amplifier is crosstalk from the write head.

d. Use the TX-1000 TAPE TRANSPORT EXERCISER to write all ones on all channels. Refer to the TAPE TRANSPORT EXERCISER manual (Part No. 9580062) for equipment interconnect and set-up instructions.

e. Connect oscilloscope Channel A to TP604 and Channel B to TP704.

f. The amplitude of the signal displayed on the oscilloscope should be less than 0.5 volt.

g. If the signal amplitude is greater than the allowed limit, remove the head covers. Loosen the two screws securing the flux gate (see figure 5-1) and adjust the flux gate until the voltage is within limits. Be careful that the flux gate does not touch the tape.

5-36 STAIRCASE SKEW MEASUREMENT

A quick check of all read/write adjustments can be made by observing the waveform at TP5 (see figure 5-8). The length of time from the first step to the last is the total amount of skew displacement. If the skew is greater than 175 microinches (see table 5-4) and cannot be brought within limits by shimming the fixed guides, the tape path adjustment (paragraph 5-40) should be performed. Perform the measurements as follows:

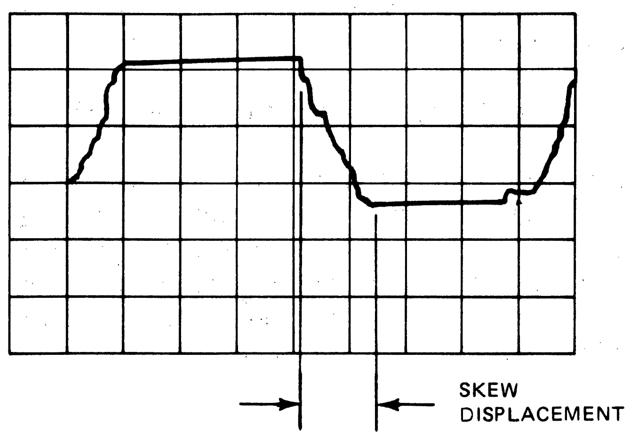


Figure 5-8. Staircase Waveform (TP5)

a. Connect oscilloscope to TP5.

b. Load a skew tape on the tape unit and perform the PE Read Skew Measurement Procedure given in steps c and d.

c. Using the maintenance switch, run the tape forward. Measure the skew and verify the static skew is less than 100 microinches, and the skew jitter is less than 75 microinches (refer to table 5-4).

d. Run the tape in reverse and measure the amount of skew. The static skew must be less than 100 microinches and the skew jitter is less than 75 microinches.

e. Replace the skew tape with a standard tape and perform the PE Read/Write Skew Measurement Procedure given in steps f and g.

f. Set up the TX-1000 TAPE TRANSPORT EXERCISER (Part No. 00295) to write all ones on all channels.

g. With the exerciser writing all ones on all channels on the tape, measure the total skew time. Verify the total skew is less than 150 microinches (refer to table 5-4).

5-37 THRESHOLD MEASUREMENT

The correct threshold voltages are necessary to correctly read data from tape. To measure the threshold voltages, perform the following steps:

a. Apply power to the tape unit.

b. Load a reel of tape on the tape unit. Press and release the LOAD control twice (once on units equipped to automatically position the tape at the BOT marker) to tension the tape and to advance the tape to the BOT marker.

c. Verify that Read Threshold 1 and Read Threshold 2 are not asserted.

d. Set the tape unit off line. Connect oscilloscope to test point TP4. The voltage should be 0.9 volt.

e. Set the tape unit on line. Assert Read Threshold 2. The voltage should be 0.3 volt.

f. For dual gap version data heads, use the TX-1000 to write data. Single gap version assert Read Threshold 1. The voltage should be 1.6 volts.

5-38 Mechanical Checkout and Alignment

The following paragraphs present checkout and alignment procedures for the mechanical components of the Model 2750 Magnetic Tape Unit. Refer to figures 4-2 and 5-1 for verious mechanical views of the tape units.

5-39 TAPE PATH ALIGNMENT MEASUREMENT

Load a tape on the tape unit and perform the following steps:

a. Using the maintenance switch SW1, run the tape forward and reverse.

b. Check at all of the guides if the tape is being curled or warped at the edges while tape is moving. If it is, perform the Tape Path Adjustment (paragraph 5-40).

c. Check that the tape stays in the center of the capstan as the tape is run forward and reverse. If it doesn't, perform the Tape Path Adjustment (paragraph 5-40).

d. Remove the tape guide caps from the fixed tape guides on the head plate assembly.

e. Press the spring loaded tape guides washers to the head plate. Secure to this position.

f. Using the maintenance switch SW1, run the tape forward and reverse.

g. Verify that the tape movement across the fixed tape guides is less than 10 mils. If the tape movement is greater than 10 mils, perform the Tape Path Adjustment (paragraph 5-40).

h. Replace tape guide caps on the guides. Release the spring loaded washer.

i. Perform the Staircase Skew Measurement (paragraph 5-27 or 5-36).

5-40 TAPE PATH ADJUSTMENT

Alighment of the tape path components is accomplished by using the Bright Alignment Tool, Part No. 00326. The tape path components consist of the head plate, the tape guide rollers (supply and take-up), the supply and take-up hub, and the capstan.

CAUTION

The alignment tool is precision made. It must be handled with care to avoid damage.

5-41 Vacuum Machine Head Plate Adjustment

The alignment of the head plate should only be required when the vacuum chamber has been replaced. The adjustment of the head plate is accomplished by using Bright Alignment Tool, Part No. 00326.

a. Remove the power from the tape unit.

b. Remove the head covers.

c. The tape unit overlay is secured to the tape unit by tape coated with adhesive material on both sides. Gently remove the overlay, taking care not to damage any components mounted on the head plate assembly.

d. Remove fixed guide caps and the vacuum column door by removing the hinge screws.

e. Using the screws supplied with the Bright Alignment Tool, mount the alignment tool on the fixed guides as shown in figure 5-9.

f. Measure with a feeler gauge at the three points (A,B,C). If they are not equal to 0.040 ± 0.001, then the head plate has to be shimmed.

g. Insert shims on the head plate spacers so that the three points are equal to 0.040 ± 0.001. A 1 mil shim on the spacer closest to the head will cause the point at B to lower 3 mils.

5-42 Tape Guide Roller Adjustment

The following tape guide roller adjustment procedure applies to both the supply and take-up guide roller assemblies.

a. Remove tape and reels from the tape unit.

b. Remove the power from the tape unit.

c. Remove the head covers and the caps from the fixed guides.

d. The tape unit overlay is secured to the unit by tape coated with adhesive material on both sides. Gently remove the overlay, taking care not to damage any components mounted on the head plate assembly.

e. Figure 5-9 shows how to position the tool (Part No. 00326) for the vacuum unit.

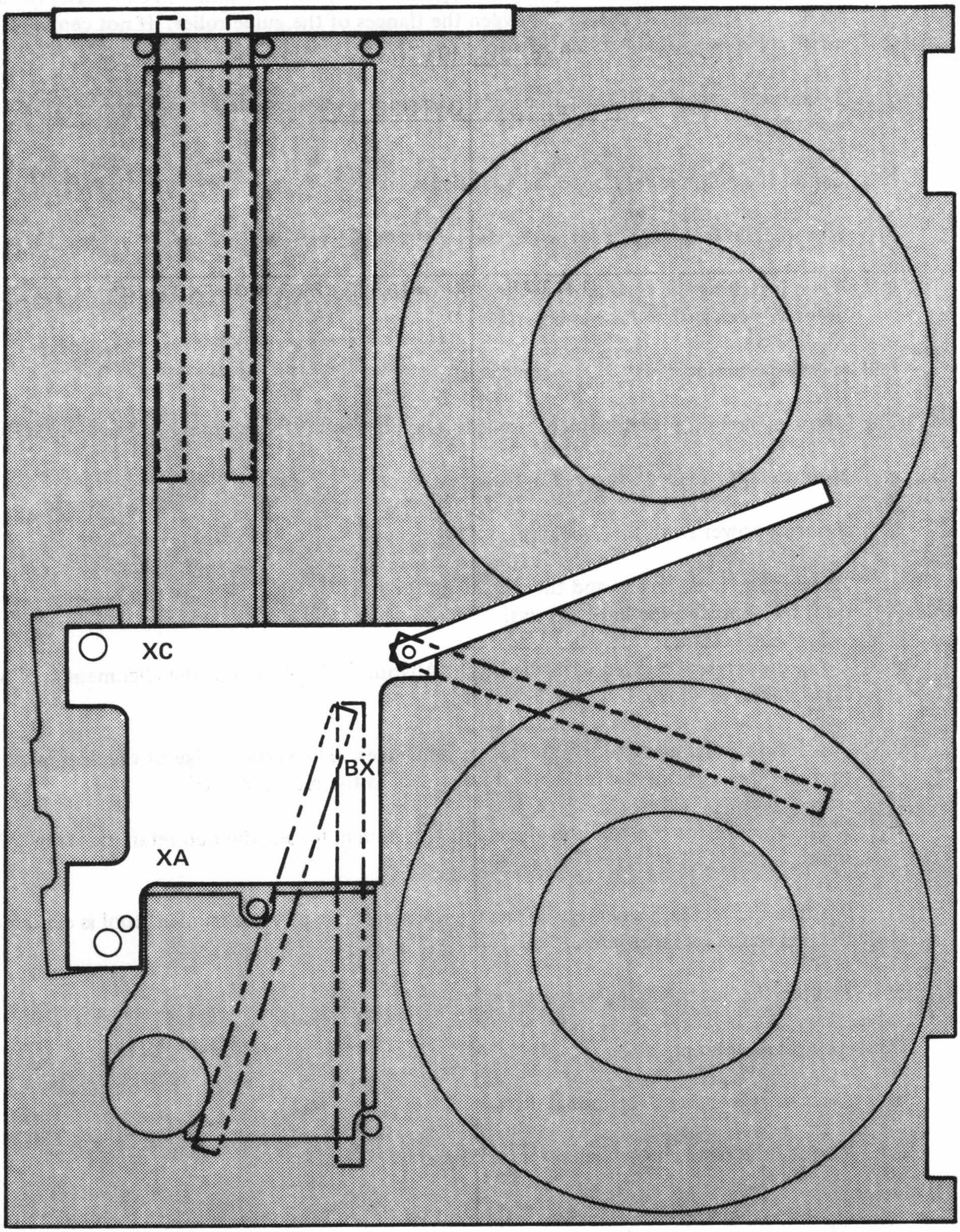


Figure 5-9. Tape Guide Alignment Tool

f. Position the alignment tool against each guide roller, one at a time. In each case, the alignment tool should be centered between the flanges of the guide roller. If not centered, a guide roller height adjustment is necessary.

g. To adjust the height of the guide roller, loosen the setscrew securing the guide roller assembly.

h. Center the guide roller flanges on the alignment tool.

i. When height is established, tighten the guide roller setscrew.

j. When installing the tape unit overlay, the original tape must be replaced with tape coated on both sides with adhesive material.

5-43 Reel Height Adjustment

The following reel height adjustment procedure applies to both the supply and take-up reels.

a. Mount empty reels on the reel hubs.

b. Remove power from the tape unit.

c. Remove the head covers and the caps from the fixed guides. Remove the vacuum column door by removing the hinge screws.

d. Using the screws supplied with the Bright Alignment Tool, mount the alignment tool on the fixed guides as shown in figure 5-9.

e. Position the alignment tool between the reel edges. The vertical edge of the alignment tool and the edges of the reel should not touch as the reel is rotated.

f. If the edges of the reel and the alignment tool touch, loosen the hub retaining screw. See figure 4-2.

g. Position the reel hub assembly so that the vertical edge of the alignment tool is centered in the reel as the reel is rotated.

h. Tighten the hub retaining screw.

5-44 Capstan Height Adjustment

a. Remove power from the tape unit.

b. Remove the head covers and the caps on the fixed guides.

c. The tape unit overlay is secured to the unit by tape coated with adhesive material on both sides. Gently remove the overlay, taking care not to damage any components mounted on the head plate assembly.

d. Remove the three screws from the entry guide and remove the entry guide.

e. Figure 5-9 shows how to position the tool (Part No. 00326) for the vacuum unit. Position the alignment tool against the capstan. The center of the capstan should be in the center of the tool.

f. To adjust the height of the capstan, loosen the setscrew securing the capstan to the capstan motor shaft.

g. Position the capstan so that the cener of the capstan and the alignment tool are centered.

h. Tighten setscrew.

i. When replacing tape unit overlay, original tape must be replaced with tape coated with adhesive material on both sides.

5-45 VACUUM MOTOR BELT TENSION ADJUSTMENT

The vacuum motor belt tension can be adjusted as follows:

a. Remove power from the tape unit.

b. Loosen the four screws that secure the vacuum motor to the vacuum motor plate assembly.

c. Position the vacuum motor assembly until there is only one-fourth inch deflection in the vacuum motor belt.

d. Tighten the four screws that secure the vacuum motor to the vacuum motor plate assembly.

5-46 WRITE LOCKOUT ASSEMBLY ADJUSTMENT

Remove power from tape unit and perform the following steps to adjust the write lockout assembly.

a. Install a reel without a write protect ring on the supply reel hub. Check that the write lockout plunger (see figure 4-2) is centered in the write protect ring groove and doesn't rub on the bottom of the groove.

b. If the plunger is not centered in the groove, loosen the two write lockout mounting screws and reposition the assembly. Tighten the mounting screws.

c. If the plunger rubs on the bottom of the groove, loosen the solenoid mounting screws and position the solenoid until the plunger just clears the bottom of the groove. Tighten the mounting screws.

d. Install a reel with a write protect ring on the supply reel hub and check to see if the write lockout microswitch closes.

e. If the microswitch does not close, loosen the solenoid mounting screws and position the solenoid until the microswitch closes. Tighten the mounting screws.

f. Apply power to the tape unit. The plunger should be pulled away from the reel and not rub against the reel, when the LOAD control is pressed and released and the tape is tensioned.

5-47 TROUBLESHOOTING

Troubleshooting of the Bright Model 2750 Magnetic Tape Unit requires a thorough knowledge of the contents of Chapter 4. Before performing any detailed troubleshooting, the preliminary checks contained in the following paragraph should be performed. If the problem is not corrected by performing the preliminary check, refer to paragraphs on system level troubleshooting and to the troubleshooting charts. Note that the troubleshooting procedures do not include individual components such as switches, capacitors, resistors, etc. Checking of such components is to be done by conventional voltage and resistance tests, with the aid of the schematic and assembly diagrams in the attached drawing package.

5-48 Preliminary Checks

Preliminary checks are performed to ascertain that the equipment is connected properly and that the proper operating voltages are present.

a. Verify that all cables and connectors are in good condition and that connections are made correctly.

b. Verify that the five fuses on the rear panel are not burned out, and that they are of the specified rating (see figure 2-8).

c. Inspect for evidence of broken wires, and overheated components.

5-49 System Level Troubleshooting

An initial check should always be made of the power supply circuits. Specifically, the ±5V regulator supplies should be checked to ensure correct output voltage. Also, eliminate the possibility of external equipment causing the malfunction. If the malfunction is a control function, or if all channels of data are affected, ensure that all inputs to the tape unit (control and data) are correct.

If a fault is associated with all channels, check the control circuits that provide control signals to the data processing operation. Check for the presence of the control signals at the Data Board and verify correct logic levels and timing. If a specific signal is missing, conventional signal tracing techniques may be used to lead to the defective circuit. This method should be used to locate problems associated with either read or write data functions. If the problem is associated with only one channel, compare a signal level of a good channel to those of a defective one (all data channels are identical).

If a control problem exists, determine what control function is defective and troubleshoot the appropriate control circuit. Check the suspected circuit for defective logic levels. Also, verify that timing relationships of the signals developed in the suspected circuits are correct when compared to signals developed independent of the suspected circuit.

5-50 Troubleshooting Charts

The system troubleshooting charts in table 5-6 are provided to aid the maintenance technician in isolating malfunctions in the tape unit. The troublsehooting charts provide typical symptons of

TABLE 5-6. TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
Does not start to load.	EOT and BOT not working properly.	Check operation and adjust the BOT and EOT amplifiers.	para 4-29, 5-9
	LOAD or RESET switch defective.	Check operation of switches. Replace as necessary.	para 4-16, 4-24
	Logic Problem, LDA flip-flop is not	Repair Tape Control Board.	para 4-15
Load operation does not move tape into column.	K3 Relay or Driver defective.	Check to see if K3 contacts close. Replace.	para 4-16
	Load reel motor driver defective.	Check to see if 17 volts is at J7-3 when Q4 turns on and the reel motors turn.	para 4-16
	Interlock switches defective.	Check operation of switches. Adjust or replace.	para 4-16
Load operation moves tape into vacuum column, but tension is not made.	Interlock switches do not close.	Check operation of switches. Adjust or replace.	para 4-16
	K1 relay or driver defective.	Check to see if K1 contacts close. Replace.	para 4-16
	Osc and Sync Det malfunction.	Loop a length of tape in the columns (figure 5-3). Press the load switch to turn on the vacuum motor. Check operation of the Osc and Sync detectors. Replace.	para 4-18, 5-19
	Reel Servo Amplifiers malfunction.	Check operation of servo amplifiers. Adjust.	para 4-17, 5-18
When the capstan moves tape, the interlock switches open.	Osc and Sync detectors malfunction.	Loop a length of tape in the columns (figure 5-3). Press the load switch to turn on the vacuum motor. Check the operation of the Osc and Sync detectors. Replace.	para 4-18, 5-19

TABLE 5-6. TROUBLESHOOTING CHART (continued)

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
	Capstan speed or ramp not correct.	Remove tape from around capstan. Check capstan speed and ramp at TP12.	para 4-20, 5-12, 5-17
	Reel Servo is out of adjustment.	Adjust Reel Servo.	para 4-17, 5-18
Tape moves past BOT marker during LOAD or REWIND.	Dul BOT tab.	Replace BOT tab.	
	BOT amplifier malfunction.	Check operation and adjust the BOT amplifier.	para 4-29, 5-9
	Logic problem. LDB flip-flop is not reset or RWDB is not set.	Repair Tape Control Board.	para 4-16, 4-27
Tape unit does not respond to For./Rev commands but to manual switch.	Tape unit not on line or selected.	Check that correct select line is asserted. Check on-line switch and flip-flop. Repair if necessary.	para 4-24, 4-25
	Select, SFC or SRC cable or receiver defective.	Check outputs or receivers for correct levels. Repair.	para 4-26
Does not respond to manual For./Rev.	Defective BOT and EOT sensor or amplifier.	Check operation and adjust amplifier.	para 4-29, 5-9
	Tape unit is not ready.	Check inputs to gate U36-8 to determine which one is not high.	para 4-15
	Tape unit is on line.	Check and replace on-line flip-flop.	para 4-24
	K1 Relay contacts 10/9 do not make.	Check if TP14 and J1-1 are at the voltage. Replace.	para 4-16
	Component failure in For./Rev Ramp Generator or Capstan Amplifier.	Check the operation of the components in the ramp generator and amplifier.	para 4-21, 4-23, 4-26, 5-12, 5-17
	Manual switch defective.	Check MFWD and MREV signals.	para 4-26
Interlock switches are opened during rewind.	K2 Relay or driver not working properly.	Check that the contacts of K2 close.	para 4-16, 4-28

TABLE 5-6. TROUBLESHOOTING CHART (continued)

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
	The high gain is not switched on in the reel servos.	During a rewind operation, check that each pair of voltages – TP26 and cathode of CR6004, and TP29 and cathode of CR7004 – are at the same voltage. Replace defective component if necessary.	para 4-19
	Reel Servos are not adjusted or working properly.	Check and adjust the reel servos.	para 4-17, 5-19
	Rewind speed or ramp are not correct.	Adjust the rewind speed and check the ramp times.	para 4-22, 5-16
	Logic problem asserting a forward command during rewind operation.	Check that TP33 is zero during rewind. Repair.	para 4-21, 4-26
Responds to Forward command but doesn't write. Reads a good tape correctly.	No write power to data board or write current is not enabled.	Check write lockout microswitch is closed and TP3 for PE or TP2 for NRZI Data Boards is at +5 volts and collector of Q3 is at –5 volts. Repair.	para 4-27, 4-31, 4-35, 4-38, 5-47
	Interface cable or receiver malfunction.	Check write data, data ready, LRC strobe and SWRT receiver outputs for proper levels.	para 4-35, 4-38
	Write head connector not properly plugged into J1.	Check that head connector is securely into J1.	
Data is incorrectly written but a good tape can be read.	The tape is bad.	Replace the tape.	
	Intermittent connection with write power.	Check that the write lockout solenoid is energized and microswitch is solidly closed. Adjust or replace.	para 4-31, 5-47
	Incorrect Data format.	Check pre-delays, post-delays, and Data Format.	Table 3-6
	Write deskew needs adjustment.	Adjust the write deskew.	para 4-35, 5-24

TABLE 5-6. TROUBLESHOOTING CHART (continued)

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
	Component in write electronics defective.	Check operation of write channels and repair if necessary.	para 4-35, 4-38, 5-27, 5-37
A correctly written tape cannot be read while being written.	Flux gate improperly adjusted.	Adjust flux gate.	para 5-28, 5-36
A good tape cannot be correctly read.	Tape path needs cleaning.	Clean the head, guides, and tape cleaner.	para 5-3
	Read electronics need adjustment.	Adjust the read amplifiers and read strobe.	para 4-36, 4-39, 5-21, 5-30, 5-33
	Read head connector not properly plugged into J2.	Check that head connector is securely into J2.	
	Interface cable or receiver malfunction.	Check the outputs of the read data cable drivers for proper levels.	
	PE Data Board component failure in envelope detector circuit.	Check the envelope detector relays. Replace.	para 4-39
	Component failure in threshold circuit.	Check threshold voltage (PE: TP4, NRZI: TP11). Repair.	para 4-36, 4-40, 5-31, 5-38
	No select, motion or high density signals on data board.	Check that the signals are present on the Data Board. Repair.	para 4-25, 4-26, 4-30
	Component failure in the read channels.	Check operation of read channels and repair if necessary.	para 4-36, 4-39
	For single gap head, faulty write head driver.	Check if any head driver is causing current to flow in the head. Repair.	

malfunctions along with probable causes, possible remedies and references to procedures within the manual which may aid the maintenance technician in isolating a faulty circuit. These tables should be used in conjunction with the assembly and schematic diagrams in the attached drawing package.

5-51 COMPONENT REPLACEMENT

The following paragraphs provide procedures for replacing various components within the Model 2750 Magnetic Tape Unit. Before attempting any of the procedures, they should be read thoroughly. When performing these procedures, the maintenance technician should refer to the mechanical assembly illustration in figure 4-2 and to the various illustrations and drawings in the attached drawing package.

5-52 Tape Guide Roller Replacement

a. Remove the C-clamp securing the tape guide flange to the tape guide shaft. Refer to figure 5-1.

b. Remove the tape guide flange and bearing assembly.

c. Install the new tape guide flange and bearing assembly.

d. Secure the new tape guide flange to the tape guide shaft with the C-clamp removed in step a.

e. Check the tape guide height by mounting the Bright Alignment Tool as shown in figure 5-9. Position the alignment tool against the tape guide roller.

f. If the alignment tool is not centered between the flanges of the guide roller, perform the Tape Guide Roller Adjustment Procedure detailed in paragraph 5-42.

5-53 Reel Servo Motor Replacement Procedure

a. Disconnect the power leads and capacitors from the reel servo motor (see figure 4-2).

b. Loosen the setscrew that secures the reel hub to the motor shaft.

c. Remove the four screws attaching the motor to the baseplate and remove the motor. Use these screws to attach the new motor to the baseplate.

d. Mount the reel hub on the new motor's shaft.

e. Perform the Reel Height Adjustment Procedure (paragraph 5-43).

f. Connect power leads and capacitors to the reel servo motor.

5-54 Capstan Motor Replacement

a. Remove the head covers.

b. Gently remove the tape unit overlay, taking care not to damage any components mounted on the head plate assembly.

c. Loosen the setscrews securing the capstan to the capstan motor shaft and remove the capstan.

d. Disconnect the power leads from the capstan motor (figure 4-2).

e. Remove the screws attaching the capstan motor to the tape unit baseplate. Note location of shims so that the new motor can be shimmed the same way. Re-install screws and shims in same manner when installing the new capstan motor to the tape unit baseplate.

f. Secure the capstan to the capstan motor shaft. Perform Capstan Height Adjustment Procedure, paragraph 5-44.

g. Install new tape unit overlay. The original tape must be replaced with tape coated with adhesive material on both sides.

h. Install the head covers.

i. Connect power leads to the capstan motor.

5-55 Vacuum Motor Belt Replacement Procedure

a. Loosen the four screws that secure the vacuum motor to the vacuum motor plate assembly.

b. Remove the old vacuum motor belt.

c. Install the new vacuum motor belt.

d. The vacuum blower pulley has three positions for mounting the vacuum motor belt. Starting with the position of smallest diameter: this position is of 60 Hz operation at 6,000 feet; the next position is for 60 Hz operation above 6,000 feet; and the final position is for 50 Hz operation at sea level.

e. Perform the Vacuum Motor Belt Tension Adjustment Procedure, paragraph 5-45.

5-56 Head Replacement Procedure

The head may require replacement for one of two reasons: internal fault in the head or cable, or wear. The first reason can be established by reading a master tape; the second can be verified by measuring the depth of the wear on the head crown.

a. Remove the head covers.

b. Disconnect the tape head connectors (see figure 5-1).

c. Remove the two screws which attach the head to the head plate assembly.

d. Ease the head cable through the hole in the deck.

e. Route the new head cable through the deck hole.

f. Using the two screws mounted in step c, attach the new head to the head plate assembly.

g. Connect the tape head connector.

h. Perform the NRZI or Phase Encoded Data Electronics Adjustment Procedure, paragraph 5-20 or 5-32, respectively.

i. Install the head covers.

5-57 Vacuum Column Replacement Procedure

a. Remove power from the tape unit.

b. Remove the head covers.

c. Gently remove the tape unit overlay, taking care not to damage any components mounted on the head plate assembly.

d. Remove the screws attaching column entry block and remove the block.

e. Remove the six screws attaching the vacuum column assembly to the tape unit baseplate.

f. Carefully lift the vacuum column assembly from the tape unit baseplate and disconnect the vacuum hoses and signal plug.

g. Connect the vacuum hoses and signal plug to the new vacuum column assembly.

h. Using the four screws removed in step e, attach the new vacuum column assembly to the tape unit baseplate. Using the screws removed in step d, attach the vacuum entry block.

i. Perform the Tape Path Alignment Measurement Procedure, paragraph 5-39.

j. Perform the Vacuum Column Electrical Adjustment Procedure, paragraph 5-18.

k. Replace the tape unit overlay. The original tape must be replaced with tape coated with adhesive material on both sides.

l. Replace the head covers.

5-58 Transducer Replacement Procedure

a. Perform the Vacuum Column Replacement Procedure, steps a through f.

b. Remove the ten screws attaching the transducer to the vacuum column assembly.

c. Gently lift the transducer from the vacuum column assembly.

d. Disconnect signal leads from the transducer, noting the terminal connection of the wires.

e. Disconnect the vacuum hoses from the transducer. Remove the transducer.

f. Solder the signal leads and connect the hoses to the new transducer.

CAUTION

When connecting signal leads to the transducer, take precautions not to melt or damage the plastic insulation washers on the solder posts.

g. Using the screws removed in step b, attach the new transducer to the vacuum column assembly. Do not tighten screws.

h. Connect a 24-inch H_2O vacuum source to transducers through a V/2 tube, and then tighten screws at terminal end of transducer that is being replaced. Tighten remaining screws in order, working toward opposite end of transducer.

i. Disconnect vacuum source from transducers.

j. Perform the Vacuum Column Replacement Procedure, steps g through l.

5-59. Vacuum Chamber Window Replacement Procedure

a. Remove four screws that attach vacuum chamber window to window hinges.

b. Remove vacuum chamber window.

c. Hold new window down firmly in place against vacuum chamber while installing and tightening hinge screws.

CAUTION

To prevent possible vacuum leaks, make certain that window is held flush against vacuum chamber while tightening hinge screws.

Chapter 6
DRAWINGS AND PARTS LISTS

6-1 INTRODUCTION

This chapter contains parts location views and replaceable parts lists for the Bright Model 2750 Magnetic Tape Unit. Figures 6-1 through 6-4 show parts locations for the Model 2750. Table 6-1 is a list of applicable parts for the Model 2750 Magnetic Tape Unit.

The drawings contained in the attached drawing package consist of PWBA and schematic drawings for both the NRZI and PE Data Boards, and the Tape Control Board. Various wiring diagrams and interconnection diagrams for the tape units are also included. The drawings contained in the attached drawing package are as follows:

DRAWING NAME	DRAWING NUMBER
Control Board PWBA	9040119
Control PWBA Schematic Diagram	9940119
NRZI Data PWBA, Single Data Card Version	9040116
NRZI Data PWBA, Two Data Card Version, Dual Density	9040087
NRZI Data PWBA, Three Data Card Version, Quad Density	9040093
NRZI Data PWBA Schematic Diagram	9940116
PE Data PWBA	9040121
PE Data PWBA Schematic Diagram	9940121
System Interconnect Diagram, Single Data Card Version	9930023
System Interconnect Diagram, Two Data Card Version	9930025
System Interconnect Diagram, Three Data Card Version (Quad Density)	9930032
System Interconnect Diagram, Without Data Card	9930026
Power Supply Assembly, Single and Two Data Card Versions	9020087
Power Supply Assembly, Three Data Card Version (Quad Density)	9020103
Power Supply Assembly With Transformer Barrier Terminal Block	9020092
Power Supply Wiring Diagram	9930027
Power Supply Wiring Diagram With Transformer Barrier Terminal Block	9930029
Power Supply Schematic Diagram	9930035
Heat Sink Assembly, Power Supply	9020046
Blower Motor Wiring Diagram	9930031
Vacuum Chamber Wiring Diagram	9930016
Triac Cable Assembly	9060130
Triac PWBA	9040130
Cable Assembly – Transformer/Triac	9060129
Jumper Plug Subassembly – Options Diagram	9060070

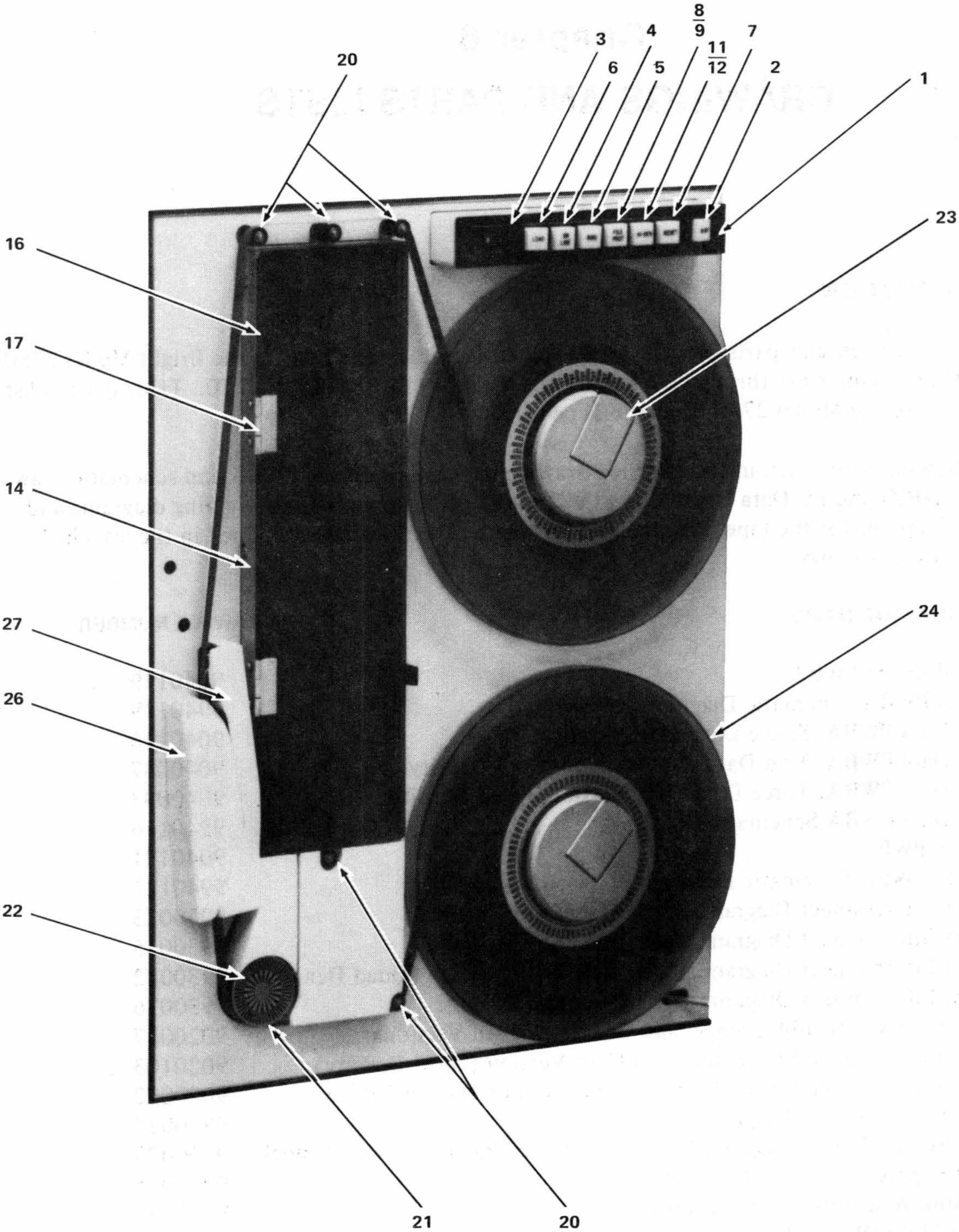


Figure 6-1. Model 2750 Parts Location, Front View

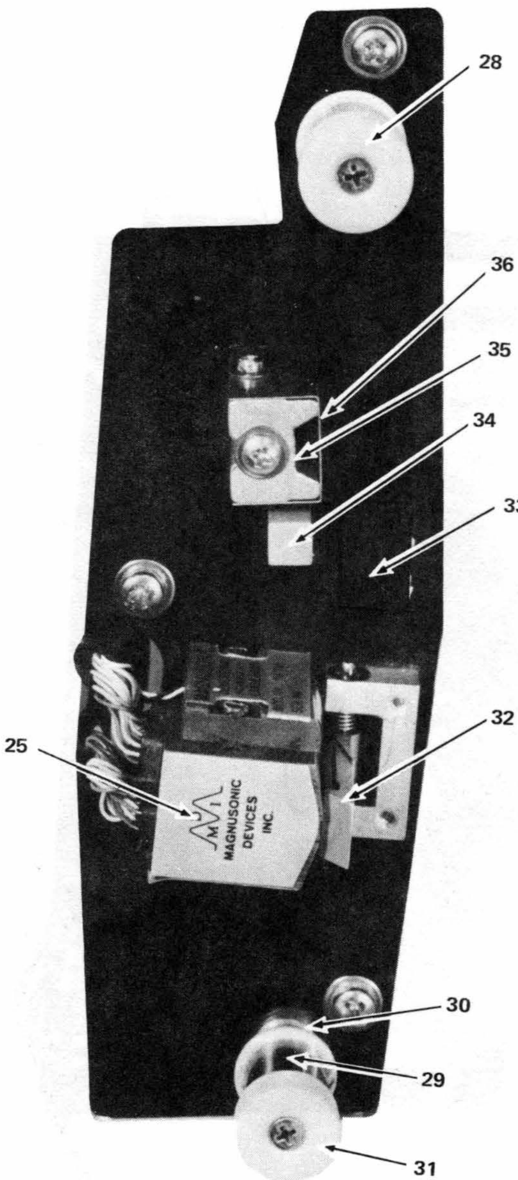


Figure 6-2. Head Plate Assembly (9020049-01) Parts Location

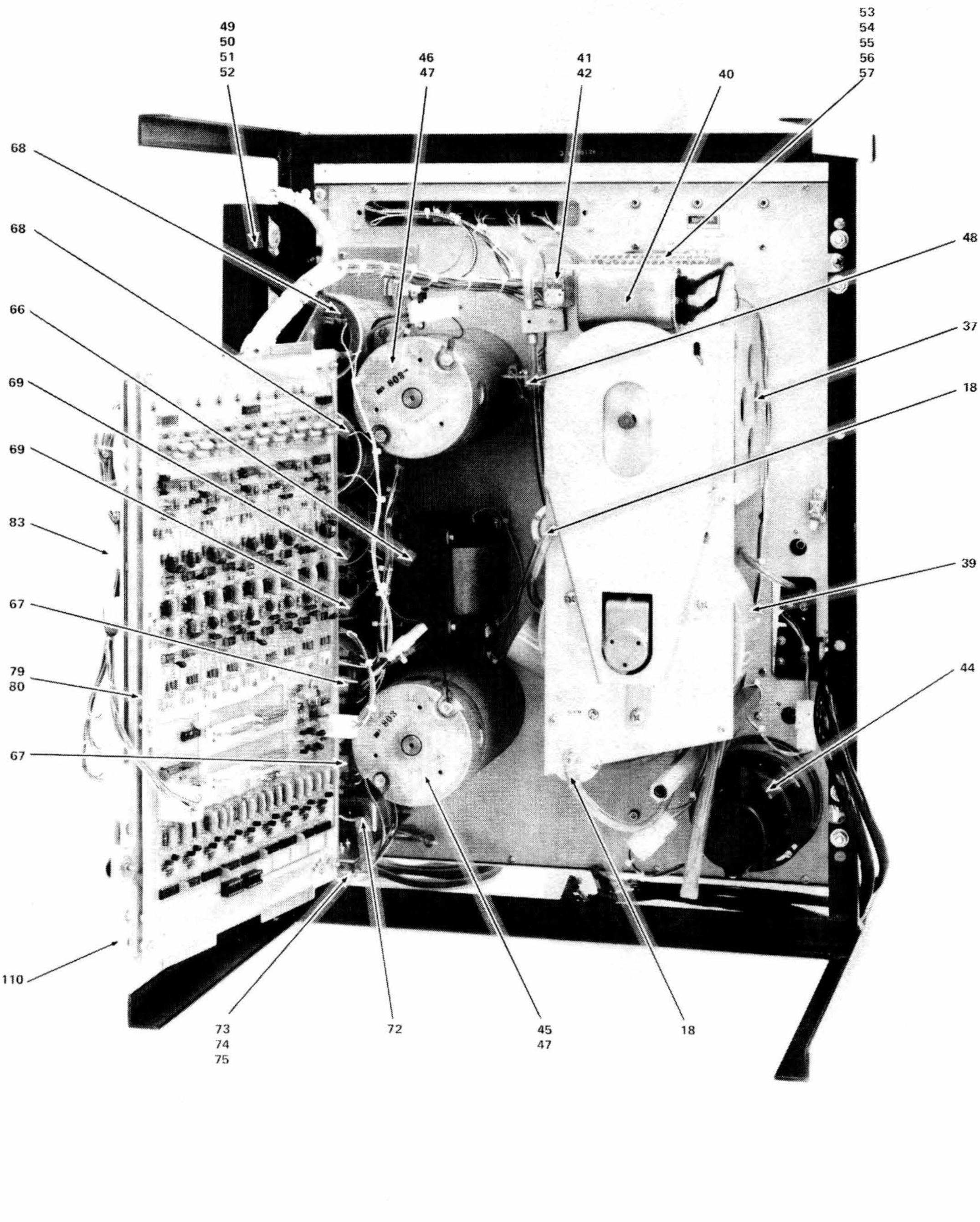


Figure 6-3. Model 2750 (Single Data Card Machine) Parts Location, Rear View

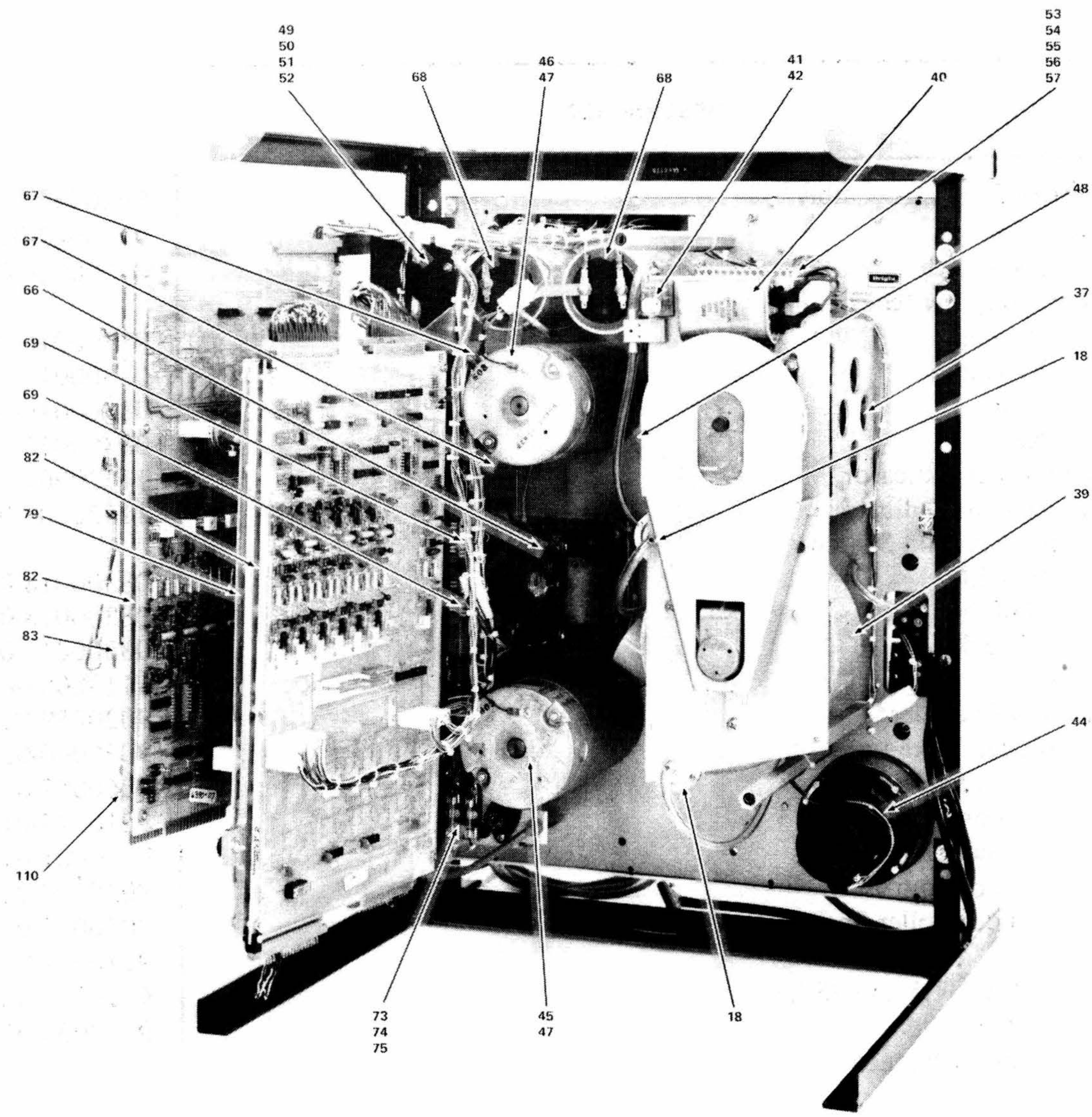


Figure 6-4. Model 2750 (3 Data Card, Quad Density) Parts Location, Rear View

TABLE 6-1. MODEL 2750 REPLACEABLE PARTS LIST

FIGURE REF	DESCRIPTION	PART NUMBER
1	Control Switch Assembly[1]	9020042-[ ]
2	Power Switch	9260049-01
3	Address Switch	08200004-01
	Momentary Switches:	
4	On Line	08300016-02
5	Rewind	08300016-03
6	Load	08300016-04
7	Reset	08300016-05
8	File Protect Indicator	11520001-01
9	Write Enable Indicator	11520001-02
	Alternate Action Switch:	
10	HI DEN	08300018-01
11	1600 bpi	08300018-01
12	9-Track	08300018-01
13	Lamp[2]	11130001-01
14	Vacuum Chamber	9020059-01
15	Transducer, Take-up[2]	9020060-02
16	Vacuum Chamber Window	9260097-01
17	Hinge, Door	9210349-01
18	Vacuum Switch	0870001-01
19	Transducer, Supply[2]	9020060-01
20	Tape Guide, Roller Short	9020039-02
21	Capstan	9210532-01
22	Speed Disc, 37.5 and 75 ips	9210378-02
23	Reel Retainer	9020035-01
24	Reel, Tape, 10½-inch	50000065-01
25	Head:	
	7-Track, Dual Gap	9510010-01
	7-Track, Single Gap	9510025-01
	9-Track, Dual Gap	9510026-01
	9-Track, Single Gap	9510027-01
	7-Track/9-Track, Dual Gap	9510037-01
	7-Track/9-Track, Read Only (Chrome)	9510043-01
26	Head Cover, Short	9260055-01
27	Head Cover, Long	9260056-01
28	Fixed Tape Guide	9210306-01
29	Washer, Tape Guide	9210068-01
30	Spring, Tape Guide	9210069-01
31	Cap, Tape Guide	9260030-01
32	Head Shield Assembly	9020032-01
33	EOT/BOT Assembly	9060063-01
34	Reflective Post	9210325-01

NOTES:
1. Indicate Machine Model Number and Tape Speed when ordering.
2. Not illustrated in figures 6-1, 6-2, 6-3 and 6-4.

TABLE 6-1. MODEL 2750 REPLACEABLE PARTS LIST (continued)

FIGURE REF	DESCRIPTION	PART NUMBER
35	Body, Tape Cleaner	9210277-01
36	Blade, Tape Cleaner	9210279-01
37	Vacuum Motor	9510019-01
38	Vacuum Motor Belt[2]	32000001-04
39	Vacuum Blower	50000089-01
40	Capacitor, 6 μF, 320-volt	01574066-01
41	Relay (K3)	41445042-01
42	Retainer, Relay[2]	50000088-01
43	Resistor, Wire Wound, 20Ω, 10-watt, 1%[2]	04680200-01
44	Capstan Motor Assembly	9020095-01
45	Reel Motor Assembly, Take-Up	9060101-01
46	Reel Motor Assembly, Supply	9060101-02
47	Reel Motor	9510032-01
48	Write Lockout/File Protect Assembly	9020031-02
49	Heat Sink Assembly, Power Supply	9020046-01
50	Power Transistor, 2N3055[2] (Mounted on Heat Sink)	05703055-01
51	Power Transistor, 2N6058[2] (Mounted on Heat Sink)	05706058-01
52	Power Transistor, 2N6051[2] (Mounted on Heat Sink)	05706051-01
53	Triac Cable Assembly	9060130-01
54	Printed Wire Board, Triac[2]	9040130-01
55	Triac (MAC10-4)[2]	05500104-01
56	Cable Assembly, Triac[2]	9060129-01
57	Cover, Triac Cable Assembly[2]	9210524-01
58	Connector (26-pin)[2]	07120007-01
59	Tape, Foam Closed Cell[2]	33800008-01
60	Tape, Foam Double Coated[2]	33700001-02
61	Shim, 0.001 inch Thickness[2]	9210250-01
62	Shim, 0.0005 inch Thickness[2]	9210250-02
63	Shim, 0.003 inch Thickness[2]	9210248-01
64	Shim, 0.005 inch Thickness[2]	9210249-01
65	Shim, 0.010 inch Thickness[2]	9210246-01
	POWER SUPPLY ASSEMBLY	
66	Power Transformer (T1)	9510042-01
67	Capacitor, 38000 μF, 25-volt	01518389-01
68	Capacitor, 71000 μF, 25-volt	01518719-02
69	Capacitor, 9600 μF, 25-volt	01518968-01
70	Diode[2]	02400831-01
71	Diode Bridge[2]	02509622-01
72	Filter	05000001-01
73	Fuse, 5-amp	09230001-01
74	Fuse, 10-amp	09240001-01

NOTES:
1. Indicate Machine Model Number and Tape Speed when ordering.
2. Not illustrated in figures 6-1, 6-2, 6-3 and 6-4.

TABLE 6-1. MODEL 2750 REPLACEABLE PARTS LIST (continued)

FIGURE REF	DESCRIPTION	PART NUMBER
75	Power Fuse:	
	32V, 10A (Slo-Blo)	09240002-01
	125V, 5A (Slo-Blo)	09230002-01
	250V, 10A (Slo-Blo)	09240003-01
	250V, 5A (Slo-Blo)	09230004-01
76	Resistor, Carbon – 6.815Ω, ½ watt, 5%[2]	04132682-01
77	Resistor, Power Wire Wound, 4Ω, 20-watt, 1%[2]	04380566-01
78	Resistor, Wire Wound, 4Ω, 25-watt, 1%[2]	04680040-01

TAPE CONTROL AND DATA ELECTRONICS

FIGURE REF	DESCRIPTION	UTILIZATION			PART NUMBER
		CONTROL BOARD	NRZI BOARD	PE BOARD	
79	PE Data PWBA[1]			X	9040121-XX
80	NRZI Data PWBA, Single Data Card Machine[2]		X		9040116-XX
81	NRZI Data PWBA, Dual Data Card Machine[1,2]		X		9040087-XX
82	NRZI Data PWBA, Three Data Card Machine (Quad Density)[1]		X		9040093-XX
83	Control PWBA[1]	X			9040119-XX
84	IC, 741[2]	X			03502741-01
85	IC, 15836[2]			X	03100836-01
86	IC, LM339[2]	X	X	X	03000339-01
87	IC, 836[2]	X	X		03100836-01
88	IC, 75451[2]	X			03155451-01
89	IC, 74107[2]	X	X	X	03204107-01
90	IC, 74123[2]	X			03204123-01
91	IC, 7400[2]	X	X	X	03207400-01
92	IC, 7404[2]	X	X	X	03207404-01
93	IC, 7408[2]	X			03207408-01
94	IC, 7410[2]	X	X	X	03207410-01
95	IC, 7411[2]	X			03207411-01
96	IC, 7420[2]	X			03207420-01
97	IC, 7430[2]	X			03207430-01
98	IC, 7438[2]	X	X	X	03207438-01
99	IC, 72709[2]		X	X	03052709-01
100	IC, 1805[2]		X		03101805-01
101	IC, 7401[2]		X		03207401-01
102	IC, 7405[2]		X		03207405-01

NOTES:
1. Indicate Machine Model Number and Tape Speed when ordering.
2. Not illustrated in figures 6-1, 6-2, 6-3 and 6-4.

TABLE 6-1. MODEL 2750 REPLACEABLE PARTS LIST (continued)

TAPE CONTROL AND DATA ELECTRONICS (continued)

FIGURE REF	DESCRIPTION	UTILIZATION			PART NUMBER
		CONTROL BOARD	NRZI BOARD	PE BOARD	
103	Transistor, 2N3904[2]	X	X	X	05103904-01
104	Transistor, 2N3906[2]	X	X	X	05203906-01
105	Transistor, 2N5639[2]	X			05305639-01
106	Transistor, 2N3053[2]	X			05703053-01
107	Transistor, 2N5323[2]		X	X	05705323-01
108	Transistor, 2N5321[2]		X	X	05705321-01
109	SCR, 40654[2]	X			05500654-01
110	Switch, Toggle[2]	X			08100003-01
111	Relay (K1, K2)[2]	X			41445042-01
112	Retainer, Relay[2]	X			50000088-01
113	Diode, 1N4003[2]	X		X	02104003-01
114	Diode, 1N4735[2]	X			02204735-01
115	Diode, 1N4740[2]	X			02204740-01
116	Diode, 1N914B[2]	X	X	X	02100914-03

NOTES: 1. Indicate Machine Model Number and Tape Speed when ordering.
2. Not illustrated in figures 6-1, 6-2, 6-3 and 6-4.