AMCOMP

Model 2730 and Model 2740

Magnetic Tape Units

OPERATION & MAINTENANCE MANUAL

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AMCOMP

686 WEST MAUDE AVENUE
SUNNYVALE, CALIFORNIA 94086

ISSUED: JANUARY, 1974
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REVISED: AUGUST, 1976

Bright Tape Drive Family Born

SUNNYVALE, Calif. – Bright Industries has introduced a series of industry-compatible 10-1/2 inch magnetic tape drives and formatters called the Bright 2700 Series.

The Bright 2730, 2740 and 2750 units feature easy, one-hand loading, tension-arm retract or automatic vacuum column loading, as well as quick release hubs, the firm said. All of the models can read and write 7- or 9-track NRZI or phase-encoded tapes, and dual NRZI/phase-encoded option is available. Conversion from NRZI to phase-encoded formats can be accomplished in the field with a simple, single board swap.

All models have three separate read clipping levels for maximum error recovery capability. To assure high reliability in the read-while-writing operation, the company has added high write clipping levels. The character gate time is also reduced to minimize skew errors when the tape is read on another tape transport, the company said.

The Bright 2730 is a tension-arm tape drive which has tape speeds from 12.5- to 45 in./sec.

The Bright 2740 is a vacuum column tape handler with speeds from 12.5 to 45 in./sec. The unit's wide 3-inch vacuum column reduces sound levels so that data reliability can be achieved even in areas which require a low audible noise environment, according to the firm.

The Bright 2750 is a two-column vacuum tape handler system which provides tape speeds up to 75 in./sec.

NRZI, PE or dual NRZI/PE formatters are available in rack-mountable 3-1/2 inch-high chassis. All power supplies are built in, and each formatter can handle up to four tape transports. Unit prices including formatters range from $3,000 to $5,000.

All of the units are available for 60-day delivery, and quantity and OEM prices are available. In addition, the company backs the new units with a 13-month parts and workmanship guarantee.

Bright Industries is at 686 W. Maude Ave., 94086.

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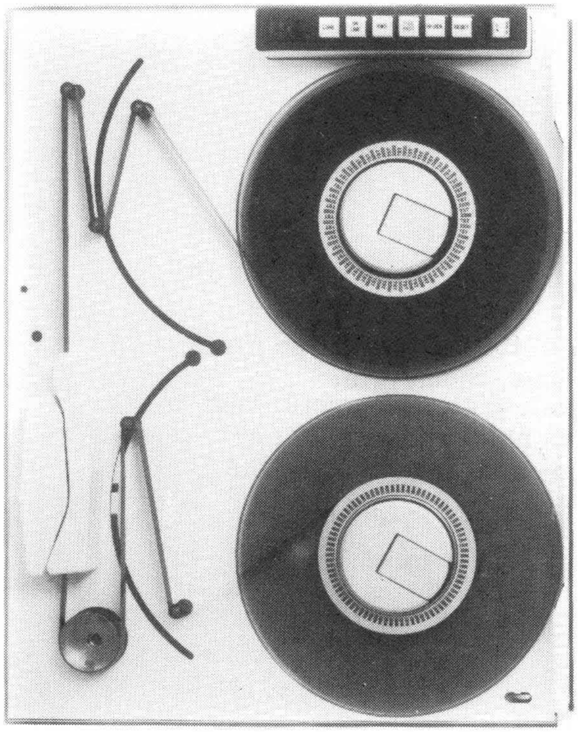
INTRODUCTION

This manual describes the Model 2730 and Model 2740 Magnetic Tape Units manufactured by AMCOMP, INC., 686 West Maude Avenue, Sunnyvale, California. The Models 2730 and 2740 are 10-1/2 inch reel, digital magnetic tape units that read and write ANSI and IBM compatible formats using either NRZI or Phase Encoded (PE) methods. The Model 2730 is a tension arm machine and the Model 2740 is a vacuum chamber machine.

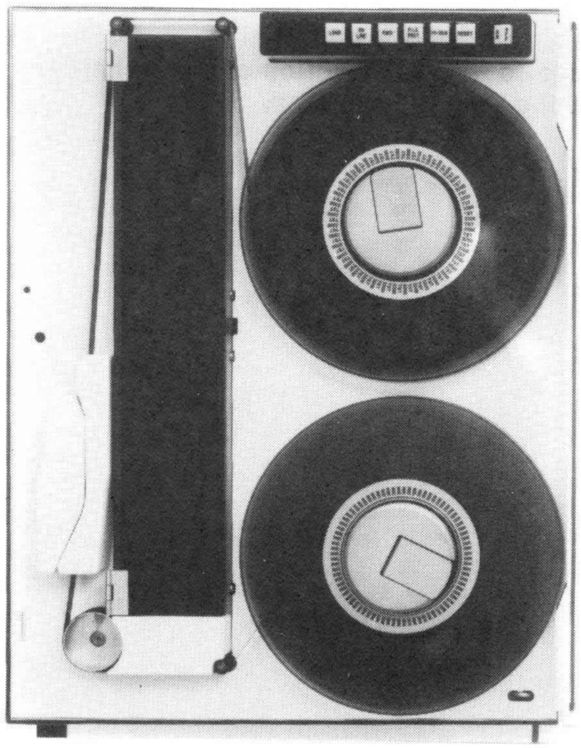
The manual is divided into six chapters as follows:

Chapter 1, General Information;
Chapter 2, Installation;
Chapter 3, Operation;
Chapter 4, Principles of Operation;
Chapter 5, Maintenance;
Chapter 6, Drawings and Parts List.

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



(a) Model 2730 Tension Arm Tape Unit



(b) Model 2740 Vacuum Buffer Tape Unit

Figure 1-1. The 2700 Series Tape Units

Chapter 1
GENERAL INFORMATION

1-1 INTRODUCTION

This chapter contains a description of the Model 2730 and Model 2740 Magnetic Tape Units, their internal components and the optional equipment, interface configurations and accessories available on the units. Performance specifications and equipment characteristics pertaining to the tape units are listed at the end of the chapter.

1-2 GENERAL DESCRIPTION

The Model 2730 and Model 2740 are highly reliable digital magnetic tape units. See figure 1-1. The Model 2730 Tape Units use mechanical tension arms for tensioning tape and the Model 2740 Tape Units use a vacuum column. In other respects the two model groups are identical in construction. Both models read and write 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 12.5, 18.75, 25, 37.5 or 45 inches per second (IPS). Magnetic tape recorded on the Model 2730 and Model 2740 can be read on any other ANSI or IBM compatible tape unit. Also, the Model 2730 and 2740 can be read 7-track or 9-track tapes recorded on any other ANSI or IBM compatible tape drive. The tape units use maximum 10-1/2 inch diameter tape reels.

The Model 2730 and Model 2740 Magnetic Tape Units use either a single gap read/write head, or dual gap, simultaneous read and write heads. A separate erase head is mounted ahead of the write head, except on read-only tape units. A wide choice of other standard options pertaining to tape speed, bit densities and other features are available on the Model 2730 and Model 2740. Options are described in paragraph 1-4.

Both tape units are designed specifically for remote control of the read, write, forward, reverse, rewind, and packing density select functions. Up to four tape units can be daisy chained and individually addressed by the same external controller.

1-3 PHYSICAL DESCRIPTION

The components of the Model 2730 and Model 2740 Magnetic Tape Units are mounted on a precision machined tape unit baseplate. All tape handling components, the head 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, the vacuum or tension arm components, and other mechanical and electromechanical components are mounted on the back of the tape unit baseplate. See figures 1-2 and 1-3.

The control and data electronics are mounted on two circuit boards attached to a frame that is hinged to the back of the tape unit baseplate. All external control and signal cables connect directly to the edge connectors of the two circuit boards. The control and data electronics are described in Chapter 4, Principles of Operation. Cables are discussed in Chapter 2, Installation.

1-4 OPTIONAL CONFIGURATIONS

Both the Model 2730 and Model 2740 Magnetic Tape Units have a wide choice of operational equipment, interface connections 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 27VW-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 in installations 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 Lines Enable (Opt. 1) - 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 (Opt. 2) - allows all status lines to be enabled when the tape unit is selected and off line.

6. Status Lines Enable (Opt. 3) - 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.

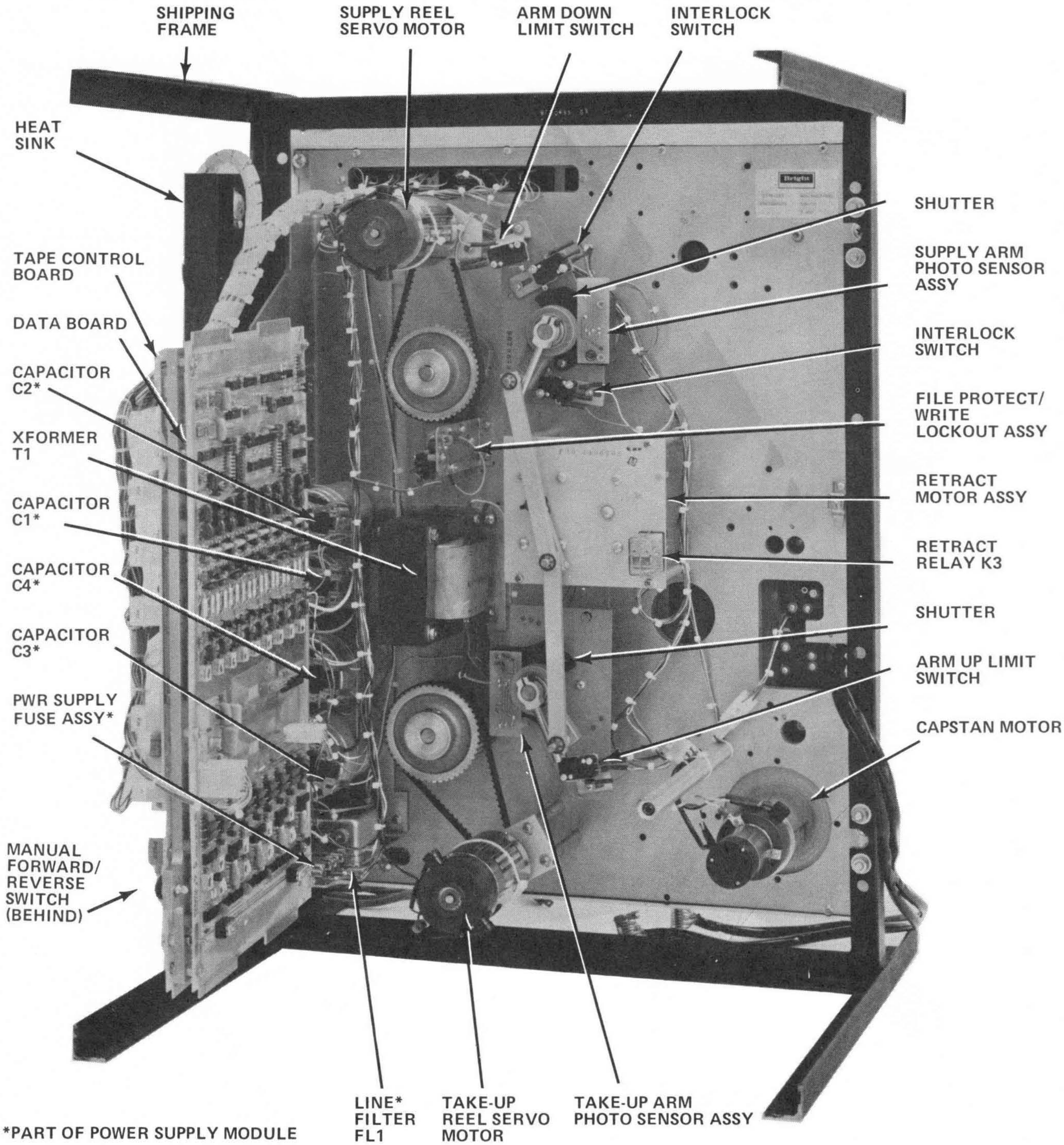


Figure 1-2. Open View of Model 2730 Magnetic Tape Unit

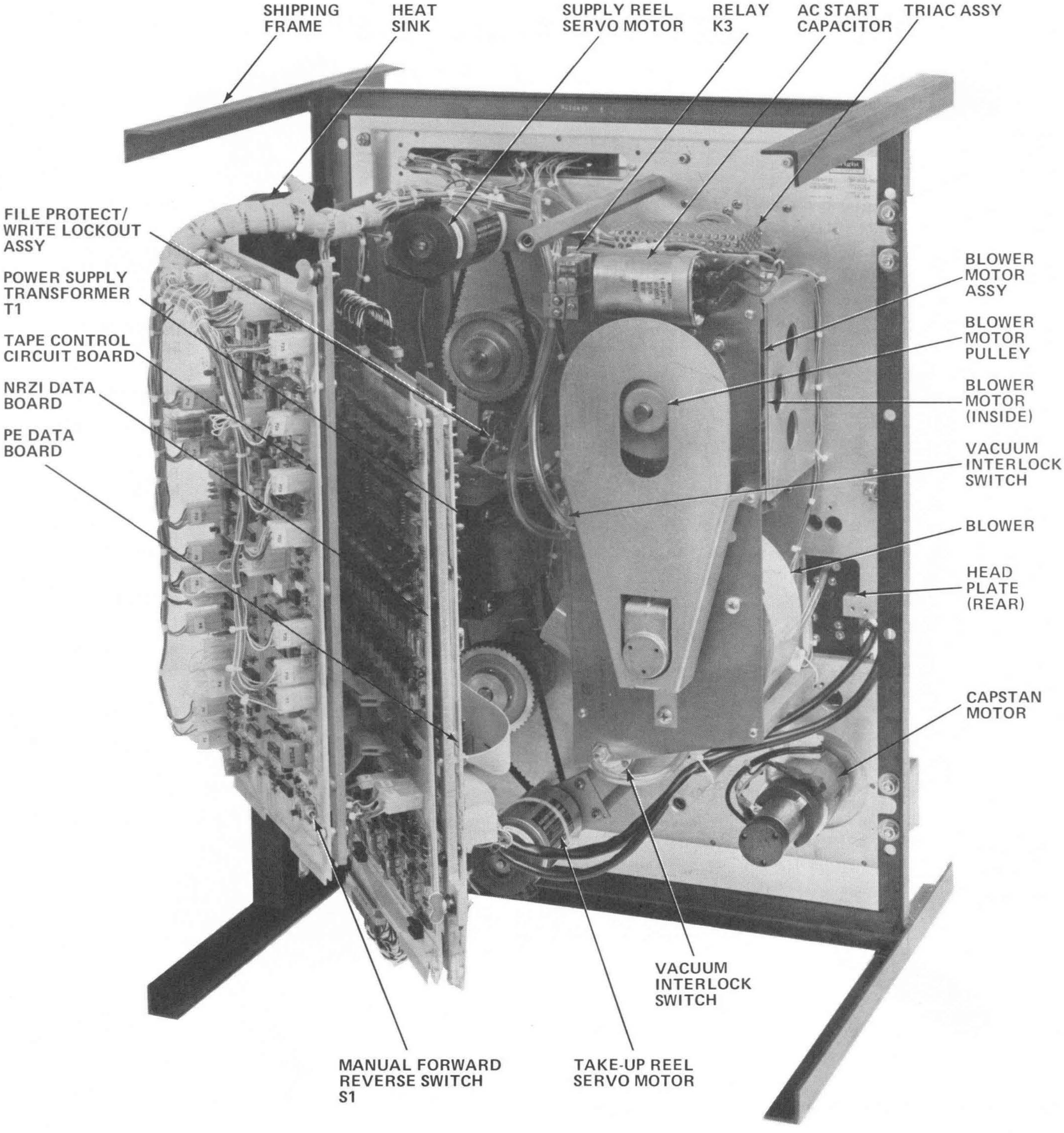


Figure 1-3. Open View of Model 2740 Magnetic Tape Unit

TABLE 1-1. OPTIONAL CONFIGURATION IDENTIFICATION LIST

The Model Number 27VW-XYZ designates equipment configuration as shown here *

V	TAPE STORAGE
3	tension arm
4	vacuum chamber

W	NUMBER OF TRACKS
7	seven-track head
8	nine and seven track head, read only
9	nine-track head

X	HEAD CONFIGURATIONS
1	dual-gap head
2	single-gap head
3	dual-gap head, read only
4	single-gap head, read only

Y	PACKING DENSITY AND RECORDING METHOD
0	no data board
3	800/200 BPI (NRZI, 7 tracks)
4	556/200 BPI (NRZI, 7 tracks)
5	800/556 BPI (NRZI, 7 tracks)
6	1600 BPI (PE, 9 tracks
7	800/1600 BPI (NRZI/PE, 9 tracks)
8	800 BPI (NRZI, 7 or 9 tracks)

Z	TAPE SPEEDS	
1	12.5	ips
2	18.75	ips
3	25	ips
4	37.5	ips
5	45	ips
6	25/12.5	ips
7	37.5/18.75	ips
8	45/22.5	ips
9	45/37.5	ips

* A "U" prefix indicates tape unit is UL-recognized component.

7. 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.

8. Single or Double Load - two different tape loading modes. On tape units equipped with single load circuits, the tape is tensioned and advanced to the BOT marker all in one continuous sequence when load switch is pressed. With double load circuits, the tape is tensioned first, then the operator must press LOAD to cause the tape to advance to the BOT marker. The double load sequence allows the operator to verify that the tape has been threaded and seated in the tape guides properly, before the tape is advanced to the BOT marker.

9. Load and On Line - on tension arm tape units, this interface line allows the tape to be tensioned and the tape unit to be placed on line after a power failure during normal operation.

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

11. Rewind and Unload - allow a tape unloading sequence to be initiated from a remote controller.

12. Front Panel Disable - allows front panel switches to be disabled when the tape unit is selected and on line.

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

1-5 PERFORMANCE SPECIFICATIONS AND EQUIPMENT CHARACTERISTICS

Table 1-2 describes the electrical, environmental and mechanical specifications pertaining to the Model 2730 and Model 2750 Magnetic Tape Units.

TABLE 1-2. PERFORMANCE SPECIFICATIONS AND EQUIPMENT CHARACTERISTICS

CHARACTERISTIC	VALUE
Type of Tape Storage	Tension Arm or Vacuum Chamber - Both linear servo driven.
Recording mode	NRZI or Phase Encoded - IBM and ANSI compatible
Number of Tracks	7 or 9
Head Configuration	Single or Dual Gap
Bit Density	200, 556, 800, 1600 BPI
Tape Speed	12.5, 18.75, 22.5, 25.0, 37.5, 45.0 ips.
Rewind Speed	200 ips.
Data Transfer Rate	72000 characters per second, max.
Speed Variation:	
Instantaneous	± 3%
Average	± 1%
Start/Stop Time (milliseconds)	375/tape speed (ips)
Start/Stop Displacement	0.190 (±0.02) inches
Skew:	
Write (NRZI)	Electronically compensated
Read	100 μinches, maximum
Dynamic	75 μinches, maximum
Tape Tension	8.0 (±0.5) oz.
Reel Size	10.5 in., maximum
Tape Type (IBM P/N457892 or equivalent):	Computer Grade
width	0.5 inches
thickness	1.5 mil
Beginning of Tape (BOT) and End of Tape (EOT) Detectors	Photoelectric, IBM compatible spacing
Tape Cleaner	Perforated Plate type

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

CHARACTERISTIC	FUNCTION
Read Thresholds	NRZ: 12%, 25%, and 45%, selectable remotely. PE: 5%, 15%, and 30%, selectable remotely.
NRZI Deskew Window	50% of character time in Read mode. 40% of character time in Write mode.
Input Signal Parameters	
Asserted (True) Not Asserted (False)	40mA max. 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)
Energy Consumption Rate	
Tension Arm Unit Vacuum Chamber Unit	300 Watts maximum 700 Watts maximum
Environment	
Temperature, Operating Storage Humidity Altitude, Tension Arm Unit Vacuum Chamber Unit	30^{o}F to 122^{o}F -50^{o}F to 160^{o}F 15% to 95% without condensation 0 to 20,000 feet 0 to 10,000 feet (in 2 steps - must change belt on pulley)
Dimensions	
Height Width Depth, overall Depth, from mounts	24 inches 19 inches 15.4 inches (18.4 in. for 3 & 4 card unit) 12.0 inches (15.0 in. for 3 & 4 card unit)
Weight	
Tension Arm Unit Vacuum Chamber Unit	80 lbs., maximum 110 lbs., maximum
Daisy Chaining	Built-in provision

Chapter 2
INSTALLATION

2-1 INTRODUCTION

This chapter contains information pertaining to the installation of the Model 2730 and Model 2740 Magnetic Tape Units. Included are the instructions and data necessary to plan and complete the installation of either of the tape units 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 2730 and Model 2740 Magnetic Tape Units 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 units. The tape units 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 units, 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 a tape unit is mounted. Refer to American National Standard X3.40-1973 or tape manufacturer's data for operation and storage requirements of magnetic tape.

Both the magnetic tape units are designed to be mounted in a suitable 19-inch electronic equipment rack cabinet which conforms to RETMA standards. Both models require 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 both the Model 2730 and Model 2740.

2-4 CABLING CONSIDERATIONS

Both the Model 2730 and Model 2740 Magnetic Tape Units are shipped with internal interconnect cabling completed. All external data and control interface signal cabling, and primary 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 grounding devices are required in addition to the ground lead in the primary power input cable.

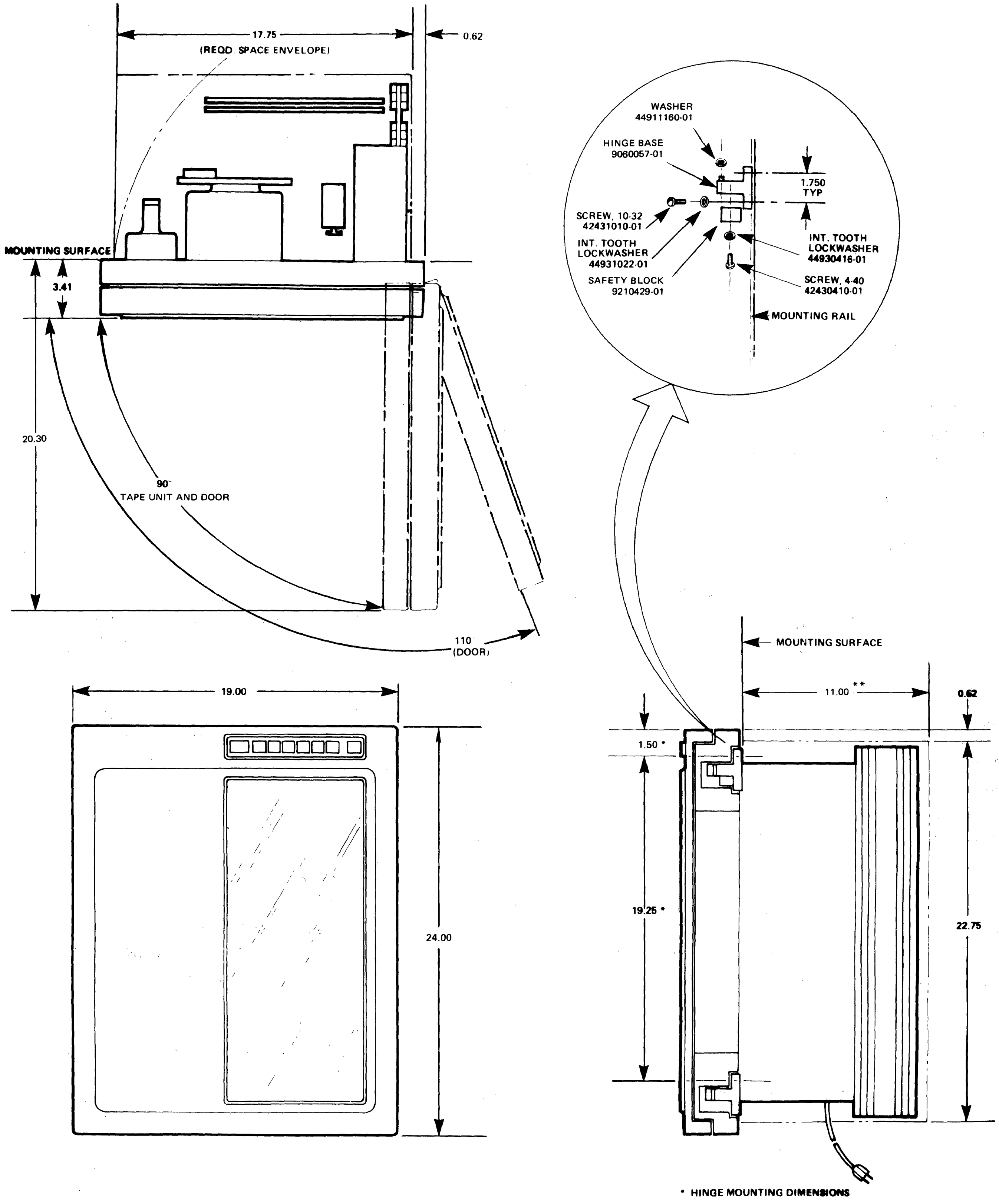
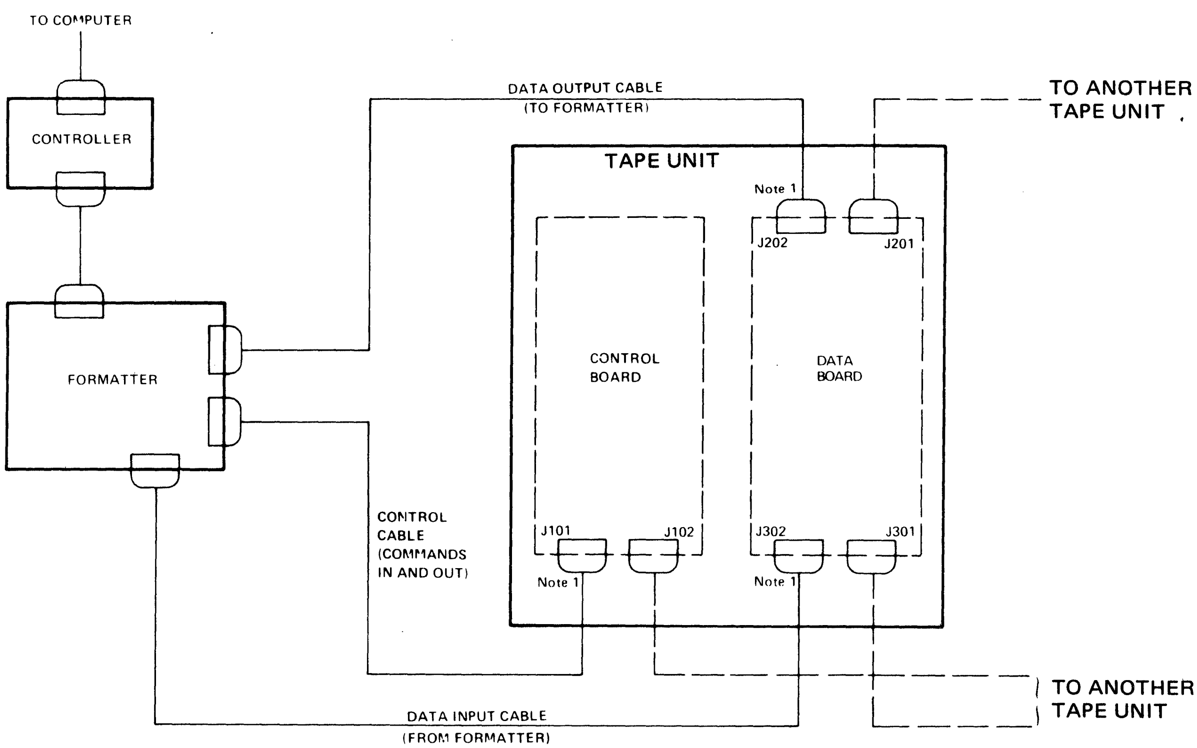


Figure 2-1. Installation Mounting Dimensions for the 2700 Series Tape Unit

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.

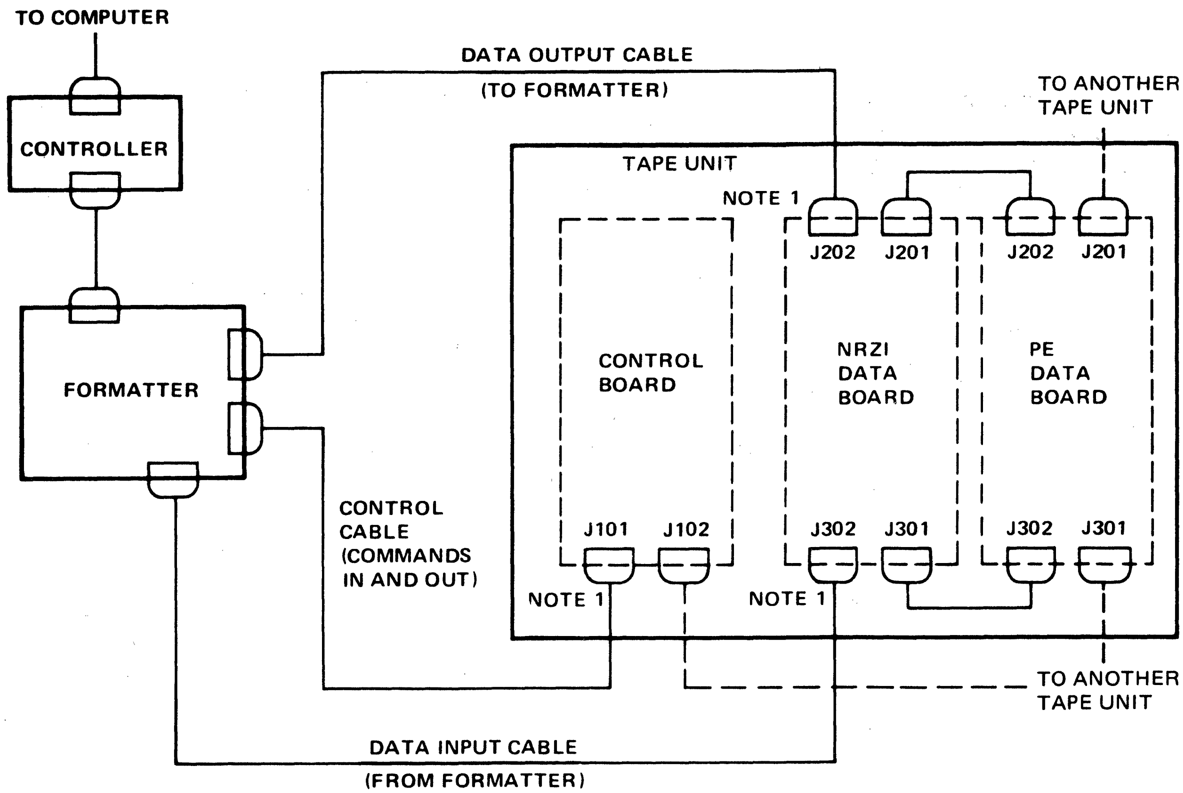
Data input and output lines connect to edge connectors J302 and J202, respectively, on the data electronics circuit board. Refer to figure 2-2. The data electronics circuit board may be accessed by swinging the electronic card rack out from the tape unit. A single quarter-turn fastener at the lower right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

Figure 2-3 shows a typical cabling diagram for a PE/NRZI dual-density (three-card) tape unit. In addition to the Tape Control Board, this tape unit uses one PE Data Board and one NRZI Data Board. Figure 2-4 shows a typical cabling diagram for a quad-density (four-card) tape unit. In addition to the Tape Control Board, this tape unit uses two NRZI Data Boards (7-track and 9-track) and one PE Data Board.



NOTE 1: MATING CONNECTION P/N 07120007-01 (SUPPLIED).

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



NOTE 1: MATING CONNECTOR P/N 07120007-01 (SUPPLIED).

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

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 tape 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.

2-6 INTERFACE CIRCUITS

The tape unit 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 +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 **return** grounded. The wire should be 26 AWG with thin insulation and twisted about 20 turns/foot. The maximum

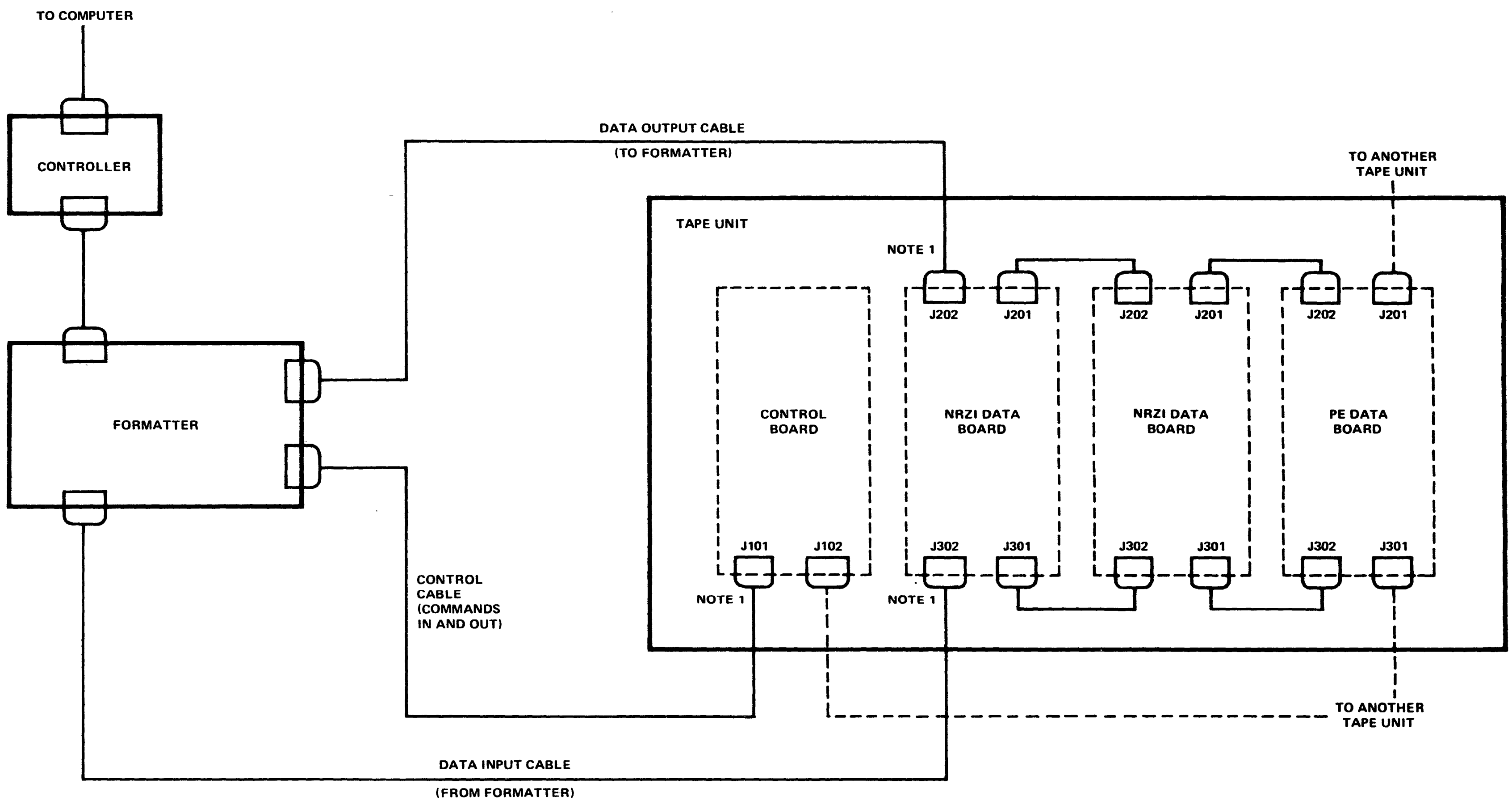
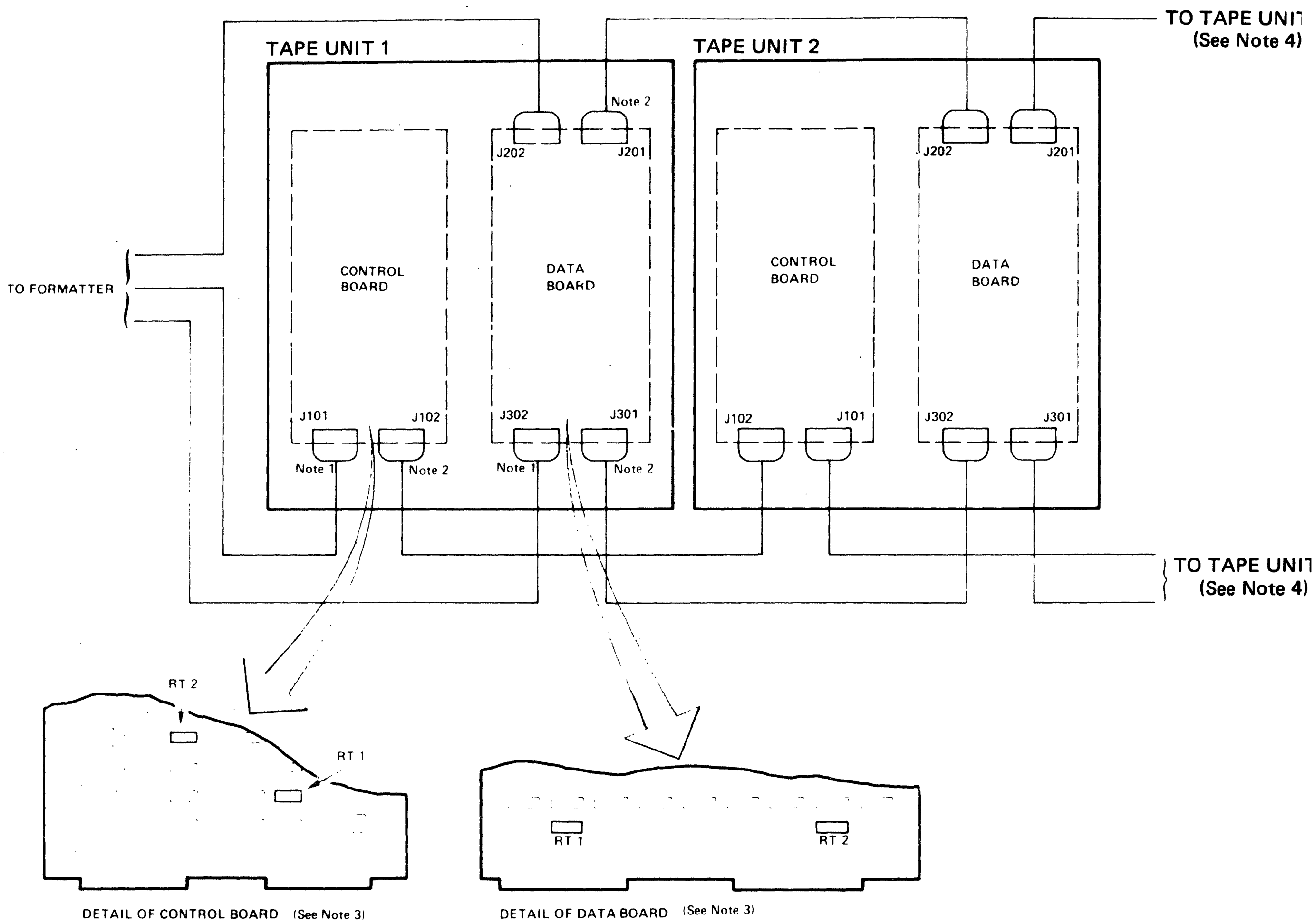


Figure 2-4. Typical Cabling Diagram (Quad-Density)



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 length can be 20 feet. The twisted pairs should be grounded within a few inches of the driver and receiver.

The mating connector is Part No. 07120007-01 or equivalent. All connectors pin assemblies are contained in tables 2-1, 2-2, and 2-3.

2-8 INSTALLATION

2-9 UNPACKING AND INSPECTION

The tape units are shipped in a special double packing case, which should be saved if reshipment of the equipment is planned. Within the packing case the tape unit is attached to a shipping frame (see figure 1-2 or 1-3) 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 unit 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 AMCOMP, INC., and file a claim with the transfer company. The crated weight of the tape unit is approximately 150 pounds. The following procedure 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 AMCOMP, INC. if damage is evident. Specify nature and extent of damage.

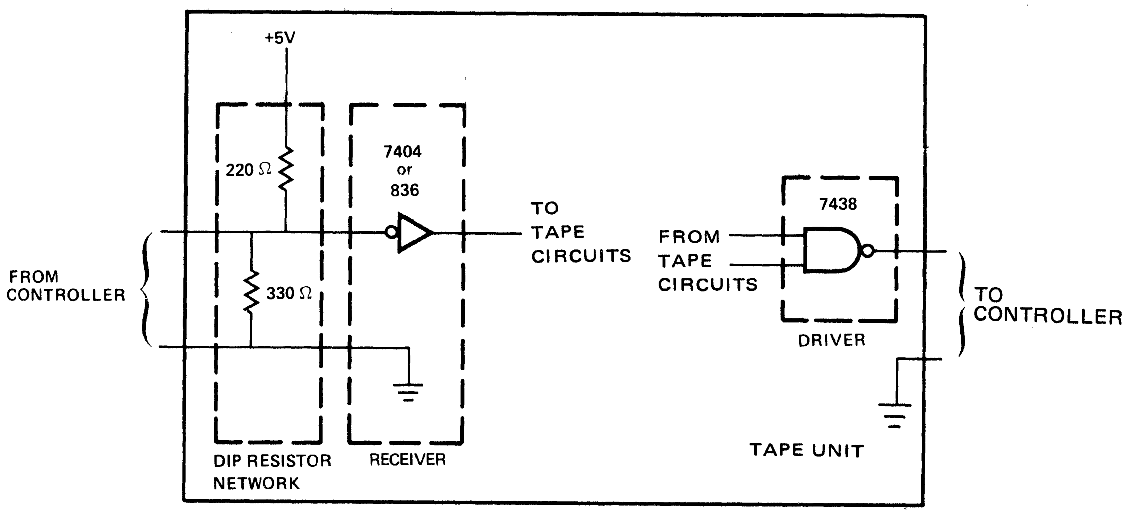


Figure 2-6. Tape Unit Interface Circuits

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

SIGNAL CONNECTOR PIN	GROUND CONNECTOR PIN	SIGNAL NOMENCLATURE
		COMMAND INPUTS
I	2	* ILOL (Load and On Line)
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	IREU (Rewind and Unload)*
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)
U	17	IEOT (EOT)
R	14	IBOT (BOT)
P	13	IFPT (File Protect)
F	6	IDDI (High Density)
S		* + 5 Volts

* indicates tape unit option

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 units.

* indicates tape unit option

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

SIGNAL CONNECTOR PIN	GROUND CONNECTOR PIN	SIGNAL NOMENCLATURE
		<u>DATA INPUTS</u>
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.

CAUTION

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

b. Open the outer and inner packing case and remove the contents. Check items removed against the shipping list to verify packing case contents. Contact AMCOMP, INC. in the event of a packing shortage. The Operation and Maintenance Manual for the tape unit is attached to the inner carton.

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 figure 2-2, 2-3, 2-4, or 2-5. To mount the tape unit, refer to figure 2-1 and proceed as follows:

a. Remove the two hinge bases from the shipping kit and mount them onto the rack cabinet 19.5 inches apart. Refer to figure 2-1.

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

c. Life the tape unit and set it on the hinges in the 90 degree open position (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 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 the tape 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 (figure 1-2 or 1-3) is connected correctly to supply the primary power voltage from which the tape unit is to be operated. Refer to figure 2-7.

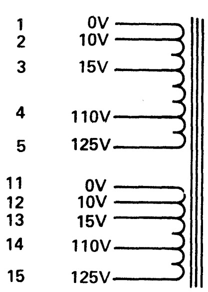
f. On Model 2740, ensure that the blower motor pulley/belt positioning is correct as shown in figure 2-8.

g. Check the five fuses located at the lower left corner on the back of the tape unit. See figure 1-2 or 1-3. These fuses are identified in figure 2-9.

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

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

j. 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.



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. Input Power Transformer Primary Winding Diagram

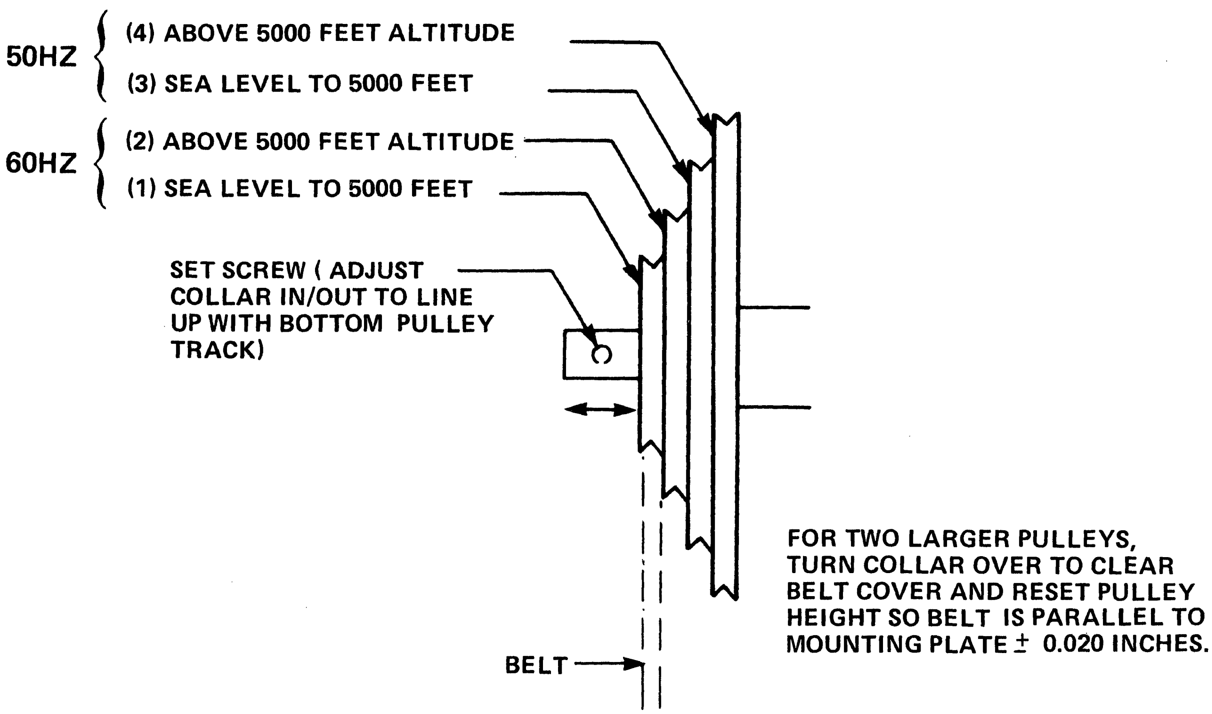


Figure 2-8. Model 2740 Blower Motor Pulley/Belt Positioning

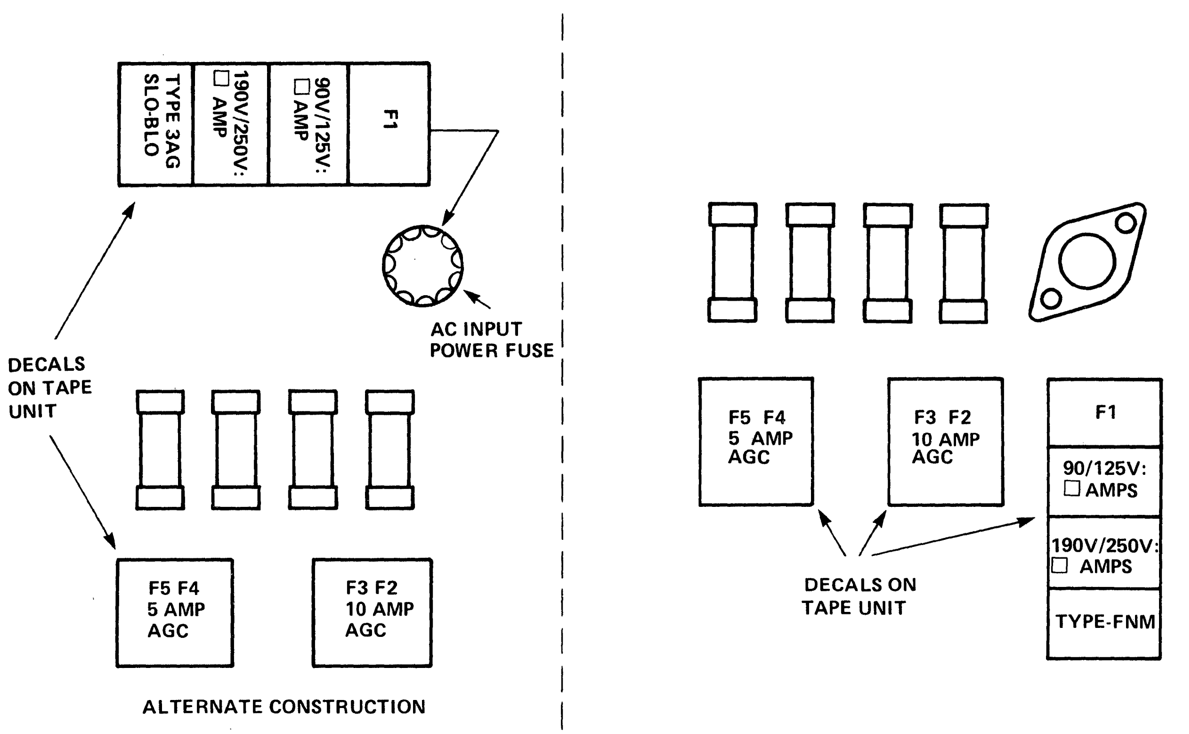


Figure 2-9. Tape Unit Fuses

k. Use the Forward/Reverse toggle switch on the tape control logic board to move the tape first in the forward direction and then in the reverse direction. 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 or 1-3.)

l. Press the RWD pushbutton to verify that the tape properly rewinds (at 200 ips) and stops at the BOT marker.

m. 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.

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.

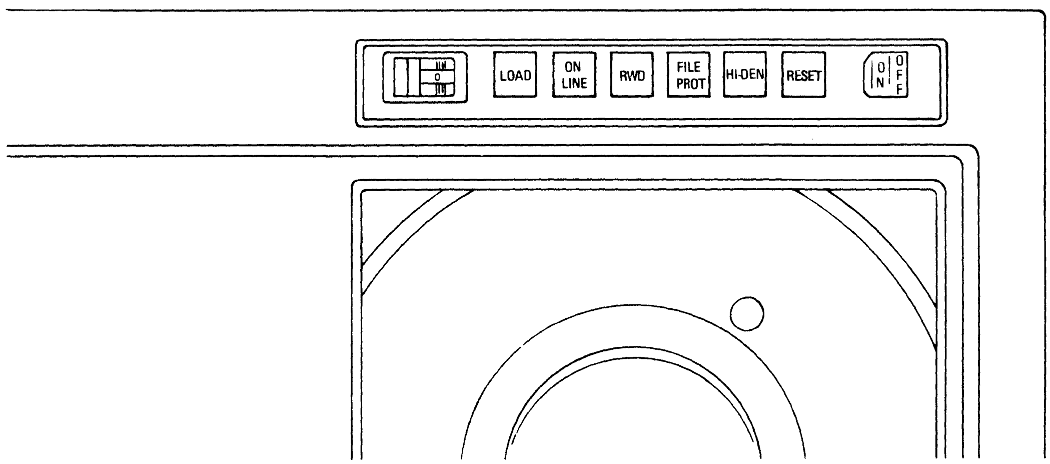


Figure 3-1. Tape Unit Front Panel Controls and Indicators

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 the table 3-1 and shown in figure 3-1; table 3-1 also includes a Forward/Reverse switch located on the control board.

TABLE 3-1. CONTROLS AND INDICATORS

NAME	FUNCTION
RWD	A pushbutton that is operative 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 the take-up reel.
RESET	A backlighted pushbutton that functions to: 1) stop tape motion if the tape unit is in forward, reverse, or rewind mode; and 2) place the tape 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 both selected and on line.
FILE PROTECT	An indicator that lights to indicate that a file reel without a write ring is installed on the tape unit. This light is meaningful only after tape has been tensioned. It indicates that writing or erasing on the tape is not possible until the write ring is installed.
HI-DEN	An alternate action indicator switch pressed to select the packing density. When the switch is lighted the higher density is selected. The switch is functional either in the dual density NRZI tape units which may be dual speed tape units, and operates in parallel with the optional IDDS command input line signal from the controller. This switch is not operational in the single density versons of the tape unit.
1600 BPI	An optional alternate action indicator switch that replaces the HI-DEN switch on NRZI/PE combination tape units. This switch is illuminated when 1600 BPI Phase Encoded operation is selected. Operates in parallel with the optional IDDS command input line from the controller.
7/9 TRACK	An optional alternate action indicator switch used with HI-DEN switch on quad-density NRZI/PE tape units. This switch is illuminated when 9-track operation is selected.

TABLE 3-1. CONTROLS AND INDICATORS (CONT)

NAME	FUNCTION
FORWARD/ REVERSE	A three-position toggle switch mounted on the tape control board (accessible when the tape unit 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 on, the OFF side to turn off. The switch is lighted in the ON position by the +5volt regulator.
LOAD	A backlighted pushbutton that is used during loading of tape. After the tape is threaded, press the LOAD pushbutton to apply tension to the tape and/or advance the tape to the BOT tab. (Paragraph 3-6 describes the operation of LOA D pushbutton in single-load and double-load versions of the tape unit). The LOAD lamp 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 (optional)	A rotary thumbwheel switch 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 the control of pushbuttons on the tape unit (off line), but in this respect it operates in parallel both with the RESET pushbutton and the IREU 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 the tape unit is on line. Note, however, that it can be depressed an 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, Operators Preventive Maintenance.

b. Keep the dust cover closed whenever tape is not actually being loaded or unloaded. This prevents contaminates from causing data drop-outs and impairing operation of the tape 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 leader portion of the tape.

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, to ensure maximum data reliability.

3-5 OPERATORS PREVENTIVE MAINTENANCE

The tape 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. See paragraph 5-2.

To clean these components use a clean, lint-free cloth or cotton swab 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 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 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 tension arms and 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 of BOT (either manually with Forward/Reverse switch or by command after the tape unit is placed on line.)

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

h. If the tape unit is equipped with AUTO LOAD/ON LINE option, the tape unit will be set ON LINE when the BOT is reached. Otherwise 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. If the tape unit is equipped with the Front Panel Disable option , and is selected, the front panel operater switches are disabled.

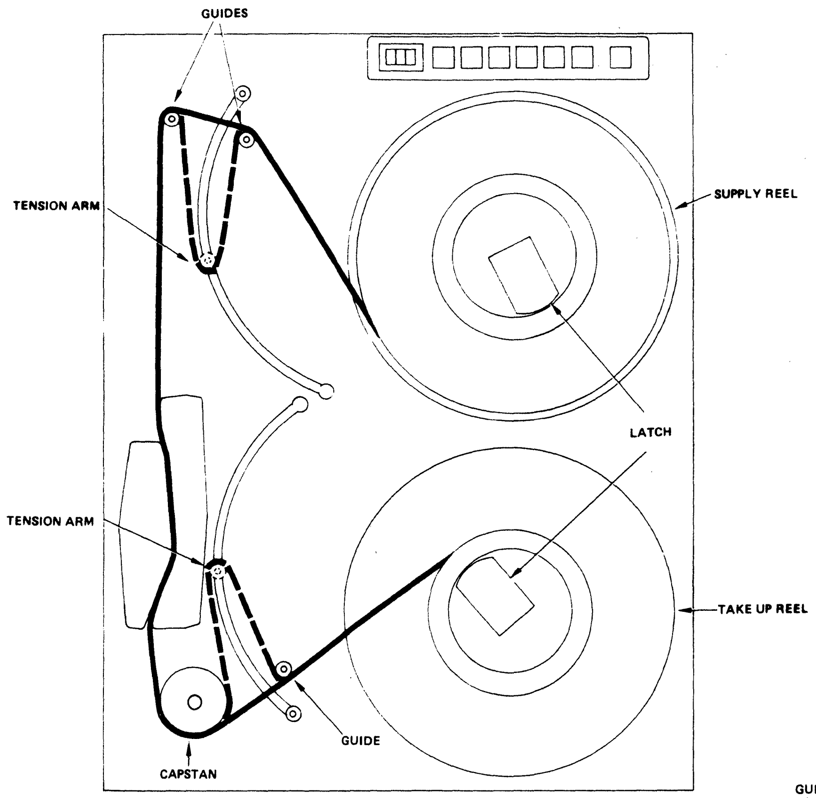
3-7 UNLOADING TAPE

To unload tape proceed as follows:

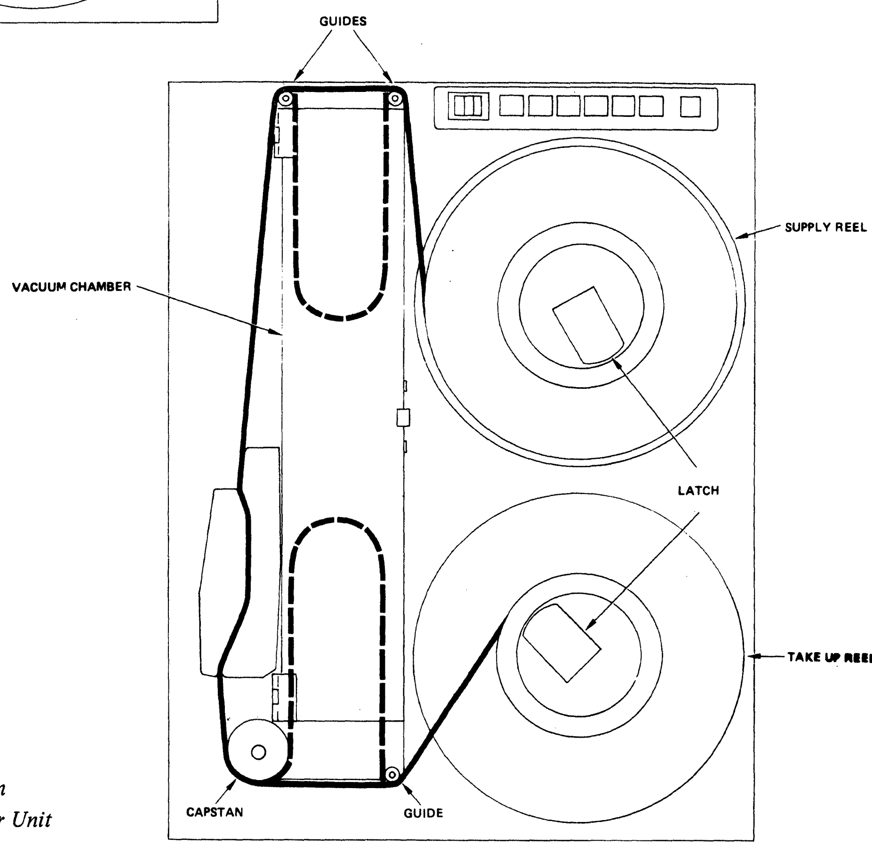
a. Press RESET or ON LINE pushbutton to select off line operation.

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 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 to thread the remaining tape onto the upper reel.



(a) Tension Arm Unit



(b) Vacuum Chamber Unit

Figure 3-2. Diagram Showing Tape Threading Paths

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 TAPE TRACK LAYOUT AND DATA FORMATS

3-9 TAPE TRACK LAYOUT

Depending on the exact equipment configuration, the Model 2730 and Model 2740 read and write standard 9-track or 7-track tapes. Figure 3-3 shows the orientation and layout dimensions of tape tracks 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.

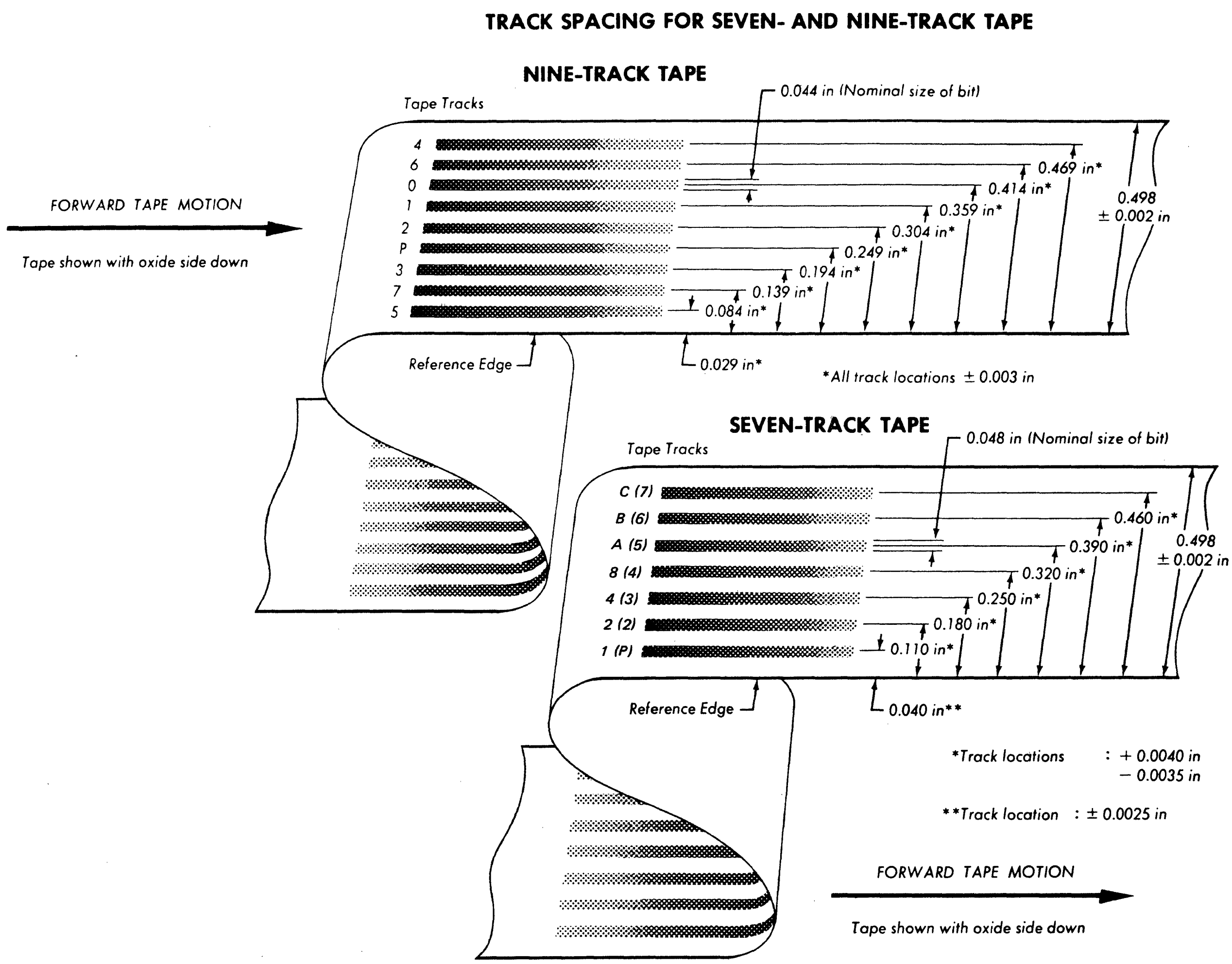


Figure 3-3. Tape Track Layouts

3-10 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 is it 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.

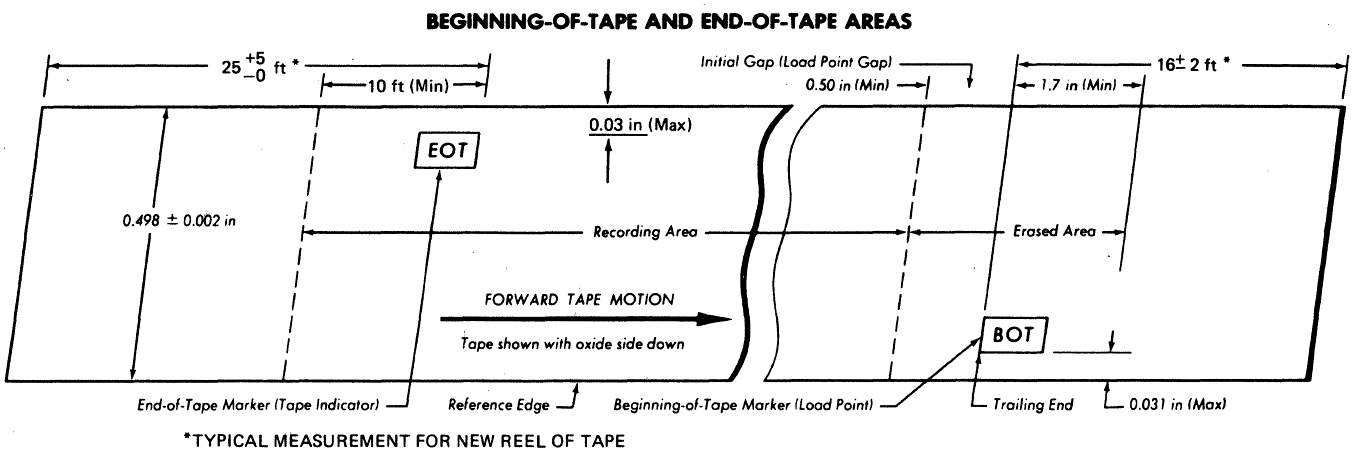


Figure 3-4. BOT and EOT Erase Formats.

3-11 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 inches 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 inches.

3-12 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 is 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 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 inches is required between records. (PE data is always recorded on 9-track tape).

3-13 RECORD AND FILE MARKS

Standard end - of - record and end - of - file mark formats that are used for NRZI recording are show 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.

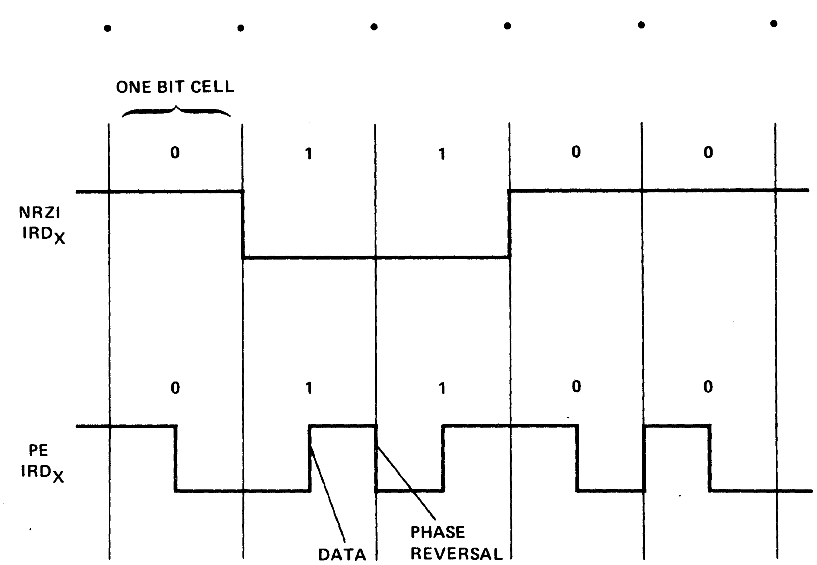


Figure 3-5. NRZI and Phase Encoded Data Formats.

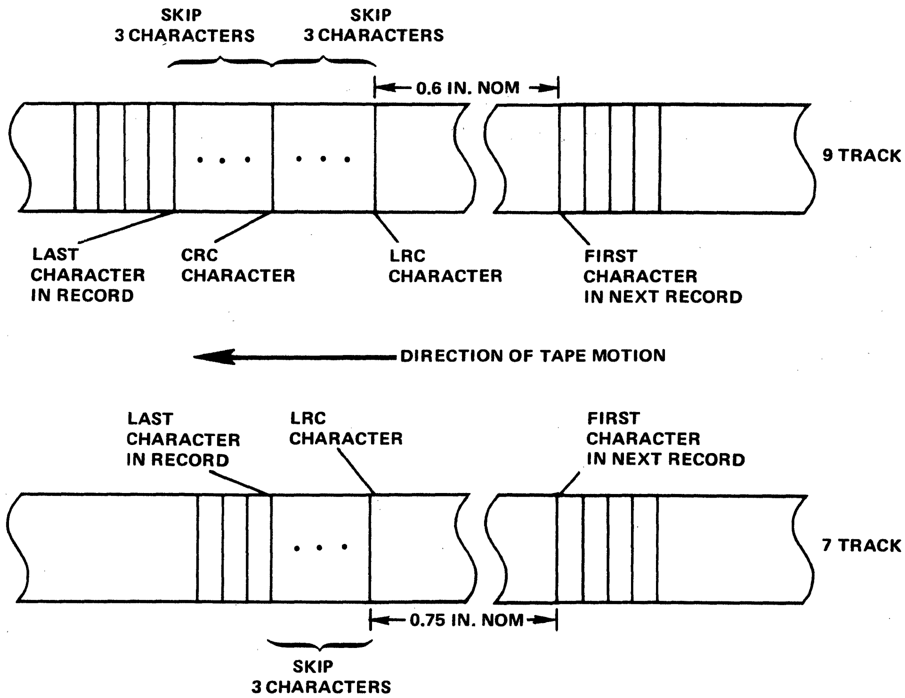


Figure 3-6. End-of-Record Mark Formats for 7 and 9 Track NRZI Tapes

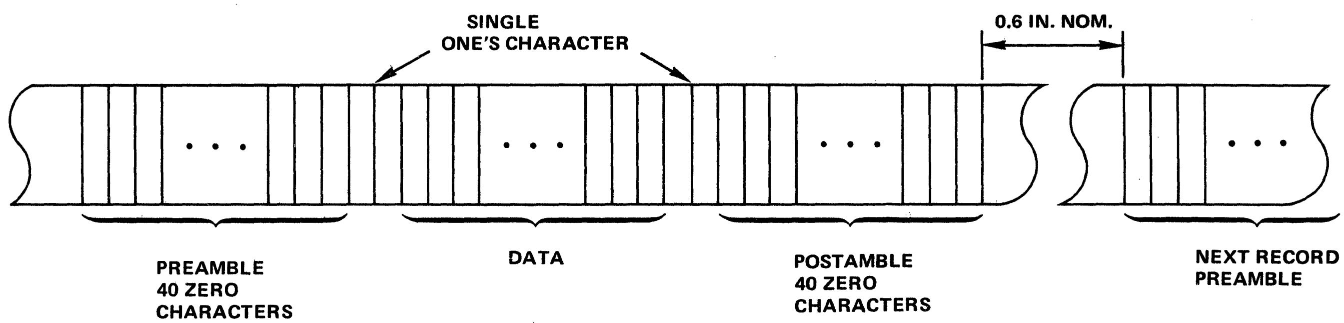


Figure 3-7. PE Record Data Formats

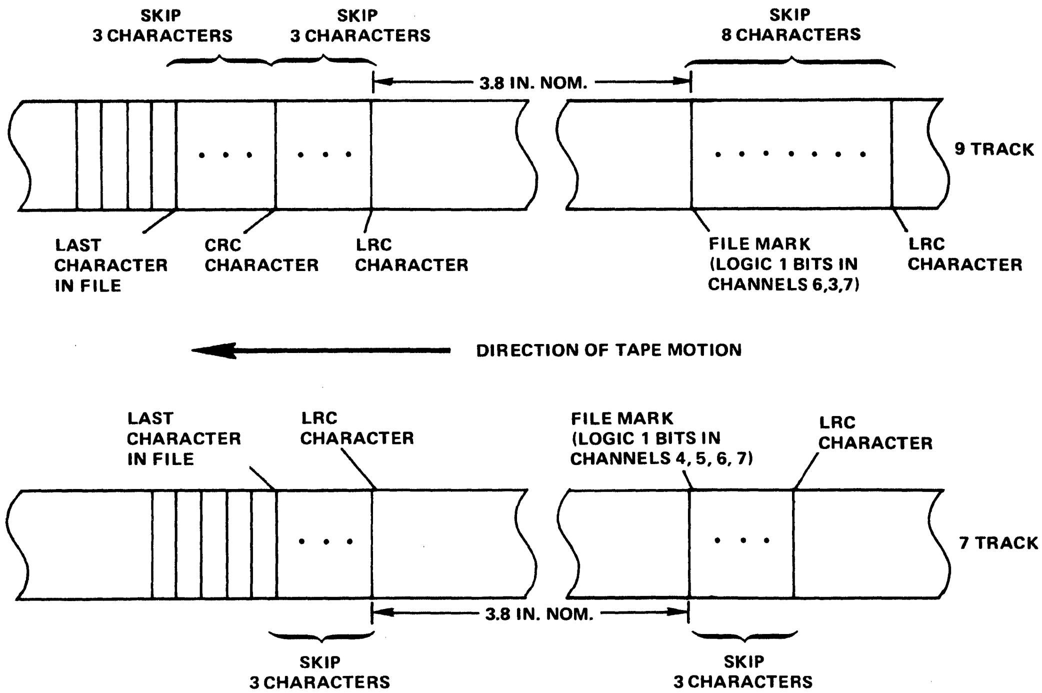


Figure 3-8. End-of-File Mark Formats for 7 and 9 Track NRZI Tapes

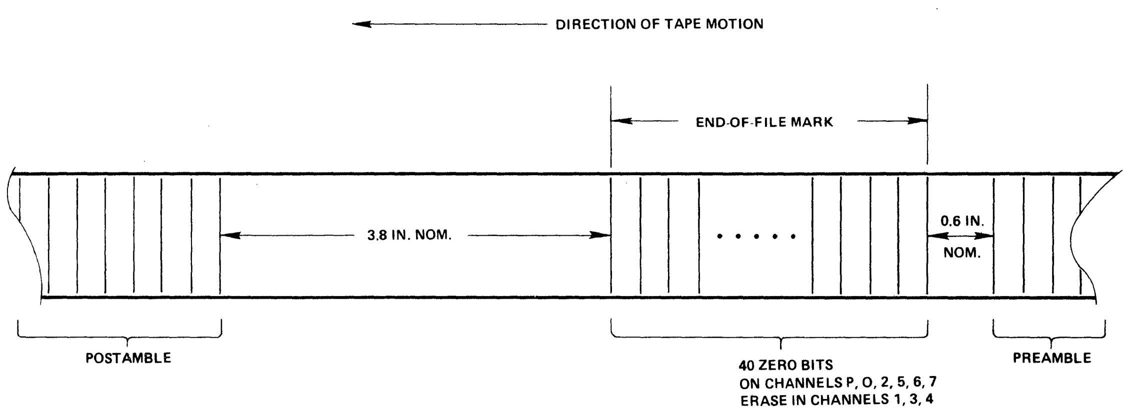


Figure 3-9. End-of-File Mark for PE Tapes

3-14 PROGRAMMING INFORMATION

The tape unit has four catagories 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 function and typical examples of use of these lines are listed in tables 3-2 through 3-5, and the following paragraphs. All logic levels are low true; that is, when a signal line is asserted its logic level is 0 to 0.4 volts and when it is not asserted (cleared) the logic level is 2.5 to 5.0 volts. 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.

3-15 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. Table 3-2 lists the data input lines and there functions. Figure 3-10 shows typical timing interrelationships between these lines.

3-16 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 lists the data output lines and there functions.

3-17 COMMAND INPUTS

Functions of the 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.

3-18 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 3-2. TAPE UNIT DATA INPUT LINES

NAME	FUNCTION
DATA READY	This line must be asserted for a minimum of 1 microsecond during the time when 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 percent. The write data lines should not change for 0.5 microseconds before or after DATA READY.
WRITE DATA 7 or 9 lines	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.
LRC STROBE	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.
IRDT, 1,2 (Read Threshold 1 and 2)	The status of these lines defines the read head 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: IRDT 1 / IRDT 2 / READ THRESHOLD (NRZI) / READ THRESHOLD (PE) false / false / 25% / 15% true / false / 45% / 30% false / true / 12% / 5% 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 and IRDT1 not asserted will select the low threshold (12% or 5%) instead.

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 stack head. 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.
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.

TABLE 3-4. TAPE UNIT COMMAND INPUT SIGNALS

NAME	FUNCTION
ILOL (Load and On Line)	An optional line (available on 2730 models only). Allows remote restart after power fails. See 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 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 tape 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.
IREU (Rewind and Unload)	Must be asserted for at least 1 usec to place tape unit off line and initiate a rewind and unload operation. The tape unit ON LINE indicator will go out. If the tape is not at BOT the tape will be rewound to BOT and then will unload onto the file reel at low speed. If the tape is at BOT the tape will unload onto the file reel at low speed.
ISWRT (Set Write)	Asserted for at least 10usec with ISFC to place the tape unit in write mode. Note that ISWRT must be asserted before the leading edge of ISFC.
IOVW (Over Write)	Asserted for at least 10usec 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.
IREW (Rewind)	When this line is asserted for a minimum of 1usec, the tape will be rewound to BOT. When the tape is at BOT, this line is inhibited.

TABLE 3-4. TAPE UNIT COMMAND INPUT SIGNALS (CONT.)

NAME	FUNCTION
IDDS (Density Select)	Optional on 7 track tape units. 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.

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 IREU 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 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 units 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.

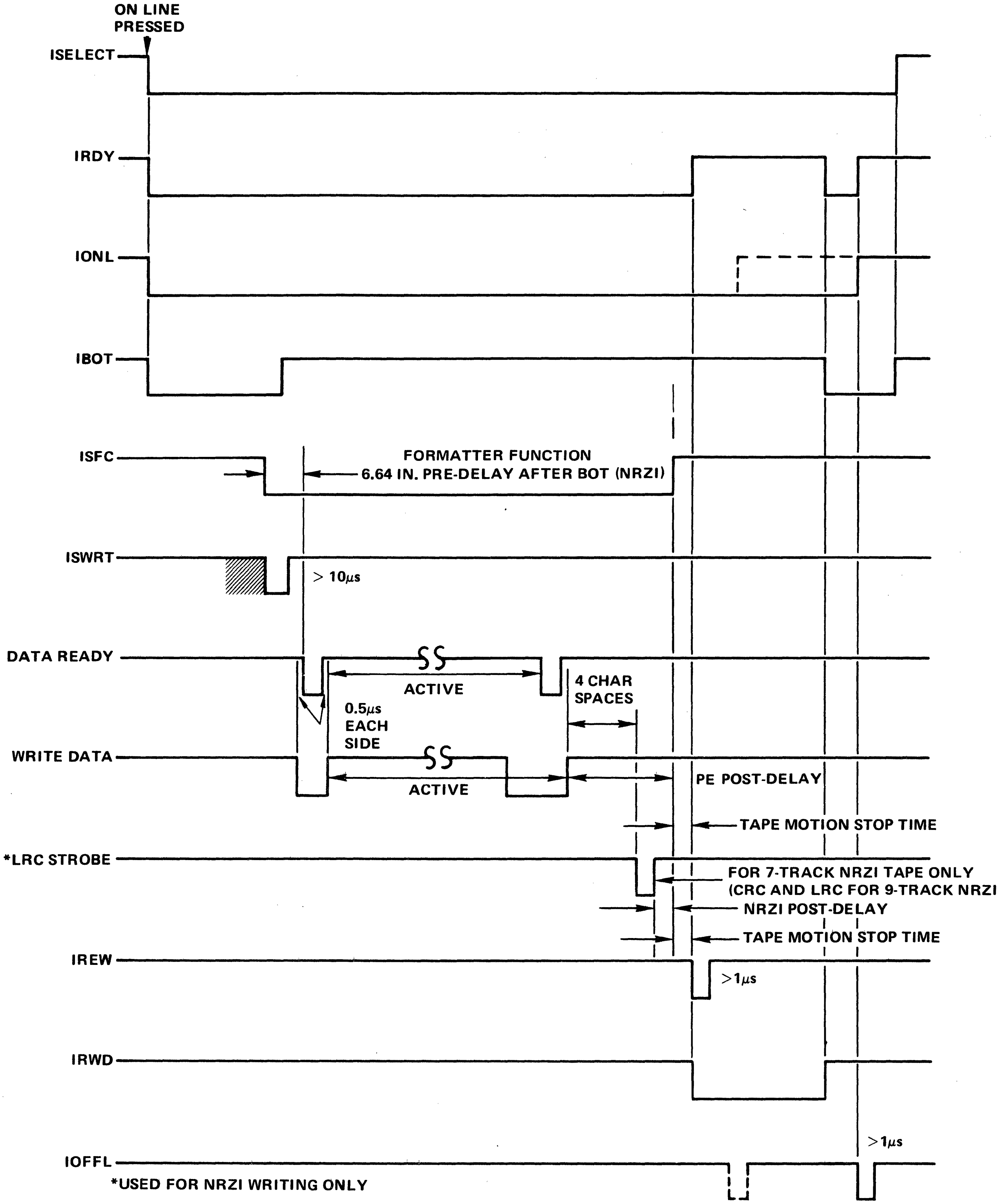


Figure 3-10. Timing Diagram for a Typical Start-Write-Stop Sequence

3-19 PROGRAM SEQUENCES

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 (called pre-delays) and delays after completing an operation (called post-delays). Because the length of the gaps, as measure 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).

3-20 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, and IBOT signals from the tape unit.

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

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 inches.

g. Assert IREW for at least 1 usec.

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

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

OPERATION	PRE-DELAYS	
	Typical Delay, in milliseconds (at 37.5 ips)	Total Delay, in inches (At any speed)
Write from BOT	182.0	6.640
Write - dual gap head		
7-channel	14.6	0.365
9-channel	11.3	0.240
Write - single gap head		
7-channel	18.6	0.515
9-channel	15.3	0.390
Write File Mark	100.0	3.565
Read from BOT	37.8	1.233
Read forward	8.0	0.120
Read reverse	8.0	0.120
Read reverse/edit	8.0	0.120
	POST-DELAYS	
Write	2.0	0.265
Write File Mark	2.0	0.265
Read forward	0	0.190
Read reverse/edit		
7-channel	8.6	0.515
9-channel	5.3	0.390
Read reverse		
7-channel	5.3	0.390
9-channel	2.0	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 inches*
3. *Write head to erase head distance = 0.340 inches on all heads*

3-21 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.

3-22 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.

3-23 RESTART AFTER POWER FAIL

On all Model 2730 Magnetic Tape Units an optional command input line ILOL can be used to restart the tape unit remotely following power failure. Program the following sequence:

1. Clear all command input lines,
2. Wait one second,
3. Assert SELECT (0, 1, 2, or 3),
4. Assert ILOL for one second,
5. Wait one second,
6. Assert ILOL for one microsecond,
7. Check IRDY. If not true, the tape is not under tension. The operator must rethread the tape.
8. Assert IREW,
9. 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 Model 2730 and 2740 Magnetic Tape Units and a more detailed description of the individual electronic circuits contained within each unit. The material in this chapter must be read by maintenance personnel to gain an understanding of the tape units 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, i. e., U2-8.

The method used to indicate signal flow and logic component interconnection on the schematics and logic diagrams is shown below. A circled number at the output of a logic component indicates that the output is the signal source at other inputs. For example, the circled "1" shown below at the output of inverter U7-10 indicates that FORWARD is the signal source at one other input. An alphanumeric number in parenthesis at the input to a logic element indicates the vertical-horizontal coordinates (example· D-20) of the input signal source component on the drawing. For example, the notation (D-20) FORWARD shown at the input to NAND gate U18-12 indicates that the signal source for FORWARD is located at drawing coordinates D-20 (vertical-horizontal). Table 4-1 provides a complete listing of the definitions for signal mnemonics that are used on the schematics and logic diagrams. The assembly, schematic and logic diagrams in the attached drawing package should also be referred to when reading this chapter.

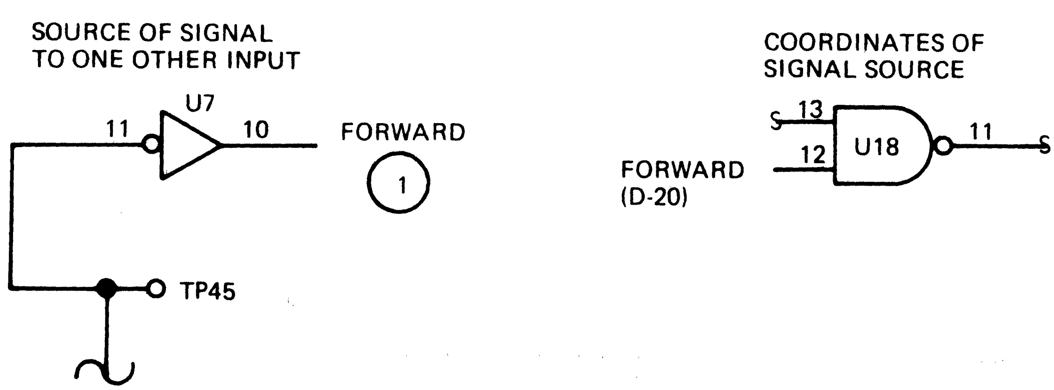


TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS

MNEMONICS	DESCRIPTION	FUNCTION
ADDR SELECT	Address Select	Asserted when tape unit address is selected.
BOTA & $\overline{\text{BOTA}}$	Beginning-of-tape	Asserted when beginning-of-tape is detected.
BOT & $\overline{\text{BOT}}$	Beginning-of-tape	Asserted when beginning-of-tape tab is detected not during a rewind, load or detection of EOT tab.
DATA READY	Date Ready	Strobes write data from interface into write register.
EOTA & $\overline{\text{EOTA}}$	End-of-tape	Asserted when end-of-tape tab is detected.
EOT & $\overline{\text{EOT}}$	End-of-tape	Asserted when end-of tape tab is detected, but not during rewind or detection of BOT tab.
FORWARD & $\overline{\text{FORWARD}}$	Forward command	Asserted when tape unit is selected, ready and on line.
HID & $\overline{\text{HID}}$	High density	Asserted when tape selected at high density by either front panel switch or interface signal.
$\overline{\text{HI DEN}}$	High density	High density command to Data Board.
HOLD		Delay during which K1 is held on until interlock switches close.
IBOT		Interface beginning-of-tape signal.
IDDI		Interface density status.
IDDS		Interface density select command.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
IEOT		Interface end-of-tape signal status.
IFPT		Interface file protect signal.
IOVW		Interface overwrite command.
ILOL		Interface load and on line.
INTLA	Interlock A	Asserted when K1 relay and interlock switches are closed.
INTL & $\overline{\text{INTL}}$	Interlock	Asserted when K1 relay and interlock switches are closed.
IONL		Interface on line status.
IRDY		Interface ready status.
IREU		Interface rewind and unload command.
IREW		Interface rewind command.
IRWD		Interface rewind status.
ISELECT 0 - 3		Interface select commands.
ISFC		Interface synchronous forward command.
ISRC		Interface synchronous reverse command.
ISWRT		Interface set write command.
KIDLY	K1 (Relay) Delay	Delays setting of K1 relay during a remote load and on line operation on a vacuum tape unit.
KILOL	K1 & load and on line	Sets K1 relay during a load and on line operation.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
LDA & $\overline{\text{LDA}}$	Load flip-flop A	Asserted to tension tape.
LDB & $\overline{\text{LDB}}$	Load flip-flop B	Asserted to move tape to BOT.
LDFLT	Load fault	Asserted to reset load operation if interlock switches do not close when tape enters the vacuum columns.
LDLY	Load delay	Determines when tape is to enter the vacuum columns.
$\overline{\text{LDRDY}}$	Load ready	Sets reel motors in motion to allow tape to enter vacuum column during a load operation.
LG	Logic ground	Controls operation of some front panel switches for front panel disable option.
LOAD POS & $\overline{\text{LOAD POS}}$	Load Position	Asserted when tension arms are in the tape load position.
LOL	Load and on line	Sets off set to take up servo during load and on line operation.
LOLDLY & $\overline{\text{LOLDLY}}$	Load and on line delay	Sets how long offset is applied to take up servo during a load and on line operation.
LOLFF & $\overline{\text{LOLFF}}$	Load and on line flip-flop	Set to initiate a load and on line operation.
LOLSTR	Load and on line strobe	Sets on line flip-flop at end of load and on line operation.
LON & $\overline{\text{LON}}$	Load once flip-flop	Set when tape unit has completed a load operation.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
LRC & $\overline{\text{LRC}}$	Longitudinal redundancy character strobes	Used on Data Boards.
LRC STROBE	Longitudinal redundancy character strobes	Interface input line for longitudinal redundancy character strobes.
MFWD & $\overline{\text{MFWD}}$	Manual forward or Maintenance forward	Asserted when using maintenance switch to move tape in forward direction.
$\overline{\text{MINTL}}$	Momentary interlock	Momentary energize K1 during load sequence.
MOTION & $\overline{\text{MOTION}}$		When either forward or reverse commands are asserted, motion is high.
MREV & $\overline{\text{MREV}}$	Manual reverse or Maintenance reverse	Asserted when using maintenance switch to move tape in reverse direction.
NRZ or NRZI	Non-return-to-zero	Interface line used to indicate recording method.
ONL & $\overline{\text{ONL}}$	On line flip-flop	Set to allow the tape unit to accept commands.
OPR POS & $\overline{\text{OPR POS}}$	Operating position	Asserted when the tension arms are in the operating position.
ORS	On line ready selected	Indicates when tape unit is ready to accept a command.
$\overline{\text{PSET}}$	Power reset	Resets the control logic when power is turned on and when power fails.
RD THRESHOLD	Read threshold voltage	Voltage used to detect data.
RDY & $\overline{\text{RDY}}$	Ready	Indicates the tape unit is ready to accept a command i.e., tape unit is loaded and not rewinding.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
RDYA	Ready	Indicates tape unit is not rewinding and is loaded.
RDYNOL	Ready and not on line	Indicates tape unit is loaded, not rewinding and not on line.
READ DATA PARITY, 0, 1, . . . , 7.	Read data lines	Interface lines for either NRZI or PE recording format.
READ DATA STROBE		Interface line strobe used to load read data into formatter.
-READ THRESHOLD 1 (IRDT 1)		Interface threshold command.
-READ THRESHOLD 2 (IRDT 2)		Interface threshold command.
$\overline{\text{RESET}}$		Asserted when reset front panel switch is pressed. Resets selected flip-flop.
REU	Rewind and unload	Asserted by interface command line (IREU) input to initiate rewind and unload operation.
REVERSE & $\overline{\text{REVERSE}}$		Asserted when tape unit is on line, ready and selected.
REWIND (K4)		Indicates K4 relay used during rewind (not a signal).
REWD & $\overline{\text{REWD}}$	Rewind	Asserted when capstan is rewinding.
REWDL	Rewind delay	Delays the starting of the capstan and energizing of K2 relay during a rewind operation.
$\overline{\text{RST}}$	Reset	Resets Unload (UNL) and Load A (LDA) flip-flops when power is turned on and tape is not threaded through tape path (TPC) and load fault (LDFLT) signal is asserted.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
$\overline{\text{RSTA}}$	Reset A	Resets Rewind A (RWDA) and Rewind B (RWDB) flip-flops during completion of rewind sequence or when RSTB is asserted.
$\overline{\text{RSTB}}$	Reset B	Resets Load B (LDB) flip-flop and generates $\overline{\text{RSTA}}$ during load sequence or when $\overline{\text{RSTC}}$ is asserted.
RSTC	Reset C	Resets on line flip-flop, asserts ready (RDY) low, and generates $\overline{\text{RSTB}}$ during Unload sequence or when $\overline{\text{RSTD}}$ is asserted.
RSTD	Reset D	Asserted by RESET push-button or INTL not asserted generates $\overline{\text{RSTC}}$.
RUL	Rewind and unload flip-flop	Output asserted during rewind and unload operation.
RWDA & $\overline{\text{RWDA}}$	Rewind A	Set during rewind operation.
$\overline{\text{RWDAB}}$	Rewind A & B	Indicates rewind flip-flop A set and rewind flip-flop B not set.
RWDC	Rewind C	Generated by $\overline{\text{RWDA}}$. This signal turns on the rewind lamp and high gain to the Reel Servo Circuits.
RWDL	Rewind delay	Delays start of the capstan for a rewind operation.
$\overline{\text{RWRD}}$	Rewind ramp	Input signal that generates the rewind ramp to capstan. Asserted after rewind delay and when RWDA is set and RWDB is not set.
SELECT		Asserted when the tape unit is selected.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
SETHOLD & $\overline{\text{SETHOLD}}$		Asserted when HOLD signal times out resetting LDA flip-flop.
SG		Single gap, see Single Gap.
SINGLE GAP		Status signal output from the NRZI and PE Boards signifying a single gap head configuration.
SLTA & $\overline{\text{SLTA}}$	Select A	Select gated with on line when this signal is asserted, the command inputs ILOL, IREU and the internally used signal ORS are qualified.
SLTB	Select B	Qualifies the command outputs (status) IEOT, IDDI and IONL.
SLTC	Select C	Qualified command outputs IBOT, IFPT, IRWD and IRDY.
SPEED		Data PWBA status output; signifies a low speed tape unit is selected when asserted low. This is used when two different speed tape units are daisy-chained together to a signal formatter.
$\overline{\text{SPD}}$	Low speed	When asserted low, the tape unit will operate at the lower speed. (Used on dual speed units only.)
SUPPLY DET	Supply detector	Supply vacuum column detector output.
SWRT	Set Write flip-flop output	This flip-flop is set to start a write operation.
TAKE UP DET		Take-up detector circuit output.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
TPC	Tape path complete	Asserted when BOT or EOT signals are not asserted.
UNL	Unload flip-flop	Asserted during unload sequence.
VACUNL	Vacuum Unload	Asserted when Unload flip-flop is set and interlock switches are open. This signal initiates the circuits to allow the Reel Servos to perform an unload operation.
VINTL	Vacuum Interlock	Signal is used on vacuum tape unit. Asserted when vacuum interlock switch is closed.
WRTA	Write A	Asserted when write lockout switch is closed. Generates signal to solenoid lamp driver (file protect).
WRT DATA PARITY, 0, 1, ..., 7		Write data interface lines.
$\overline{\text{WRT ENA}}$	Write enable	See $\overline{\text{WRT ENABLE}}$.
$\overline{\text{WRT ENABLE}}$	Write enable	Asserted when write flip-flop is set and tape motion is true. The write electronics is enabled.
WRT PWR	Write power	+5 volts applied to write electronics when interlock switches are closed, K1 relay is energized and write lockout switch is closed.
7 TRK or SEVEN TRACK	Seven track status	Interface line asserted when a seven track tape unit is selected.
9 TRK or 9 TRACK	9 track	Interface line asserted when a nine track tape unit is selected.

4-2 FUNCTIONAL DESCRIPTION

The Model 2730 and Model 2740 Magnetic Tape Units provide a read and write data operation using either the NRZI or Phase Encoded (PE) methods. These tape units designed specifically for remote control of the read/write operation and tape motion. The operation of both models is identical except for the method of maintaining correct tape tension. The Model 2730 tape units have mechanical arms for tensioning tape and the Model 2740 tape units use vacuum chambers. The following paragraphs provide a functional descritpion of the Model 2700 Series Magnetic Tape Units and a description of the differences between the Model 2730 and Model 2740 units. Figure 4-1 shows a functional block diagram of the tape units.

4-3 TAPE CONTROL BOARD

Each tape unit contains a Tape Control printed circuit board, and up to three Data circuit boards. The circuit boards are mounted on a card frame mounted parallel to the tape unit baseplate. The Tape Control 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

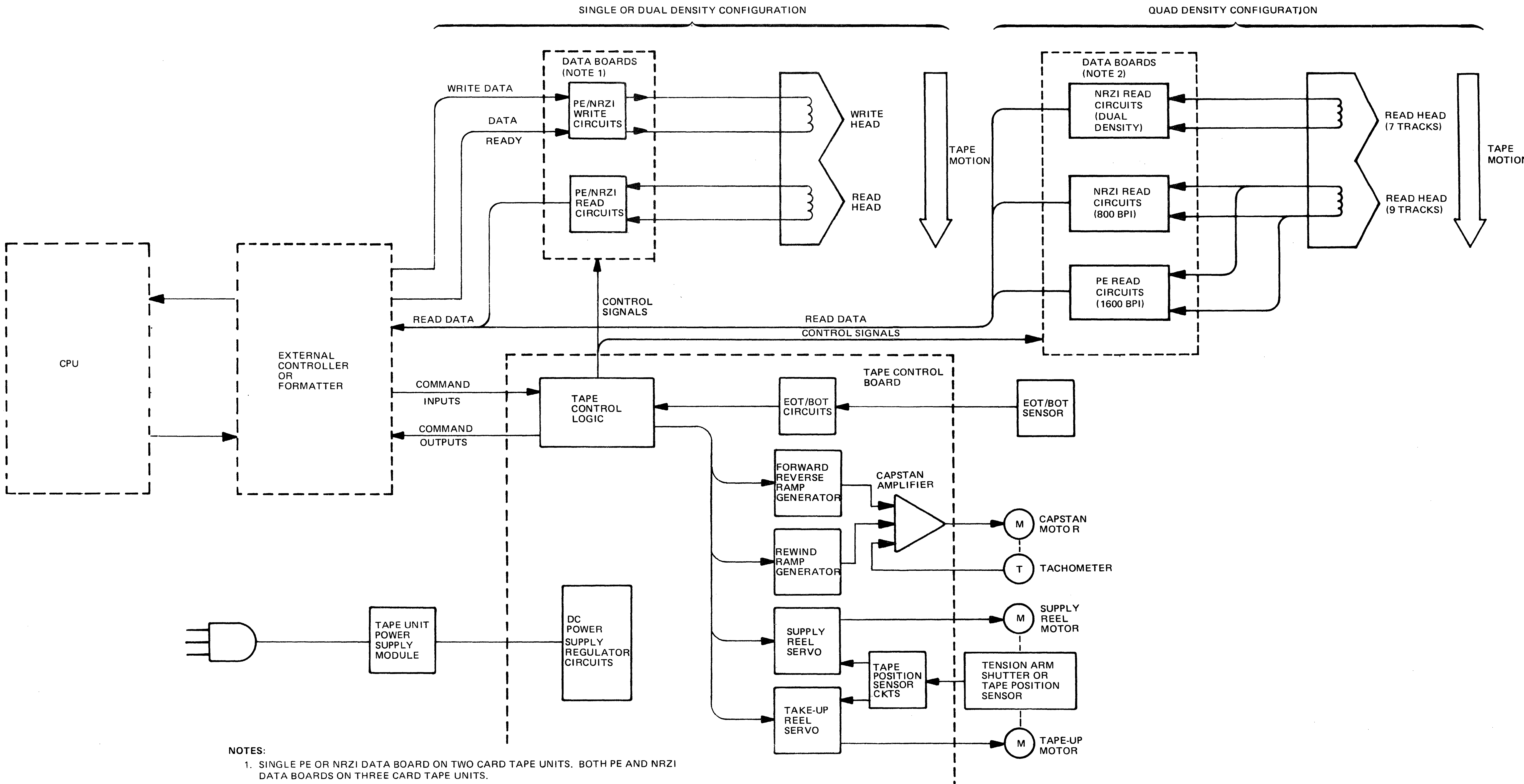
The data board provides the two functions of writing and reading of data. Write data signals enter the board by an edge connector on one side of the board. They are buffered by a register which drives the write head. The write and read head connections are made through two connectors in the center of 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 both the Model 2730 Tension Arm Tape Unit and the Model 2740 Vacuum Column Tape Unit. Figure 4-2 shows the mechanical assembly of the Model 2730 and figure 4-3 shows the mechanical assembly of the Model 2740. Detailed mechanical assembly views of the tape units are contained in Chapter 6.

4-6 MODEL 2730 TAPE UNIT

The Model 2730 Tape Unit uses a mechanical tension arm assembly to maintain tape tension. A spring attached to the mechanical arm is used to maintain tape tension at 8 ounces. To facilitate tape loading, a retract motor assembly automatically moves the tension arms outward to allow easy threading of the tape. When the LOAD switch is pressed, the retract motor assembly moves the tension arms inward, catching and tensioning the tape. Two microswitches on the assembly determine the position of the mechanical retract arm.



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

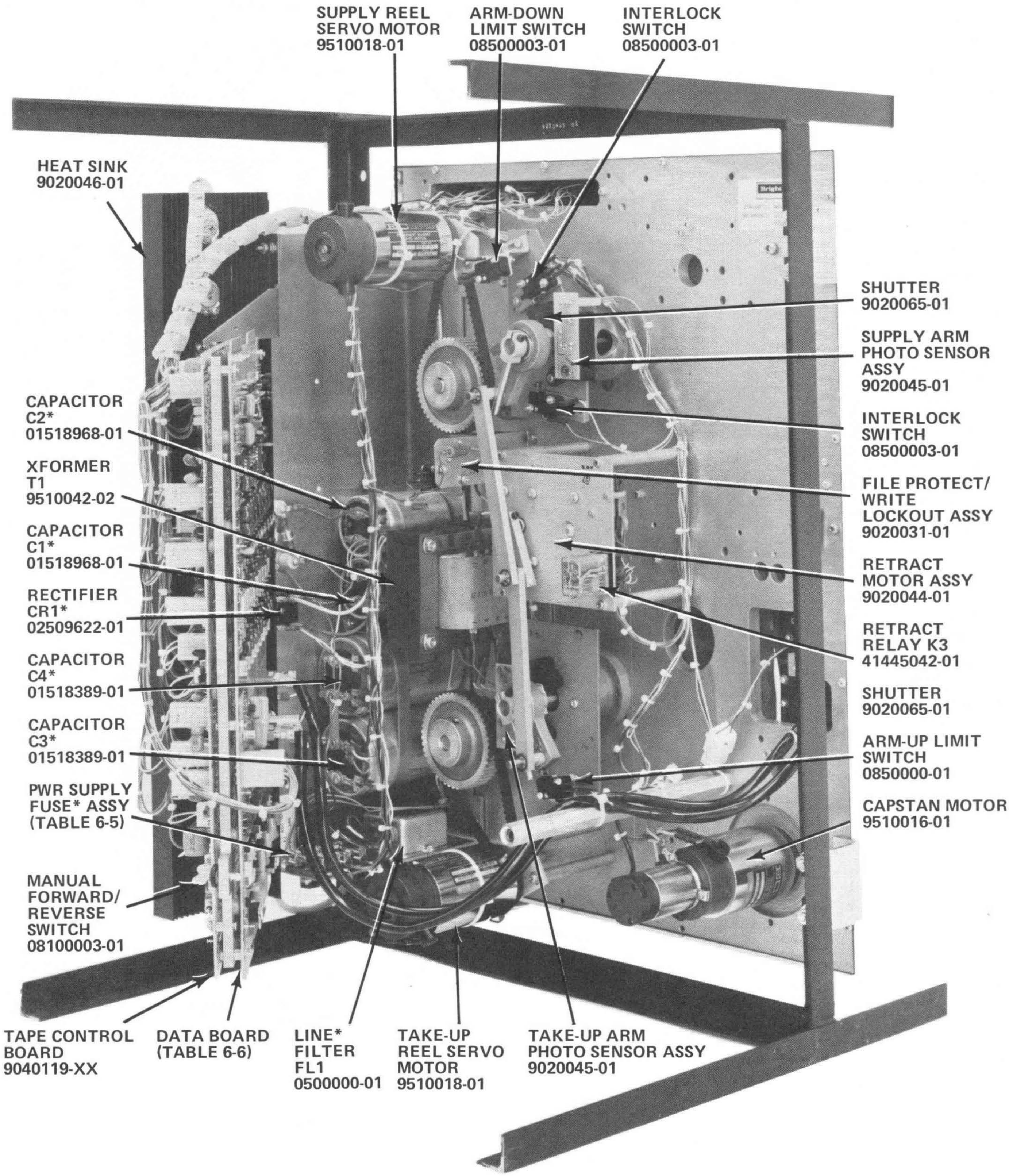


Figure 4-2. Model 2730 Tape Unit Mechanical Assembly

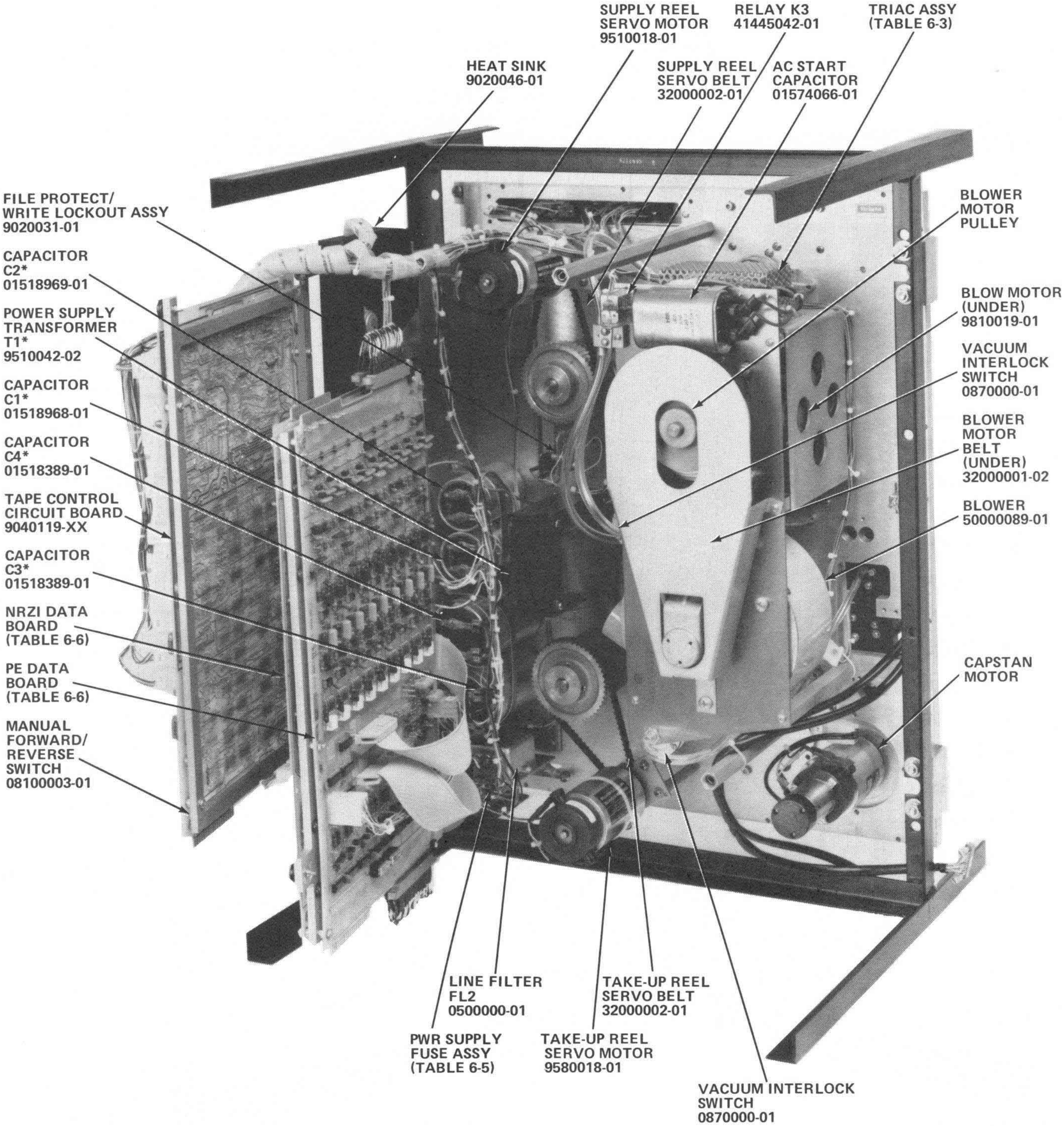


Figure 4-3. Model 2740 Tape Unit Mechanical Assembly

When the tape tension arms are in the operating range, the position of the arms is detected as a function of a shutter and photo resistive assembly. The shutter is attached to the tension arm shaft and passes between two photoresistors and a light bulb. The center connection of the two photoresistors provides a variable voltage which is directly related to the position of the tension arm.

To prevent damage to the tape, two microswitches on the shutter assembly sense if the tension arms move out of the operating range. When this happens one of the microswitches opens, immediately disconnecting the servos from the motors and removing write current from the data board. All tape motion stops and the write electronics is prevented from erasing data.

4-7 MODEL 2740 TAPE UNIT

The Model 2740 Tape Unit uses a vacuum chamber to maintain tape tension. The vacuum chamber maintains tape tension at 8 ounces. The position of the tape in the vacuum chamber is sensed by a tape position sensor covering the length of the chamber. The tape position sensor is driven by an oscillator and is sensed by an amplifier and synchronous detector circuit located on the Tape Control Board. Since the tape position sensor is the length of the chamber, 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 Chamber 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 loop drops below the lower hole in the vacuum chamber, 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 chamber, 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.

4-8 PRIMARY POWER CIRCUITS

The primary power circuits consist of two parts: 1) a power supply module mounted on the tape unit baseplate (see figures 4-2 and 4-3); and 2) the power supply regulator circuits located on the Tape Control Board. The power supply module contains a power transformer, rectifiers, capacitors, fuses, and two power resistors. A heatsink, for mounting the power supply and servo power transistors, is attached to the power supply module. The power supply regulator circuits consist of the four regulator circuits and a power reset circuits. Figure 4-4 shows a simplified diagram of the primary power circuits used on both models of the tape unit. The following paragraphs describe both the power supply module and the power supply regulator circuits.

4-9 POWER SUPPLY MODULE

The power supply module supplies unregulated ± 36 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 4-4. Primary power is supplied through optional line filter FL1 and front panel ON/OFF switch S1 to stepdown transformer T1. (The Model 2740 tape unit uses a triac assembly and, if the dual triac assembly is used, a Service

Power switch S2. Refer to the description the blower motor circuits in paragraph 4-16.) The unregulated ±17 volt outputs are supplied by full-wave rectifier CR1, and the ± 36 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.

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 ±36 volt outputs are distributed to the other circuits on the Tape Control Board.

4-10 POWER SUPPLY REGULATOR CIRCUITS

The power supply regulator circuits on the Tape Control Board consist of four separate regulator circuits which supply +10 volt, +5 volt, -10 Volt and -5 volt outputs. Refer to functional module 1000 on the Tape Control Board schematic diagram in the attached drawing package. In addition, the power supply regulator circuits also provide a reset (PSET) signal to the tape unit control circuits. The 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.

4-11 +10 Volt Regulator

The +10 volt regulator consists of series regulator transistor Q4, mounted on the heatsink, and a voltage sensing network associated with Q1004. See figure 4-5. 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 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 volts.

4-12 -10 Volt Regulator

The -10 volt regulator consists of series regulator transistor Q8 and reference diodes CR1007, CR1004 and CR1005. See figure 4-6. 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 provided over-current protection by always maintaining the -10 volt output at pin F more negative than -9.4 volts. If the voltage at F rises above -9.4 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 F from exceeding +0.6 volts.

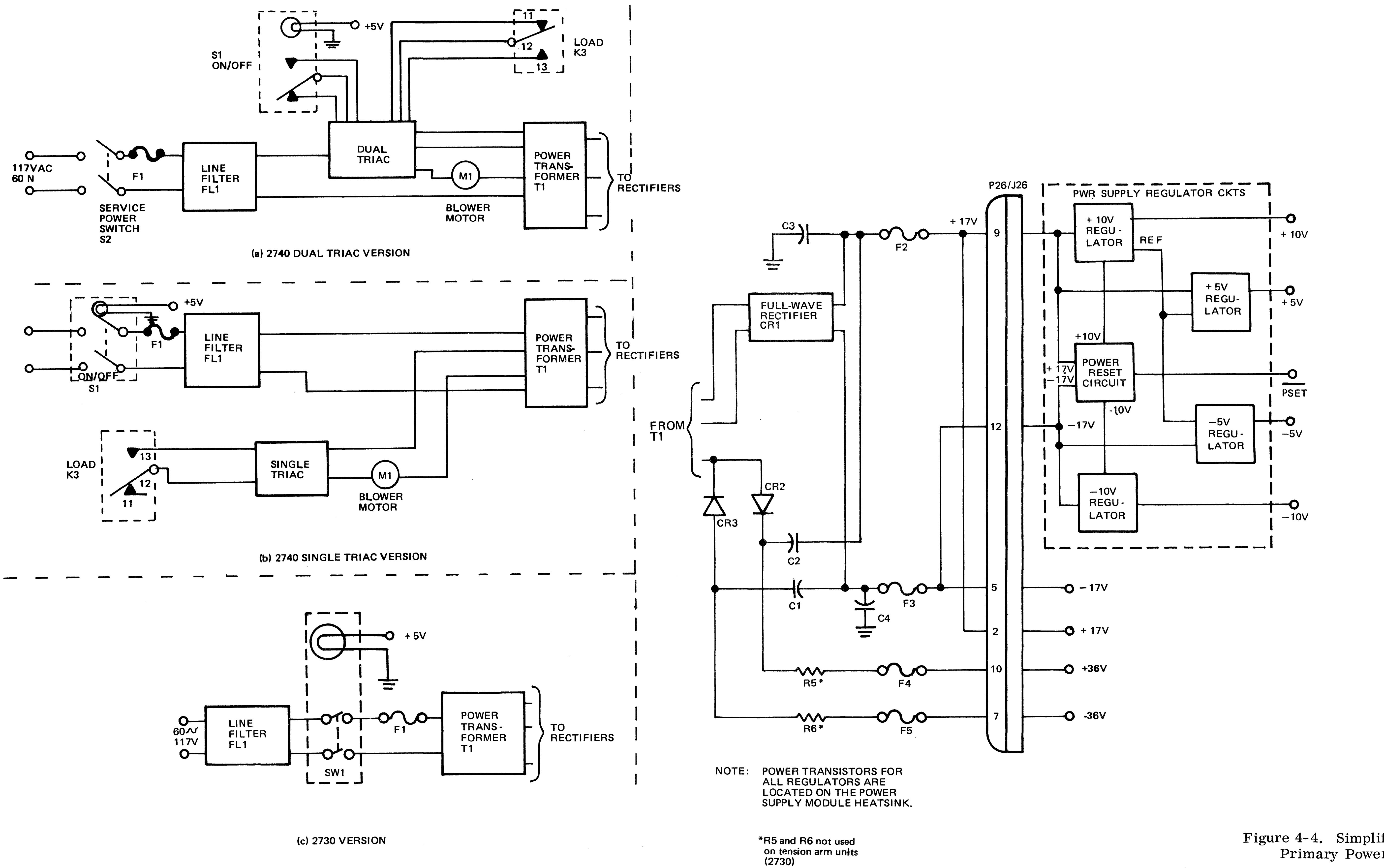


Figure 4-4. Simplified Diagram of Primary Power Circuits

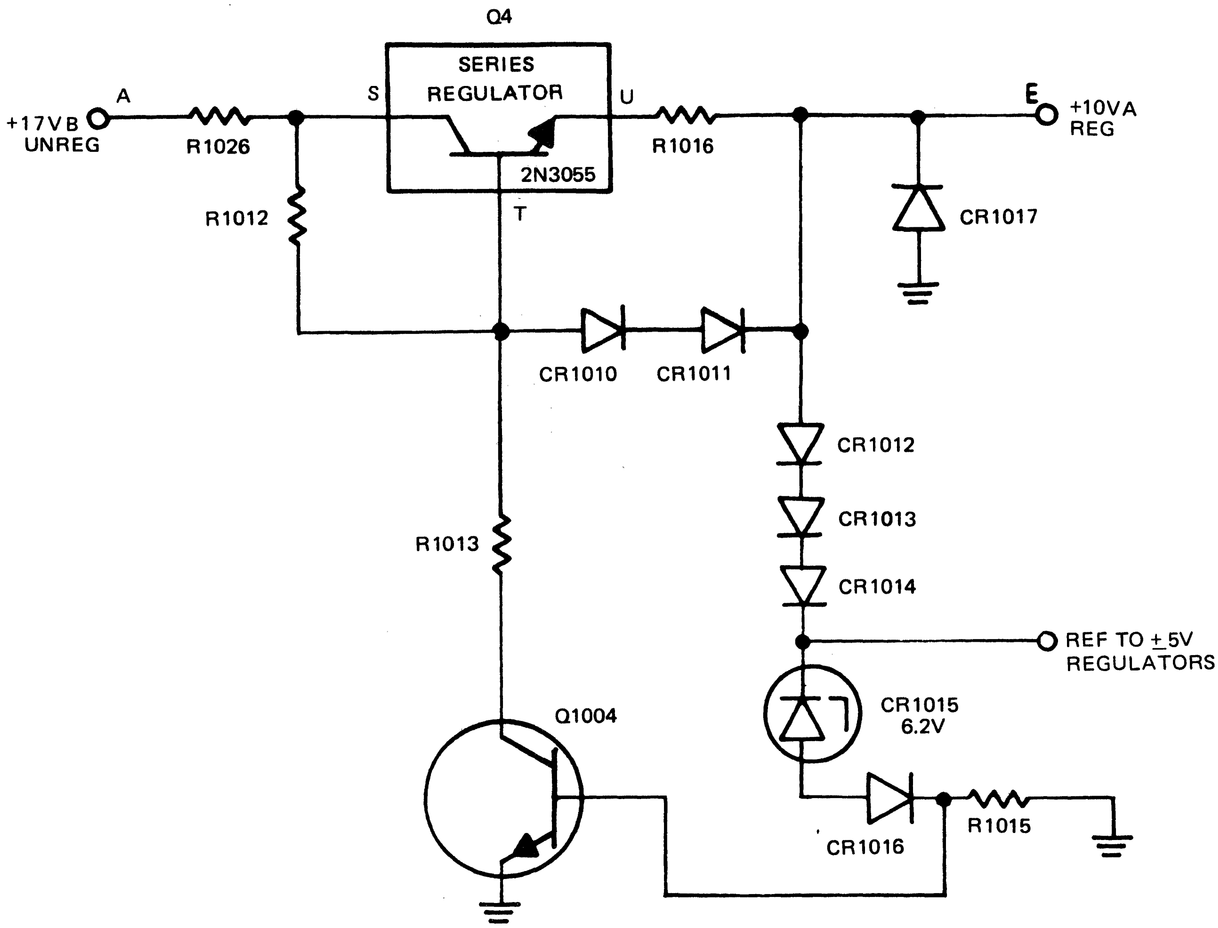


Figure 4-5. +10 Volt Regulator Circuit Simplified Diagram

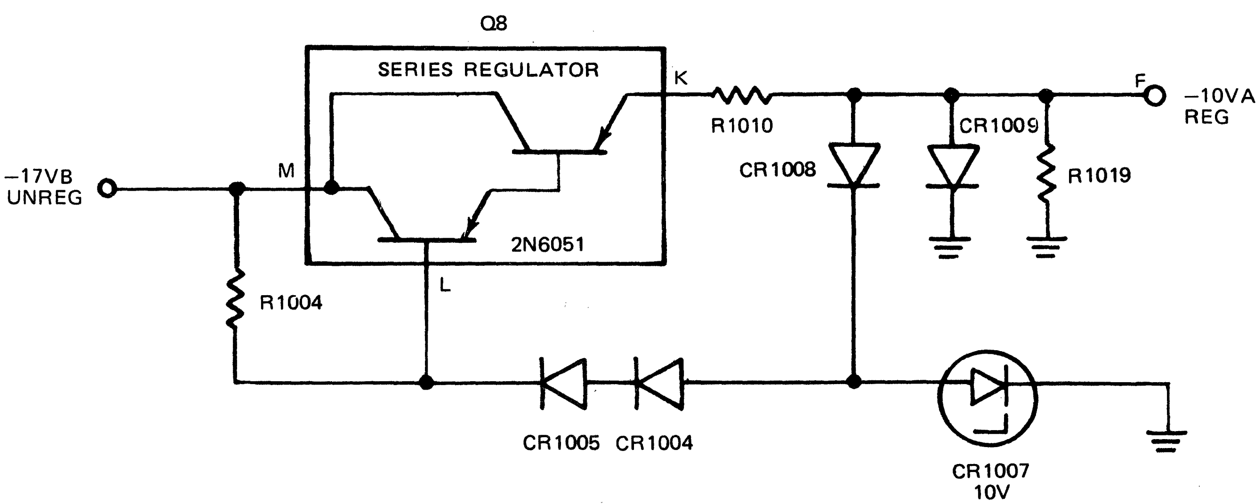


Figure 4-6. - 10 Volt Regulator Circuit Simplified Diagram

4-13 +5 Volt Regulator

The +5 volt regulator circuit is referenced to Zener diode CR1015 in the +10 volt regluator and uses a remote sensing for regulating its output. See figure 4-7. The circuit consists of series regulator transistor Q9 and operational amplifier U46, with associated components.

To maintain +5 volts at the remote location (at TP1 of Forward-Reverse Ramp Generator) the operational 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 to 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 over-current 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 CR1020 is for protection against transients during power turn-on and keeps output (C) from going below -0.6 volts.

The +5 volt regulator also incorporates an SCR crowbar protection circuit, consisting of Zener diode 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.

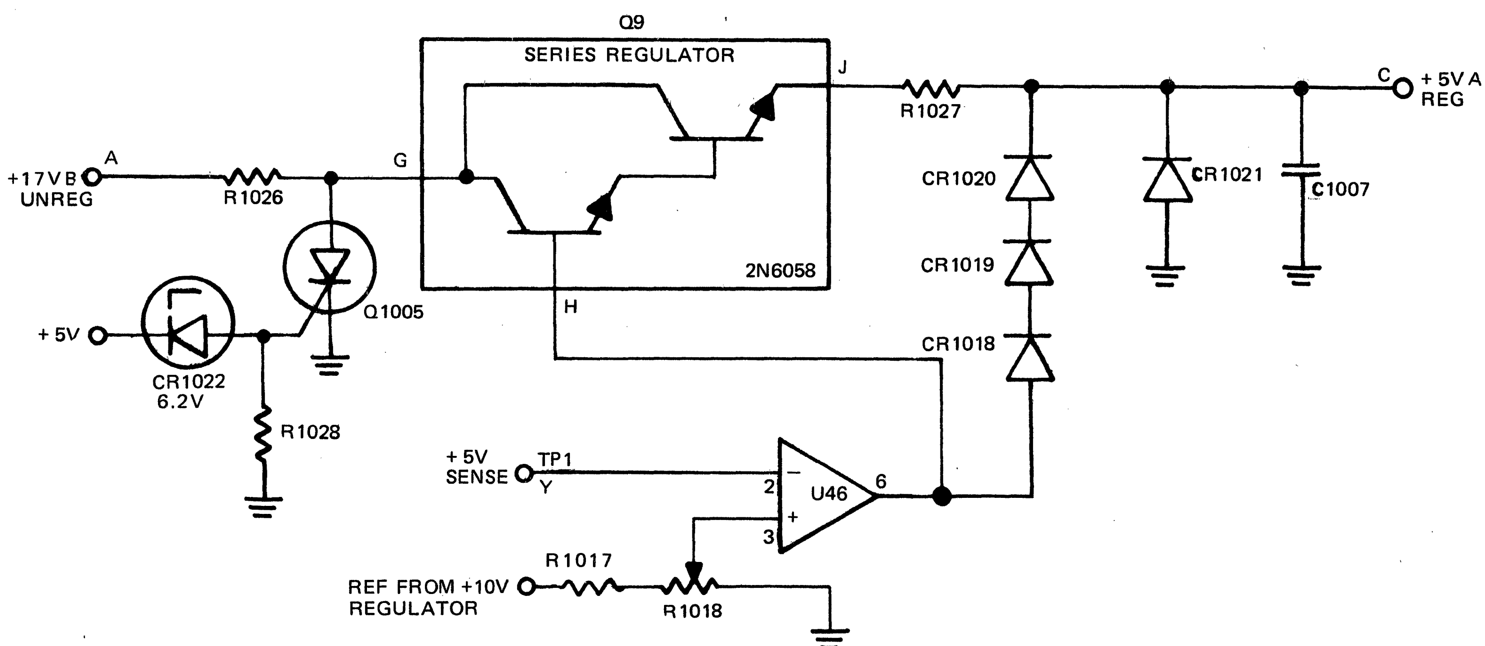


Figure 4-7. + 5 Volt Regulator Circuit Simplified Diagram

4-14 -5 Volt Regulator

The -5 volt regulator functions very similar to the +5 volt regulator. See figure 4-8. 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 operational amplifier U48 is referenced to ground, while the other is taken from a voltage divider R1020 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 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 overcurrent 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 preceeding paragraphs.

4-15 Power Reset Circuit

Figure 4-9 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 through R1026, 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 the +10 volts rises, and the V_{be} of Q1003 becomes less than 0.6 volts, transister Q1003 turns off and $\overline{\text{PSET}}$ becomes less than 0.6 volts, 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 the -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 volts and Q1002 shut off. If, however, the -17 volt line rises to near -10 volts, or the -10 volts falls to near -17 volts and the V_{be} of Q1001 falls below 0.6 volts, 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.

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 Tape Control Board.

4-16 BLOWER MOTOR CIRCUITS

Figure 4-10 shows simplified diagrams of the blower motor circuits used on the Model 2740 Vacuum Chamber tape unit. On the tape unit using the single triac assembly (figure 4-10b). 115 Vac is switched through LOAD relay K3 contracts 12 and 13, on the Tape Control Board, when the relay is energized during the tape load sequence. This connects 115 Vac to the gate of triac CR1 through resistor R1, turning on the triac and applying AC operating voltage from power supply transformer T1 through the triac to the blower motor M1. When relay K3 is de-energized, triac CR1 turns off and removes AC operating voltage from the blower motor. The single triac assembly is located on top of the blower motor assembly.

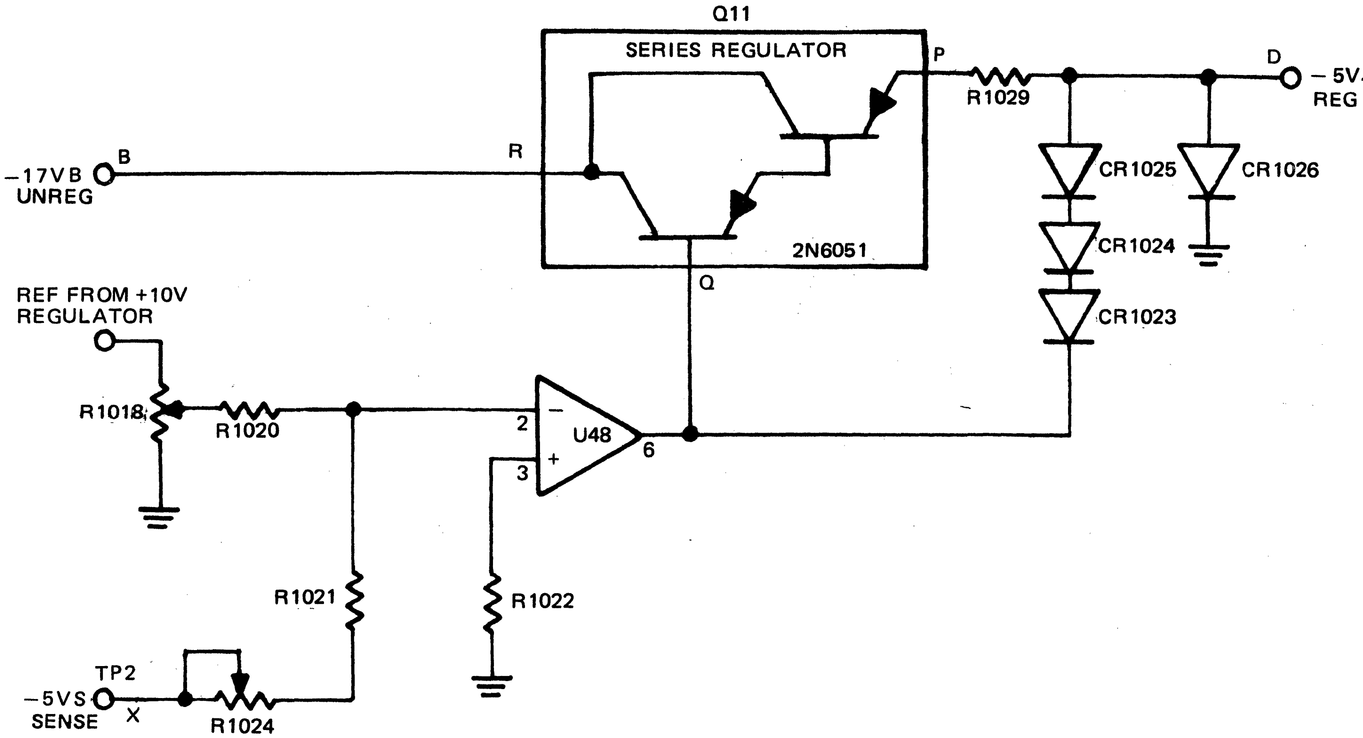


Figure 4-8. -5 Volt Regulator Circuit Simplified Diagram

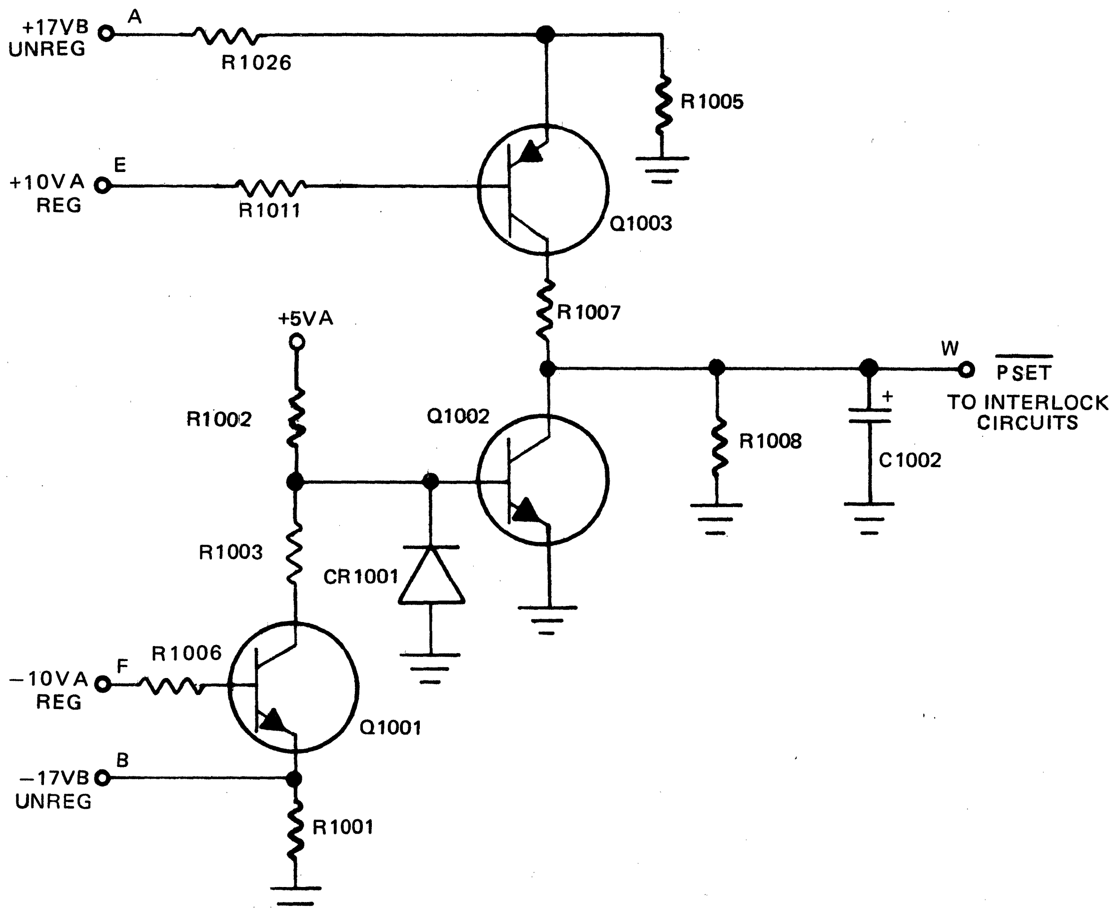
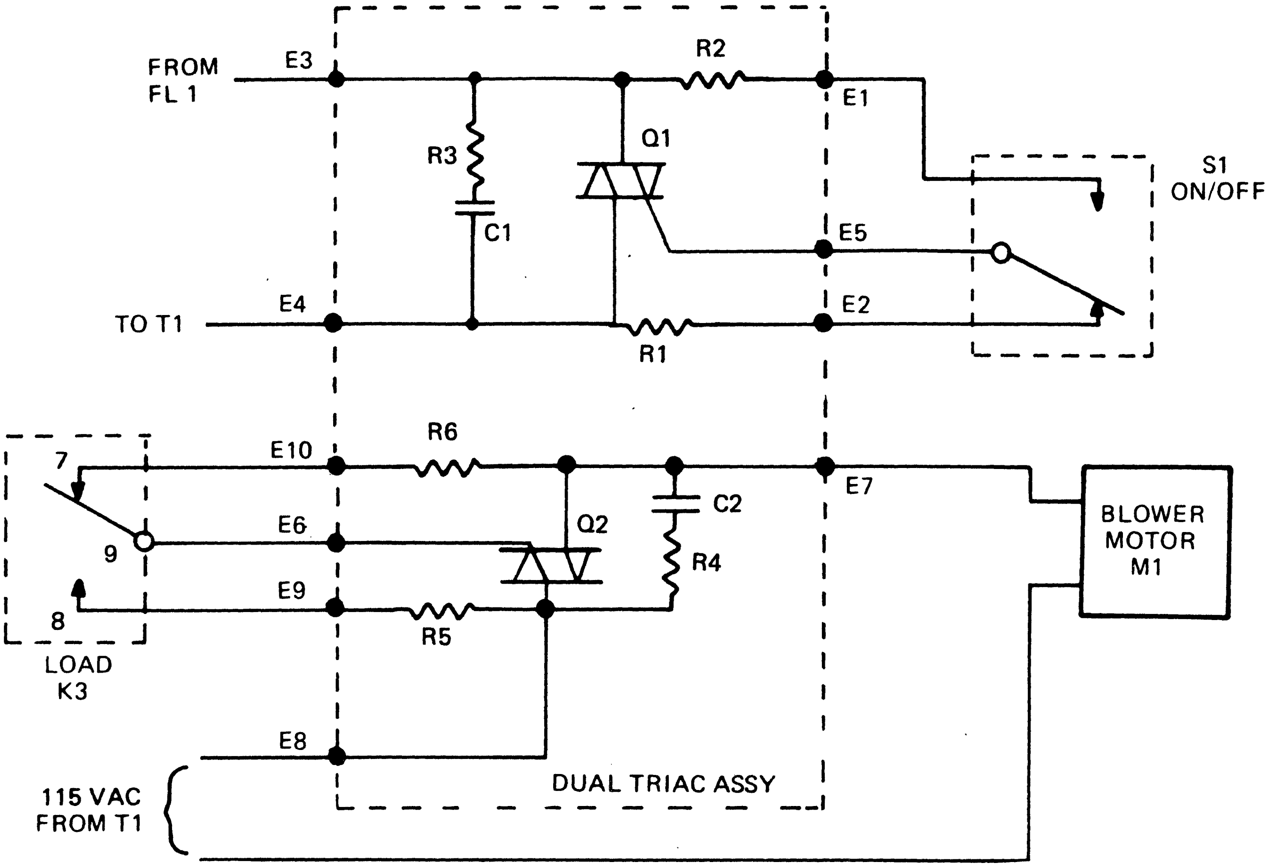
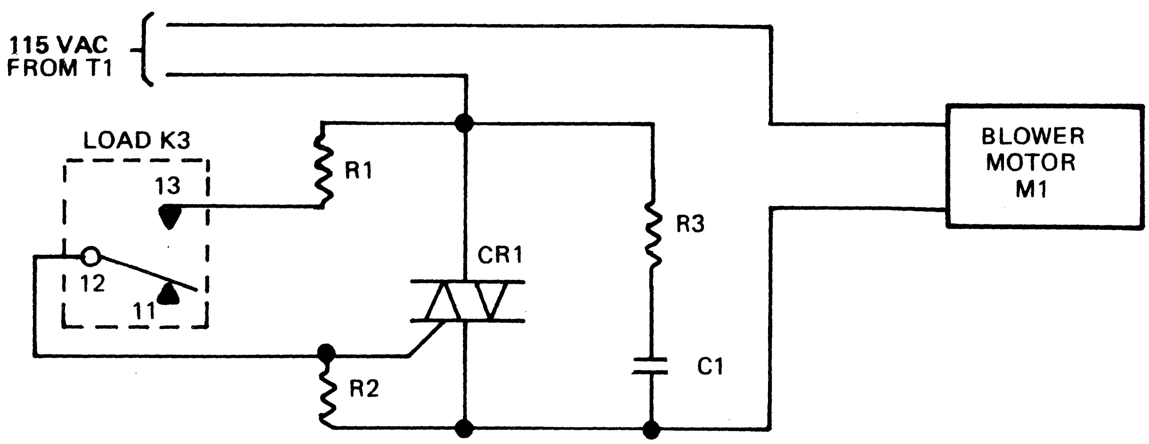


Figure 4-9. Power Reset Circuit Simplified Diagram



(a) DUAL TRIAC VERSION



(b) SINGLE TRIAC VERSION

Figure 4-10. Blower Motor Circuits Simplified Diagram

When the dual triac assembly (figure 4-10a) is used primary power is switched through one of the triac circuits to power supply transformer T1 by front panel ON/OFF switch S1. The second triac circuit is used to switch AC operating power to blower motor M1 when LOAD relay K3 is energized during the tape loading sequence. The second triac circuit operates exactly as the single triac circuit explained in the preceding paragraph. The dual triac assembly is also located on top of the blower motor assembly.

4-17 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 is contained in the attached drawing package. Simplified schematics of the various Tape Control Board circuits are contained in the following paragraphs where necessary for clarify of explanation.

4-18 LOAD LOGIC CIRCUITS

The load logic circuits have several differences depending on the model of machine, and the load option used. Both the Model 2730 Tension Arm machine and Model 2740 Vacuum Column machine are available in either a single load or double load configuration. For ease in explanation, the following paragraphs describe the tension arm machine with the single load option and the vacuum column machine with the double load feature.

4-19 Tension Arm Single Load Sequence

Figure 4-11 is a simplified logic diagram of the tension arm load logic with the single load option. Figure 4-12 shows single load sequence timing. The tension arm machine single load sequence starts when the LOAD switch/indicator is pressed and then released. This causes flip-flop U26-8 to produce a positive pulse output which sets the LDA flip-flop U27-3. LDA is gated with $\overline{\text{OPR POS}}$ at U43-2.

The tension arms are held at the load position by the retract motor arm. The position of the tension arms and retract motor is sensed by two microswitches on retract motor assembly. The arm-up microswitch generates the $\overline{\text{LOAD POS}}$ signal and the arm-down microswitch generates the $\overline{\text{OPR POS}}$ signal.

Since the $\overline{\text{OPR POS}}$ and LDA signlas are high, U43-3 applies a low to relay driver U38. A low at either input turns on U38 and energizes relay K3 turning on the retract motor and moving the tension arms into the operating range and into the tension arm stops.

LDA is gated at U15 with $\overline{\text{INTL}}$. LDLY is held high by pull-up resistor R39 on tension arm machines. Since $\overline{\text{INTL}}$ is high until the K1 relay is energized, LDRDY goes low turning on transistors Q5 and 2N6058 in the Reel Servo circuits. See figure 4-13. When these transistors turn on, they apply - 17 volts through a resistor to both reel motors. Current through the reel motors creates a torque in the direction to allow tape to be moved by the retract motor.

When the retract motor has moved the tension arms to the stops, the Arm Down microswitch NC contact is grounded causing $\overline{\text{OPR POS}}$ signal to go low at U43-2, deenergizing relay K3. LDA at U33-1 is gated with OPR POS at U33-2 and, since both signals are high, MINTL at U33-3 goes low. MINTL triggers single-shot multivibrator U37-13 (HOLD) and, as an input to U35-4, turns on relay driver U45, energizing relay K1. Relay K1 connects

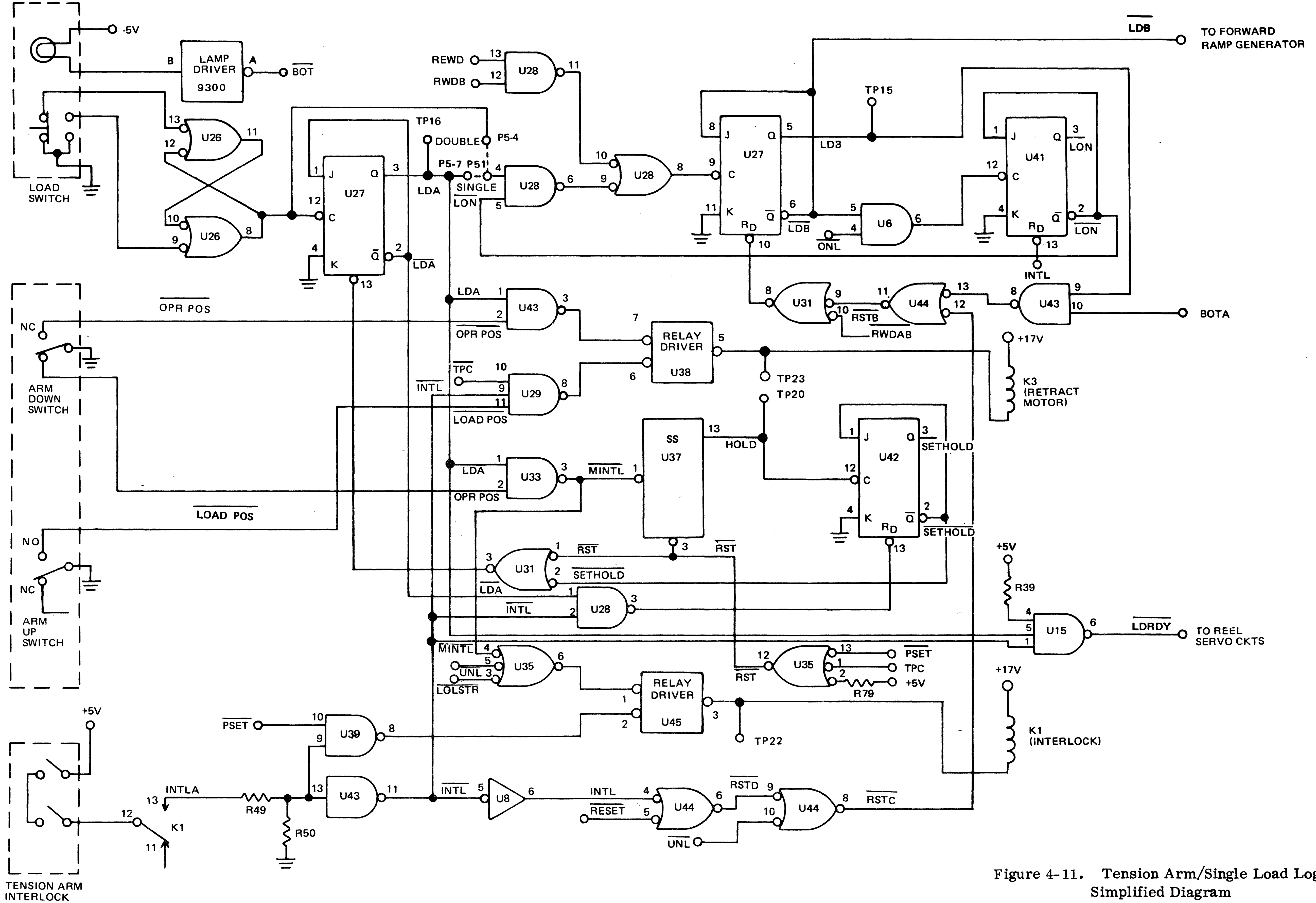


Figure 4-11. Tension Arm/Single Load Logic Simplified Diagram

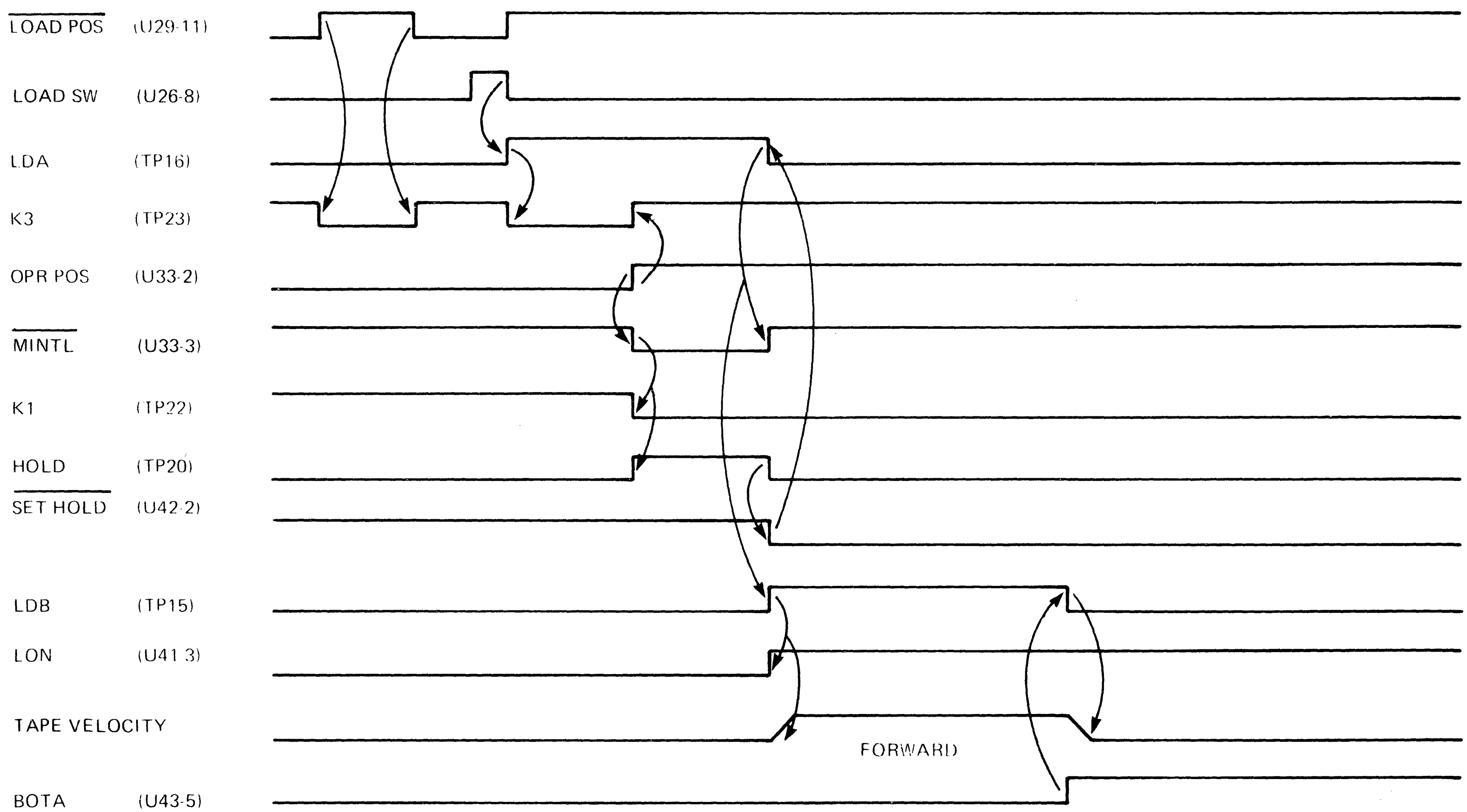


Figure 4-12 Single Load Sequence Timing Diagram (Model 2730)

the reel and capstan motors to their amplifiers. The tension arms are now positioned by the servos to the center of the operating range. The interlock microswitches are closed as long as the tension arms are in their operating range. This also sets INTL and INTLA high. INTLA at U39-9 is gated with $\overline{\text{PSET}}$ from the power supply circuits at U39-10 causing U39-8 to go low, keeping relay K1 energized until $\overline{\text{PSET}}$ goes low or either interlock microswitch is opened.

When the HOLD Single-Shot U37 times out it sets flip-flop U42-3 (SET HOLD). $\overline{\text{SET HOLD}}$ is an input to U31-3 which resets LDA flip-flop U27-3. Therefore, if the interlock microswitches are not closed, relay K1 will deenergize.

For the single load option LDA at U28-4 is gated with $\overline{\text{LON}}$ at U28-5. Since $\overline{\text{LON}}$ is high until the tape unit has been loaded, the reset of LDA will cause flipflop 27-5 (LDB) and flip-flop U41-3 (LON) to be set. $\overline{\text{LDB}}$ is an input to the Forward Ramp Generator chich 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 $\overline{\text{RSTB}}$ go low at U44-11. 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.

When the tape is not in the tape path, $\overline{\text{TPC}}$ and $\overline{\text{INTL}}$ at U29-10 and -9, respectively, are high and, if the tension arms are not at the load position, $\overline{\text{LOAD POS}}$ is also high. U29-8 is therefore low and any low at the inputs to U38 energizes relay K3. This causes the retract motor to move the tension arms until the arm-up microswitch closes. $\overline{\text{LOAD POS}}$ is then high, making U29-8 go high, turning relay K3 off and stopping the retract motor. The arms are now at the Load Position.

4-20 Vacuum Column/Double Load Sequence

Figure 4-13 shows the simplified schematic for a vacuum machine load sequence with the double load option. Figure 4-14 shows double load sequence timing. 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 $\overline{\text{RSTD}}$ and $\overline{\text{RSTB}}$ are 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. 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 volts. When $\overline{\text{LDA}}$ 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 LDRDY at U15-6 goes low. $\overline{\text{LDRDY}}$ low saturates Q5 and 2N6058 in the reel servo circuits applying -17 volts through a resistor to the reel motors. See figure 4-13. Current through the reel motors creates a torque that allows the tape to enter the vacuum chambers.

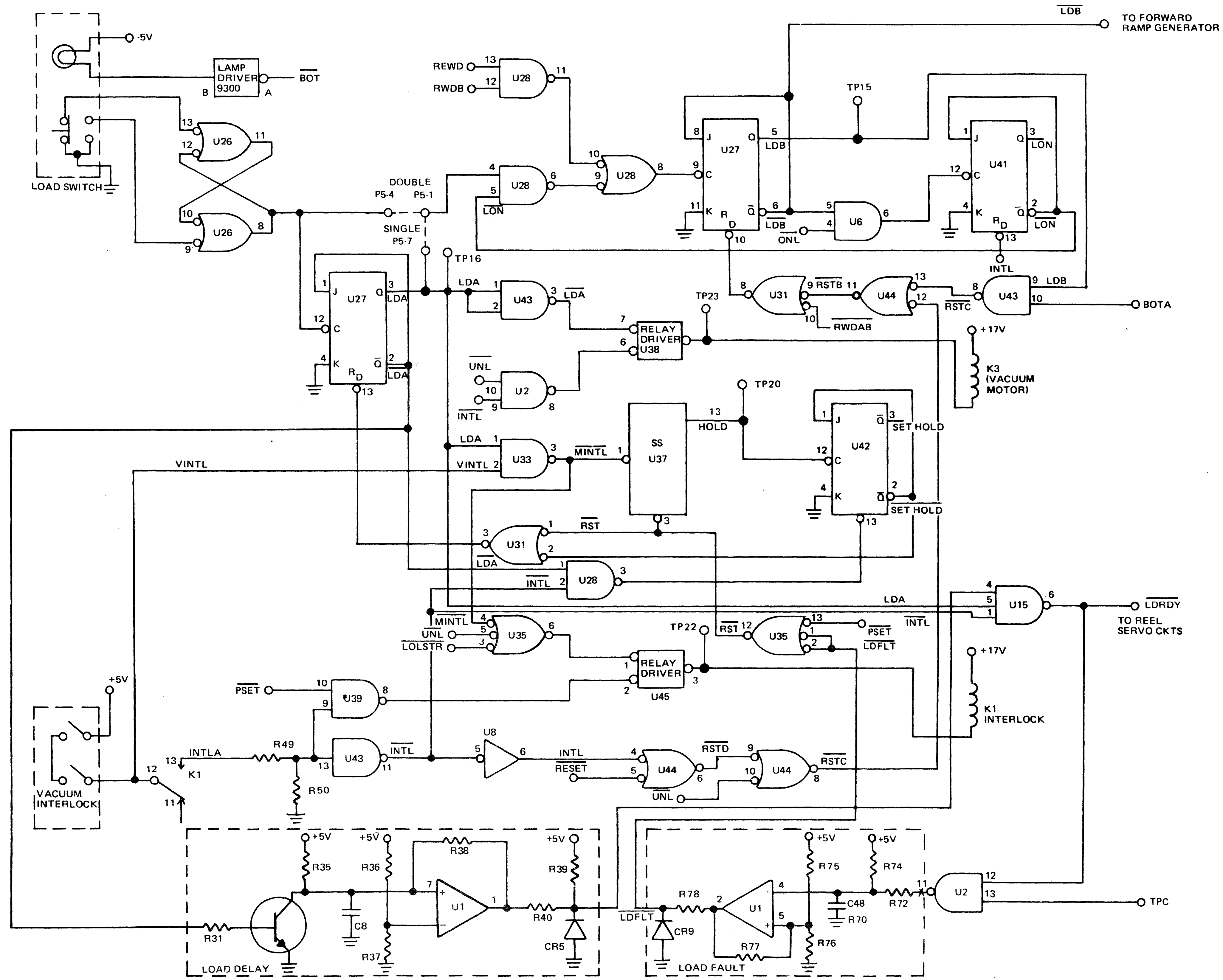


Figure 4-13. Vacuum Chamber/Double Load Logic Simplified Diagram

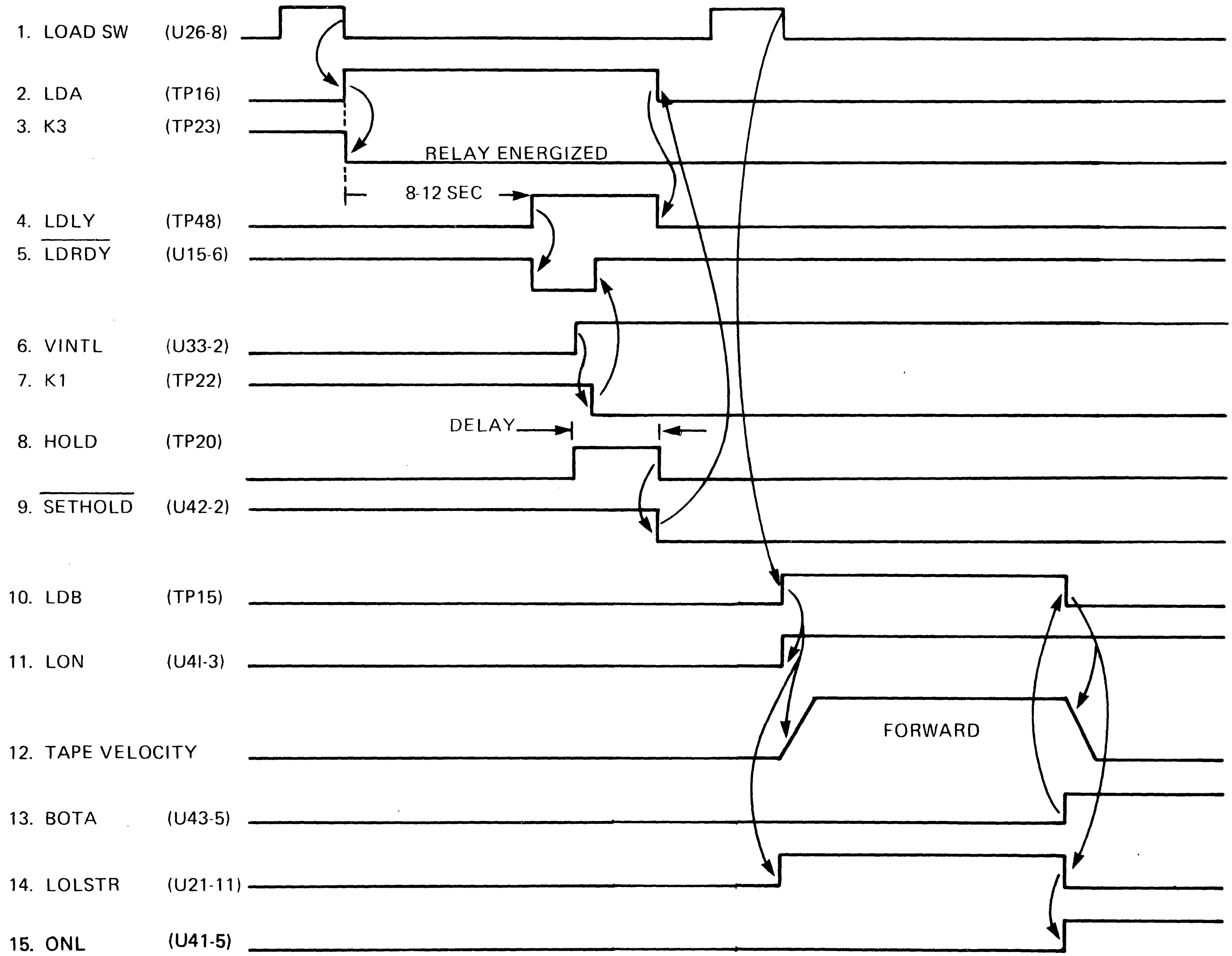


Figure 4-14 Double Load Sequence Timing Diagram (Model 2740)

$\overline{\text{LDRDY}}$ is also an input to the load fault circuits at U2-12. When $\overline{\text{LDRDY}}$ goes low U2-11 allows C48 to charge toward +5 volts at U1-4. Refer to figure 4-15 for the load fault sequence timing. 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 $\overline{\text{LDFLT}}$ will go low. This causes $\overline{\text{RST}}$ 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, $\overline{\text{INTL}}$ goes low at U15-1. This causes $\overline{\text{LDRDY}}$ to go high and U2-11 goes low causing C48 to discharge through R72. LDFLT will remain high allowing the load sequence to complete.

When the tape is in the vacuum chambers, the vacuum interlock switches close making VINTL high. With LDA at U33-1 and VINTL at U33-2 high, $\overline{\text{MINTL}}$ goes low triggering single-shot multivibrator U37 (HOLD). $\overline{\text{MINTL}}$ also applies a low at U3504. Any low at U45 relay driver energizes 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 chambers. 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 interlock switches are closed, INTL and INTLA also go high. INTLA at 39-9 is gated with $\overline{\text{PSET}}$ at U39-8 to go low keeping relay K1 energized until 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). $\overline{\text{SET HOLD}}$ 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 deenergized.

Pressing and releasing of the LOAD switch a second time causes a positive pulse output from U26-8 which is gated with $\overline{\text{LON}}$ at gate U28-5. Since $\overline{\text{LON}}$ 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 $\overline{\text{RSTB}}$ go low. $\overline{\text{RSTB}}$ 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.

4-21 REEL SERVO ELECTRONICS

Figure 4-16 shows a simplified schematic of the Reel Servo electronics on a Model 2730 Tension Arm tape unit, and figure 4-17 shows a simplified schematic of the Reel Servo electronics on a Model 2740 Vacuum Column tape unit. The reel servo electronics on each tape unit consists 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 of each tape unit is described.

The input to the Reel Servo Amplifier is a tape position sensor which can be either the shutter assembly for a Model 2730 Tension Arm tape unit or the tape position sensor and detector for a Model 2740 Vacuum Column tape unit. 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.

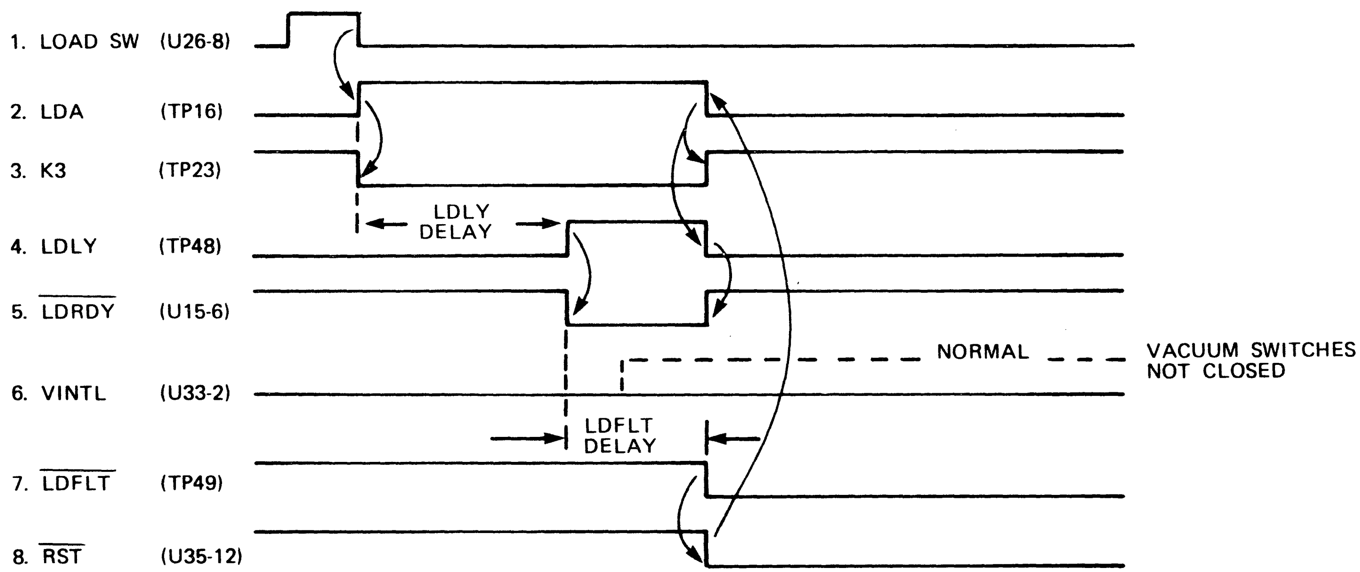


Figure 4-15 Load Fault Sequence Timing Diagram (2740)

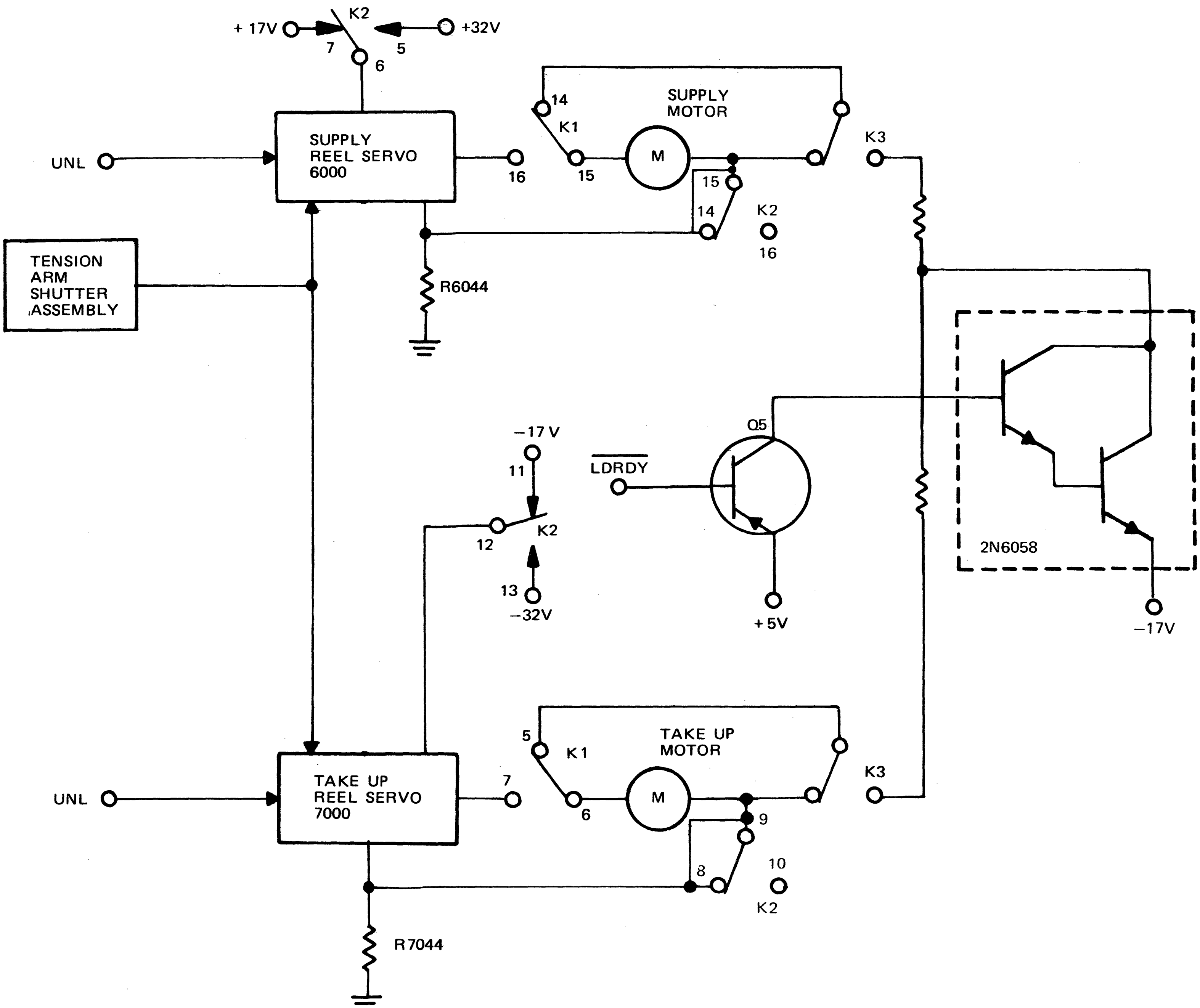


Figure 4-16. Reel Servo Electronics Simplified Diagram (Model 2730)

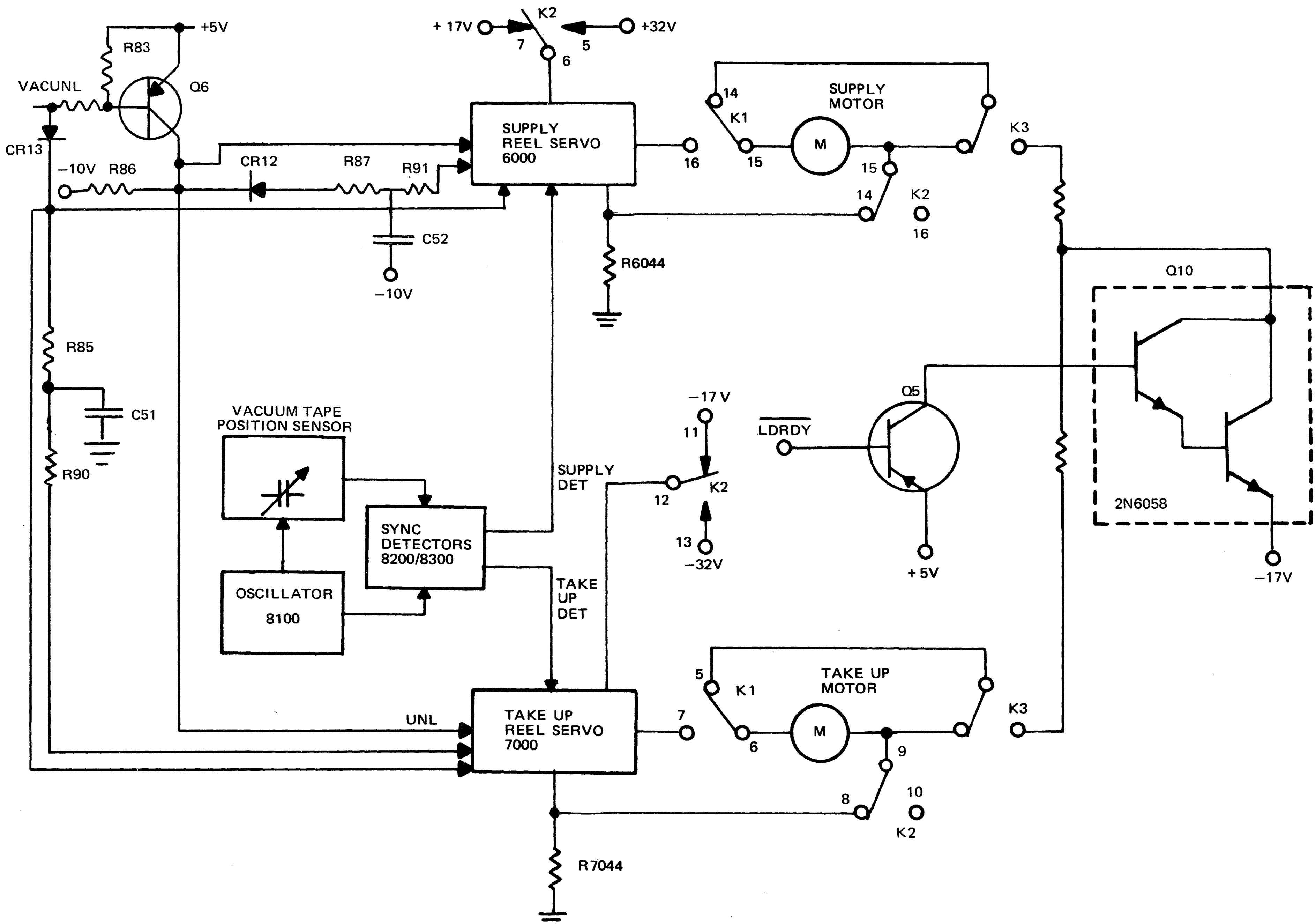


Figure 4-17. Reel Servo Electronics Simplified Diagram (Model 2740)

4-22 Tension Arm Tape Position Sensor Circuits

The Model 2730 Tension Arm machines generate a position voltage using a photoresistor and shutter assembly that is connected to each tension arm. Two photoresistors are connected together with their ends connected to + 5 and - 5 volts. A shutter mechanism, connected to the tension arms, is positioned between the photoresistors and the light bulb. The shutter is constructed so that as arms are moved from one end of the operating range to the other, one photoresistor gets more or less light than the other one. The voltage at the center connection of the photoresistors is related to the resistances of the two photoresistors. Therefore, as one photoresistor becomes less resistive when it receives more light, the center voltage will change. Thus, the center voltage changes positive and negative as the tension arm is moved through its range.

4-23 Vacuum Chamber Tape Position Sensor Circuits

The Model Vacuum Chamber machines use an oscillator that drives the variable capacitor tape position sensors. The output of the capacitor tape position sensor is detected and amplified by a synchronous detector. Figure 4-18 shows a simplified diagram of the vacuum chamber tape position oscillator and sync circuits. Figure 4-19 shows timing for the vacuum tape position sensor 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 Q8102 and Q8103 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 approximately 75 microseconds.

The triangular waveform is applied to the vacuum column tape position sensors. The tape position sensors 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 tape position sensor is connected to pin 2 of amplifier U55. Amplifier U55 has a gain that is the ratio between R 8302 and the tape position sensor's capactiive reactance. The amplifier's gain increases at 20db per decade. This is characteristic of a differentiator amplifier. As the capacitance of the tape position sensor 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 tape position sensor'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

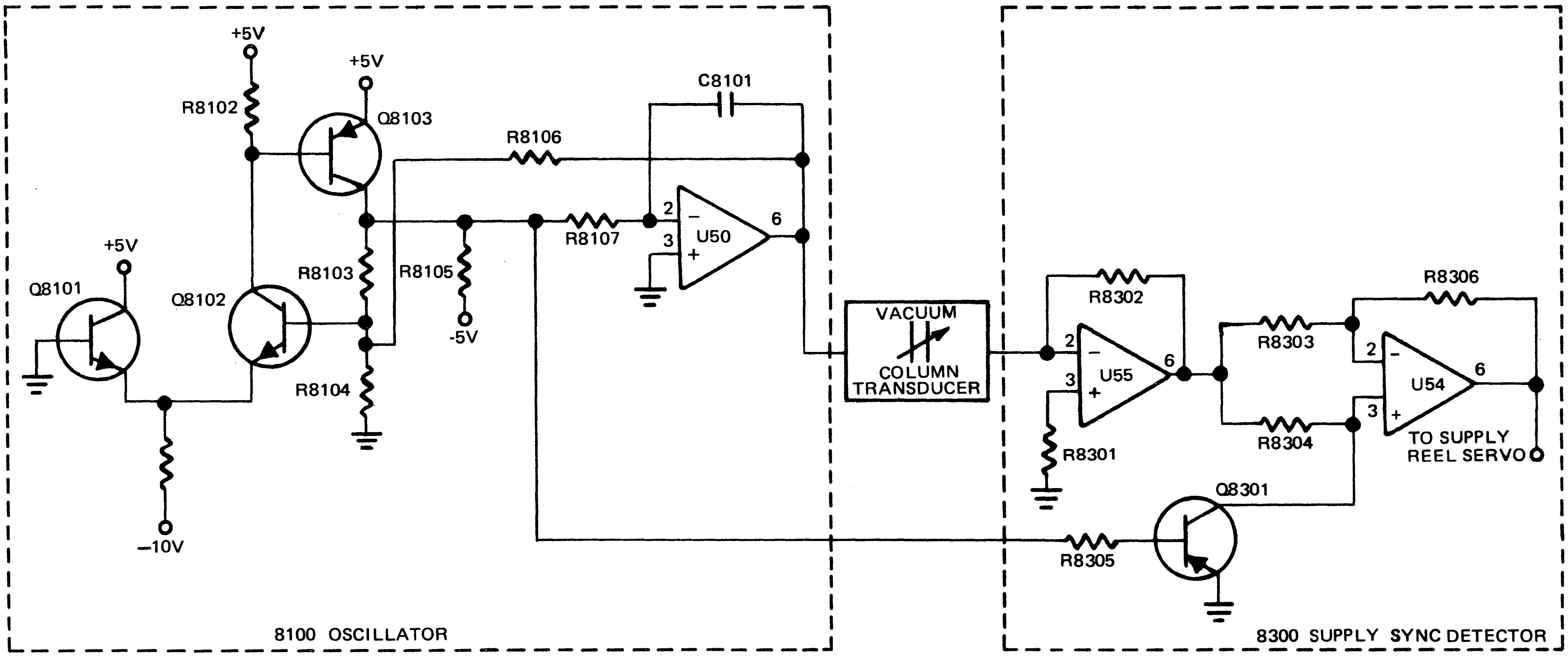


Figure 4-18. Vacuum Column Tape Position Sensor Circuits Simplified Diagram

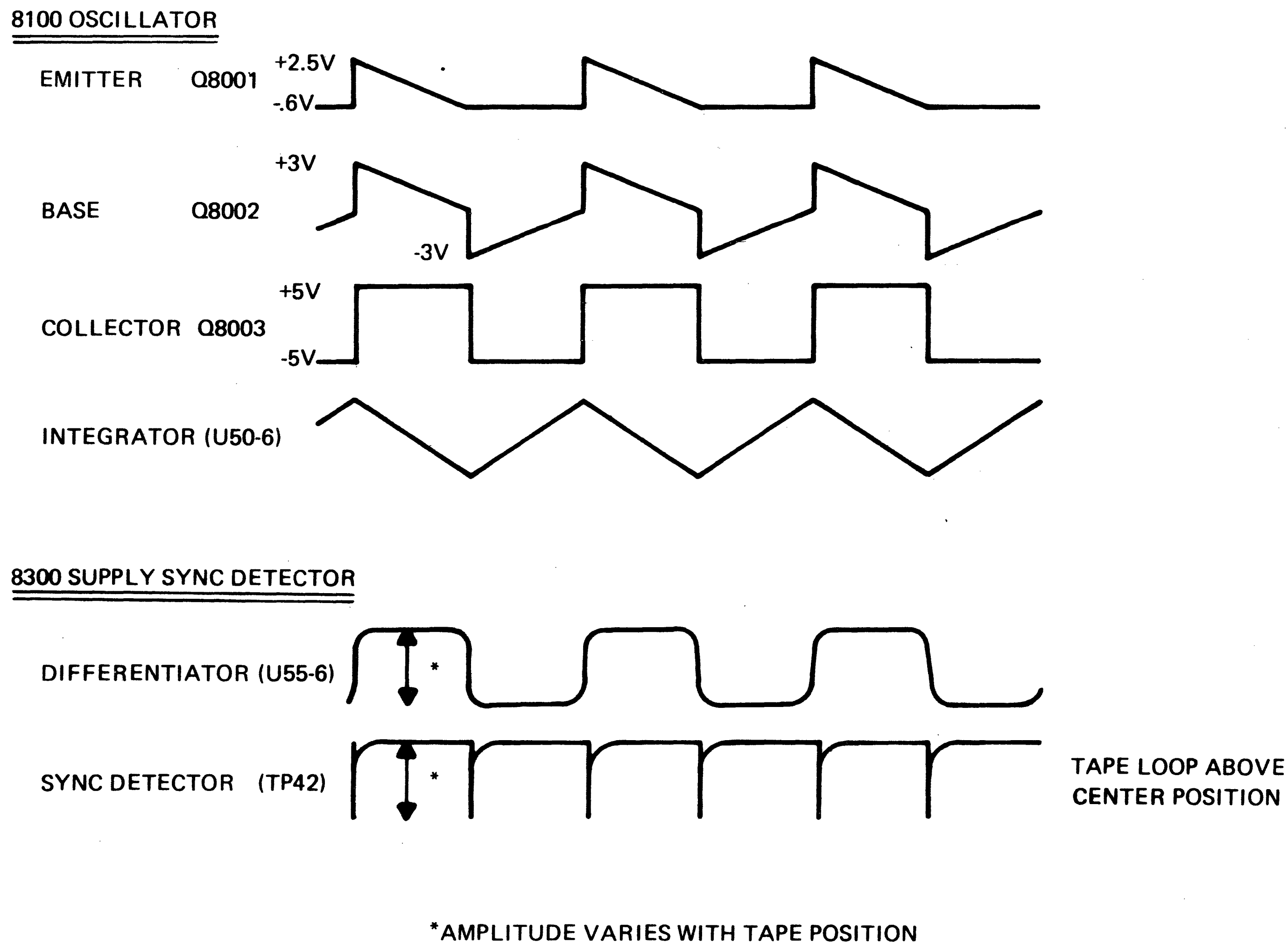


Figure 4-19. Tape Position Sensor Circuit Timing Diagram (2740)

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 unit 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 applies 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 unit gain of U54 supplying a positive voltage level output to the Supply Reel Servo circuit.

4-24 Reel Servo Circuits

The output of the Model 2730 Tension Arm position sensor is connected through R6007 to reel servo amplifier U6047-2. Figure 4-20 is a simplified schematic of the Model 2730 reel servo circuits. The feedback around U6047 is the series connection of R6010 and potentiometer R6011. The closed loop gain U6047 is changed by adjusting potentiometer R6011.

On Model 2740 Vacuum Column tape units, the output of the Sync Detector is connected to U6047-2 through a filter network of R6003, C6001, C6002, and R6007. Figure 4-21 is a simplified schematic of the Model 2740 reel servo circuits. On the Model 2740 tape units, potentiometer R6011 is used to adjust the closed loop gain of U6047. The 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. 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 $\overline{\text{RWDAB}}$ 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 $\overline{\text{RWDAB}}$ 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 volts, CR6005 will be back biased, turning on FET Q6001 and connecting the output of U6047 to R6019. When $\overline{\text{RWDAB}}$ 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 no current flow through R6019, and since U6053-2 is a virtual ground, the cathode of CR6004 is also at 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.

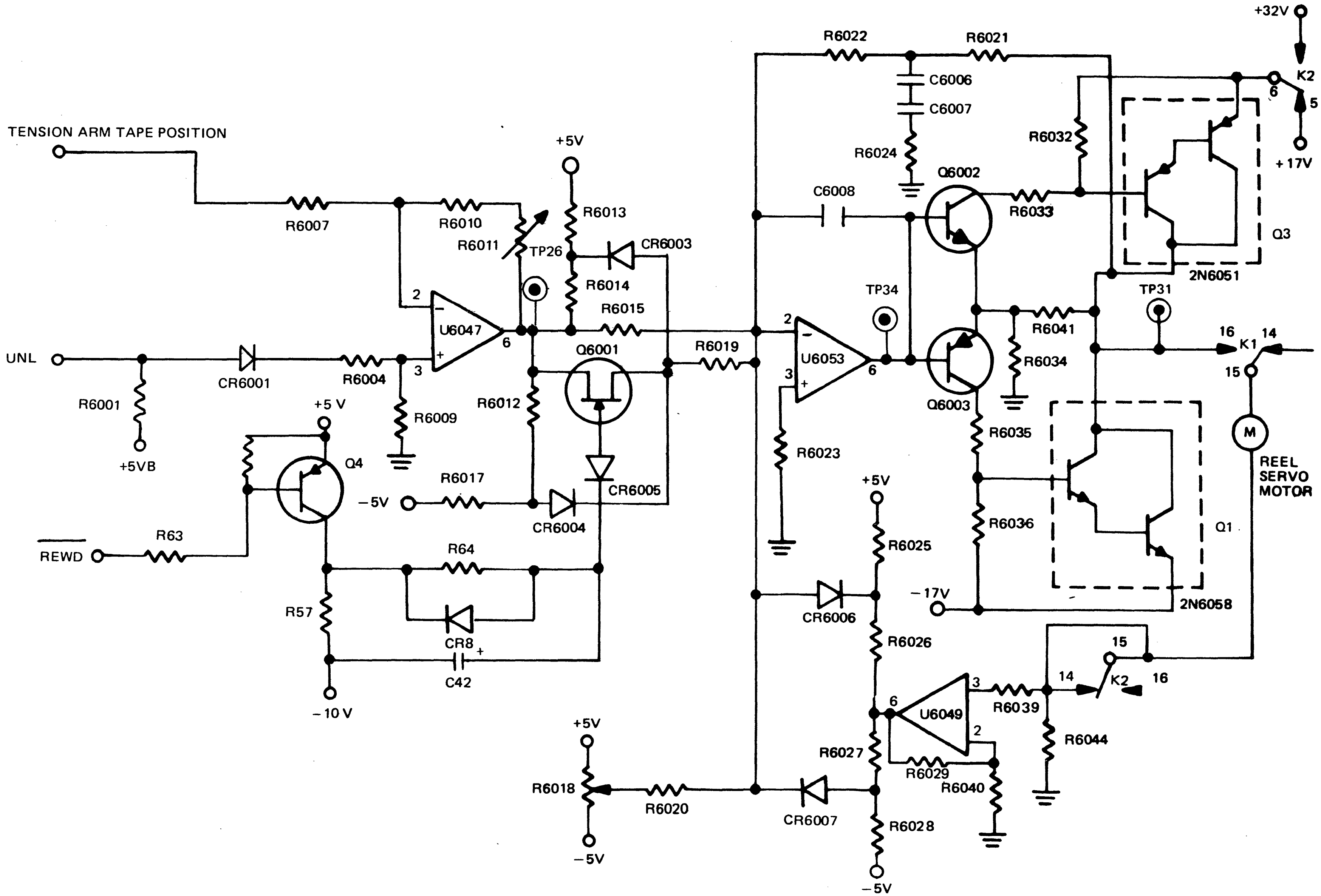


Figure 4-20. Supply Reel Servo Circuits Simplified Diagram. (Model 2730)

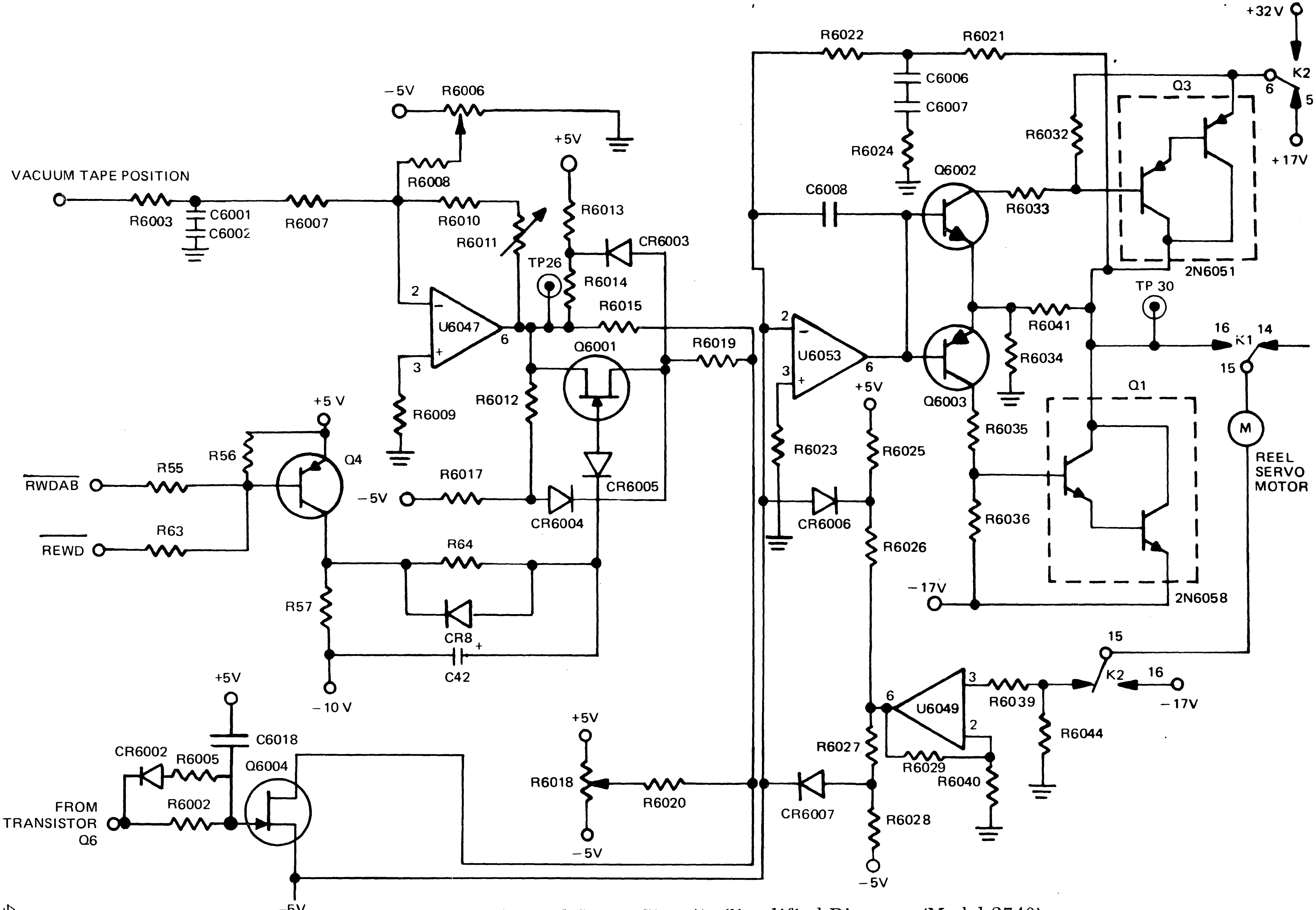


Figure 4-21. Supply Reel Servo Circuits Simplified Diagram (Model 2740)

On Model 2730 tape units, potentiometer R6018 is connected to the input of U6053 through R6020 and the jumper between E6001 and E6002 (figure 4-20). On Model 2740 tape units, R6018 is connected to the input of U6053 through R6020 and FET Q6004 (figure 4-21). Potentiometer R6018 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 on the Model 2740, 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 4-33).

The output of U6053 is connected to the bases of Q6002 and Q6003. If the output of U6053 increases positive 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 8 amps (6 amps for 2730) Closed loop gain of U6049 is set by R6029 and $6040. 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 +2.5 volts, CR6007 becomes forward biased. The cathode of CR6007 is connected to pin 2 of U6053. Consequently, any further increase in the output of U6049 will decrease the output of the power amplifier.

When the tape unit starts to rewind, K2 relay 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 connected to the +21 volt supply. The motor return is normally connected to R6044. However, when K2 is energized the motor return is connected to -17 volts for 2740 Models. 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, the position of the tape is moved away from the center of the operating range. On Model 2730 tape units, the arms are moved toward the tension arm stops so that when the tape is pulled off the arms, the arms have a short distance to fall onto the stops. UNL is set high to unload the tape and is connected to CR6001 in the Supply Reel Servo (Model 2730 only). CR6001 is forward biased so R6004 is also set high. Since R6004 is connected to pin 3 of U6047, the output of U6047 is changed creating an offset voltage.

4-25 CAPSTAN SERVO ELECTRONICS

The Forward/Reverse Ramp Generator and the Rewind Ramp Generator are inputs to the Capstan Amplifier. Figure 4-22 shows a block diagram of the capstan servo circuits. 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.

4-26 Forward/Reverse Ramp Generator

The Forward/Reverse Ramp Generator has five inputs, two reverse and three forward. Figure 4-23 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 voltage 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 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 of 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. Wehn $\overline{\text{FORWARD}}$ 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 to flow through R5015 and R5020 to discharge C5001, therefore, decreasing 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 regualtors since the remote voltage sense for these two power supply regulators comes from the Forward-Reverse Ramp Generator circuits.

For example, if the $\overline{\text{REVERSE}}$ is set low, Q5002 conducts at saturation applying +5 volts through R5010 to U11-3. U11-6 swithces 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 unload operations (Refer to paragraph 4-27).

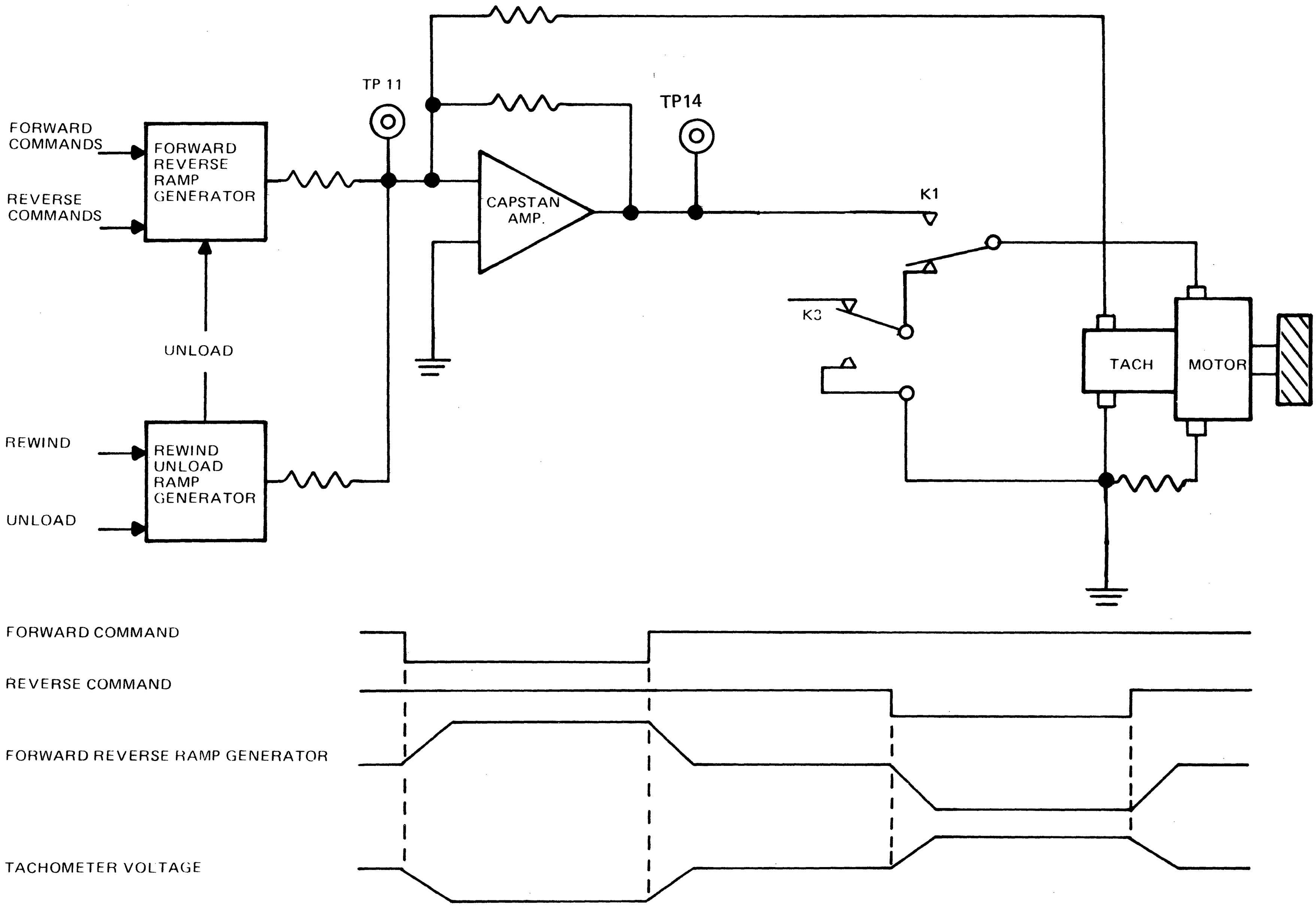


Figure 4-22. Capstan Servo Block Diagram

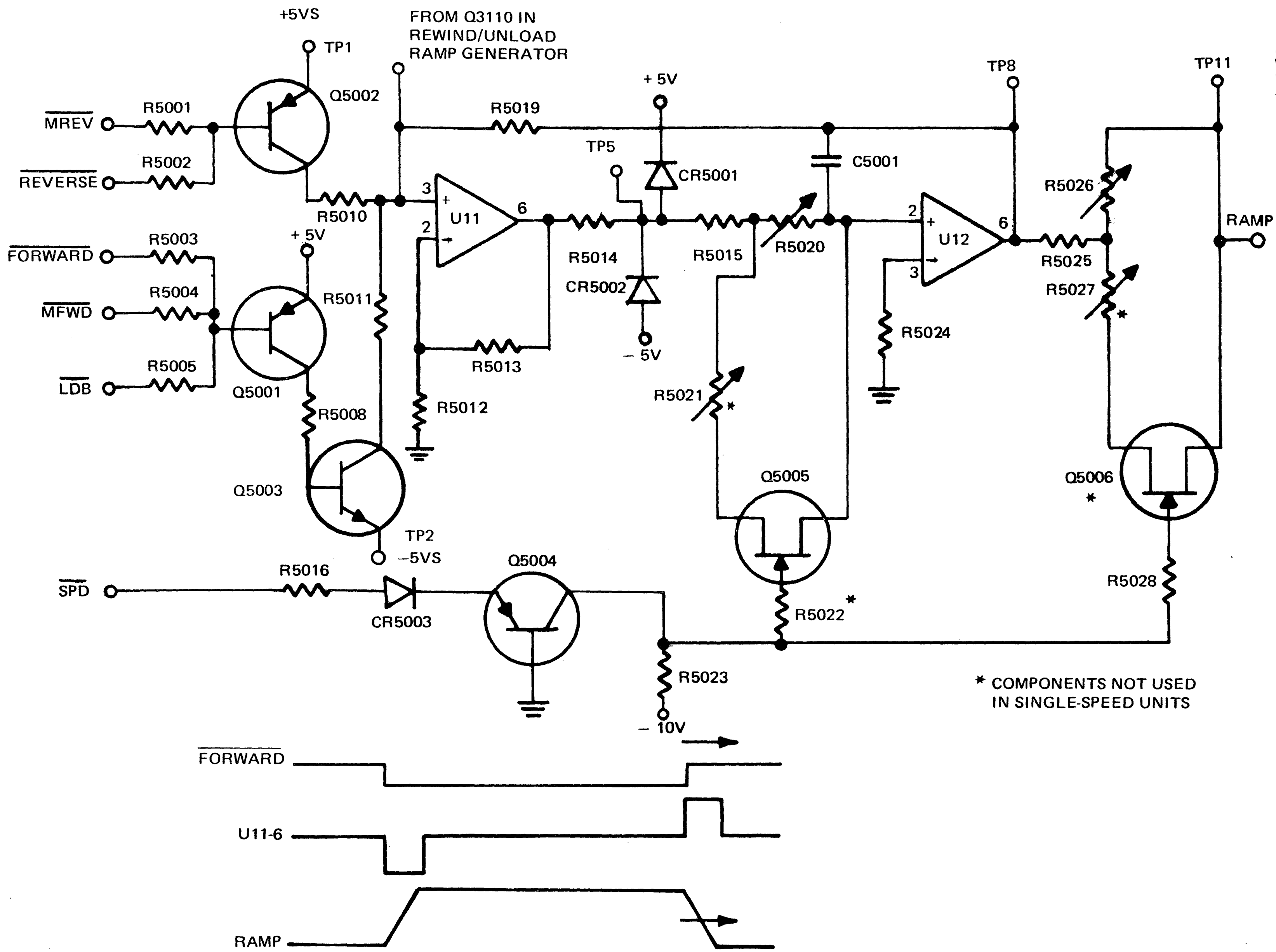


Figure 4-23. Forward/Reverse Ramp Generator Simplified Diagram

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 $\overline{SPD}$ is low, back biasing CR5003. 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, $\overline{SPD}$ is set high, forward biasing CR5003 and causing Q5004 to conduct. R5022 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.

4-27 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 unload operations. Figure 4-24 shows a simplified schematic of the rewind generator, and figure 4-25 shows rewind sequence timing. Inputs to the ramp generator are the rewind signal $\overline{RWRD}$ and unload signal $\overline{UNL}$. These two signals are normally high. Consequently during normal operation Q3002 conduct at saturation and Q3003 and Q3001 are turned off, the REWD is low and $\overline{REWDL}$ is high.

During a rewind operation, a low input from $\overline{RWRD}$ sets the anode of CR3003 low, turning off Q3002 and allowing C3001 and C3002 to charge toward -10 volts causing itto go more negative than U30-11. This causes the output of U30 and REWD to switch high. As C3001 and C3002 charge, the base of Q3003 becomes negative, turning Q3003. As C3001 and C3002 continue to charge $\overline{REWDL}$ swithces low and 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 $\overline{UNL}$ goes low, Q3001 conducts at saturation with the collector at +5 volts. Q3001 then applies +5 volts through 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 $\overline{RWRD}$ is high. Q3002 turns on, forcing C3001 and C3002 to charge toward +5 volts through R3001. The voltages at the base and emitter of Q3003 move toward +5 volts setting $\overline{REWDL}$ high, 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 CR 3004.

4-28 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 4-26. Offset potentiometer R4001 is connected to U20-2 through R4002, The output of U20-6 is set to zero by R4001 compensating for component variations. Feed-

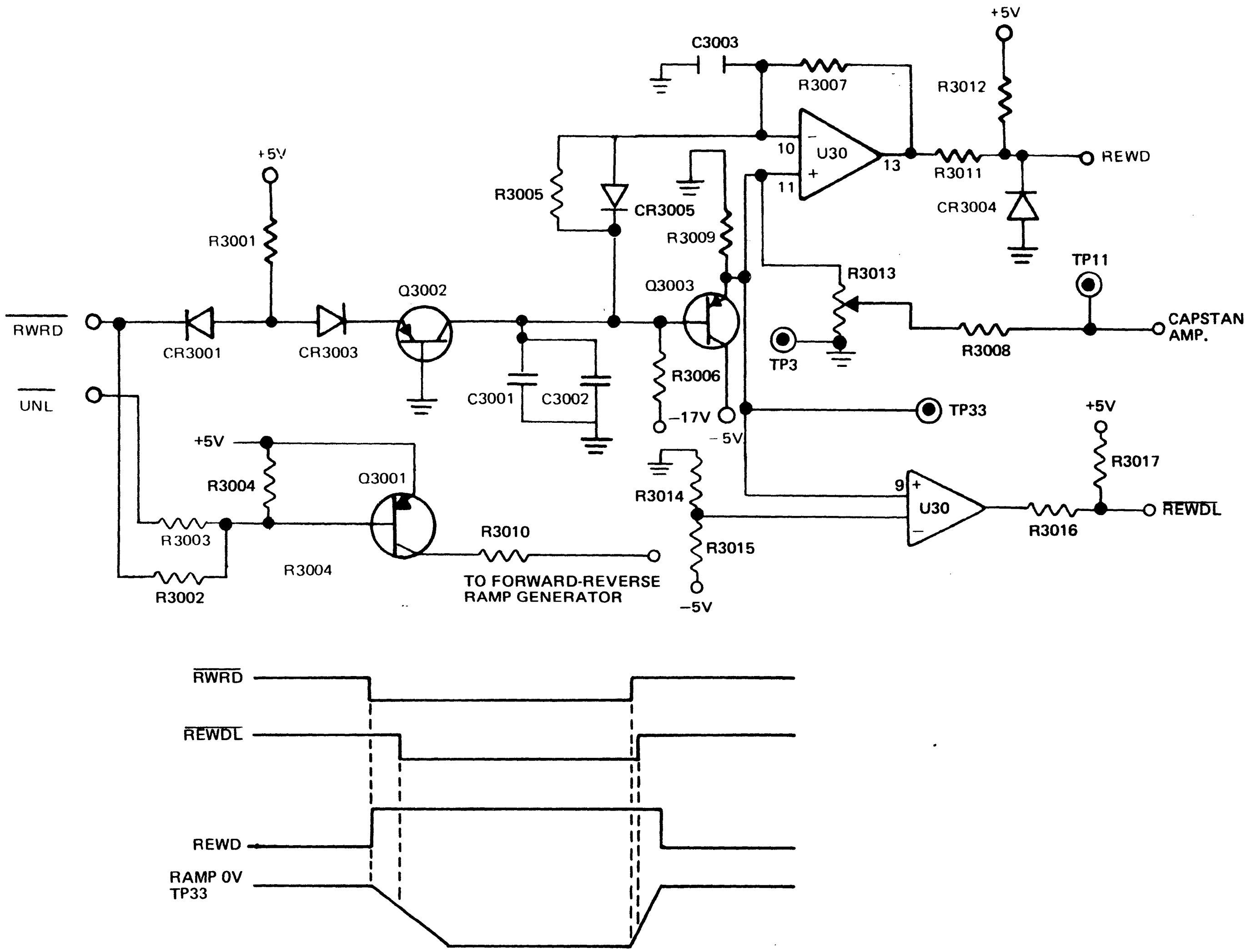


Figure 4-24. Rewind/Unload Ramp Generator Circuit Simplified Diagram

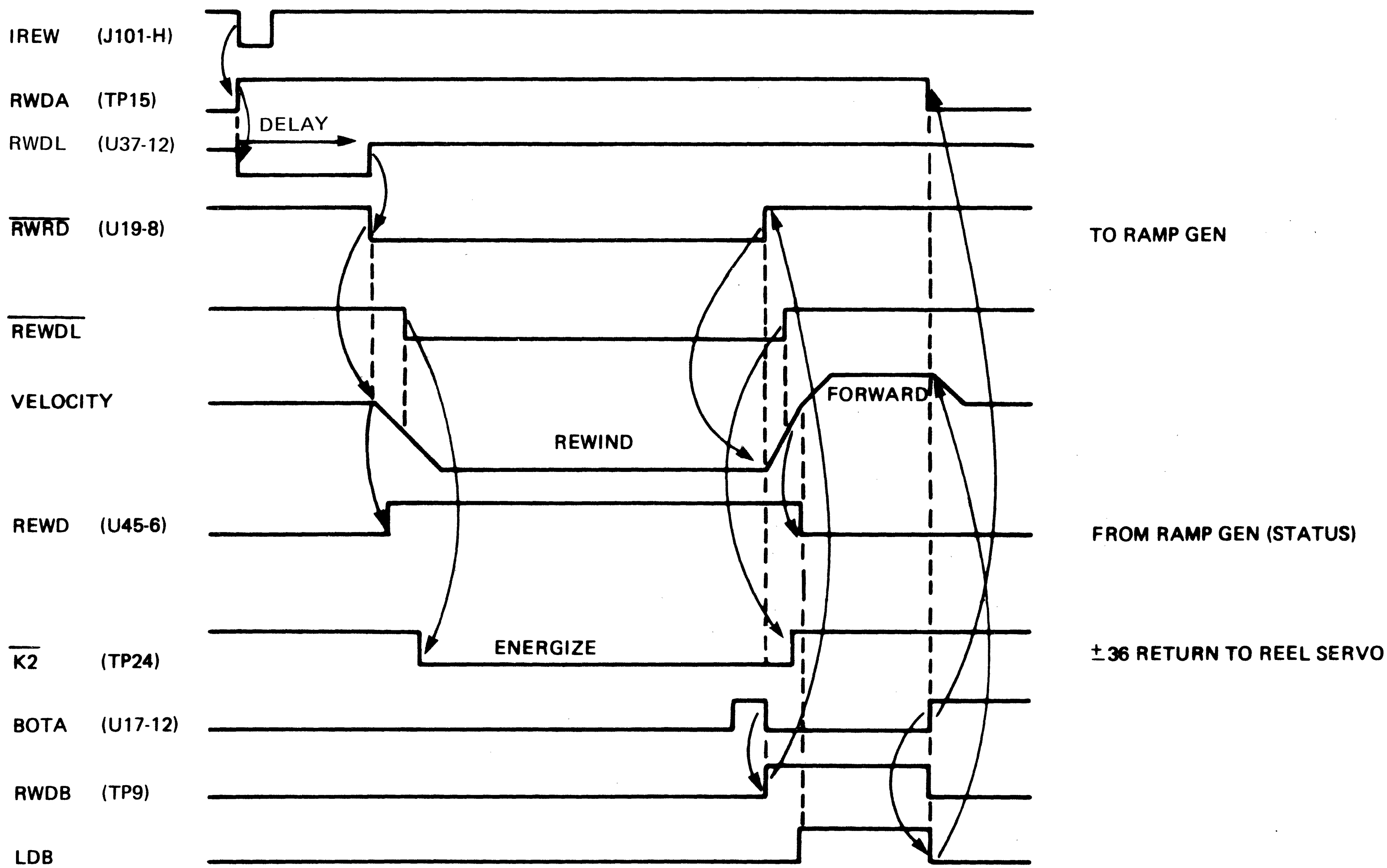


Figure 4-25. Rewind Sequence Timing Diagram

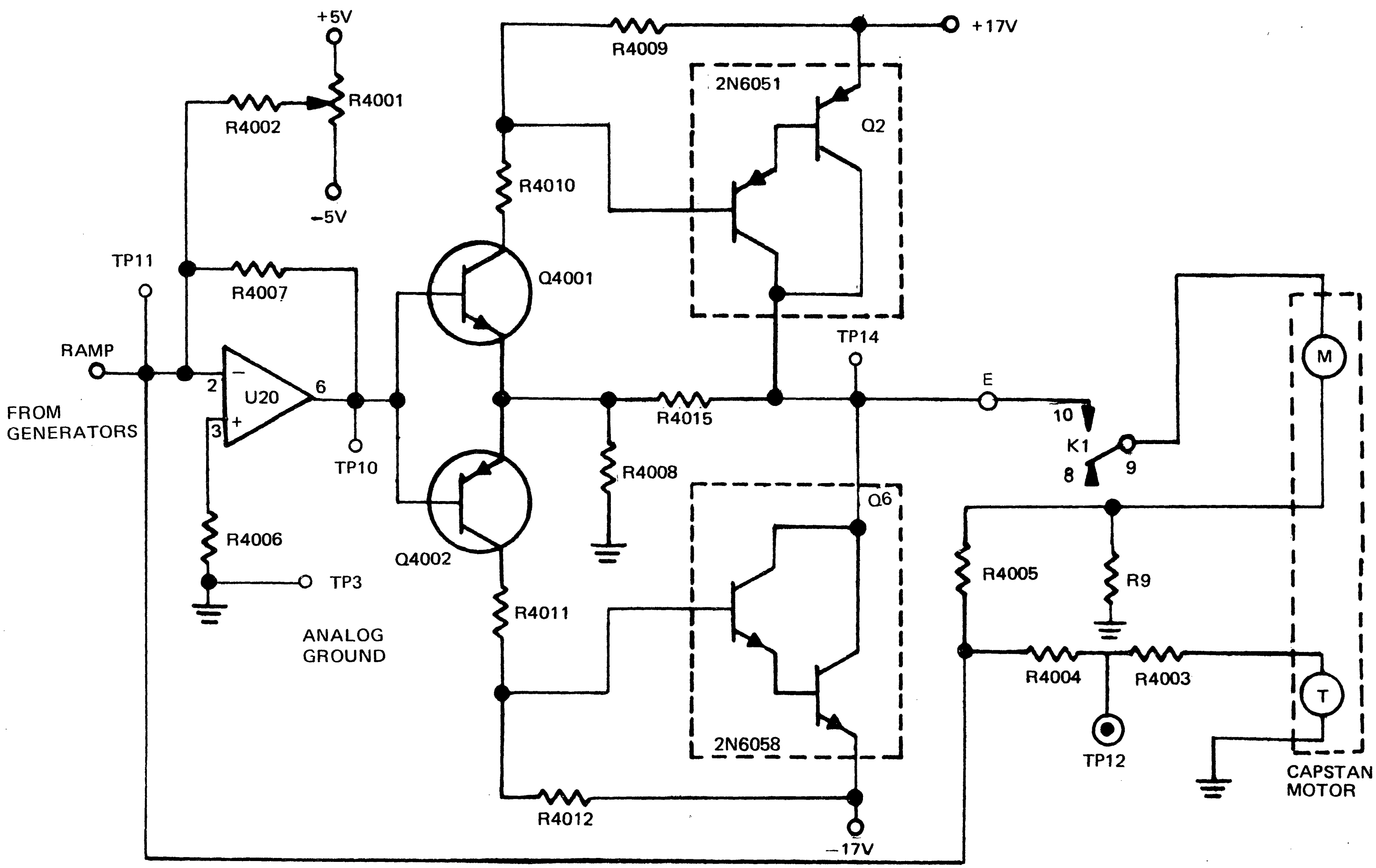


Figure 4-26. Capstan Amplifier Circuit Simplified Diagram

back 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 volts. 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 volts, 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 Cppstan speed.

4-29 ON LINE/OFF LINE LOGIC

Figure 4-27 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 till 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 IREU signal input through J101-L/J102L. When IREU 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.

If the tape unit has been turned off in the middle of a reel of tape, the external controller can activate a tension arm tape unit by asserting the ILOL signal at J101-I/J102-I when power is restored. When using ILOL to bring the unit on line, the ILOL signal is asserted for one second, then not asserted for one second, and then asserted for one microsecond (see figure 4-28). $\overline{\text{LOLSTR}}$ is gated at U35-3 which applies a low to relay driver U45 energizing K1. See figure 4-11. This connects the reel servos to their motors, which tensions the tape and sets $\overline{\text{RSTC}}$ high enabling flip flop U41-5. LOLSTR is gated with $\overline{\text{ONL}}$ at gate U40-3 which sets 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

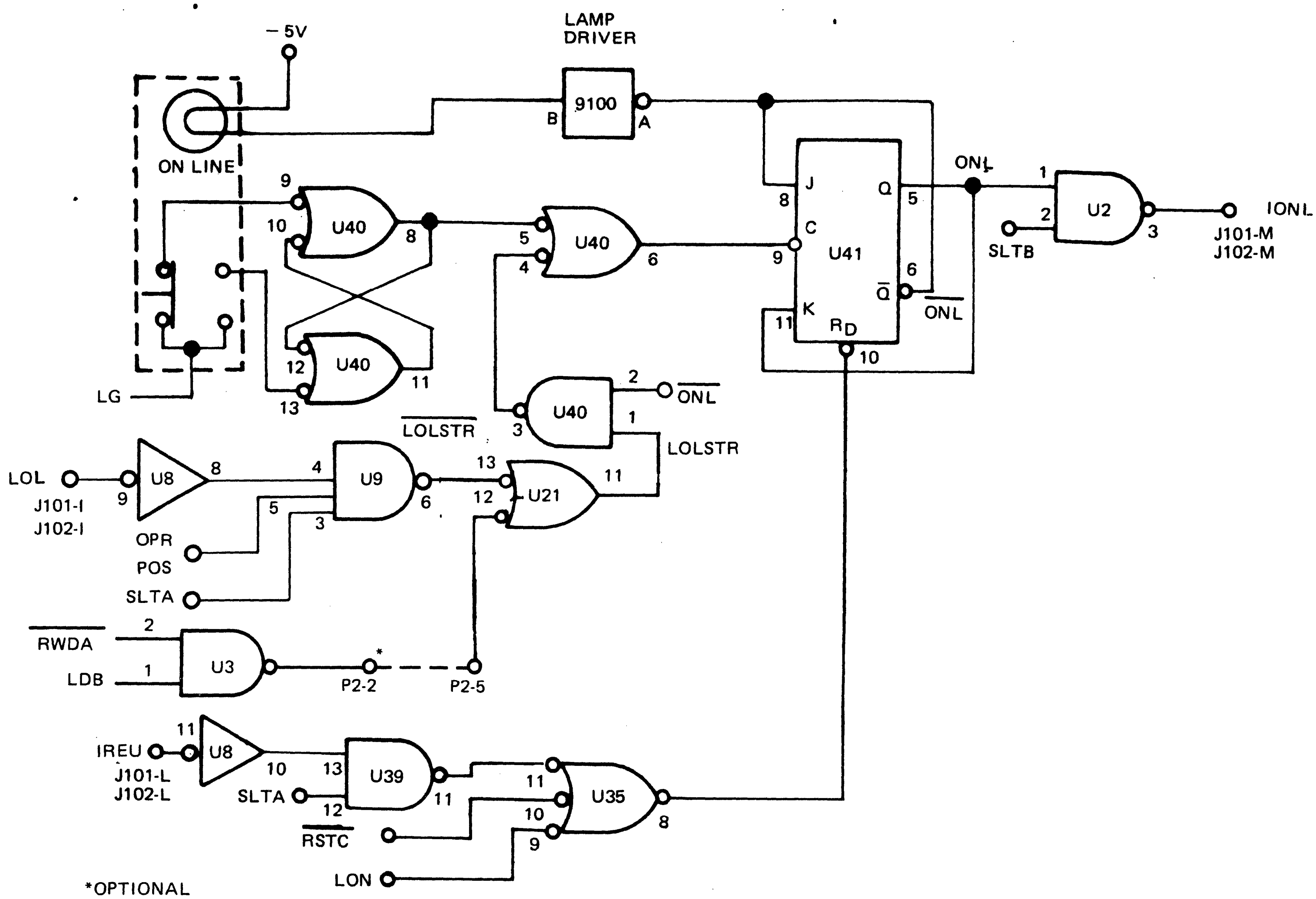


Figure 4-27. On-Line/Off-Line Logic Circuit Simplified Diagram

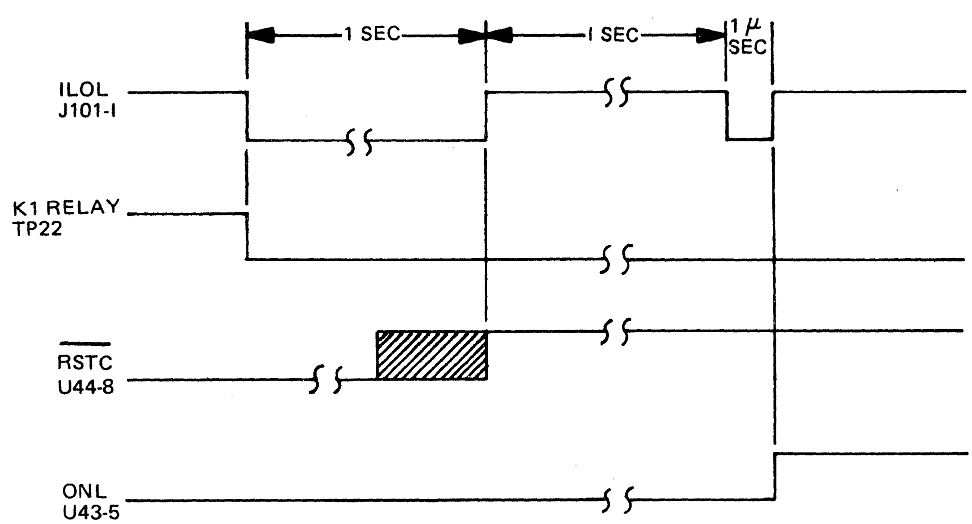


Figure 4-28. Load/On-Line Timing Diagram

setting of the LDB flip-flop also produces a high input at U3-1. Since a rewind operation is not taking place, the 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 U41-5 is not set at this time, the 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 4-18). 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), the IONL signal to the controller is asserted.

When the tape unit is equipped with the front panel disable option, the LG signal at the switch is set high when the tape unit is on line and selected. Otherwise, LG is at ground potential.

4-30 ADDRESS LOGIC

Figure 4-29 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 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 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. 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.

When the tape unit is equipped with the front panel disable option, E44 and E45 are connected. Therefore, when the tape unit is on line and selected, LG is high. Tape units without this option have a jumper between E45 and E46 setting LG to ground.

4-31 FORWARD/REVERSE CONTROL CIRCUITS

Figure 4-30 shows a simplified schematic diagram of the forward/reverse control circuits. When the tape unit is on line, selected, not rewinding or loading, and all interlock conditions are met, 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.

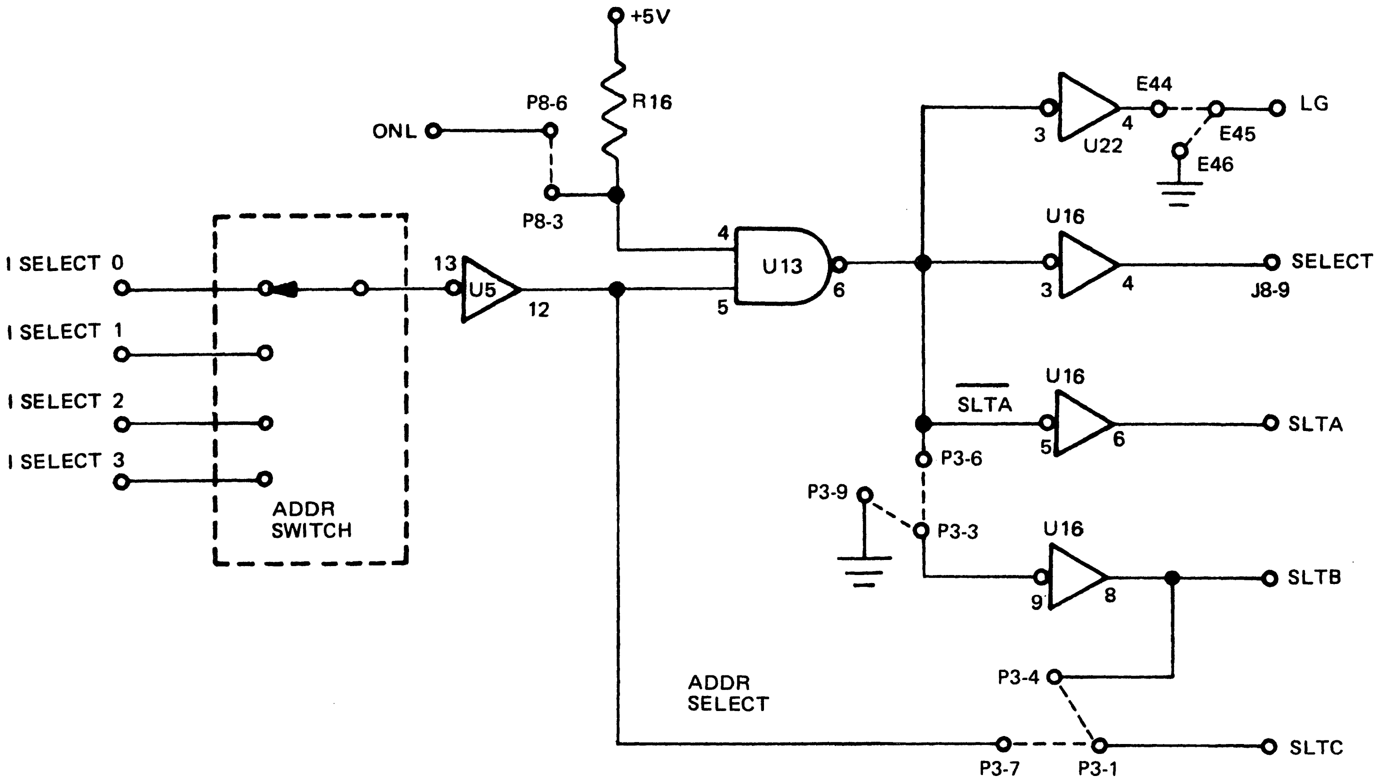


Figure 4-29. Address Logic Circuit Simplified Diagram

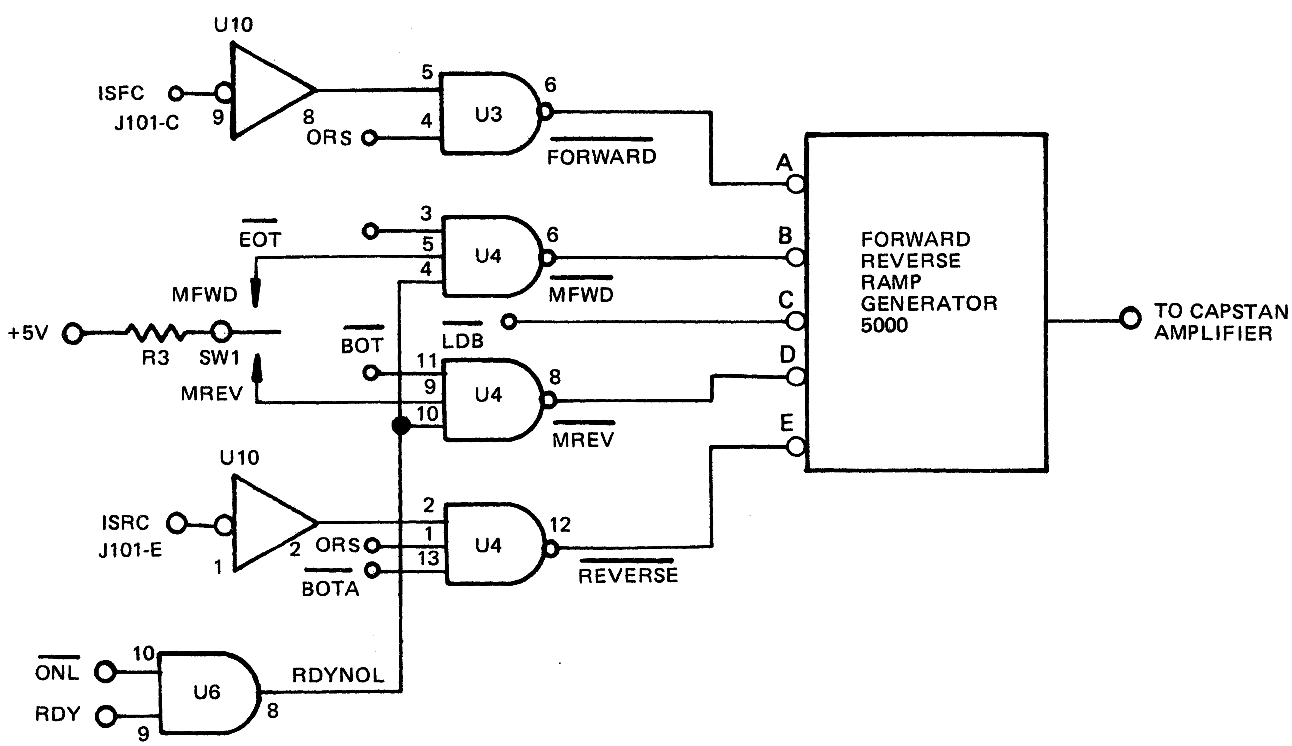


Figure 4-30. Forward/Reverse Control Circuits Simplified Diagram

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.

4-32 WRITE/OVERWRITE CONTROL CIRCUIT

Figure 4-31 shows a simplified schematic diagram of the write/overwrite control circuit and figure 4-32 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 theoutput of U3-8 is high, producing a high 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, U9-12, 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 WRITE ENABLE output at J8-6 to the Data Electronics.

To perform an overwrite operation, the ISFC, ISFC, ISWRT, and IOVW inputs must all be asserted (see figure 4-32). When these signals are asserted, flip-flops U9-3, U9-5, and U14-3 are set. Gate U14-6 is inhibited by the $\overline{\text{Q}}$ output of U9-61 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.

4-33 REWIND/UNLOAD CONTROL CIRCUITS

Figure 4-33 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.

To UNLOAD, for example, the REWIND switch is pressed and then released, and U26-3 produces a positive pulse output. Whenthe tape BOT marker is at the BOT/EOT sensor, and the $\overline{\text{RWDA}}$and $\overline{\text{ONL}}$ are high, U24-12 produces a negative pulse output, setting the $\overline{\text{UNL}}$ 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 EOT/BOT sensor.

The remainder of the tape unload sequence for a Model 2730 Tension Arm Tape Unit is described first in the paragraphs that follow. Following this description, the remainder of the tape unload sequence for a Model 2740 Vacuum Column tape unit is described. Figure 4-34 shows unload sequence timing for the Model 2740.

When the $\overline{\text{UNL}}$ signal at U32-6 goes low on Model 2730 tape units, $\overline{\text{RSTC}}$ and RSTAare kept low and UNL drives relay driver U45 through U35-6 (figure 4-11). Consequently relay K1 is kept energized after the interlock switches have opened. At the same time, the UNL signal at pin B of the Rewind Ramp Generator also goes low and turns on transistor Q3001 (refer to paragraph 4-27). As a result, the capstan motor is driven in the reverse direction.

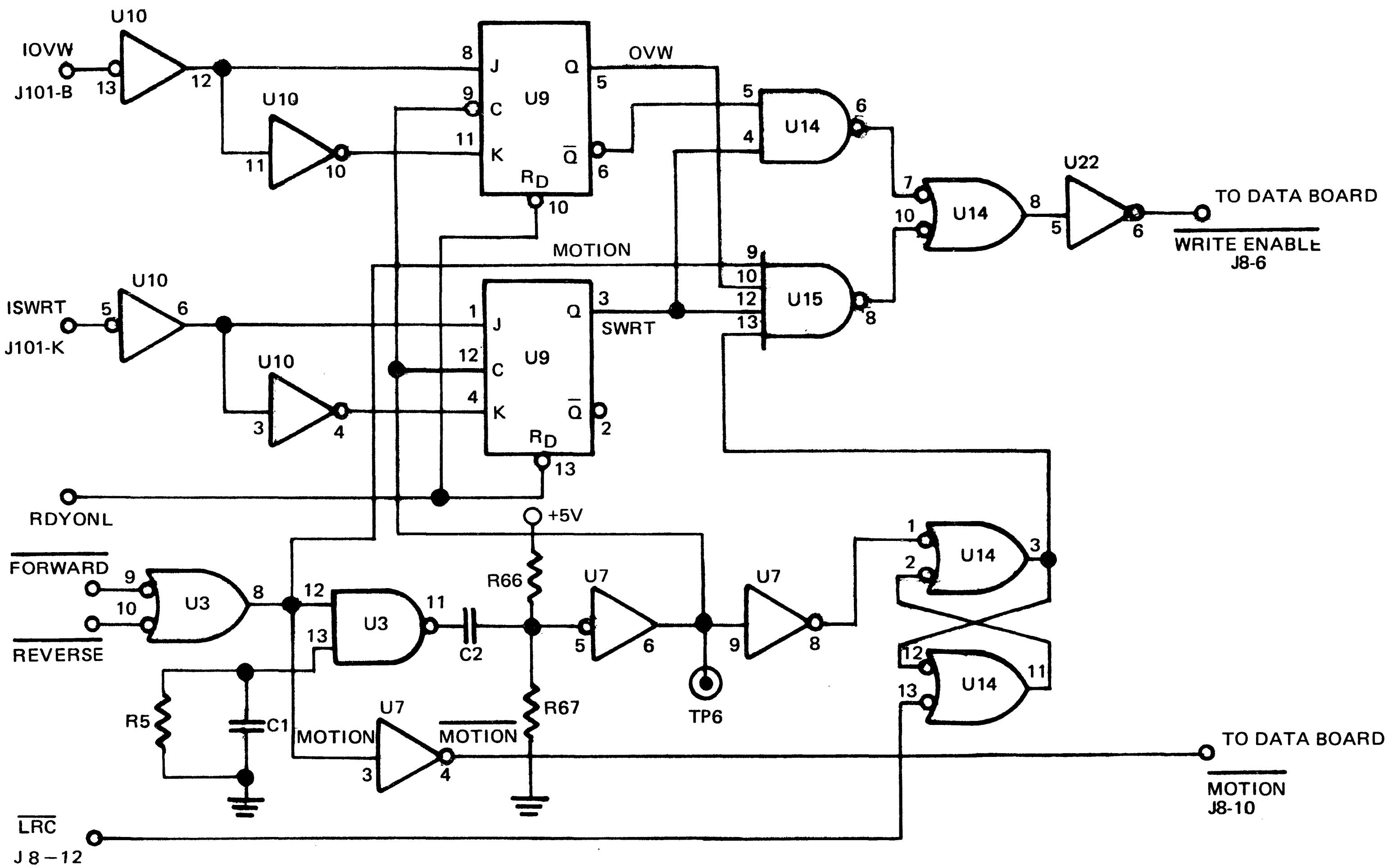


Figure 4-31. Write/Overwrite Control Circuits Simplified Diagram

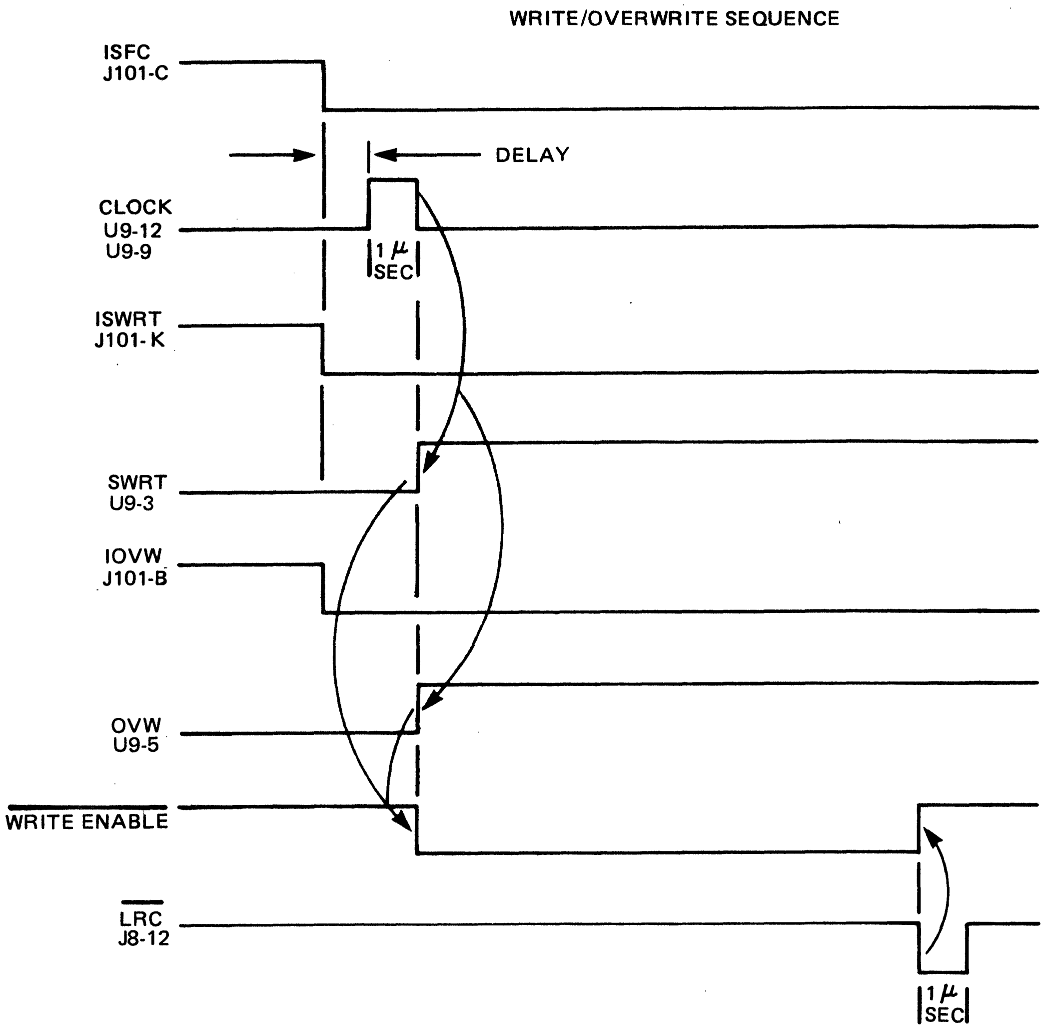


Figure 4-32. Write/Overwrite Timing Diagram

Tape on the takeup reel is pulled off by the capstan and the interlock switches are opened. The supply reel motors keep turning until the tape has been pulled out of the EOT/BOT assembly. At this point, $\overline{\text{TPC}}$ at U35-1 goes low and causes RST at U35-12 to go low. The low RST signal resets $\overline{\text{UNL}}$.

When the $\overline{\text{UNL}}$ signal at U32-6 goes low on Model 2740 tape units, $\overline{\text{RSTC}}$ and $\overline{\text{RSTA}}$ are kept low and the $\overline{\text{UNL}}$ input at U2-10 also goes low. This deenergizes relay K3, turning off the vacuum motor. At the same time, the $\overline{\text{UNL}}$ input at U35-5 goes low (figure 4-13). 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 (refer to paragraph 4-27). As a result, the capstan motor is driven in the reverse direction.

The vacuum drops until 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 supply Reel and Takeup Reel Servos respectively (refer to paragraph 4-24).

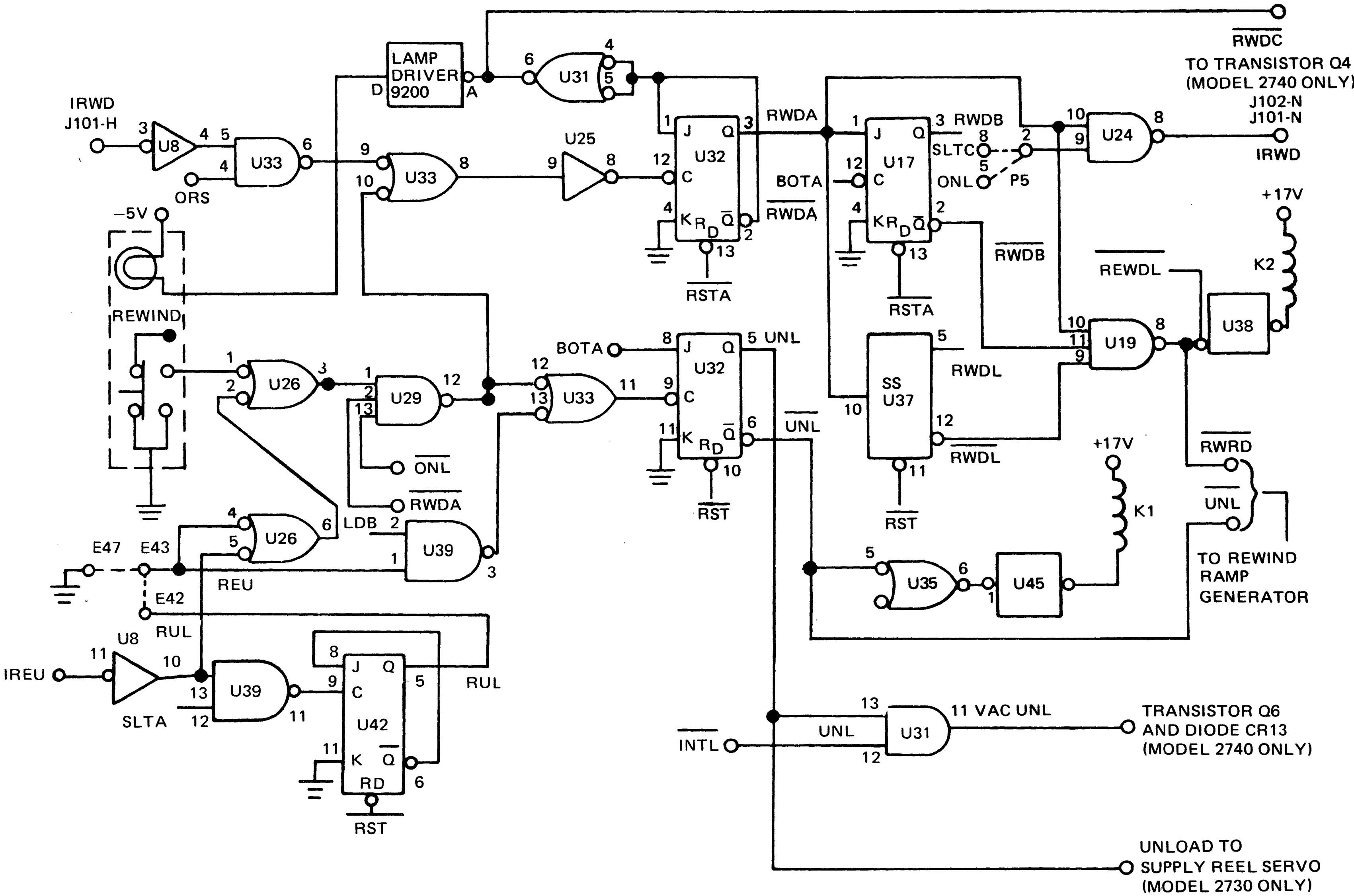


Figure 4-33. Rewind/Unload Control Circuits Simplified Diagram

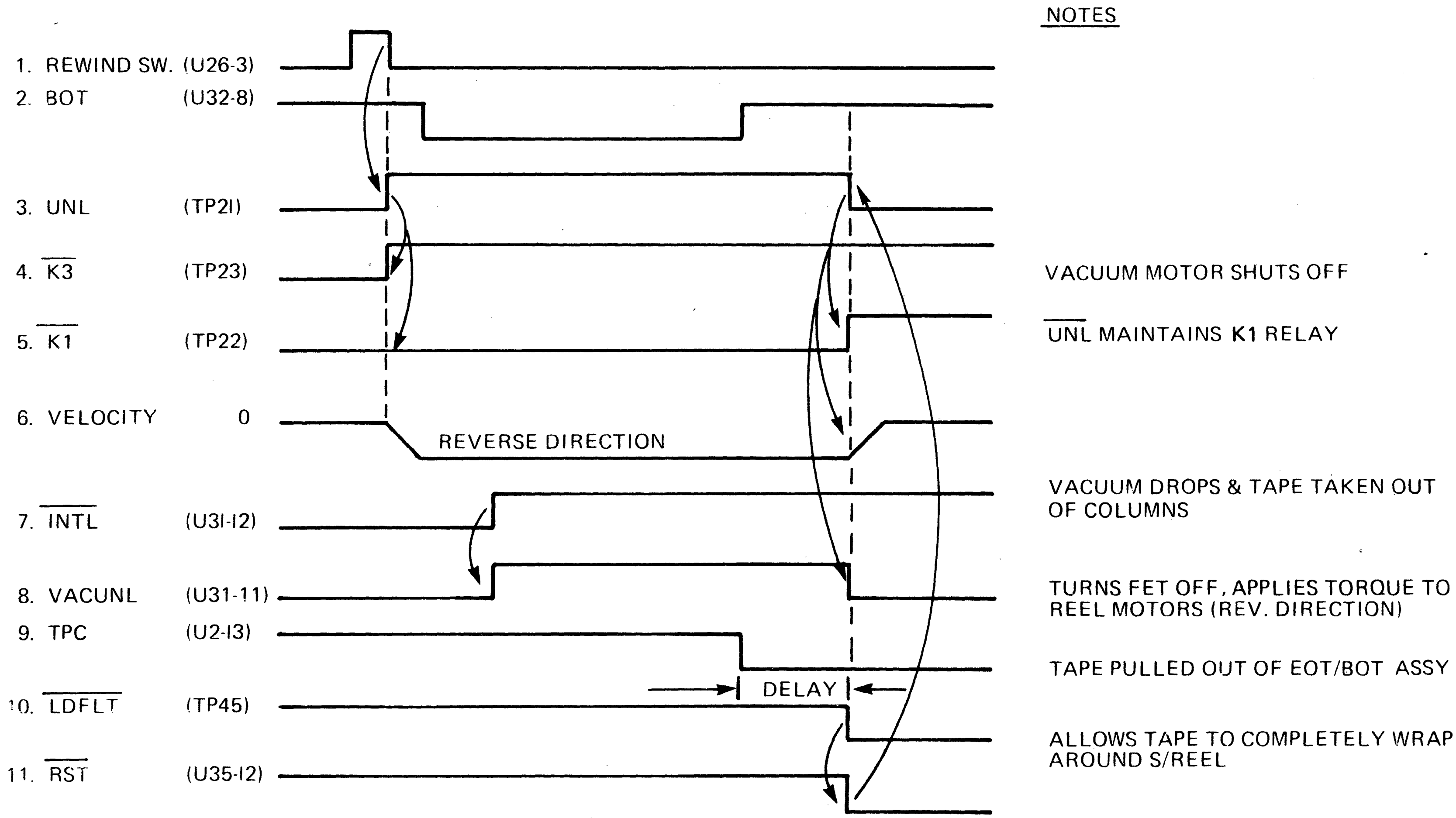


Figure 4-34. Tape Unload Sequence Timing Diagram (Model 2740)

The supply reel motors are kept turning by the VACUNL signal 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 of U2-11 goes high (figure 4-13). This allows capacitor C48 to charge through R74. When the voltage at U1-4 reaches the voltage at U1-5, the output of U1 switches to -10 volts and LDFLT is clamped low at -0.6 volts by CR9. When $\overline{\text{LDFLT}}$ goes low, it causes the $\overline{\text{RST}}$ signal at U35-12 to go low. This resets U32, causing $\overline{\text{UNL}}$ to go low.

The following rewind sequence pertains to both the Model 2730 and the Model 2740 tape units: When the tape is not positioned at the BOT marker and the external controller asserts IREW or IREU, or the REWIND switch is pressed, the tape will rewind at 200 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 high RWDA 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 the Takeup Reel Servos respectively (refer to paragraph 4-24). 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 applies a rewind command to 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 200ips. The low $\overline{\text{RWRD}}$ signal to the Rewind Ramp Generator also causes the REWD signal from the Rewind Ramp Generator to go high and the $\overline{\text{REWDL}}$ signal to go low turning on relay driver U38. When relay K2 is energized, ±32 volts is applied to the reel servos instead of ±17 volts. Relay K2 also changes the motor return voltage (2740 only). The higher voltage enables the reel servos to be driven at the increased tape speed.

When the tape passes the BOT marker, RWDB is set high by the BOTA pulse at U17-3. This causes the $\overline{\text{RWRD}}$ signal at U19-8 to go low. REWDL goes high and the rewind relay is de-energized. The Rewind Ramp Generator will ramp down until the capstan has stopped. REWD signal goes low when the capstan is stopped. Since the RWDB signal is high, when the REWD signal goes low at U28-13, flip-flop U27 (LDB) is set through NOR gate pin U28-8. The low LDB signal at U27-6 is applied to the Forward-Reverse Ramp Generator and causes the capstanbto be moved forward until the BOT marker is detected. When the BOT marker is detected, the $\overline{\text{RSTB}}$ goes low causing 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 load sequence previously described will be performed by the tape unit. If IREV was asserted setting the tape unit into a rewind operation, RUL at U42-5 is set. RUL applies a high at U39-1 and when LDB is set then resets, flip-flop U32-5 (UNL) is set and a tape unload sequence is initiated.

4-34 EOT/BOT CONTROL LOGIC

Figure 4-35 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 tape marker. The output of the EOT/BOT circuits are passed through appropriate interface circuits to the external controller.

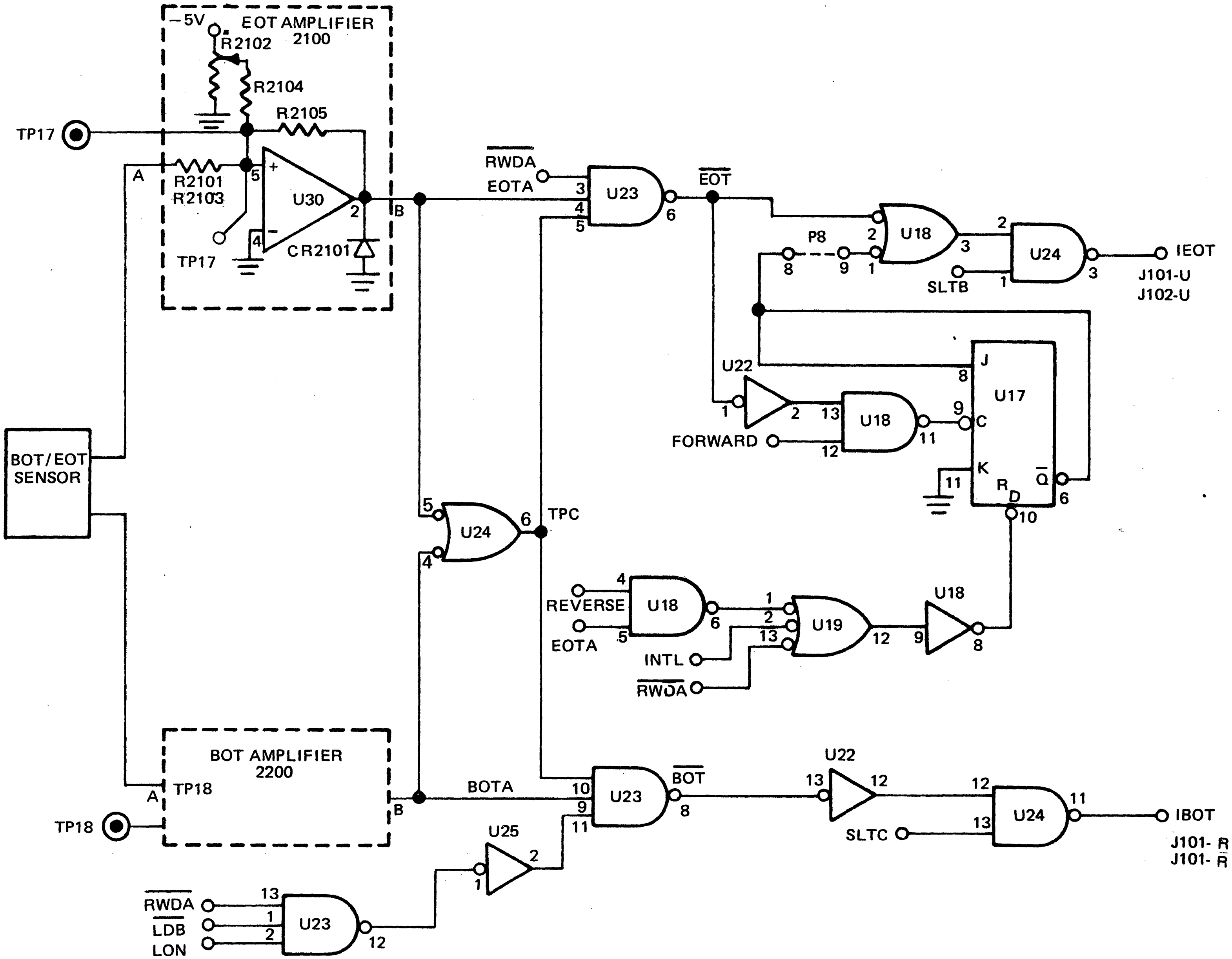


Figure 4-35. EOT/BOT Control Logic Circuit Simplified Diagram

The output of both the EOT and BOT amplifiers are 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.

Initially the current through R21-4 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 volts by CR 2101. The phototransistor receives an invrease of light from the EOT reflective marker creating an increase of current through R2101 and R2103. The increase in current caused by the EOT markercreates 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, a reflector post in front of the assembly reflects the light setting both EOT and BOT amplifiers high. Two highs at U24-4 and 5 set TPC at U24-6 low, gating 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 command is asserted at U18-12. If the jumper between pins P8-8 and 9 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, RWDA, LDB and LON from U23-12 at U23-11. IBOT at J101-R/J102-R is not asserted if the transport is loading, rewinding or the tape is not on the tape path.

4-35 DENSITY SELECT CIRCUITS

Figure 4-36 shows a simplified diagram of the density select cirucits. When the density select option is selected, pins P8-1 and 4, or pins P8-2 and 5 are connected. Therefore, when either input at U13-12 or 13 goes low, the output U13-11 goes high. As a result, the HI DEN lamp is illuminated and the $\overline{\text{HI DEN}}$ 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 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 front panel disable option is used, LG is set high when the tape unit is on line and selected. When LG is high, flip-flop U34-8 cannot change state.

4-36 9-TRACK CIRCUIT

Figure 4-37 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 P1-4 are connected. When the 9-TRACK switch is pressed, U39-3 goes low at pin A of lamp driver 9500 and at inverter U16-1. This causes the 9-TRACK swithc 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

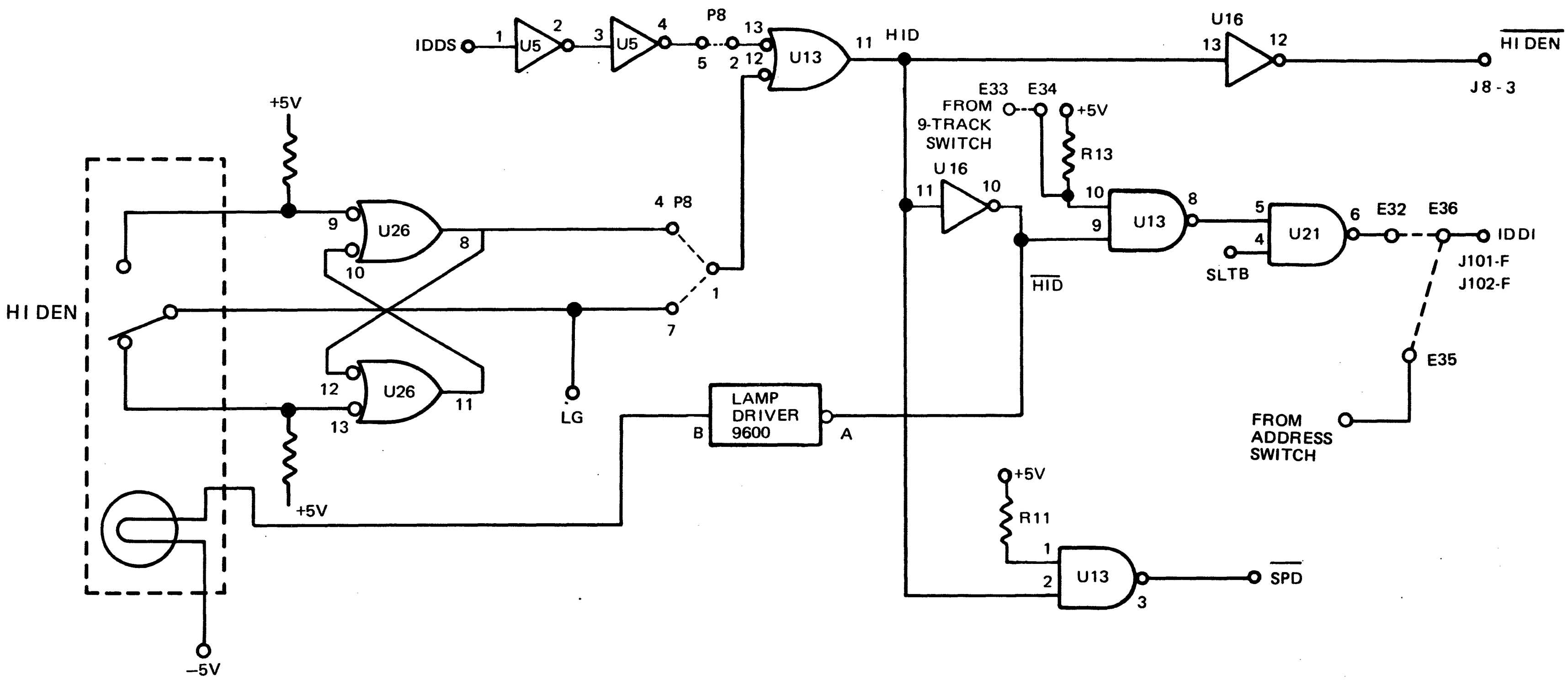


Figure 4-36. Density Select Circuits Simplified Diagram

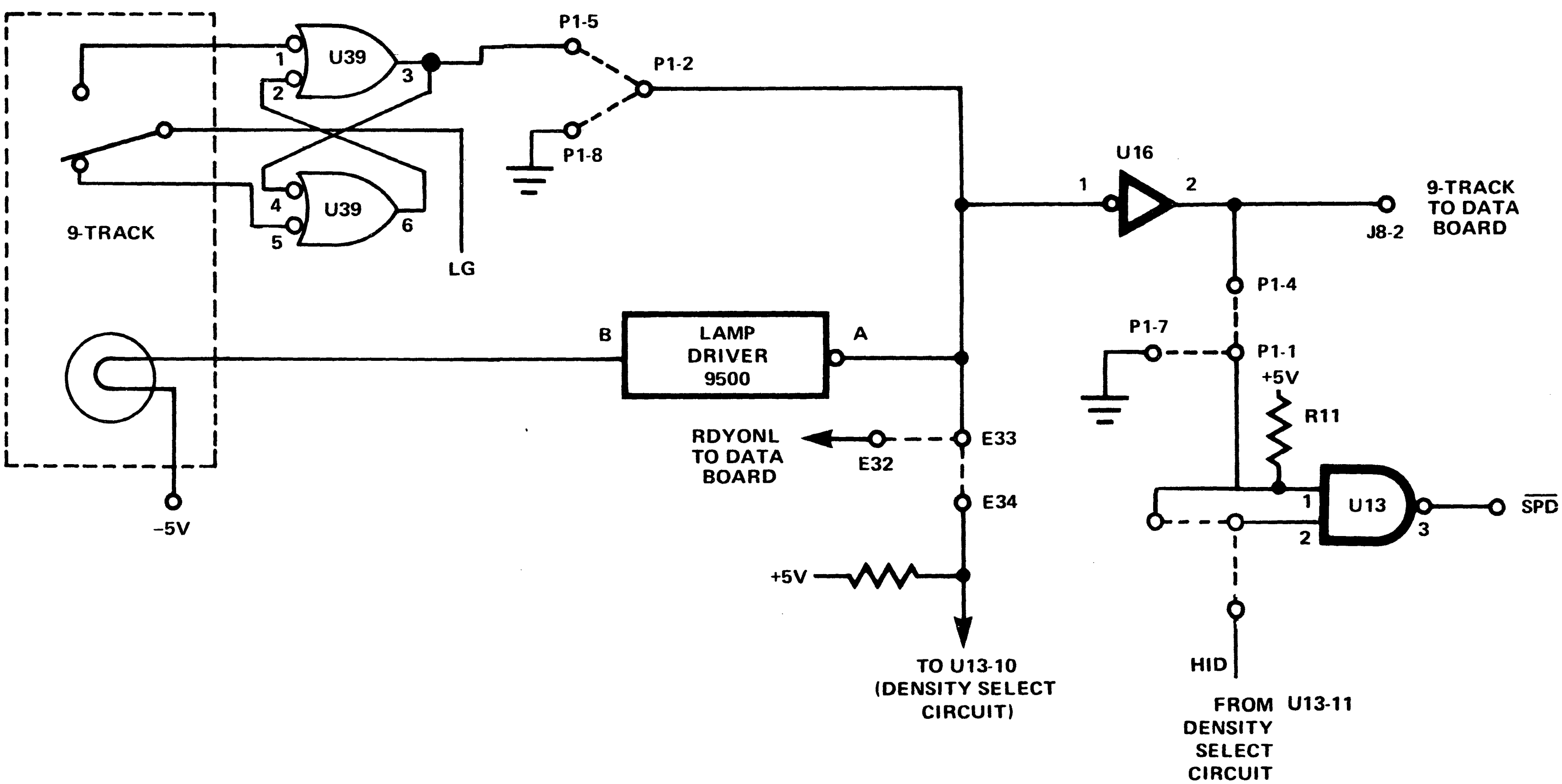


Figure 4-37. 9-Track Circuit Simplified Diagram

U13-10 in the density select circuit. This holds the IDDI signal to the controller low in 9-track operation (indicating high density). The $\overline{\text{SPD}}$ 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.

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 SPD signal 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 SPD singal to be held high. The RYDYONL signal is used on read only tape units. This signal is jumpered through pins E32 and E33 to the 9-TRACK switch. When the Front Panel Disable option is used, LG goes high when the tape unit is on line and selected. When LG is high, flip-flop U39-3 cannot charge status.

4-37 FILE PROTECT CIRCUIT

The file protect circuit (figure 4-38) 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 indicated 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.

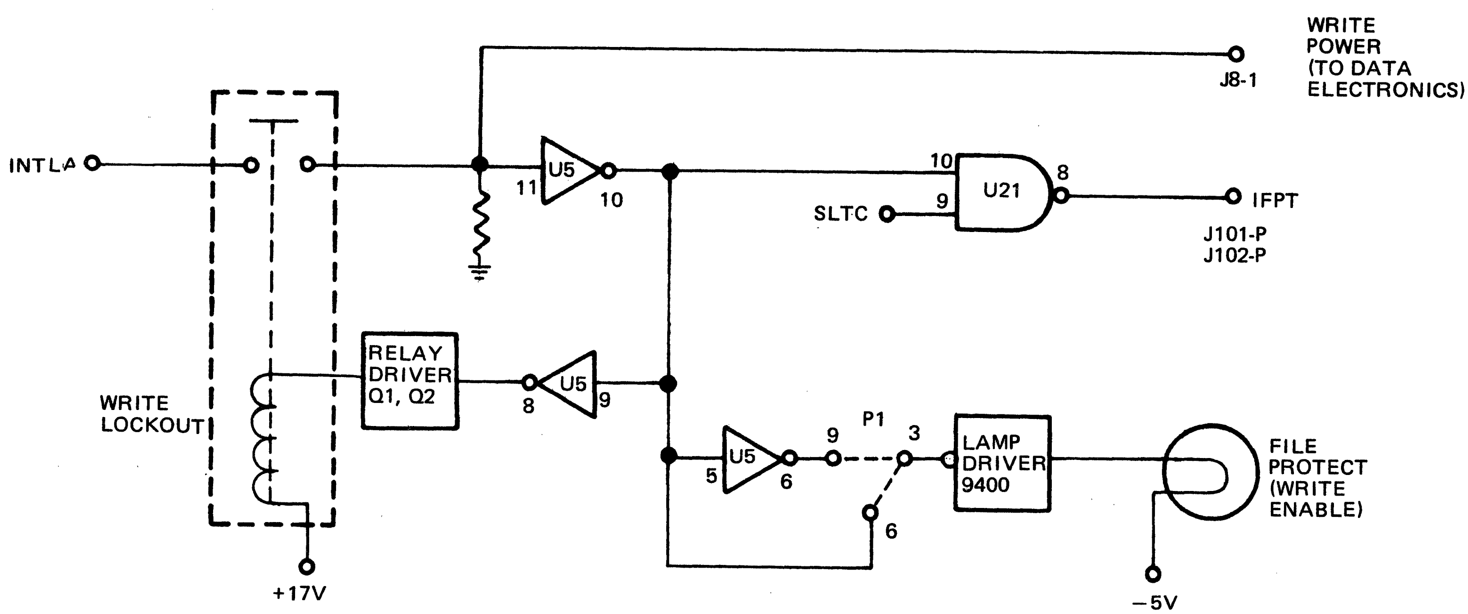


Figure 4-38. File Protect Circuit Simplified Diagram

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.

4-38 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.

4-39 NRZI DATA BOARD OPERATION

The NRZI Data Board contains nine circuits, one for each of the data tracks. For a seven-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 and the read operation are described in the following paragraphs. Since the circuits for the different tracks are identical, only one will be described. Figure 4-39 shows a simplified logic diagram of the NRZI write circuits and figure 4-40 shows write data timing. Figure 4-41 shows a simplified diagram of the NRZI read circuits and figure 4-42 shows read data timing.

4-40 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 one is present on the interface. Refer to figures 4-39 and 4-40. The low transition through C101 turns off Q101 setting U29-10 low keeping U32-10 low through jumper 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 gap head, U32-10 is connected directly to U33-13 through jumper 102 to 104. Another DATA READY and logic one 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 WRT ENABLE signals. If 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 between 13 and 14 is installed when the High Density (HI DEN) signal controls the operations of the NRZI Data Board when it is used with a PE Data Board. A jumper is installed between 17 and 18 for 9-track, and between 17 and 19 for 7-track, NRZI Data Boards when the 9-TRACK signal controls the Data Boards on a quad-density (three data board) tape unit.

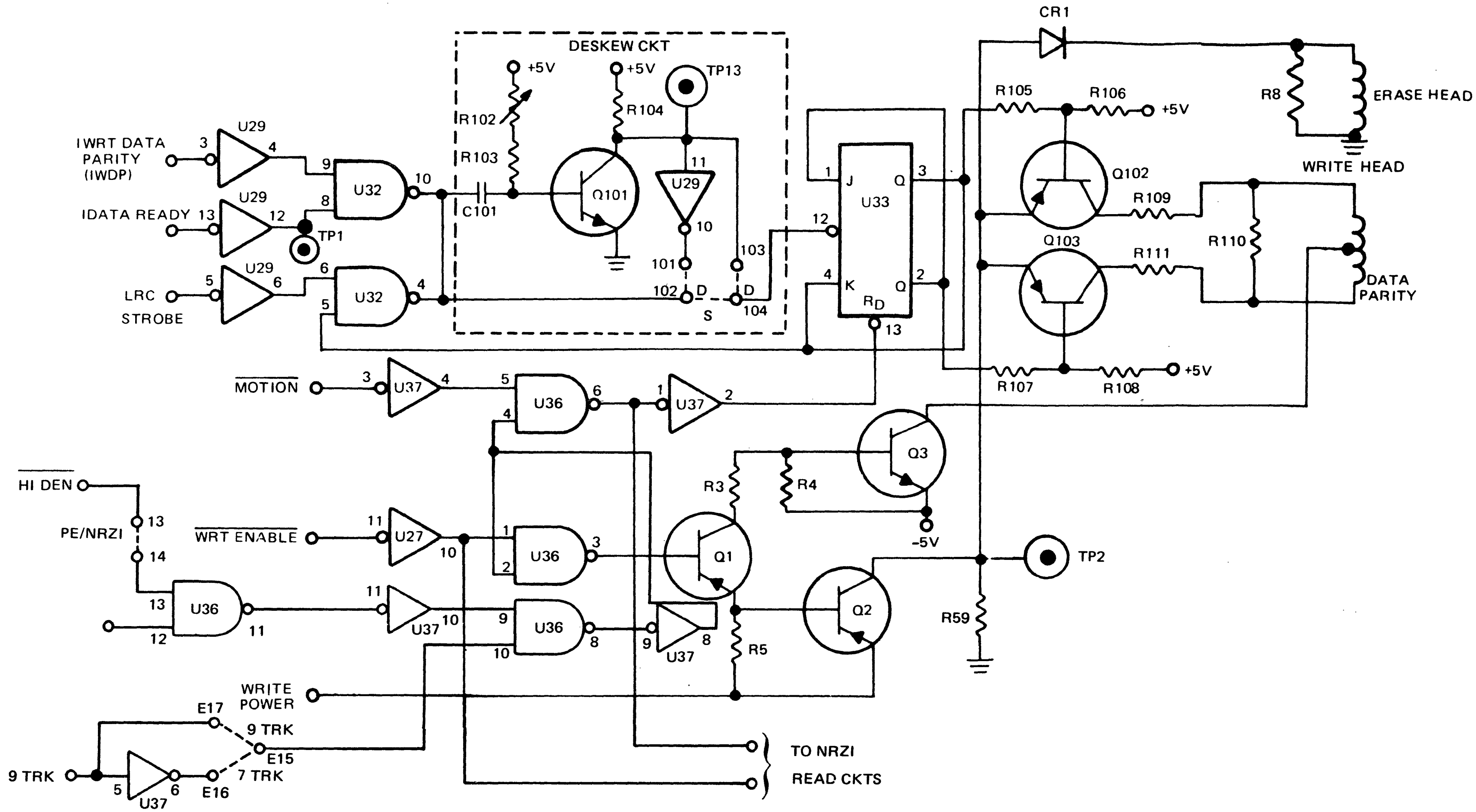


Figure 4-39. NRZI Data Board Write Circuits Simplified Diagram

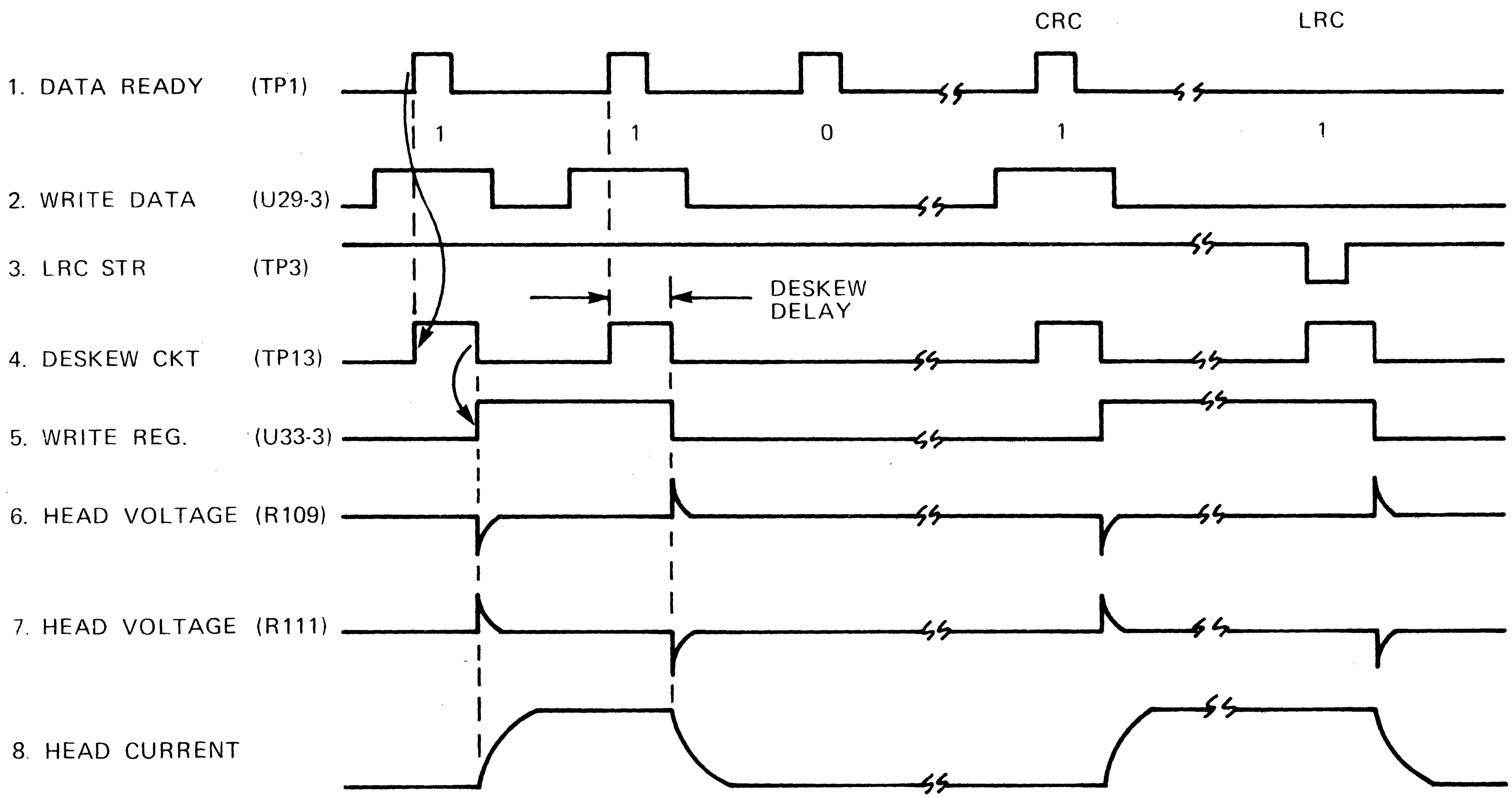


Figure 4-40. NRZI Write Data Timing Diagram

4-41 NRZI Read Circuits

Read head signals ranging from 5 to 35 millivolts are amplified by U103. Refer to figures 4-41 and 4-42. The gain of U103 is determined by series connection of R115, R118 and potentiometer R117. For a single gap head, a jumper from J3 to J4 is included as well as diodes CR101, CR102, CR103, and CR104. Refer to the attached drawing package.

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, READ THRESHOLD 1 is) volts and 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 U26-12 high and turning off Q4 and A5. Since R15 has a higher resistance than the parallel combination of R13 and R15, the read threshold is set lower, at approximately 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 DATA 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 U308 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 second. When U3-14 switches high U28-3 goes low until U3-13 goes high. This 1 second pulse is gated at U31-1 with MOTION to create the READ DATA STROBE.

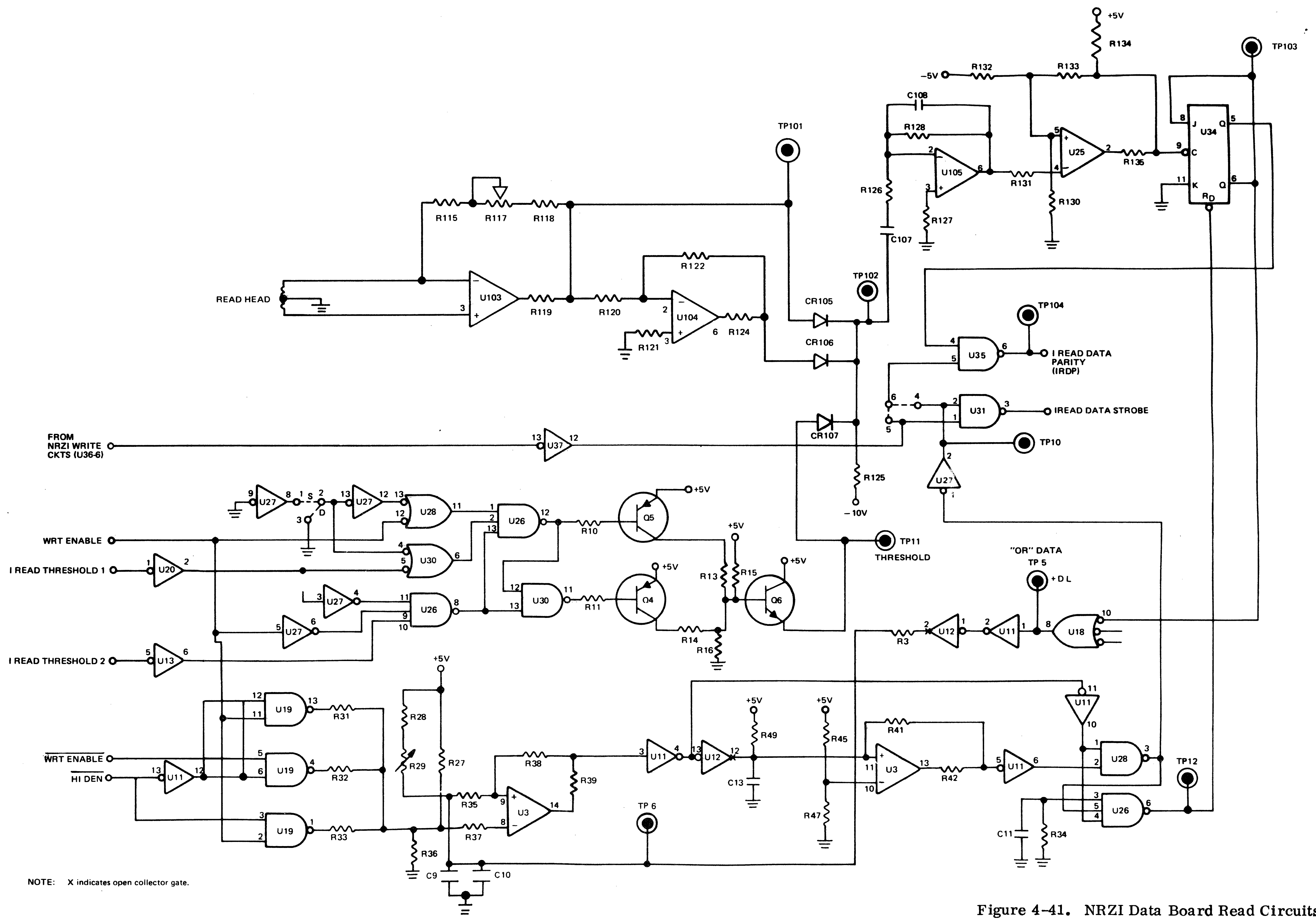


Figure 4-41. NRZI Data Board Read Circuits Simplified Diagram

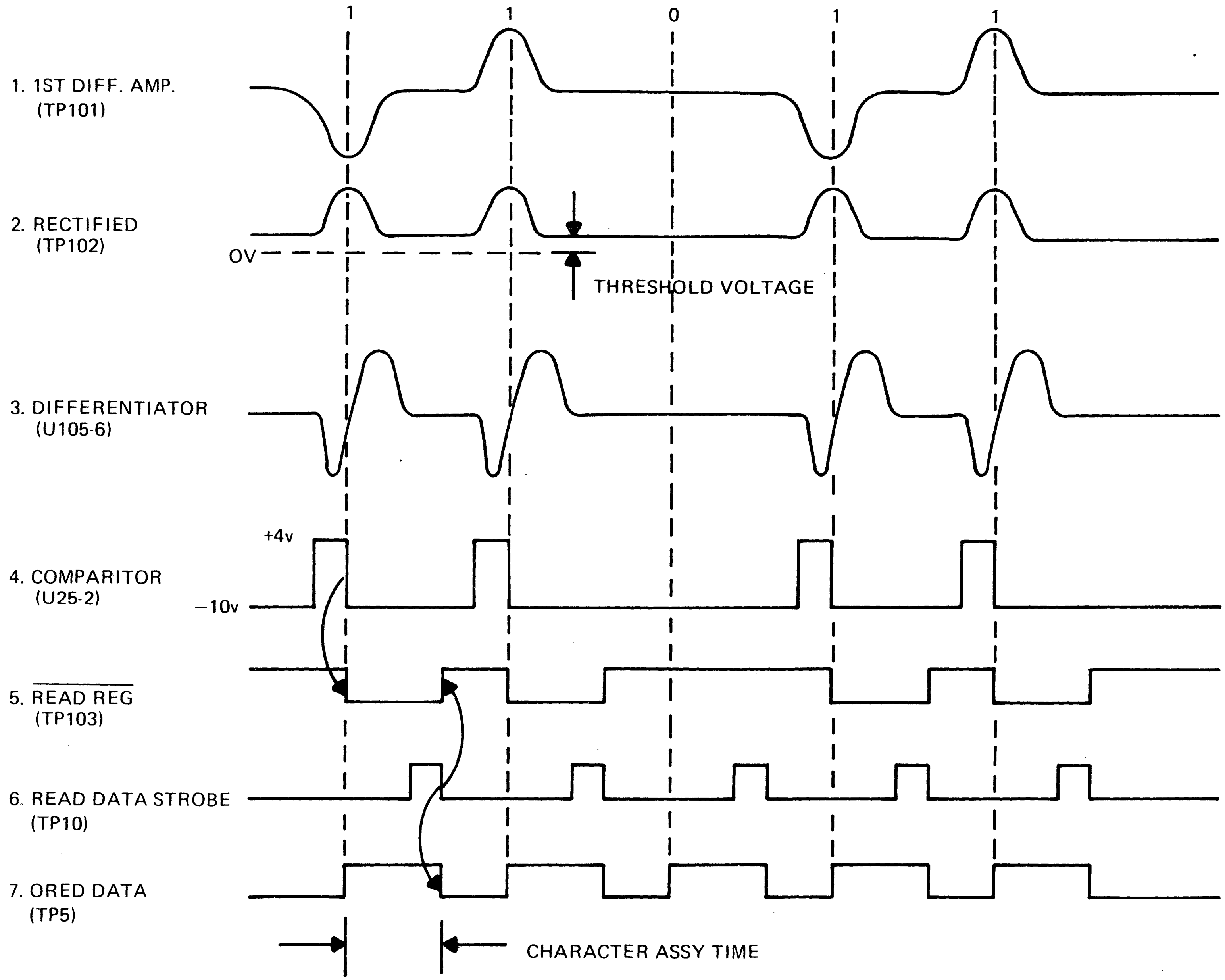


Figure 4-42. NRZI Read Data Timing Diagram

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

Jumpers on the board determine if seven track, single gap, 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.

4-42 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 data track will be described. Figure 4-43 shows a simplified diagram of the PE Data Board write circuits and figure 4-44 shows a simplified diagram of the PF Data Board read circuits. Figure 4-45 shows PE Write/Read data timing.

4-43 PE Write Circuits

The WRT DATA PARITY input is inverted at U10 and clocked into flip-flop U11-5 by DATA READY. Refer to figures 4-43 and 4-45. 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 direction of the flux change is 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. Ajumper is installed between 12 and 13 when the 9-TRACK signal controls the operation of the PE Data Board when used in a quad-density (three data card) unit. Therefore, when WRITE ENABLE is true, U13-11 will be low, 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 heads and for the differential head drivers Q101 and Q102.

4-44 PE Read Circuits

The read head signals ranging from 3 to 18 millivolts are amplified by U101. Refer to figures 4-44 and 4-45. The gain of U101 is determined by a resistor network consisting of R110, R116 and potentiometer R112. For a single gap head, a jumper from J3 and 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 10 db per decade until cut off by R119 and C114. Therefore, thepeaks 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.

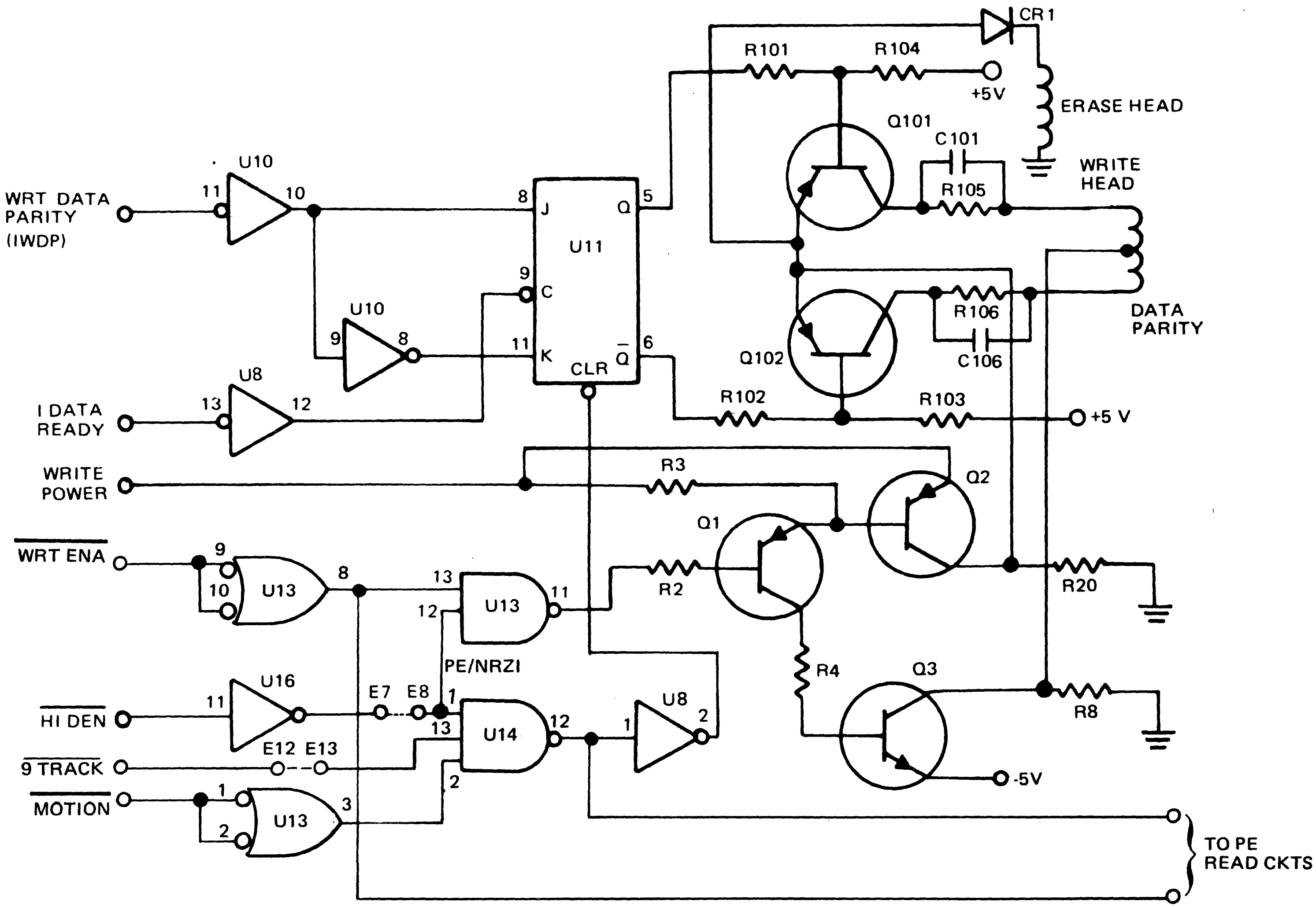


Figure 4-43. PE Data Board Write Circuits Simplified Diagram

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 threshold are 30%, 15% and 5%. If the signal is more negative than the threshold, U103-2 switches high, reverse biasing CR109, allowing C118 to charge through R132. The R132/C118 time constant is such that Q103 isturned 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 U12-2 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 a saturation supplying +5 volts to Q104 and R133. Q4 is turned on whenever $\overline{\text{MOTION}}$ is true.

4-45 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 then R15, the Read Threshold is set high, at approximately 30% of maximum voltage. If, for example, READ THRESHOLD 2 is asserted, U1408 goes low setting U15-3 and U14-6 high and 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 saturation 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.

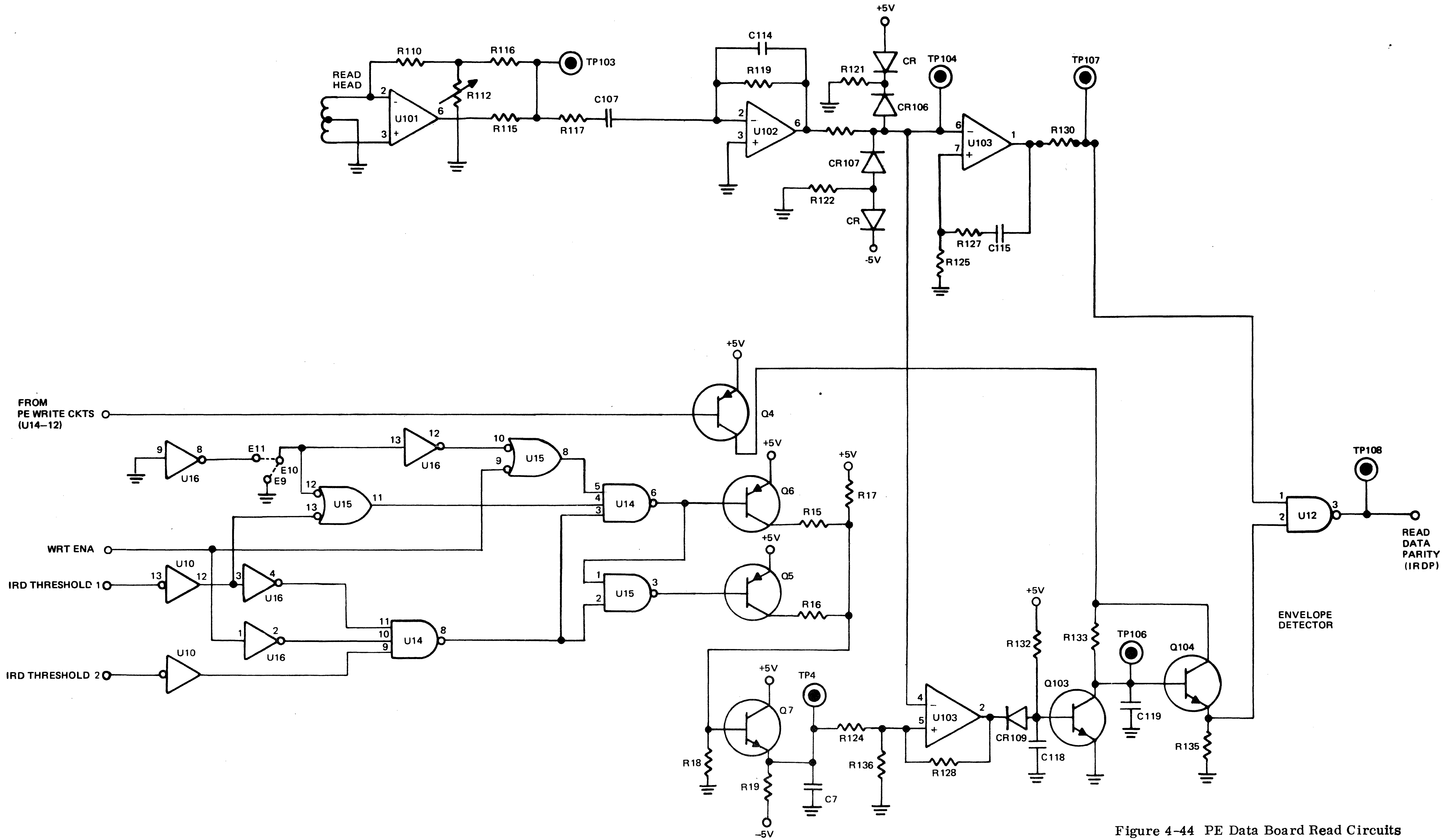
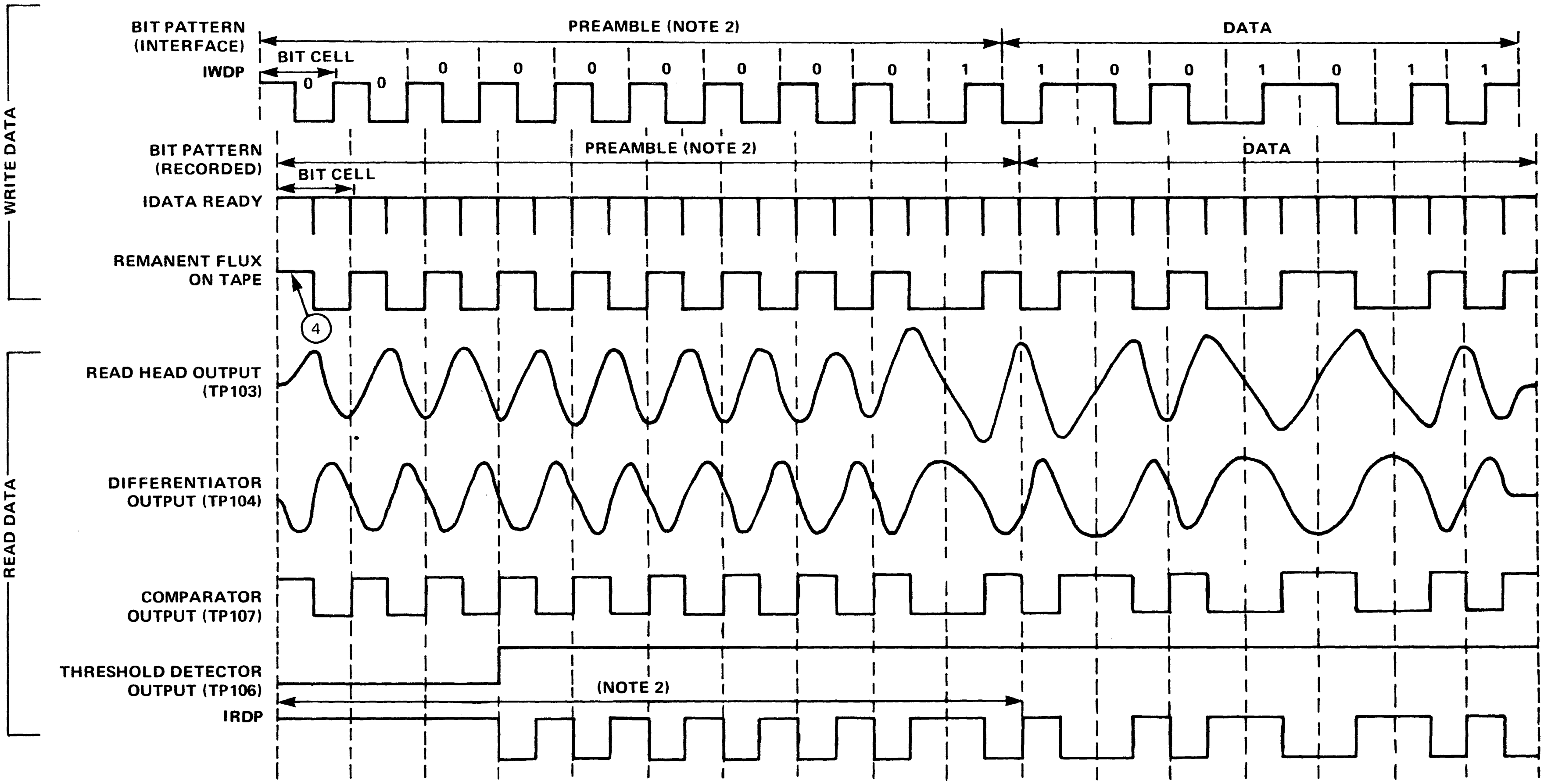


Figure 4-44 PE Data Board Read Circuits
Simplified Diagram



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 4-45. PE Data Write/Read Timing Diagram

Chapter 5
MAINTENANCE

5-1 INTRODUCTION

This chapter contains the information required to perform maintenance on the Models 2730 and 2740 Magnetic Tape Units. 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 of the simplified schematic, logic diagrams and timing diagrams in Chapter 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 Models 2730 and 2740 Magnetic Tape Units consists of periodic cleaning, checking for alignment and wear of tape handling components and replacement of worn parts as necessary. Component replacement instructions are presented in paragraph 5-63. 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 service engineer or maintenance technician.

5-3 CLEANING THE TAPE UNIT

The tape unit required 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 unit 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	.13
Clean vacuum chamber (2740 only)	16	.1
Check tape guides and capstan	16	.1
Clean tape cleaner	80	.1
Clean tape unit surface	3000	.1

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	.75
Replace reel motor brushes and check tape tension	5000	.15
Replace capstan motor, blower motor and blower belt	10,000	1.0
Replace reel motors and reel drive belts	15,000	.35
Replace control switches and lamps	15,000	.70

* Duty cycle dependent; hours should be counted only when tape is under tension.

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 swab moistened with isopropyl alcohol to remove 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 inside of the vacuum column glass (Model 2740 only), use a lint-free cloth and any commercial glass cleaner (preferably liquid, not spray). Remove any matter which covers the vacuum holes. Wipe the bottom and sides of this vacuum column with a lint-free cloth, moistened with isopropyl alcohol, to remove oxide dirt.

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 paragraph 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 5-59. For component location on the circuit boards refer to the assembly drawings.

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.

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. Any change to the + 5 or - 5 regulator voltage will require additional adjustments to the EOT/BOT amplifier, capstan speed, etc.

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 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 ± 10volt 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 ouputs of both are correct. Limits for the ± 10 volt and ± 5 volt supply are listed below. Any adjustment of the voltage regulators generally necessitates readjustment of the capstan speed, ramps, reel servos and EOT/BOT. Apply primary power to the tape unit and proceed with the alignment listed in the following paragraphs. Power supply information is shown in the following list.

POWER SUPPLY	NOMINAL VALUE	ACCEPTABLE RANGE	ADJUST TO:
+ 10 volt supply	+ 10 volts	+ 11.50 to +9.50V	
- 10 volt supply	- 10 volts	- 11.50 to -9.50V	
+ 5 volt supply	+ 5.2 volts	+ 5.35 to +5.05V	+5.25 to+5.15V
- 5 volt supply	- 5.2 volts	+ 5.35 to +5.05 V	+5.25 to +5.15V

TABLE 5-3. TOOLS AND TEST EQUIPMENT

COMMON NAME	MANUFACTURING MODEL OR TYPE NUMBER
Tension Arm Alignment Tool	00243
Vacuum Column Alignment Tool	9810017-01
Micrometer	
IBM Master Skew Tape	432640
Dual Channel Oscilloscope	Tektronix 453
1 lb. Gauge	Chatillon DPP-1
15 lb. Gauge	Chatillon LP-15
5M Gauge	Gates Rubber Co. P/N 3609371
Miscellaneous shims	(Refer to Recommended Spare Parts List, Chapter 6)
TX-1000 Tape Transport Exerciser	00295
Digital Multimeter	Weston 4440

5-7 <u>+5 Volt Supply Regulator Adjustment</u>

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

b. The digital multimeter's display should indicate +5.2Vdc $\pm$0.15Vdc. If the display's indication is out of tolerance, adjust potentiometer R10018 (refer to the tape control board drawing) for an indication of+5.2Vdc.

5-8 <u>-5 Volt Supply Regulator Adjustment</u>

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

b. The digital multimeter's display should indicate -5.2V $\pm$0.15Vdc. If the multimeter indicates it is out of tolerance, adjust potentiometer R104 for an indication of -5.2Vdc.

5-9 ADJUSTMENT 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 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. Alternately position the tape on and off the BOT marker and adjust potentiometer R2202 so that the on BOT marker voltage is 1.5 volts minimum above ground and has a swing of at least 3 volts minimum between the on and off markers.

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. Alternately position the tape on and off the EOT marker and adjust potentiometer R2102 so that the on EOT marker voltage is 1.5 volts above ground and has a swing of at least 3 volts between the on and off markers.

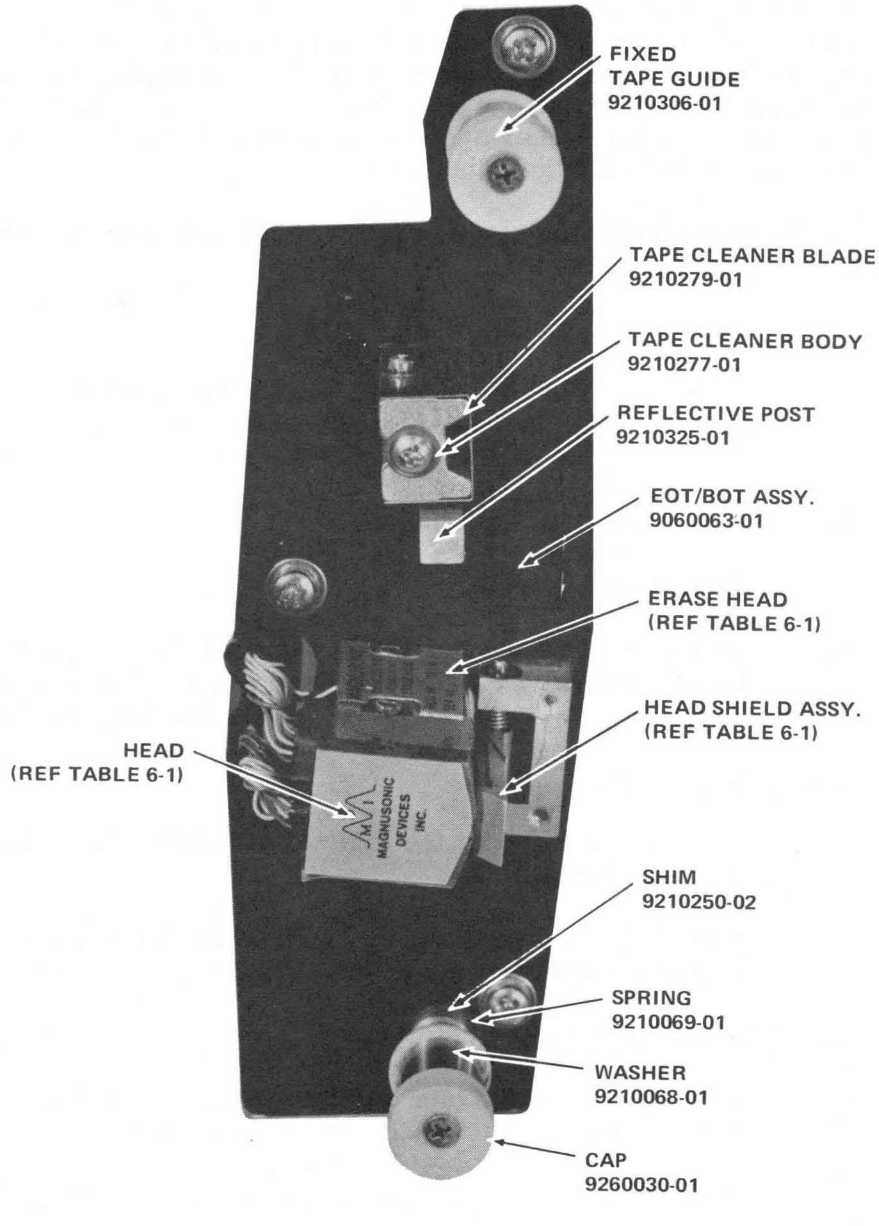


Figure 5-1. Head Assembly

5-12 ADJUSTMENT OF CAPSTAN SPEED

The synchronous forward and reverse speed is adjustable. The following procedure includes the capstan amplifier offset adjustment, a coarse speed adjustment and then a fine speed adjustment.

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 Captstan Speed Coarse Adjustment and the Capstan Speed Fine Adjustment. For the higher speed adjustment, instead of using potentiometer R5026, use potentiometer R5027 for the adjustment.

Perform 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 readjusting 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 (analog 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. Thread tape on the tape unit so that it does not wrap around the capstan and use maintenance switch S1 to generate forward motion.

b. Connect the lead of the digital multimeter between TP12(+) and TP3 (analog gnd.).

c. 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 shown in the following list.

SPEED (IPS)	VOLTAGE (VDC)	TOLERANCE
12.5	.179 vdc	±.005
18.75	.268 vdc	±.005
25	.358 vdc	±.005
37.5	.537 vdc	±.005
45	.644 vdc	±.005

5-15 Capstan Speed Fine Adjustment

The capstan mounted strobe disc is used to perform fine tape speed adjustments of the synchronous speed. Tape speed adjustments made using the strobe disc are accomplished by illuminating the capstan hub from a flourescent light source and adjusting potentiometer R5026 (R5027) until the disc image, created by the pulsating light source, becomes stationary. The accuracy of the adjustment is determined by the length of time in which the disc image completes one revolution.

time for one revolution = 628/(tape speed)(accuracy percent)

Tape Speed (IPS)	1% Tolerance (rotation time)
12.5	< 50 sec
18.75	< 34 sec
25	< 25 sec
37.5	< 17 sec
45	< 17 sec

The strobe disc has two sets of rings and should be used with the following rules:

Part No. 9210378-04 (12.5/25 ips) - the outer ring is used when the light source is 50Hz, and the inner ring is used when the light source is 60Hz;

Part No. 9210378-02 (37.5 ips) - the outer ring is used when the light source is 50Hz, and the inner ring when the light source is 60Hz;

Part No. 9210378-03 (45 ips) - the outer ring is used when the light source is 60Hz, and the inner ring is used when the light source is 50Hz.

Perform the adjustments as follows:

a. Rethread tape around capstan.

b. 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 within 1% in reverse direction.

c. On dual-speed tape units, set HI DEN switch to low density (high speed). Adjust potentiometer R5027 until disc image becomes stationary (within 1%) in reverse direction.

d. Set maintenance switch SW1 to forward position, and adjust -5 volt potentiometer R1025 until disc image becomes stationary (within 1%) for higher 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 tape 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 (analog 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:

$$\frac{\text{Measured voltage}}{\text{tape speed}} \times 200 = \text{rewind voltage.}$$

g. After calculating the rewind voltage, initiate a rewind operation. Adjust potentiomater 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 units set the tape 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 adjustments, using potentiometer R5021. Load a reel of tape on the tape unit and proceed with the following adjustments.

NOTE

The $\pm$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 at 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 to the appropriate time for the tape unit speed. See the following list:

TAPE UNIT SPEED (IPS)	RAMP TIME (ms)
12.5	30.0
18.75	20.0
25	15.0
37.5	10.0
45	8.33

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

5-18 REEL SERVO MECHANICAL TENSION ARM ADJUSTMENT (2730 only)

The reel servo mechanical tension arm adjustment consist of the adjustment of the tension arm's photo-sensor shutter. The photo-sensor shutter is located on the tension arm assembly mounted on the tape unit baseplate. Refer to figure 5-3. Perform the following steps to prepare the tape unit for the tension arm adjustments.

a. Apply power to the tape unit.

b. Remove the head covers. Place a dark piece of paper over the reflective block in front of the BOT/EOT sensor. (See figure 5-1.)

c. Momentarily engage the LOAD control. This should bring the tension arms out of the LOAD position.

5-19 Reel Servo Supply Tension Arm Adjustment

a. Connect the leads of the digital multimeter between TP28 (+) and TP3 (-), ground.

b. Move the supply arm to the center mark on the overlay.

c. Loosen the tension arm supply shutter. Rotate the shutter until the digital multimeter's display indicates between +0.1 and -0.1 vdc. Tighten the shutter assembly.

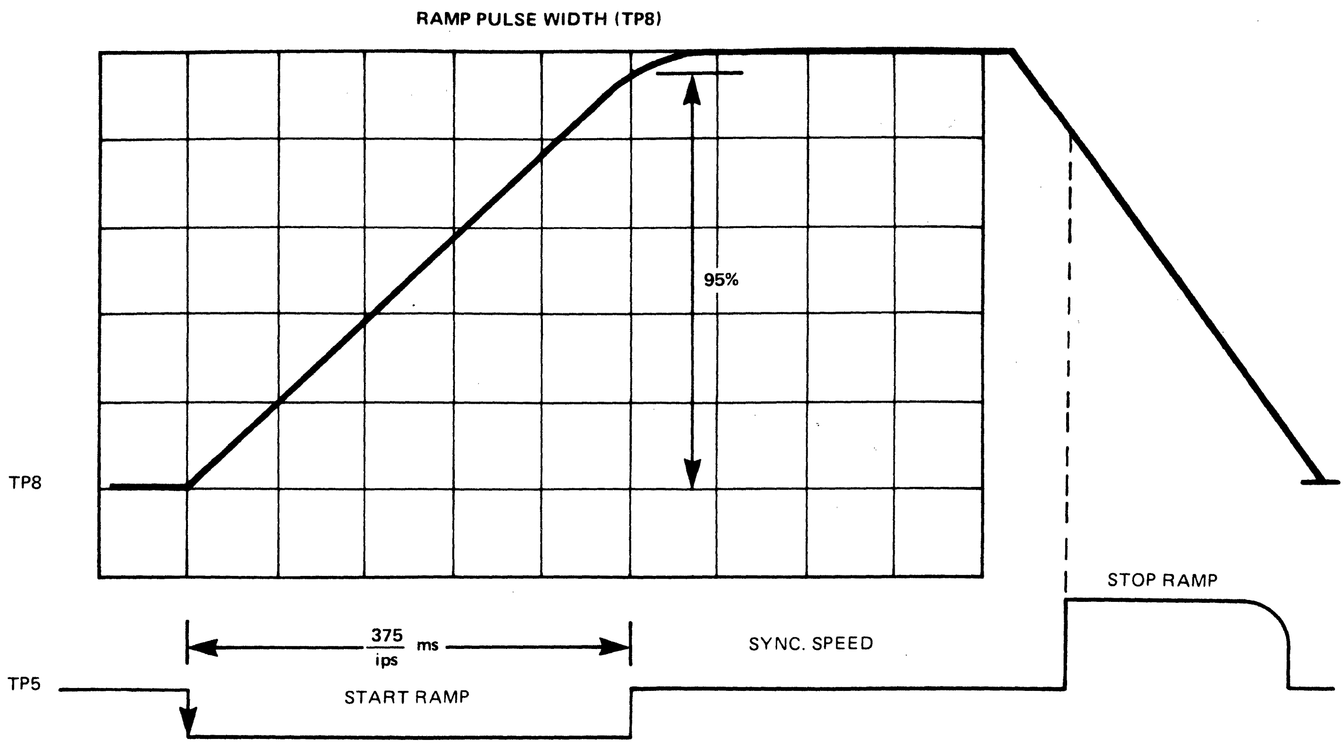


Figure 5-2. Forward Ramp Waveform

d. The multimeter should indicate equal voltages of opposite polarity at the two outer marks on the overlay. If not, loosen and adjust the photoresistor assembly (figure 5-3) and repeat steps b and c.

e. The shutter should be within 1/32 inch of photoresistor but must not rub against it at any point of the tension arm travel.

5-20 Reel Servo Take-up Tension Arm Adjustment

a. Connect the leads of the digital multimeter between TP27 (+) and TP3 (-), ground.

b. Repeat steps b, c, and d of the Reel Servo Supply Tension Arm Adjustment procedure, paragraph 5-19.

5-21 REEL SERVO TENSION ARM ELECTRICAL ADJUSTMENT

The reel servo supply and take-up electrical tension arm adjustments are identical. Consequently, only one procedure is presented with the take-up reel servo test points and potentiometers indicated in parenthesis. Test points and potentiometers not in parenthesis are those required for the supply reel servo adjustment. Perform the following steps to prepare the tape unit for the adjustment.

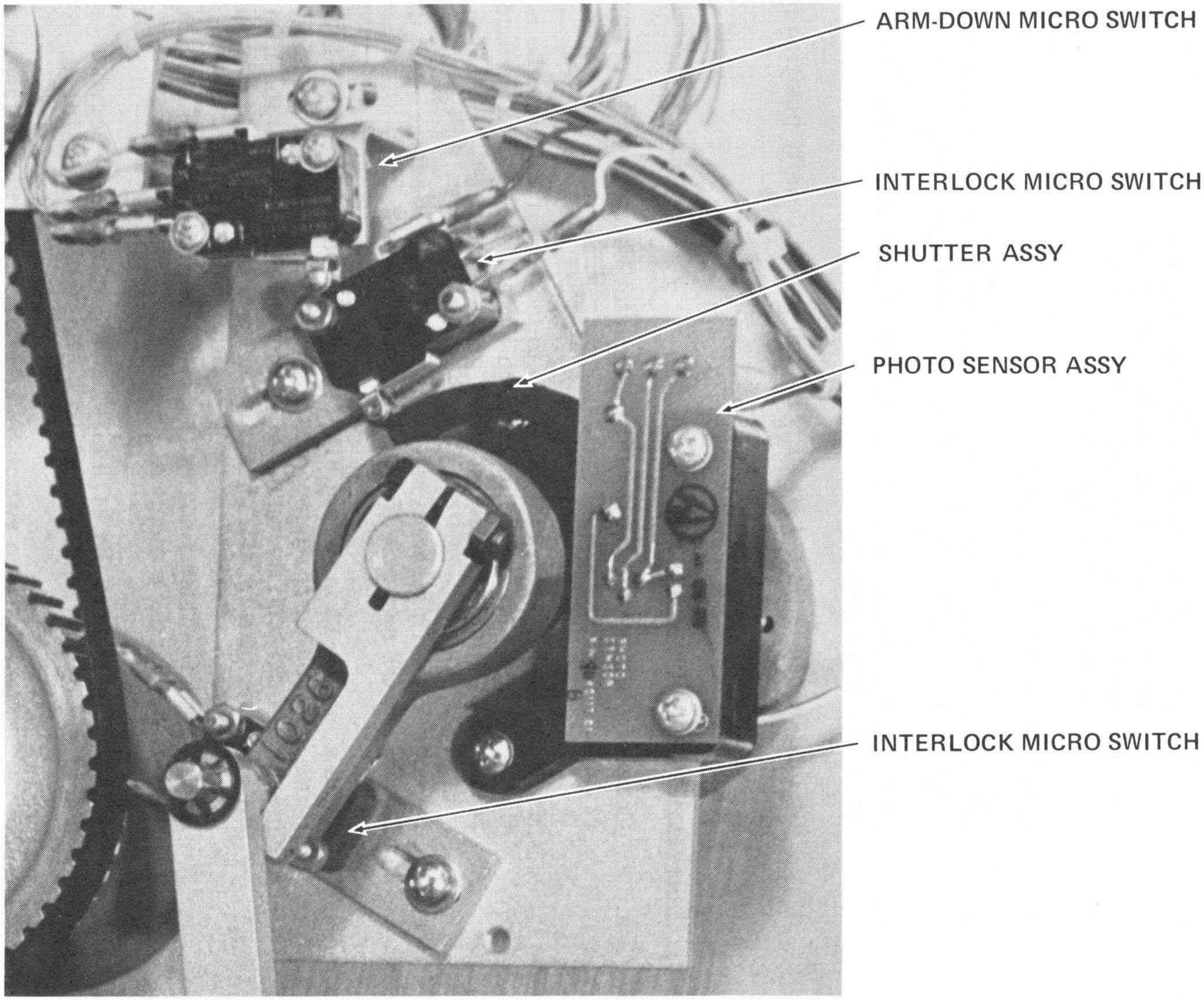


Figure 5-3. Supply Reel Shutter/Limit Switches

NOTE

The +5V regulators must be checked and adjusted, if necessary, prior to checking the reel servo electrical tension arm adjustment.

a. Apply power to the tape unit.

b. Remove the head covers. Place a dark piece of paper over the reflective block in front of the BOT/EOT sensor. See figure 5-1.

c. Momentarily engage the LOAD control This should bring the tension arms out of the Load position.

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

5-22 Tension Arm Electrical Adjustment

a. Connect the leads of the digital multimeter between TP26 (TP29) and TP3, ground.

b. Move the supply arm (take-up arm) to the center mark in the overlay. Check the multimeter indicates zero $\pm$.2 volts. If not, perform the Reel Servo Mechanical Arm Adjustment procedures.

c. Remove the dark piece of paper covering the reflective block in front of the BOT/EOT sensor. Replace the head covers.

d. Load a full 10-12 inch reel of tape. 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 EOT marker when adjusting the take-up reel servo.

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

f. Advance the tape to the EOT marker for supply reel servo 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 R6011 (R7011) so that the tension arm travel approaches the two outer marks on the overlay, as follows:

45	IPS	in line with marks
37-1/2	IPS	1/4 inch within each mark
25	IPS	1/2 inch within each mark
18-3/4	IPS	3/4 inch within each mark
12-1/2	IPS	1 inch within each mark

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. By using the maintenance switch, SW1, alternately run the tape in the forward and reverse directions. Adjust potentiometer (R7018) so that the tension arm travel is symmetrical between the two outer marks on the overlay.

5-23 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 servo test points and potentiometers indicated in parenthesis. Test points and potentiometers not in parenthesis are those required for the supply reel servo adjustments. Perform the following steps to prepare the tape unit for the adjustment procedure

NOTE

The regulators must be checked and adjusted, if necessary, prior to checking the electrical cacuum 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 5-4.

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.

5-24 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 (-).

c. Position the tape loop such that the tape intersects a point one quarter inch from the vacuum column wall and half the distance between the interlock holes. Adjust potentiometer R6006 (R7006) for an indication of zero volts (±0.01 vdc) on the digital multimeter.

d. Locate the tape loop such that the tape intersects a point one-quarter inch from the vacuum column wall and 1.5 inches from the supply (take-up) column's open end interlock hole. (For 37.5 ips tape units move the outer marks an additional 1-inch toward the center.) Adjust R6011 (R7011) until 1.8 volts (±0.03 vdc) is measured.

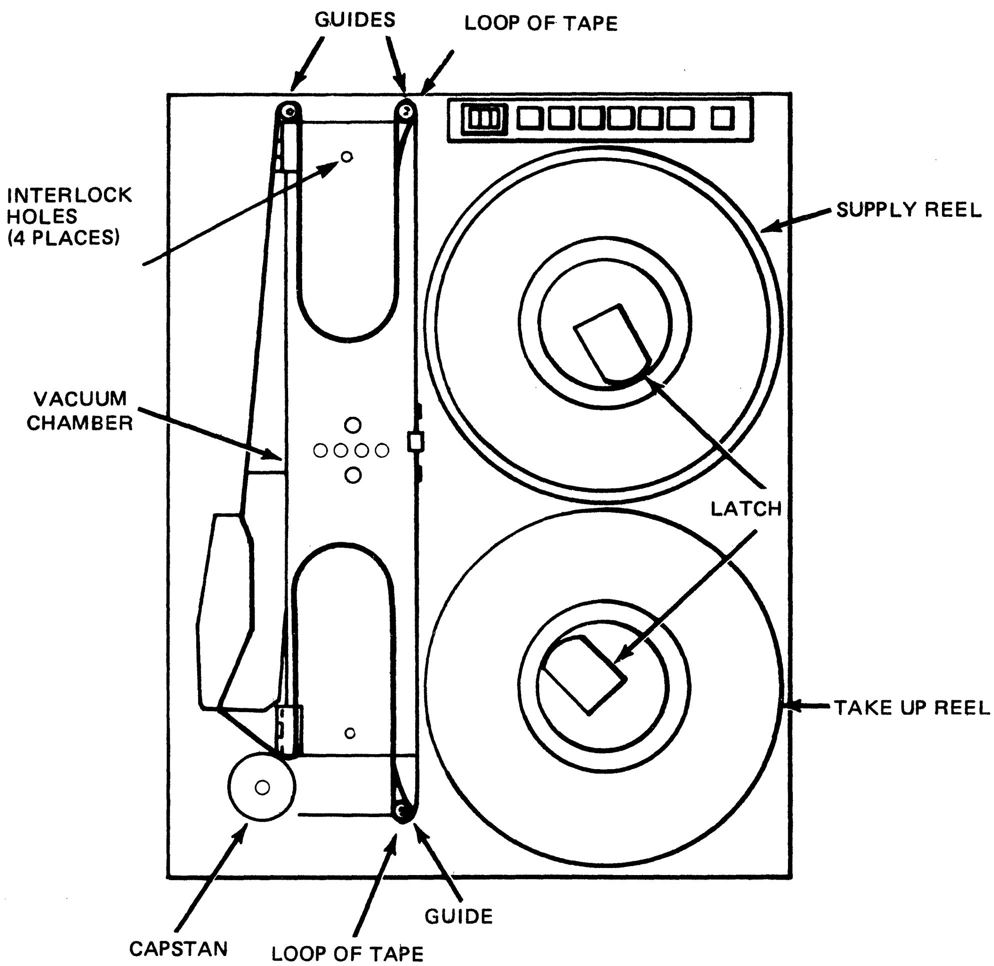


Figure 5-4. Tape Loop For Vacuum Column Servo Adjustment

e. Locate the tape loop in the center of the column, as in step c. Adjust R6006 (R7006) for an indication of zero volts (±0.01 vdc) on the digital multimeter.

f. Connect the multimeter's leads to TP31 (TP30) and TP(-), and adjust R6018 (R7018) until +1.5 volts (±0.1 vdc) is measured on the digital multimeter.

g. Load an empty reel on the supply or take-up hub.

h. Using the maintenance switch SW1, alternately run the tape in the forward and reverse directions.

i. Adjust the potentiometer R6011 (R7011) for proper tape travel. The tape should intersect a point one quarter-inch from the vacuum column wall and 1.5 inches (+0.1, -0.2) from the open end interlock hole. The loop position at the closed end of the chamber should operate between 1 and 1.7 inches from the interlock hole.

NOTE

If the operating points do not fall within the above regions, complete steps j, k, and l, then repeat steps h and i.

j. Load a full reel on the supply or take-up hub.

k. Using the maintenance switch, SW1, alternately run the tape in the forward and reverse directions.

l. Adjust potentiometer R6018 (R7018) such that the tape travel is symmetrical between the two interlock holes (±0.5 inches).

5-25 NRZI DATA BOARD ELECTRICAL ADJUSTMENTS

The following paragraphs describe the adjustments required for proper operation of the NRZI Data Board. Refer to 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 procedures 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.

5-26 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 instructions.

e. After recording all ones on all channels, rewind the 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 (figure 5-5).

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

5-27 Read Head Skew Measurement and Adjustment

The read head skew measurement and adjustment procedures should only be required when the tape head has been replaced. The adjustment of read skew is accomplished mechanically by shimming one of the fixed head guides. The shims are 0.0005 inches 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.

5-28 Skew Measurement and Adjustment

a. Using a dual trace oscilloscope, connect channel A to TP603 and channel B to TP 703 for nine channel uniits. 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 (figure 5-6). Calculate the amount of displacement (refer to table 5-4).

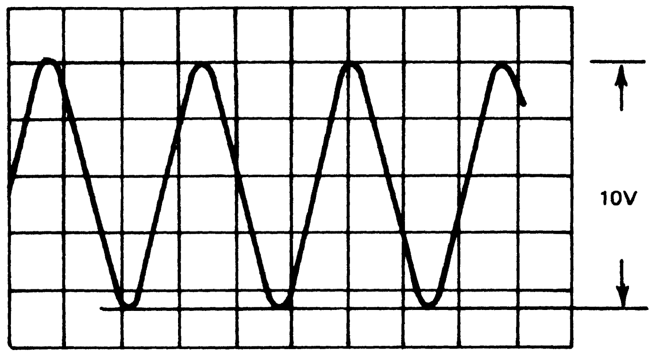


Figure 5-5. Amplifier Waveforms

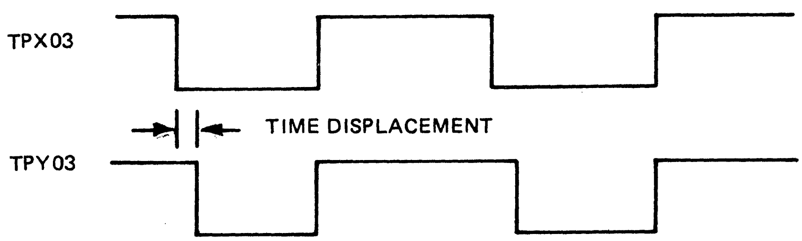


Figure 5-6. Output Waveforms (TP103, TP203, TP603, TP703)

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
12.5	8	6
18.75	5.3	4
25	4	3
37.5	4	2
45	2.2	1.7

If the displacement is less than 100 microinches, no shimming is required. If the displacement is greater than 100 microinches and TP703 (nine track) or TP 103 (seven 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:

$$\text{NUMBER OF SHIMS} = \frac{\text{(TAPE SPEED)} \quad \text{(TIME DISPLACEMENT)}}{37.5 \times 10^{-6}}$$

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

5-29 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.

5-30 Read Head Gap Scatter Plot

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

b. Use the maintenance swithc SW1 to run the tape forward and monitor TP203 with channel B of the oscilloscope. Record the time displacement between channels A and B (figure 5-6).

5-31 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 tape 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 TPAE 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 24 microseconds at 12.5 ips; 17 microseconds at 18.5 ips; 12.5 microseconds at 25 ips; 8.5 microseconds at 37.5 ips; or 7 microseconds at 45 ips. Set potentiometer R202 through 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 deskew potentiometers (R202 through R902) so that the READ HEAD GAP SCATTER PLOT is duplicated.

5-32 Staircase Skew Measurement

A quick check of all read/write adjustments can be made by observing the waveform at TP9 (figure 5-7). 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 read after write skew is greater than 150 microinches (table 5-4) and cannot be brought within limits by shimming the fixed head guides, the Tape Path Adjustment (paragraph 5-46) should be performed.

5-33 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.

5-34 Adjustment of Flux Gate

a. Connect oscilloscope channel A to TP601 and channel B to TP701 (nine channel) or channel A to TP901 and channel B to TP101 (seven channel).

b. The amplitude of the signal displayed on the oscilloscope should be less than 0.5 volts.

c. If the signal amplitude is greater than the allowed limit, remove the head cover. Loosen the two screws securing the flux gate (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.

5-35 Read Character Assembly Time 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).

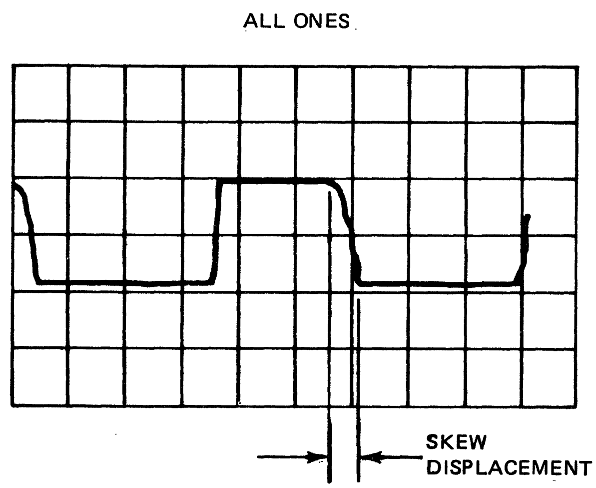


Figure 5-7. Staircase Waveform (TP9)

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
12.5	50	72	200
18.75	34	48	136
25	25	36	100
37.5	17	24	68
45	14	20	56

5-36 Threshold Measurement

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

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 inactive.

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

e. Set the tape unit on line. Activate Read Threshold 2. The voltage should be approximately 0.7 volts.

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

5-37 PHASE ENCODED DATA BOARD ELECTRICAL ADJUSTMENTS

The adjustments procedures contained in this section should be performed whenever a tape head is 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 Board drawing in the attached drawing package for component location on the Phase Encoded Data Board.

5-38 Read Amplifier Gain Adjustment

The gain of each of the read amplifiers located on the Phase Encoded (PE) Data Board is independently 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 tape 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 (P/N 9580062) for equipment interconnect and set up instructions.

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

f. Connect 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 5-8).

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

5-39 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 inches thick and correct for 37.5 microinches of skew. The maximum allowed shims under any one guide is four. Only one of the guides should be shimmed on the same headplate 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 headplate assembly. Perform the following measurement and adjustment steps.

a. Apply power to the tape unit.

b. Load the IBM Master Skew Tape on the tape unit. Press and release the LOAD control twice (once on tape 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 5-6). Calculate the amount of displacement (refer to table 5-4).

If the 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:

$$\text{NUMBER OF SHIMS} = \frac{\text{(TAPE SPEED) X (TIME DISPLACEMENT)}}{37.5 \text{ X } 10^{-6}}$$

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

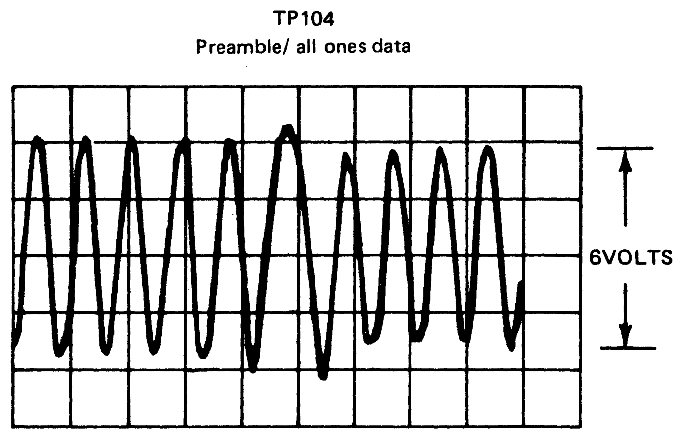


Figure 5-8. Amplifier Waveform (TP104)

5-40 Flux Gate Adjustment

The flux gate adjustment is necessary to minimize the crosstalk between the read and write heads. Perform the following steps to accomplish the flux gate adjustments.

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 (P/N9580062) 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 volts.

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.

5-41 Staircase Skew Measurement

A quick check of all read/write adjustments can be made by observing the waveform at TP5 (figure 5-9). Set up the TX-1000 TAPE TRANSPORT EXERCISER (Part No. 00295) to write all ones on all channels. The length of time from each step to the last is the total amount of skew displacement. If the Read/Write skew is greater than 150 microinches (see table 5-4) and cannot be brought within the limits by shimming the fixed head guides the tape path adjustment (paragraph 5-45) should be performed.

5-42 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 a and Read Threshold 2 are inactive.

d. Set the tape unit off line. Connect oscilloscope to test point TP4. The voltage should be approximately 0.7 volts.

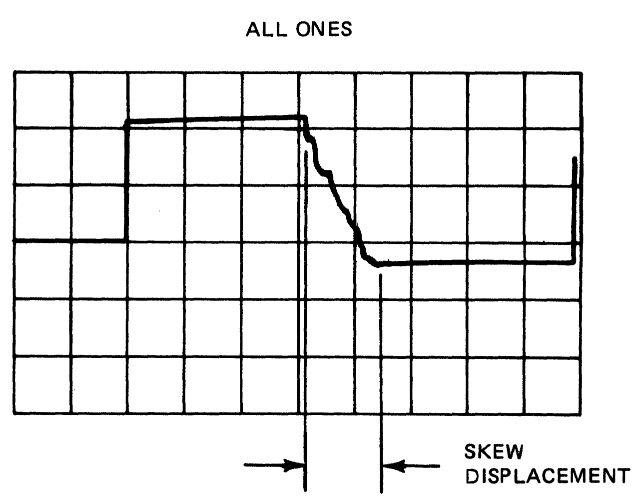


Figure 5-9. Staircase Waveform (TP5)

e. Set the tape unit on line. Activate Read Threshold 2. The voltage should be approximately 0.3 volts.

f. For dual-gap data boards, use the TX-1000 to write data. Single-gap version, activate Read Threshold 1. The voltage should be approximately 1.3 volts.

5-43 MECHANICAL CHECKOUT AND ALIGNMENT

The following paragraphs present checkout and alignment procedures for the mechanical components of the Models 2730 and 2740 Magnetic Tape Units. Refer to figures 4-2, 4-3, 5-1 and 5-3 for various mechanical views of the tape units.

5-44 Tension Arm Limit Switches

There are two limit switches associated with the supply tension arm assembly. These switches are located on mounting plates attached to the bearing housings and are shown in figure 5-3 with the tension arm in the LOAD position. When either limit switch is replaced, both limit switches in that set should be checked for the proper positioning and operation. Perform the following steps to ensure the proper positioning and operation of the limit switches.

a. Apply power to the tape unit.

b. Remove the tape head assembly dust cover. Place a dark piece of paper over the reflective block in front of the BOT/EOT sensor.

c. Momentarily press the load switch. This should bring the tension arms to their stops.

d. Remove power from the tape unit and the paper from the tape head assembly.

e. Monitor the switch contacts of lower limit switch. The contacts should be open when the tension arm is resting against the backstop (unload position).

f. Manually rotate the tension arm slowly toward the center of the arm swing. Switch contact closure should occur one-half inch before the outer mark on the overlay is reached. If the switch contact closure is out of tolerance, perform the adjustment procedure steps h through j.

g. Repeat steps e and f for the remaining limit switch.

h. Slightly loosen the bracket containing the misaligned limit switch.

i. Position the limit switch so that closure occurs when the tension arm is one-half inch from the outer mark on the overlay.

j. Tighten the relevant bracket retaining screws.

5-45 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 for tape curling or warping at the edges while tape is moving. If it is, perform the Tape Path Adjustment (paragraph 5-46).

NOTE

The tape used for this check must be in new condition.

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 5-46).

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

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

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

g. Verify that the tape position across the fixed tape guides is even with or below the top surface of the guide by 15 mils. If the tape is outside these limits, either above or below, perform the Tape Path Adjustment.

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

i. Perform the Staricase Skew Measurement (paragraph 5-32 or 5-41).

5-46 Tape Path Adjustment

Alignment of the tape path components is accomplished by using Alignment Tool Part No. 00243 or 9810017-01. The tape path components consist of the headplate, the tape guide rollers (supply and take-up), the supply and take-up hub, and the capstan.

CAUTION

Both alignment tools are precision made and must be handled with care to avoid damage.

5-47 Vacuum Machine Fixed Tape Guide (Headplate) Adjustment

The alignment of the fixed tape guides on headplate assembly should only be required when a tape guide is replaced. The adjustment is accomplished by using Alignment Tool (P/N 9810017-01) to check the tape guide height and by shimming the headplate assembly to bring the tape guide height into adjustment.

a. Remove power from the tape unit and remove the head covers.

b. Gently remove the tape unit overlay from the tape unit, taking care not to damage any of the components mounted on the headplate assembly. The tape unit overlay is secured to the tape unit by either tape coated with adhesive material on both sides, or by Velcro. For both methods the overlay should be peeled away from the tape unit with caution.

c. Remove the fixed tape guide caps and the vacuum column door.

d. Place the flat edge of the alignment tool across the top edge of the vacuum column so that the tool edge extends across the top of the fixed guide. Refer to figures 5-10(A) and 5-11. Hold tool firmly in place.

e. Measure the distance between the edge of the tool and the top of the fixed guide with a feeler gauge. Refer to figure 5-11. The fixed tape guide should be .003 to .0035 inches below the flat edge of the alignment tool.

f. If necessary, insert or remove shims on the headplate assembly spacer nearest the fixed tape guide being adjusted until the correct measurement (0.003 to 0.0035) is obtained.

g. Replace the tape guide cap and the vacuum column window. Refer to paragraph 5-73 for vacuum column window replacement.

5-48 Tension Arm Machine Tape Guide Roller Adjustment

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

a. Remove tape and reels from the tape unit.

b. Remove 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 either Vecro or tape coated with adhesive material on both sides. Gently remove the overlay, taking care not to damage any components mounted on the headplate assembly.

e. Mount the alignment tool (Part No. 00243) as shown in figure 5-12.

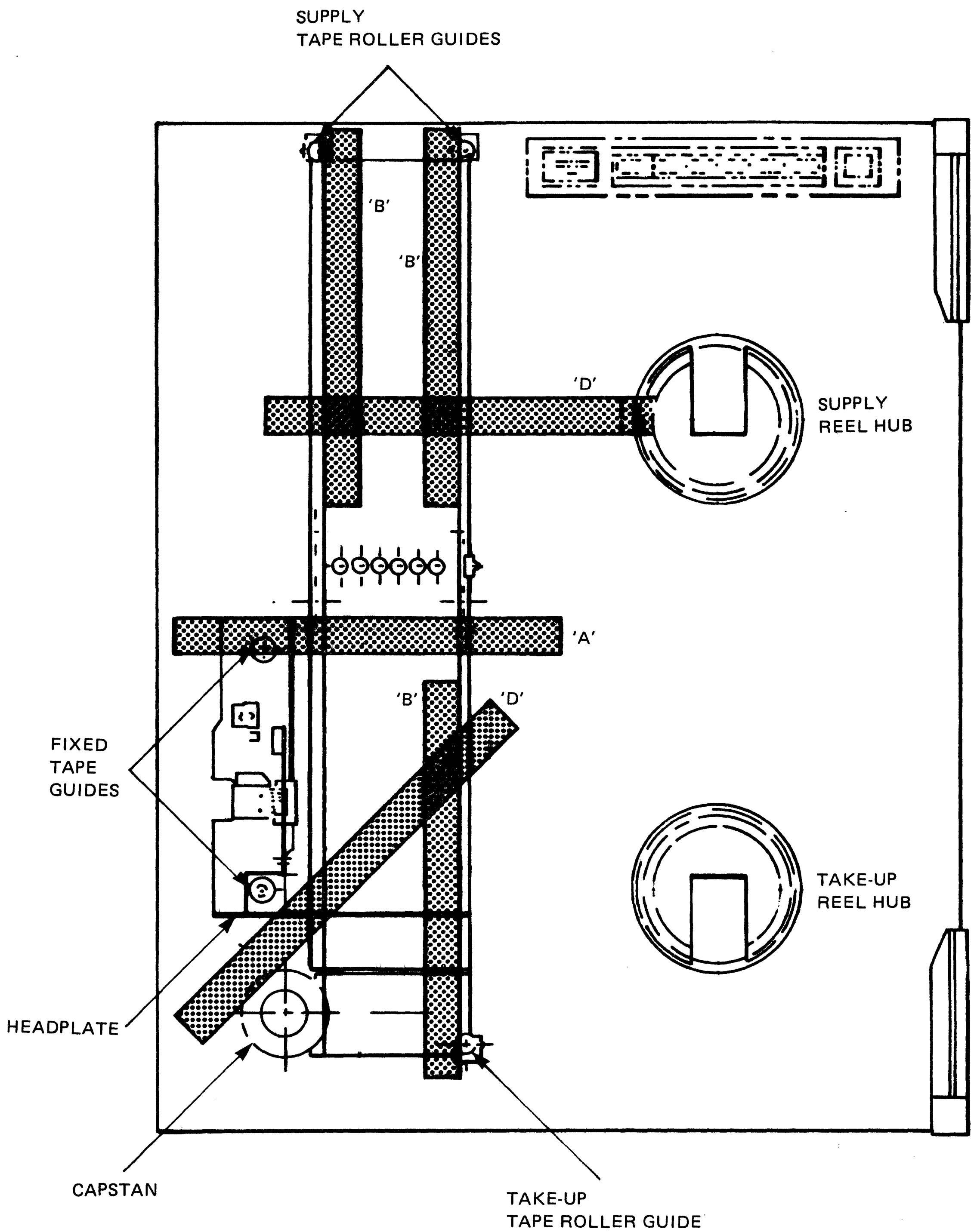


Figure 5-10 Vacuum Tape Path Alignment Tool Positioning

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 set-screw securing the guide roller assembly.

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

i. When height is established, tighten the guide roller set-screw.

j. When installing the tape unit overlay, the original tape must be replaced with tape coated on both sides with adhesive material (P/N 33700001-2).

5-49 Vacuum Machine Tape Guide Roller Adjustment

The following tape guide roller adjustment procedure applies to both the supply and take-up guide roller assemblies. Refer to figure 5-10(B) and 5-13 for alignment tool positioning.

a. Remove tape and reels from the tape unit.

b. Remove the power from the tape unit.

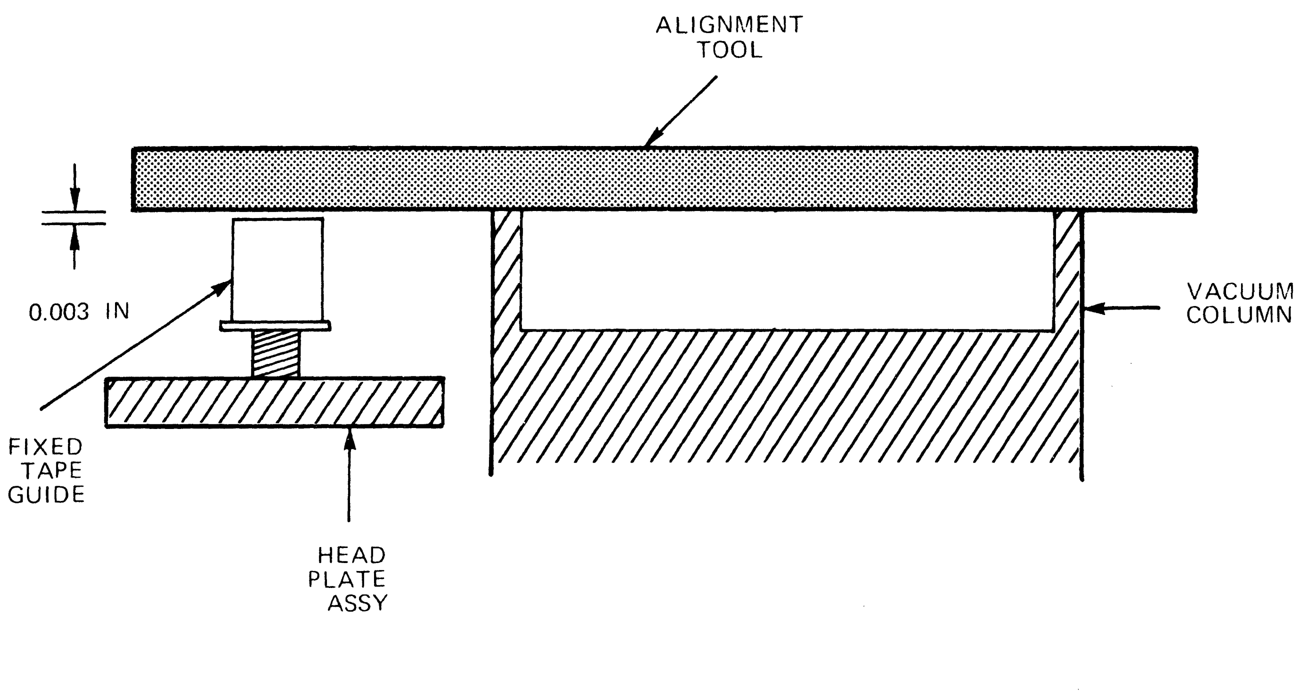


Figure 5-11. Vacuum Machine Fixed Tape Guide Alignment Tool Positioning

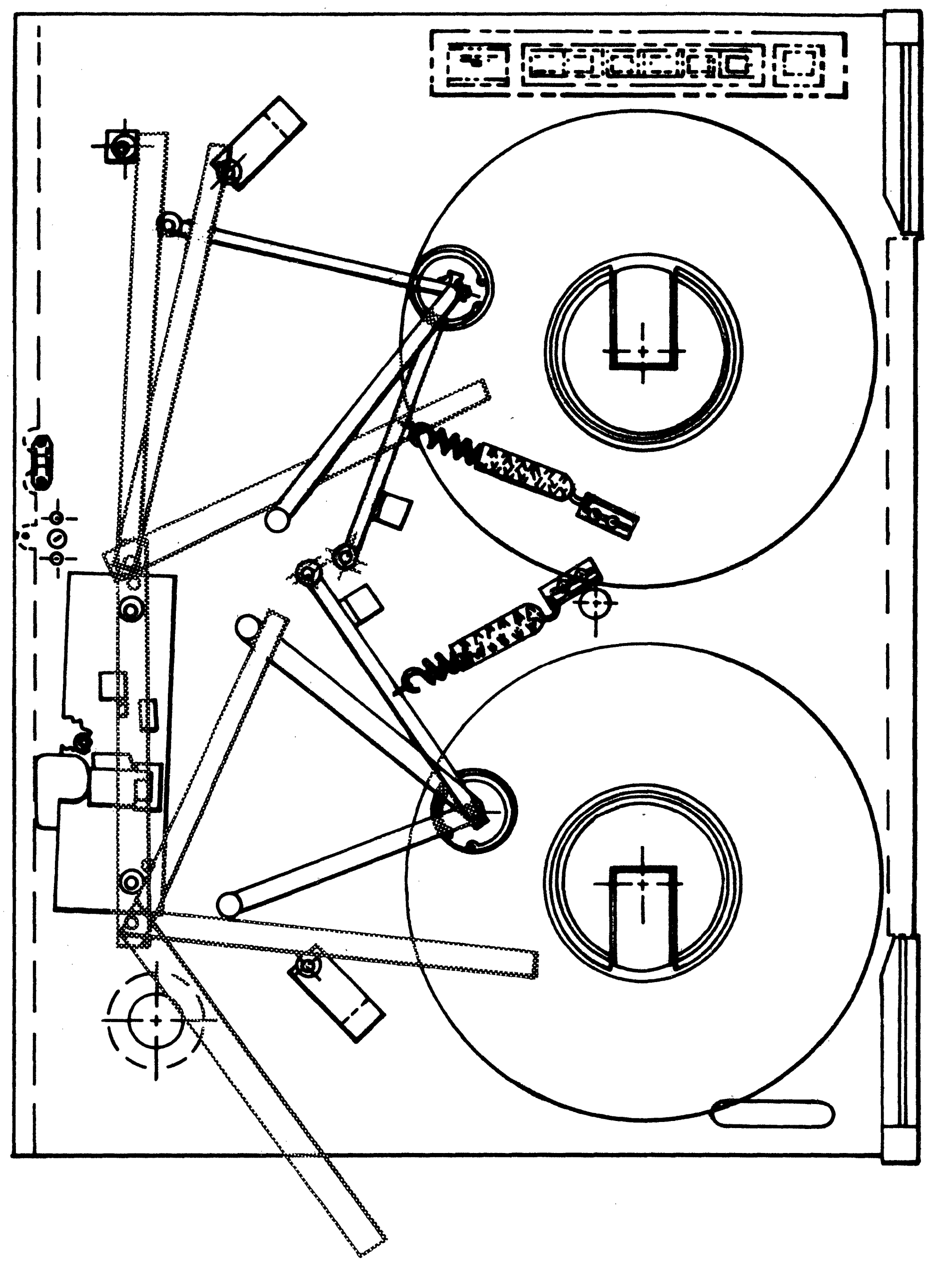


Figure 5-12. Tape Guide Alignment Tool Tension

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

d. Position the alignment tool against each guide roller, one at a time. In each case, the alignment tool should line up as illustrated in figure 5-13. The .0015 edge of the tool is for height and the .0375 edge is for offset.

e. To adjust the height of the guide roller, loosen the set screw securing the guide roller assembly and move the guide roller up or down as necessary.

f. When height is established, tighten the guide roller set-screw.

g. For offset adjustment, loosen the roller block and position the tape guide roller assembly as necessary, then retighten the roller block.

h. When reinstalling the tape unit overlay, the original tape must be replaced with tape coated on both sides with adhesive material. For Velcro method, position overlay and press around edges and center of overlay to engage Velcro.

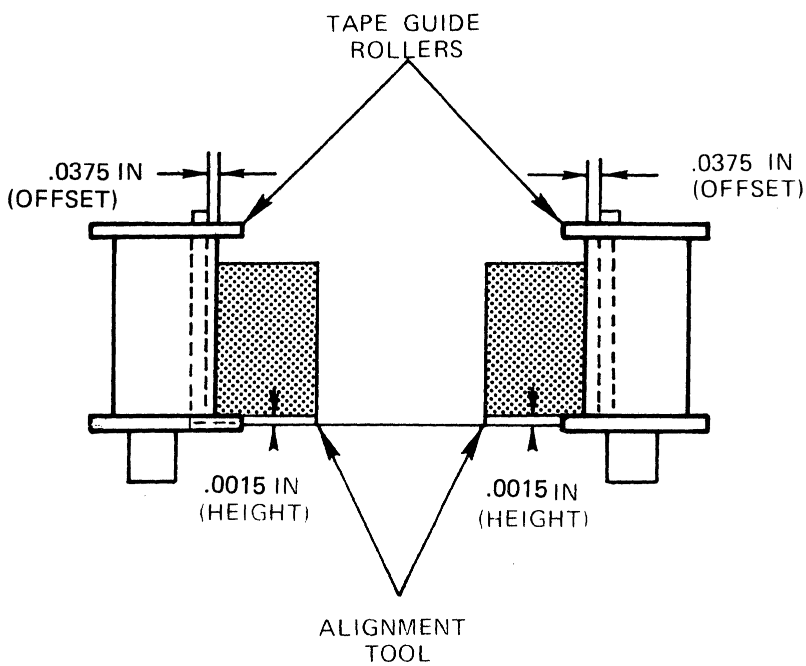


Figure 5-13. Tape Guide Roller Alignment Tool Positioning

5-50 Tension Arm Machine Reel Hub 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.

d. Using the screws supplied with the Alignment Tool, mount the alignment tool on the fixed guides as shown in figure 5-12.

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 screws. The hub retaining screw is accessible through the hole in the bearing housing casting at the rear of the tape unit (figure 4-2).

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

h. Tighten the hub retaining screws.

5-51 Vacuum Machine Reel Hub Height Adjustment

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

a. Remove the reels on the reel hubs.

b. Remove power from the tape unit.

c. Remove the vacuum column door by removing the hinge screws.

d. Position the alignment tool against the reel hub edge as shown in figure 5-10(C). The L-shaped edge of the alignment tool and the edges of the reel hub should just touch as the reel hub is rotated.

e. If the reel hub and the alignment tool do not touch, loosen the hub retaining screw. See figure 4-3.

f. Position the reel hub assembly so that the L-shaped edge of the alignment tool just touches the reel hub edge as the reel hub is rotated.

g. Tighten the hub retaining screw.

5-52 Tension Arm Machine 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 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 headplate assembly.

d. Mount alignment tool (P/N 00243) as shown in figure 5-12.

e. 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 set-screw securing the capstan to the capstan motor shaft.

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

h. Tighten set-screw.

5-53 Vacuum Machine Capstan Height Adjustment

a. Remove power from the tape unit.

b. The tape unit overlay is secured to the unit either by tape coated with adhesive material on both sides or by Velcro. Gently remove the overlay, taking care not to damage any components mounted on the headplate assembly.

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

d. Figure 5-10(D) shows how to position the alignment toool. Position the alignment tool over the vacuum column and against the capstan. The capstan should be flush against the 0.0215 inch edge of the alignment tool.

e. To adjust the height of the capstan, loosen the set-screw securing the capstan to the capstan motor shaft.

f. Position the capstan so that the capstan and the alignment tool edge touch.

g. Tighten set-screw.

h. When replacing tape unit overlay, original tape must be replaced with tape coated with adhesive material on both sides. For Velcro method, pssition overlay and apply pressure around edges and center to engage Velcro.

5-54 Reel Servo Belt Tension Adjustment

The following reel servo belt tension adjustment procedures applies to both the supply and the take-up reel assemblies. The reel servo belt tension can be adjusted as follows:

a. Remove power from tape unit.

b. Loosen the three screws that secure tha motor mounting plate to the deck stand-offs. (See figure 4-2.)

5-55 Vacuum Motor Belt Tension Adjustment

For Model 2740 tape units with serial numbers preceding Serial No. V0576XXXXX adjust the vacuum motor belt tension 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 1/4-inch deflection in the vacuum motor belt with a 1-pound force applied. Do not over-tighten belt.

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

For Model 2740 tape units with serial numbers after Serial No. V0576XXXXX adjust the vacuum motor belt tension using one of the two following methods:

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 1/8-inch deflection in the vacuum motor belt with a 1-pound force applied. Do not over-tighten the belt.

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

Alternate method:

a. Remove power from the tape unit.

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

c. Using a Gates 5M tension gauge (table 5-3) position the vacuum motor for 10-12 pounds of belt tension.

d. When installing a new belt, run the tape unit for approximately 1/2-hour and remeasure belt tension. Readjust if necessary.

5-56 Tape Tension Adjustment (Tension Arm Unit)

Tape tension is controlled by the spring attached to each of the tension arms. The tension is adjusted by means of the spring anchor. Figure 5-14 shows the measurement and adjustment of the tape tension. A 3-foot length of tape with loops at each end is used: tape is mounted as shown. A 1-pound force gauge is used to measure the tape tension. Care must be taken to zero the scale in the correct orientation of the gauge and to pull on the tape in the direction it would be going on the reel. The spring anchor is adjusted until the tension is 8 ± 1/2 ounces with the arm in the center of its operating region.

5-57 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 enable ring on the supply reel hub. Check that the write lockout plunger (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.

c. If the plunger rubs on the bottom of the groove, loosen the plunger's locking nut and rotate the plunger screw until it just clears the bottom of the groove.

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

e. If the microswitch doesn't close, loosen the locking nut, rotate to lengthen the plunger until the microswitch just closes. Tighten the locking nut.

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.

5-58 Retract Motor Limit Switch Adjustment

Remove power from the tape unit and perform the following steps to adjust the retract motor switch.

a. Loosen the bolt which fastens the motor shaft to the motor connecting arm. (See figure 4-2.)

b. Turn the connecting arm until the connecting rods are perpendicular, and the supply retract arm is next to the arm-up microswitch.

c. Loosen the arm-up microswitch mounting screw and position the assembly such that the microswitch closes in the center of the retract arm's end. Tighten the mounting screw.

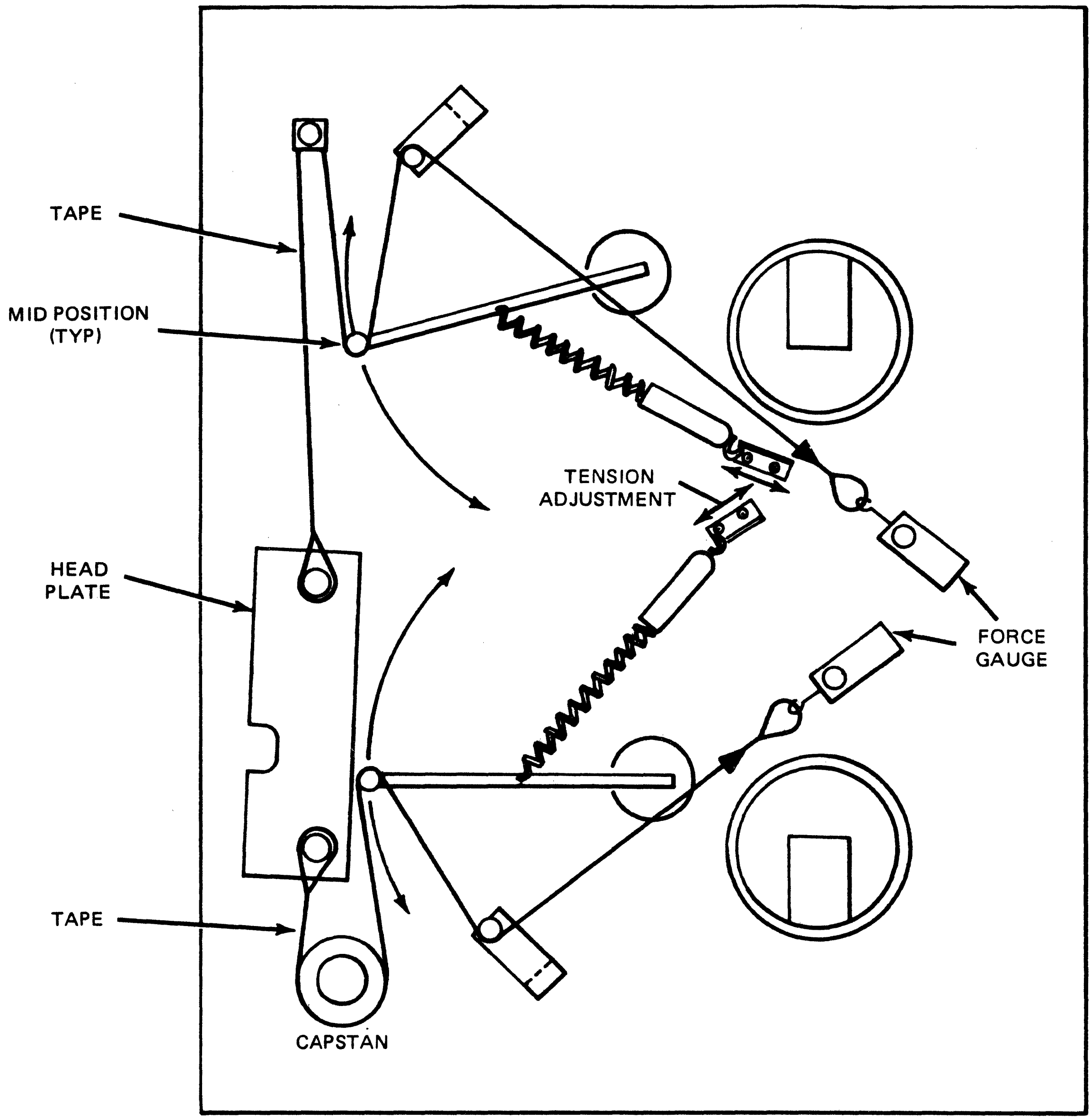


Figure 5-14. Tape Tension Adjustment Setup

d. Turn the motor connecting arm until the connecting rods are perpendicular and the take-up retract arm is next to the arm-down microswitch microswitch.

e. Loosen the arm-down mounting screw and position the assembly such that the microswitch closes in the center of the retract arm's end. Tighten the mounting screw.

f. Tighten the motor shaft bolt.

5-59 TROUBLESHOOTING

Troubleshooting of the Models 2730 and 2740 Magnetic Tape Units 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 checks, refer to the paragraphs on system level troubleshooting and to the troubleshooting charts. Note that the troubleshooting procedures do not include checking 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.

5-60 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 (figure 2-7).

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

5-61 SYSTEM LEVEL TROUBLESHOOTING

An initial check should always be 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 signal developed in the suspected circuits are correct when compared to signals developed indipendent of the suspected circuit.

5-62 TROUBLESHOOTING CHARTS

The system troubleshooting charts in table 5-6 are provided to aid the maintenance tenchnician in isolating malfunctions in the tape unit. The troubleshooting charts provide typical symptoms of malfunctions along with probable causes, possible remedies and references to procedures within the manual which may aid the maintenance technician in isolating a fault circuit. These tables should be used in conjunction with the assembly and schematic diagrams in the attached drawing package.

5-63 COMPONENT REPLACEMENT

The following paragraphs provide procedures for replacing various components within the Models 2730 and 2740 Magnetic Tape Units. Before attempting any of the maintenance, technician should refer to the mechanical assembly illustrations in figures 4-2, 4-3, 5-1, 5-3, and to the various illustrations and drawings in the attached drawing package.

5-64 LIMIT SWITCH REPLACEMENT PROCEDURE

a. Disconnect the power leads from the limit switch (figure 5-3) and note terminal connection of power leads.

b. Remove the two mounting screws that attach the mounting bracker to the retract arm motor assembly.

c. Remove the two screws that attach the limit switch to its plate and remove the switch.

d. Attach the new limit switch to the plate, using the two mounting screws removed in step c.

e. Attach the limit switch bracket to the retract arm motor assembly using the two screws removed in stop b.

f. Attach the power leads to the limit switch. Perform the limit switch adjustment procedure shown in paragraph 5-44 or 5-58.

5-65 TAPE GUIDE ROLLER REPLACEMENT

a. Remove the clip-ring and washer securing the tape guide roller to the tape guide shaft.

b. Remove the tape guide roller and bearing assembly.

TABLE 5-6 TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
Does not start to load.	EOT and BOT not working properly or reflective post dirty or out of adjustment.	Check operation and adjust the BOT and EOT amplifiers.	para. 4-34, 5-9 fig. 5-1
	LOAD or RESET switch defective.	Check operation of switches. Replace as necessary.	para. 4-18, 4-28
	Retract Motor Limit Arm-up switch or flip-flop defective.	Check operation of switch and flip-flop. Adjust as necessary.	para. 4-19, 5-58
	Logic Problem, LDA flip-flop is not set.	Repair Tape Control Board	para. 4-17
Load operation does not move tape into column or move the tension arms properly.	K3 Relay or Driver defective.	Check to see if K3 contacts close. Replace.	para. 4-18
	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. 4-18
	Interlock switches defective.	Check operation of switches. Adjust or replace.	para. 4-18, 5-44
Load operation moves tension arm or moves tape into vacuum column, but tension is not made.	Interlock switches do not close.	Check operation of switches. Adjust or replace.	para. 4-18, 5-44
	Kl relay or driver defective.	Check to see if Kl contacts close. Replace.	para. 4-18
	Retract Motor Limit Arm-up switch or flip-flop defective.	Check operation of the switch and its flip-flop. Adjust.	para. 4-19, 5-58
	Osc and Sync Det. malfunction.	Loop a length of tape in the columns (figure 5-4). Press the load switch to turn on the vacuum motor. Check operation of the OSC and sync detectors. Replace.	para. 4-22, 5-24

TABLE 5-6 TROUBLESHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
	Photo Resistor/Shutter Assembly not operative.	Check the operation of the assembly. Adjust.	para. 4-23, 5-18
	Reel Servo Amplifiers malfunction.	Check operation of servo amplifiers. Adjust.	para. 4-21, 5-21, 5-23
Retract Motor doesn't move tension arms to load position when tape path is clear.	EOT/BOT amplifiers not working properly or reflective post dirty or out of adjustment.	Check operation and adjust the EOT and BOT Amplifiers.	para. 4-34, 5-9 fig. 5-1
	Defective arm down switch.	Check operation of the switch and adjust it if necessary.	para. 4-19, 5-55
	K3 relay or driver defective.	Check to see if K3 contacts close. Replace.	para. 4-18
When the capstan moves tape, the interlock switches open.	Photo Resistor/Shutter assembly not operative.	Check operation of the assembly. Adjust.	para. 4-23, 5-18
	Osc and Sync Det. malfunction.	Loop a length of tape in the columns (figure 5-4). Press the LOAD switch to turn on the vacuum motor. Check the operation of the OSC and Sync Detectors. Replace.	para. 4-22, 5-24
	Capstan speed or ramp not correct.	Remove tape from around capstan. Check capstan speed and ramp at TP12.	para. 4-25, 5-12, 5-17
	Reel Servo is out of adjustment.	Adjust Reel Servo.	para. 4-21, 5-21, 5-23

TABLE 5-6 TROUBLESHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
Tape moves past BOT marker during LOAD or REWIND.	Dull BOT tab.	Replace BOT tab.	
	BOT amplifier malfunction.	Check operation and adjust the BOT amplifier.	para. 4-34, 5-9
	Logic problem, LDB flip-flop is not reset or RWDB is not set.	Repair tape control board.	para. 4-18, 4-33
Tape unit doesn't respond to For/Rev commands but to manual switch.	Tape unit not online or selected.	Check that the correct select line is asserted. Check on-line switch and flip-flop. Repair if necessary.	para. 4-29, 4-30
	Select, SFC or SRC cable or receiver defective.	Check outputs of receivers for correct levels. Repair.	para. 4-31
Doesn't respond to manual For/Rev.	Defective BOT and EOT sensor or amplifier.	Check operation and adjust amplifier.	para. 4-34, 5-9
	Tape unit is not ready.	Check inputs to gate U36-8 to determine which one is not high.	para. 4-17
	Tape unit is online.	Check and replace online flip-flop.	para. 4-29
	Kl Relay contacts 10/9 do not make.	Check if TP14 and J1-1 are at the same voltage. Replace.	para. 4-18
	Component failure in For/Rev Ramp Gen. or Capstan Amp.	Check the operation of the components in the ramp gen. and amplifier.	para. 4-26, 4-28, 4-31, 5-12, 5-17
	Manual switch defective.	Check MFWD and $\overline{\text{MREV}}$ signals.	para. 4-31

TABLE 5-6 TROUBLESHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
Interlock switches are opened during rewind.	K2 Relay or driver not working properly.	Check that the contacts of K2 close. Replace.	para. 4-18, 4-33
	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. 4-24
	Reel Servos are not adjusted or working properly.	Check and adjust the reel servos.	para. 4-21, 5-21, 5-23
	Rewind speed or ramps are not correct.	Adjust the rewind speed and check the ramp times.	para. 4-27, 5-16
	Logic problem asserting a forward command during rewind operation.	Check that TP33 is zero during rewind. Repair.	para. 4-26, 4-30
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. 4-32, 4-36, 4-39, 4-42, 5-57
	Interface cable or receiver malfunction.	Check write data, data ready, LRC strobe and SWRT receiver outputs for proper levels. Repair.	para. 4-39, 4-42
	Write head connector not properly plugged into J1.	Check that head connector is securely into J1.	

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
Data is incorrectly written but a good tape can be read.	The tape is bad.	Replace the tape.	
	Intermittant connection with write power.	Check that the write lockout solenoid is energized and microswitch is solidly closed. Adjust or replace.	para. 4-36, 5-57
	Incorrect Data format.	Check pre-delays, post-delays and Data Format.	Table 3-6
	Write deskew needs adjustment.	Adjust the write deskew.	para. 4-39, 5-29
	Component in write electronics defective.	Check operation of write channels and repair if necessary.	para. 4-39, 4-42, 5-32, 5-41
A correctly written tape can not be read while being written.	Flux gate improperly adjusted.	Adjust flux gate.	para. 5-33, 5-40
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. 4-40, 4-43, 5-26, 5-35, 5-38
	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.	

TABLE 5-6 TROUBLESHOOTING CHART (Continued)

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
	PE Data Board component failure in envelope detector circuit.	Check the envelope detector delays. Replace.	para. 4-43
	Component failure in threshold circuit.	Check threshold voltage (PE: TP4, NRZI: TP11) Repair.	para. 4-40, 4-44, 5-36, 5-42
	No select, motion or high density signals on data board.	Check that the signals are present on the Data Board. Repair.	para. 4-30,4-31 4-35
	Component failure in the read channels.	Check operation of read channels and repair if necessary.	para. 4-40, 4-43
	For single gap head, faulty write head driver.	Check if any head driver is causing current to flow in the head. Repair.	para. 4-39, 4-42

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

d. Secure the new tape guide roller to the tape guide shaft with the clip-ring and washer removed in step a.

e. Check the tape guide height as shown in figures 5-10 or 5-12.

f. If the alignment is not correct, perform the tape guide roller adjustment procedures detailed in paragraphs 5-49 or 5-50.

5-66 REEL SERVO MOTOR REPLACEMENT PROCEDURE

a. Disconnect the power leads from the reel servo motor (figure 4-2) and note terminal connnection of power leads.

b. Remove the three screws that secure the motor mounting plate. Use these screws to attach the new motor to the motor mounting plate. Install pulley on new motor shaft.

c. Remove the screws attaching the motor to the motor mounting plate. Use these screws to attach the new motor to the motor mounting plate. Install pulley on new motor shaft.

d. Use the screws removed in step b to secure the motor mounting plate to the deck stand-offs.

e. Perform the Reel Servo Belt Tension Adjustment (paragraph 5-54).

f. Connect power leads to the reel servo motor.

5-67 CAPSTAN MOTOR REPLACEMENT

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

b. Remove the head covers.

c. Gently remove the tape unit overlay (secured with double adhesive tape, etc.), taking care not to damage any components mounted on the headplate assembly.

d. Loosen the set-screw securing the capstan to the capstan motor shaft and remove the capstan.

e. Remove the screws attaching the capstan motor to the tape unit base-plate. Note location of shims so that new motor can be shimmed in same manner. Reinstall 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, paragraph 5-52 or 5-53.

g. Install the tape unit overlay. The original tape must be replaced with tape coated with adhesive material on both sides (Part No. 33700001-01).

h. Install the head covers.

i. Connect power leads to the capstan motor.

5-68 REEL SERVO BELT REPLACEMENT

a. Loosen the three screws that secure the motor mounting plate to the deck stand-offs(figure 4-2).

b. Remove old reel servo belt.

c. Install new reel servo belt. Ensure that the belt teeth are seated correctly in the pulley teeth.

d. Perform the Reel Servo Belt Tension Adjustment (paragraph 5-54).

5-69 VACUUM MOTOR BELT REPLACEMENT PROCEDURE

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

b. Remove the old vacuum motor belt.

c. Install the new vacuum motor belt.

d. The vacuum blower pulley has four positions for mounting the vacuum motor belt (figure 2-7). Starting with the position of smallest diameter: this position is for 60 Hz operation for sea level to 5,000 feet: the next position is for 60 Hz operation from 5,000 to 10,000 feet; the next position is for 50 Hz operation from sea level, and the final position is for 50 Hz operation from 5,000 to 10,000 feet.

e. Align pulley such that belt is same distance (±0.020 inches) from plate assembly at both blower pulley and motor pulley.

f. Perform the Vacuum Motor Belt Tension Adjustment (paragraph 5-55).

5-70 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 (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 removed 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 5-25 or 5-37, respectively.

i. Install the head covers.

5-71 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 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 six 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 (paragraph 5-45).

j. Perform the Vacuum Column Electrical Adjustment (paragraph 5-23).

k. Replace the tape unit overlay. The original tape must be replaced with tape coated with adhesive material on both sides (Part No. 33700001-2).

l. Replace the head covers.

5-72 TRANSDUCER REPLACEMENT PROCEDURE

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

b. Remove the ten screws securing 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 body of the sensor.

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 finger tighten screws at terminal end of transducer that is being replaced. Tighten remaining screws, in order, working toward opposite end of transducer. Continue to gradually tighten screws in the above sequence. Do not exceed 4 inch-lb. of torque.

i. Disconnect vacuum source from transducers.

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

5-73 VACUUM CHAMBER WINDOW REPLACEMENT PROCEDURE

a. Remove the four screws that attach the vacuum chamber window hinges to the vacuum chamber and remove the old window.

b. Attach the new window to the vacuum chamber using the mounting hardward removed in step a. Do not tighten the four attaching screws.

c. Position the window until it is mounted squarely on the vacuum chamber and turn on the tape unit. The vacuum should hold the window firmly in place.

CAUTION

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

d. Tighten the hinge screws.

e. Verify the vacuum chamber window latch hold window closed. If necessary, reposition the window latch by removing the tape unit overlay, loosening the two latch screws, repositioning the latch unit overlay. The original tape holding the overlay must be replaced with tape coated with adhesive on both sides (P/N 33700001-02).

Chapter 6
DRAWINGS AND PARTS LIST

6-1 INTRODUCTION

This chapter contains parts location views and replaceable parts list tables for the Model 2730 and Model 2740 Magnetic Tape Units. Figures 6-1 and 6-2 show parts location for the Model 2730, and figures 6-3 and 6-4 show parts location for Model 2740. Figure 6-5 shows the parts location for the headplate assembly used on both models of the tape unit. Tables 6-1 through 6-6 list replaceable parts for both models of the tape unit. Tables 6-1 and 6-2 list replaceable parts unique to the Model 2730 and Model 2740, respectively. Tables 6-3 through 6-6 list replaceable parts applicable to both models to the tape units. Numerical callouts on figures 6-1 through 6-5 are keyed to the item numbers in Tables 6-1 through 6-6.

The drawings applicable to the tape unit with which this operation and maintenance manual has been shipped are contained in an attached drawing package. The drawings consist of PWBA and schematic drawings for all electronic components in the tape unit, and various wiring and interconnection diagrams applicable to the tape unit. The following list shows all of the drawings for the Model 2730 and Model 2740 Magnetic Tape Units which may be contained in an attached drawing package. Only the drawings applicable to a specific model and configuration of that unit will be included in a drawing package.

DRAWING TITLE	DRAWING No.
Tape Control Board PWBA	9040119
Tape Control Board Schematic Diagram	9940119
PE Data Board PWBA	9040121
PE Data Board PWBA Schematic Diagram	9940121
NRZI Data Board PWBA (Single Data Card Unit)	9040116
NRZI Data Board Schematic Diagram (Single Data Card Unit)	9940116
NRZI Data Board PWBA (Dual Data Card Unit)	9040087
NRZI Data Board Schematic Diagram (Dual Data Card Unit)	9940087
NRZI Data Board PWBA (Three Data Card, Quad Density Unit)	9040093
NRZI Data Board Schematic Diagram (Three Data Card, Quad Density Unit)	9940093
System Interconnect Diagram (Single Data Card Unit (Model 2730)	9930018
System Interconnect Diagram (Single Data Card Unit) (Model 2740)	9930038
System Interconnect Diagram (Two Data Card Unit)	9930024
System Interconnect Diagram (Three Data Card Unit)	9930041
System Interconnect Diagram (No Data Card Unit)	9930040
Power Supply Wiring Diagram (Model 2730)	9930014
Power Supply Wiring Diagram (Model 2730)	9930013
Power Supply Wiring Diagram (Model 2740)	9930030
Power Supply Wiring Diagram (Model 2730, No Data Card)	9930039
Power Supply Heat Sink Assembly	9020046
Power Supply Schematic Diagram (Model 2730, with Data Card)	9910031
Power Supply Schematic Diagram (Model 2730, No Data Card)	9910037
Power Supply Schematic Diagram (Model 2740)	9910035
Retract Arm Motor Wiring Diagram	9930012
Vacuum Chamber Wiring Diagram	9930016
Blower Motor Wiring Diagram (Single Triac)	9930031
Single Triac Cable Assembly	9060130
Single Triac PWBA	9040130
Transport Assembly Wiring Diagram (Dual Triac)	9930037
Dual Triac Cable Assembly	9060146
Dual Triac PWBA	9040132
Dual Triac Schematic Diagram	9940132

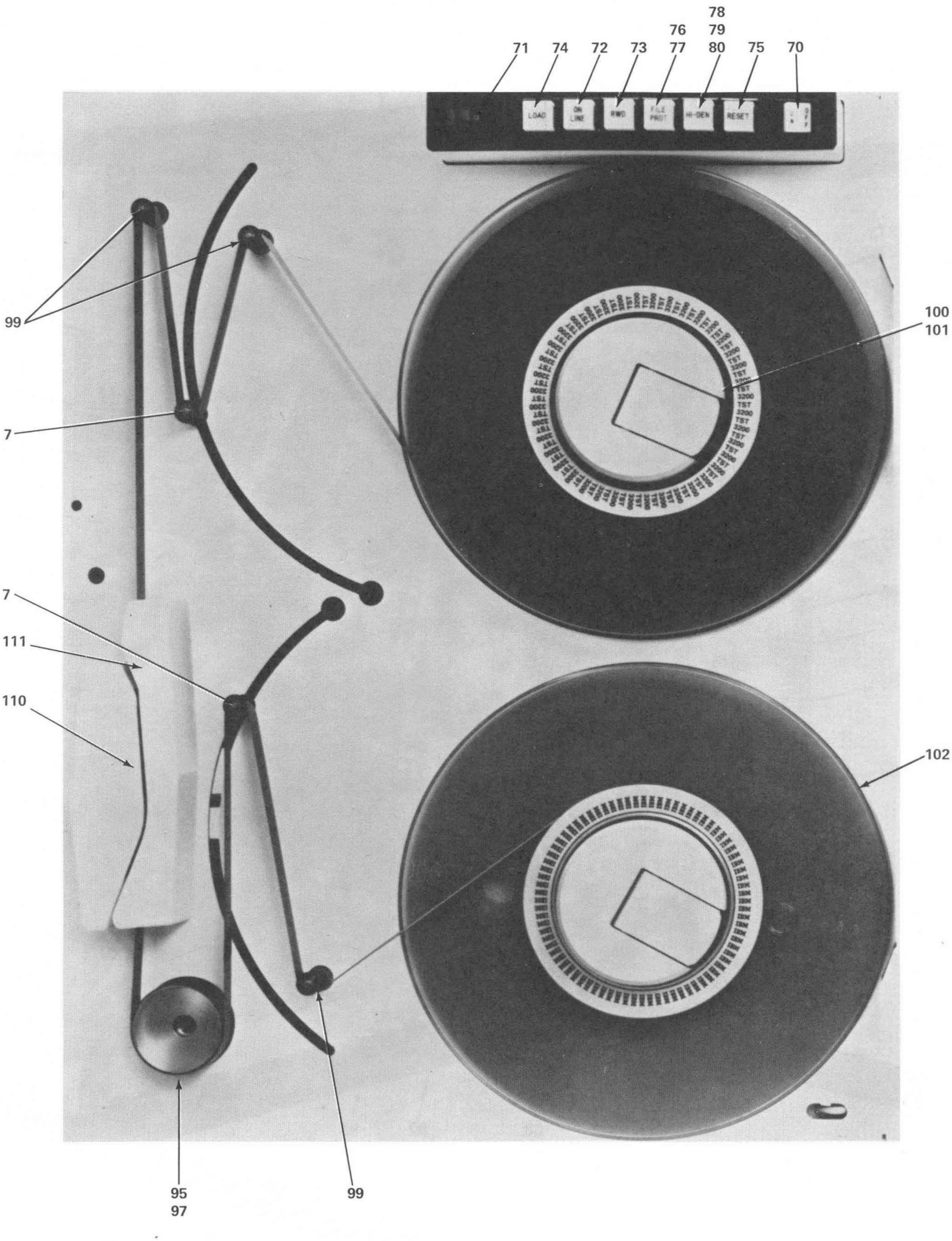


Figure 6-1. Model 2730 Parts Location, Front View

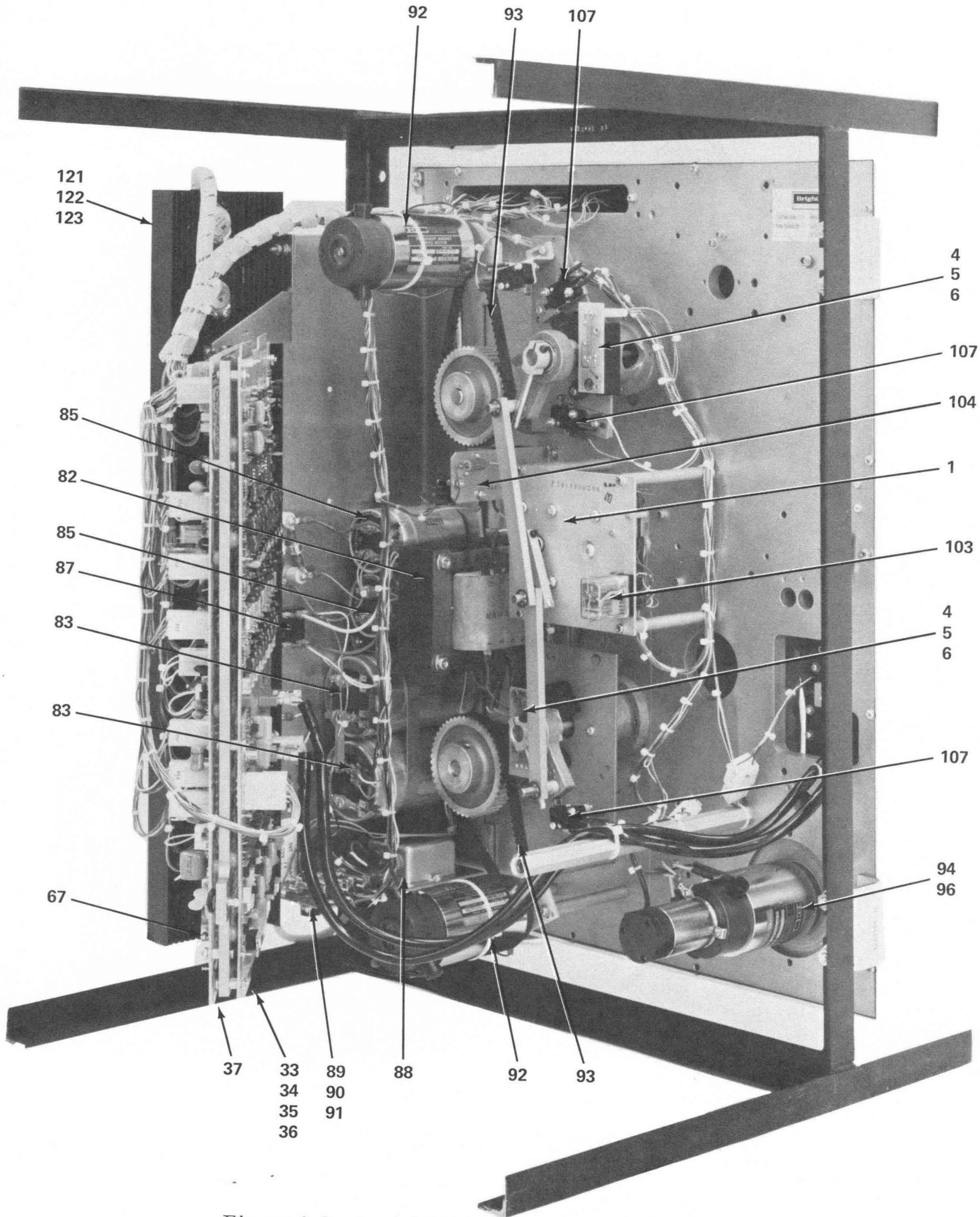


Figure 6-2. Model 2730. Parts Location, Rear View

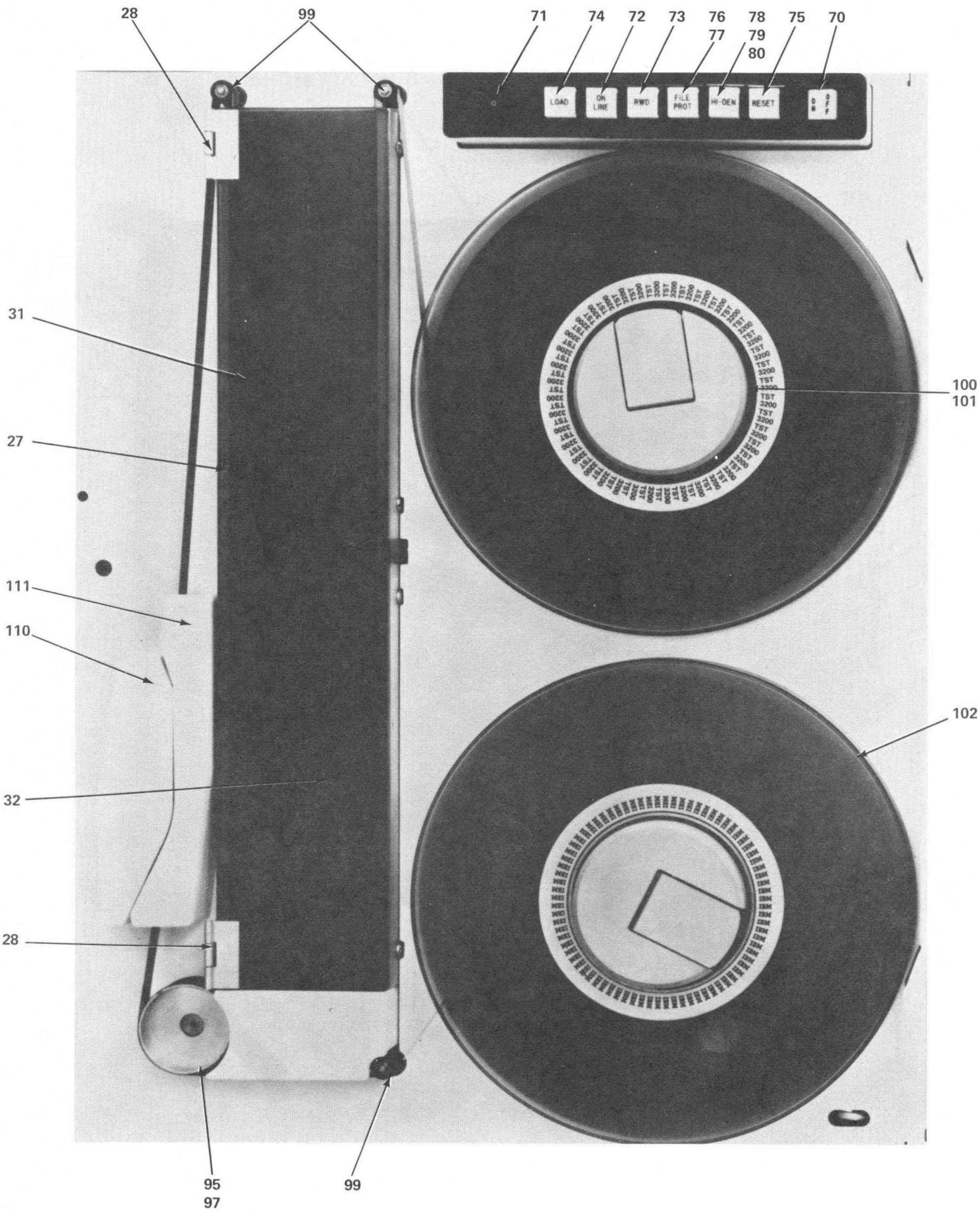


Figure 6-3. Model 2740. Parts Location, Front View

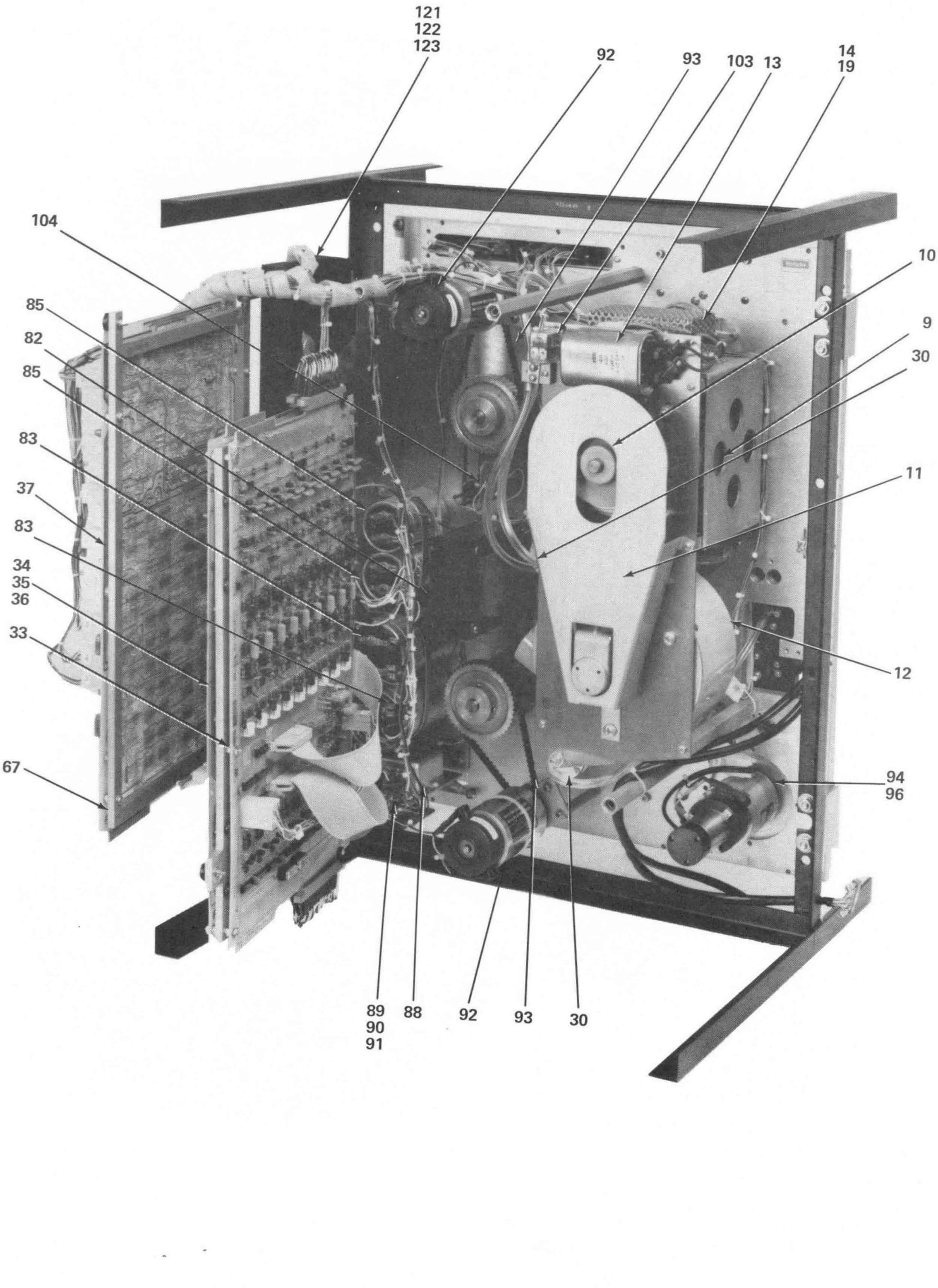


Figure 6-4. Model 2740. Parts Location, Rear View

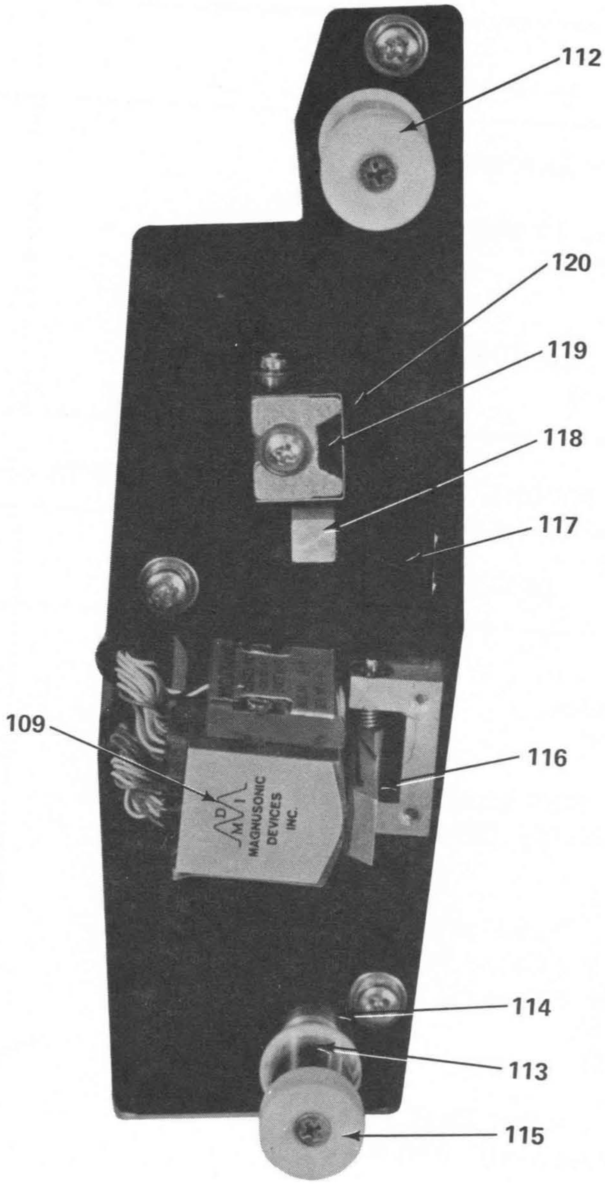


Figure 6-5. Head Plate Assembly (9020049-01) Parts Location

TABLE 6-1. MODEL 2730 REPLACEABLE PARTS LIST

FIGURE REF	DESCRIPTION	PART NUMBER
1	Retract Arm Motor Assembly	902-0044-01
2	Retract Motor	951-0022-01
3	Resistor, 200 ohm, 10 watt	04680201-01
4	Photo Sensor Assembly	902-0045-01
5	Photocell	04609752-01
6	Lamp	11110004-01
7	Tape Roller Assembly (Long)	902-0039-01
8	Tension Arm Spring	921-0337-01

TABLE 6-2. MODEL 2740 REPLACEABLE PARTS LIST

FIGURE REF	DESCRIPTION	PART NUMBER
9	Blower Motor	9510019-01
10	Blower Motor Pulley	9210272-01
11	Blower Motor Belt	3200001-02
12	Blower	50000089-01
13	Capacitor, 6uF, 320V (Single)	01574066-1
14	Triac Cable Assembly (Single)	906-0130-01
15	Triac PWBA	904-0130-01
16	Triac (MAC 10-4)	05500104-01
17	Cable Assembly, Transformer, Single Triac	906-0129-01
18	Cover Single Triac Cable Assembly,	921-0524
19	Dual Triac Cable Assembly	9060146-01
20	Dual Triac PWBA	9040132-02
21	Triac (S C250E3)	05500250-01
22	Triac (SC260E3)	0550260-01
23	Cable Assembly, Relay Dual Triac	9060171-01
24	Cover, Dual Triac Cable Assembly	9210578-01
25	Switch (S2)	08600004-01
26	Vacuum Chamber Assembly	9020050-01
27	Vacuum Chamber Window	926-0044-01
28	Hinge	921-0349-01
29	Latch	926-0081-01
30	Vacuum Switch	08700001-01
31	Tape Position Sensor (supply)	902-0038-01
32	Tape Position Sensor (take-up)	902-0038-02

TABLE 6-3. TAPE CONTROL AND DATA ELECTRONICS REPLACEABLE PARTS LIST

FIGURE REF	DESCRIPTION	UTILIZATION Control Board	NRZI Board	PE Board	PART NUMBER
33	PE Data PWBA			X	9040121-XX *
34	NRZI Data PWBA, Single Data Card Machine		X		9040116-XX *
35	NRZI Data PWBA, Dual Data Card Machine		X		9040087-XX *
36	NRZI Data PWBA, Three Data Card Machine (Quad Density)		X		9040093-XX *
37	Control PWBA	X			9040119-XX
38	IC, LM339	X	X		03000339-01
39	IC, SN 72709		X		03052709-01
40	IC, SN 72741	X			03052741-01
41	IC, SN 15836	X	X	X	03100936-01
42	IC, SN 151805		X		03101805-01
43	IC, SN 7400	X	X	X	03207400-01
44	IC, SN 7401		X		03207401-01
45	IC, SN 7404	X	X		03207404-01
46	IC, SN 7405		X		03207405-01
47	IC, SN 7408	X			03207408-01
48	IC, SN 7410	X	X	X	03207410-01
49	IC, SN 74H11	X			03207411-01
50	IC, SN 7420	X			03207420-01
51	IC, SN 7430	X			03207430-01
52	IC, SN 7438	X	X	X	03207438-01
53	IC, SN 74107	X	X	X	03204107-01
54	IC, SN 74123	X			03204123-01
55	IC, SN 75451	X			03155451-01
56	Transistor, 2N3053	X			05703053-01
57	Transister, 2N3904	X	X	X	05103904-01
58	Transistor, 2N3906	X	X	X	05203906-01
59	Transistor, 2N5321		X	X	05705321-01
60	Transistor, 2N5323		X	X	05705823-01
61	Transistor 2N5639	X			05305639-01
62	Diode, 1N914B	X	X	X	02100914-03
63	Diode, 1N4003	X		X	02104003-01
64	Diode, 1N4735	X		X	02204735-01
65	Diode, iN4740	X			02204740-01

* Indicate Machine Model Number and Tape Speed when ordering.

TABLE 6-3. TAPE CONTROL AND DATA ELECTRONICS
REPLACEABLE PARTS LIST (continued)

FIGURE REF	DESCRIPTION	UTILIZATION			PART NUMBER
		Control Board	NRZI Board	PE Board	
66	SCR 40654	X			05500654-01
67	Toggle Switch	X			08100003-01
68	Relay (K1 & K2)	X			414450 42-01
69	Relay Retainer	X			50000088-01

TABLE 6-4. TAPE UNIT CONTROL SWITCHES REPLACEABLE PARTS LIST

FIGURE REF	DESCRIPTION	PART NUMBER
70	Power Switch	926-0049-01
71	Address Switch	08200004-01
	Momentary Switches	
72	Online	08300016-02
73	Rewind	08300016-03
74	Load	08300016-04
75	Reset	08300016-05
76	File Protect Indicator	11520001-01
77	Write Enable Indicator	11520001-02
	Alternate Action Switch	
78	HI DEN	08300018-01
79	1600 BPI	08300018-02
80	9 Track	08300018-03
81	Lamp	11130001-01

TABLE 6-5. POWER SUPPLY REPLACEABLE PARTS LIST

FIGURE REF	DESCRIPTION	PART NUMBER
82	Transformer	9510042-01
83	Capacitor, 38,000 uF, 25V (C3, C4)	01518389-01
84	Capacitor, 71,000uF, 25V (C5, C6)	01518719-02
85	Capacitor, 10,000uF, 25V	01538109-01
86	Diode (CR2, CR3)	02400831-01
87	Diode Bridge (CR1)	02509622-01
88	Filter (FL1)*	05000001-01
89	Fuse, 5Amp (F4, F5)	09230001-01
90	Fuse, 10 Amp (F2, F3)	09240001-01
91	Power Fuse (CF1), 3 Amp, Slo Blo(2730)/220VAC)	09220000-01
	2.5 Amp, Slo Blo (2730/220VAC) (UL)	09220002-01
	5 Amp Slo Blo (2730/115VAC, 2740/ 220VAC)	09230002-01
	8 Amp Slo Blo (2740/220VAC) (UL)	09230004-01
	10 Amp, Slo Blo (2740/115VAC)	09240002-01
	10 Amp, Slo Blo (2740/115VAC) (UL)	09240003-01

*Not used on Power Supplies
9020030-02 and -04 (Model 2730)

TABLE 6-6. MISCELLANEOUS REPLACEABLE PARTS LIST

FIGURE REF	DESCRIPTION	PART NUMBER
92	Reel Motor	951-0018-01
93	Reel Motor Belt	32000002-01
94	Capstan Motor (Electrocraft)	951-0016-01
95	Capstan	921-0264-02
96	Capstan Motor (PMI)	951-0017-01
97	Capstan	921-0264-01
98	Speed Disc	
	12.5 and 25 IPS	921-0378-04
	37.5 IPS	921-0378-02
	45 IPS	921-0378-03
99	Tape Roller Assembly (Short)	902-0030-02
100	Reel Retainer Assembly	902-0035-01
101	Rubber Ring	926-0070-01
102	Reel	50000065-01
103	Relay (K3)	41445042-01
104	Write Lockout Assembly	902-0031-01
105	Solenoid	951-0029-01
106	Resistor, WW 20ohm, 5W	04670200-01
107	Miniature Switch (with Roller)	08500003-01

TABLE 6-6. MISCELANEOUS REPLACEABLE PARTS LIST (continued)

FIGURE REFERENCE	DESCRIPTION	PART NUMBER
108	Connector (26-pin)	07120007-01
109	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
110	Head Cover, Short	9260055-01
111	Head Cover, Long	9260056-01
112	Fixed Tape Guide	9210306-01
113	Washer, Tape Guide	9210068-01
114	Spring, Tape Guide	9210069-01
115	Cap, Tape Guide	9260030-01
116	Head Shield Assembly	9020032-01
117	EOT/BOT Assembly	9060063-01
118	Reflective Post	921035-01
119	Body, Tape	921-277-01
120	Blade, Tape Cleaner	9210279-01
121	Power Transistor 2N3055 (Mounted on Heat Sink)	05703055-01
122	Power Transistor 2N6058 (Mounted on Heat Sink)	05706058-01
123	Power Transistor 2N6051 (Mounted on Heat Sink)	05706051-01
124	Tape, Foam Closed Cell	33800008-01
125	Tape, Foam Double Coated, 1/8-inch	33700001-01
126	Tape, Foam Double Coated, 1/4-inch	33700001-02
127	Shim .001 inch thickness	9210250-92
128	Shim. 0005 inch thickness	9210250-02
129	Shim. 003 inch thickness	9210348-01
130	Shim .005 inch thickness	9210246-01

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