MANUAL NO. 9580017-00

END-ITEM MODEL NO. ____

END-ITEM PART NO. ____

SALES ORDER NO. ____

SERIAL NO. ____

DATE ____

Model 2760 Magnetic Tape Unit

OPERATION & MAINTENANCE MANUAL

AMCOMP

686 WEST MAUDE AVENUE
SUNNYVALE, CALIFORNIA 94086

ISSUED: JUNE, 1976

LIST OF EFFECTIVE PAGES

Insert latest change pages. Destroy superceded pages. Total number of pages in this manual is 176 consisting of:

Page	Issue
Title	Original
A	Original
i through iii	Original
viii blank	Original
ix	Original
1-0 through 1-7	Original
1-8 blank	Original
2-1 through 2-11	Original
2-12 blank	Original
3-1 through 3-20	Original
4-1 through 4-74	Original
5-1 through 5-39	Original
5-40 blank	Original
6-1 through 6-9	Original
6-10 blank	Original

* The asterisk indicates pages changed, added or deleted by the current change.

TABLE OF CONTENTS

CHAPTER 1 - GENERAL INFORMATION

CHAPTER 2 - INSTALLATION

CHAPTER 3 - OPERATION

TABLE OF CONTENTS (continued)

CHAPTER 4 - PRINCIPLES OF OPERATION

CHAPTER 5 - MAINTENANCE

TABLE OF CONTENTS (continued)

CHAPTER 5 - MAINTENANCE

Chapter 6 - DRAWINGS AND PARTS LISTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (continued

LIST OF TABLES

INTRODUCTION

This manual describes the Model 2760 Magnetic Tape Unit manufactured by AMCOMP, INC., 686 West Maude Avenue, Sunnyvale, California. The Model 2760 is a 10-1/2 inch reel, dual vacuum column, digital magnetic tape unit that reads and writes ANSI and IBM compatible formats using either NRZI or phase encoded (PE) methods.

The manual is divided into 6 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.

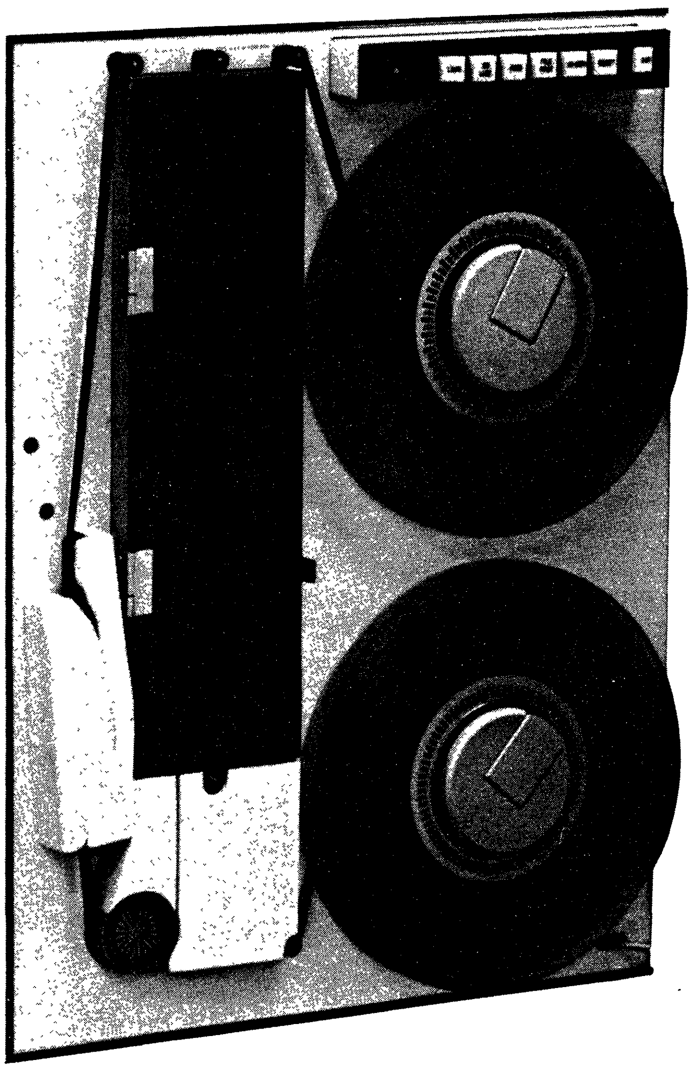


Figure 1-1. Model 2760 Magnetic Tape Unit

Chapter 1
GENERAL INFORMATION

1-1 INTRODUCTION

This chapter contains a description of the Model 2760 Magnetic Tape Unit, its internal components and the optional equipment, interface configurations and accessories available on the unit. Performance specifications and equipment characteristics pertaining to the Model 2760 are listed at the end of the chapter.

1-2 GENERAL DESCRIPTION

The Model 2760 is a highly reliable, dual vacuum column, digital magnetic tape drive. See figure 1-1. The Model 2760 reads and writes data in ANSI and IBM compatible formats using either NRZI or phase encoded (PE) methods. Data is recorded on either 7-track or 9-track tapes at 125 inches per second (ips). A dual speed 125/75 ips tape unit is also available. Magnetic tape recorded on the Model 2760 can be read on any other ANSI or IBM compatible tape unit. Also, the Model 2760 can read 7-track or 9-track tapes recorded on any other ANSI or IBM compatible tape unit. The tape unit uses Maximum 10-1/2 inch diameter tape reels.

The Model 2760 Magnetic Tape Unit uses either a single gap read/write head, or a dual gap, simultaneous read and write head. A separate erase head is always mounted ahead of the write head. A wide choice of other standard options pertaining to bit densities and other features are available on the Model 2760. Options are described in paragraph 1-4.

The tape unit is designed specifically for remote control of the read, write, forward, reverse, rewind, and packing density select functions. Up to four Model 2760 Tape Units can be daisy-chained and individually addressed by the same external controller.

1-3 PHYSICAL DESCRIPTION

The components of the Model 2760 Magnetic Tape Unit are mounted on a precision machined tape unit baseplate. All tape handling components, the heads and the operator controls on the front of the baseplate. A dust cover, mounted on the front of the baseplate, protects the tape and tape handling components from contaminants during operation. All operator controls are accessible through the front of the dust cover. The capstan motor, reel servo motors, vacuum components, and all other mechanical and electromechanical components are mounted on the back of the tape unit baseplate. Refer to figure 1-2.

The control and data electronics are mounted on two circuit boards attached to a frame that is hinges to the back of the tape unit baseplate. If the dual data board option is selected, the second data board is mounted to an additional hinged frame attached to

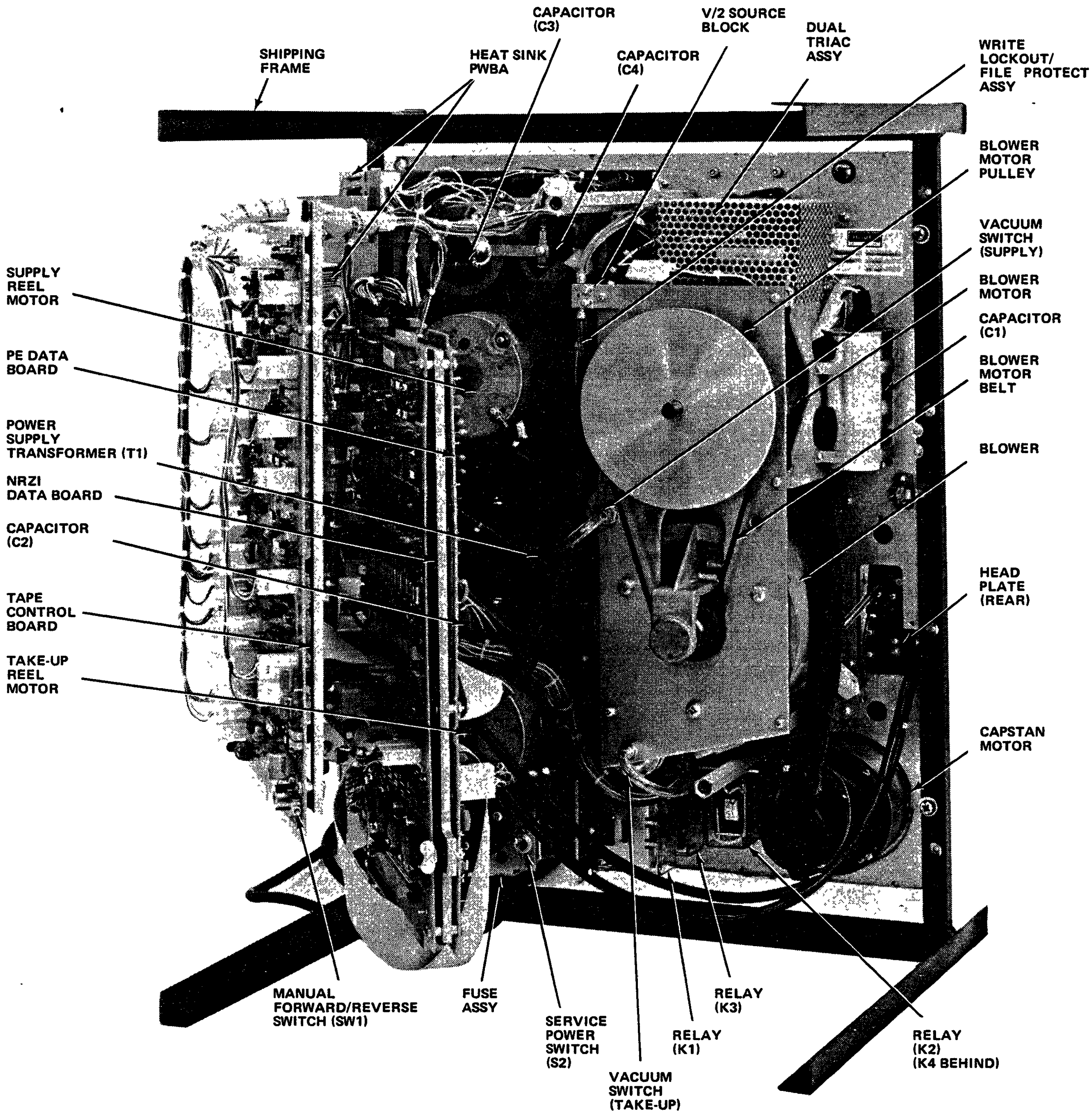


Figure 1-2. Open View of Model 2760 Magnetic Tape Unit

the back of the tape unit baseplate. The power transistors are mounted on an air cooled heatsink and connected to a circuit board on the heatsink. All external control and signal cables connect directly to the edge connectors of the 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

The Model 2760 Magnetic Tape Unit has a wide choice of optional equipment interface configurations and accessories available. The configuration of each tape unit can be determined by the model number. The model number is located on the identifying tag attached to the back of the tape unit baseplate. The model number appears in the following form:

MODEL 276W-XYZ

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

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

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

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

3. Density Select Interface Line - allows the packing density or speed to be selected via the interface.

4. Status Line (Opt. 1) - allows the status lines (rewind, 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.

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

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

TABLE 1-1. OPTIONAL CONFIGURATION IDENTIFICATION LIST

The Model Number 276W-XYZ designates equipment configuration as shown here

W	NUMBER OF TRACKS	X	HEAD CONFIGURATION
7	seven track head	1	dual gap head
8	seven and nine track head (read only)	2	single gap head
9	nine track head		
		Y	**PACKING DENSITY AND RECORDING METHOD**
		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 and PE, 9 tracks)
		8	800 BPI (NRZI, 7 or 9 tracks)
		Z	**TAPE SPEEDS**
		1	125 ips
		2	125/62.5 ips
		3	112.5 ips
		4	125/75 ips
		5	125/37.5 ips

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

10. Automatic On Line - the tape unit is set on line at the completion of a load sequence when the BOT marker is reached.

11. 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.

12. Rewind and Unload - allows a tape unloading sequence to be initiated from a remote controller.

13. Front Panel Disable - allows front panel switches to be disabled when 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 & EQUIPMENT CHARACTERISTICS

Table 1-2 describes the electrical, environmental and mechanical specifications pertaining to the Model 2760 Magnetic Tape Unit.

TABLE 1-2 PERFORMANCE SPECIFICATIONS & EQUIPMENT CHARACTERISTICS

CHARACTERISTIC	VALUE
Type of Tape Storage	Vacuum Chamber - Linear servo driven.
Recording mode	NRZI or Phase Encoded - IBM and ANSI compatible
Number of Tracks	7 or 9
Head Configuration	Single or Dual Gap
Bit Density	200, 556, 800, 1600 BPI
Tape Speed	125 ips (maximum)
Rewind Speed	375 ips
Data Transfer Rate	200,000 characters per sec., maximum
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 μ inches, maximum
Dynamic	75 μ inches, maximum
Tape Tension	8.0 (±0.5) oz.
Reel Size	10.5 inches, maximum
Tape Type (IBM P/N 457892 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
Read Thresholds	NRZ: 12%, 25%, and 45% selectable remotely. PE: 5%, 15%, and 40%, selectable remotely.
Input Signal Parameters	
Asserted (True)	0.0 to +0.4 volts
Not Asserted (False)	+2.5 to +5.0 volts
Output Signal Parameters	
Asserted (True)	40 mA max. current sink
Not Asserted (False)	open collector

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

CHARACTERISTICS	VALUE
Power Requirements	
Line Frequency	48 to 62 Hz
Line Voltage	95 - 125 Vac ±10% (in 5 steps) 190 - 250 Vac ± 10% (in 10 steps)
Power Consumption	1200 Watts maximum
Environment	
Temperature, Operating	$30^{o}F$ to $122^{o}F$.
Storage	150^{o} to $160^{o}F$.
Humidity	15% to 95% without condensation
Altitude	0 to 10,000 feet
Dimensions	
Height	24 inches
Width	19 inches
Depth, overall	15.4 inches
Depth, from mounting surface	12.0 inches
Weight	130 lbs., maximum
Daisy Chaining	Built in provision

Chapter 2

INSTALLATION

2-1 INTRODUCTION

This chapter contains information pertaining to the installation of the Model 2760 Magnetic Tape Unit. Included are the instructions and data necessary to plan and complete the installation of the tape unit up to the point at which the tape unit has been checked out and is ready for normal operation.

2-2 INSTALLATION PLANNING

2-3 EQUIPMENT LOCATION

The Model 2760 Magnetic Tape Unit may be located adjacent to any other electronic data processing equipment provided the temperature, humidity, and other environmental characteristics are within specified limits. Refer to table 1-2, Performance Standards and Equipment Characteristics for the environmental characteristics of the tape unit. The tape unit should notbe located in a strong magnetic field because the recording head assemblies and other components can become magnetized causing interference with the read/write operation. To obtain optimum performance from the tape unit the ambient temperature fluctuation should be kept as small as possible and a reasonably clean and dust free environment should be provided. It is also important that a free flow of air is allowed around the tape unit and through the rack in which the tape unit is mounted.

The magnetic tape unit is designed to be mounted in an adequate 19-inch electronic equipment rack cabinet. The tape unit requires 24 inches of vertical rack space. When the tape unit is mounted, the rack should be located on a firm, vibration free surface. See figure 2-1 for mounting dimensions on the Model 2760.

2-4 CABLING CONSIDERATIONS

The Model 2760 Magnetic Tape Unit is shipped with all internal interconnect cabling completed. All external data and control interface signal cabling, and primary AC power connections must be completed in the field at the time of installation. Refer to figure 2-2 for a typical cabling diagram. No external grounding straps or other grounding devices are required in addition to the ground lead in the primary AC power input cable.

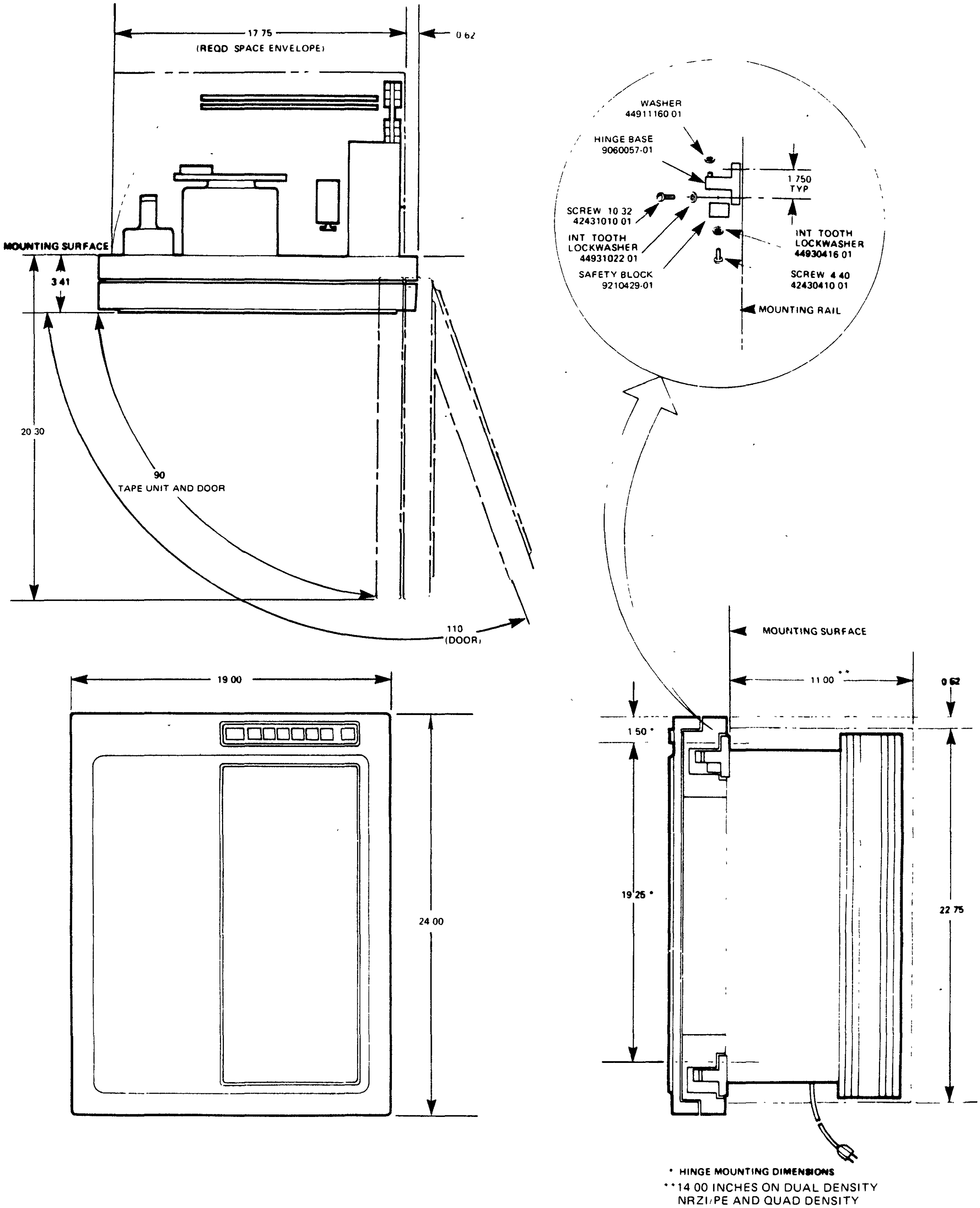
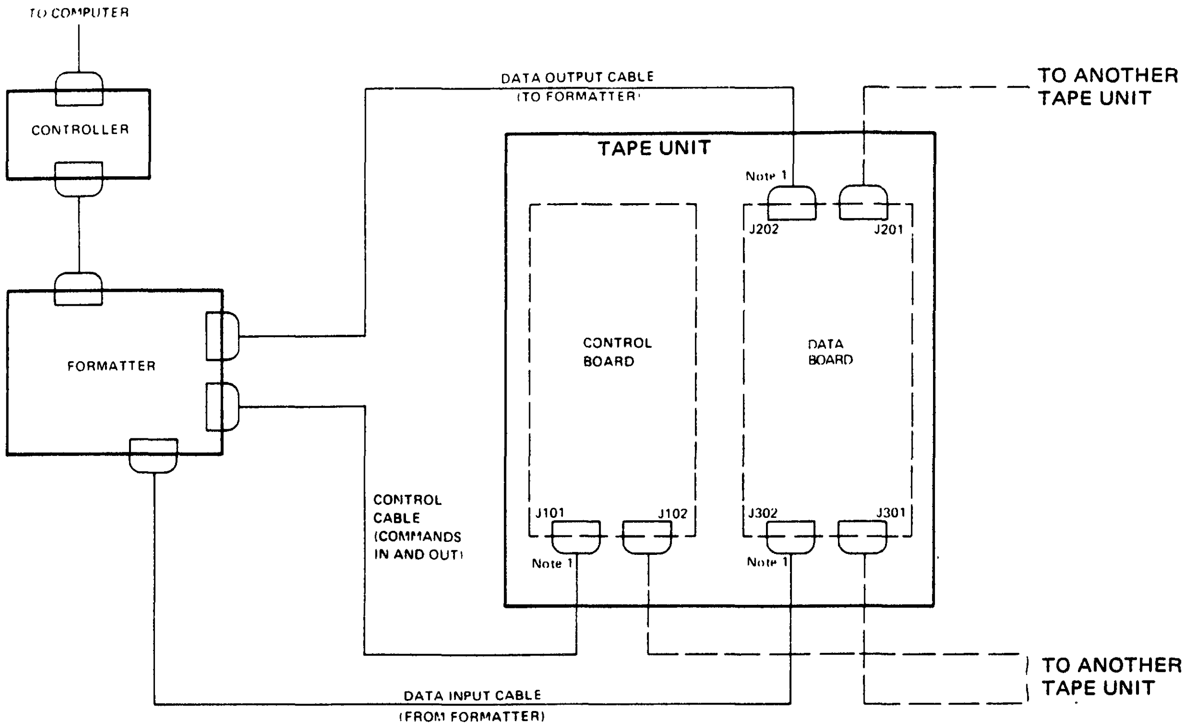


Figure 2-1. Installation Mounting Dimensions for the 2700 Series Tape Units



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

Figure 2-2. Typical Cabling Diagram, Single Data Board Option

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 for a typical cabling diagram of the single data board option and to figure 2-3 for a typical cabling diagram of the dual data board option.

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 2-4. The additional circuit card edge connectors must be ordered and cables must be fabricated. The total length of all sets of data or control cables cannot exceed 20 feet. All tape units have the auxiliary data and control signal output connectors, so that no equipment modifications have to be performed. However, the signal line terminating resistors normally installed on all units at the factory must be removed on all except the last unit in the daisy-chain. These resistor networks are 220/330 DIP type and their location is shown in figure 2-4. Figure 2-5 shows a schematic of the resistor networks.

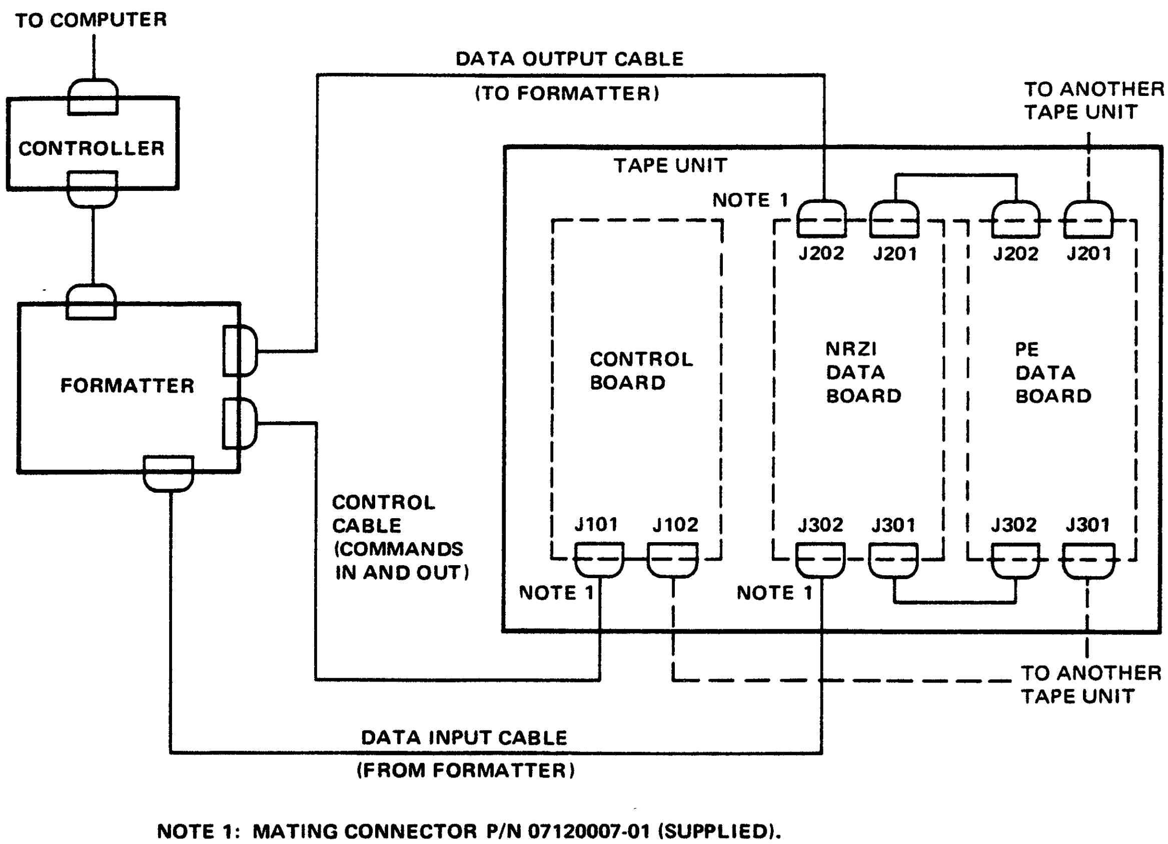


Figure 2-3. Typical Cabling Diagram, Dual Data Board Option

2-6 INTERFACE CIRCUITS

The tape unit data board drivers and receivers are shown in figure 2-5. The interface must be compatible with these circuits in order for the tape unit to function correctly.

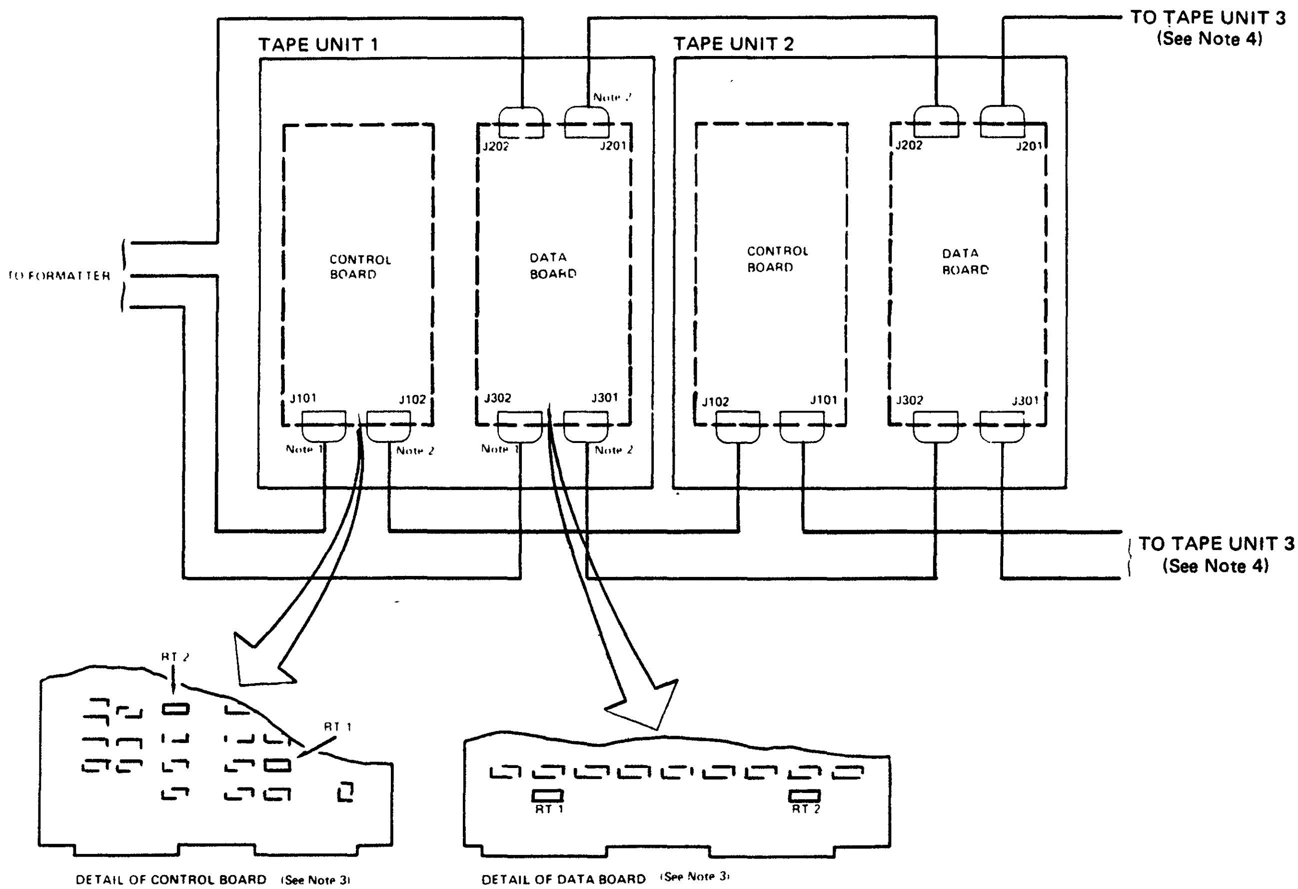
Logic Levels are:

Asserted (True)	0.0 to +0.4 vdc
Not Asserted (False)	+2.5 to +5.0 vdc

2-7 CABLE FABRICATION

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

The mating connector is AMCOMP P/N 07120007-01 or equivalent. All connector pin assignments are contained in tables 2-1, 2-2 and 2-3.



NOTES:
1. SAME AS ON FIGURE 2-2.
2. MATING CONNECTOR – SAME AS NOTE 1, BUT NOT SUPPLIED.
3. TERMINATING RESISTOR (P/N 04600001-02) NETWORKS ARE TO BE REMOVED FROM ALL EXCEPT THE LAST TAPE UNIT IN THE DAISY-CHAIN.
4. UP TO FOUR TAPE UNITS MAY BE DAISY-CHAINED.

Figure 2-4. Typical Cabling Diagram for Daisy-Chained Installations

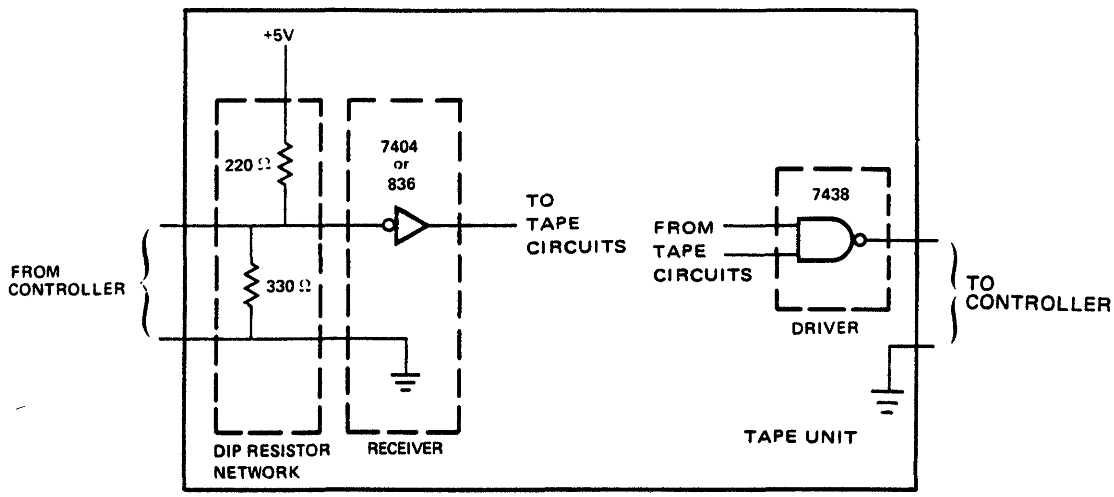


Figure 2-5. Tape Unit Interface Circuits

2-8 INSTALLATION

2-9 UNPACKING AND INSPECTION

The tape unit is shipped in a special double packing case, which should be saved if reshipment of the equipment is planned. Within the packing case the tape unit is attached to a shipping frame with three bolts. The shipping frame will hold the tape unit upright when the unit is removed from the packing case and placed on a level surface. There is also a separate shipping kit contained in the packing case. The shipping kit contains the rack mounting hardware for the tape 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 160 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.

CAUTION

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

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

SIGNAL CONNECTOR PIN	GROUND CONNECTOR PIN	MNEMONICS	SIGNAL NOMENCLATURE
			COMMAND INPUTS
J	8	ISEL 0	Address Select Unit 0
A	8	ISEL 1	Address Select Unit 1
18	8	ISEL 2	Address Select Unit 2
V	8	ISEL 3	Address Select Unit 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
I	2	ILOL	Load and On Line
			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*

NOTES: 1. (*) Indicates tape unit option.
2. "I" Prefix refers to interface signals.

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

SIGNAL CONNECTOR PIN	GROUND CONNECTOR PIN	MNEMONIC	SIGNAL NOMENCLATURE
2	B	IRDS	Read Data Strobe
1	A	IRDP	Read Data Parity
3	C	IRD0	Read Data 0
4	D	IRD1	Read Data 1
8	J	IRD2	Read Data 2
9	K	IRD3	Read Data 3
14	R	IRD4	Read Data 4
15	S	IRD5	Read Data 5
17	U	IRD6	Read Data 6
18	V	IRD7	Read Data 7
12	N	ISST	Single Gap
10	L	INRZI	NRZI
13	P	ISPD	Speed
11	M	17TRK	Seven Track

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

2. "I" prefix indicates interface signals.

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

SIGNAL CONNECTOR PIN	GROUND CONNECTOR PIN	MNEMONIC	SIGNAL NOMENCLATURE
			DATA INPUTS
E	5	IRTH1	Read Threshold 1
F	6	IRTH2	Read Threshold 2
A	1	IRDY	Data Ready
C	3	ILRCS	LRC Strobe
L	10	IWDP	Write Data Parity
M	11	IWD0	Write Date 0
N	12	IWD1	Write Data 1
P	13	IWD2	Write Data 2
R	14	IWD3	Write Data 3
S	15	IWD4	Write Date 4
T	16	IWD5	Write Data 5
U	17	IWD6	Write Data 6
V	18	IWD7	Write Data 7

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

2. "I" prefix indicates interface signals.

b. Open the outer and inner packing case and remove the contents. Check items removed with the shipping list to verify packing case contents. Contact AMCOMP, INC. in the event of a packing shortage.

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

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

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

2-10 MOUNTING 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, or 2-4, To mount the tape unit, refer to figure 2-1 and proceed as follows:

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

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

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

NOTE

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

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

1. Loose relays (located below vacuum blower).

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

e. Check that the input power transformer (see figure 2-1) is connected correctly to supply the primary power voltage from which the tape unit is to be operated. Refer to figure 2-6.

f. Ensure that the blower motor pulley/belt is correct as shown in figure 2-7.

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

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

i. Plug in the primary power cable and turn on equipment power with the ON/OFF switch on the front of the tape unit, and the Service Power Switch at the rear of the tape unit. Verify that tape unit power comes on.

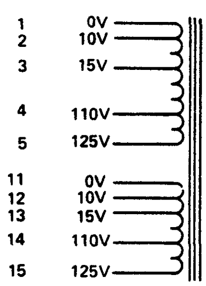
j. Load a reel of tape on the tape unit according to the procedures in chapter 3. This will verify that the tape unit can move tape and can execute the loading sequence properly.

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

l. Press the RWD pushbutton to verify that the tape properly rewinds (at 375 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.



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 2-6. Input Power Transformer Primary Winding Diagram

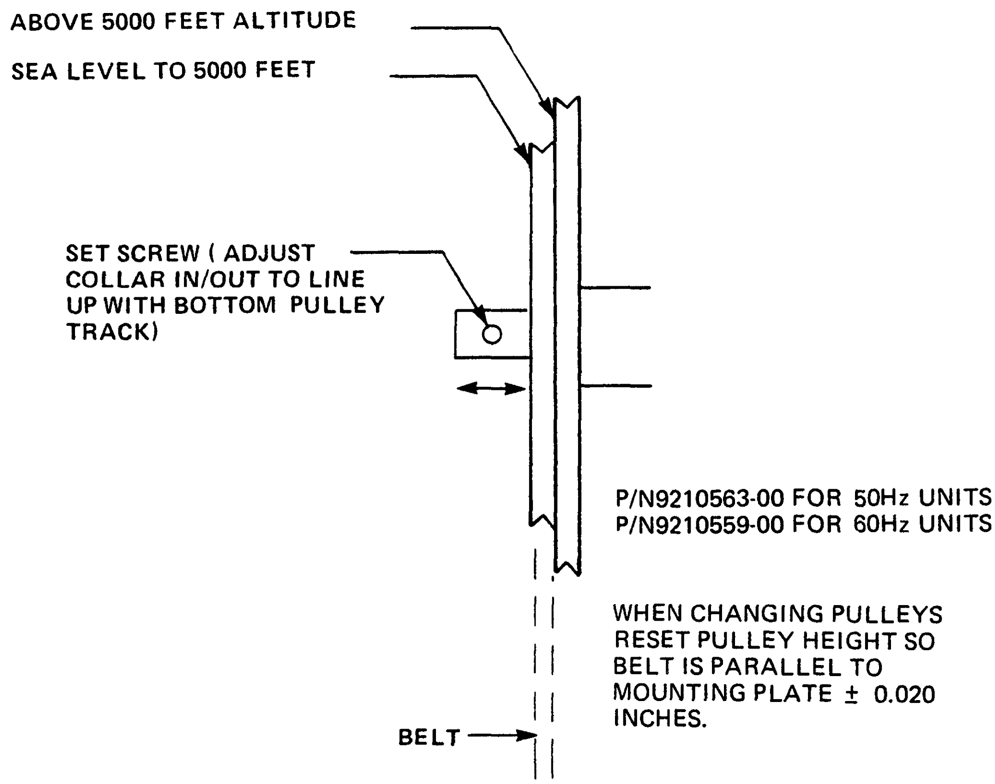


Figure 2-7. Model 2760 Blower Motor Pulley/Belt Positioning

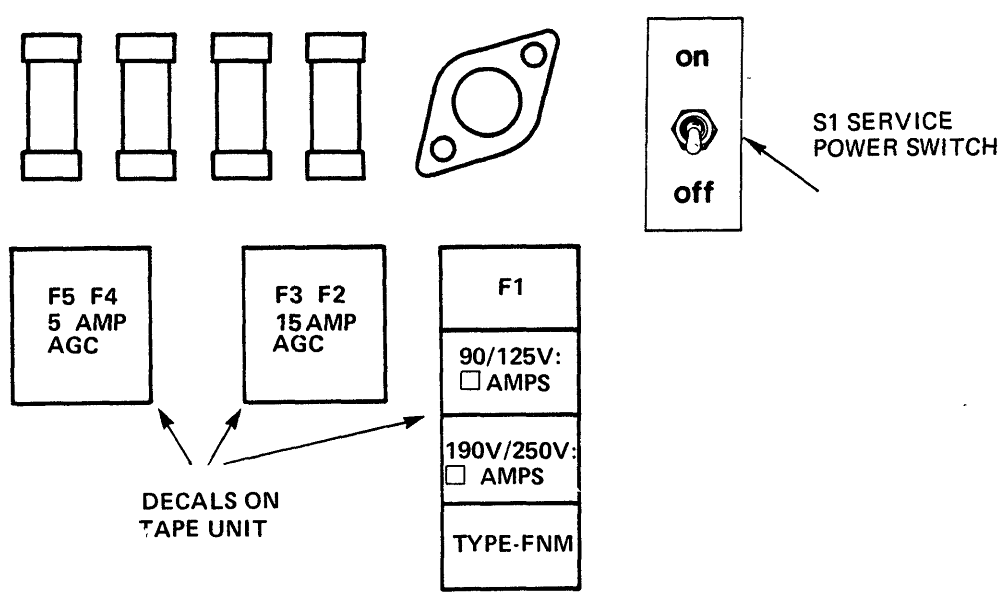


Figure 2-8. Tape Unit Fuses.

Chapter 3
OPERATION

3-1 INTRODUCTION

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

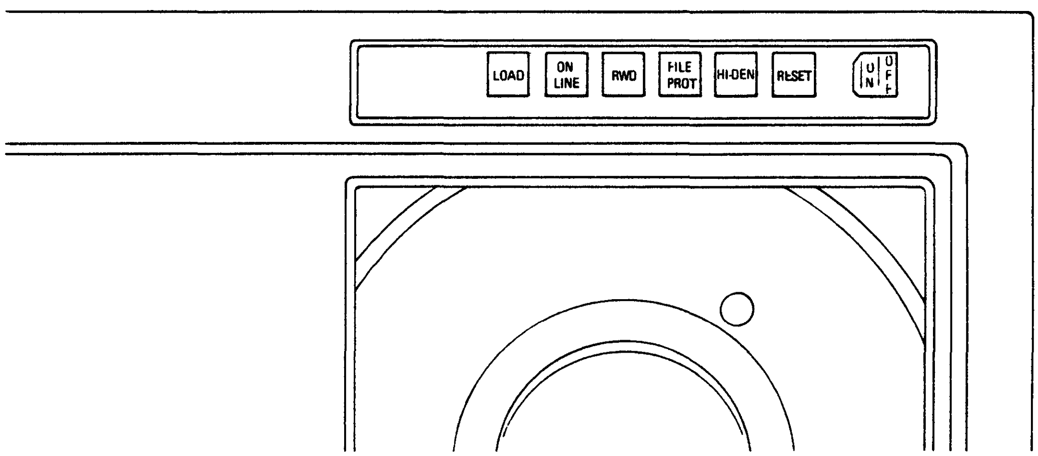


Figure 3-1. Tape Unit Front Panel Controls and Indicators

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

TABLE 3-1. CONTROLS AND INDICATORS (continued)

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

3-3 OPERATING PROCEDURES

3-4 GENERAL OPERATING PRECAUTIONS

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

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

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

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

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, in order to ensure maximum data reliability.

3-5 OPERATORS PREVENTIVE MAINTENANCE

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

To clean these components use a clean, lint-free cloth or cotton 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 verify Service Power switch S2 is on is on and proceed as follows:

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

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

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

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

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

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

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

h. Press ON LINE switch to enable the controller to assume control. Whenever the controller asserts the ISELECT address line the tape unit is under remote
cn 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 it is selected, the operator switches are disabled.

3-7 UNLOADING TAPE

To unload tape proceed as follows:

a. Press RESET or ON LINE pushbutton to place unit off line.

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

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

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

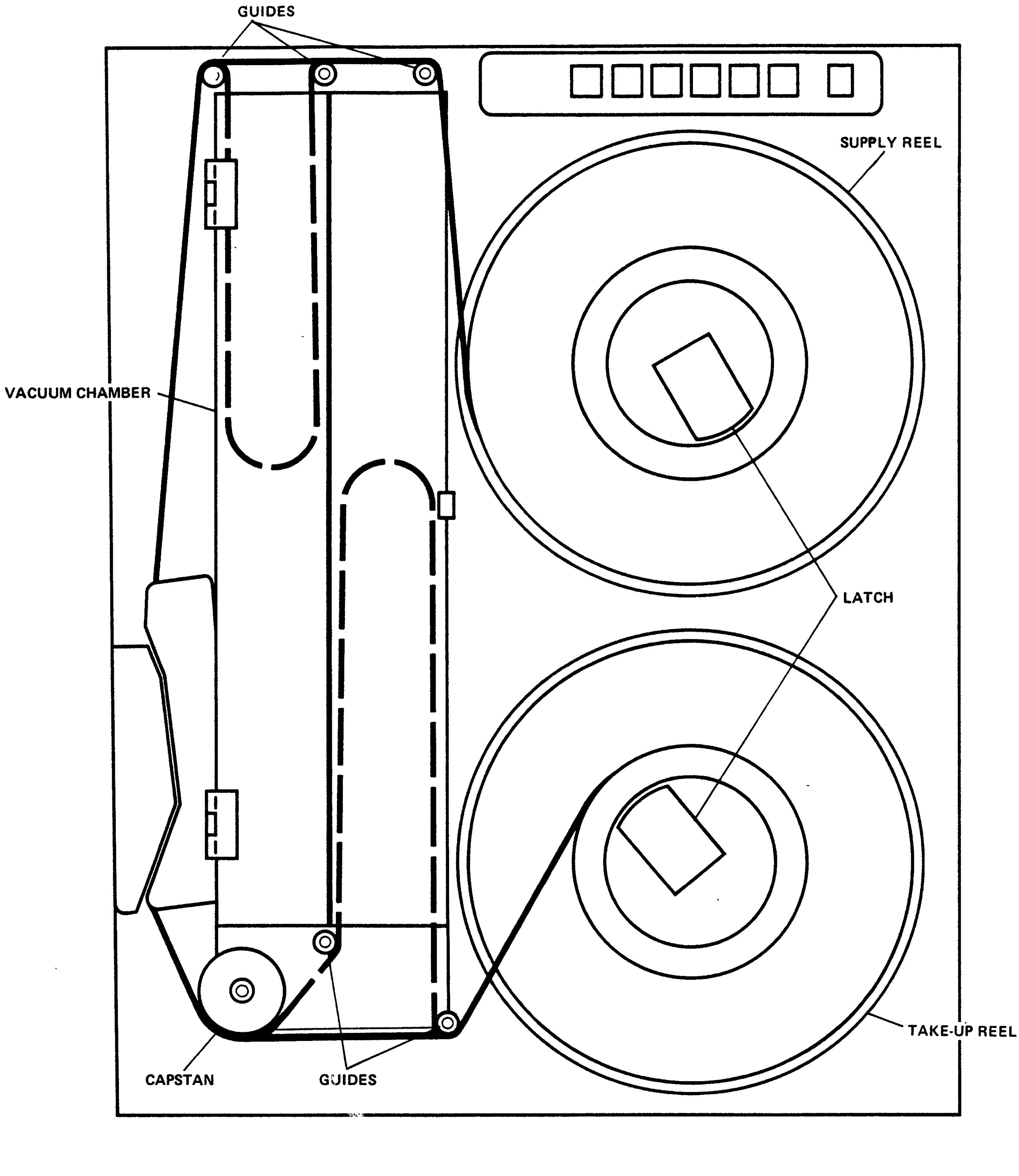


Figure 3-2. Diagram of Tape Threading Path

3-8. TAPE TRACK LAYOUT AND DATA FORMATS

3-9 TAPE TRACK LAYOUT

Depending on the exact equipment configuration, the Model 2760 Tape Unit can read and write standard 9-track or 7-track tapes. Figure 3-3 shows the orientation and layout dimensions of tape tracks for both formats. Note that 9-track tape is used both for PE recording or NRZI, whereas 7-track tape is used only for NRZI.

3-10 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.

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

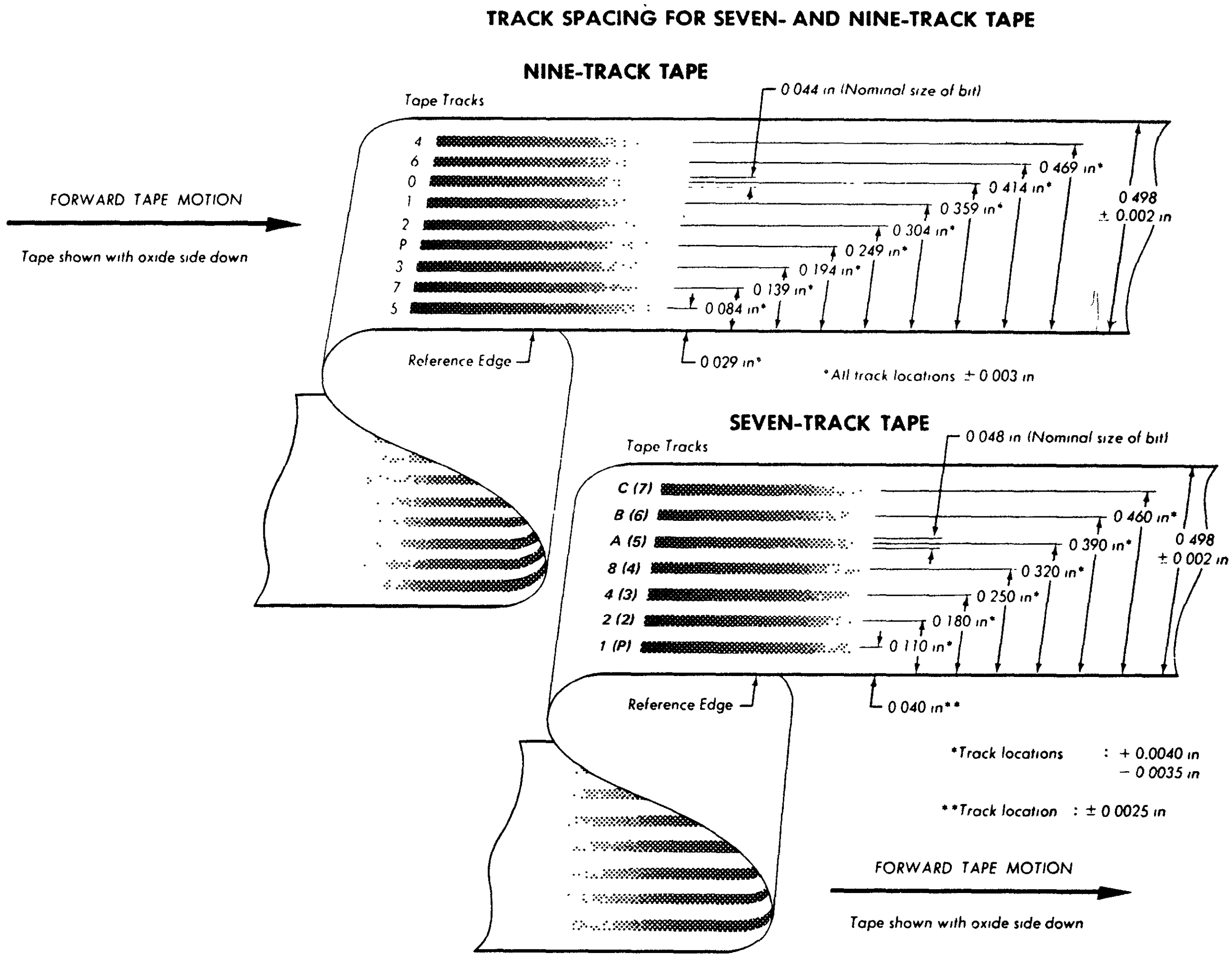


Figure 3-3. Tape Track Layouts

BEGINNING-OF-TAPE AND END-OF-TAPE AREAS

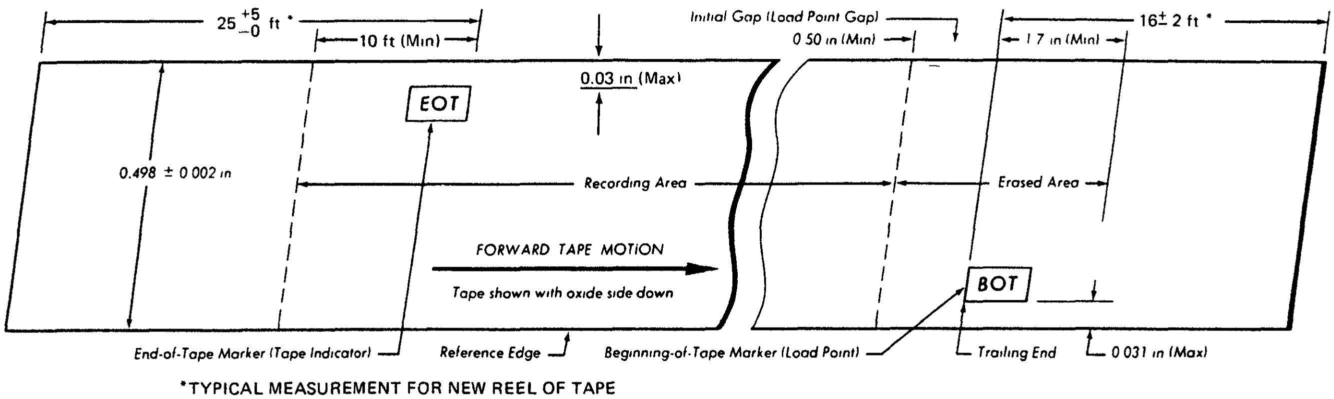


Figure 3-4. BOT and EOT Erase Formats.

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 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 as a flux change in the opposite direction. On the output lines the data is self clocked and does not require an output clock (Read Strobe).

The data is formatted on the tape in records, with each record consisting of a preamble, the data, and a postamble. See figure 3-7. The preamble consists of 40 characters of all logic 0's and one character of all logic 1's. The postamble is a mirror image of the preamble, and consists of one character of all logic 1's and 40 characters of all logic 0's. A minimum spacing of 0.5 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 shown in figures 3-6 and 3-8, respectively. The corresponding preamble and postamble for PE recording is described in paragraph 3-12. The end-of-file mark for PE recording is shown in figure 3-9.

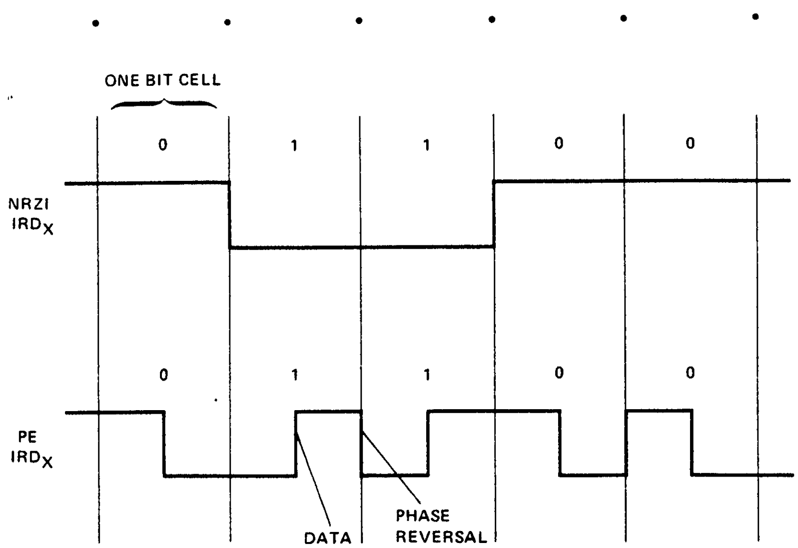


Figure 3-5. NRZI and Phase Encoded Data Formats

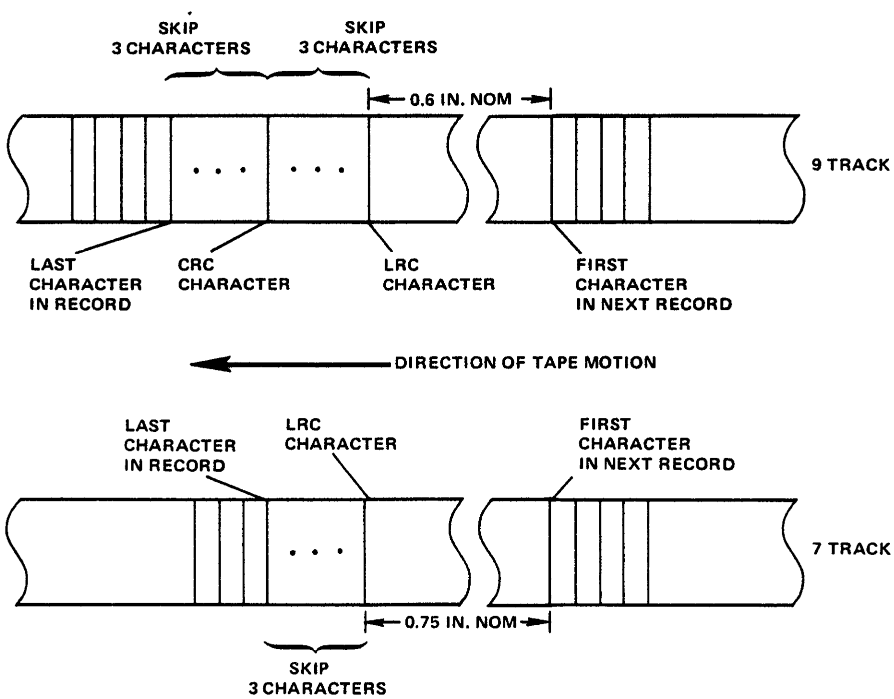


Figure 3-6. End-of-Record Mark Formats for 7 and 9 Track NRZI Tapes

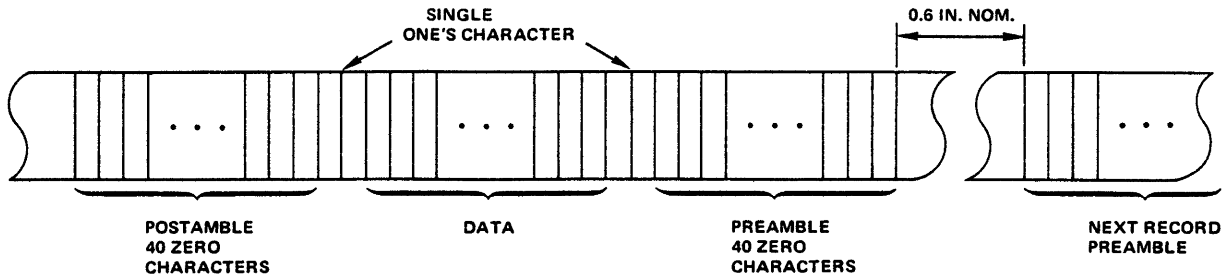


Figure 3-7. PE Record Data Formats

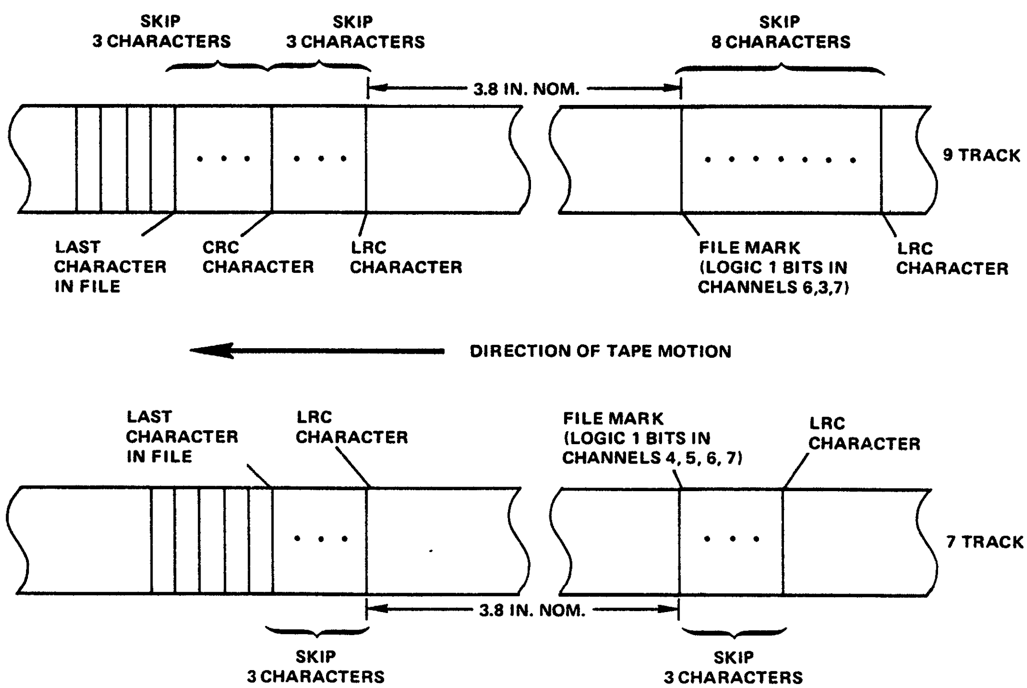


Figure 3-8. End-of-File Mark Formats for 7 and 9 Track NRZI Tapes

3-14 PROGRAMMING INFORMATION

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

1. Data Inputs - the data and parity lines, data ready line, and LRC strobe;

2. Data Outputs - data and parity lines, data strobe line, and several status lines;

3. Command Inputs - lines that select the tape unit, initiate tape motion, enable a read or write operation, and generally control operation of the tape unit; and

4. Command Outputs - lines that generally indicate the status of the tape unit, the position of the tape (at BOT or EOT), and other similar information.

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

3-15 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. Figure 3-10 shows typical timing interrelationships between these lines.

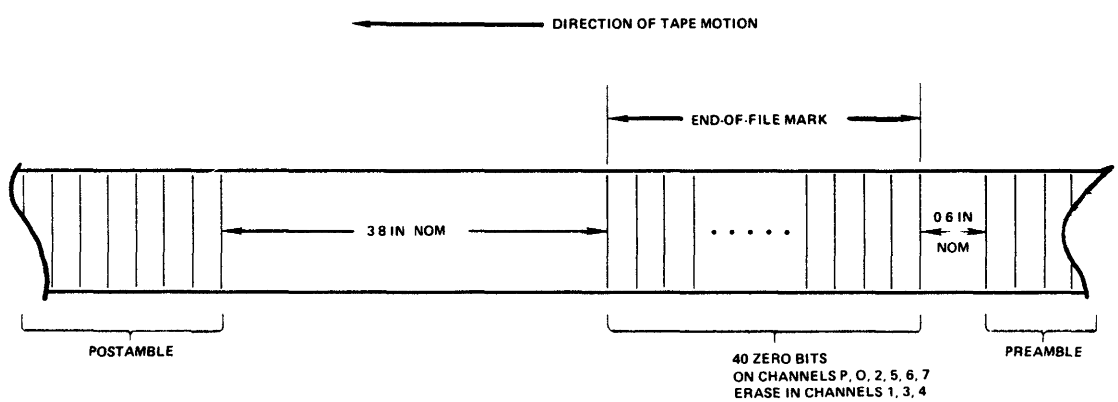


Figure 3-9. End-of-File Mark for PE Tapes

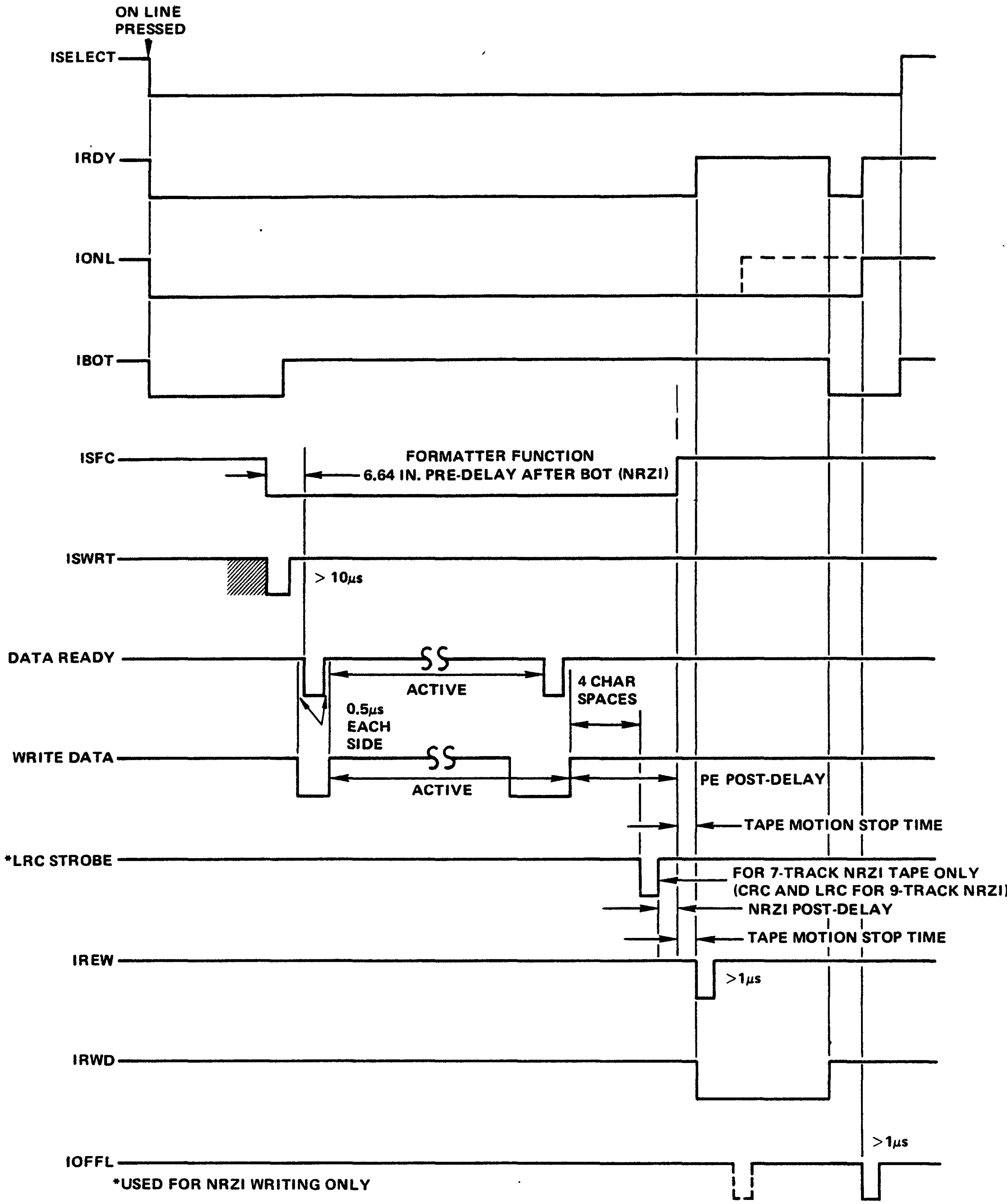


Figure 3-10. Timing Diagram for a Typical Start-Write-Stop Sequence

TABLE 3-2. TAPE UNIT DATA INPUT LINES

<table>
<tr><th>NAME</th><th>FUNCTION</th></tr>
<tr><td>DATA READY</td><td>This line must be asserted for a minimum of 1 microsecond during the time 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 microsecond before or after DATA READY.</td></tr>
<tr><td>WRITE DATA
7 or 9 lines</td><td>For recording NRZI data, any of these lines must be asserted each time a logic 1 bit is to be recorded on that track. The leading edge of the DATA READY pulse transfers the data into the tape unit write register.

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

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

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

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

3-16 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. 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 5 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 for tape units with a single gap head. It is not asserted for dual gap head units.
NRZI	A status line asserted for NRZI tape units; it is not asserted for PE tape units. This line is operative in the optional NRZI and PE combination tape units.
SPEED	This line may be used in installations in which two tape units of different operating speeds are connected to the same formatter. The line is asserted on the tape unit which has the lower of the two tape speeds.

3-17 COMMAND INPUTS

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

TABLE 3-4. TAPE UNIT COMMAND INPUT SIGNALS

NAME	FUNCTION
ISELECT 0-3	Four address select lines that are used for selecting a tape unit. These lines function in conjunction with the front panel Address Select thumbwheel switch so that if the front panel switch is in 0 position and ISELECT 0 line is asserted the tape unit is selected. Likewise, switch position 1 corresponds to ISELECT 1, etc.
ISFC (Forward)	When asserted, will cause the selected unit to accelerate to synchronous speed in the forward direction. The tape unit will automatically begin to read and output data, but tape motion will stop when this line is not asserted.
ISRC (Reverse)	When asserted, will cause the selected unit to accelerate to synchronous speed in the reverse direction and begin to read and output data. The ISRC command is not recognized if the IBOT command output is asserted. The tape unit will stop when this line is not asserted.
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.
ILOL (Load and On Line)	The logic circuitry for this signal is standard on Model 2760, but must be properly jumpered to be functional. This signal is used to remotely restart the tape unit after a power failure or when the tape unit is turned off in the middle of a reel of tape. When this signal is asserted for at least one microsecond, the tape is tensioned, the interlock is established, and the tape unit is placed on line.
ISWRT (Set Write)	Asserted for at least 10 usec 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 10 usec 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.

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

NAME	FUNCTION
IDDS (Density Select)	This line is optional on 7-track tape units and is asserted to cause the tape unit to read the higher density data. This functions the same as the HI-DEN switch described in table 3-1, but on any tape unit either the interface line or the switch is functional, but not both. This line may also be used on the optional NRZI and PE combination tape unit and asserted to cause the unit to operate in the 1600 bpi phase encoded mode. The function in this case is the same as the 1600 bpi switch described in table 3-1, but the interface line must be specified. Otherwise, the switch is functional. On dual speed tape units assertion of the IDDS line also causes the tape unit to move tape at the lower of the two speeds.
IREW (Rewind)	When this line is asserted for a minimum of 1 usec, the tape will be rewound to BOT. When the tape is at BOT, this line is inhibited.

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 3-5. 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. Press 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 can be enabled for an unselected on line unit.
IBOT (BOT)	Asserted to state that the tape unit has stopped motion and tape is positioned at the BOT tab.
IEOT (EOT)	Asserted to state that the tape unit has stopped motion and tape is positioned at the EOT tab. Optionally, the tape unit may be wired so that this signal is asserted by the EOT tab and remains on until reset by passing of the EOT tab in reverse direction of tape movement.
IFPT (File Protect)	Asserted to state that the selected tape unit has a write protected tape file mounted on it.
IDDI (High Density)	Asserted to state that the tape unit has been commanded to read the higher of two densities. In the optional NRZI and PE combination tape unit this line is asserted to indicate that the unit is operating in the Phase Encoded mode. On dual speed tape units this also indicates that the tape unit is operating at the lower speed.

3-19 PROGRAM SEQUENCE

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

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

3-20 START UNIT; READ 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 SELECT address line (0, 1, 2, or 3).

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

c. Assert ISFC and ISWRT. ISWRT can be cleared after 10 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 (milliseconds)	Total Delay (inches)
Write from BOT	54.6	6.640
Write - dual gap head		
7-channel	4.4	0.365
9-channel	3.4	0.240
Write - single gap head		
7-channel	5.6	0.515
9-channel	1.6	0.390
Write File Mark	30.0	3.565
Read from BOT	11.3	1.233
Read forward	2.4	0.120
Read reverse	2.4	0.120
Read reverse/edit	2.4	0.120
	POST-DELAYS	
Write	0.6	0.265
Write File Mark	0.6	0.265
Read forward	0.0	0.190
Read reverse/edit		
7-channel	2.6	0.515
9-channel	1.6	0.390
Read reverse		
7-channel	1.6	0.390
9-channel	0.6	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; WRITE 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 RESTART AFTER POWER FAIL

On all Model 2760 Tape Units an optional command input line ILOL can be used to restart the tape unit remotedly following power failure. Program the following sequence:

a. Clear all command input lines.

b. Wait one second.

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

d. Assert ILOL for one microsecond.

e. Wait one minute, check IRDY. If not true, the tape is not under tension.

The operator must rethread the tape.

f. Assert IREW.

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

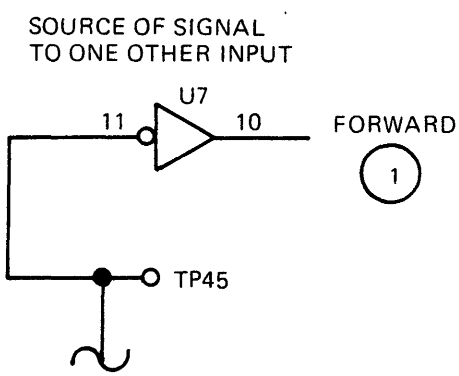
Chapter 4
PRINCIPLES OF OPERATION

4-1 INTRODUCTION

This chapter provides a general functional description of the Model 2760 Magnetic Tape Unit and a more detailed description of the individual electronic circuits contained within the unit. The material in this chapter must be read by maintenance personnel to gain an understanding of the tape unit prior to performing the maintenance described in chapter 5.

Generally, all logic symbols appearing in the logic diagrams in this manual are drawn in accordance with MIL-STD-806C. All logic elements are identified by a reference designator, such as U2, indicating the integrated circuir 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.



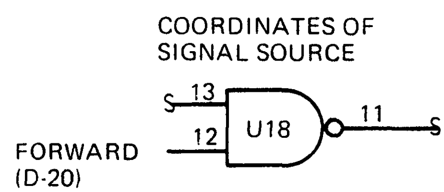


TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS

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 tab is detected.
BOT & $\overline{\text{BOT}}$	Beginning-of-tape.	Asserted when beginning-of-tape tab is detected not during a rewind, load or detecion of EOT tab.
DATA READY	Data 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.
IEOT		Interface end-of-tape signal status.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
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.
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.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
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.
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.
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 swithc 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 swithc to move tape in reverse direction.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
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.
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.
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.
RDYONL	Ready and on line	Indicates tape unit is loaded, not rewinding and 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.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
REVERSE & $\overline{\text{REVERSE}}$		Asserted when tape unit is on line, ready and selected.
REWIND (K4)		Indicates K4 relay udes 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.
$\overline{\text{RSTA}}$	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.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
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.
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 Data 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	Qualifies 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.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
$\overline{\text{SPD}}$	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.
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.

TABLE 4-1. SIGNAL MNEMONICS DEFINITIONS (continued)

MNEMONICS	DESCRIPTION	FUNCTION
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 2760 Magnetic Tape Unit provides a read and write data operation using either the NRZI or Phase Encoded (PE) methods. The tape unit is designed specifically for remote control of the read/write operation and of tape motion. The Model 2760 uses dual vacuum columns for the tensioning of tape. The following paragraphs provide a functional description of the Model 2760 Series Magnetic Tape Unit. Figure 4-1 shows a functional block diagram of the tape units.

4-3 TAPE CONTROL BOARD AND HEATSINK BOARD

Each tape unit contains a minimum of three printed circuit boards: the Tape Control circuit board; the Data circuit board; and the Heatsink circuit board. The Tape Control board and the Data board/boards are mounted on a card frame mounted parallel to the tape unit baseplate. The Heatsink circuit board is attached to the Heatsink Assembly. The Tape Control board contains the tape control logic, the reel servo amplifiers, ramp generators, capstan servo, BOT/EOT amplifier and voltage regulators. The power supply assembly supplies unregulated ± 17 volts to the Tape Control board and ± 36 volts to the Heatsink Assembly. 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 Molex option plugs on the board. Interface signals are connected to the control board by an edge connector.

The Heatsink circuit board contains relay driver transistors for relays K1 through K4 associated with the Tape Control board. The Heatsink circuit board also contains the circuitry for the reel servo and capstan servo power amplifiers and for the power supply regulator power transistors.

4-4 DATA BOARD

The Data Board provides the two functions of reading and writing 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 to the interface lines. For NRZI Data Boards, the signals are buffered and strobed out with a read strobe. The read signals are connected to the interface by an edge connector at the other end of the board.

4-5 MECHANICAL DESCRIPTION

The following paragraphs provide a mechanical description of the Model 2760 Dual Vacuum Column Tape Unit. Figure 4-2 shows the mechanical assembly of the Model 2760. Detailed mechanical assembly views of the tape unit are contained in chapter 6.

The Model 2760 Tape Unit uses a dual vacuum column to maintain tape tension. The vacuum columns maintain tape tension at 8 ounces. The position of the tape in the vacuum column is sensed by a tape position sensor covering the length of each column. The tape position sensor is driven by an oscillator and is sensed by an amplifier and a synchronous detector circuit located on the Tape Control Board. Since the tape position sensor is the length of the column, the output of the detector is a voltage linearly related to the position of the tape.

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

4-6 PRIMARY POWER CIRCUITS

The primary power circuits consist of two parts: 1) a power supply module mounted on the tape unit baseplate (see figure 4-1); and 2) the power supply regulator circuits located on the Tape Control Board and Heatsink Board. The power supply module (see figure 4-1) contains the Service Power switch, line filter, a power transformer, full wave rectifiers, capacitors, fuses and resistors. A heatsink, for mounting the power supply and servo power transistors, is attached to the power supply module. The power transistors are numbered consecutively Q1 through Q15 on the heatsink, with Q1 located at the top of the heatsink. The power supply regulator circuits consist of the two regulator circuits and a power reset circuit. Figure 4-3 shows a simplified diagram of the primary power circuit. The following paragraphs describe both the power supply module and the power supply regulator circuits.

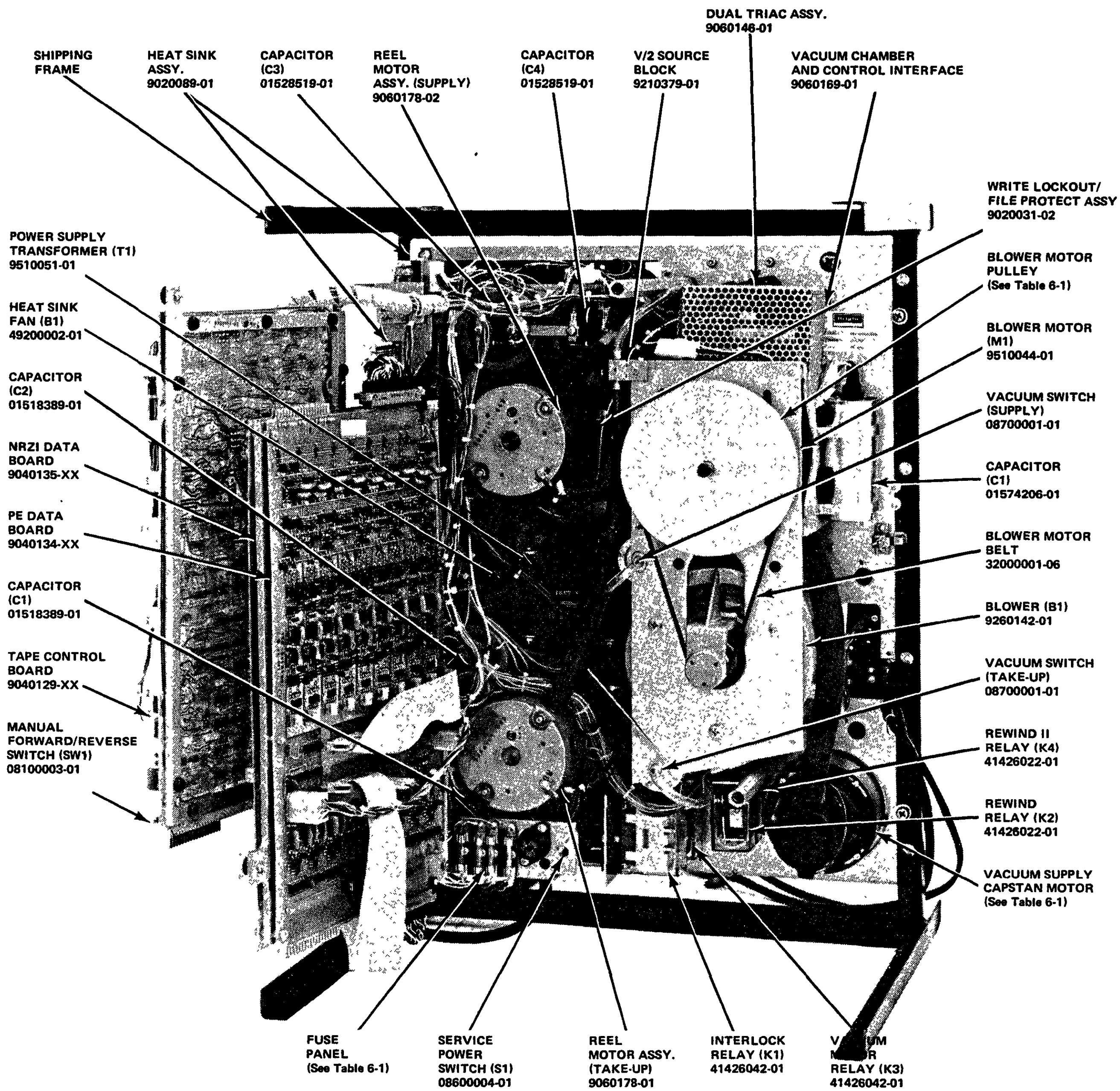


Figure 4-2. Model 2760 Tape Unit Mechanical Assembly

4-7. POWER SUPPLY MODULE

The power supply module supplies unregulated $\pm$ 17 volts to the power supply regulator circuits, and unregulated $\pm$ 17 and $\pm$ 36 volts to the reel servo and capstan servo circuits located on the Heatsink PWBA. The power supply module also supplies unregulated 12 volts ac to the relay K1 through K4 circuits located on the Heatsink PWBA (refer to figure 4-3).

During normal operation, Service Power switch S2 is closed and primary power is supplied through fuse F1 and line filter FL1 to the input of the triac circuit. When front panel ON/OFF switch S1 is placed in the ON position, contracts 7 and 6 are closed and connect the high side of the line through resistor R2 to the gate of triac Q1. This turns on Q1 and allows primary power to be applied through Q1 to stepdown transformer T1. Resistor R3 and capacitor C1 prevents Q1 from being turned on by commuting currents. Capacitors C1 through C4 are used to filter the unregulated +17 and -17 volt outputs from the full wave 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. Interconnection between the power supply module and the Heatsink PWBA is established by plugging connector P29 into Heatsink PWBA connector J29. Molex connectors are used to connect the remaining power supply connections to the Heatsink PWBA.

4-8 POWER SUPPLY REGULATOR CIRCUITS

The power supply regulator circuits on the Tape Control Board consist of two separate regulator circuits which supply regulated +5 volt and -5 volt outputs. Refer to functional module 1000 on the Tape Control Board drawing in the attached drawing package. In addition, the power supply regulator circuits also provide a reset ($\overline{\text{PSET}}$) signal to the Tape Control Board circuits. The $\overline{\text{PSET}}$ 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 $\pm$17 volt power supplies malfunction.

4-9 Reference Voltage Circuit

Figure 4-4 shows a simplified diagram of the reference voltage circuit. The reference voltage circuit supplies a reference voltage to the +5 volt and -5 volt regulator circuits which use remote sensing of the load.

The reference voltage is set by the 6.2 volt zener diode CR1015 and the base-emitter voltage of Q1004. If the current through R1015 decreases because the reference voltage changed, transistor Q1004 allows R1013 to rise toward +12 volts. This turns Q1006 on, allowing more current through CR1015. If the reference voltage increases, more current flow through R1015 turns Q1004 on. The voltage at the base of Q1006 drops and Q1004 supplies less current to CR1015.

4-10 +5 Volt Regulator

The +5 volt regulator circuit is referenced to Zener diode CR1015 in the reference voltage circuit and uses remote sensing for regulating its output. See figure 4-5. The circuit consists of series regulator transistor Q15 and operational amplifier U46, with associated components.

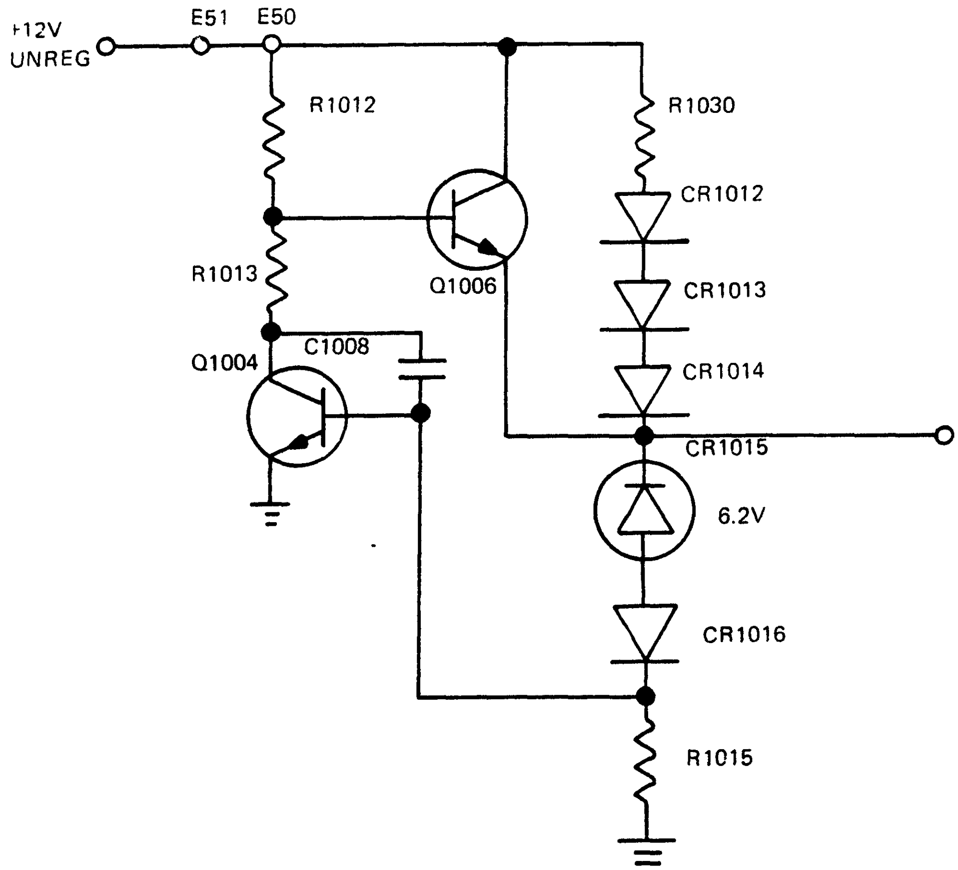


Figure 4-4. Reference Voltage Circuit Simplified Diagram

To maintain +5 volts at the remote location (at TP1 on the Forward-Reverse Ramp Generator) the operational amplifier U46 is used to control the base voltage of Q15. One input of amplifier U46 is from reference Zener diode CR1015 through R1018 and the other input comes from the remote sensing circuit. Potentiometer R1018 is adjusted so that the output of U46 provides the correct base voltage to Q15, needed to maintain +5 volts at the remote location. Diodes CR22, CR23, CR24 and resistor R62 provide the overcurrent protection. As current flow increases in the load, the voltage drop across R62 increases. When the voltage drop across R62 exceeds one diode drop, CR22, CR23 and CR24 will conduct decreasing base-emitter current through Q15. This causes Q15 to conduct less, limiting output current flow and decreasing the output voltage. Diode CR1021 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 diodes CR1022 and SCR Q1005. If the voltage at output (C) rises above 6.2 volts, CR1022 breaks down and conducts turning on Q1005. This, in turn provides a shorted path to ground for the +12 volt input (A), causing fuse F5 on the power supply assembly to open.

4-11 <u>-5 Volt Regulator</u>

The -5 volt regulator is functionally similar to the +5 volt regulator. See figure 4-6. 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.

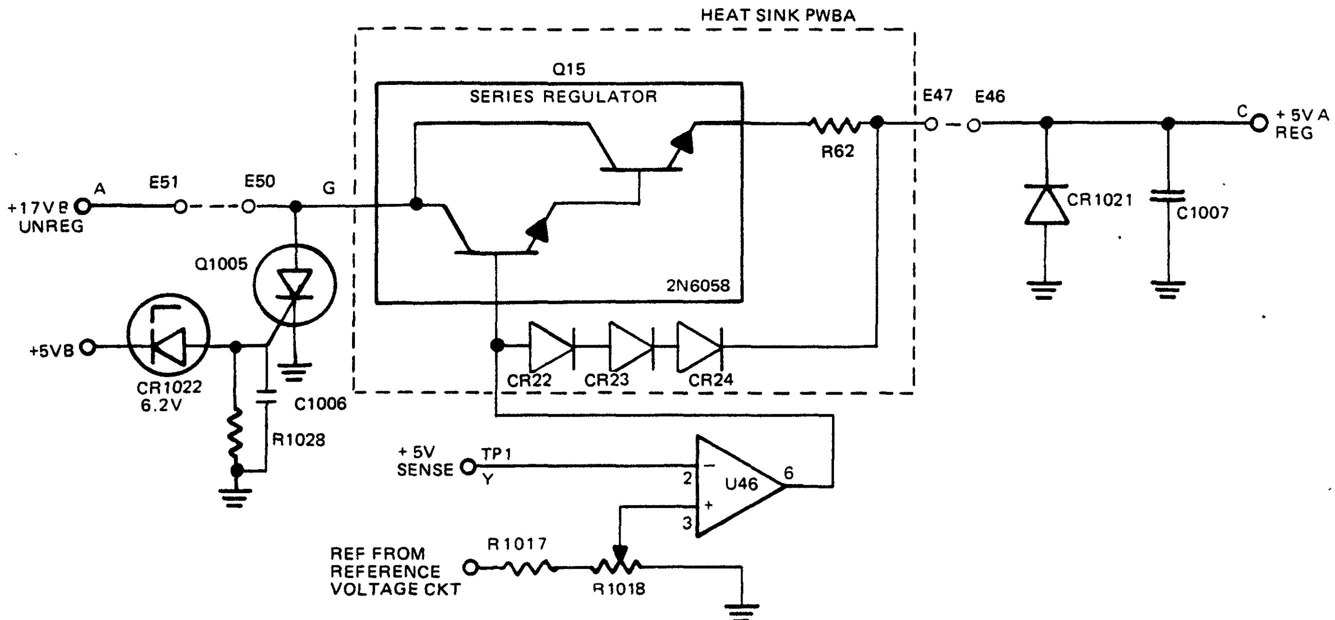


Figure 4-5. +5 Volt Regulator Circuit Simplified Diagram

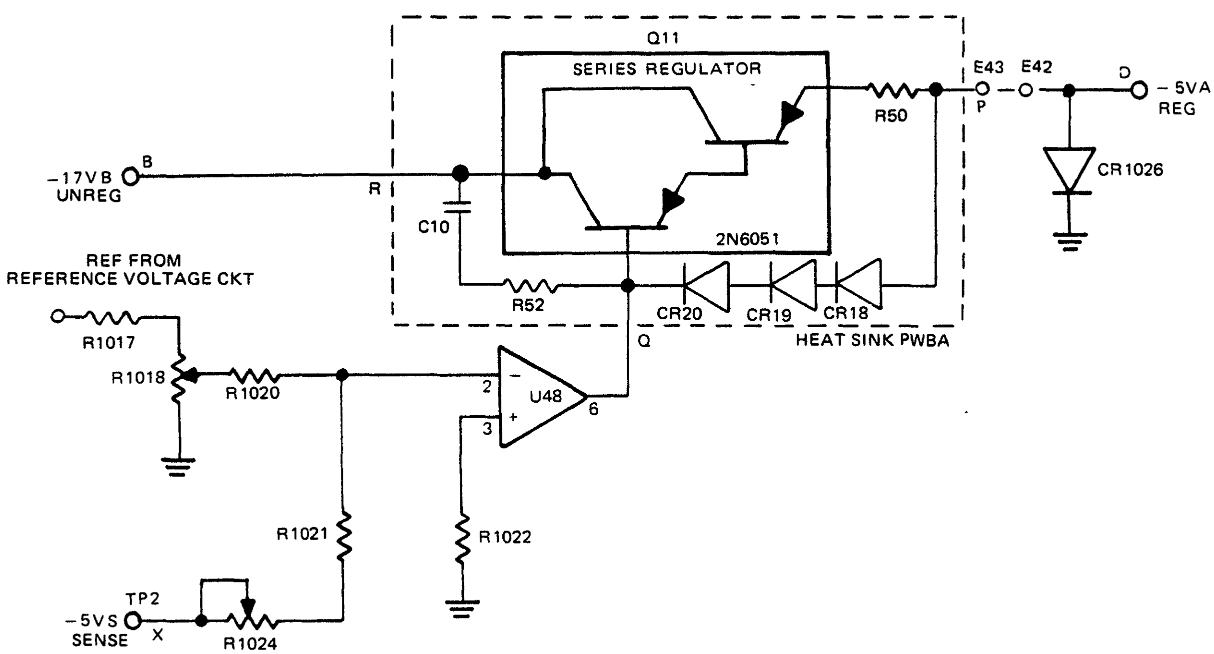


Figure 4-6. -5 Volt Regulator Circuit Simplified Diagram

One input to the operational amplifier, at U48-3, is referenced to ground through R1022. The other input, at U48-2, is a summation voltage from the junction of resistors R1020 and R1021. The summation voltage is developed from the reference voltage circuit output through potentiometer R1018 and resistor R1020, and the -5 volt remote sensing circuit output (TP2) from the forward-reverse ramp generator through potentiometer R1024 and resistor R1021. 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 CR18, CR19 and CR20 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.

4-12 Power Reset Circuit

Figure 4-7 shows a simplified diagram of the power reset circuit. The circuit consists of Q1003 and associated components. The emitter of Q1003 is connected to +17 volts, and the base is connected to +10 volts through R1011. Under these conditions Q1003 conducts at saturation, causing the collector to be near +17 volts and the voltage on the $\overline{PSET}$ output (W) at approximately +3 volts (logic high). However, if the +17 volts falls and the V_{be} of Q1003 becomes less than 0.6 volts, transistor Q1003 turns off and $\overline{PSET}$ becomes a logic low.

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

4-13 BLOWER MOTOR CIRCUIT

Figure 4-8 shows a simplified schematic of the blower motor circuit. During the tape loading sequence, relay K3 on the Tape Control board is energized (refer to paragraph 4-15). Relay K3 contacts 9 and 8 then close and connect resistor R5 to the gate of triac Q2. This turns on Q2 and allows ac operating voltage from transformer T1 to be applied through Q2 to the blower motor M1. Resistor R4 and capacitor C2 prevents Q2 from being turned on by commuting currents. When relay K3 is de-energized, relay contacts 9 and 8 open. This turns off Q2 and removes the ac operating voltage from the blower motor. The triac Q2 is part of the dual triac assembly that is located on top of the blower motor. Triac Q1 is used to switch primary power to power supply transformer T1.

4-14 TAPE CONTROL BOARD ELECTRONICS

The following paragraphs describe the operation of the circuits contained on the Tape Control board. These circuits consist of the load logic, reel servo, capstan servo, on line/off line logic, addressing logic, and the tape control circuits. A complete schematic diagram of the Tape Control board circuits drawing is contained in the attached drawing package. Simplified schematic diagrams of the various Tape Control board circuits are contained in the following paragraphs where necessary for clarity of explanation.

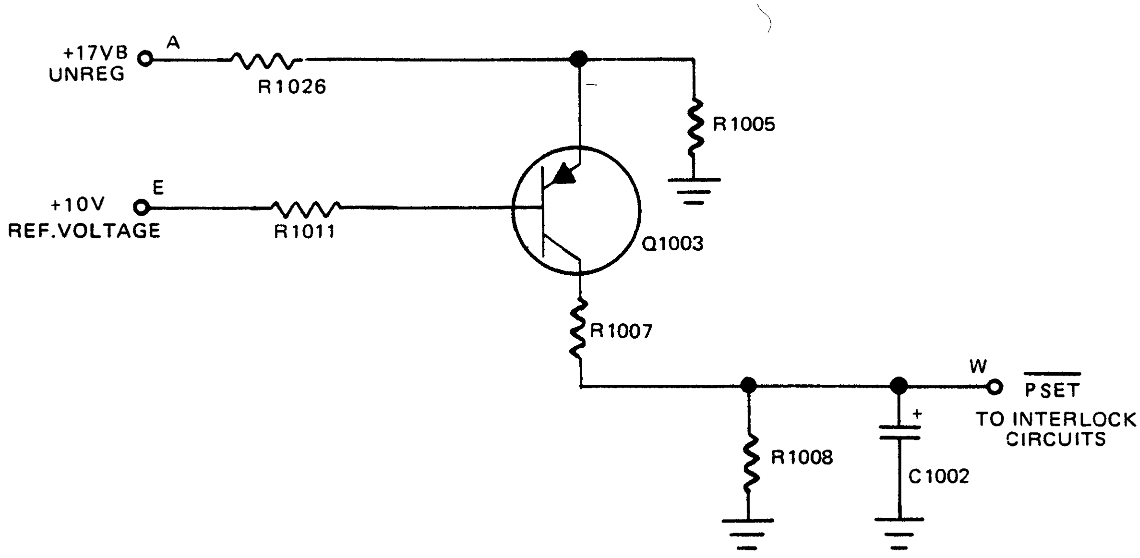


Figure 4-7. Power Reset Circuit Simplified Diagram

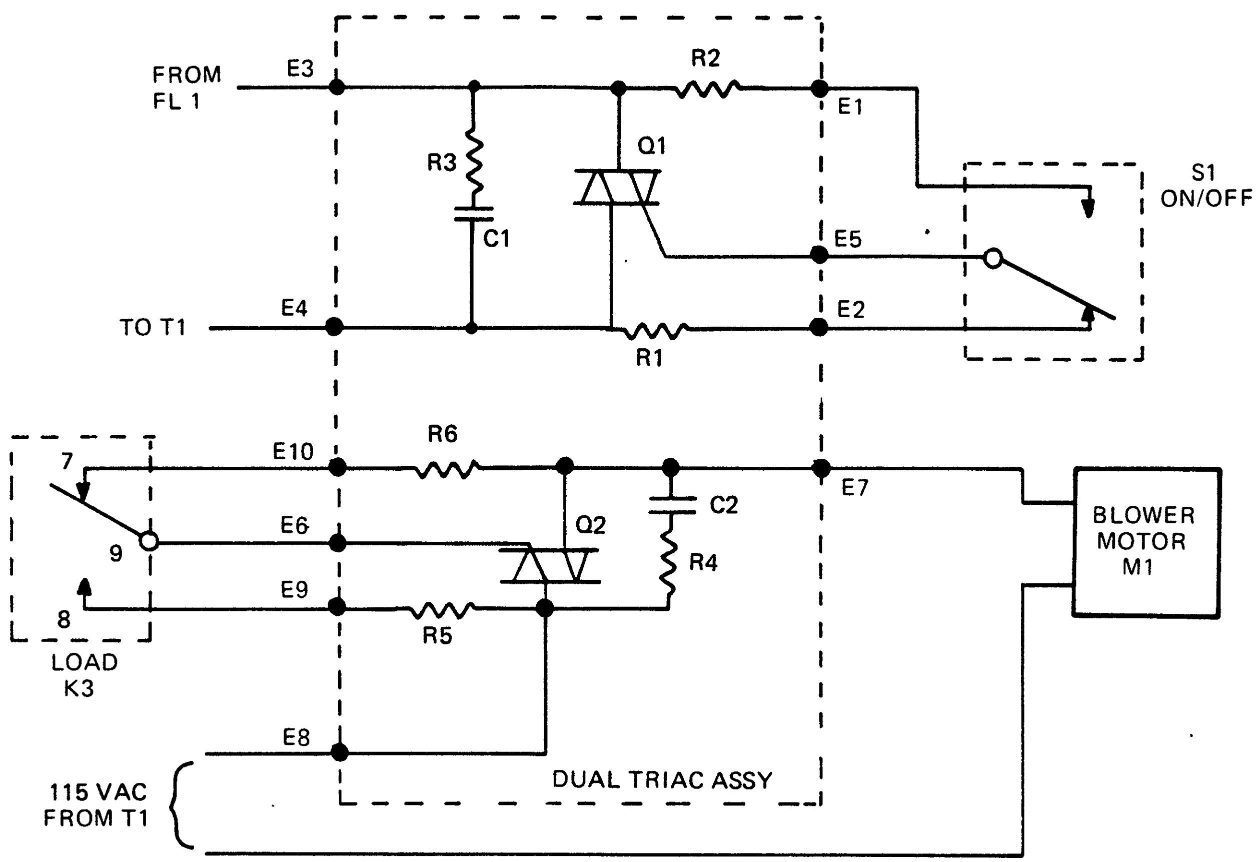


Figure 4-8. Blower Motor Circuit Simplified Diagram

4-15 LOAD LOGIC CIRCUITS

The load logic circuits have several differences depending on the model of machine, and the load option used. The Model 2760 Dual Vacuum Column machine is available in either a single load or double load configuration. For ease in explanation, the following paragraphs make reference to both the single and double load feature.

Figure 4-9 shows the simplified schematic for a vacuum machine load sequence with the option for single or double load. Figure 4-10 shows the single load sequence timing. When power is initially applied to the tape unit, or the tape unit is not in the rewind mode, REWD at the input to relay driver U45-6 and -7 will be low, turning on U45-5 and energizing relay K4. Pressing the LOAD switch and releasing it applies a positive pulse to flip-flop U27-12 which sets flip-flop U27-3 (LDA). LDB flip-flop U27-5 is not set since RSTB is low until INTL goes high. This occurs when relay K1 is energized.

LDA is connected to gate pin U34-5 and causes a high input to be applied to U43-1. This applies a low at relay driver U38-7. A low at either input to U38 energizes relay K3 through Q21 on the Heatsink PWBA and turns on the vacuum motor. LDA also produces a high input to NAND gate U15-5 with INTL at U15-1, 2 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 the low output from U43-3. This output is connected to Q3 through R31 and when high causes Q3 to conduct 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 U43-3 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, LDRDY at U15-6 goes low. LDRDY low saturates Q5 and Q4 (on the Heatsink PWBA) in the reel servo circuits applying -12 volts through resistors to the reel motors. See figure 4-12. Current through the reel motors creates a torque that slowly unreels tape from both reels and allows the tape to enter the vacuum column.

LDRDY is also an input to the load fault circuits at U2-12. See figure 4-11. When LDRDY goes low, U2-11 goes low allowing C48 to charge toward +5 volts at U1-4. The voltage at U1-4 will increase with the time constant of C48 and R74. If the voltage at U1-4 increases above the voltage at U1-5 before the interlock is set, U1-2 and LDFLT will go low. This causes 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, INTL goes low at U15-1. This causes 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 columns, the vacuum interlock switches close making VINTL high. With a high at U33-1 and VINTL at U33-2 high, MINTL goes low. The low MINTL signal is applied to the base of transistor Q7 and turns it off. Transistor Q7 is the input to the hold circuit. The hold circuit is a delay circuit that provides a delay time determined by the time constant of C6 and R88.

The low MINTL is also applied to U35-4. Any low at relay driver U45-1 or 2 will energize relay K1 through Q23 on the Heatsink PWBA, connecting the reel and capstan motors to their amplifiers. The tape is now positioned by the reel motors to the center of the vacuum columns. The vacuum interlock switch 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 U39-9 is gated with $\overline{PSET}$ at U39-10 causing U39-8 to go low keeping relay K1 energized until $\overline{PSET}$ goes low or either interlock switch is opened.

When the voltage at U56-4 has increased with the time constant of R88 and C6 until it is equal to the voltage at U56-5, the HOLD signal at U56-2 goes low and sets flip-flop U42-3 (SET HOLD). SET HOLD is an input at U31-2 which resets LDA flip-flop U27.

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

For the double load option, pressing and releasing of the LOAD switch a second time causes a positive pulse output from U26-8 which is gated with $\overline{LON}$ at gate U28-5. Since $\overline{LON}$ is high until the tape unit has been loaded, the pulse will set flip-flops U27-5 (LDB) and U41-3 (LON). $\overline{LDB}$ 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 RSTB go low. $\overline{RSTB}$ is an input at U31-9 causing U31-8 to go low resetting LDB flip-flop U27 and stopping tape motion. The tape is now tensioned and stipped at the BOT marker. The LOAD indicator will be lit.

4-16 REEL SERVO ELECTRONICS

Figure 4-12 shows a simplified schematic of the Reel servo electronics. The reel servo electronics consist of two identical circuits: the Supply Reel Servo circuits and the Take-up Reel Servo circuits. Since the operation of both circuits are identical, only the Supply Reel Servo circuit is described.

The input to the Reel Servo Amplifier is the tape position sensor. This is a tape position sensor and detector for the Model 2760 Vacuum Column machine. The purpose of the tape position sensor circuits is to provide a voltage that is linearly related to the position of the tape in the operating range.

4-17 Vacuum Column Tape Position Sensor Circuits

The Model 2760 Dual Vacuum Column machines use an oscillator that drives the variable capacitor tape position sensor. The output of the capacitor tape position sensor is detected and amplified by a synchronous detector. Figure 4-13 shows a simplified schematic diagram of the vacuum column tape position oscillator and sync detector circuits. Figure 4-14 shows tape position sensor circuit timing. The output of the 8100 oscillator is a triangular wave that is determined by the intergration of a square wave with R8107, C8101 and U50. For example, when Q8103 and Q8102 are turned on and the output of U50 is at +5 volts, the collector of Q8103 will be at +5 volts and current will flow through R9107 charging capacitor C8109. This will cause the output of U50 to decrease as capacitor C8101 is charged. Capacitor C8101 will charge until

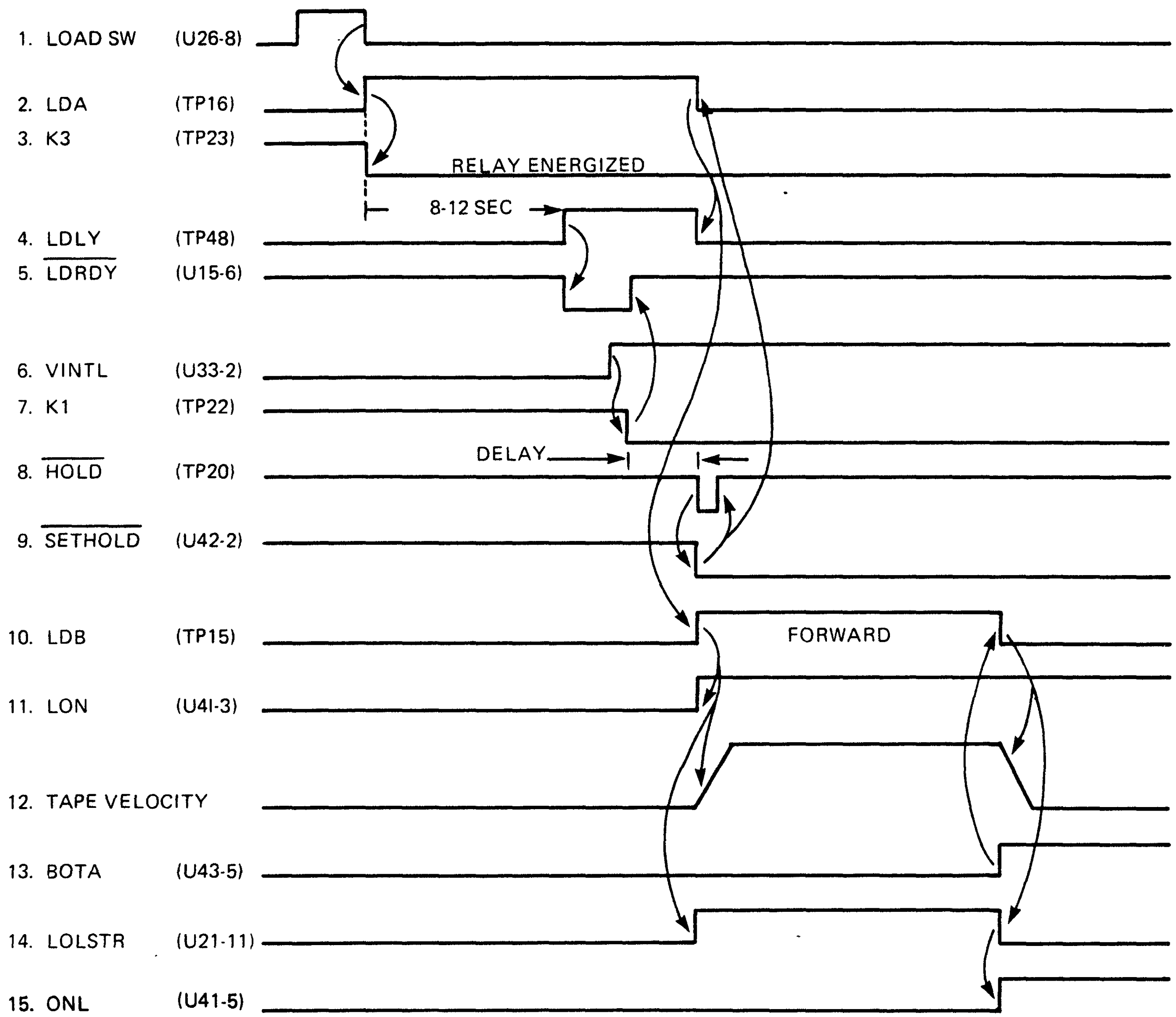


Figure 4-10. Single Load Sequence Timing Diagram

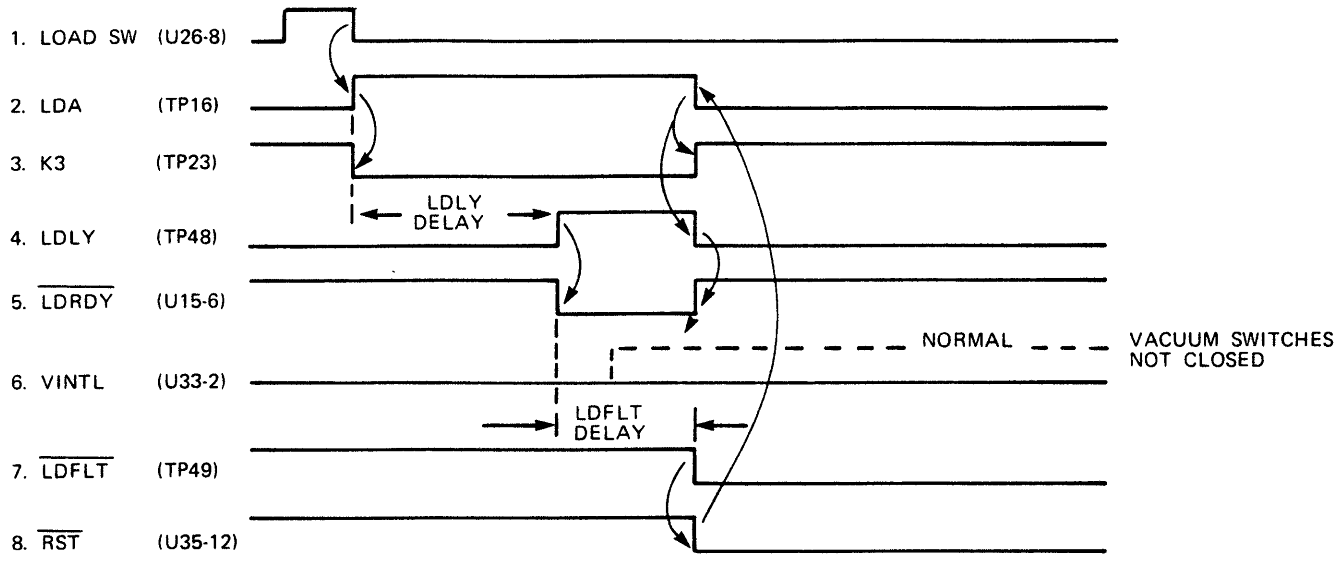


Figure 4-11. Load Fault Sequence Timing Diagram

the output of U50 reaches -5 volts. At this time the base of Q8102 will be less than the base voltage of Q8101, turning transistors Q8102 off and Q8101 on. Transistor Q8103 will also be turned off. Since R8105 is connected to -5 volts and the output of U50 will increase toward +5 volts. Since the charging rate of C8101 is constant, the output of U50 will have a triangular waveform with a period of 75 microseconds.

The triangular waveform is applied to the vacuum column tape position sensor and to pin 3 of amplifiers U52 and U55 through an associated capacitor and potentiometer. 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 R8302 and the tape position sensor's capacitive reactance. The amplifier's gain increases at 20 db per decade. This is the characteristic of a differentiator amplifier. As the capacitance of the 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. Potentiometer R8301 is connected to pin 3 of U55 and is used to adjust the output of amplifier U6047 in the reel servo circuit to zero when the tape is positioned in the center of the vacuum column.

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

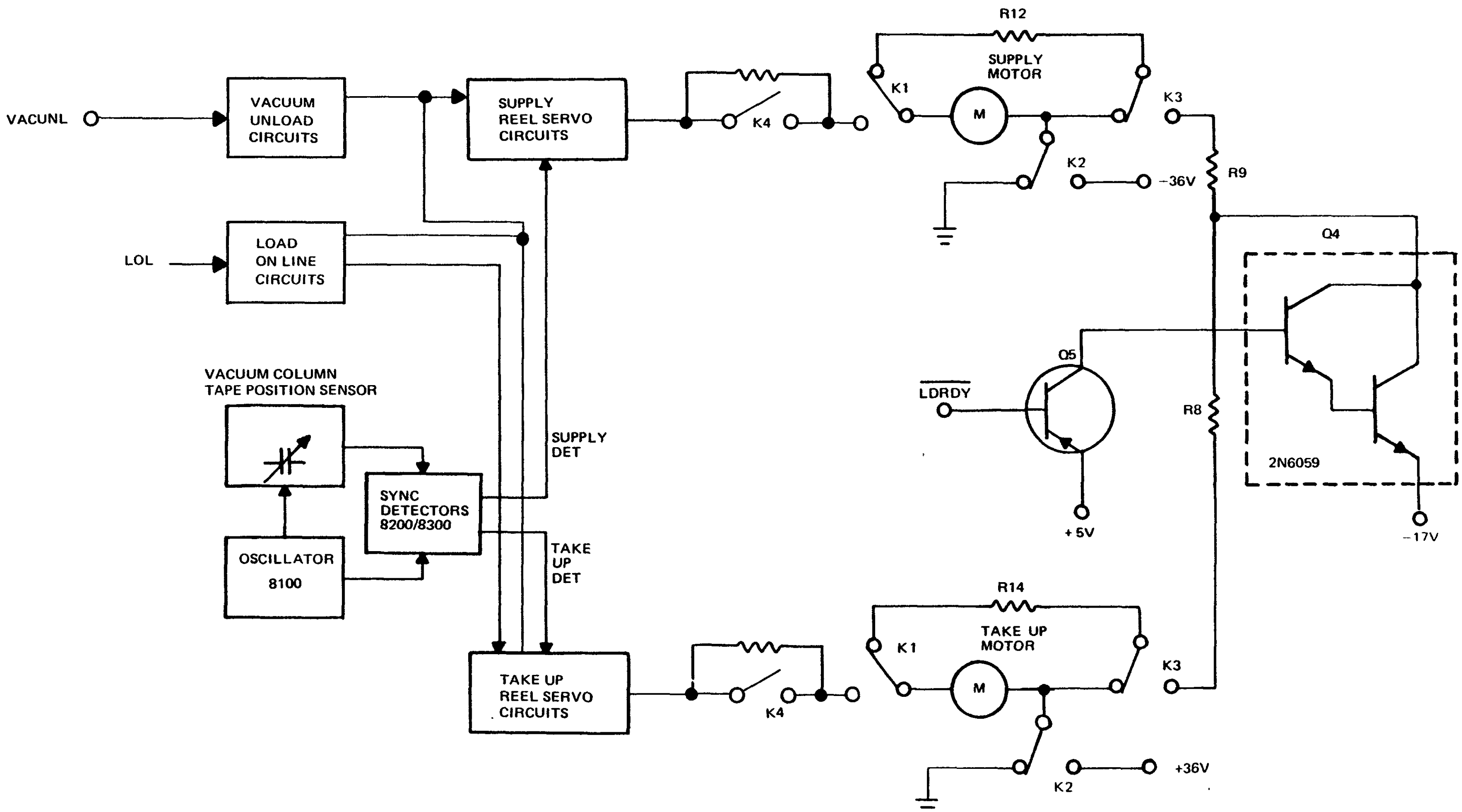


Figure 4-12. Reel Servo Electronics Simplified Diagram

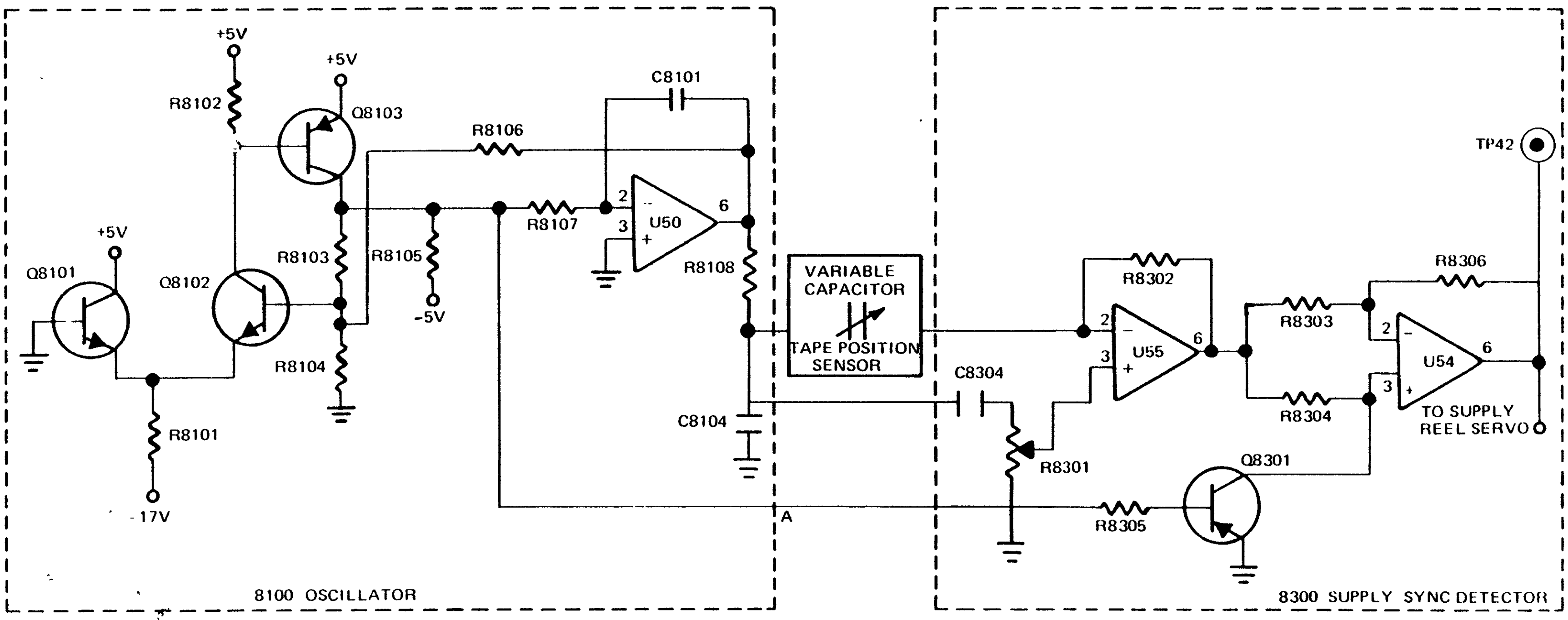


Figure 4-13. Vacuum Column Tape Position Sensor Circuits Simplified Diagram

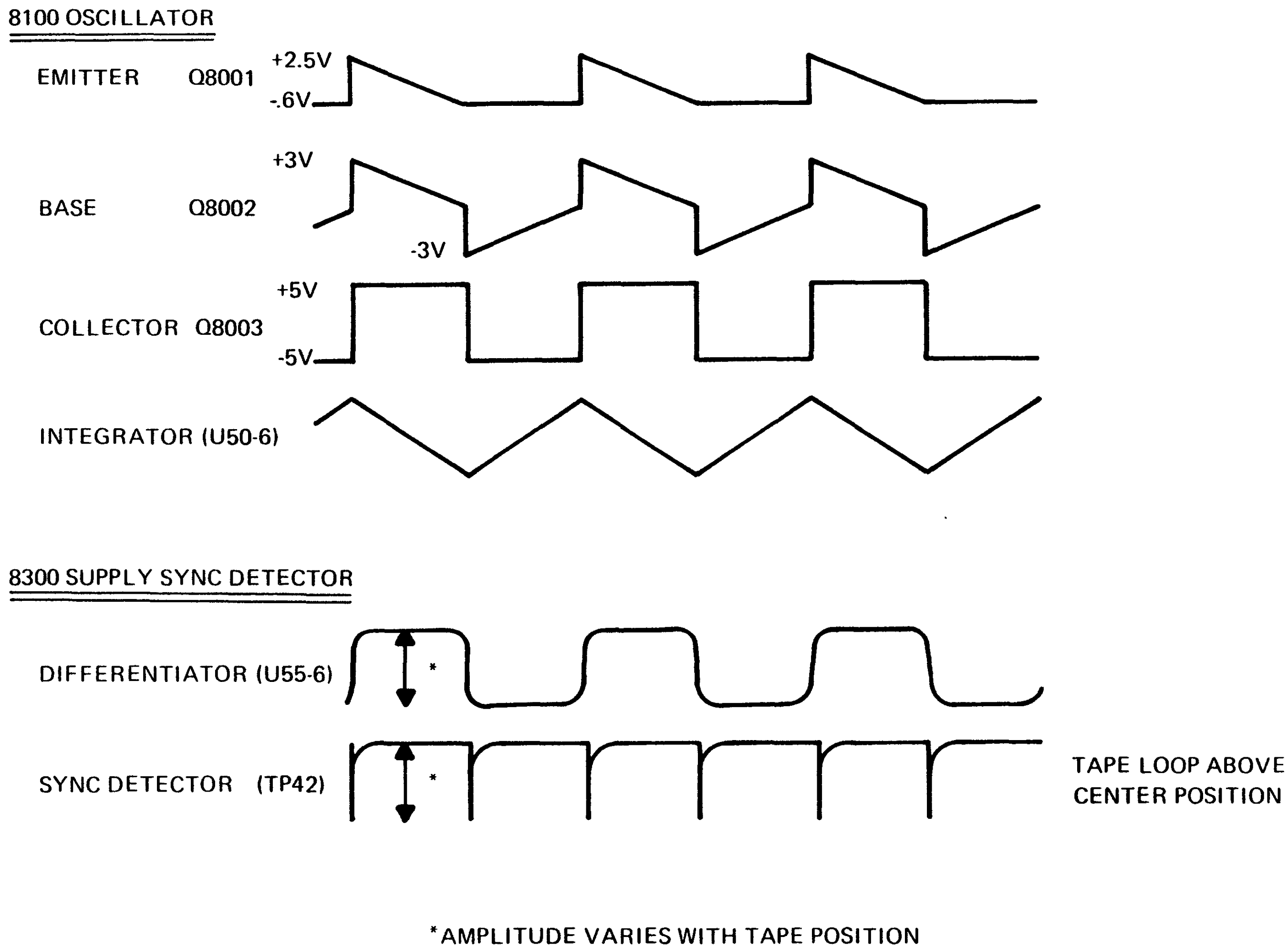


Figure 4-14. Tape Position Sensor Circuits Timing Diagram

Since pin 3 of U54 is grounded, and R8303 and R8306 are equal, the output of U54 is the inverted output of U55 with unity gain.

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

4-18 Reel Servo Circuits

The output of the Sync Detector is connected to U607-2 through a filter network of R6003, C6001 and R6007. This input network filters out the ripple from the U54 sync detectors. Figure 4-15 is a simplified schematic of the reel servo circuits. The feedback around U6047 is the series connection of R6010 and potentiometer R6011. The closed loop gain of U6047 is changed by adjusting potentiometer R6011.

U6053, Q6002 and Q6003 on the tape control board PWBA, Q18 and Q19 on the Heatsink PWBA, and Q2, Q8, Q1 and Q9 on the Heatsink 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 R6008, R6019 through FET Q6004. Since the resistance of R6019 is less than the resistance of R6015, the gain of the power amplifiers stage is approximately 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. Q4 is turned off when $\overline{RWDAB}$ and $\overline{REWD}$ are high. This is the case when the tape unit is not rewinding. The collector of Q4 will be at -17 volts as are both sides of R64 since CR8 will be forward biased. This biases the gate of FET Q6001 at -17 volts turning off Q6001. When $\overline{RWDAB}$ or $\overline{REWD}$ go low, Q4 will be saturated and its collector will go to +5 volts. The bias voltage at the gate of Q6001 will be in creased 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 R6008 and R6019. When $\overline{RWDAB}$ and $\overline{REWD}$ 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 network will be described. When there is no current flow through 6019, the cathode of CR6004 is 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.

Potentiometer R6018 is connected to input of U6053 through R6020 and FET Q6004, 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, except unload, and remote load and on line, FET Q6004 is held in the on condition. During a tape unload sequence, Q6 is turned off when the VACUNL signal goes high (refer to paragraph 4-28). This turns off Q6004 and disconnects the output of U6047 from U6053. When Q5 is turned off, a negative voltage is applied to U6053-2 through CR12 causing the Supply Reel Servo motor to turn in the reverse direction.

The output of U6053 is connected to the bases of Q6002 and Q6003. If the output ofU6-53 increases positive, Q6002 is turned on making the collector of Q6002 drop and the base of power transistor Q2 will also drop. Power transistor Q2 is turned on causing its collector potential to increase, turning on power transistor Q1. This causes the output at TP31 to increase, and turn the supply reel motor. When the output of U6053 goes negative, Q6003 and power transistor Q8 are turned on, causing power transistor Q9 to turn on. This causes TP31 to be driven negative. Transistor Q9 Zener diode CR6 and associated components serve as a voltage limiter for Q18 and Q9. Q19 turns on when the voltage across output transistor Q9 is greater than 30 volts. Transistor Q19, Zener diode CR7 and associated components serve as the voltage limiter for Q18 and Q19. Transistors Q19, Zener and Q18 also sense the current through resistors R45 and R37. If voltage drop across R45 and R37 increases to 1.5 volts, Q19 or Q8 will turn on. If, for example, Q19 turns on, the voltage across Q8 is reduced to zero turning off Q8 and Q9.

The output of the reel servo power stage is connected to the supply reel servo motor through relays K4 and K1. When power is first applied to the tape unit, relay K4 is energized and connects the output of the power stage to relay K1. The motor return goes through relay K2 to ground.

When the tape unit starts to rewind, relay K4 is de-energized by the control board logic and relay K2 is energized. This connects -36 volts to the supply reel servo motor through relay K2. This provides the voltage required for the increased rewind speed of 375 ips.

4-19 CAPSTAN SERVO ELECTRONICS

The Forward/Reverse Ramp Generator and the Rewind Ramp Generator are inputs to the Capstan amplifier. Figure 4-16 shows a block diagram of the Capstan Servo Circuit. 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.

4-20 Forward/Reverse Generator

The Forward/Reverse Ramp Generator has five inputs, two reverse and three forward. Figure 4-17 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, FORWARD is set low, Q5001 will conduct at saturation and its collector voltages goes to +5 volts. This biases Q5003 into saturation and the collector of Q5003 goes to -5 volts. Q5003 is connected to pin 3 of U11 through R5011 causing the output of U11 to switch to -17 volts. The -17 volts at U11-6 is connected through R5014 to the cathode CR5002. The cathode of CR5002 is pulled toward -17 volts. However, since the anode of CR5002 is at -5.2 volts, the voltage at the cathode will be clamped at -5.8 volts. This -5.8 volts is applied across potentiometer R5020 and resistor R5015 to U12-2, C5002, and C5001.

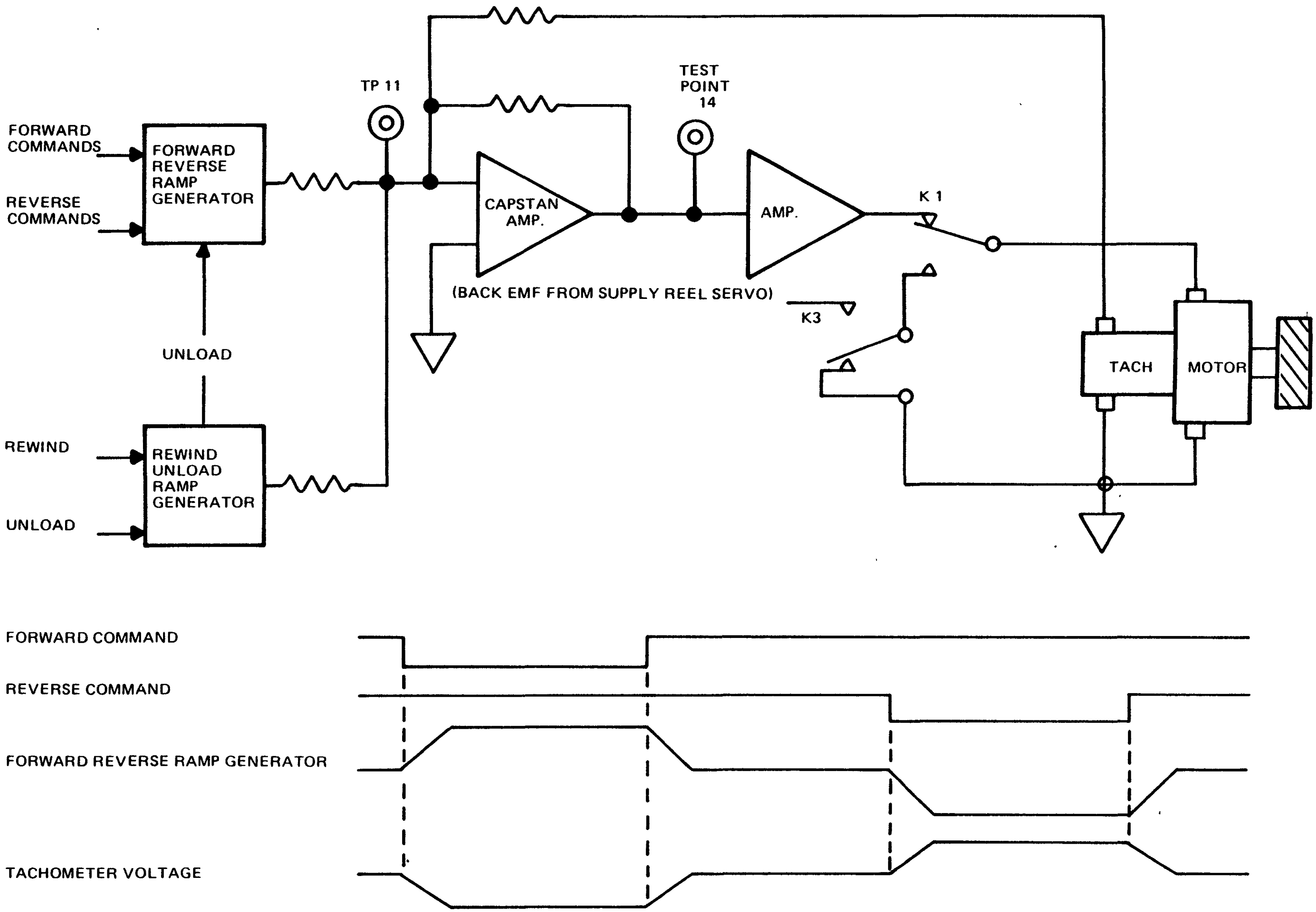


Figure 4-16. Capstan Servo Block Diagram

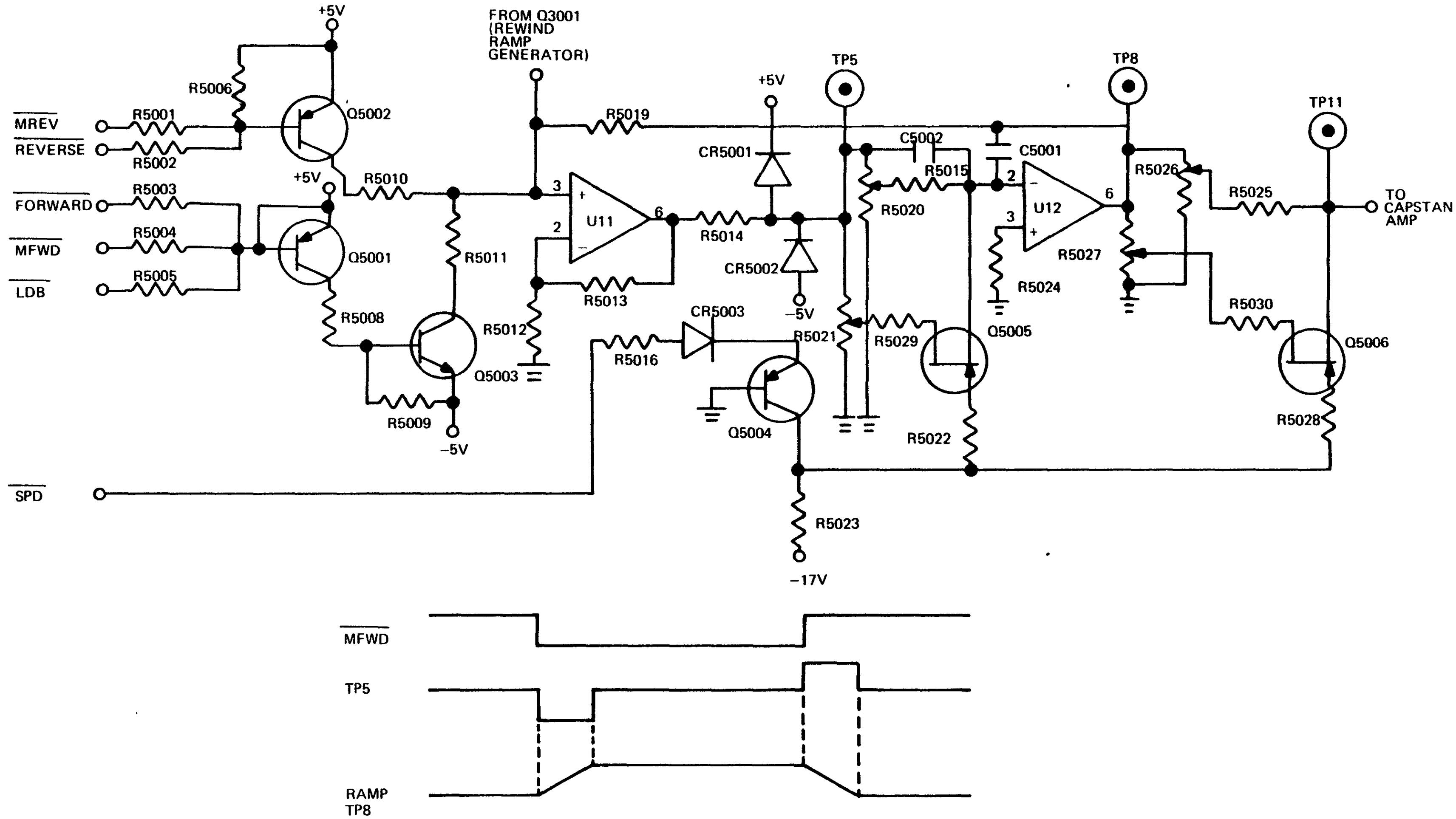


Figure 4-17. Forward/Reverse Ramp Generator Simplified Diagram

Current will flow through R5020 and R5015 and charge C5002 and 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 R5020, R5015, C5002 and C5001. Adjusting R5020 consequently changes the rise time at the output of U12. Feedback resistor R5019 is connected between output of U12 and the input to U11 and is equal to the resistance of R5011. Therefore, when the output of U12 reaches +5 volts, it balances the -5 volts generated by Q5003 at the input of U11-3. Because of the high gain at U11, the output of U11 switches to zero volts and U12-6 is stabilized at +5 volts. Any decrease in output of U12 is regulated by an increase in the output voltage of U11 and charges C5002 and C5001 back to +5 volts.

The output of U12 is connected through the connection of potentiometer 5026 and resistor R5025 to the capstan amplifier. Potentiometer R5026 sets the Forward/Reverse capstan speed. When FORWARD goes high, Q5001 and Q5003 are turned off removing the -5 volts from U11-3. This leaves the feedback resistor R5018 with positive voltage at U11-3 and the output of U11 switches to +17 volts. The anode of CR5001 is clamped to -5.8 volts causing current flow through R5020 and R5015 to discharge C5002 and C5001, therefore, decreasing the output of U12. When U12-6 reaches zero volts, the input voltages of U11 are zero and the output of U11 switches to zero volts. The fall time is determined by the discharge rate of C5002 and C5001 and is equal to the rise time.

The start/stop ramps and the output of U12 are accurately controlled by the 5.2 volt regulators since the remote voltage sense for these two power supply regulators comes from the Forward/Reverse Ramp Generator circuits.

For example, if the REVERSE input is set low, Q5002 conducts at saturation applying +5 volts through R5010 to U11-3. U11-6 switches to +10 volts. Therefore, the operation of the ramp generator is the same as for a forward except the polarity of the voltages are reversed. During rewind and unload operations, the Forward/Reverse Ramp Generator receives an input to U11-3 from the Rewind Ramp Generator (refer to paragraph 4-21).

The dual speed option FET's Q5005 and Q5006 are used to parallel R5020 and R5015 with R5029 and R5021, and parallel R5026 and R5025 with R5030 with R5030 and R5027. This will switch to the higher of the two tape speeds. For low speed operation SPD is low, back biasing CR5003 and turning off Q5004. This causes the collector of Q5004 to be pulled to -17 volts through R5023. R5022 and R5028 are also connected to the collector of Q5004 and applying the -17 volts to the gates of Q5005 and Q5006, turning the FET's off and removing R5029 and R5050 from the circuit.

To go the higher of the two speeds, SPD is set high, forward biasing CR5003 and causing Q5004 to conduct. R5022 and R5028 are pulled by Q5004's collector to approximately 3 volts turning on FET's Q5005 and Q5006. FET Q5005 parallels R5015 and R5027 increasing the speed.

4-21 Rewind Ramp Generator

The second input to the Capstan Amplifier comes from the Rewind Ramp Generator. During the rewind operation, the Rewind Ramp Generator is used to generate a negative ramp output to the Capstan Amplifier. It also contains a switching transistor that cause the Forward-Reverse Ramp Generator to generate a negative ramp output during the unload operation. Figure 4-18 shows a simplified schematic of the rewind ramp generator and figure 4-19 shows rewind sequence timing. Inputs to the ramp

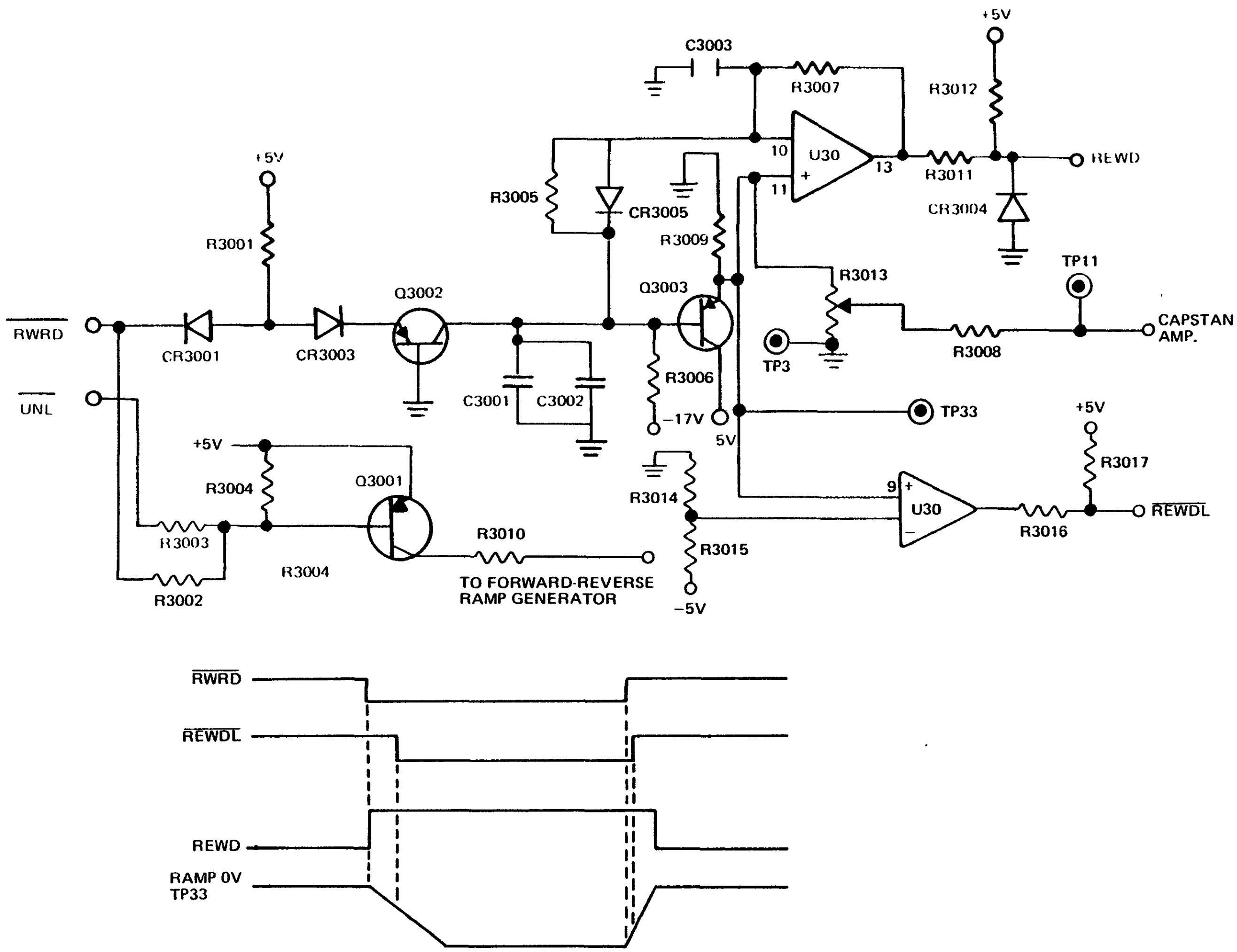


Figure 4-18. Rewind Unload Ramp Generator Circuit Simplified Diagram

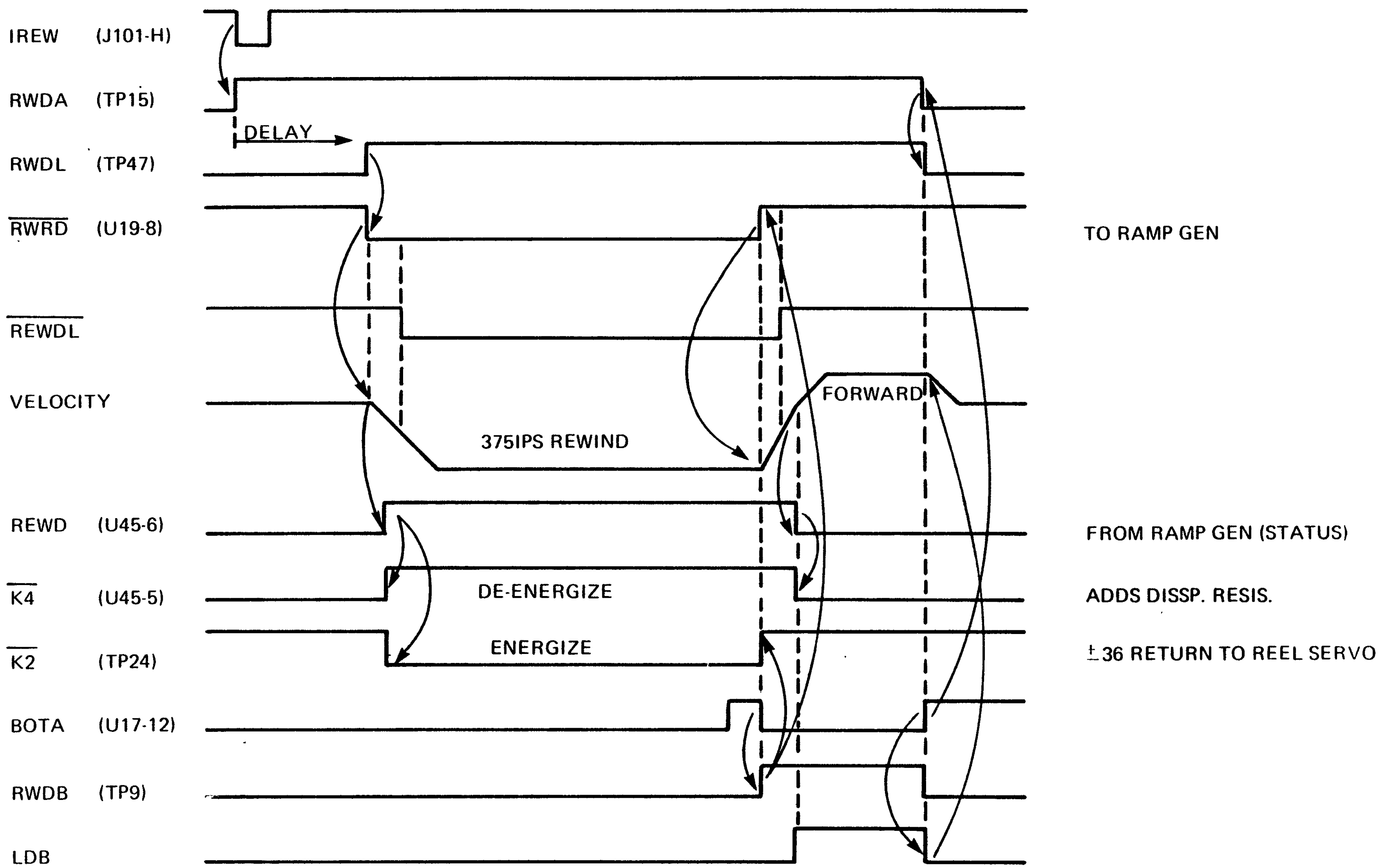


Figure 4-19. Rewind Sequence Timing Diagram

generator are the rewind signal $\overline{\text{RWRD}}$ and unload signal $\overline{\text{UNL}}$. These two signals are normally high. Consequently, during normal operation Q3002 conducts at saturation, Q3003 and Q3001 are turned off, the REWD output is low, and the $\overline{\text{REWDL}}$ output is high.

During a rewind operation, a low input from $\overline{\text{RWRD}}$ sets the anode of CR3003 low, turning off Q3002 and allowing C3001 and C3002 to charge toward -17 volts through R3006 and C3003 to charge through forward biased diode CR3005. The potential at U30-10 will move toward -17 volts causing it to go more negative than U30-11. This causes the output of U30 and REWD to switch high. As C3001 and C3002 continue to charge, the base of Q3003 becomes negative, turning on Q3303. As C3001 and C3002 continue to charge, $\overline{\text{REWDL}}$ switches low and the potential at the emitter of Q3003 will increase at the same rate, generating the rewind start ramp until Q3003 conducts at saturation holding the emitter at -5 volts. The input resistor to the Capstan Amplifier is R3008 and R3013 is adjusted to set the rewind speed.

When $\overline{\text{RWRD}}$ 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, generating the rewind stop ramp, and setting $\overline{\text{REWDL}}$ low. When the base of Q3003 reaches ground potential, Q3003 is turned off. C3003 is discharged through R5005, setting U30-10 more positive than U30-11 after Q3003 is turned off. Then U30-13 switches to -17 volts. REWD is then clamped low by CR3004.

When $\overline{\text{RWRD}}$ goes low, the base of Q3001 becomes negative causing Q3001 to conduct at saturation. Q3001 then applies +5 volts through resistor R3010 to U11-3 in the Forward-Reverse Ramp Generator. This causes the Forward/Reverse Ramp Generator to generate a negative ramp output to the Capstan Amplifier.

4-22 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 4-20. Offset potentiometer R4001 is connected to U20-2 through R4002. The output of U20-6 is set at zero by R4001 compensating for component variations. Feedback resistor R4007 sets the gain of U20. U20 drives the bases of Q4001 and Q4002 creating a null region since Q4001 and Q4002 are turned on only when the output of U20-6 has reached 0.6 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 voltage of power transistor Q3 is lowered and the collector increases the voltage at the base of power transistor Q7, resulting in an increase in voltage at the output (TP14). Consequently, a positive output at U20-6 will cause the output of the Capstan Amplifier 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. A tachometer is attached to the Capstan Motor and the output is connected to the Capstan Amplifier's summing junction through R4012, R4003, and R4004. The tachometer allows the Capstan Servo to accurately regulate the Capstan speed.

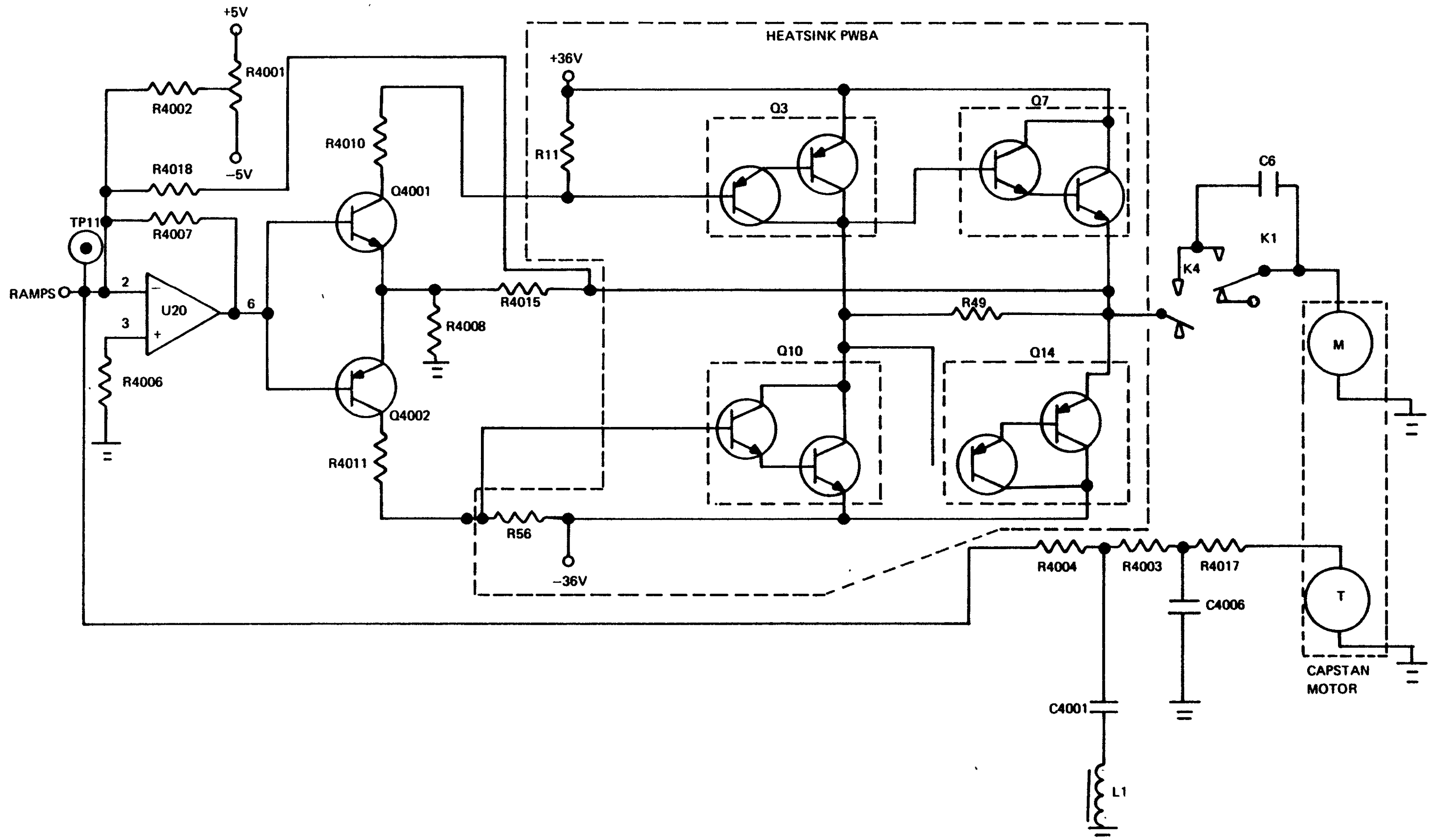


Figure 4-20. Capstan Amplifier Circuit Simplified Diagram

4-23 ON LINE/ OFF LINE LOGIC

Figure 4-21 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 $\overline{RSTC}$ signal at U35-10. The ON LINE lamp driver is driven by a low at U41-6 which turns on the ON LINE indicator. When gate U2 is enabled by the SLTB signal, the output of U2-3 is low, asserting the IONL signal. If the ON LINE switch is pressed again. flip-flop U41-5 will be reset. Flip-flop U41-5 can also be reset by pressing the RESET switch producing a negative pulse output from U39-3 $\overline{RESET}$. This causes $\overline{RSTD}$ to go low at U44-6, and $\overline{RSTC}$ 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/J102-L. 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.

When the tape unit is equipped with the Auto Load On Line option, the tape unit is automatically placed on line after the tape has been loaded on the tape unit. When the tape has been loaded, the LDB flip-flop U27 is set as previously described in the circuit description for the Load Logic Circuits. The LDB signal is an input to the Forward Ramp Generator and causes the capstan to move the tape toward the BOT marker. The setting of the LDB flip-flop also produces a high input at U3-1. Since a rewind operation is not taking place, the $\overline{RWDA}$ signal at U3-2 is also high. This causes the LOLSTR signal at U21-11 to go high. The high LOLSTR signal is applied to U40-1. Since flip-flop U41-9 is not set at this time, the $\overline{ONL}$ 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 4-15. When LDB goes low, LOLSTR goes low, setting flip-flop U41. The low output from U41-6 causes the ON LINE indicator to illuminate. When the STLB signal at U2-2 is high (tape unit address selected or continuous high), the IONL signal to the control is asserted.

4-24 REMOTE LOAD AND ON LINE LOGIC

Figure 4-22 shows a simplified schematic diagram of the Remote Load and On Line circuit. This circuit allows the external controller to use the ILOL signal to restart the tape unit after a power failure. The theory of operation of this circuit is given in the following paragraphs. A timing diagram for the circuit is shown in figure 4-23.

When the ILOL signal from the controller at U102-I/J101-I is set low, the input at U57-2 goes high. If the tape unit is selected, the input at U57-1 is also high. This produces a low output at U57-3 that is applied to U57-9, setting the flip-flop composed of U57-9 and U57-11. This causes the LOLFF signal to go high and the $\overline{LOLFF}$ signal to go low. The high LOLFF signal is applied to U34-1. The low $\overline{LOLFF}$ signal is also applied to inverter pin U8-13, producing a high input at U57-5. The input at U57-4 is also high, so the LOL signal at U22-8 goes high.

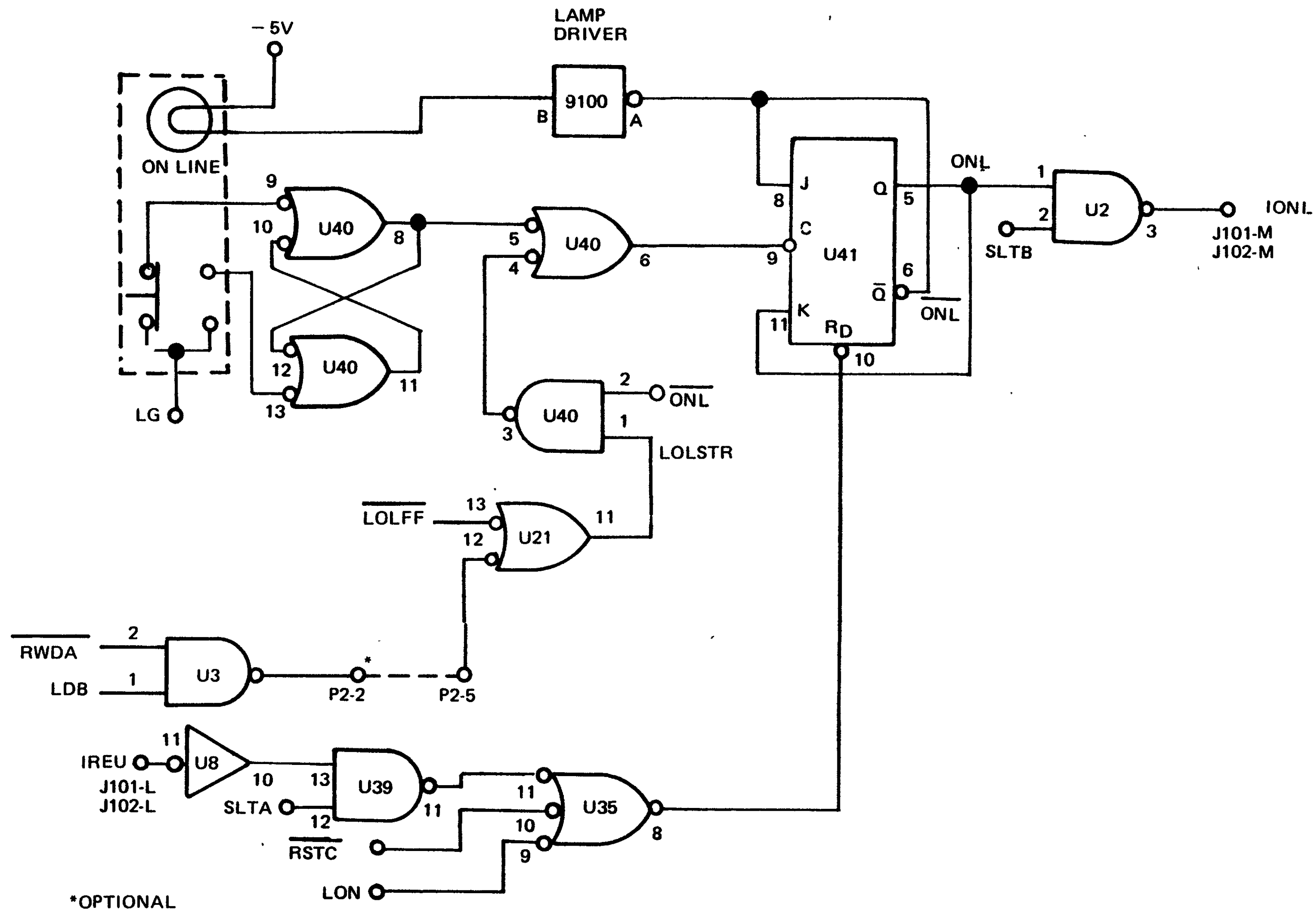


Figure 4-21. On Line/Off Line Logic Circuits Simplified Diagram

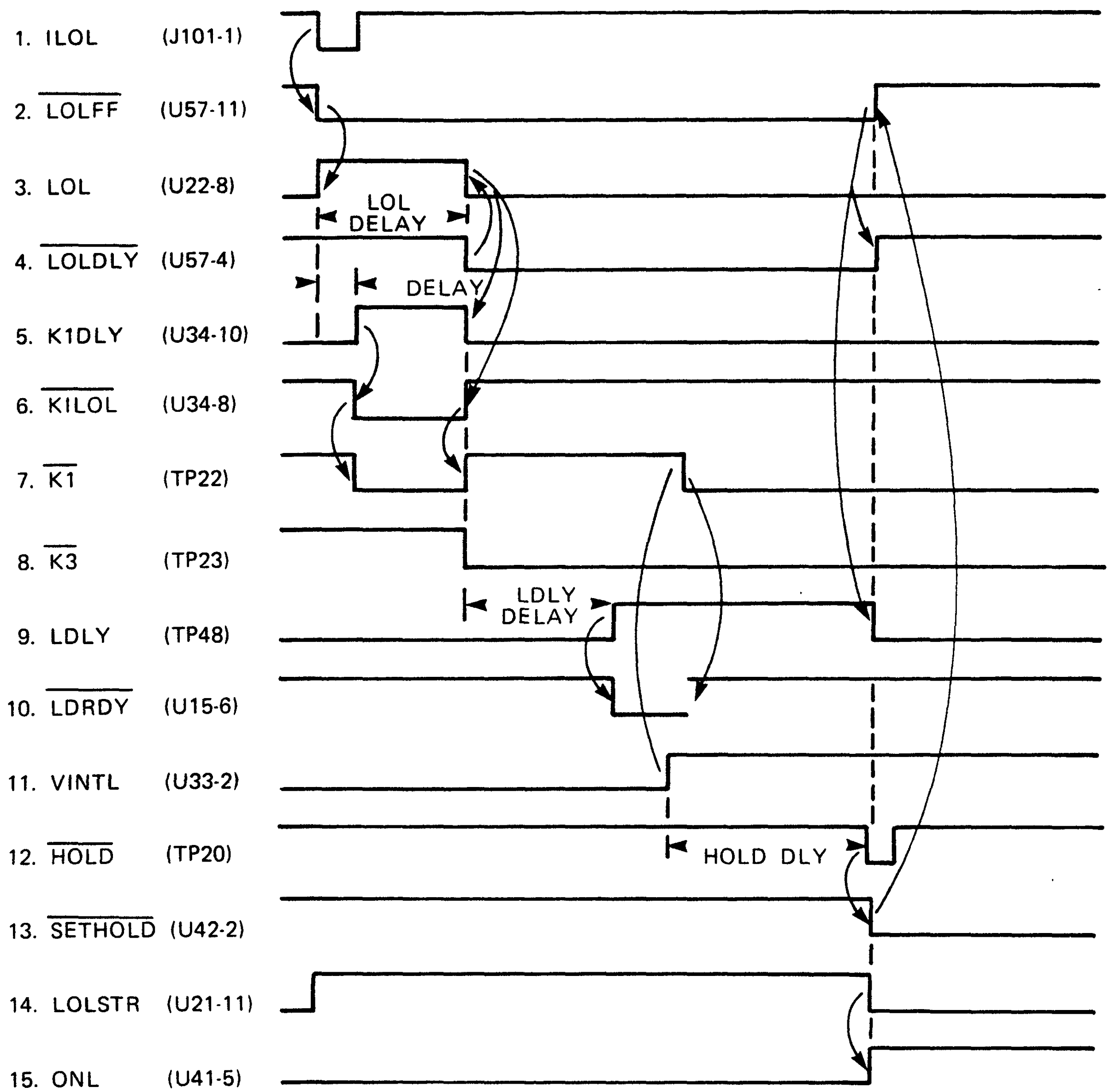


Figure 4-23. Remote Load On Line Timing Diagram

This high LOL signal is applied to transistor Q10 and diode CR17. The high signal applied to the base of Q10 turns Q10 off. Capacitor C55 then discharges through diode CR19 and resistor R116, creating a delay in turning off FET's Q6004 and Q7004 in the Supply Reel and Take-up Reel Servos, respectively. When collector of transistor Q10 reaches -4 volts, it turns off transistor Q11. When Q11 is turned off, the KIDLY signal at the collector of Q11 goes high. This high KIDLY signal is applied to U34-10 and causes the KILOL signal at U34-8 to go low. This signal is applied to U35-3 and energizes relay K1 through relay driver U45 and Q23 on the Heatsink PWBA. This connects the reel servos to their motors. At the same time, when Q10 and Q11 are turned off, -5 volts is applied through R116, CR15, R118, R120 and R124 to amplifier U7053 in the Take-Up Reel Servo. This causes the take-up reel motor to turn and take up the tape slack in the vacuum columns. R125 is connected to amplifier U6053 in the Supply Reel Servo which prevents the supply reel from moving. The low LOLFF signal at U57-11 is also applied to U40-1 and enables the clock input of the ONL flip-flop U41 with a high output from U40-6.

When the voltage at U1-10 has increased with the time constant of R108 and C53 until it is equal to the voltage at U1-11, the output at U1- 13 goes low. This causes the LOLDLY signal at inverter U17-12 to go high. This signal is applied to U34-2 and causes a high output from U34-6 that is applied to U43-1 and -2. The low output from U43-3 is applied to Q3 in the load delay circuit and turns Q3 off. Capacitor C8 in the load delay circuit then begins to charge through resistor R35 (refer to paragraph 4-15).

The low output at U1-13 also causes the LOL signal at U22-8 to go low and the KILOL signal at U34-8 to go high. The low LOL signal applied to Q10 turns Q10 and Q11 on. This turns on FET's Q6004 and Q7004 in the Supply Reel and Take-Up servos, respectively, after a delay determined by the time constant of R123 and C55.

When the load delay circuit times out, the LDLY signal goes high and the LDRDY signal goes low. The low LDRDY signal causes -17 volts to be applied to the reel motors (refer to paragraph 4-15). Current through the reel motors creates a torque that allows the tape to enter the vacuum column. The low LDRDY signal is also applied to the load fault circuit. If the interlock is not set before the load fault delay circuit times out, LDFLT goes low causing the RST signal to go low. This resets flip-flip-flop U57-11, stopping the load sequence. If the interlock is set before the load fault delay circuit times out, LDFLT remains high and the load sequence is allowed to continue.

When the vacuum interlock switches close VINTL goes high. This causes MINTL at U33-3 to go low turning off transistor U7 and INTL at U8-6 to go high. When INTL goes high, RSTD goes high causing RSTC to go high. This enables the ONL flip-flop U41. When MINTL goes low, it turns off transistor Q7. Capacitor C6 then begins to charge toward +5 volts through resistor R88. The low MINTL signal is also applied to U35-4 and energizes relay K1. This drives INTL low at U15-1, disabling LDRDY at U15-6.

When the voltage at U56-4 has increased with the time constant of R88 and C6 until it is equal to the voltage at U56-5, the output at U56-2 goes low and sets flip-flop U42-3 (SETHOLD). The low SETHOLD signal at U42-2 is applied to U31-2 and resets the flip-flop composed of U57-8 and U57-11. This causes the LOLSTR signal to go low setting the ONL flip-flop U41.

When flip-flop U57-11 is reset, transistor Q9 is turned on and the low LOLFF signal at U34-1 causes MINTL to go high. With MINTL high, transistor Q7 is turned on and relay K1 is kept energized by PSET high at U39-10 and INTLA high at U39-9. Relay K3 is kept energized by INTL high at U2-9 and UNL high at U2-10.

4-25 ADDRESS LOGIC

Figure 4-24 shows a simplified diagram of the address logic. The address logic circuits, on recognition of the tape unit's address, enables the tape unit to respond to external commands and to drive the interface lines. If only one tape unit is connected the external controller must still assert the correct ISELECT input. When the tape unit is addressed, the low input is inverted at U5-13, and a high is applied to U13-5. If P8-6 and 3 are connected, the tape unit must be on line with ONL high at U13-4 before U13 can respond to the input. When U13-6 output 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 jumped. Therefore, when the tape unit is on line and selected, LG is high at the ON LINE switch. This disables the ON LINE switch and holds flip-flop U40 in its present state. If the tape unit is not equipped with the Front Panel Disable option, E46 and E45 are jumped, holding LG at ground and not disabling the switch function.

4-26 FORWARD/REVERSE CONTROL CIRCUITS

Figure 4-25 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 that goes to the Capstan Amplifier. This ramp output will eventually stabilize at some DC voltage suitable for the tape speed requirements of the specific machine.

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

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

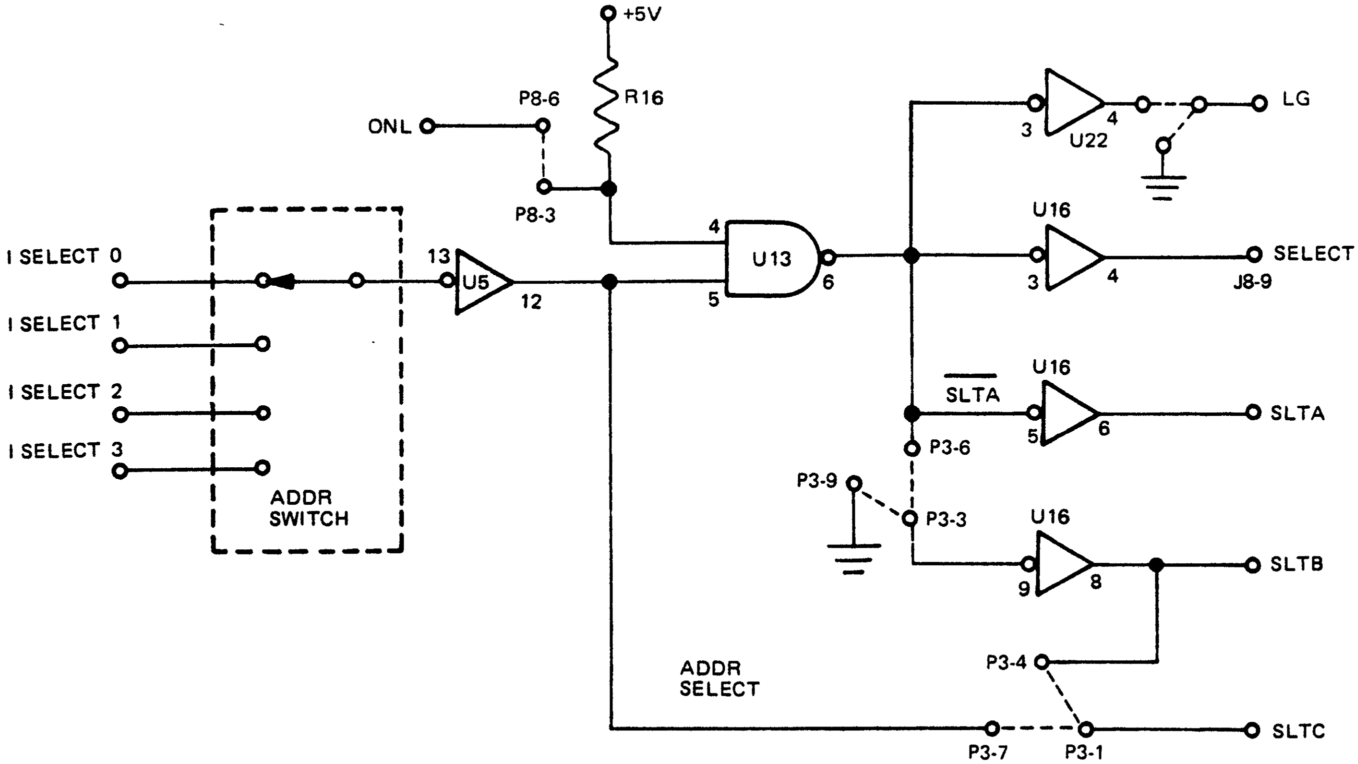


Figure 4-24. Address Logic Circuit Simplified Diagram

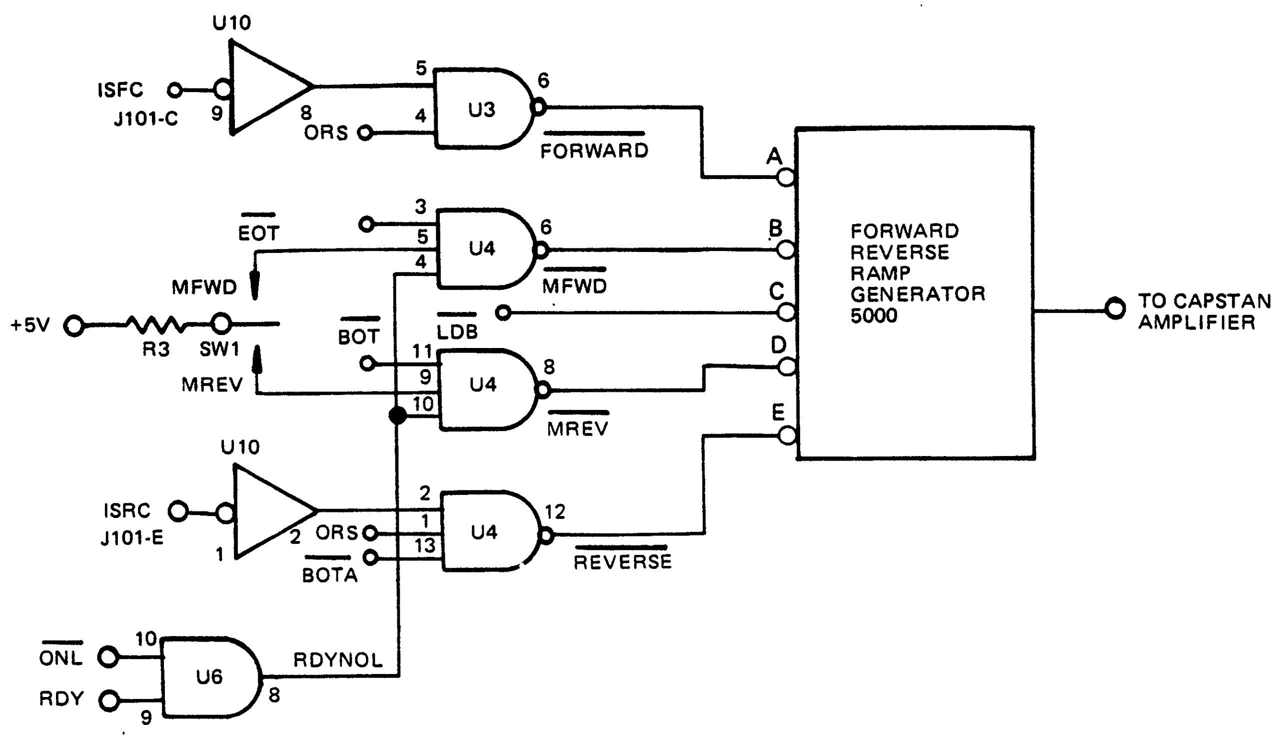


Figure 4-25. Forward/Reverse Control Circuits Simplified Diagram

4-27 WRITE/OVERWRITE CONTROL CIRCUIT

Figure 4-26 shows a simplified schematic diagram of the write/overwrite control circuit and figure 4-27 shows the write/overwrite timing diagram. To record data, the ISFC and ISWRT signals must be asserted. When the ISFC signal is asserted, the FORWARD input to U3-9 is low and the output of U3-8 is high, producing a high MOTION signal input to U3-12 and a low MOTION at U7-4, via J8-10, to the Data Electronics. The MOTION signal is delayed by the R5 and C1 time constant at U3-13 and differentiated by C2, R66, R67 generating a pulse at TP6 that is used as the clock input to flip-flops at U9-12, U9-9 and U14-1. With the ISWRT input asserted, the SWRT output of U9-3 is clocked high. With 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, ISWRT, and IOVW inputs must all be asserted (see figure 4-27). When these signals are asserted, flip-flops U9-3, U9-5, and U14-3 are set. Gate U14-6 is inhibited by the $\overline{Q}$ output of U9-6. However, all inputs to gate U15 are high and a WRITE ENABLE output to the Data Electronics is produced. Near the end of a record in which the overwrite sequence is occurring, the LRC input at U14-13 is set low, resetting the U14-3 output low. Consequently, the WRITE ENABLE is set high ending the overwrite operation.

4-28 REWIND/UNLOAD CONTROL CIRCUITS

Figure 4-28 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. Refer to figure 4-29 for a timing diagram of the unload sequence. When the tape BOT marker is at the BOT/EOT sensor and the RWDA and ONL are high, U29-12 produces a negative pulse output, setting the UNL output U32-6 low. U32-3 (RWDA) is not set because the RSTA signal is low when the tape BOT marker is under the BOT/EOT sensor.

When the UNL signal goes low at U32-6, the RSTC, RSTB, and RSTA signals are kept low and the UNL input at U2-10 is low. This de-energizes relay K3, turning off the vacuum motor. At the same time, the UNL input at U35-5 is low. This keeps relay K1 energized after the interlock switches have opened. The low UNL signal is also applied to transistor Q3001 in the Rewind Ramp Generator. This turns Q3001 on. The collector of Q3001 is connected to pin 3 of Amplifier U11 in the Forward-Reverse Ramp Generator. When Q3001 conducts, it causes the Forward/Reverse Ramp Generator to generate a negative ramp output. As a result, the capstan motor is driven in the reverse direction.

Tape on the takeup reel is pulled off by the capstan and the interlock switches open, the INTL signal at U31-12 goes high and causes the VACUNL signal at U31-11 to go high. This high signal is applied to diode CR13 and transistor Q6. The high input to the base of Q6 turns Q6 off. Capacitor C55 is discharged through CR20, turning off FET's Q6004 and Q7004 in the Supply Reel and Take-Up Reel Servos respectively. The high input to CR13 is applied to Take-Up Reel Servo Amplifier

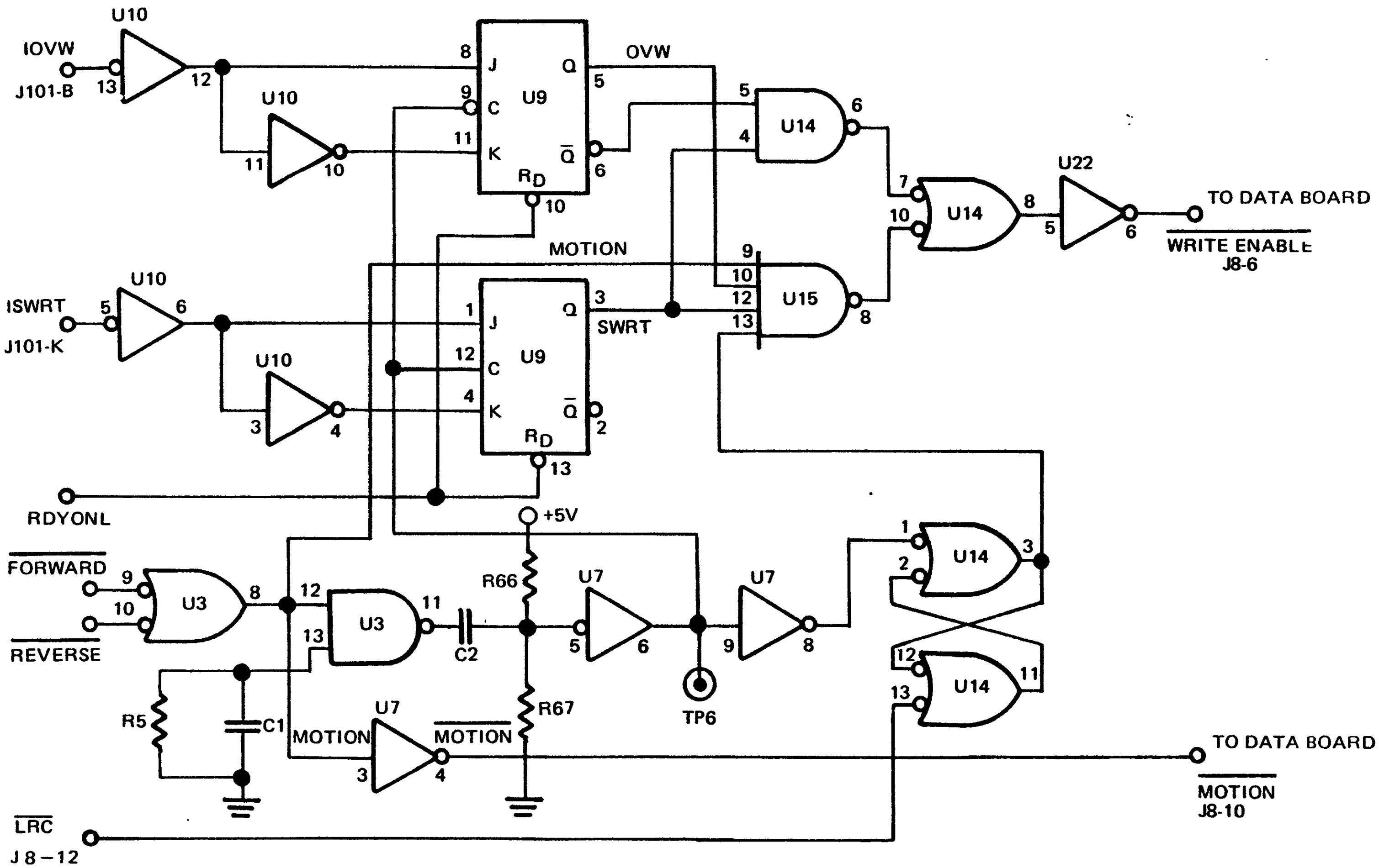


Figure 4-26. Write/Overwrite Control Circuits Simplified Diagram

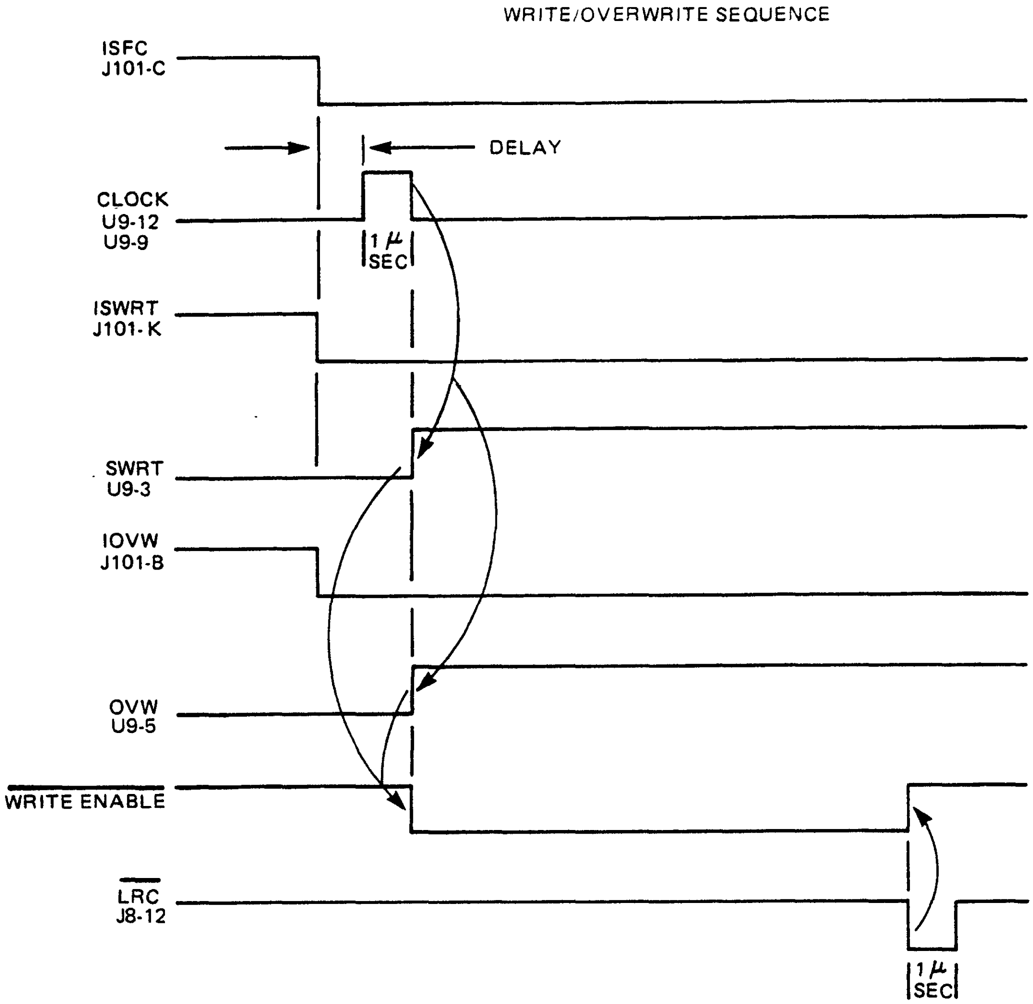


Figure 4-27. Write/Overwrite Timing Diagram

U7053 through R85 and R103, causing the Take-Up Servo motor to turn in the reverse direction.

The reel motors are kept turning by VACUNL until the tape has been pulled out of the EOT/BOT assembly. This causes TPC at U24-6 to go low. When TPC goes low, the output from U2-11 in the Load Fault circuit (figure 4-9) goes high, allowing C48 to charge through R74. When the voltage at U1-4 has increased with the time constant of R74 and C48, until it is equal to the voltage at U1-5, the output at U1-2 switches to -7 volts and $\overline{\text{LDFLT}}$ is clamped low at -0.6 volts by CR9. The low $\overline{\text{LDFLT}}$ signal is applied to U35-1 and 2, causing the $\overline{\text{RST}}$ signal at U35-12 to go low. This resets the UNL flip-flop U32 and stops the Supply and Take-Up motors.

When the tape is not positioned at the BOT marker and the external controller asserts the IREW signal, or the IREU signal or the REWIND switch is pressed, the tape will rewind at 375 ips. When the IREW signal is asserted, the output of U33-6 goes low causing U25-8 to go low, setting the RWDA flip-flop U32. The low $\overline{\text{RWDA}}$

signal from U32-2 is applied to U31-4, 5 and causes a low input to the lamp driver. This causes the REWIND lamp to illuminate. The high RWDA signal from U32-3 is also applied to U24-10, U19-10 and U19-3. If the SLTC signal at U24-9 is high (tape unit selected), the IRWD status signal is asserted to the controller at J101-N/J102-N. The low $\overline{\text{RWDA}}$ signal from U32-2 is also applied to the base of transistor Q8 through resistor R94. This turns Q8 off and allows capacitor C7 to charge through resistor R97. When the voltage at U56 has increased, with the time constant of R97 and C6, until it is equal to the voltage at U56-10, the RWDL signal at U56-13 goes high. This signal is applied to U19-9 and causes the $\overline{\text{RWRD}}$ signal at U19-8 to go low. The low $\overline{\text{RWRD}}$ signal is applied to the Rewind Ramp Generator. This causes the Rewind Ramp Generator to generate a negative ramp output to the Capstan Amplifier. The Capstan Amplifier begins to drive the capstan motor in the reverse direction at 375 ips. At the same time, the high REWD signal from the Rewind Ramp Generator is applied to relay driver U45 and to U19-5. The high input to U45 de-energizes relay K4 through Q20 on the Heatsink PWBA. The high input to U19-5 causes U19-6 to go low. This low output is applied to relay driver U38, energizing relay K2 through Q22 on the Heatsink PWBA. When relay K2 is energized, -36 volts and +36 volts are applied to the Supply Reel and Take-Up Reel Servo motors respectively. This allows the servo motors to be driven at the increased tape speed.

When the tape passes the BOT marker, the RWDB flip-flop is set when BOTA goes low. This causes the $\overline{\text{RWRD}}$ signal at U19-8 to go high. This de-energizes relay K2. The Rewind Ramp Generator ramp down until the capstan has stopped. After the capstan motor has come to a stop, REWD at U45-6, 7 goes low. Since the RWDB signal at U28-12 is high and, since the REWD signal at U28-13 was previously high and is now low, the LDB flip-flop U27 is set by the transition through U28-8. The $\overline{\text{LDB}}$ signal at U27-6 is an input to the Forward-Reverse Ramp Generator and, and when low, causes the Capstan Amplifier to move the tape in the forward direction. When the BOT marker is detected, $\overline{\text{RSTB}}$ at U44-11 goes low. This resets the LDB flip-flop U27 and causes $\overline{\text{RSTA}}$ at U44-3 to go low. The low $\overline{\text{RSTA}}$ signal resets the RWDA flip-flop U32 and the RWDB flip-flop U17. The tape is positioned at the BOT marker. If the REWIND switch is pressed again, the tape unload sequence previously described will be performed.

4-29 EOT/BOT CONTROL LOGIC

Figure 4-30 shows a simplified schematic diagram of the EOT and BOT control logic. These circuits are used to provide an indication when the tape has passed or is positioned at the EOT or BOT marker. The output of the EOT/BOT circuits are passed through appropriate interface circuits to the external controller.

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

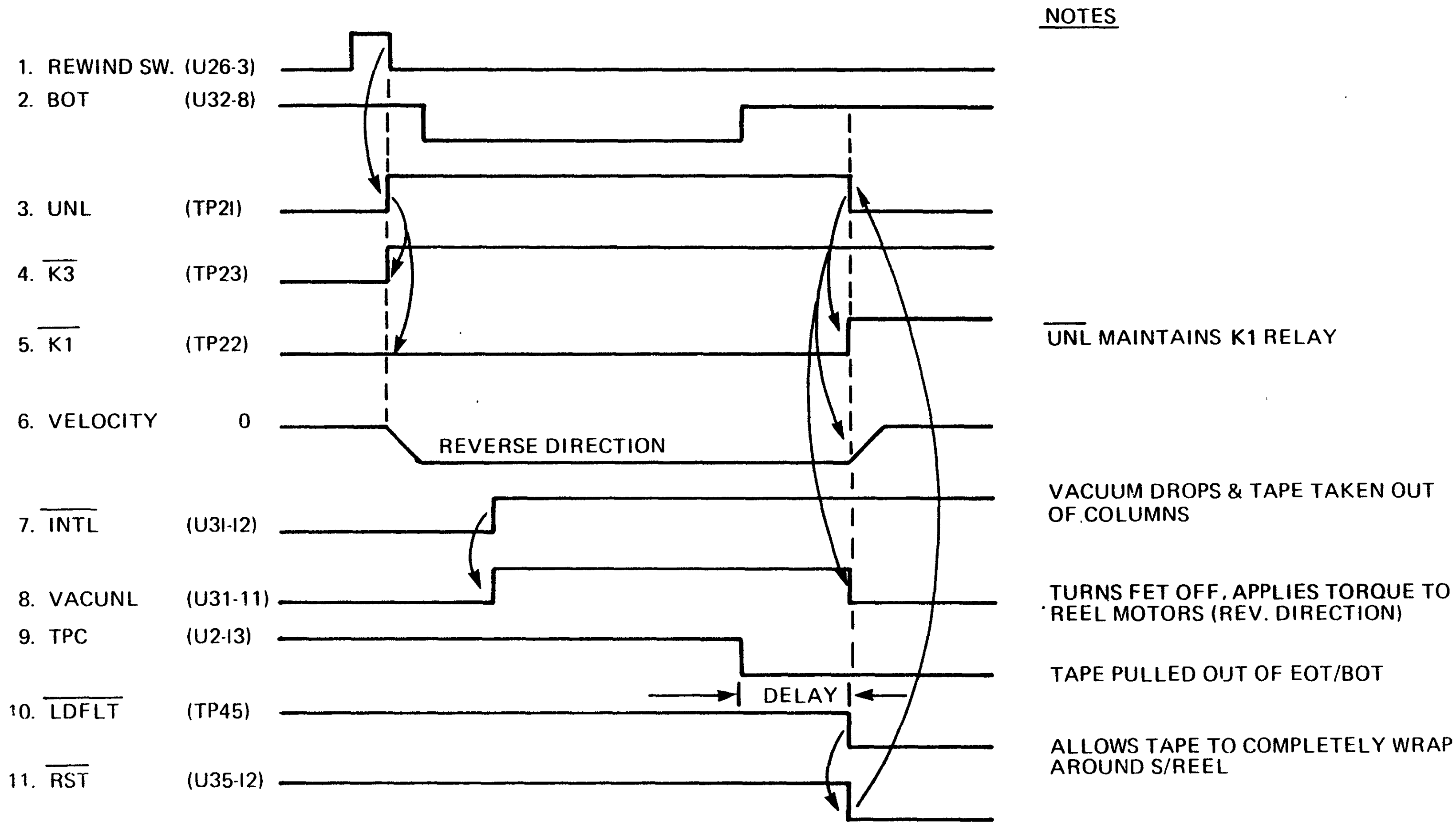


Figure 4-29. Unload Sequence Timing Diagram

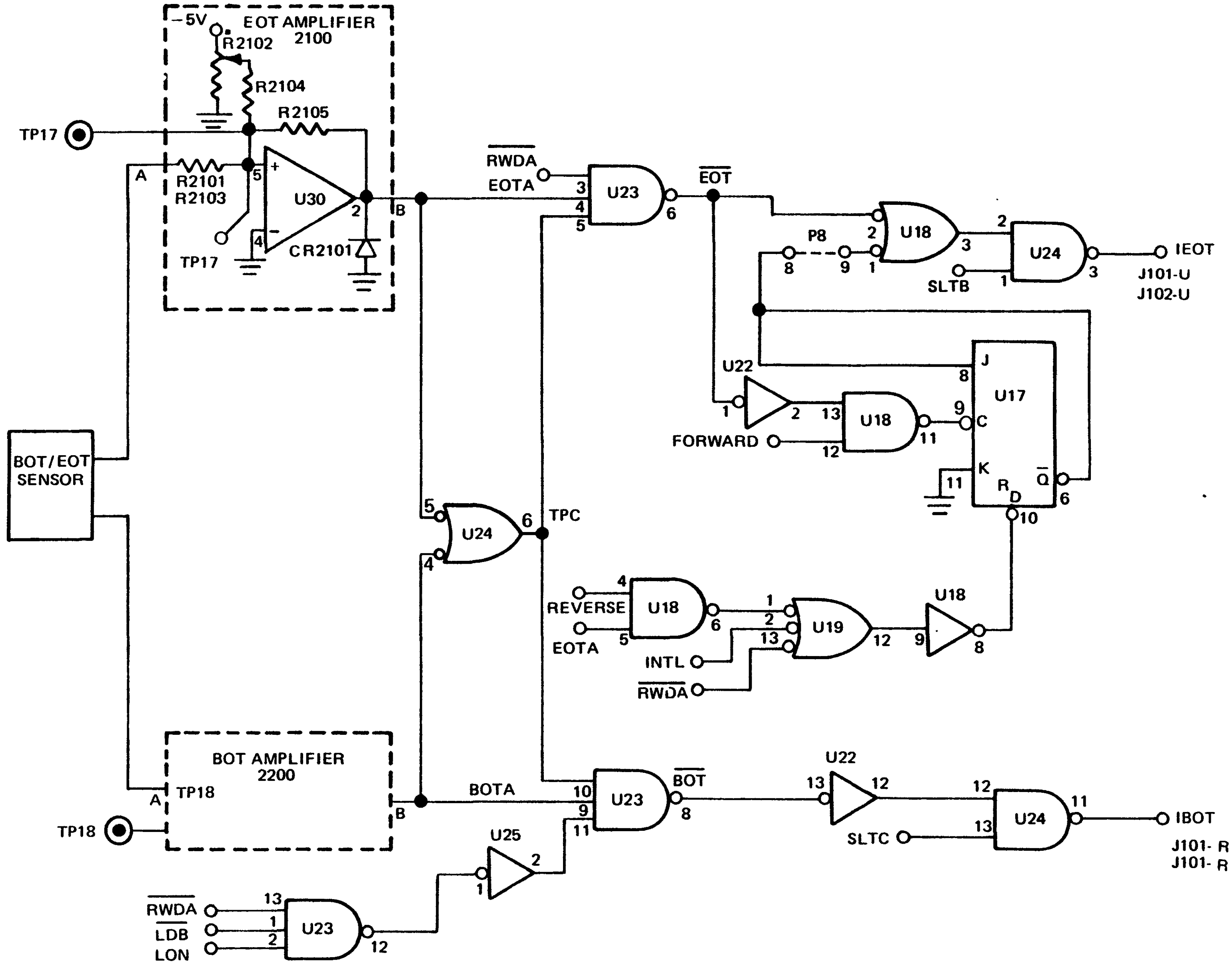


Figure 4-30. EOT/BOT Control Logic Circuit Simplified Diagram

EOTA is applied to NAND gates U23-4 and U24-5. When the tape has been removed from in front of the EOT/BOT assembly, the reflector post in front of the assembly reflects the light setting both BOT and EOT amplifiers high. Two highs at U24-4 and 5 set TPC at U24-6 low, gating EOT high at U23-6. If the tape unit is rewinding, RWDA at U23-3 is also low preventing EOT from asserting IEOT through U18-3. EOT through U18-11 sets U17-5 when the FORWARD is asserted at U18-12. If the jumper between pin P8-9 and 8 is connected, the output of U17-6 is connected to U18-1, asserting IEOT at J101-U/J102-U whenever 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 tape unit is loading, rewinding or the tape is not on the tape path.

4-30 DENSITY SELECT CIRCUITS

Figure 4-31 shows a simplified diagram of the density select circuits. When the density select option is selected, pin 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 HI DEN output to the Data Electronics at J8-3 is set low. In additon, the SLTB signal gates the output of U13-8 through line driver U21-6, setting the IDDI output at J101-F/J102-F low. The IDDI output indicates high density operation to the external controller. When the dual speed option is used, high density asserted HID at U13-11 will cause SPD at U13-3 to go low, causing the tape unit to operate at the slower speed. When the 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 U26-8 cannot charge state. When the Front Panel Disable option is not used, LG is at ground.

4-31 9-TRACK CIRCUIT

Figure 4-32 shows a simplified diagram of the 9-track circuit. The 9-TRACK switch is used with the quad density option and combination 7- and 9-track, single speed, NRZI tape units. When the 9-TRACK switch is used with the quad density option, pins P1-5 and P1-2, E33 and E34, and P1-1 and P1-4 are connected. When the 9-TRACK switch is pressed, U39-3 goes low at pin A of lamp driver 9500 and at inverter U16-1. This causes the 9-TRACK switch lamp to illuminate and the 9-TRACK signal at J8-2 to go high. The high 9-TRACK signal is applied to the data electronics, indicating 9-track operation. With the 9-TRACK switch in the 9-track position, a low is also applied to U13-10 in the density select circuit. This holds the IDDI signal to the controller low in 9-track operation (indicating high density). The 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

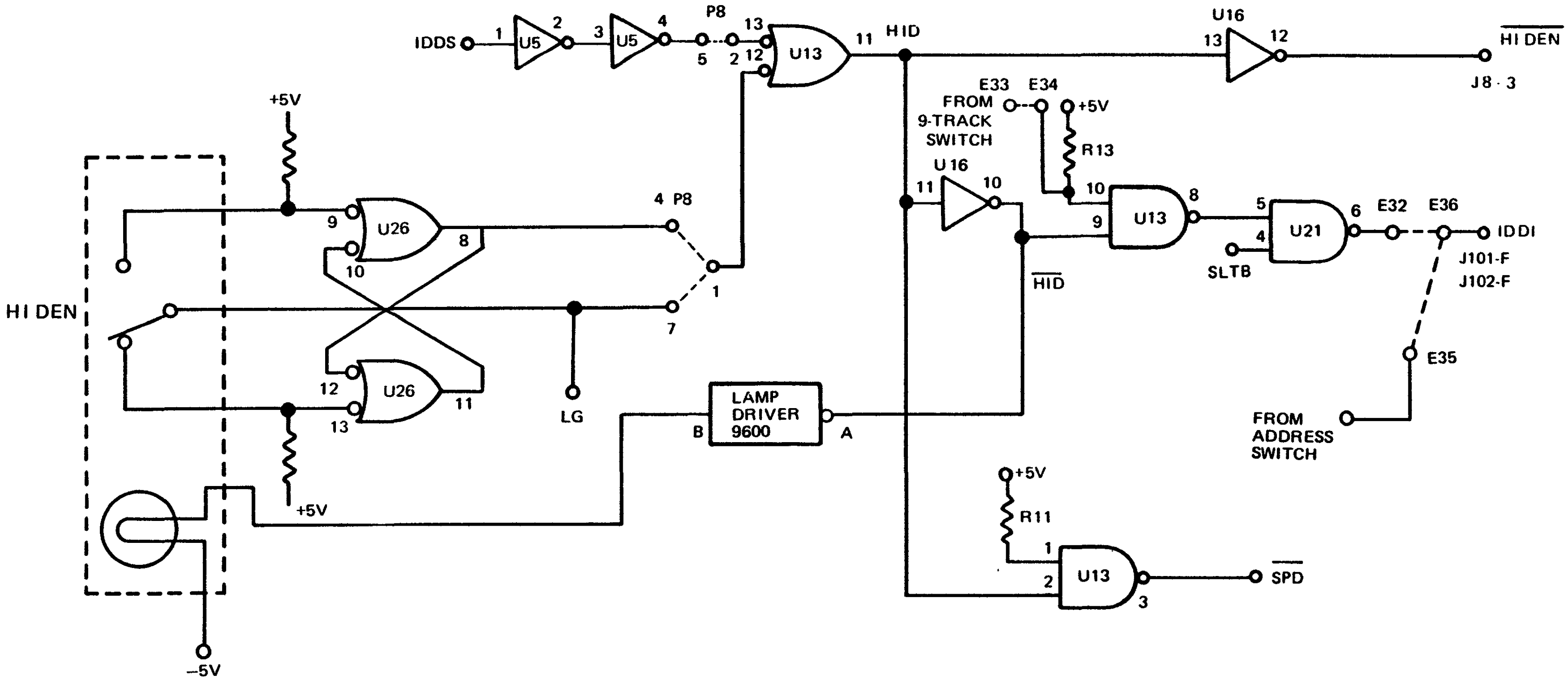


Figure 4-31. Density Select Circuits Simplified Diagram

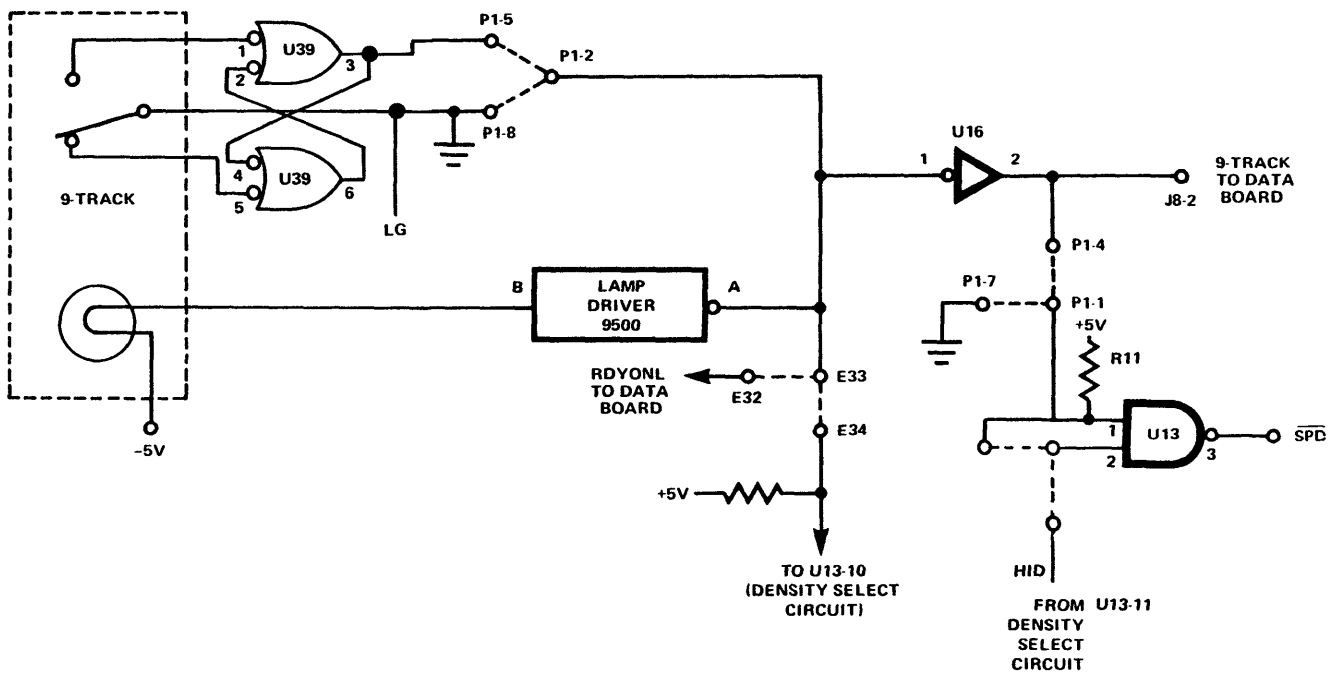


Figure 4-32. 9-Track Circuit Simplified Diagram

the 7-track position of the 9-TRACK switch, a low is applied to U13-1. This holds the SPD signal high during 7-track operation and causes the tape unit to operate at the higher speed.

The 9-track switch option is also used for combination 7- and 9-track, single speed, 800 bpi NRZI tape units. On these units, the input to U13-1 is held low. This causes the SPD signal to be held high. The RYDYONL signal is used on read only tape units only. 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.

4-32 FILE PROTECT CIRCUIT

The file protect circuit, see figure 4-33, can be connected as either a file protect circuit or a write enable circuit. When connected as a file protect circuit, the FILE PROTECT lamp is illuminated when a file reel without a write ring is mounted on the tape unit. This indicates that writing or erasing on the tape is not possible. When connected as a write enable circuit, the WRITE ENABLE 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.

When a write ring is installed in the file reel, the high INTLA signal is applied to inverter U5-11 and to the Data Electronics as the WRITE POWER signal at J8-1. The low output from U5-10 is applied to U5-9 and U21-10. The low input at U21-10 causes the IFPT signal to the controller at J101-P/J102-P to go high. This indicates that the tape is not file protected (a write ring is installed in the file reel). The low input to U5-9 is inverted and turns on relay driver Q1/Q2. This energizes the write lockout solenoid which secures the write lockout assembly. If the circuit is connected as a file protect circuit, the jumper between P1-3 and P1-9 is connected and the jumper between P1-3 and P1-6 is not connected. Since the input to lamp driver 9400 is then high, the FILE PROTECT lamp remains extinguished. This indicates that writing or erasing on the tape can be performed. If a write ring is not installed in the file reel, the input to lamp driver 9400 will be low, causing the FILE PROTECT lamp to illuminate. This indicates that writing or erasing on the tape is not possible.

When the circuit is connected as a write enable circuit, the jumper between P1-3 and P1-6 is connected and the jumper between P1-3 and P1-9 is not connected. Since the input to lamp driver 9400 is than low, the WRITE ENABLE lamp then illuminates. This indicates that writing or erasing on the tape can be performed. If a write ring is not installed in the file reel, the input to lamp driver 9400 will be high, causing the WRITE ENABLE lamp to remain extinguished. This indicates that writing or erasing on the tape is not possible.

4-33 DATA BOARD ELECTRONICS

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

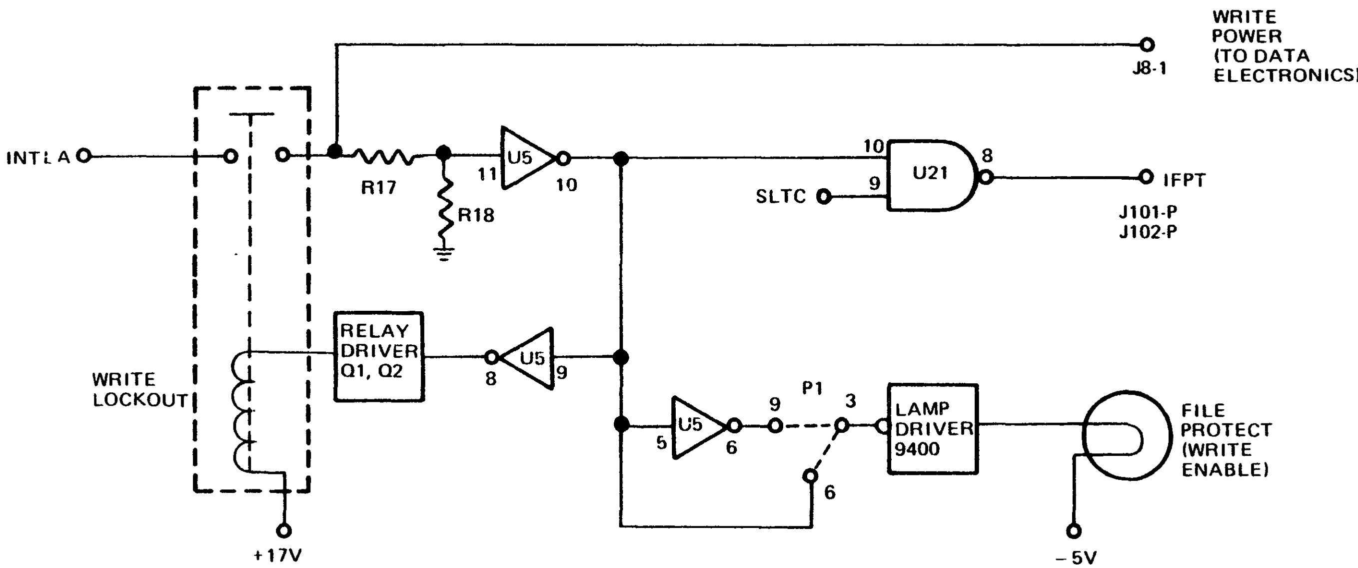


Figure 4-33. File Protect Circuit Simplified Diagram

4-34 NRZI DATA BOARD OPERATION

The NRZI Data Board contains 9 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 operation and the read operation are described in the following paragraphs. Since the circuits for the different tracks are identical, only one will be described. Figure 4-34 is a simplified logic diagram of the NRZI write circuits and figure 4-35 shows NRZI write data timing. Figure 4-36 is a simplified logic diagram of the NRZI read data circuits and figure 4-37 shows NRZI read data timing.

4-35 NRZI Write Circuits

The WRT DATA PARITY input (IWDP) is inverted at U29-4 and is gated with DATA READY (I DATA READY) setting U32-10 low if a logic one is present on the interface. Refer to figures 4-34 and 4-35. The low transition through C101 turns off Q101 setting U29-10 low keeping U32-10 low through 101 to 102. Capacitor C101 is charged through R103 and potentiometer R102 until Q101 is again conducting at saturation, setting flip-flop U33-3 through through jumper 103 to 104. This delay is adjusted for write deskew. For a single gap head, U32-10 is connected directly to U33-12 through jumper 102 and 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 every time flip-flop U33 sets or resets a flux change occurs on the tape.

The write current is supplied by the WRITE POWER and WRITE ENABLE signals. If WRT ENABLE is low, Q1 will conduct at saturation, which will cause Q2 and Q3 to conduct at saturation as long as WRITE POWER supplies +5 volts to Q2 emitter. A jumper is installed between 13 and 14 when the High Density (HI DEN) signal controls the operation of the NRZI Data Board when it is used with a PE Data Board. A jumper is installed between E17 and E15 for 9-track operation, or between E16 and E15 for 7-track operation, when the 9-TRACK signal controls the operation of the NRZI Data Board when it is used on a quad-density (three data card) tape unit. Transistor Q2 supplies current through CR1 for the erase head and for the differential head drivers Q102 and Q103 transistor Q3 supplies the head current.

4-36 NRZI Read Circuits

Read head signals ranging from 5 to 35 millivots are amplified by U103. Refer to figures 4-36 and 4-37. The gain of U103 is determined by the 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 NRZI Data Board drawing in the attached drawing package.

The output of U103 at TP101 is connected to diode CR105 and to the unity gain inverter composed of Q104, Q105, and Q106. The output of Q106 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 goes low

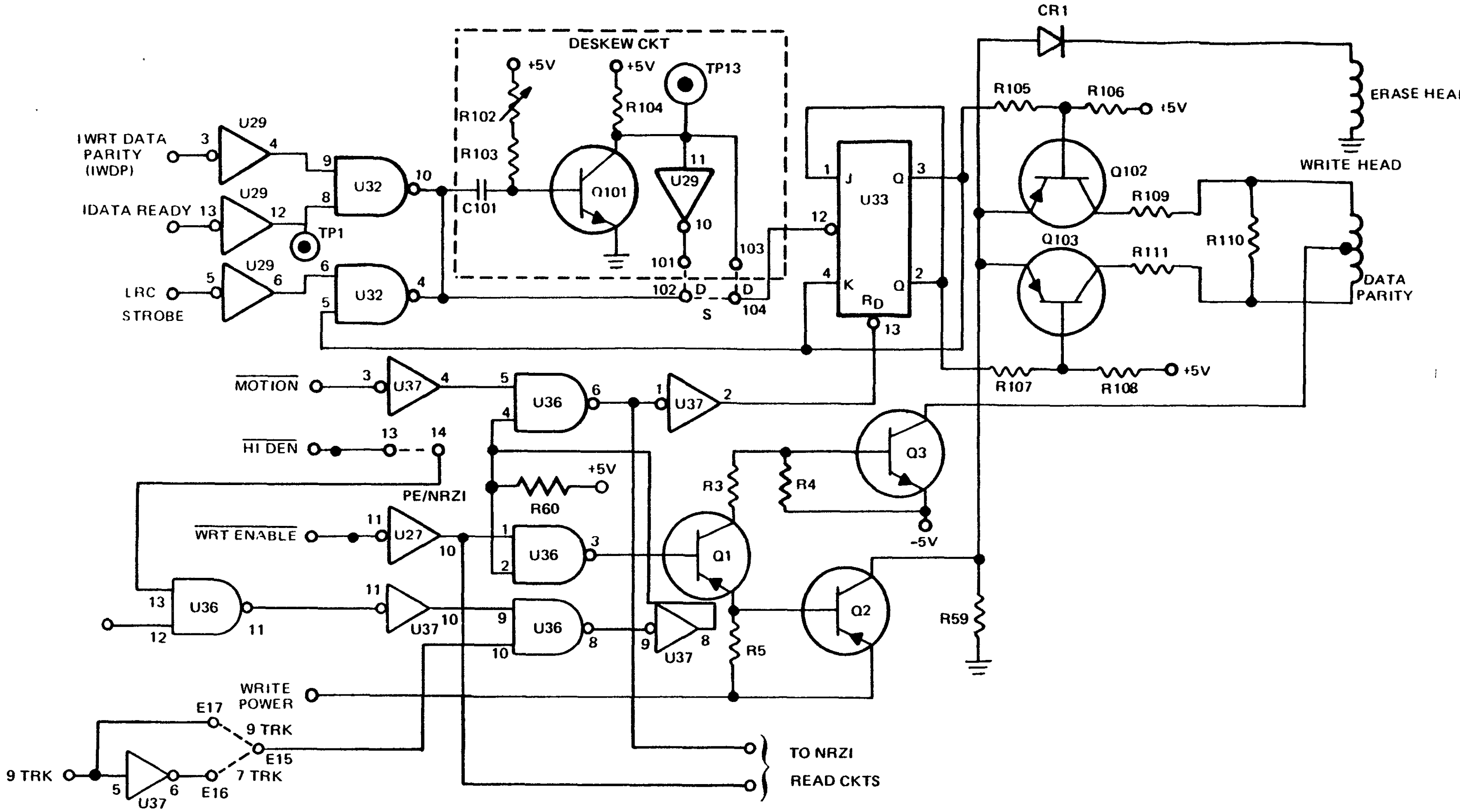


Figure 4-34. NRZI Data Board Write Circuits Simplified Diagram

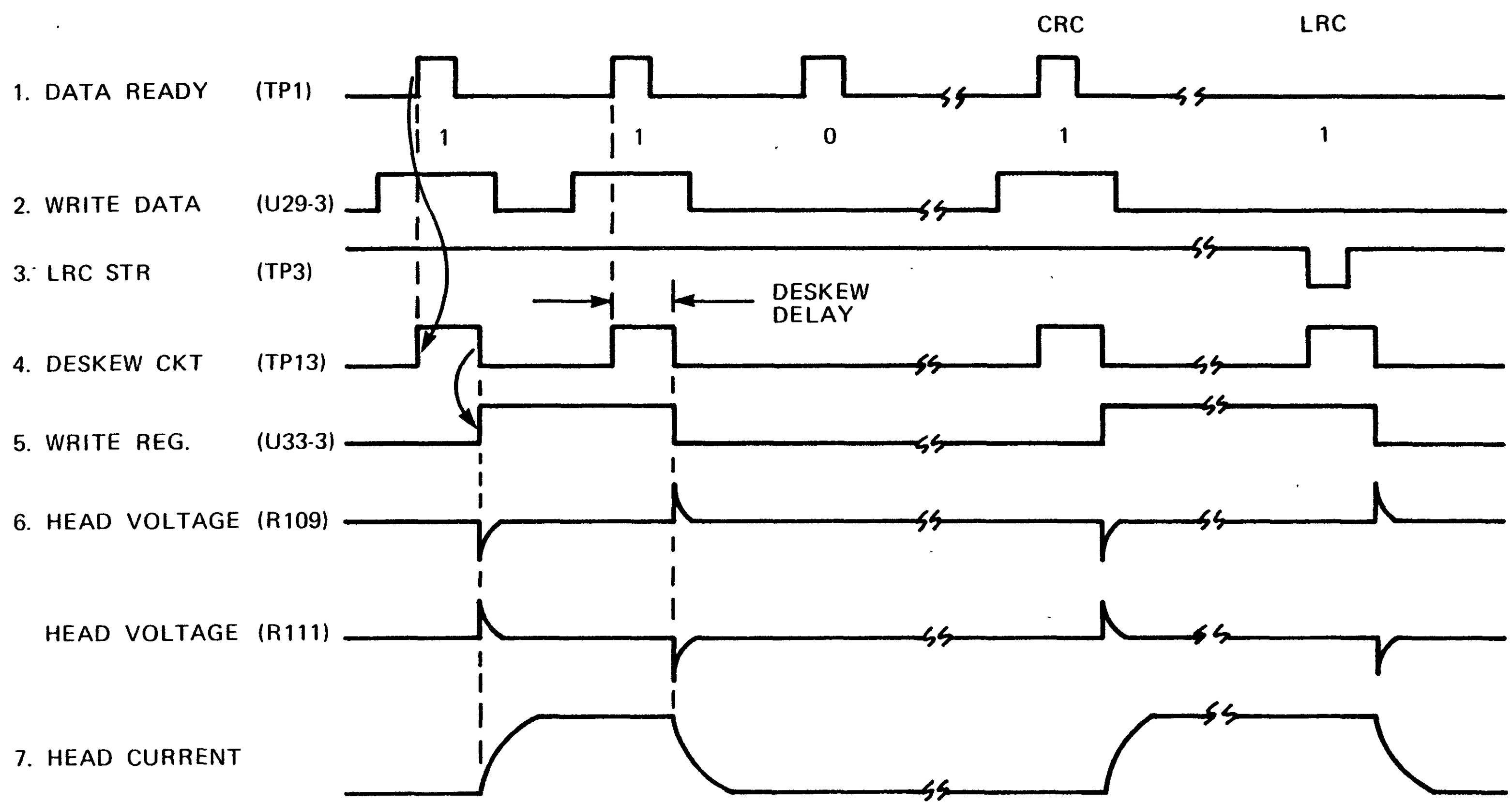


Figure 4-35. NRZI Write Data Timing Diagram

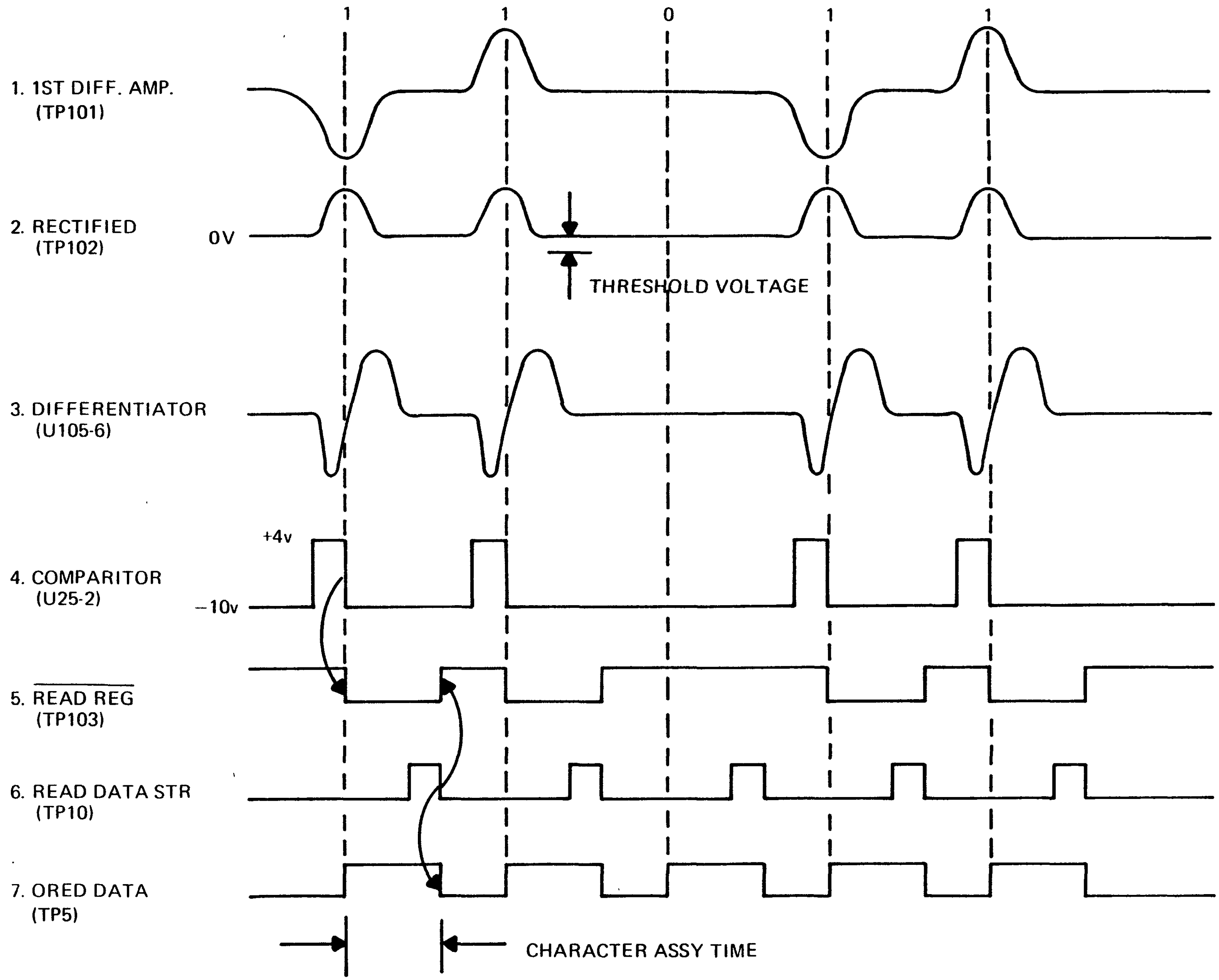


Figure 4-37. NRZI Read Data Timing Diagram

setting U30-11 and U26-12 high and turning off Q4 and Q5. Since R15 has a higher resistance than the parallel combination of R13 and R15, the read threshold is set lower, at about 12% of the maximum voltage.

For single gap heads, a jumper is connected from 1 to 2 setting U28-8 goes 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 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 U105-2 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; this lowers the voltage at U3-8 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 approximately 1 usecond. When U3-14 switches high U28-3 goes low until U3-13 goes high. This 1 usecond pulse is gated at U3-1 with MOTION to create the READ DATA STROBE. When U28-3 goes high, all inputs to U26-6 are high which sets U26-6 low resetting flip-flop U34.

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.

4-37 PE DATA BOARD OPERATION

The PE Data Board contains nine circuits, one circuit for each of the data tracks. The circuits are divided into the Write and the Read circuits. Both the write operation and read operation is described in the following paragraphs. Since the circuits for different tracks are identical, only one track will be described. Figure 4-38 is a simplified logic diagram of the PE Write circuits, and figure 4-39 is a simplified logic diagram of the PE Read circuits. Figure 4-40 shows timing for both the PE Write and Read circuits.

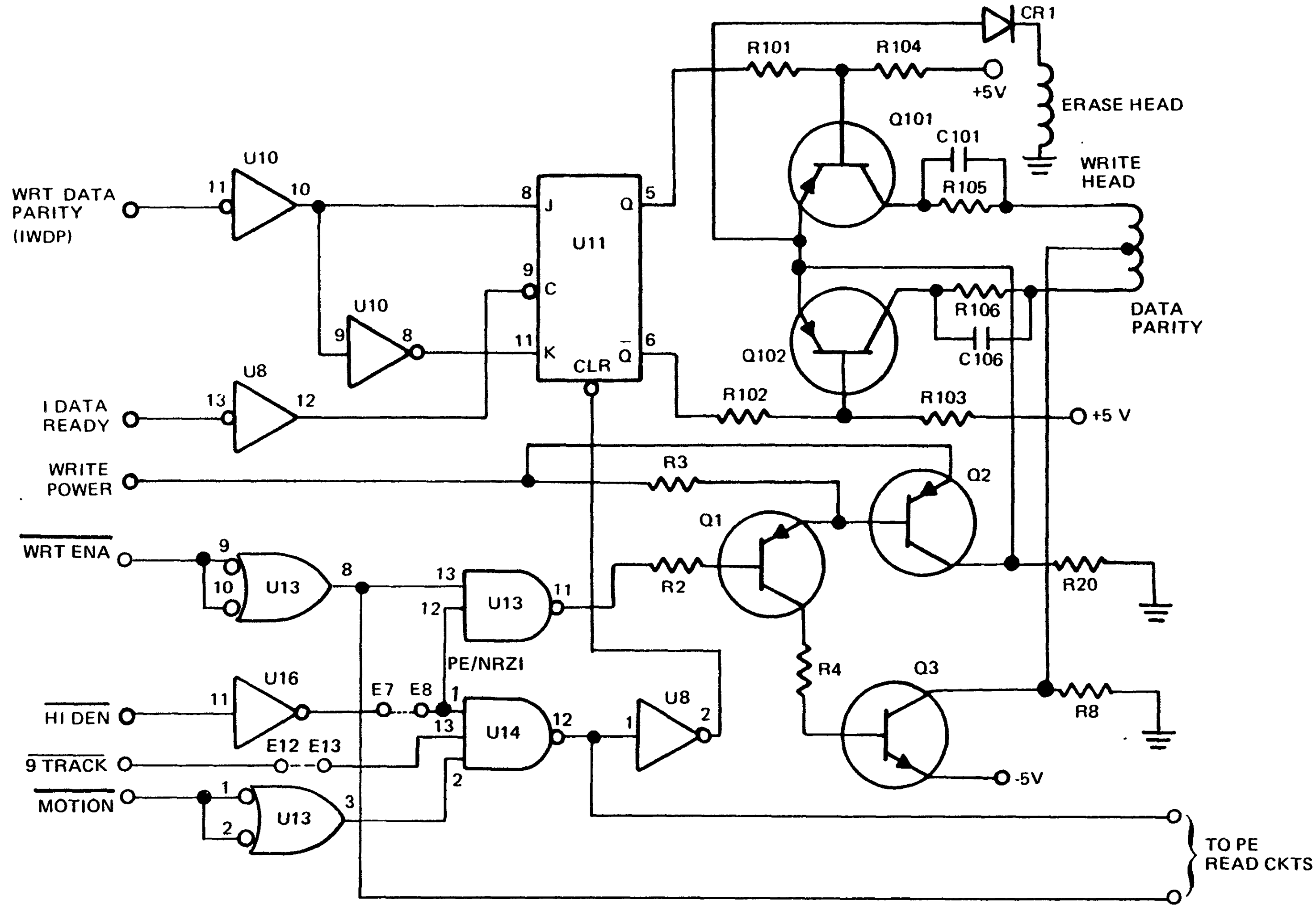


Figure 4-38. PE Data Board Write Circuits Simplified Diagram

4-38 PE Write Circuits

The WRT DATA PARITY input is inverted at U10 and clocked into flip-flop U11-5 by DATA READY. The outputs of the flip-flop U11-5 and 6 alternately drives Q101 and Q102 creating a flux change on the tape. The read current is determined by R105 and R106. The directions 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 the 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. A jumper is installed between E12 and E13 when the 9-TRACK signal controls the operation of the PE Data Board when used on a quad-density (three data board) tape unit. Therefore, when WRITE ENABLE is true, U13-11 turns on Q1, Q2 and Q3. Q3 conducts at saturation,supplying the current for the write heads, and Q2 supplies the current through CR1 for the erase head and the differential head drivers Q101 and Q102.

4-39 PE Read Circuits

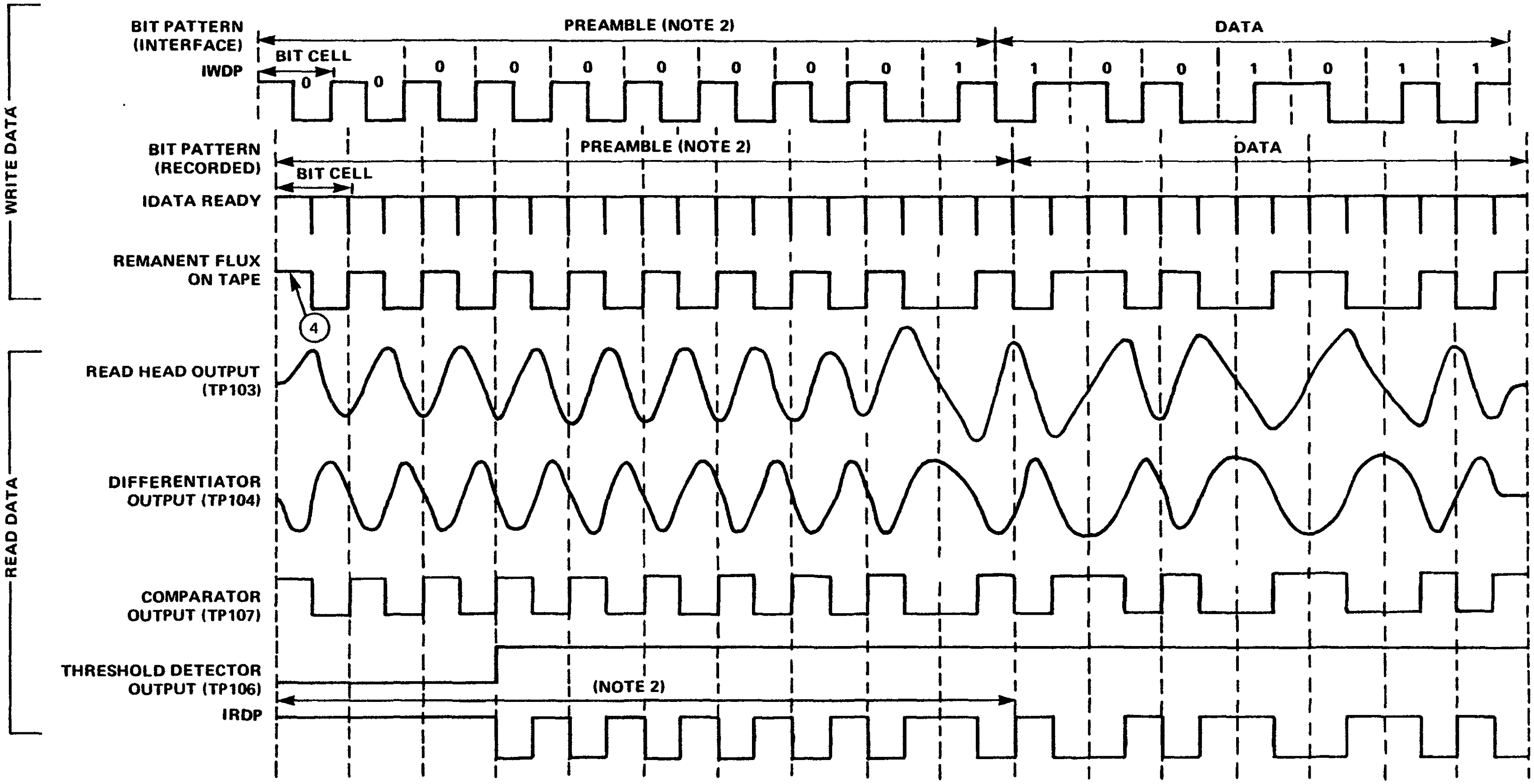
The read head signals ranging from 3 to 18 millivolts are amplified by U101. The gain of U101 is determined by a resistor network consisting of R110, R116 and potentiometer R112. For a single stack head, a jumper from J3 to J4 is included.

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

The envelope detector includes U103-2, Q103 and Q104. U103-2 compares the output of the differentiator with the TP4 read threshold reduced to 1/2 by R136 and R124. Refer to PE threshold description in paragraph 4-40. The thresholds are 30%, 15% and 5%. If the signal is more negative than the threshold, U103-2 switches high, reverse biasing CR107, allowing C118 to charge through R132. The R132/C118 time constant is such that Q103 is turned on if there are no negative pulses from U103-2 within two data character times. When a negative pulse occurs Q103 is turned off and C119 is charged up through R133. The emitter of Q104 follows the voltage increase of C119 enabling U12-3 when the emitter voltage reaches approximately 2 volts. The R133/C119 time constant is such that U12-2 is enabled after three character times if Q4 is conducting at saturation supplying +5 volts to Q104 and R133. Q4 is turned on whenever MOTION is true.

4-40 PE Threshold Circuits

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



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 4-40. PE Data Write/Read Timing Timing Diagram

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

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

Chapter 5

MAINTENANCE

5-1 INTRODUCTION

This chapter contains the information required to perform maintenance on the Model 2760 Magnetic Tape Unit. The chapter contains preventive maintenance information, checkout and alignment procedures, component replacement instructions, and troubleshooting procedures to isolate malfunctions. Before using the information in this chapter, the maintenance technician must have a thorough knowledge of the material contained in chapter 4. One or more of the simplified schematics, logic diagrams and timing diagrams in chapter 4 may also prove helpful during checkout and alignment, and when troubleshooting the tape unit.

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

5-2 PREVENTIVE MAINTENANCE

Preventive maintenance on the Model 2760 Magnetic Tape Unit consists of periodic cleaning, checking for alignment and wear of the tape handling components and replacement of worn parts as necessary. Component replacement instructions are presented in paragraph 5-51. To ensure reliable operation of the tape unit at optimum design potential, and to assure high mean time between failures, a scheduled preventive maintenance program is recommended. For ease of use this program has been divided into operator preventive maintenance and service engineer preventive maintenance. Table 5-1 lists preventive maintenance which should be performed periodically by the equipment operator and table 5-2 lists preventive maintenance procedures which should only be performed by a qualified engineer or maintenance technician.

5-3 CLEANING THE UNIT

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

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

TABLE 5-1. OPERATOR PREVENTIVE MAINTENANCE SCHEDULE

MAINTENANCE PROCEDURE	HOURS BETWEEN MAINTENANCE	MAINTENANCE TIME (HOURS)
Clear head, tape guides, tape cleaner face, and capstan surface	8	.13
Clear vacuum chamber	16	.1
Check tape guides and capstan	16	.1
Clear tape cleaner	80	.1
Clean tape unit surface	3000	.5

TABLE 5-2. SERVICE ENGINEER PREVENTIVE MAINTENANCE

MAINTENANCE PROCEDURE	HOURS BETWEEN MAINTENANCE	MAINTENANCE TIME (HOURS)
Check skew, tape tracking, head wear, tape speed, EOT/BOT, and Data Electronics	2000	.75
Replace reel motor brushes and check tape tension	5000	.15
Replace capstan motor, blower motor, and blower motor belt	10,000	1.0
Replace reel motors	15,000	.25
Replace control switches and lamps	15,000	.25

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.

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

CAUTION

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

To clean the inside of the vacuum column glass, 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 paragraphs is listed in table 5-3. Test equipment with equivalent characteristics may be substituted for the equipment listed in table 5-3. If abnormal indications are obtained during performance of the following procedures, refer to the troubleshooting procedures in paragraph 5-47. For component location on the circuit boards, refer to the PWBA drawings listed in chapter 6.

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-volt and -5-volt regulated power supply outputs must be checked prior to attempting any electrical. Any change to the +5 or -5 regulated voltage outputs will necessitate readjustment of other electrical outputs such as the EOT/BOT amplifier, capstan speed, etc. Refer to the regulated power supplies adjustment procedure.

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 the attached drawing package for component location on the Tape Control Board.

CAUTION

Primary power should be removed from the unit when rear access is required except in cases of electrical testing and adjustments. This is done by disconnecting the power cord, or by turning the Service Power switch to the OFF position.

5-6 Adjustment of Regulated Supplies

The ±5 volt regulated supplies are located on the Tape Control Board. Adjustments made on one regulator affect the other, so both regulators must be adjusted until the outputs of both are correct. Limits for the ± 5 volt supply are listed below. Any adjustment of the voltage regulator must be followed by a check of the capstan speed, ramps, and reel servos (paragraph 5-9 through 5-17). 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 INFORMATION

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

TABLE 5-3. TOOLS AND TEST EQUIPMENT

COMMON NAME	MANUFACTURER MODEL OR TYPE NUMBER
Vacuum Column Alignment Tool	9810019-01
Micrometer	
IBM Master Skew Tape	432640
Dual Channel Oscilloscope	Tektronix 453
1 lb. Gauge	Chatillon DPP-1
15 lb. Gauge	Chatillon LP-15
5 M Gauge	Gates Rubber Co. P/N 3609371
Miscellaneous shims	(Refer to Spare Parts Lists in chapter 6)
TX-1000 Tape Transport Exerciser	00295
Digital Multimeter	Weston 4440

5-7 +5 Volt Supply Regulator Adjustment

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

b. The digital multimeter's display should indicate + 5.2V ± 0.15 vdc. If the display's indication is out of tolerance, adjust potentiometer R1018 (refer to the Tape Control Board drawing) for an indication of +5.2V ± 0.05 vdc. 5 vdc.

5-8 -5 Volt Supply Regulator Adjustment

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

b. The digital multimeter's display should indicate -5.2V) ± 0.15 vdc. If the multimeter indicates it is out of tolerance, adjust potentiometer R1024 for an indication of -5.2V ± 0.05 vdc.

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 above ground and has a swing of at least 3 volts 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.

5-12 ADJUSTMENT OF CAPSTAN SPEED

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

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

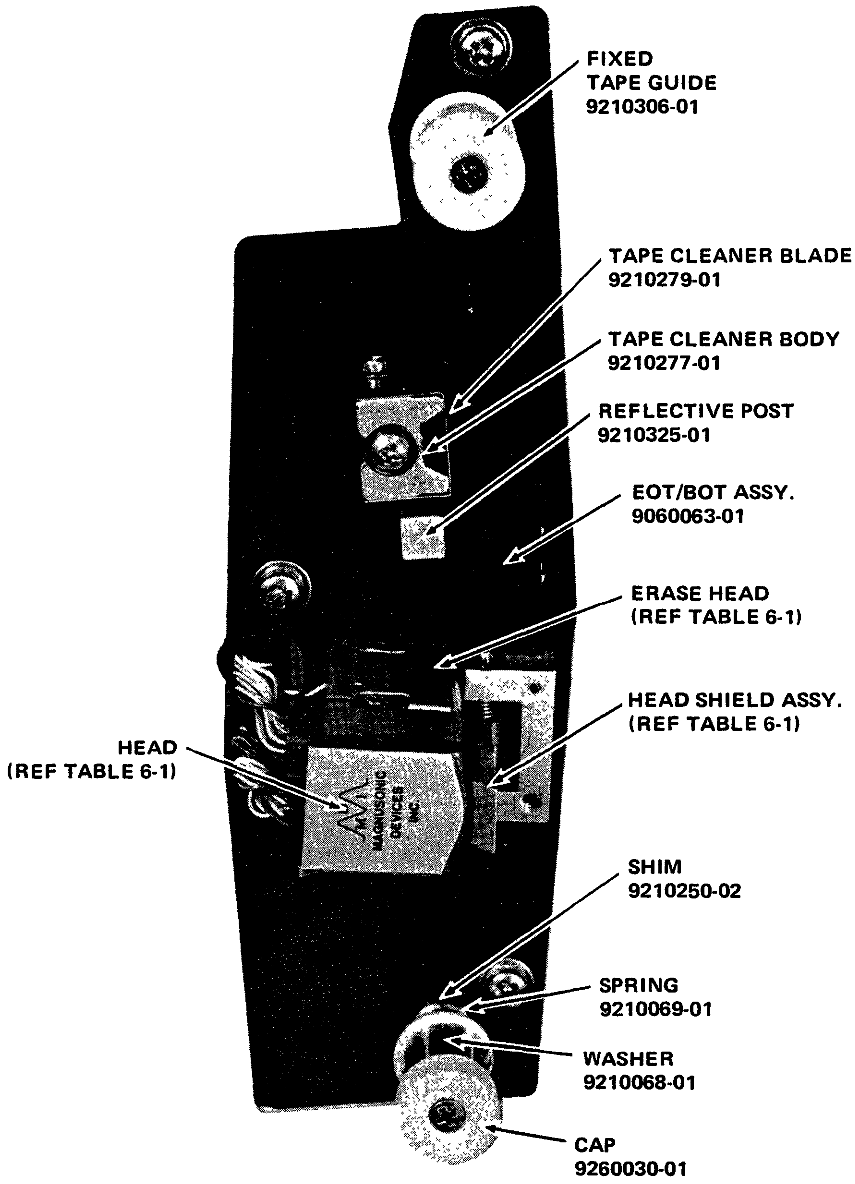


Figure 5-1. Head Assembly

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 checking the capstan speed.

a. Apply power to the tape unit.

b. Load a reel of tape.

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

5-13 Offset Adjustment

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

b. Adjust offset potentiometer R4001 until the voltage displayed on the digital multimeter is between -0.5V and +0.5V.

5-14 Capstan Speed Coarse Adjustment

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

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

SPEED (IPS)	VOLTAGE (VDC)	TOLERANCE
37.5	0.465	±0.005
75	0.978	±0.006
125	1.630	±0.005

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)
37.5	< 17 sec.
75	< 8.4 sec.
125	< 5.0 sec

The strobe disks have two sets of rings and should be used with the following rules:

1. Part No. 9210378-02 (37.5/75 ips). The outer ring is used when the light source is 50 Hz, and the inner ring is used when the light source is 60 Hz.

2. Part No. 9260138-01 (125 ips). The outer ring is used when when the light source is 60 Hz, and the inner ring is used when the light source is 50 Hz.

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 R1024 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 proceding procedures). Perform the following steps for the tape unit rewind adjustment.

NOTE

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

a. Apply power to the tape unit.

b. Load a reel of tape.

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

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

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

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

$$\frac{\text{measured voltage}}{\text{tape speed}} = X\ 375 = \text{rewind voltage}$$

g. After calculating the rewind voltage, initiate a rewind operation. Adjust potentiometer R3013 until that voltage calculated in step f ($\pm$) is displayed on the digital multimeter.

5-17 RAMP TIMING ADJUSTMENT

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

NOTE

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

a. Connect the oscilloscope to TP5. Ground oscilloscope to TP3.

b. Initiate forward-stop tape sequence by using the maintenance switch SW1. Observe the oscilloscope display (see figure 5-2).

c. The correct pulse width (at the 25% points) is calculated by using the following formula:

$$\frac{375}{\text{Tape Speed}} = \text{ramp time in milliseconds}$$

d. After calculating the ramp timing, adjust potentiometer R5021) until the displayed waveform's pulse width is the value calculated in step c.

5-18 VACUUM COLUMN ELECTRICAL ADJUSTMENT

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

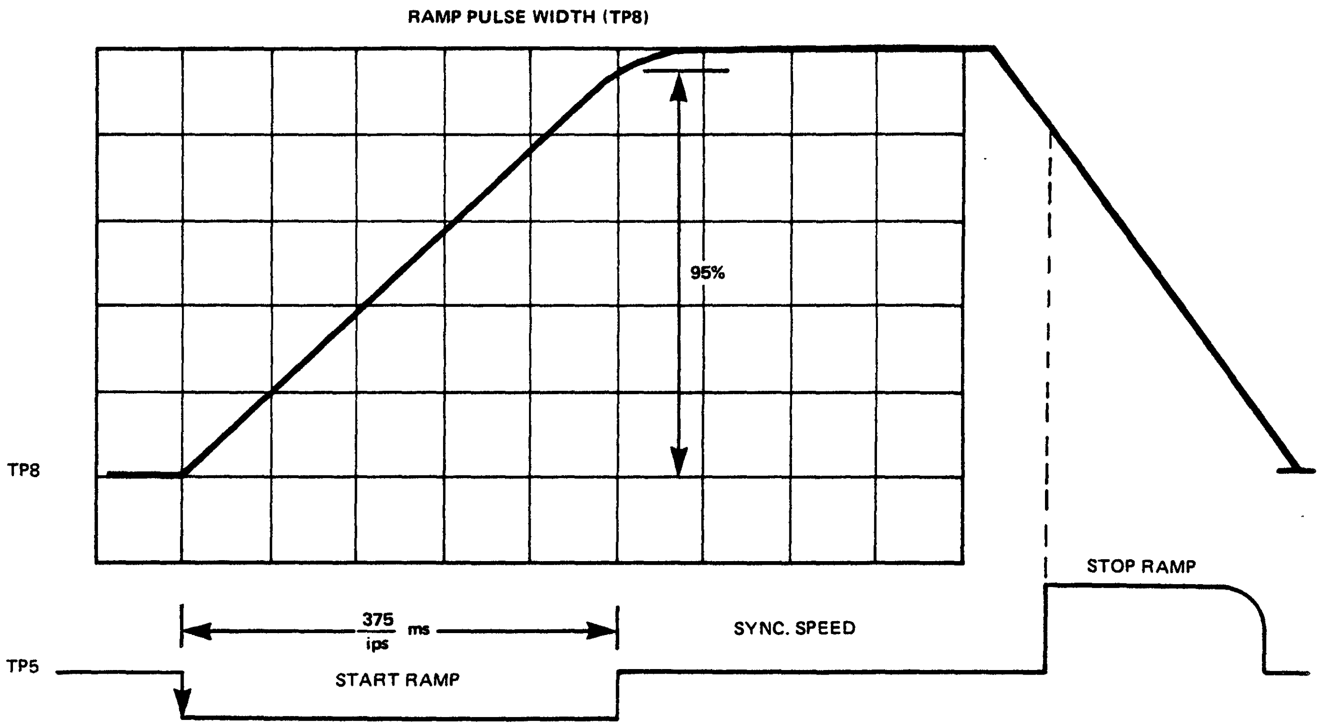


Figure 5-2. Forward Ramp Waveform

NOTE

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

a. Apply power to the tape unit.

b. Load a loop of tape in the vacuum column as shown in figure 5-3, and mark the vacuum column window as shown.

c. On dual speed units, set to higher of two tape speeds.

d. Momentarily engage the LOAD control.

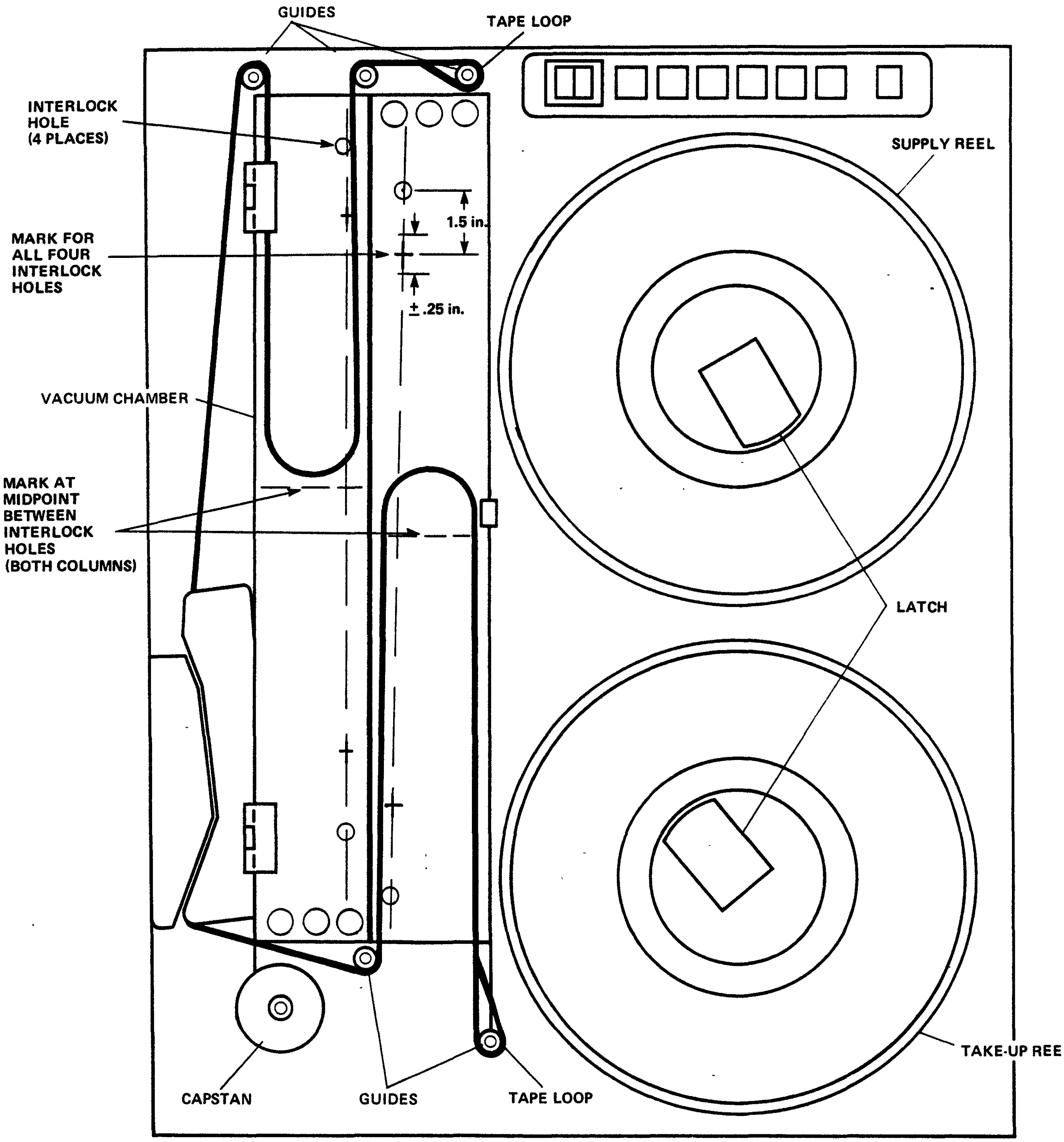


Figure 5-3. Tape Loop for Vacuum Column Servo Adjustment

5-19 Vacuum Column Adjustment

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

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

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.

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 TP3 (-), 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).

5-20 NRZI DATA BOARD ELECTRICAL ADJUSTMENTS

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

5-21 Read Amplifier Gain Adjustment

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

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

b. Apply power to the tape unit.

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

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

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

f. Connect oscilloscope to TP101.

g. Run the tape forward in the read mode.

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

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

5-22 Read Head Skew Measurement and Adjustment

The read head skew measurement and adjustment procedures should only be required when the read head has been replaced. The adjustment of read skew is accomplished mechanically by shimming one of the head guides. The shims are 0.005 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 IBM Master Skew Tape on the tape unit and perform the following adjustments.

5-23 Skew Measurement and Adjustment

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

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

TABLE 5-4. EQUIVALENT DISPLACEMENT TIMES FOR 100 AND 175 MICROINCHES OR SKEW AT VARIOUS TAPE SPEEDS

SPEED (IPS)	100 MICROINCHES (microseconds)	175 MICROINCHES (microseconds)
37.5	2.7	2.0
75	1.3	2.3
125	0.8	1.4

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 TP103 (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:

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

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

5-24 Write Head Deskew Adjustment

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

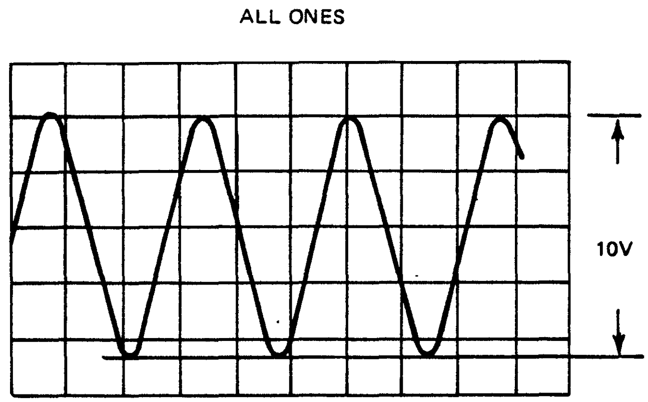


Figure 5-4. Amplifier Waveforms (TP101)

5-25 Read Head Gap Scatter Plot

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

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

5-26 Write Deskew Adjustment

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

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

c. Use the TX-10000 TAPE TRANSPORT EXERCISER to write all ones in all channels. Refer to the TAPE TRANSPORT EXERCISER manual (Part No. 9580062) for equipment interconnection and set up instructions.

d. Connect oscilloscope to TP13.

e. Adjust potentiometer R102 so that the negative pulse displayed on the oscilloscope is 2.6 microseconds at 125 ips or 4.3 microseconds at 75 ips, (as applicable to tape unit). Set potentiometers R202 through R902 to minimum value (clockwise).

f. Connect channel A of oscilloscope to TP103. Connect channel B of oscilloscope to TP203 through TP902 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.

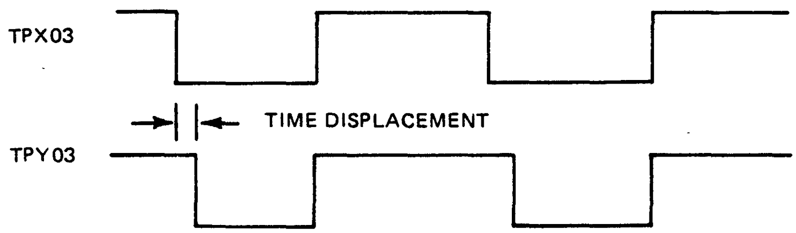


Figure 5-5. Output Waveforms (TP103, TP203, TP603, TP703)

5-27 Staircase Skew Measurement

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

5-28 Flux Gate Adjustment

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

a. Apply power to the tape unit.

b. Load a reel of tape on the unit. Press and release the LOAD control twice (once on unit 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. 958002) for equipment interconnect and set up instructions.

5-29 Adjustment of Flux Gate

a. Connect oscilloscope channel A to TP601 and channel B to TP701 (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.

d. Check the rest of the tracks and verify the amplitude is less than .5 volts.

5-30 Read StrobeAdjustment

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).

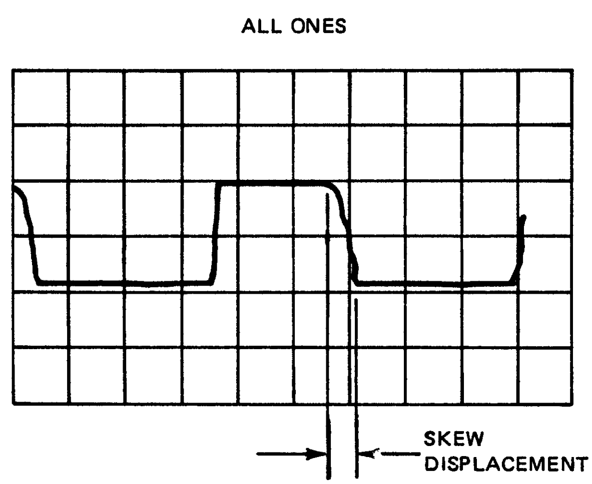


Figure 5-6. Staircase Waveform (TP9)

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
37.5	17.0	24.0	68
75	8.5	12.0	34
125	5.0	7.2	20

5-31 Threshold Measurement

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

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 unit equipped to automatically position the tape at the BOT marker) to tension the tape and to advance the tape to the BOT marker.

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

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

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

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

5-32 PHASE ENCODED DATA BOARD ELECTRICAL ADJUSTMENTS

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

1. Read amplifier gain adjustment.

2. Read head skew measurement and adjustment.

3. Flux gate adjustment.

Refer to drawing number 9040134 in the attached drawing package for component location on the Phase Encoded Data Board.

5-33 Read Amplifier Gain Adjustment

The gain of each of the read amplifiers located on the Phase Encoded (PE) Data Board is 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 units equipped to automatically position the tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

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

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

f. Connect the oscilloscope to TP104.

g. Run the tape forward in the read mode.

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

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

5-34 Read Head Skew Measurement and Adjustment

The read head skew measurement and adjustment procedures should only be required when the read head has been replaced. The adjustment of read skew is accomplished mechanically by shimming one of the head guides. The shims are 0.0005 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 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 units equipped to automatically position to tape at the BOT marker) to tension the tape, and to advance the tape to the BOT marker.

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

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

If 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:

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

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

5-35 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 (Part No. 9580062) for equipment interconnect and set up instructions.

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

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

g. If the signal amplitude is greater than the allowed limit, remove the head covers. Loosen the the two screws 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.

h. Check the other tracks and verify the amplitude is less than 0.5 volts

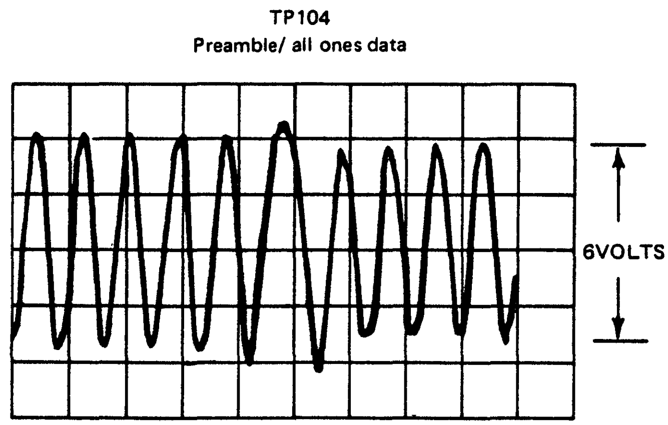


Figure 5-7. Amplifier Waveform (TP104)

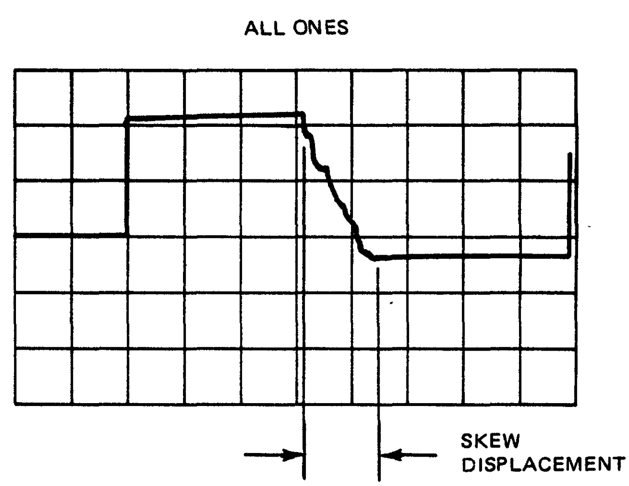


Figure 5-8. Staircase Waveform (TP5)

5-36 Staircase Skew Measurement

A quick check of all read/write adjustments can be made by observing the waveform at TP5 (figure 5-8). Set up the TX-1000 TAPE TRANSPORT EXERCISER (Part No. 00295) to write all ones on all channels. The length of time from the first step to the last is the total amount of skew displacement. If the skew is greater than 175 microinches (see table 5-4) and cannot be brought within limits by shimming the read head, Tape Path Adjustment (paragraph 5-40) should be performed.

5-37 Threshold Measurement

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

a. Apply power to the tape unit.

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

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

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

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

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

5-38 MECHANICAL CHECKOUT AND ALIGNMENT

The following paragraphs present checkout and alignment procedures for the mechanical components of the Model 2760 Magnetic Tape Unit. Any mechanical alignment procedure not included in the following paragraphs is a factory procedure and should not be attempted in the field. Refer to figures 4-2 and 5-1 for various mechanical views of the tape units.

5-39 Tape Path Alignment Measurement

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

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

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

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

d. Remove the tape guide caps from the fixed tape guides on the 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 movement across the fixed tape guides is less than 10 mils. If the tape movement is greater than 10 mils, perform the Tape Path Adjustment (paragraph 5-40).

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

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

5-40 Tape Path Adjustment

Alignment of the tape path components is accomplished by using the Alignment Tool (P/N 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

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

5-41 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 5-9(A) and 5-10. 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 5-10. The fixed tape guide should be .003 to .0035 inches below the flat edge of the alignment tool.

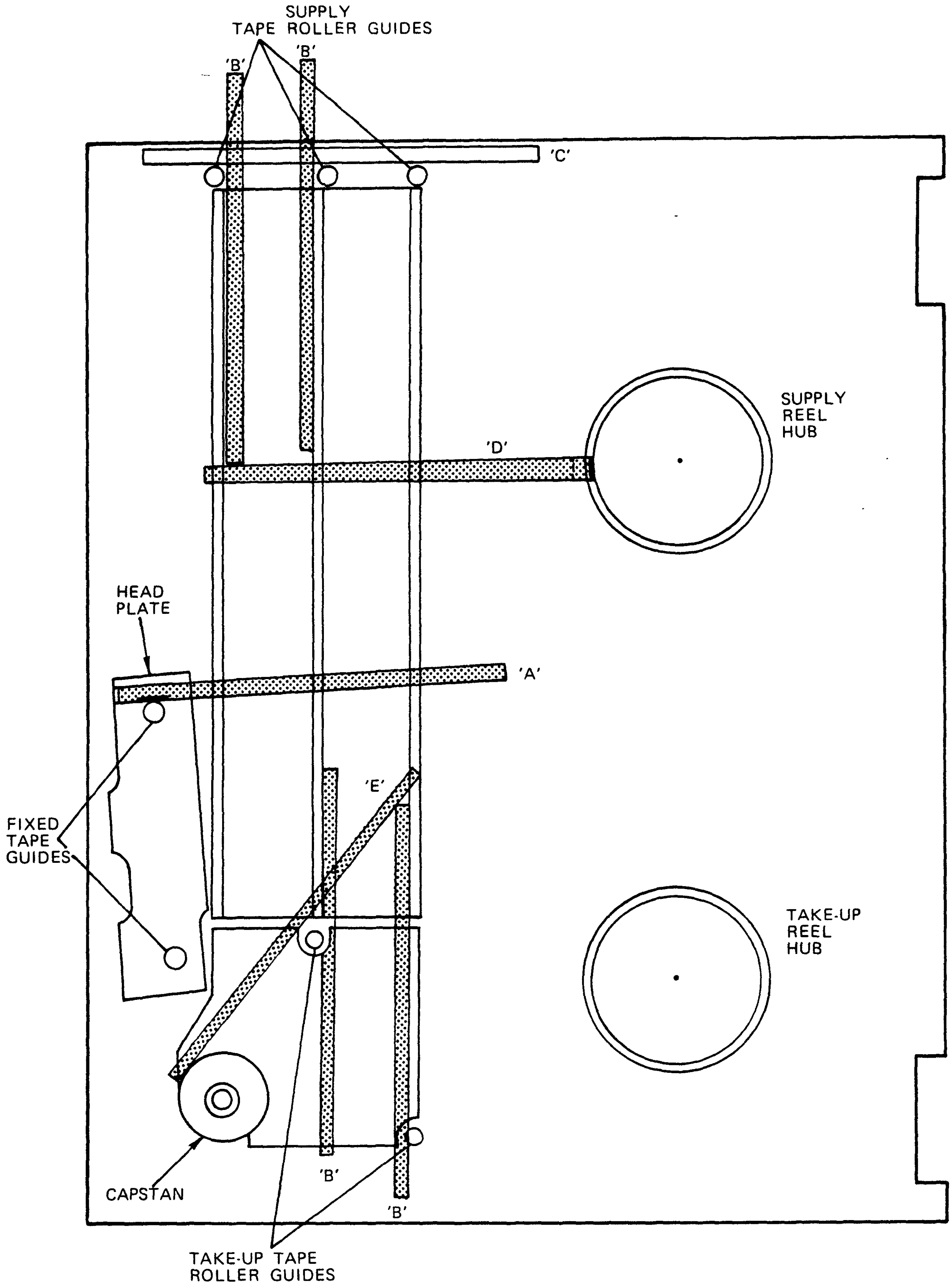


Figure 5-9. Tape Path Alignment Tool Positioning

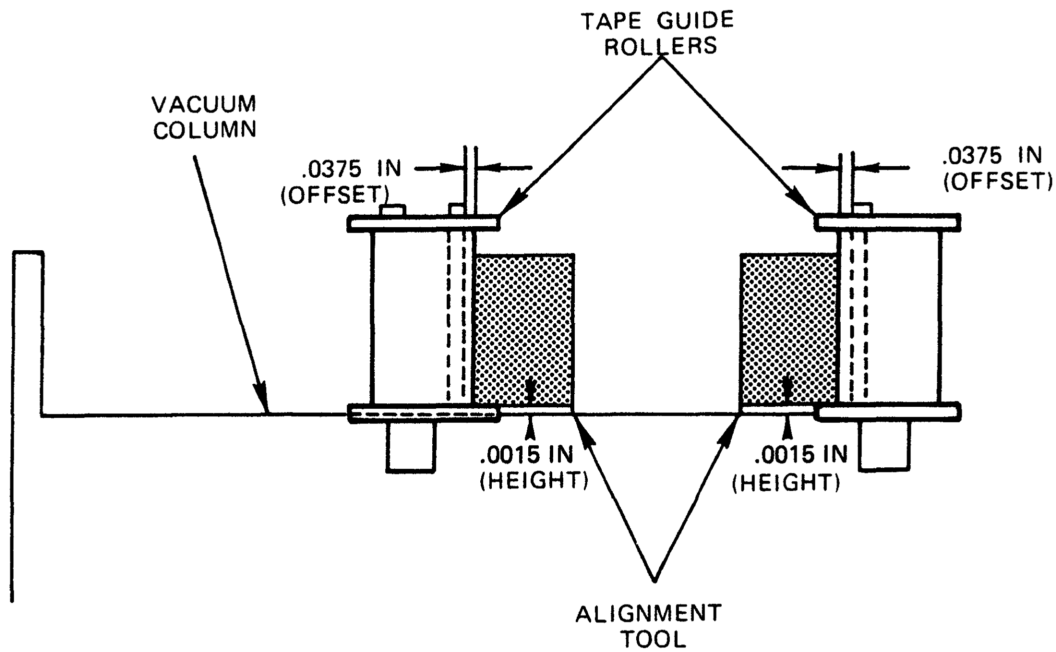


Figure 5-10. Fixed Tape Guide Alignment Tool Positioning

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

g. Replace the tape guide cap and the vacuum column window. Refer to paragraph 5-58 for vacuum column window replacement.

5-42 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 5-9(B) and 5-11 for alignment tool positioning.

a. Remove tape and reels from the tape unit.

b. Remove the power from the tape unit.

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 5-11. 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. To align the right outside tape guide roller, lay the flat side of the alignment tool across the three rollers at the top of the vacuum column as shown in figure 5-9(C). All three rollers should turn as the alignment tool is moved across them. If not, adjust the roller block position until the correct alignment is achieved.

i. To check the height of the right outside guide roller, place the flat edge of the alignment tool against the bottom edge of the three guide rollers. The bottom edge of all three guide rollers should be flush with the edge of the alignment tool. If not, loosen the set-screw in the right outside roller block and adjust the guide roller for the correct height. Retighten the set screw.

j. 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.

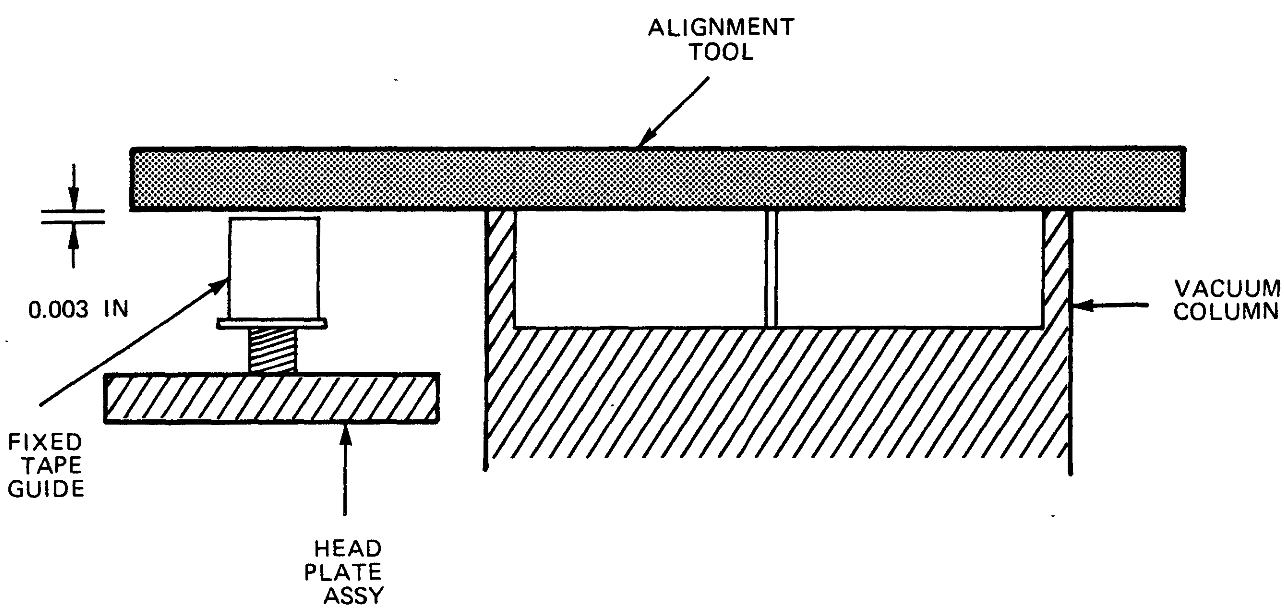


Figure 5-11. Tape Guide Roller Alignment Tool Positioning

5-43 Reel Hub Height Adjustment

The following reel hub height adjustment procedure applies to both the supply and 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 5-9(D). 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 4-2.

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.

5-44 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 headplast assembly.

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

d. Figure 5-9(E) shows how to position the alignment tool. 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, position overlay and apply pressure around edges and center to engage Velcro.

5-45 Vacuum Motor Belt Tension Adjustment

The vacuum motor belt tension can be adjusted by removing the belt cover and using one of the two following procedures:

a. Remove power from 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 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.

5-46 Write Lockout Assembly Adjustment

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

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

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

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

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

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

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

5-47 TROUBLESHOOTING

Troubleshooting of the Model 2760 Magnetic Tape Unit requires a thorough knowledge of the contents of chapter 4. Before performing any detailed troubleshooting, the preliminary checks contained in the following paragraph should be performed. If the problem is not corrected by performing the preliminary checks, refer to 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.

5-48 PRELIMINARY CHECKS

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

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

b. Verify that the five fuses on the rear panel are not burned out, and that they are of the specified rating (figure 2-7).

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

5-49 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 signals developed in the suspected circuits are correct when compared to signals developed independent of the suspected circuit.

5-50 TROUBLESHOOTING CHARTS

The system troubleshooting charts in table 5-6 are provided to aid the maintenance technician in isolating malfunctions in the tape unit. The 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. This table should be used in conjunction with the assembly and schematic diagrams in the attached drawing package.

5-51 COMPONENT REPLACEMENT

The following paragraphs provide procedures for replacing various components within the Model 2760 Magnetic Tape Unit. Before attempting any of the procedures, they should be read thoroughly. When performing these procedures the maintenance technician should refer to the mechanical assembly illustration in figure 4-2 and to the various illustrations and drawings in the attached drawing package.

5-52 TAPE GUIDE ROLLER REPLACEMENT

a. Remove the tape guide and shaft from block by loosening set screw on block.

b. Install the new tape guide and shaft and secure by tightening set screw.

c. Perform the Tape Guide Roller Adjustment Procedure detailed in paragraph 5-42.

5-53 REEL SERVO MOTOR REPLACEMENT PROCEDURE

a. Disconnect the air hose, power leads, and capacitors from the reel servo motor (see figure 5-2).

b. Loosen the set screws that secures the reel hub to the motor shaft.

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

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

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

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

5-54 CAPSTAN MOTOR REPLACEMENT

a. Remove the head covers.

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

c. Loosen the set-screws securing the capstan to the capstan motor shaft and remove the capstan.

TABLE 5-6 TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
Does not start to load.	EOT and BOT not working properly.	Check operation and adjust the BOT and EOT amplifiers.	Paragraph 4-29, 5-9
	LOAD or RESET switch defective.	Check operation of switches. Replace as necessary.	Paragraph 4-15, 4-23
	Logic Problem, LDA flip-flop is not set.	Repair Tape Control Board.	Paragraph 4-14
Load operation does not move tape into column.	K3 Relay or Driver defective.	Check to see if K3 contacts close. Replace.	Paragraph 4-15
	Load reel motor driver defective.	Check to see if 17 volts is at J7-3 when Q4 turns on and the reel motors turn.	Paragraph 4-15
	Interlock switches defective	Check operation of switches. Adjust or replace.	Paragraph 4-15
Load operation moves tape into vacuum column, but tension is not made.	Interlock switches do not close.	Check operation of switches. Adjust or replace.	Paragraph 4-15
	K1 relay or driver defective.	Check to see if K1 contacts close. Replace.	Paragraph 4-15
	Osc and Sync Det malfunction.	Loop a length of tape in the columns (figure 5-3). Press the load switch to turn on the vacuum motor. Check operation of the OSC and sync detectors. Replace.	Paragraph 4-17, 5-19
	Reel Servo Amplifiers malfunction.	Check operation of servo amplifiers. Adjust.	Paragraph 4-16, 5-18

TABLE 5-6. TROUBLESHOOTING CHART

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE
When the capstan moves tape, the interlock switches open.	Osc and Sync. Det malfunction.	Loop a length of tape in the columns (figure 5-3). Press the LOAD switch to turn on the vacuum motor. Check the operation of the OSC and Sync Detectors. Replace	Paragraphs 4-17, 5-19
	Capstan speed or ramp not correct.	Remove tape from around capstan. Check capstan speed and ramp at TP12.	Paragraphs 4-19, 5-12, 5-17
	Reel Servo is out of adjustment	Adjust Reel Servo.	Paragraphs 4-16, 5-18
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.	Paragraphs 4-29, 5-9
Tape unit does not respond to For/Rev commands but to manual switch.	Tape unit not on line or selected.	Check that the correct select line is asserted. Check on line switch and flip-flop. Repair if necessary.	Paragraphs 4-23, 4-25
Does not respond to manual For/Rev.	Defective BOT and EOT sensor or amplifier.	Check operation and adjust amplifier.	Paragraphs 4-29, 5-9
	Tape unit is not ready.	Check inputs to gate U36-8 to determine which one is not high.	Paragraph 4-14
	Tape unit is on line.	Check and replace on line flip-flop.	Paragraph 4-15
	K1 Relay contacts 10/9 do not make.	Check if TP14 and J1-1 are at the same voltage. Replace.	Paragraph 4-15
	Component failure in For/Rev Ramp Gen. or Capstan Amp.	Check the operation of the components in the ramp gen. and amplifier.	Paragraphs 4-20, 4-22, 4-26, 5-12, 5-17.
	Manual switch defective.	Check MFWD and MREV signals.	Paragraph 4-26

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.	Paragraphs 4-15, 4-28
	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.	Paragraph 4-18
	Reel Servos are not adjusted or working properly.	Check and adjust the reel servos.	Paragraph 4-16, 5-18
	Rewind speed or ramp are not correct.	Adjust the rewind speed and check the ramp times.	Paragraphs 4-21, 5-16
	Logic problem asserting a forward command during rewind operation.	Check that TP33 is zero during rewind. Repair.	Paragraphs 4-20, 4-26
	Fuses F2 or F3 open.	Replace bad fuse.	
Responds to Forward command but doesn't write. Reads a good tape correctly.	No write power to data board or write corrent is not enabled.	Check write lockout micro-switch is closed and TP3 for PE or TP2 for NRZI Data Boards is at +5 volts and collector of Q3 -5 volts. Repair.	Paragraphs 4-27, 4-31 4-34, 4-37, 5-47
	Interface cable or receiver malfunction.	Check write data, data ready, LRC strobe and SWRT receiver outputs for proper levels.	Paragraphs 4-35, 4-37
	Write head connector not properly plugged into J1.	Check that head connector is securely into J1.	

TABLE 5-6. TROUBLESHOOTING CHART (continued)

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE (Paragraphs)
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	4-31, 5-47
	Incorrect Data format.	Check pre-delays, post-delays, and Data Format.	Table 3-6
	Write deskew need adjustment.	Adjust the write deskew.	4-34, 5-24,
	Component in write electronics defective.	Check operation of write channels and repair if necessary.	4-34, 4-37, 5-27, 5-30, 5-33
A correctly written tape can not be read while being written.	Flux gate improperly adjusted.	Adjust flux gate.	5-28, 5-36
A good tape cannot be correctly read.	Tape path needs cleaning.	Clean the head, guides, and tape cleaner.	5-3.
	Read electronics need adjustment.	Adjust the read amplifiers and read strobe.	4-35, 4-38, 5-21, 5-30 5-33.
	Read head connectornot properly plugged into J2.	Check that head connector is securely into J2.	
	Interface cable or receiver malfunction.	Check the outputs of the read data cable drivers for proper levels.	
	PE Data Board component failure in envelop detector circuit.	Check the envelop detector delays. Replace.	4-38
	Component failure in threshold circuit.	Check threshold voltage (PE;TP4, NRZI; TP11)	4-35, 4-39, 5-31 5-38

TABLE 5-6. TROUBLESHOOTING CHART (continued)

SYMPTOM	PROBABLE CAUSE	REMEDY	REFERENCE (Paragraphs)
	for single gap head, faulty write head driver.	Check if any head driver is causing current to flow in the head. Repair.	

d. Disconnect the powerleads and airhose from the capstan motor (figure 4-2).

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

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

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

h. Install the head covers.

i. Connect powerleads and airhose to the capstan motor.

5-55 VACUUM MOTOR BELT REPLACEMENT PROCEDURE

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

b. Remove the old vacuum motor belt.

c. Install the new vacuum motor belt and perform the Vacuum Motor Belt Tension Adjustment, paragraph 5-45.

d. Check pulley's and belt for alignment and true running without belt flipping or oscillation.

NOTE

The vacuum blower pulley has two positions for mounting the vacuum motor belt. The proper pulley for 50Hz or 60 Hz operation must be installed (see chapter 6 for part number). The smaller position on the pulley is for sea level to 5000 feet operation, and the larger position is for operation above 5000 feet.

5-56 HEAD REPLACEMENT PROCEDURE

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

a. Remove the head covers.

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

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

g. Connect the tape head connector.

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

i. Re-install the head covers.

5-57 TAPE POSITION SENSOR 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 headplate assembly.

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

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

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

g. Remove the ten screws attaching the tape position sensor to the vacuum column assembly.

h. Gently lift the tape position sensor from the vacuum column assembly.

i. Disconnect signal leads from the tape position sensor, noting the terminal connection of the wires.

j. Disconnect the vacuum hoses from the tape position sensor. Remove the tape position sensor.

k. Solder the signal leads and connect the hoses to the new tape position sensor.

CAUTION

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

l. Using the screws removed in step g, attach the new tape position sensor to the vacuum column assembly. Do not tighten screws.

m. Connect a 24-inch H_2O vacuum source to tape position sensors through a V/2 (1/2 vacuum) tube, and then tighten screws at terminal end of tape position sensor that is being replaced. Tighten remaining screws in order, working toward opposite end of tape position sensor.

n. Disconnect vacuum source from tape position sensor.

o. Connect the vacuum hoses and signal plug to the vacuum column assembly.

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

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

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

s. Replace the tape unit overlay. The original tape must be replaced with tape coated with adhesive material on both sides. For Velcro method, position the overlay and press on the edges and at the center to engage Velcro.

t. Replace the head covers.

5-58 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 hardware 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 and 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). If the tape unit overlay is mounted with Velcro, position the overlay and press on the edges and at the center to engage the Velcro.

Chapter 6

DRAWINGS AND PARTS LISTS

6-1 INTRODUCTION

This chapter contains parts location views and a replaceable parts list table for the Model 2760 Magnetic Tape Unit. Figures 6-1 and 6-3 show parts location for the Model 2760. Figure 6-2 shows the parts location for the headplate assembly used on the tape unit. Table 6-1 lists replaceable parts for the tape unit. Numerical callouts on figures 6-1 through 6-3 are keyed to the item numbers in tables 6-1.

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. The following list shows all the drawings for Model 2760 Magnetic Tape Units which may be contained in an attached drawing package. Only the drawings applicable to a specific model and configuration of that tape unit will be included in a drawing package.

DRAWING TITLE	DRAWING No.
Tape Control Board PWBA	9040129
Tape Control Board Schematic Diagram	9940129
PE Data Board PWBA	9040134
PE Data Board PWBA Schematic Diagram	9940134
NRZI Data Board PWBA (Single Data Card Unit)	9040133
NRZI Data Board Schematic Diagram (Single Data Card Unit)	9940133
NRZI Data Board PWBA (Single Data Card Unit)	9040133
NRZI Data Board Schematic Diagram (Single Data Card Unit)	9940133
NRZI Data Board PWBA (Dual Data Card Unit)	9040135
NRZI Data Board Schematic Diagram (Dual Data Card Unit)	9940135
NRZI Data Board PWBA (Three Data Card, Quad Density Unit)	9040136
NRZI Data Board Schematic Diagram (Three Data Card, Quad Density Unit)	9940136
System Interconnect Diagram (Single Data Card Unit)	9930035
System Interconnect Diagram (Two Data Card Unit)	9930034
Power Supply Assembly	9020090
Power Supply Wiring Diagram	9930033
Power Supply Schematic Diagram	9910036
Heatsink Assembly	9940128
Heatsink PWBA	9930016
Heatsink PWBA Schematic Diagram	9060169
Vacuum Chamber Wiring Diagram	9930036
Vacuum Chamber and Control Interface Cable Assembly	9060146
Transport Assembly Wiring Diagram	9040132
Dual Triac Cable Assembly	9940132
Dual Triac PWBA	9060070
Dual Triac Schematic Diagram	
Option Jumper Plug Assembly	

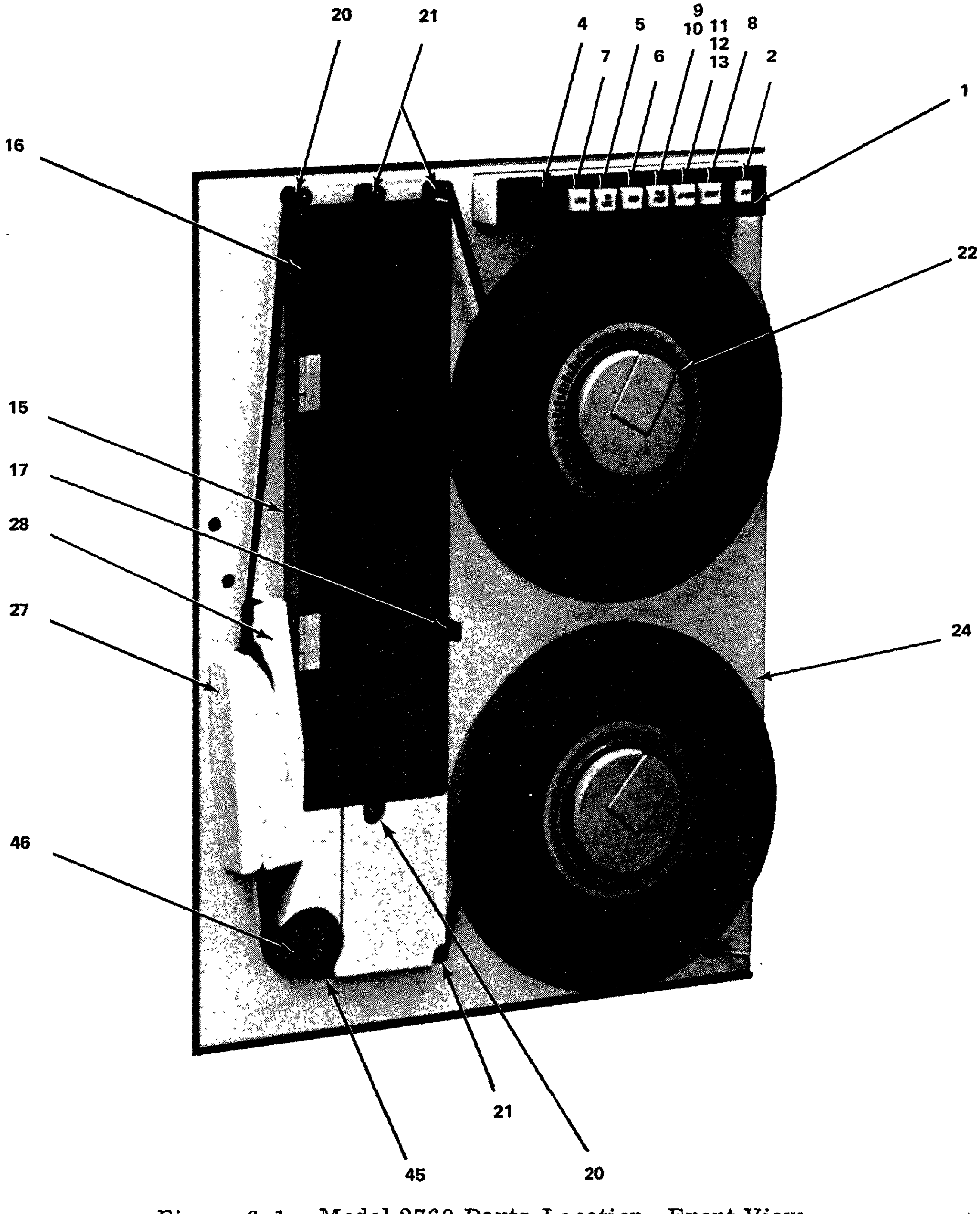


Figure 6-1. Model 2760 Parts Location, Front View

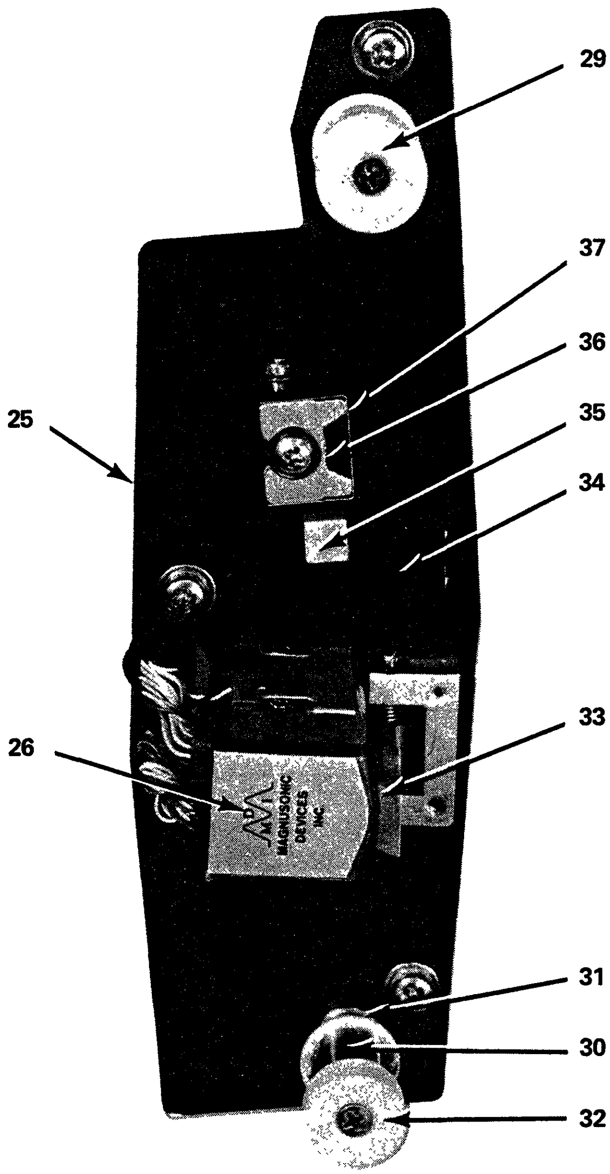


Figure 6-2. Headplate Assembly (9020049-01) Parts Location

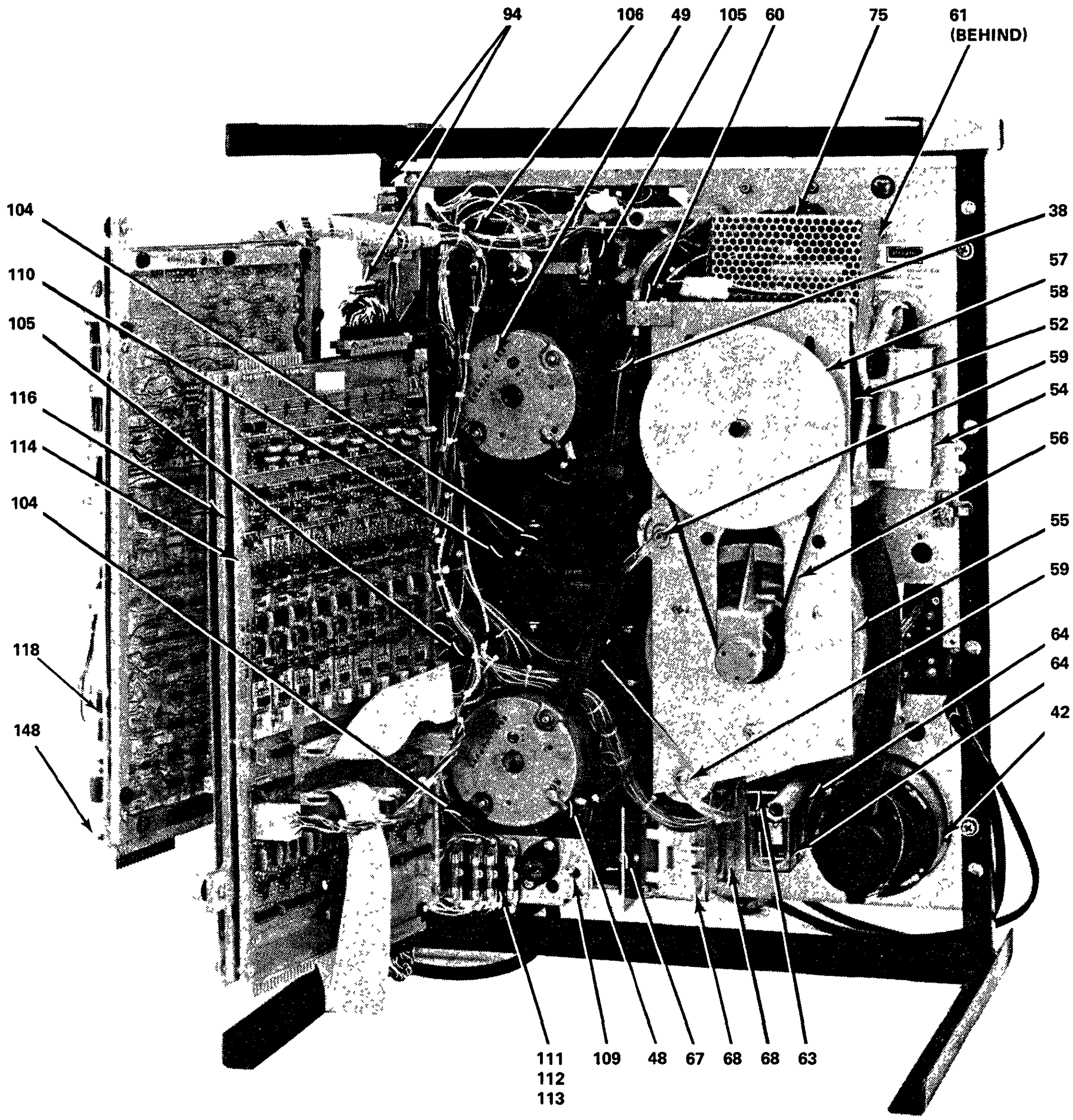


Figure 6-3. Model 2760 Parts Location, Rear View (Two Data Card Tape Unit)

7/9 Track Head 9510037-01

TABLE 6-1. MODEL 2760 REPLACEABLE PARTS LIST

FIGURE REF.	DESCRIPTION	PART NUMBER
1	Control Switch Assembly	9020042-XX*
2	Power Switch	0850000-99
3	Bulb	
4	Address Switch	0820004-01
	Momentary Switches:	
5	On Line	0830016-02
6	Rewind	0830016-03
7	Load	0830016-04
8	Reset	0830016-05
9	File Protect Indicator	11520001-01
10	Write Enable Indicator	11520001-02
	Alternate Action Switches:	
11	HI DEN	08300018-01
12	1600 BPI	08300018-02
13	9-Track	08300018-03
14	Lamp	11130001-01
15	Vacuum Chamber Assembly	
16	Vacuum Chamber Window Assembly	9020059-50
17	Latch	9260081-01
18	Tape Position Sensor (Supply)	9020060-01
19	Tape Position Sensor (Take-Up)	9020060-02
20	Tape Guide Roller (Low Inertia)	9020099-01
21	Tape Guide Roller (Short)	9020039-02
22	Reel Retainer Assembly	9020035-02
23	Rubber Ring	9260070-01
24	Tape Reel, 10-1/2 Inch	50000065-01
25	Head Plate Assembly	9020049-01
26	Head:	
	7-Track, Dual Gap (Chrome)	9510049-01
	9-Track, Dual Gap	9510040-01
	9-Track, Dual Gap (Chrome)	9510048-01
27	Head Cover, Short	9260055-01
28	Head Cover, Long	9260056-01
29	Fixed Tape Guide	9210306-01
30	Washer, Tape Guide	9210068-01
31	Spring, Tape Guide	9210069-01
32	Cap, Tape Guide	9260030-01
33	Head Shield Assembly	9020032-01
34	EOT/BOT Assembly	9060063-01
35	Reflective Post	9210325-01
36	Body, Tape Cleaner	9210277-01
37	Blade, Tape Cleaner	9210279-01
38	Write Lockout/File Protect Assembly	9020031-02
39	Solenoid/L1	9510029-01
40	Resistor, Wire Wound, 20 ohms, 1%, 5W/R1	04670200-01
41	Switch, Miniature (With Roller)	08500003-01
42	Vacuum Supply Capstan Motor Assembly	9020095-XX*

TABLE 6-1. MODEL 2760 REPLACEABLE PARTS LIST (continued)

FIGURE REF.	DESCRIPTION	PART NUMBER
43	Capstan Motor Assembly	9060100-XX *
44	Capacitor, Mylar, 2200pf, 10%, 100V/C1	01144222-01
45	Capstan	9210532-01
46	Speed Disc:	
	25ips	9210378-04
	37.5 and 75ips	9210378-02
	45ips	9210378-03
	50ips	9210378-01
	125ips	9260138-01
47	Vacuum Supply	9210534-01
48	Reel Motor Assembly (Take-up)	9060178-01
49	Reel Motor Assembly (Supply)	9060178-02
50	Reel Motor	9510032-01
51	Capacitor, Ceramic, .01uf, 100V/C1, C2	01446103-01
52	Blower Motor Assembly	9020098-XX
53	Blower Motor/M1	9510044-01
54	Capacitor, Electrolytic, 20uf, 370V/C1	01574206-01
55	Blower/B1	9260142-01
56	Belt	32000001-06
57	Pulley, 50 Hz Unit	9210563-01*
58	Pulley, 60 Hz Unit	9210559-01*
59	Vacuum Switch/S1, S2	08700001-01
60	V/2 Source Block	9210379-01
61	Vacuum Chamber and Control Interface Cable Assembly	9060169-01
62	Resistor, Carbon, 100 ohm, 1/4W, 5%/R1, R2	04122101-01
63	DPDT Relay Assembly	9020102-01
64	Relay, DPDT/K2, K4	41426022-01
65	Resistor, Wire Wound Power, 4 ohm, 20W, 1%/r1	04380566-01
66	Resistor, Wire Wound Power, 2 ohm, 20W, 1%/R2	04380565-01
67	4PDT Relay Assembly	9020101-01
68	Relay, 4PDT/K1, K3	4142602-01
69	Foam Tape Double Coated Adhesive, 1/8-inch	33700001-01
70	Foam Tape Double Coated Adhesive, 1/4-inch	33700001-02
71	Shim, 0.001 Inch Thickness	9210250-01
72	Shim, 0.0005 Inch Thickness	9210250-02
73	Shim, 0.003 Inch Thickness	9210248-01
74	Shim, 0.010 Inch Thickness	9210246-01
75	Connector (26 Pin)	07120007-01
76	Dual Triac Cable Assembly	9060146-01
77	Dual Triac PWBA	9040132-02
78	Capacitor, Mylar, 0.1uf, 400V, 10%/C2	01183104-01
79	Capacitor, Mylar, 0.1uf, 600V, 10%/C1	01184104-01
80	Resistor, Carbon, 47 ohm, 1/4W, 5%/R3, R4	04122470-01
81	Resistor, Carbon, 100 ohm, 2W, 5%/R1, R2, R5, R6	04152101-01
82	Transistor, Triac, SC250/Q2	05500250-01
83	Transistor, Triac, SC260/Q2	
84	Cover, Dual Triac Assembly	05500260-01
85	Cable Assembly, Relay/Triac	9060171-01
86	Cable Assembly, Transformer/Triac	9060129-02

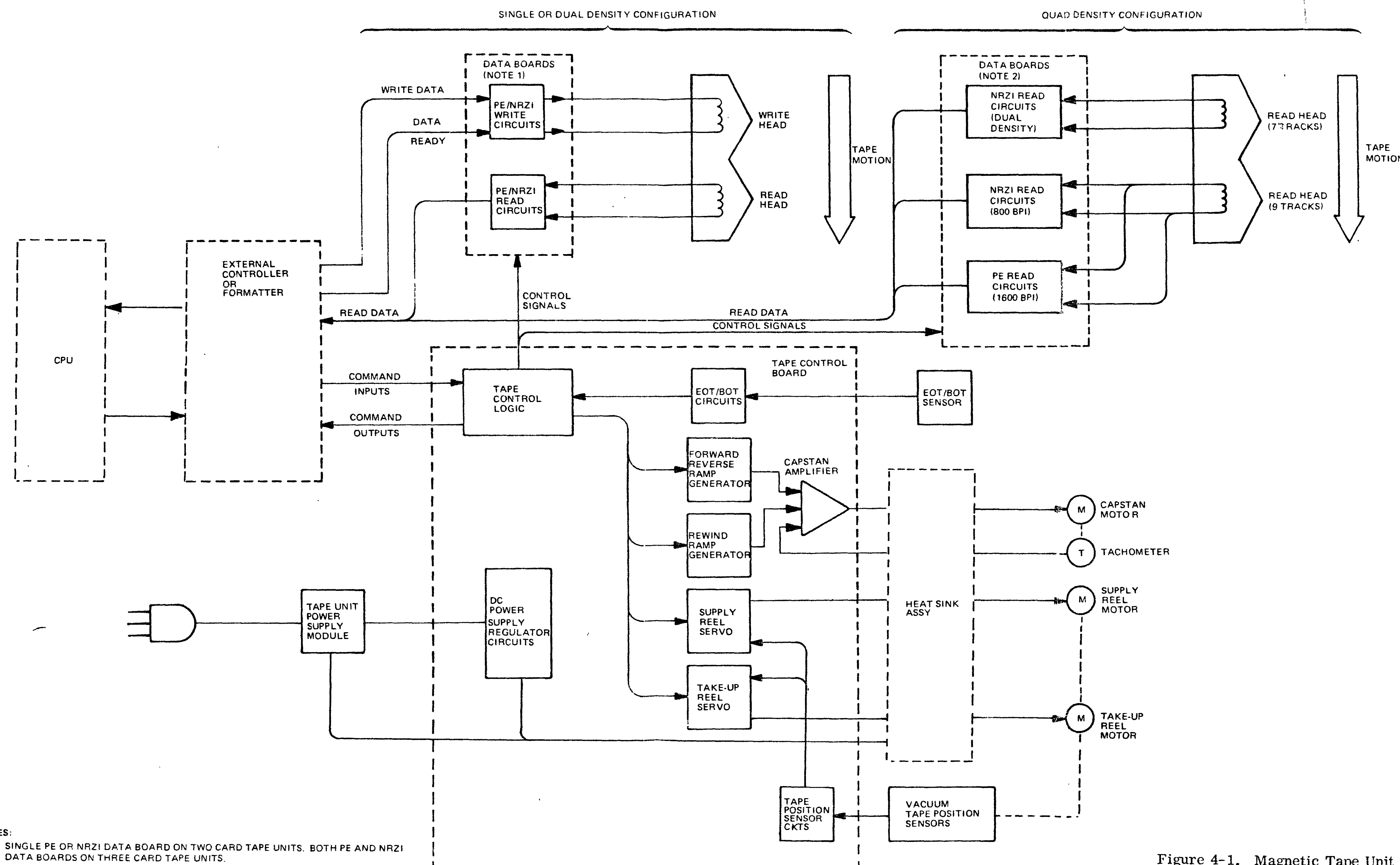
TABLE 6-1. MODEL 2760 REPLACEABLE PARTS LIST (continued)

FIGURE REF.	DESCRIPTION	PART NUMBER
87	Heatsink Assembly	9020089-01
88	Power Transister-2N5684/Q9, Q12	05605684-01
89	Power Transistor-2N5686/Q1, Q5	057-5686-01
90	Power Transistor-2N6051/Q11	05706051-01
91	Power Transistor-2N6052/Q2, Q3, Q6, Q14	05706052-01
92	Power Transistor-2N6058/Q5	05706058-01
93	Power Transistor-2N6059/Q4, Q7, Q8, Q10, Q13	05706059-01
94	Heatsink PWBA	9040128-01
95	Diode-1N9148/CR18-CR20, CR22-CR24	02100914-03
96	Diode-1N4003/CR12, CR13, CR15-CR17, CR21	02104003-01
97	Diode, Zener-1N4747/CR3, CR6, CR7, CR14	02204747-01
98	Diode-MR831/CR1, CR2, CR4, CR5, CR8-CR11	02400831-01
99	Transistor-2N3904/Q7, Q19	05103904-01
100	Transistor-2N3906/Q16, Q18	05103906-01
101	Transistor-2N5323/Q20-Q23	05705323-01
102	Thermal Protector	09140001-07
	POWER SUPPLY ASSEMBLY	
103	Power Supply Assembly	9020090-01
104	Transformer/T1	9510051-01*
105	Capacitor, Electrolytic, 3800uf, 25V/C1, C2	0518389-01
106	Capacitor, Electrolytic, 51,000uf, 40V/C3, C4	0528519-01
107	Diode Bridge/CR1, CR2	02500400-01
108	Line Voltage Filter/FL1	05000004-01
109	Service Power Switch/S1	08600004-01
110	Heatsink Fan/B1	49200002-01
111	Fuse, 5-Amp/F4, F5	09230001-01
112	Fuse, 15-Amp/F2, F3	09150001-01
113	Power Fuse (F1):	09150001-01
	220VAC, 7-Amp (SLO-BLO)	09230003-01*
	115VAC, 15-Amp (SLO-BLO)	09250001-01*

TABLE 6-1. MODEL 2760 REPLACEABLE PARTS LIST

TAPE AND DATA CONTROL ELECTRONICS					
FIGURE REF	DESCRIPTION	UTILIZATION Control Board	NRZI Board	PE Board	PART NUMBER
114	PE Data PWBA			X	9040134-XX *
115	NRZI Data PWBA, Single Data Card Machine		X		9040133-XX *
116	NRZI Data PWBA, Dual Data Card Machine		X		9040135-XX *
117	NRZI Data PWBA, Three Data Card Machine (Quad Density)		X		9040136-XX
118	Control PWBA	X			9040129-XX
119	IC, LM339	X	X	X	03000339-01
120	IC, SN 72709		X	X	03052709-01
121	IC, SN 72741	X			03052741-01
122	IC, SN 15836	X	X	X	03100836-01
123	IC, SN 151805		X		03101805-01
124	IC, SN 7400	X	X	X	03207400-01
125	IC, SN 7401		X		03207401-01
126	IC, SN 7404	X	X		03207404-01
127	IC, SN 7405		X		03207405-01
128	IC, SN 7408	X			03207408-01
129	IC, SN 7410	X	X	X	03207410-01
130	IC, SN 74H11	X			03207411-01
131	IC, SN7420	X			03207420-01
132	IC, SN 7430	X			03207430-01
133	IC, SN 7438	X	X	X	03207438-01
134	IC, SN 74107	X	X	X	03204107-01
135	IC, SN 74123	X			03204123-01
136	IC, SN 75451	X			03155451-01
137	Transistor, 2N3053	X			05703053-01
138	Transistor, 2N3904	X	X	X	05103904-01
139	Transistor, 2N3906	X	X	X	05203906-01
140	Transistor, 2N5321		X	X	05705321-01
141	Transistor, 2N5323	X	X	X	05705323-01
142	Transistor, 2N5639	X			05305639-01
143	Diode, 1N914B	X	X	X	02100914-03
144	Diode, 1N4003	X		X	02104003-01
145	Diode, 1N4735	X		X	02204735-01
146	Diode, 1N4740	X			02204740-01
147	SCR 40654	X			05500654-01
148	Toggle Switch	X			08100003-01

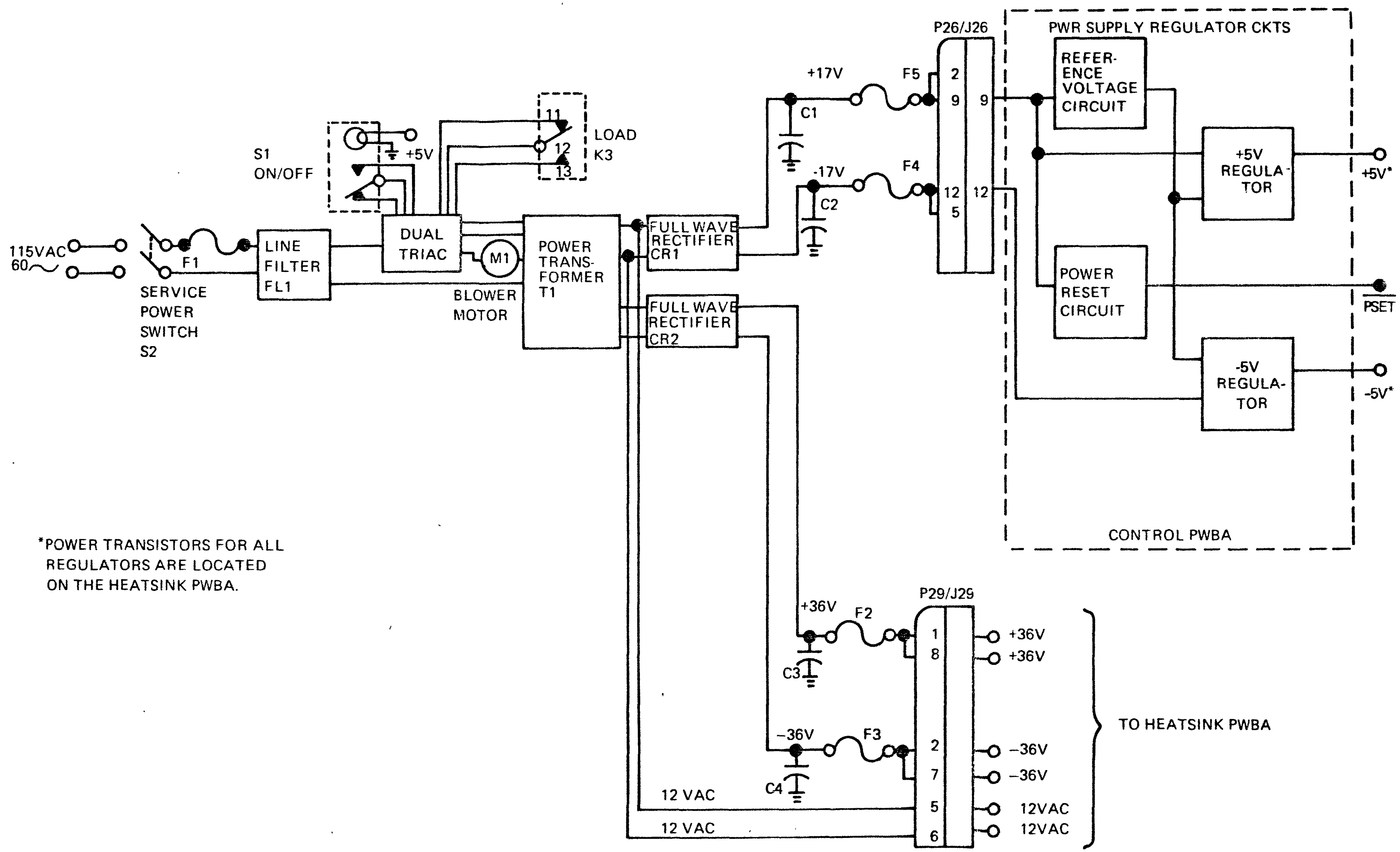
* Indicate Machine Model Number and Tape Speed when ordering.



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



*POWER TRANSISTORS FOR ALL REGULATORS ARE LOCATED ON THE HEATSINK PWBA.

Figure 4-3. Primary Power Circuits Simplified Diagram

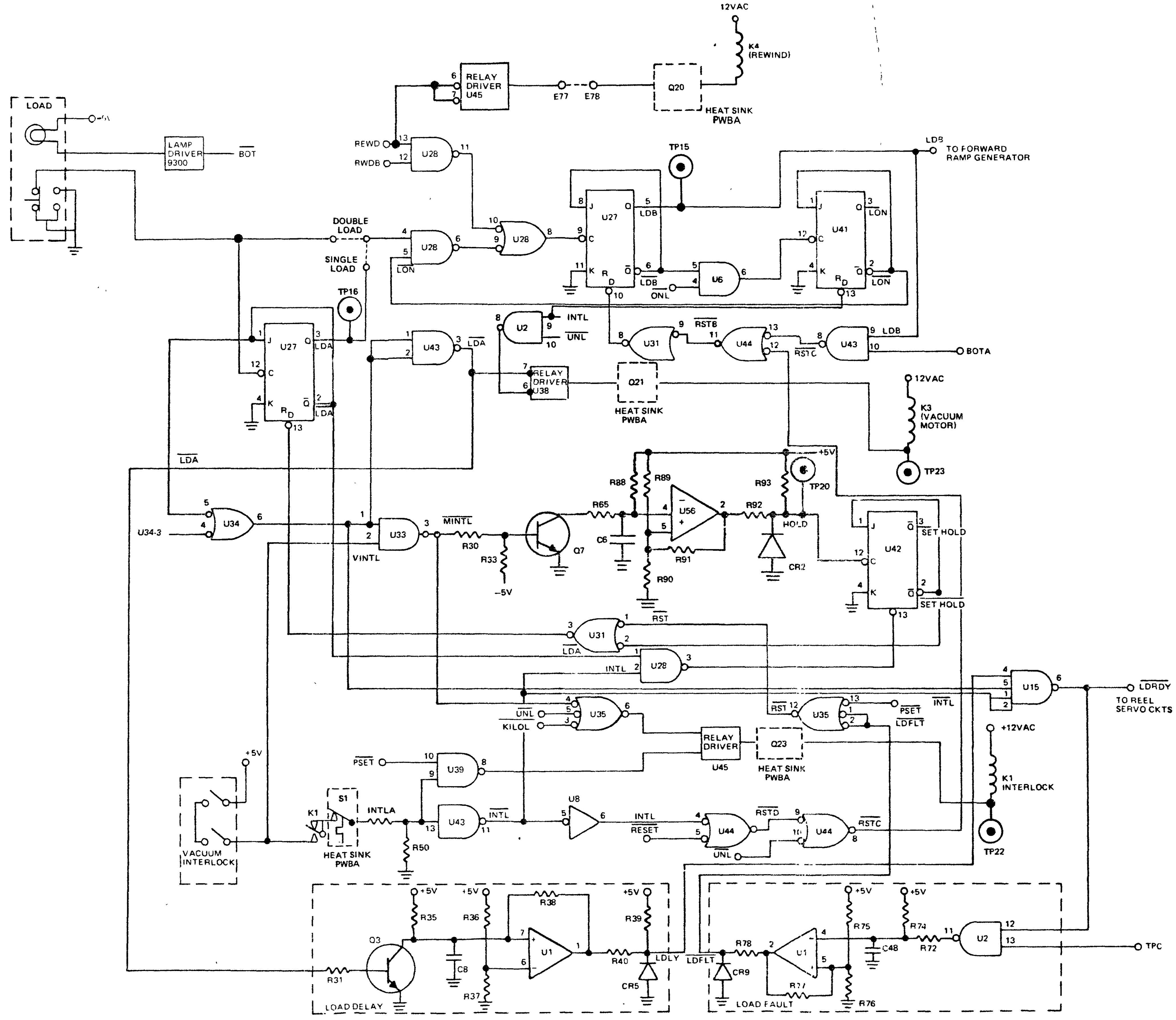


Figure 4-9. Vacuum Column/Double Load Logic Simplified Diagram

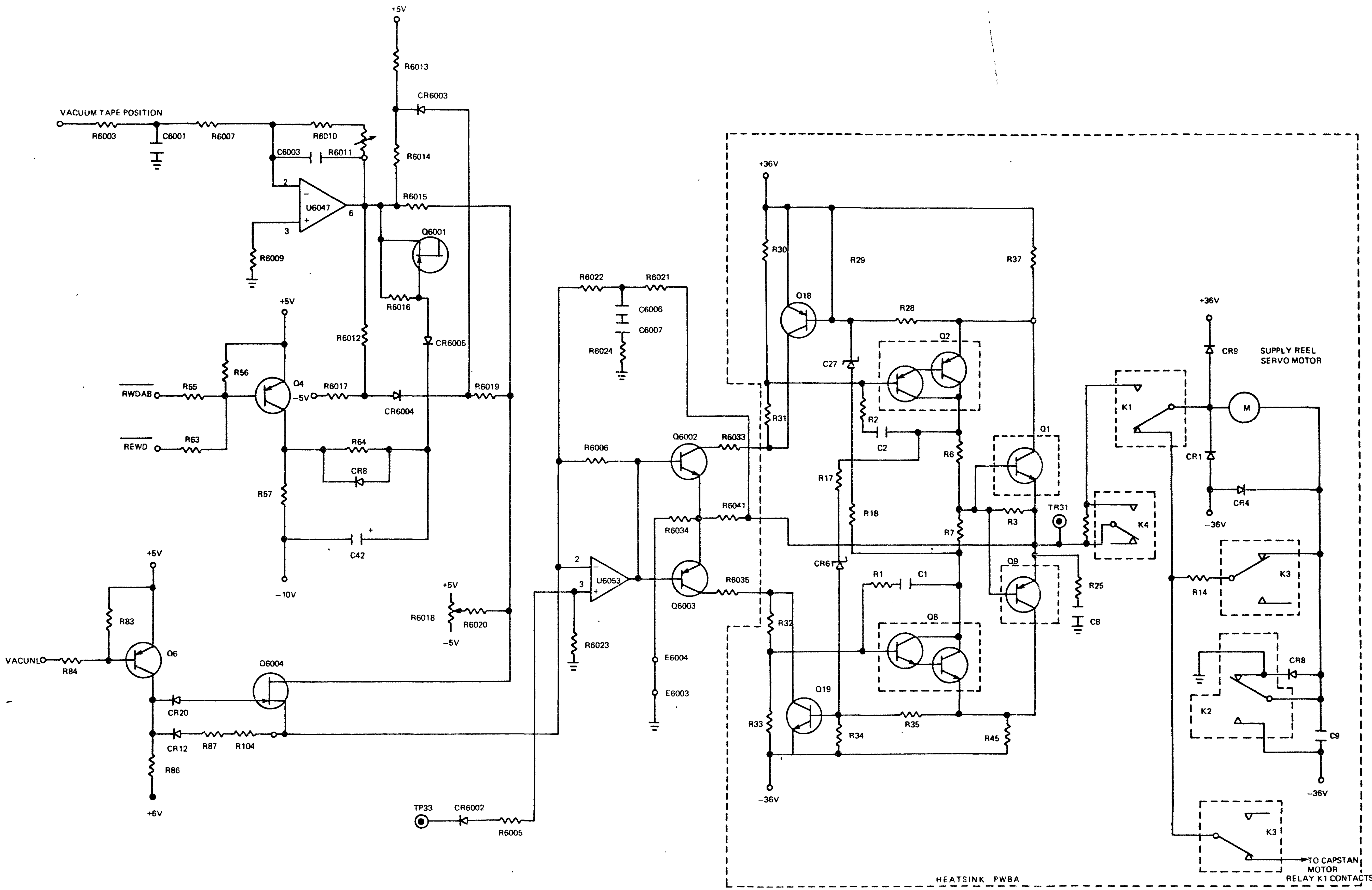


Figure 4-15. Reel Servo Circuits Simplified Schematic Diagram

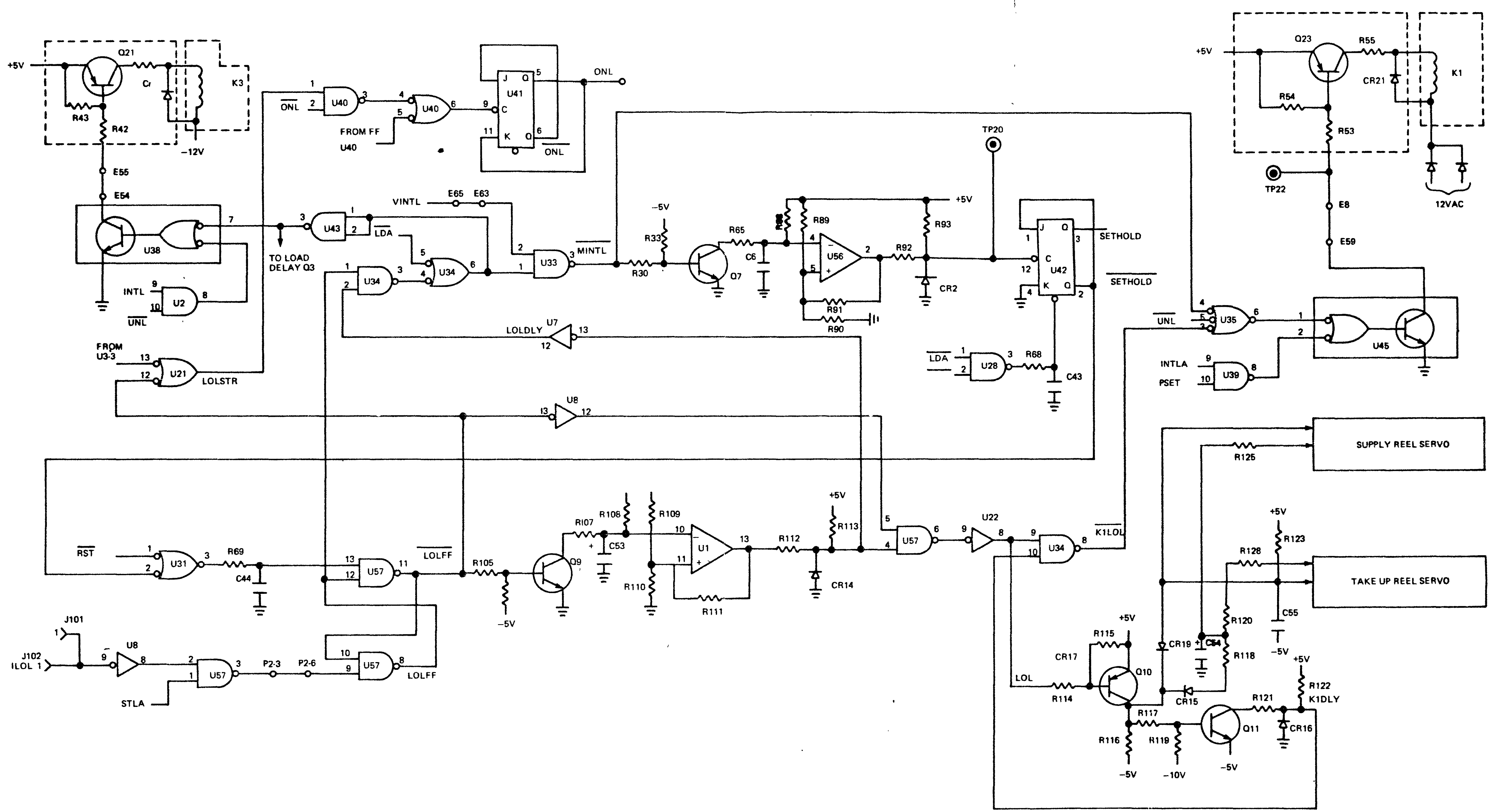


Figure 4-22. Remote Load and On Line Logic Circuits Simplified Diagram

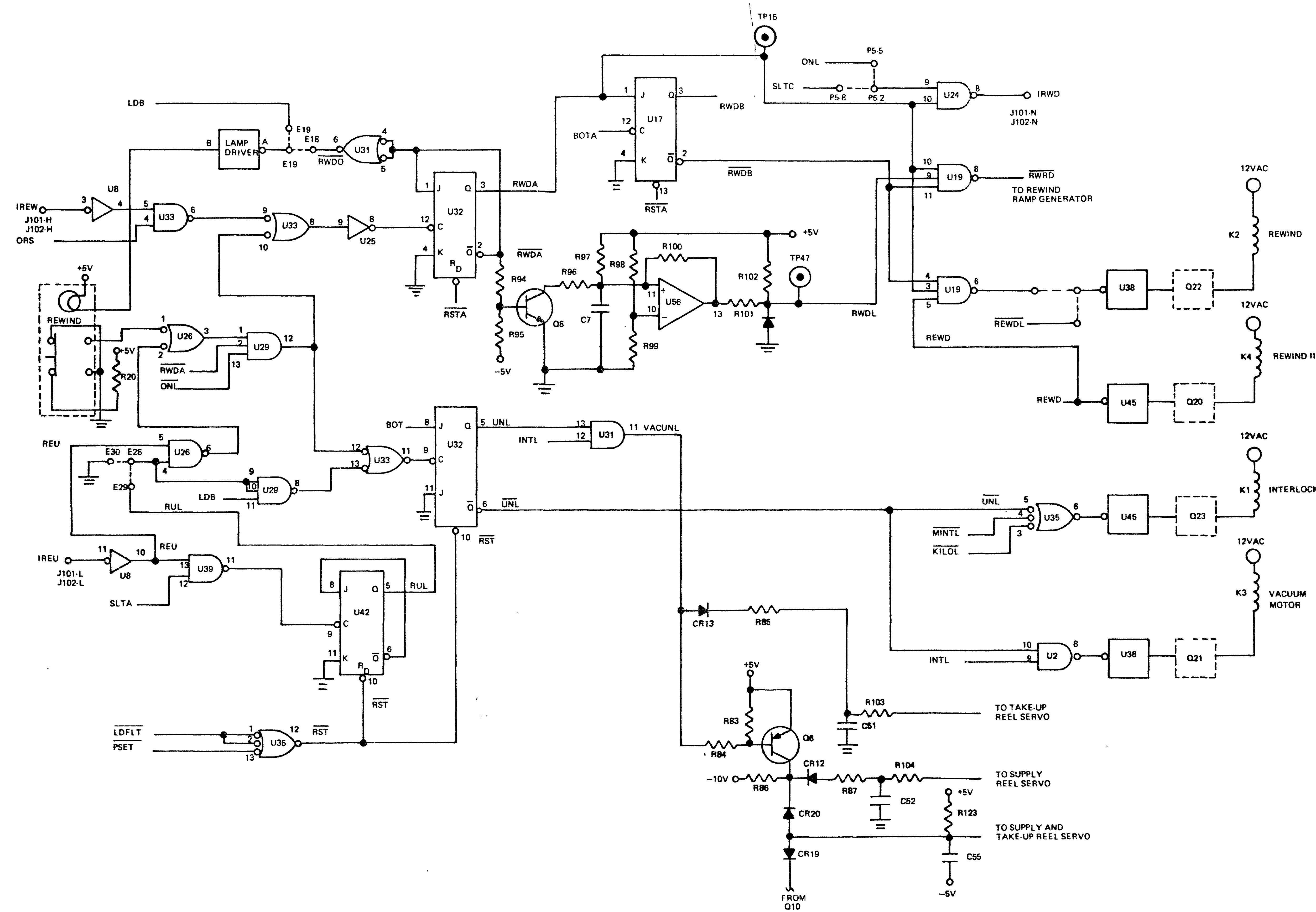


Figure 4-28. Rewind/Unload Control Circuits Simplified Diagram

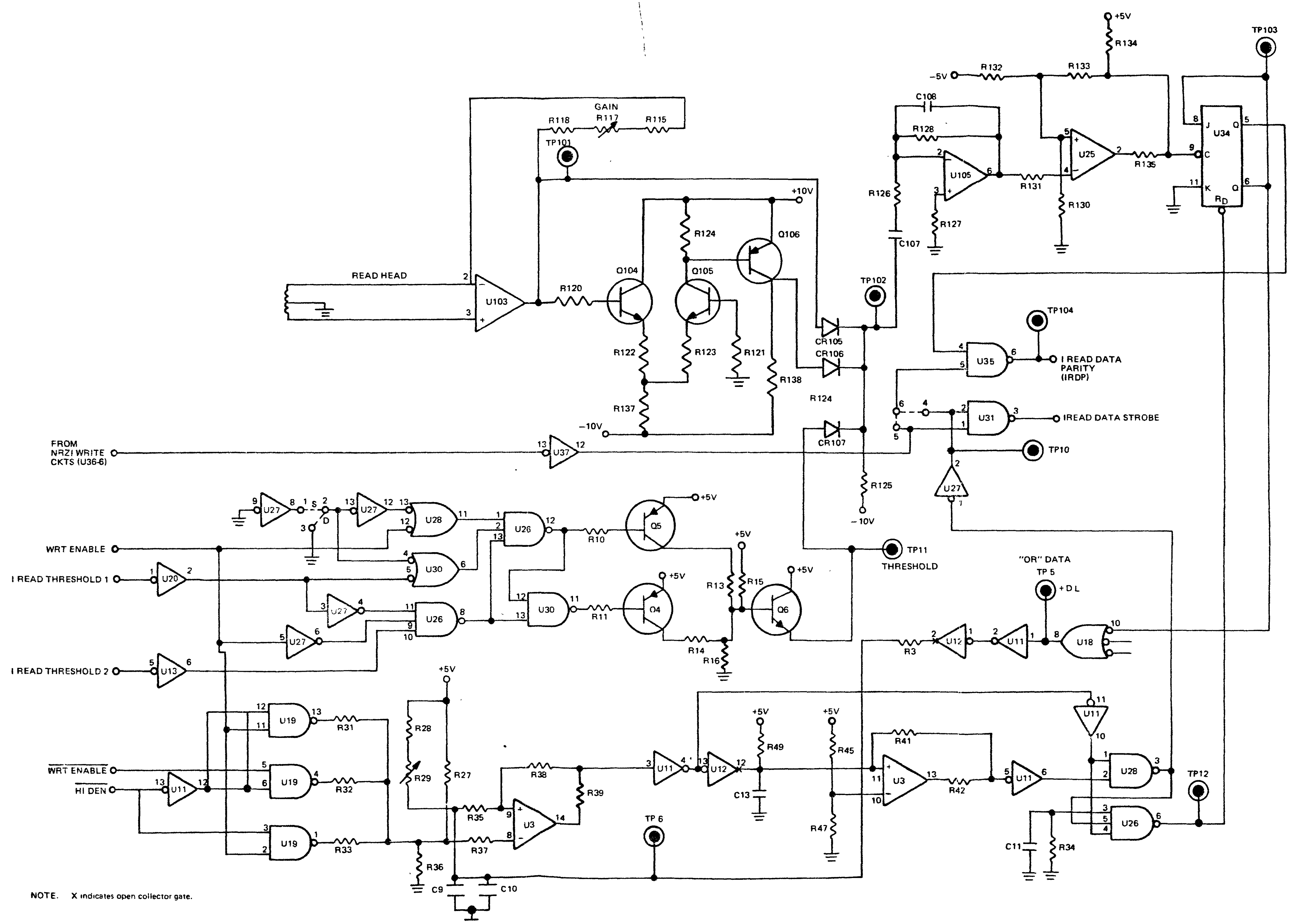


Figure 4-36. NRZI Data Board Read Circuits Simplified Diagram

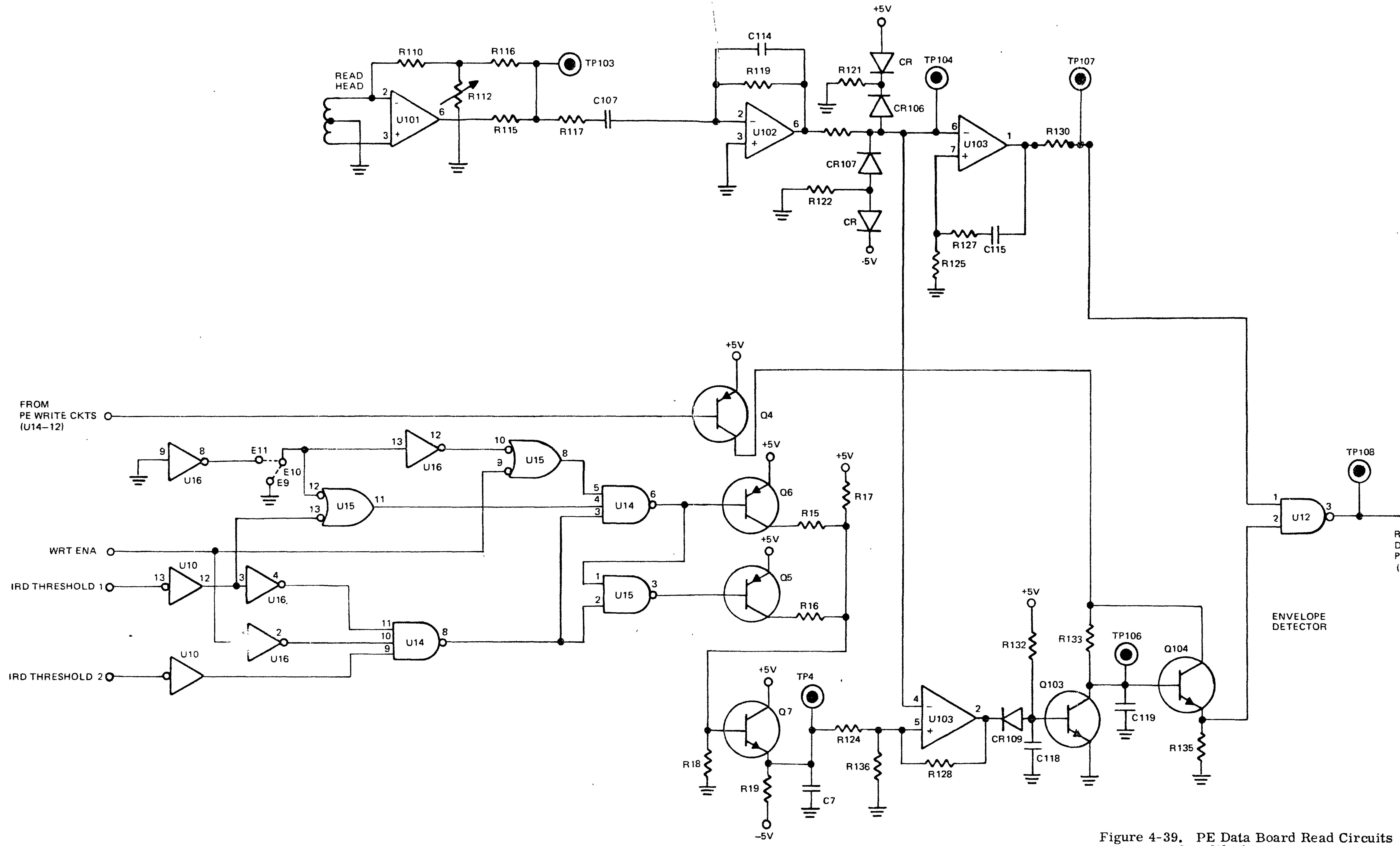


Figure 4-39. PE Data Board Read Circuits Simplified Diagram