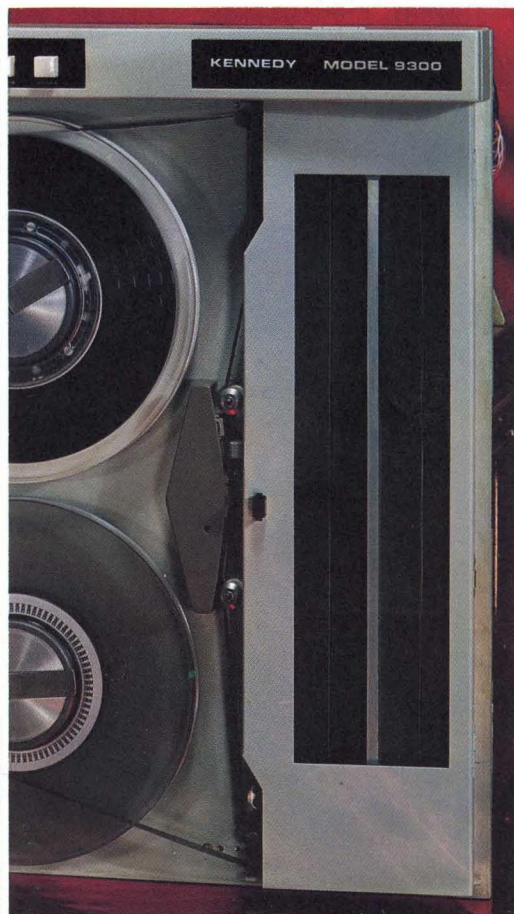
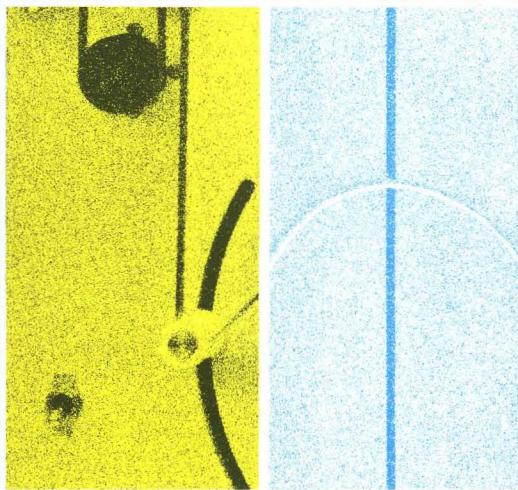
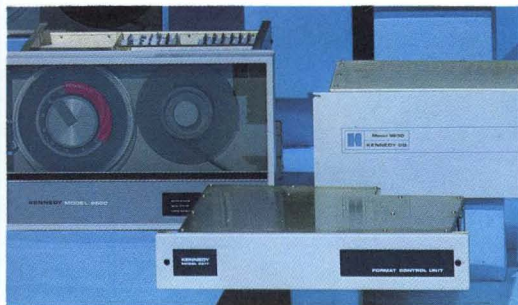


Application and interface guide

KENNEDY
Subsidiary, Magnetics & Electronics, Inc.

Kennedy Tape Transports Models 9000, 9700, 9800, 9100, 9300



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SECTION I

INTRODUCTION

This document defines the performance specifications and operating characteristics and also sufficient information for designing an interface for Kennedy series 9X00 digital synchronous tape transports. Models 9000, 9700 and 9800 utilize tension arms for tape buffering and offer tape speeds up to 45 ips. Model 9100/9300 utilize vacuum column for higher speeds and are available for speeds up to 125 ips. Series 9X00 provides reel sizes of 7, 8½ and 10½ inches. (Refer to Section II, Tables 2-2 and 2-3, for operational specification.)

1.1 GENERAL DESCRIPTION

The Kennedy series 9X00 is a digital synchronous tape transport that with proper external formatting control is capable of reading and writing IBM compatible tapes. Typical applications include operation with minicomputers, high speed data collection systems, and computer peripherals.

The series 9X00 is equipped with the electronics necessary for reading and writing tapes and for controlling the tape motion. The head specifications and the mechanical and electrical tolerances of the series 9X00 meet the requirements for IBM compatibility. However, the formatting electronics — parity generator, cyclic redundancy check character (CRCC) generator, gap control, etc. — are not included and must be provided by the tape control and formatter in order to generate properly formatted IBM compatible tapes.

The standard series 9X00 is available in 7 or 9 track NRZI and 9 track phase encoded recording configurations. Standard data recording densities are: 200/566 cpi or 556/800 cpi for 7 track NRZI, 800 cpi for 9 track NRZI, 1600 cpi for 9 track phase encoded or 800/1600 cpi for 9 track dual.

On Models 9100/9300 a tape unit select switch and a density select switch are provided as standard features.

The transports feature the industry standard interface so that similar system design considerations pertain to all 9X00 series transports.

1.2 FEATURES

- * Industry compatible interface
- * Automatic read threshold scanning
- * Off-line customer engineering test panel
- * Marginal skew check
- * Quick release hubs
- * LED indicators
- * Read-after-write shortened skew gate
- * Crystal controlled timing
- * Switch selectable addressing
- * Small functional printed circuit cards
- * Variable capacitance tape location detector (Models 9100/9300 only)
- * Simplified tape loading
- * Automatic power restart (optional)

1.3 RELATED DOCUMENTS

- a. ANSI X3.22 Recorded magnetic tape for information interchange (800 cpi, NRZI)
- b. ANSI X3.39 Recorded magnetic tape for information interchange (1600 cpi, PE)
- c. ANSI X3.40 Unrecorded magnetic tape for information interchange (9 track 200 and 800 cpi, NRZI, and 1600 cpi, PE)
- d. Model 9000 Product specification PN 102-0025-001
- e. Model 9000 Operation and maintenance manual
- f. Model 9100 Product specification PN 102-0019-001
- g. Model 9100 Operation and maintenance manual
- h. Model 9300 Product specification PN 102-0020-001
- i. Model 9300 Operation and maintenance manual
- j. Model 9700 Product specification PN 102-0026-001
- k. Model 9700 Operation and maintenance manual
- l. Model 9800 Product specification PN 102-0027-001
- m. Model 9800 Operation and maintenance manual

SECTION II SPECIFICATIONS

Although all Kennedy tape transports feature a common electrical interface, the various models are uniquely packaged. This section provides mechanical and electrical information to interface 9X00 series Kennedy transports with any computer system.

2.1 MECHANICAL SPECIFICATION

Tables 2-1 and 2-2 are summaries of operational specifications for Kennedy tape transports. When integrating a Kennedy transport into a system, it should be noted that the units utilize convection cooling as the sole means of heat dissipation (except Model 9300) and that heat sinks are oriented for

vertical transport mounting. A fan is provided in Model 9300 for heat dissipation. The operating range of the units is consistent with normal environments; however, care must be taken when enclosing the units to provide adequate air flow to assure that operating temperature limits will not be exceeded.

In the case of horizontally mounted units, it is suggested that forced air cooling be utilized.

All necessary mounting and interfacing hardware are provided as an installation kit with each unit. Figures 2-1 through 2-5 provide details for rack mounting and installing the various units.

2.2 OPERATIONAL SPECIFICATION MODELS 9100/9300

Model	9100	9300
Data Density	7 Track — 200/556, 556/800 CPI 9 Track — 800 CPI, 1600 CPI, 800/1600 CPI	Same
Number of Tracks	7 or 9 Read after Write	Same
Format	NRZI/PE IBM Compatible	Same
Tape Velocity	75 IPS	125 IPS
Instantaneous Speed Variation	+/-3%	Same
Long Term Speed Variation	+/-1%	Same
Interchannel Displacement Error	150 m inches maximum 800 CPI 200 m inches maximum 556 CPI	Same
Read Data	NRZI 7 or 9 Data Output Levels Deskewed with Read Strobe PE 9 Output Levels peak and envelope detected	Same
Start/Stop Time	5 MS +/- 0.5 MS at 75 IPS Inversely proportional to tape speed	3 MS +/-0.3 MS at 125 IPS
Start/Stop Displacement	0.1875 +/-0.0125 inch	Same
Gaps	Externally Timed	Same
Parity	Externally Generated	Same
Tape Tension	8.0 oz	Same

Table 2-1A. Operational Specification, Models 9100/9300

Model	9100	9300
Reel Size	10.5 inch 2400 feet 1.5 mil 0.5 inch wide tape	Same
Drive System	Single Capstan 180° wrap	Same
Tape Buffer Tape Detection	Vacuum Column Capacitive	Same
Rewind Speed	200 IPS nominal	300 IPS nominal
Electronics	TTL	Same
Tape Unit Interface	TTL Industry Compatible Low True	Same
Physical Dimensions	24.5" H x 19" W x 21" D	Same
Mounting	Standard EIA Rack	Same
Weight	155 lb	170 lb
Power	115 VAC +/-10% 48-60 Hz 750 watts maximum	Same
Operating Temperature	+2° to 50° C	Same
Altitude	0-4000 feet	Same
Humidity	15 to 95% noncondensing	Same
Options Available	High Altitude Kit Special Paint 230 VAC	Same

Table 2-1B. Operational Specification, Models 9100/9300

2.3 OPERATIONAL SPECIFICATION

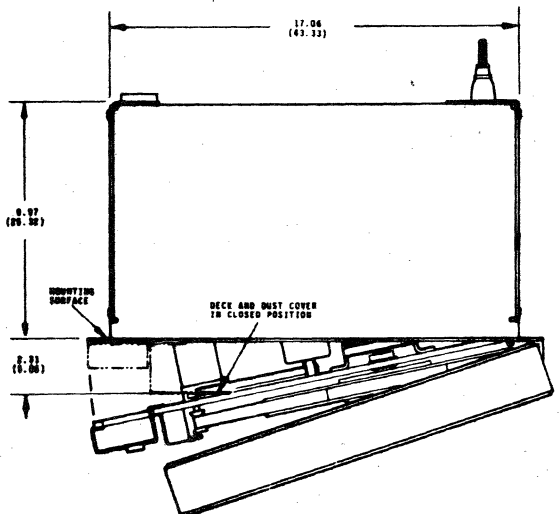
MODELS 9000/9800/9700

Model	9000	9800	9700
Data Density	7 Track - 200/556, 556/800 CPI 9 Track - 800 CPI, 1600 CPI, 800/1600 CPI	7 Track - 200/556, 556/800 CPI 9 Track - 800 CPI, 1600 CPI	7 Track - 200/556, 556/800 CPI 9 Track - 800 CPI, 1600 CPI
Number of Tracks	7 or 9 Read after Write	7 or 9 Read after Write	7 or 9 Read after Write
Format	NRZI/PE IBM Compatible	NRZI/PE IBM Compatible	NRZI/PE IBM Compatible
Tape Velocity	10-45 IPS	10-37.5 IPS	10-37.5 IPS
Instantaneous Speed Variation	+/-3 percent	+/-3 percent	+/-3 percent
Long Term Speed Variation	+/-1 percent	+/-1 percent	+/-1 percent
Interchannel Displacement Error	150 m inches maximum 800 CPI 200 m inches maximum 556 CPI	150 m inches maximum 800 CPI 200 m inches maximum 556 CPI	150 M inches maximum 800 CPI 200 M inches maximum 556 CPI
Read Data	NRZI 7 or 9 Data Output Levels Deskewed with Read Strobe PE 9 Output Levels peak and envelope detected	NRZI 7 or 9 Data Output Levels Deskewed with Read Strobe PE 9 Output Levels peak and envelope detected	NRZI 7 or 9 Data Output Levels Deskewed with Read Strobe PE 9 Output Levels peak and envelope detected

Table 2-2A. Operational Specification, Models 9000/9800/9700

Model	9000	9800	9700
Start/Stop Time	15 MS +/-1 MS at 25 IPS Inversely proportional to tape speed	15 MS +/-1 MS at 25 IPS Inversely proportional to tape speed	15 MS +/-1 MS at 25 IPS Inversely proportional to tape speed
Start/Stop Displacement	0.1875 +/-0.0125 inch	0.1875 +/-0.0125 inch	0.1875 +/-0.0125 inch
Gaps	Externally Timed	Externally Timed	Externally Timed
Parity	Externally Generated	Externally Generated	Externally Generated
Tape Tension	8.0 (+/-0.5) oz	8.0 (+/-0.5) oz	8.0 (+/-0.5) oz
Reel Size	10.5 inch 2400 feet 1.5 mil 0.5 inch wide tape	8.5 inches, 1200 feet 1.5 mil 0.5 inch wide tape	7 inches, 600 feet 1.5 mil 0.5 inch wide tape
Drive System	Single Capstan 180° wrap	Single Capstan 180° wrap	Single Capstan 180° wrap
Servo Buffer Arm Positioning	Electromagnetic	Electromagnetic	Electromagnetic
Rewind Speed	150 IPS nominal	120 IPS nominal	120 IPS nominal
Electronics	TTL	TTL	TTL
Tape Unit Interface	TTL Industry Compatible Low True	TTL Industry Compatible Low True	TTL Industry Compatible Low True
Physical Dimensions	24.5" H x 19" W x 11" D	12.5" H x 19" W x 13.0" D	8.75" H x 19" W x 13.0" D
Mounting	Standard EIA Rack	Standard EIA Rack	Standard EIA Rack
Weight	90 lb	45 lb	35 lb
Power	115 VAC +/-10% 48-400 Hz UL approved	115/230 VAC +/-10% 48-500 Hz	115/230 VAC +/-10% 48-500 Hz
Operating Temperature	+2° to 50°C	+2° to 50°C	+2° to 50°C
Altitude	0-30,000 feet	0-30,000 feet	0-30,000 feet
Humidity	15 to 95% noncondensing	15 to 95% noncondensing	15 to 95% noncondensing
Options Available	37.5, 45 IPS Switch Selectable Addressing Special Paint 230 VAC	25, 37.5 IPS Special Paint	25, 37.5 IPS Special Paint

Table 2-2B. Operational Specification, Models 9000/9800/9700

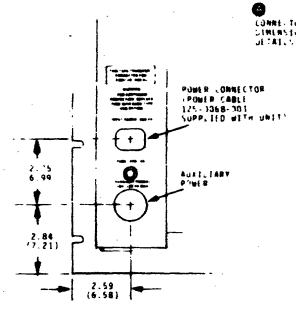


DUST COVER OPENS TO APPROX 120° FOR ACCESS TO TAPE BELLS

WARNING

DUST COVER MUST BE FULLY OPENED BEFORE OPENING DECK ASSEMBLY

DECK ASSEMBLY OPENS TO APPROX 90° FOR ACCESS TO TRANSPORT & ELECTRONICS



FIRST DIMENSIONS SHOWN ARE IN INCHES. DIMENSIONS IN PARENTHESES ARE IN CENTIMETERS. UNLESS OTHERWISE SPECIFIED DIMENSIONS SHOWN ARE NOMINAL.

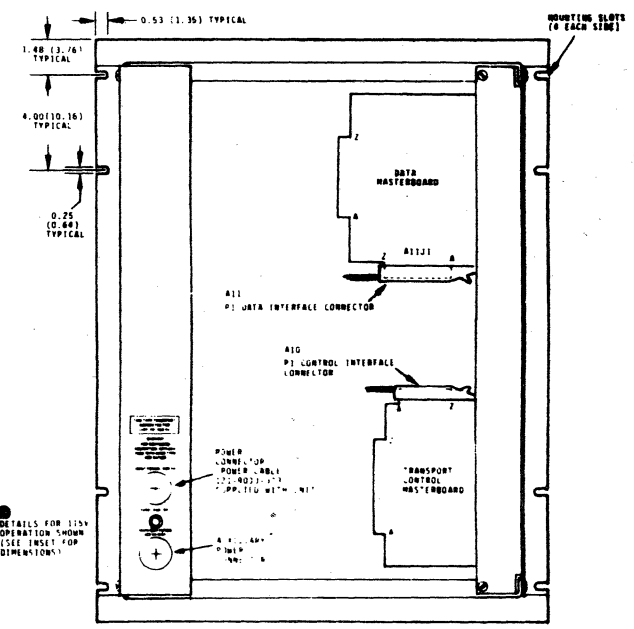
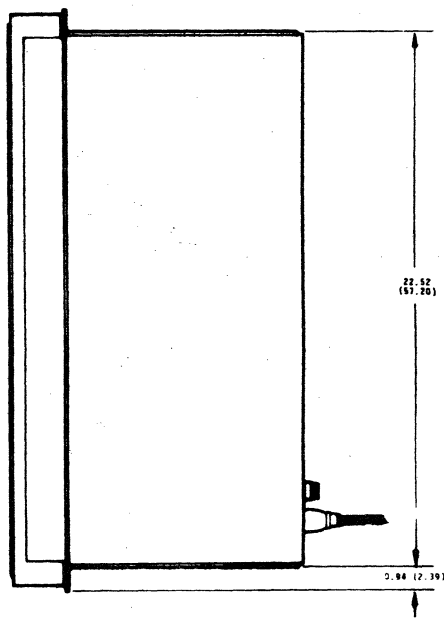
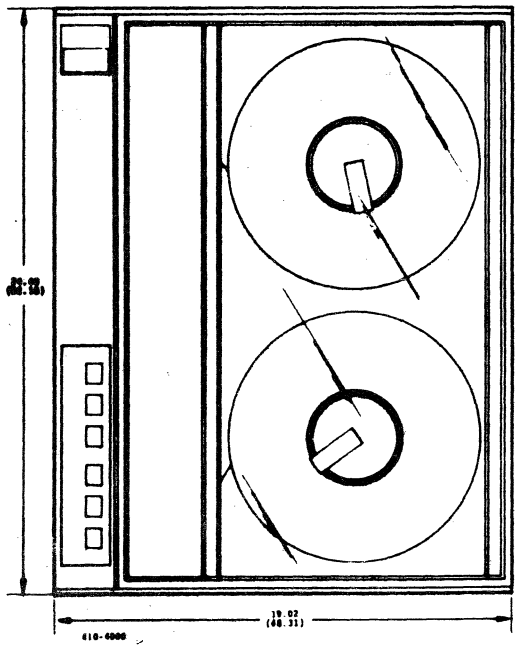


Figure 2-1. Model 9000 Outline and Installation Drawing

410-4013

NOTE: DIMENSIONS FIRST SHOWN ARE IN INCHES.
DIMENSIONS IN PARENTHESES ARE IN CENTIMETERS.

MOUNTING HOLES ARE FOR
ZERO NORTILY TYPE SLIDE
NO. C300-14 (NOT SUPPLIED
WITH UNIT) (DIMENSIONS
TYPICAL ON BOTH SIDES)

MOUNTING SURFACE

CONTROL PANEL RETAINING
HINGE (PULL OUT LOWER
END OF PANEL FOR ACCESS
TO RACK MOUNTING SCREWS)

DUST COVER OPENS
TO APPROXIMATELY
110 DEGREES.

MOUNTING SURFACE

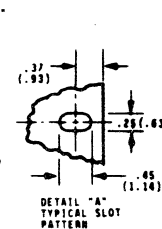
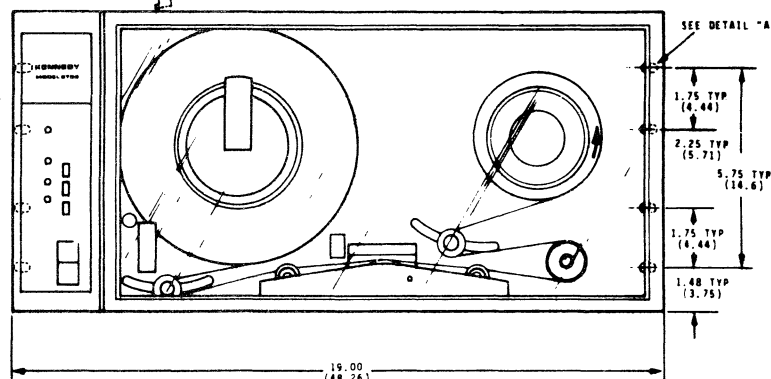
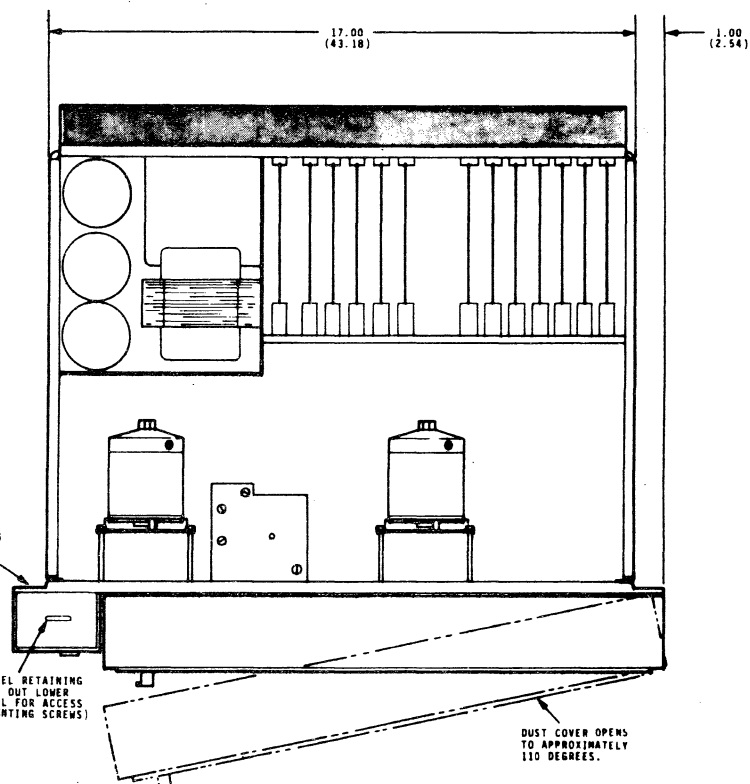
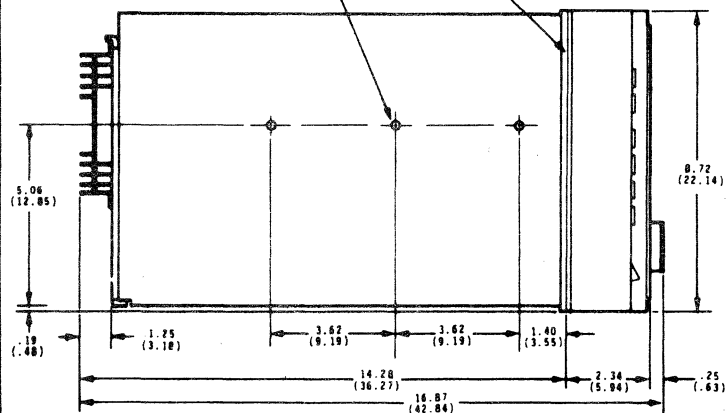
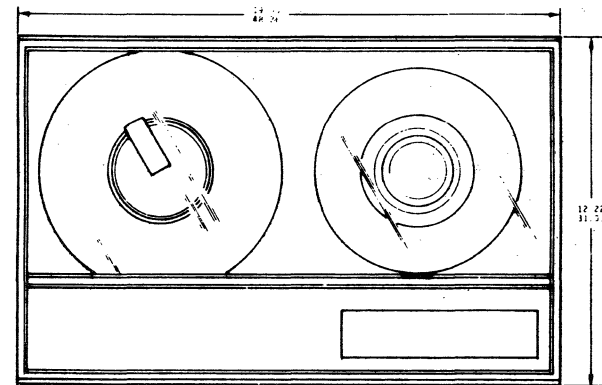
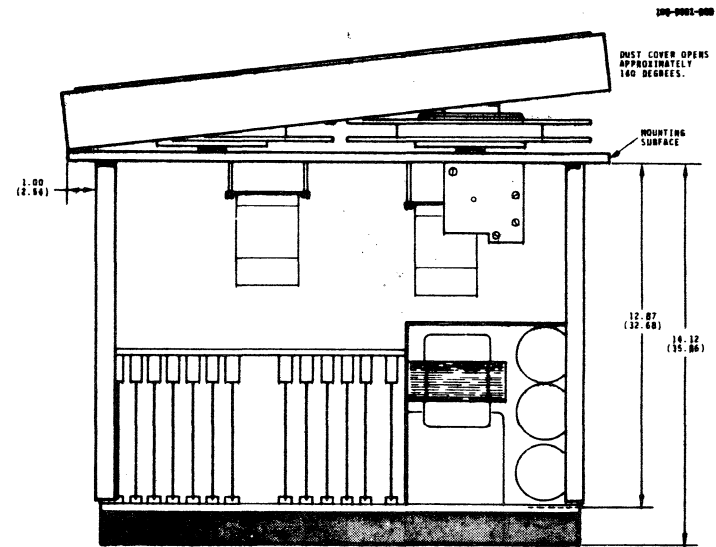
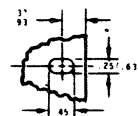
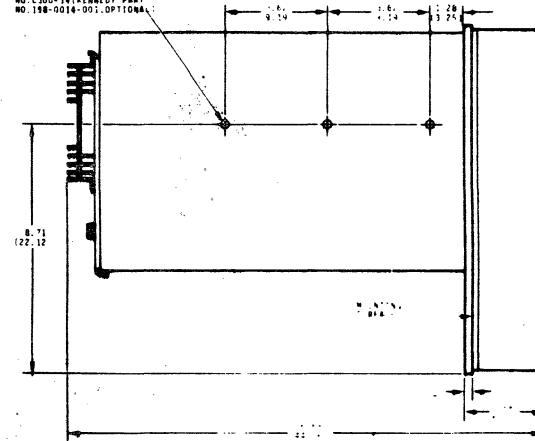
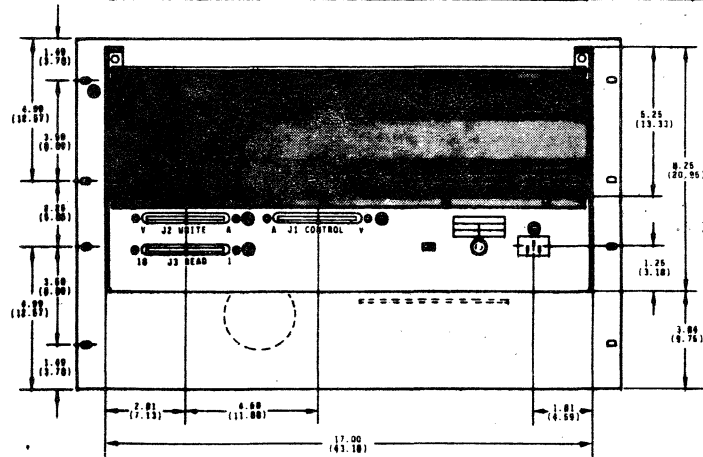


Figure 2-2. Model 9700 Outline and Installation Drawing



MOUNTING HOLES ARE FOR ZERO MOUNTLY TYPE SLIDE NO. C300-14 (KENNEDY PART NO. 100-0014-001, OPTIONAL)



- INPUT POWER CONNECTOR (POWER CABLE 120-0068-00) SUPPLIED WITH UNIT
- P1 CONTROL CONNECTOR MATING CONNECTOR PART NUMBER 121-0066-036
- P2 WRITE CONNECTOR MATING CONNECTOR PART NUMBER 121-0066-036
- P. RIAC (P. RIAC PART NUMBER 121-0066-036)

610-6010

610-6010

Figure 2-3. Model 9800 Outline and Installation Drawing

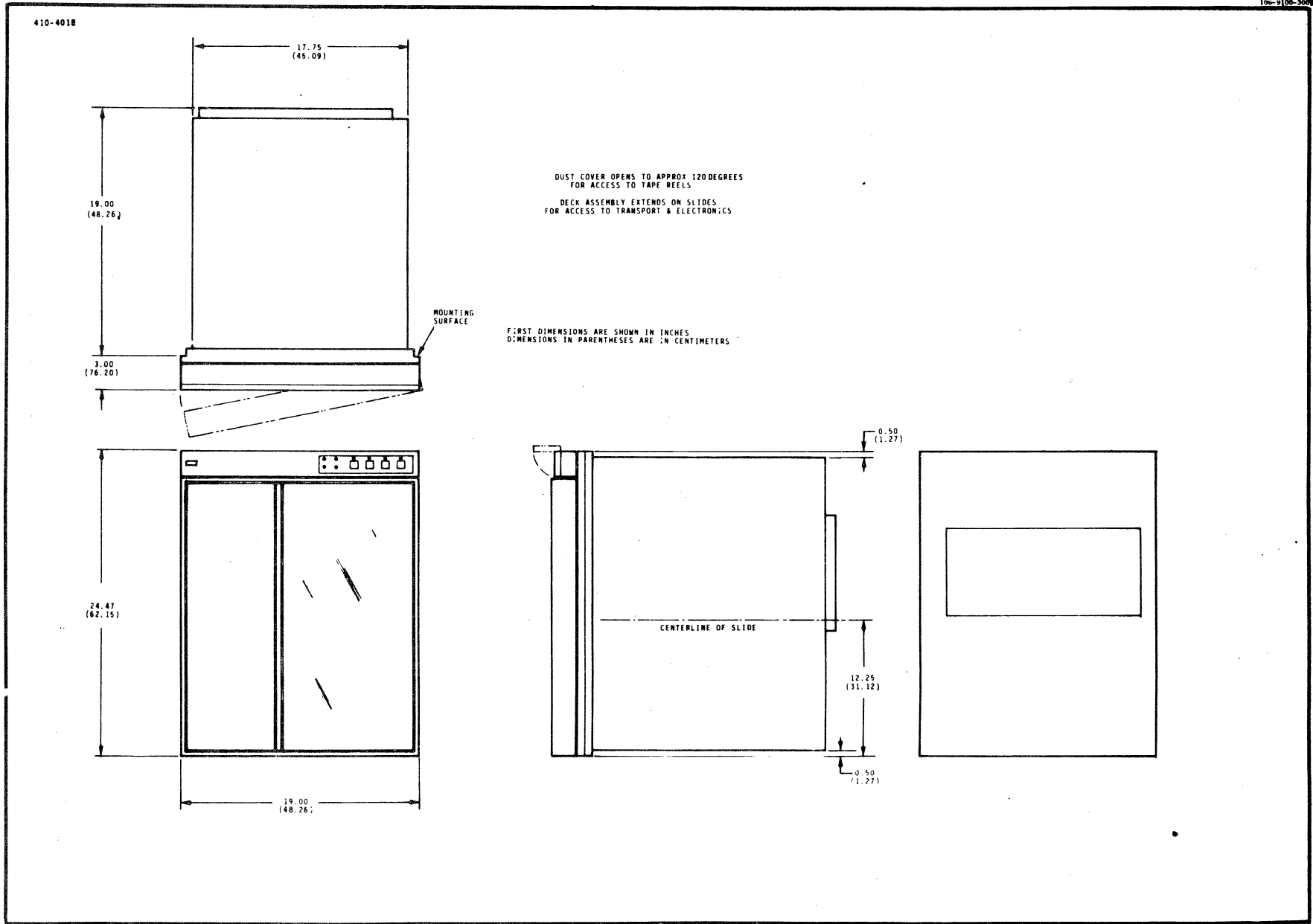
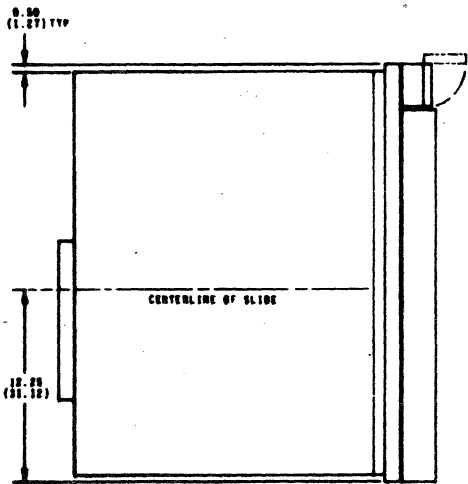
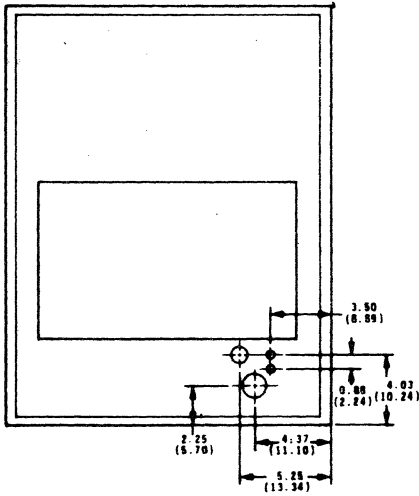
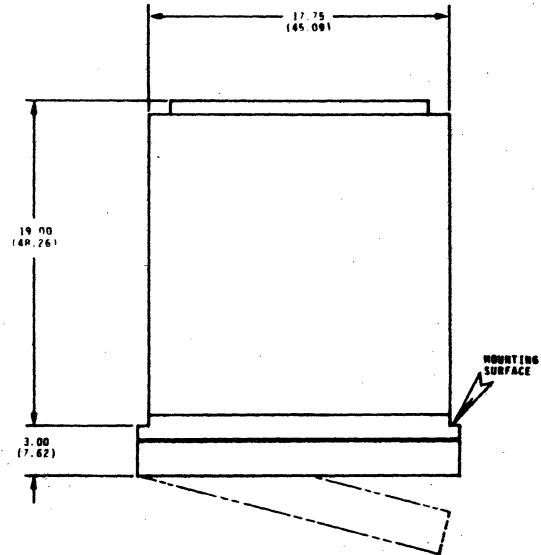


Figure 2-4. Model 9100 Outline and Installation Drawing

106-1300-2nd

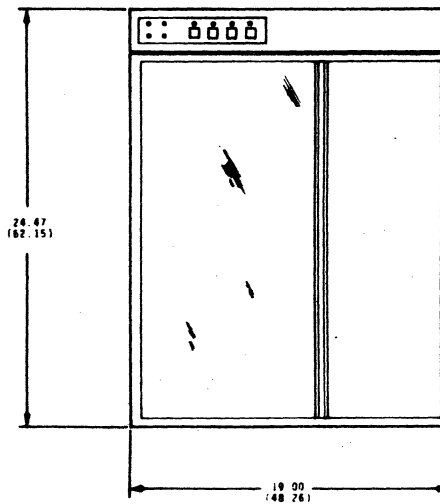


FIRST DIMENSIONS ARE SHOWN IN INCHES.
DIMENSIONS IN PARENTHESES ARE IN CENTIMETERS.



DUST COVER OPENS TO APPROX 90 DEGREES FOR ACCESS TO TAPE REELS.

DECK ASSEMBLY EXTENDS ON SLIDES FOR ACCESS TO TRANSPORT & ELECTRONICS.



106-1300-2

Figure 2-5. Model 9300 Outline and Installation Drawing

206-9X00-080

SECTION III

PHYSICAL CHARACTERISTICS

3.1 CONTROL AND INDICATORS

An illustration of controls and indicators on the series 9X00 transports is shown in Figure 3-1. These local controls and indicators are utilized to prepare the transports for operation and to monitor key functions. They are described only to provide greater familiarization with the units.

3.1.1 POWER

On Models 9100, 9300 and 9700, there is a momentary pushbutton switch/indicator which connects line voltage to the power transformer. Models 9000 and 9800 utilize a power switch only. When power is on: all power supplies are established; all motors are open-circuited (low value resistors are connected across the reel motors), and a reset signal is applied to key control flip-flops.

3.1.2 LOAD

The momentary pushbutton activates the reel servos (tensions tape) and starts the load sequence. Tape runs forward at normal speed to the reflective foil load point marker, then stops. The indicator is illuminated when the reel servos are activated and tape is tensioned.

3.1.3 ONLINE

A momentary pushbutton, which functions as alternate action. When first activated the tape unit is placed in an on line condition; when the tape unit is on line it can be remotely selected and will be ready if tape is loaded to or past the load point tape marker. When activated again it takes the tape unit off line. The indicator is illuminated in the on line condition.

3.1.4 REWIND

This momentary pushbutton activates a rewind operation. This control is enabled only when tape is tensioned and unit is off line. The indicator is illuminated during either a local or remote rewind operation.

Enabling this control causes tape to rewind at the specified speed. On reaching the load point marker, the rewind operation ceases and the load sequence is automatically entered, positioning the tape approximately 0.19 inch beyond the load point marker.

If the REWIND control is depressed and released when tape is at load point (LOAD indicator illuminated), tape rewinds off the takeup reel and tension is lost.

LOAD and REWIND pushbuttons are disabled when the tape unit is on line.

3.1.5 READ

Illuminates when tape unit is on line, selected and read selected. (This indicator is not available on Model 9700.)

3.1.6 WRITE

Illuminates when tape unit is on line, selected and write status selected. Write enable signal must also be true, indicating a tape with a write enable ring mounted on the transport.

3.1.7 SELECT

Illuminates when tape unit is on line and selected.

3.1.8 WRITE ENABLE

Write enable is an indicator which is illuminated whenever power is ON and a reel of tape with a write enable ring installed is mounted on the transport.

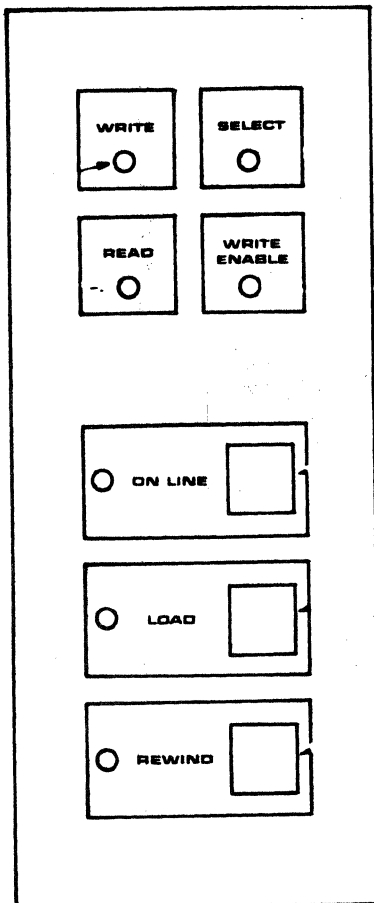
3.1.9 UNIT SELECT SWITCH

This rotary selector switch is utilized in applications requiring addressing one of several transports. Activating the SLT line corresponding to the address (0-3 or 1-4) selected causes the transport to be selected. This feature is optional on Models 9000, 9700 and 9800, but is standard on Models 9100/9300.

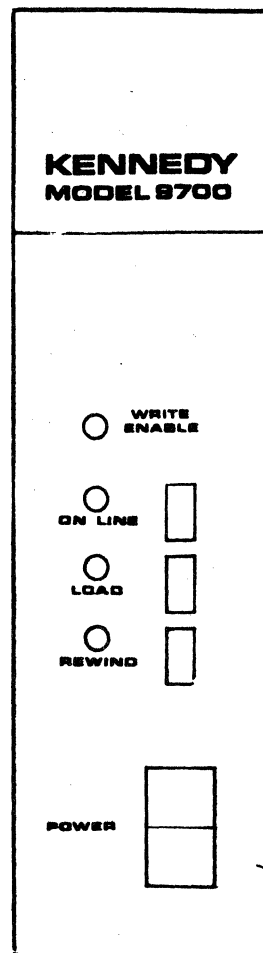
3.2 TEST PANEL

Models 9000, 9100 and 9300 contain test panels which provide a means of exercising, testing, and adjusting the tape transport while it is off line, eliminating the need for a separate test fixture or for the use of valuable computer time. (Test panels are optional in Models 9700 and 9800.) The test panel can initiate forward and reverse tape motions at either normal or high tape speeds. It can also initiate a write test, generating a crystal controlled all-1's test pattern on tape. The test panel also provides indicators for load

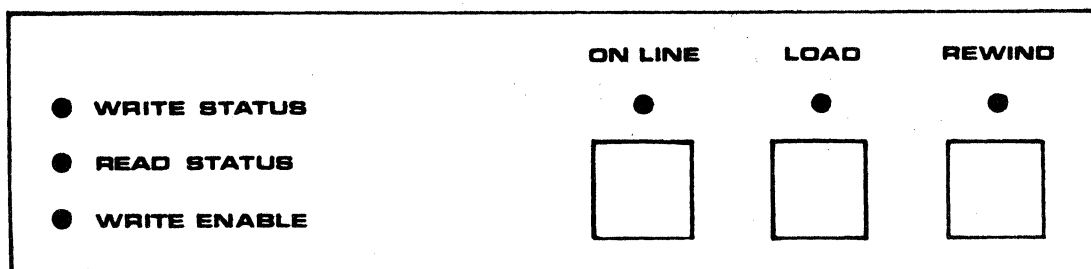
Model 9000



Model 9700



Model 9800



Models 9100; 9300

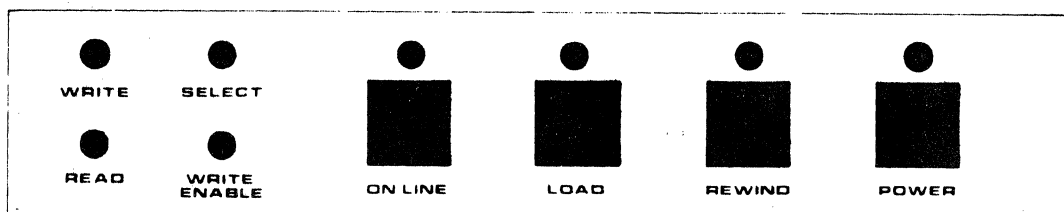


Figure 3-1. Control Panel Controls and Indicators

point, end of tape, and data available. An additional indicator monitors excessive skew, and is used to align the read/write head in conjunction with an 800 cpi skewmaster tape. When the head is properly aligned and the data is written on tape properly the SKEW indicator is extinguished.

The controls and interlocks for the test panel are located on the Pushbutton Control card. The skew detect network is located on the Delay Timing module in the read logic section of the transport. The test panel becomes operational only when the transport is off line with the test panel STOP pushbutton depressed. If these conditions are satisfied the test panel pushbuttons are enabled when the TEST MODE pushbutton is pressed.

Figure 3-2 illustrates the test panel of various transports.

3.2.1 TEST POINT AND SKEW INDICATOR

Indicator lights if tape skew exceeds the appropriate skew (read or write) gate setting. An oscilloscope test point is available for monitoring skew gate timing.

3.2.2 HDS

Indicates that high density mode has been selected.

3.2.3 EOT

Indicates that tape has reached or passed the reflective end of tape marker.

3.2.4 LOAD POINT

Indicates that tape is at load point.

3.2.5 CYCLE (9100/9300 Transports Only)

An interlocked pushbutton which runs tape in alternating forward and reverse modes. Useful for making ramp or vacuum sensor adjustments. Depressing STOP pushbutton terminates this operation.

3.2.6 FAST FORWARD

An interlocked pushbutton switch that allows tape unit to run forward at fast speed. Depressing STOP pushbutton or advancing tape to EOT marker terminates this operation.

3.2.7 REVERSE RUN

An interlocked pushbutton switch that allows tape unit to run in reverse at normal speed. Depressing

STOP pushbutton or rewinding tape to load point marker terminates this operation.

3.2.8 FORWARD RUN

An interlocked pushbutton switch that allows tape unit to proceed forward at normal speed. Depressing STOP pushbutton or advancing tape to EOT marker terminates this operation.

3.2.9 STOP

An interlocked pushbutton switch that terminates tape motion.

3.2.10 WRITE TEST

A momentary pushbutton which programs 1's to be written on all channels to facilitate write skew adjustment. WRITE TEST remains active in FORWARD RUN mode only. (STOP pushbutton must be depressed and TEST MODE selected to actuate this feature.) The indicator remains illuminated while unit is in this mode.

3.2.11 TEST MODE

This momentary pushbutton selects test mode and activates test panel. When indicator is illuminated, test panel is active. (Tape unit must be off line and STOP pushbutton depressed before test panel will function.)

3.2.12 FAST REVERSE

An interlocked pushbutton switch that allows tape unit to run in reverse at specified speed. Depressing STOP pushbutton or rewinding tape to BOT marker will terminate this operation.

3.2.13 DATA

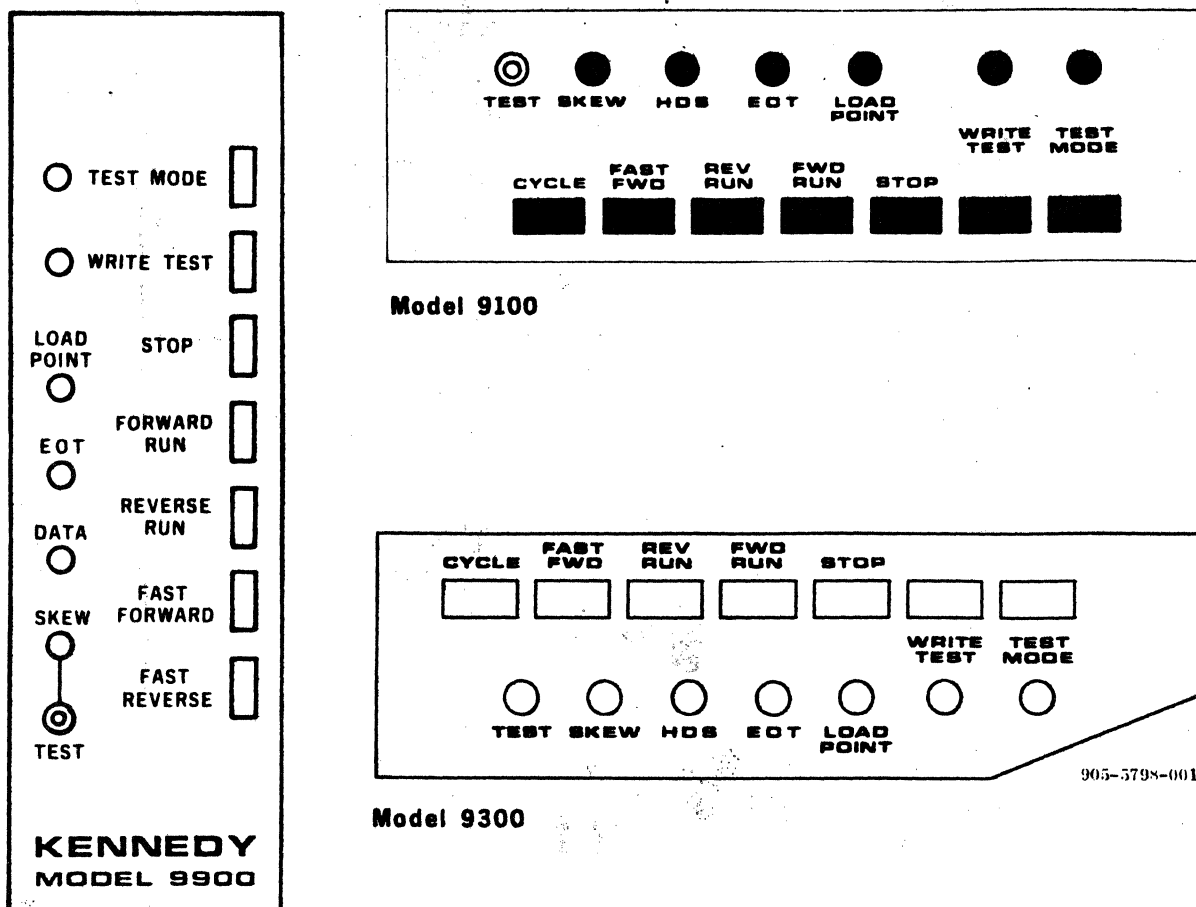
Indicates when data is being processed by read/write electronics.

3.3 OPTIONS

When incorporated in series 9X00 tape transports the type 4843 Pushbutton Control module allows use of several factory installed optional features. These functions are determined by optional straps and use of components.

3.3.1 AUTO POWER RESTART

With the standard APR option, this circuitry continually monitors the line voltage and whether the tape unit is online or offline. If the external voltage



Model 9000; Model 9900 Test Box

Figure 3-2. Test Panel Controls and Indicators

falls below the minimum value required by the tape unit, this option will force the unit into an offline state and issue a BROKEN TAPE command. When the input power level returns to an acceptable value, the APR circuitry will do one of two things, depending on whether the deck was online before the power failure: (1) nothing, if the unit was in an offline state, or (2) load, advance tape several inches and place the unit online if it was previously in an on-line state.

3.3.2 ON TAPE (OT)

With this option the tape unit cannot be placed online until a reel of tape is loaded and positioned at or past the BOT tab.

3.3.3 ONLINE LOCK (ONLL)

This feature prevents the operator from manually taking the unit offline via the front panel switch unless the tape controller allows him to do so.

3.3.4 FAST (FST)

This feature allows interface control of high speed forward and high speed reverse tape searches.

3.3.5 LOAD ONLINE

This feature allows the user, through a control interface signal, to load and place the tape unit online.

SECTION IV

INTERFACE DESCRIPTION

4.1 GENERAL

Three printed circuit board edge connectors are supplied with each unit shipped by Kennedy (with Model 9000 MTA boards must be ordered to receive three 36-pin connectors). These 36-pin connectors mount on the edge of the data and control electronics PCBAs. The connectors are designed for twisted pair inputs and outputs. For each active pin there is a ground pin. All input and output signals for the transports pass through these connectors. Pin assignments in each series are such that all Kennedy transports are plug compatible.

The tape unit responds to zero true inputs and provides zero true outputs. Each signal input is terminated in such a manner as to provide matching for twisted pair cables. See Figure 4-1. Each output line is driven with an open collector driver. For best results the typical interfacing circuit configurations shown in Figure 4-2 should be used. The recommended twisted pair cable will reduce the magnitude of intercable crosstalk. Unless otherwise specified all wires should be 24 AWG minimum, with a minimum insulation thickness of 0.01 inch. Each pair should have not less than one twist per inch and the input-output cables should not exceed 20 feet in length.

Table 4-1 summarizes the pin assignments and related signals for the various transports.

4.2 INPUT-OUTPUT SIGNALS

The input receiver circuits, due to zero true current sinking logic design, will interpret a disconnected wire or removal of power at the transmitter as a logic 0 or false condition. The logic 1, or true state, requires 25 ma current sink with less than 0.4v. The logic 0, or false state, will be 3v due to the input matching resistors (see Figure 4-1). The recommended input pulsewidth is 2 microseconds. The rise and fall times for pulses and levels must be less than 0.5 microsecond. Each input is enabled when the tape transport is on line and selected.

Each output line is driven with an open collector current sinking logic driver which is capable of sinking up to 40 ma in the true state. All outputs are disabled (false) when the tape unit is not on line and/or not selected.

All commands from and to the input/output connector are preconditioned by loading the machine and placing it on line using the front panel controls. The next commands set up the recorder.

4.3 CONTROL COMMANDS

Tables 4-2 through 4-4 summarize the control command input signals, and Tables 4-5 through 4-7 summarize the control command output signals.

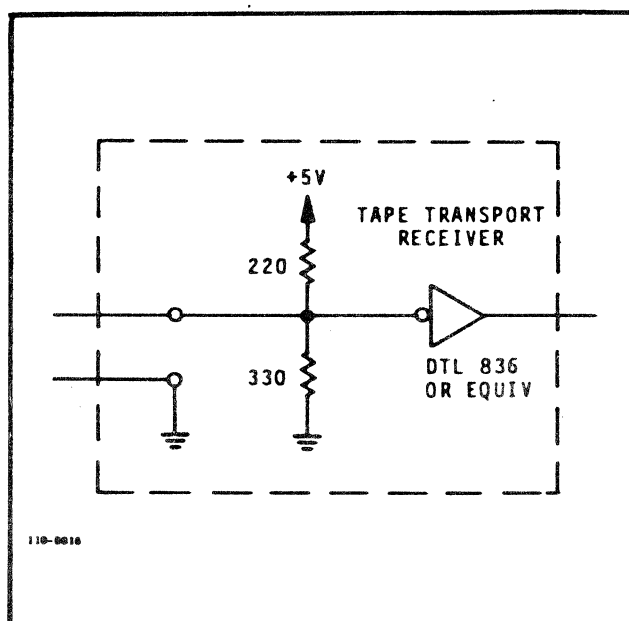


Figure 4-1. Recommended Signal Line Termination

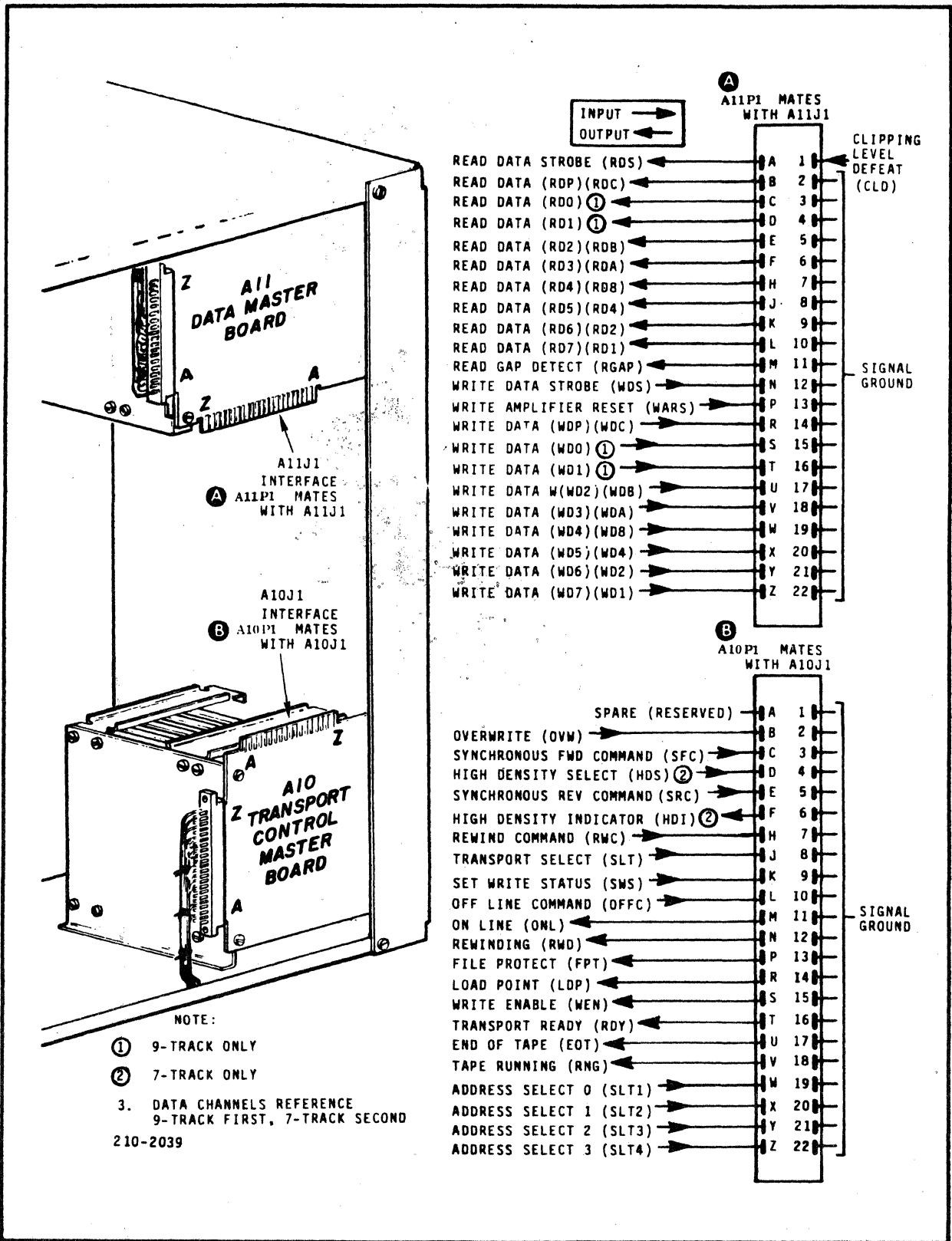
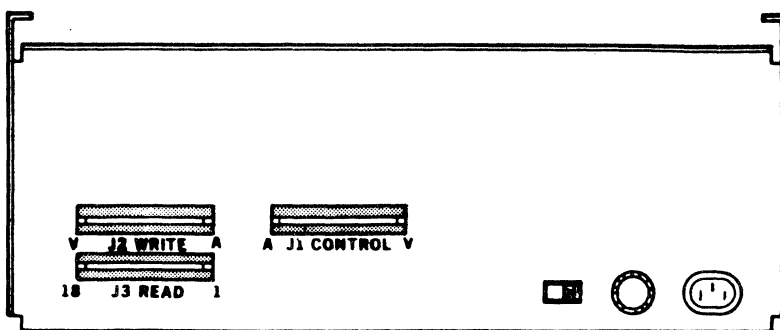


Table 4-1A. Model 9000 Interface



← INPUT
→ OUTPUT

WRITE CONNECTOR J2

ACTIVE	GROUND	SIGNAL	MNEMONIC
A	1	← WRITE DATA STROBE	WDS
B	2	← N.C.	
C	3	← WRITE AMPLIFIER RESET	WARS
D	4	← NOT USED	
E	5	← NOT USED	
F	6	← NOT USED	
H	7	← NOT USED	
J	8	← NOT USED	
K	9	← NOT USED	
L	10	← WRITE DATA CHANNEL P	WDP
M	11	← WRITE DATA CHANNEL 0	WDO
N	12	← WRITE DATA CHANNEL 1	WD1
P	13	← WRITE DATA CHANNEL 2	WD2
R	14	← WRITE DATA CHANNEL 3	WD3
S	15	← WRITE DATA CHANNEL 4	WD4
T	16	← WRITE DATA CHANNEL 5	WD5
U	17	← WRITE DATA CHANNEL 6	WD6
V	18	← WRITE DATA CHANNEL 7	WD7

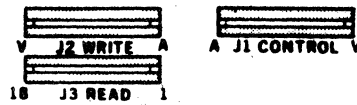
CONTROL CONNECTOR J1

ACTIVE	GROUND	SIGNAL	MNEMONIC
A	1	← SPARE	
B	2	← OVERWRITE	OVW
C	3	← SYNCHRONOUS FORWARD	SFC
D	4	← DATA DENSITY SELECT	DDS
E	5	← SYNCHRONOUS REVERSE	SRC
F	6	← DATA DENSITY INDICATOR	DDI
H	7	← REWIND COMMAND	RWC
J	8	← SELECT	SLT
K	9	← SET WRITE STATUS	SWS
L	10	← OFF LINE COMMAND	OFFC
M	11	← ON LINE	ONL
N	12	← REWINDING	RWD
P	13	← FILE PROTECT	FPT
R	14	← LOAD POINT	LP
S	15	← WRITE ENABLE	WEN
T	16	← TRANSPORT READY	ROY
U	17	← END OF TAPE	EOT
V	18	← TAPE RUNNING	RNG

READ CONNECTOR J3

ACTIVE	GROUND	SIGNAL	MNEMONIC
1	A	→ READ DATA CHANNEL P	RDP
2	B	→ READ DATA STROBE	RDS
3	C	→ READ DATA CHANNEL 0	RDO
4	D	→ READ DATA CHANNEL 1	RD1
5	E	→ NOT USED	
6	F	→ AUTO DISABLE	
7	H	→ NOT USED	
8	J	→ READ DATA CHANNEL 2	RD2
9	K	→ READ DATA CHANNEL 3	RD3
10	L	→ NOT USED	
11	M	→ NOT USED	
12	N	→ GAP DETECT	
13	P	→ NOT USED	
14	R	→ READ DATA CHANNEL 4	RD4
15	S	→ READ DATA CHANNEL 5	RD5
16	T	→ NOT USED	
17	U	→ READ DATA CHANNEL 6	RD6
18	V	→ READ DATA CHANNEL 7	RD7

Table 4-1B. Models 9700; 9800 Interfaces



← INPUT
→ OUTPUT

WRITE CONNECTOR J2

ACTIVE	GROUND	SIGNAL	MNEMONIC
A	1	← WRITE DATA STROBE	WDS
B	2	← N.C.	
C	3	← WRITE AMPLIFIER RESET	WARS
D	4	← NOT USED	
E	5	← NOT USED	
F	6	← NOT USED	
H	7	← NOT USED	
J	8	← NOT USED	
K	9	← NOT USED	
L	10	← WRITE DATA CHANNEL P	WDP
M	11	← WRITE DATA CHANNEL 0	WDO
N	12	← WRITE DATA CHANNEL 1	WD1
P	13	← WRITE DATA CHANNEL 2	WD2
R	14	← WRITE DATA CHANNEL 3	WD3
S	15	← WRITE DATA CHANNEL 4	WD4
T	16	← WRITE DATA CHANNEL 5	WD5
U	17	← WRITE DATA CHANNEL 6	WD6
V	18	← WRITE DATA CHANNEL 7	WD7

CONTROL CONNECTOR J1

ACTIVE	GROUND	SIGNAL	MNEMONIC
A	1	← LOAD ON LINE (OPTIONAL)	LOL
B	2	← OVERWRITE	OVW
C	3	← SYNCHRONOUS FORWARD	SFC
D	4	← HIGH DENSITY SELECT	HDS
E	5	← SYNCHRONOUS REVERSE	SRC
F	6	← HIGH DENSITY INDICATOR	HDI
H	7	← REWIND COMMAND	RWC
J	8	← SELECT	SLT
K	9	← SET WRITE STATUS	SWS
L	10	← OFF LINE COMMAND	OFFC
M	11	← ON LINE	ONL
N	12	← REWINDING	RWD
P	13	← FILE PROTECT	FPT
R	14	← LOAD POINT	LP
S	15	← WRITE ENABLE	WEN
T	16	← TRANSPORT READY	RDY
U	17	← END OF TAPE	EOT
V	18	← TAPE RUNNING	TRNG

READ CONNECTOR J3

ACTIVE	GROUND	SIGNAL	MNEMONIC
1	A	→ READ DATA CHANNEL P	RDP
2	B	→ READ DATA STROBE	RDS
3	C	→ READ DATA CHANNEL 0	R00
4	D	→ READ DATA CHANNEL 1	RD1
5	E	→ NOT USED	
6	F	→ AUTO DISABLE	
7	H	→ NOT USED	
8	J	→ READ DATA CHANNEL 2	RD2
9	K	→ READ DATA CHANNEL 3	RD3
10	L	→ NOT USED	
11	M	→ NOT USED	
12	N	→ GAP DETECT	
13	P	→ NOT USED	
14	R	→ READ DATA CHANNEL 4	RD4
15	S	→ READ DATA CHANNEL 5	RD5
16	T	→ NOT USED	
17	U	→ READ DATA CHANNEL 6	RD6
18	V	→ READ DATA CHANNEL 7	RD7

STATION SELECT CONNECTOR J4

ACTIVE	GROUND	SIGNAL	MNEMONIC
A,C	B	← SELECTS STATION 1	SLT1
D,F	E	← SELECTS STATION 2	SLT2
H,K	J	← SELECTS STATION 3	SLT3
P,R	M	← SELECTS STATION 4	SLT4

Table 4-1C. Models 9100; 9300 Interfaces

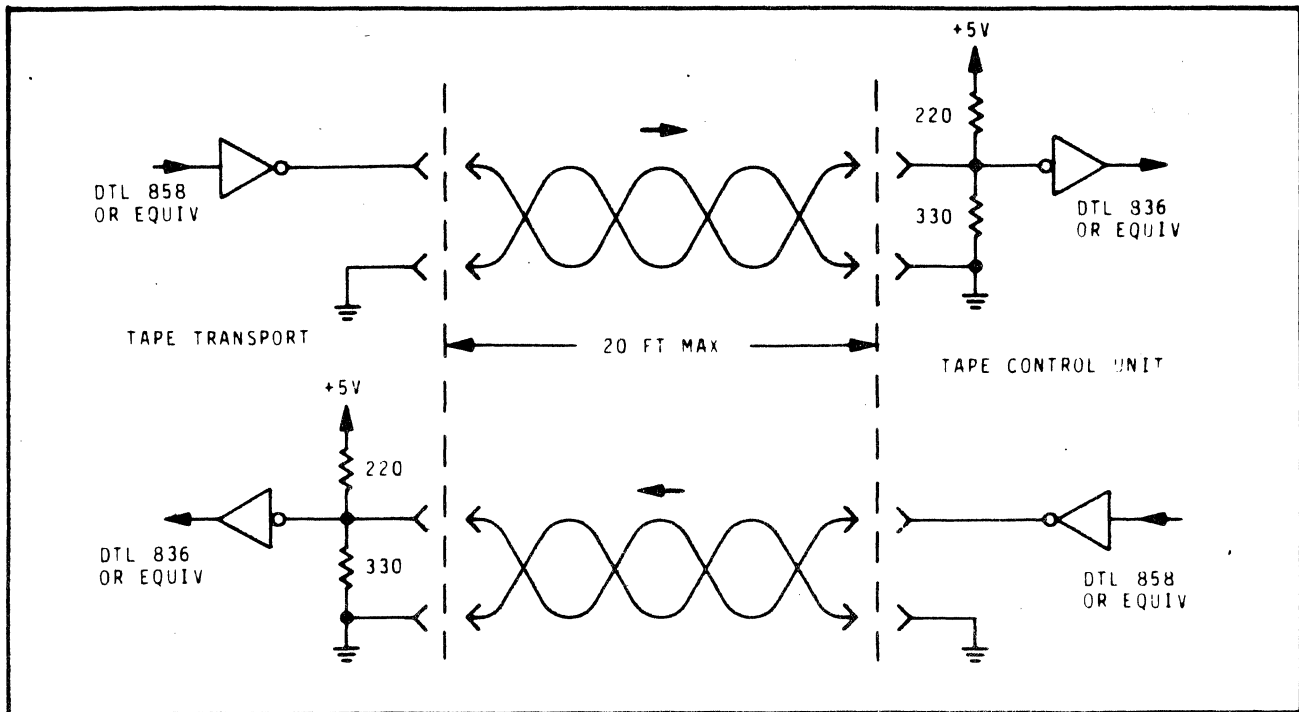


Figure 4-2. Typical Interface Configuration

Signal Name	Mnemonic	Description
Transport Select	SLT	A level that when true enables all the interface drivers and receivers in the transport, thus connecting the transport to the controller. Transport must also be on line, and SLT must be true for entire sequence (until tape motion stops). The SLT level may be removed to disconnect the machine from the system. The read or write status will remain in the last established condition.
Data Density Select (Dual Density only)	DDS	Used when the TRANSPORT DENSITY SELECT switch is in the remote position. When true, this level selects the high read density (dual density).
Overwrite (Optional)	OVW	A level that when true conditions appropriate circuitry in the transport to allow updating (rewriting) of a selected record. The transport must be in the write mode of operation to utilize the OVW feature.
Synchronous Forward Command	SFC	A level that when true, and the transport is ready and on line, causes tape to move forward at the specified speed. When the level goes false, tape motion ramps down and ceases.
Synchronous Reverse Command	SRC	A level that when true, and the transport is ready and on line, causes tape to move in a reverse direction at the specified speed. When the level goes false, tape motion ramps down and ceases. If the load point marker is detected during a SRC, the SRC will be terminated. If a SRC is given when the tape is at load point, it will be ignored.

Table 4-2A. Control Command Input Signals

Signal Name	Mnemonic	Description
Rewind Command	RWC	A pulse input will rewind the tape past the load point and stop. The transport will then initiate a load forward sequence and return the tape to the load point marker. This input will be accepted only if the load point output is false. The transport may be taken off line while rewind is still in process. Rewind will continue normally.
Load On Line (Auto Power Restart Option)	LOL	A special optional input that is provided with the APR option. If power has failed and has returned to normal, a minimum pulse of 250 ms, maximum of 1 sec, applied to this line will load the servo system, advance tape in the forward direction several inches, and place the tape deck ONL.
Set Write Status	SWS	A level that must be true at the leading edge of a SFC (or RUN and FWD) when the write mode of operation is required, and must remain true for a minimum of 10 usec after the leading edge of the SFC (or RUN and FWD). SWS is sampled at the leading edge of the SFC (or RUN and FWD), toggling the read/write flip-flop to the appropriate state. Internal interlocks in the tape unit will prevent writing in the reverse direction, if the write enable ring is missing, if the tape unit is off line, when loading to load point, and during a rewind.
Write Data Lines	WDP,WD0-WD7 (9 Track) WDC,WDB,WDA, WD8,WD4,WD2,WD1 (7 Track)	Nine lines for nine track operation, seven lines for seven track operation. These are levels that if true at WDS time will result in a flux transition being recorded on tape (transport is in the write mode). Inputs must remain quiescent 0.1 usec beyond the trailing edge of the WDS pulse. The CRCC is written by providing the correct data character together with a WDS four character times after the last data character of the record. The LRCC is written using the WARS signal. The LRCC can also be written by providing the correct data character together with a WDS. If the LRCC is written (DATA-WDS) in this manner a WARS should be given one character time after the LRCC to insure proper IRG erasure in case of data input error.
Write Data Strobe	WDS	A pulse of 1 usec nominal width for each character to be written. Writing occurs on the trailing edge of the WDS. WDS may be a 1 usec minimum, 1.5 usec maximum pulse. Data inputs must have settled for at least 0.1 usec before the leading edge of WDS and remain quiescent for at least 0.1 usec beyond the trailing edge.
Write Amplifier Reset	WARS	A pulse of 1 usec nominal width that, when true, resets the write amplifier circuits on the leading edge which is delayed internally by the write deskewing network. The purpose of this line is to enable writing of the longitudinal redundancy check character (LRCC) at the end of a record. This insures that all tracks are properly erased in an interrecord gap (IRG).

Table 4-2B. Control Command Input Signals

		In a seven track system, the leading edge of the WARS pulse should be four character times after the leading edge of the WDS associated with the last data character in the block. In a nine track system, the leading edge of the WARS pulse should be eight character times after the leading edge of the WDS associated with the last data character in the block (four character times after the CRCC is written).
Read Commands		The tape unit will always have read selected. When write is selected (SWS) the data just written will be read back using a high threshold level on the read amplifiers. When SWS is false the normal threshold is applied to the read amplifiers.
Automatic Clipping Level Disable	ACLD	When true this level overrides the automatic clipping level electronics and holds the read electronics in the normal clipping level. The switching between read and write clipping levels is not affected.
Off Line Command	OFFC	A level or pulse (minimum width 1 usec) that resets the on line flip-flop to the zero state, placing the transport under manual control. It is gated only by SELECT in the transport logic, allowing an OFFC to be given while a rewind is in progress. An OFFC should be separated from a rewind command by at least 2 usec.

Table 4-2C. Control Command Input Signals

Signal Name	Mnemonic	Description
On Line	ONL	A level that is true when the on line flip-flop is set. When true, the transport is under remote control. When false, the transport is under local control.
Transport Ready	RDY	A level that is true when the tape transport is on tape; that is, when the initial load sequence is complete and the transport is not rewinding. When true, the transport is ready to receive a remote command.
High Density Indicator (Dual Density only)	HDI	A level that is true only when the high density mode of operation is selected.
File Protect	FPT	A level that is true when a reel of tape without a write enable ring is mounted on the transport supply (or file) hub.
Write Enable	WEN	A level that is true when a reel of tape with a write enable ring is mounted on the transport supply (or file) hub. Opposite of file protect.
Load Point	LDP	A level that is true when the load point marker is under the photosensor and the transport is not rewinding. After receipt of a SFC the signal will remain true until the load point marker leaves the photosense area.
Tape Running	RNG	This is a level that is true when tape is being moved under capstan control and remains true until tape motion has ceased (includes forward, reverse and rewind tape motion).

Table 4-3A. Control Command Output Signals

Signal Name	Mnemonic	Description
End of Tape	EOT	A level that is true when the EOT marker is detected in the forward direction. Goes false when the EOT marker is detected in reverse (SRC or REWIND).
Rewinding	RWD	A level that is true when the transport is engaged in a rewind operation or returning to the load point at the end of the rewind operation.
Read Data Strobe (NRZI only)	RDS	A pulse for each data character read from tape in NRZI. The average time (τ_1) between two read data strobes is $\tau_1 \text{ (sec)} = \frac{1}{s \cdot d}$ Read clock pulse width (t_w) is $t_w = \frac{1}{s \cdot d \cdot 32} = \frac{\tau_1}{32}$ where s = tape speed in inches per second d = density characters per inch The minimum time between consecutive read data strobes is less than this figure owing to skew and bit crowding effects. A guaranteed safe value for the minimum time is $\frac{1}{2} \tau_1$.
Read Gap Detect (NRZI only)	RGAP	A level that is true approximately 20 character spacings after the last data byte (16 character spacings on seven channel), and remains true until the first data byte of the subsequent data block. Note: This level will be true whenever tape motion is at rest.
Read Data Level (NRZI only)	RDP, RD0-RD7 (9 track) RDC, RDB, RDA, RD8, RD4, RD2, RD1 (7 track)	Nine lines, nine track; seven lines, seven track. These lines may be strobed by either edge of the read clock and remain true for 1/64 of a character time following the trailing edge of the read clock. Note: A CRC character may be all zeros, which will not cause a read clock. (Refer to Figures 4-3 and 4-4 for PE and NRZI Read waveforms.)
NRZI		The individual bits of each data character are assembled into parallel form in a one stage deskewing register. The register outputs drive the read data interface lines. A true level signifies a data 1. The complete character will be available by sampling RDP, RD0-RD7 simultaneously on the trailing edge of the RDS.
PE		The transport PE data are the outputs of nine peak detectors individually gated with the outputs of the PE envelope detectors associated with each channel. These lines are held false when no signals are detected. The value of data bit is determined by the direction of the transition at the middle of the bit cell. A transition from false to true is a data 0; conversely, a transition from true to false is a data 1.

Table 4-3B. Control Command Output Signals

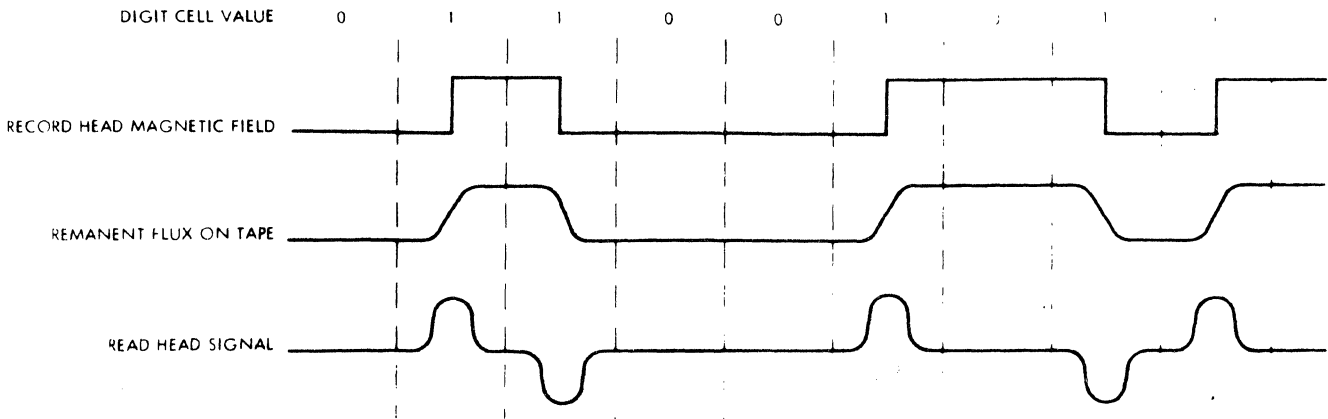


Figure 4-3. NRZI Write and Read Waveforms

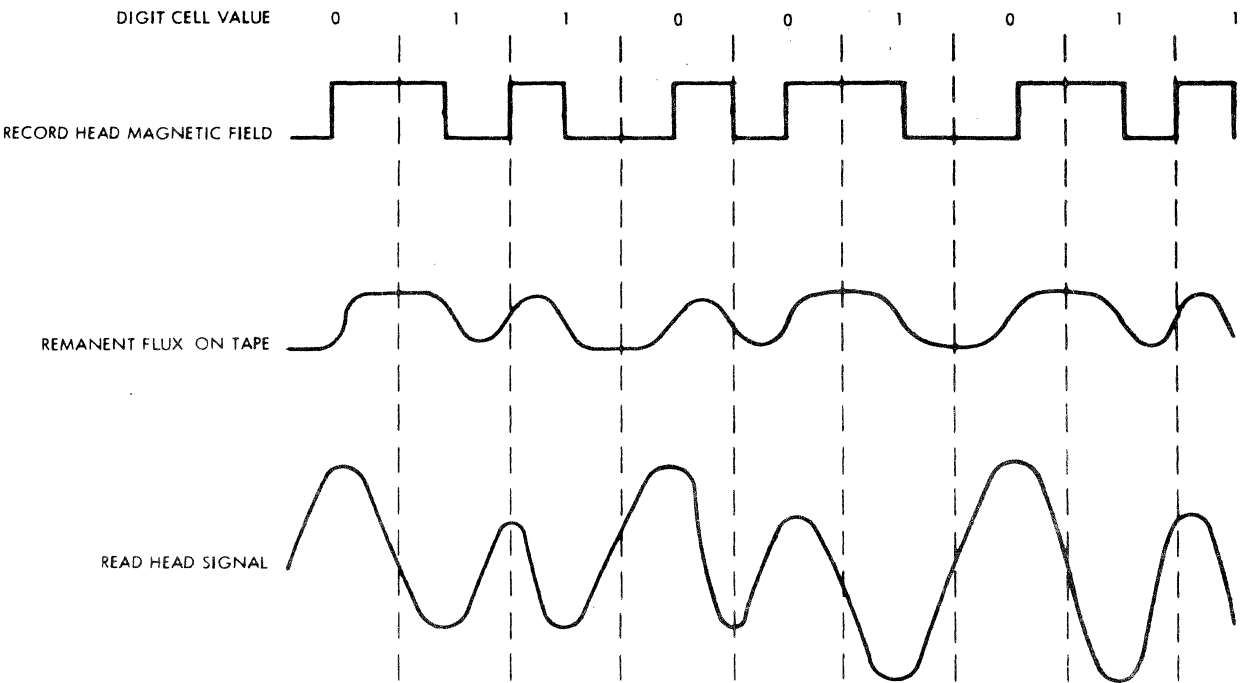


Figure 4-4. PE Write and Read Waveforms

SECTION V

MODES OF OPERATION

This section provides details on utilization of the commands described in Section IV for reading and writing data. Included are Motion Control PE writing and reading, and NRZI writing and reading. This section restricts itself to basic modes of operation. For detailed description of electronics refer to operation and maintenance manual for the appropriate series 9X00 transport.

5.1 TAPE MOTION COMMANDS

For maximum interface convenience, series 9X00 is configured to control tape motion and direction using the SYNCHRONOUS FORWARD command and SYNCHRONOUS REVERSE command. The tape transport capstan servo accelerates the tape to the required speed with a linear ramp up. The tape is also decelerated to a stop with a linear ramp down. Start and stop occurs within the interrecord gaps. The ramp time is 3 ms for 125 ips and varies inversely with tape speed. The amount of tape travel during the ramp up or ramp down is always 0.19 inch.

Ramp times must always be considered when writing and gapping. A delay is required before writing to insure that tape is up to speed and to permit error checking by reading tape. Timing diagrams for pertinent commands to provide properly formatted tapes are shown in Figures 5-1 through 5-3.

Figure 5-1 shows the timing requirements for writing a block in a read after write system in the write mode with read occurring immediately after writing. Figure 5-2 shows the timing requirements for reading a block in the forward direction. Figure 5-3 shows the timing requirements for reading a block on a read after write system in the reverse direction.

5.2 PHASE ENCODED WRITE OPERATION

A write operation is one in which tape motion takes place with current flowing in the transport's write head. Writing occurs for commands such as WRITE RECORD, WRITE FILE MARK or ERASE. Writing occurs for the "Write ID Burst" function and is normally performed automatically when writing from the BOT marker.

An interface line, SET WRITE STATUS (SWS), under the control of the customer, specifies whether a read or a write command is required. Shortly after a SYNCHRONOUS FORWARD command (SFC) is given at the beginning of each data transfer, the condition of SWS is sampled. This condition is stored in a control flip-flop (WSEL/) in the transport logic. If a write status command is issued, WSEL/ is set low true to turn on the write current in the heads. During read operations WSEL/ is set high false, turning off

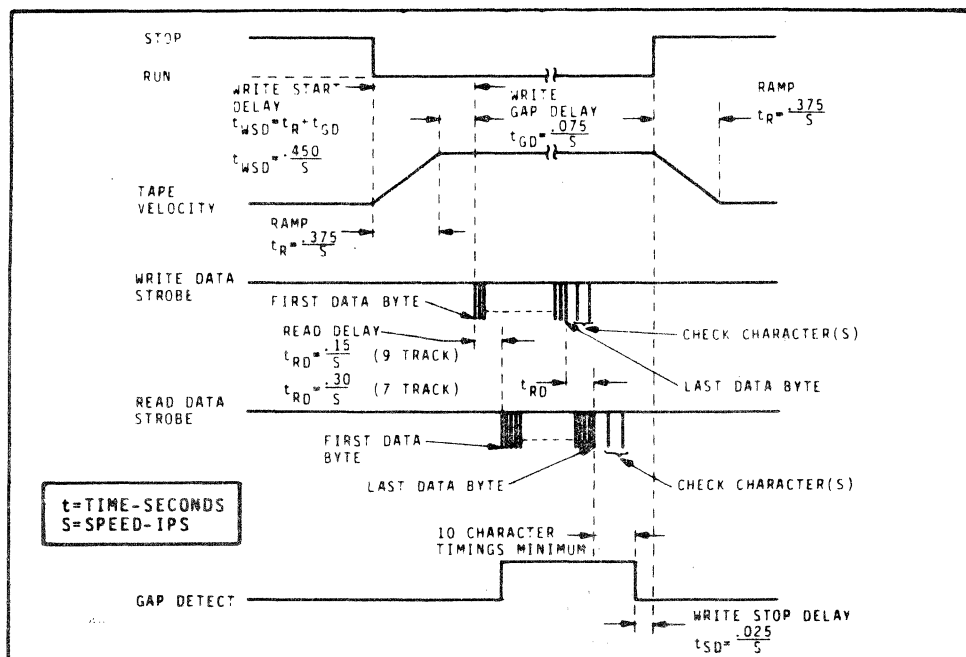


Figure 5-1. Write Start and Stop Delays, Read after Write Transport

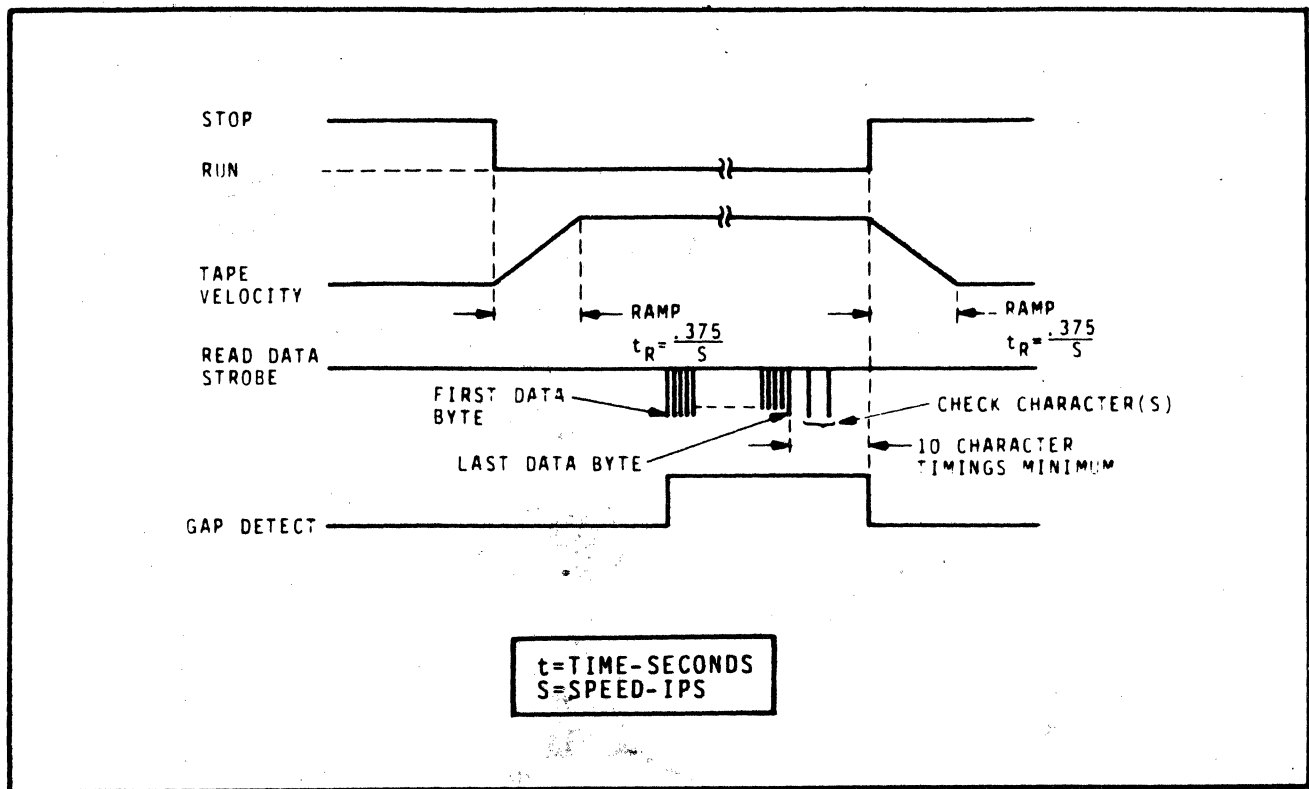


Figure 5-2. Read Forward Operation, Read after Write Transport

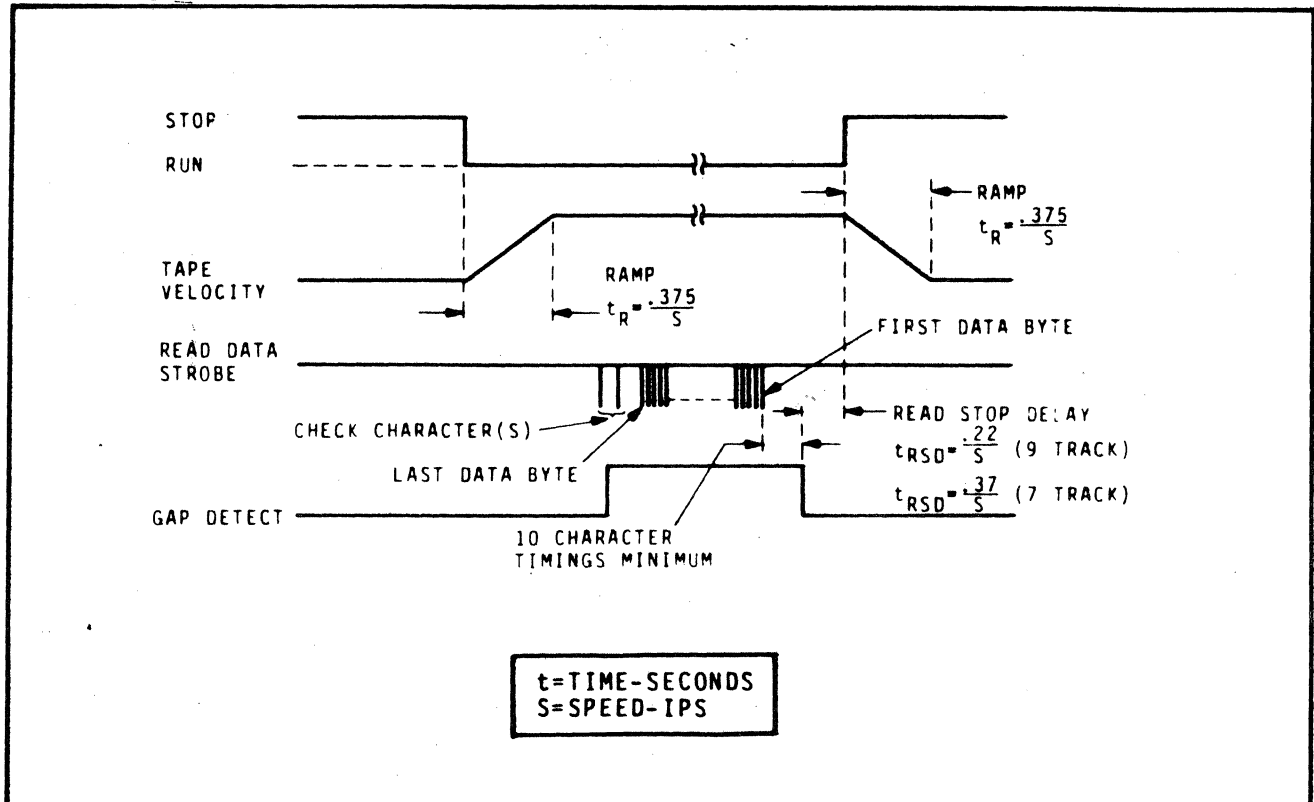


Figure 5-3. Read Reverse Operation, Read after Write Transport

the write current. (Note that a read operation is always occurring when SWS/ is set false.)

The state of WSEL/ retains the existing read/write status unless it is changed at the beginning of the next command, or is forcibly reset to the false state by one of the following:

- A REWIND command (RWD) (SYNCHRONOUS REVERSE COMMAND).
- Switching to the off line mode either by an OFFLINE command (OFFC) or by depressing the illuminated ONLINE control.
- Loss of interlock.

A simplified design showing a means of generating phase encoded data is illustrated in Figure 5-4. The clock circuitry illustrated is common to all channels. Additional circuits are required to generate the ID burst, preambles and postambles, and file marks. An easy method of generating a file mark is to hold the logic of channels 1, 3 and 4 reset and generate the 40 zero bits of the preamble. The PE data illustrated in Figure 5-4 is as it should appear on the controller interface.

5.2.1 WRITE FIRST RECORD FROM BOT

The following is the sequence of events which will occur when writing a tape in the PE format. Typical waveforms are shown in Figure 5-5.

- Load and bring tape to BOT. Tape should be positioned at BOT through either a manual Load, Synchronous Forward command or a Rewind command. Positioning tape through a Reverse command may cause improper positioning of the ID burst.
- Set SWS true.
- Set SFC true, starting tape motion. The transport logic will sample SWS and set the WSEL/ flip-flop, thus turning on the write current.
- Generate a prerecord delay for Write First Record from BOT as specified in Table 5-1A, item 1.
- Generate Write Data Strobe (WDS) pulses together with the ID burst data on channel WDP. Channels WD0-WD7 are held false for the duration of the ID burst. (The ID burst is placed according to Table 5-1B. An ID burst is 1600 bpi or 3200 frpi (since there are 2 flux reversals per bit in PE mode) which is composed of alternate ones and zeros. WDS frequency is $2 \times 1600 \times \text{tape speed} \pm 0.25$ percent.)
- Generate an ID burst in accordance with Table 5-1B (according to speed). (To maintain compatibility with IBM and ANSI the correct ID burst should always be written onto tape even though the user does not intend to make use of it.)

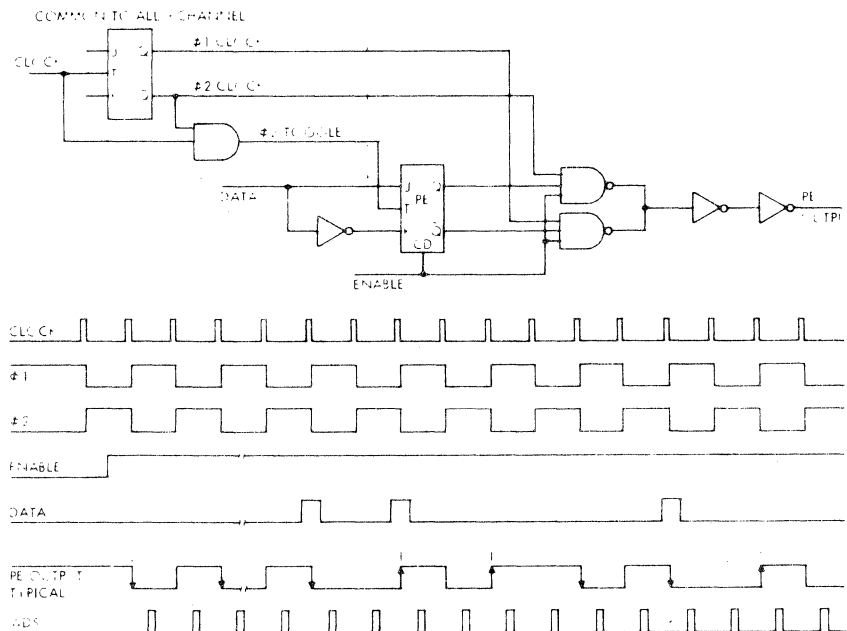


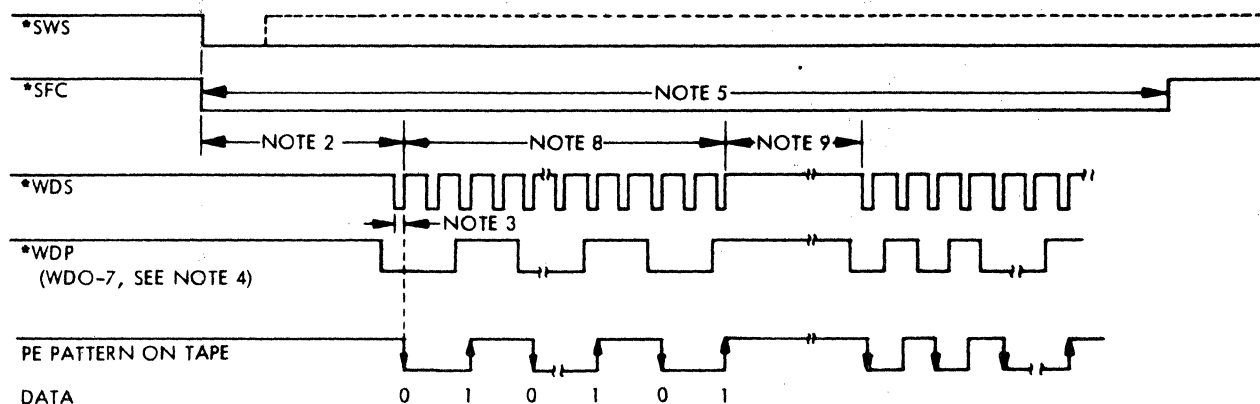
Figure 5-4. Phase Encoder Block Diagram

7. After the ID burst has been written and the Write First Record from BOT prerecord delay is complete, the first record is written.
8. Generate preamble. The preamble is written by generating WDS pulses together with the appropriate inputs on WDP, WD0-WD7. The frequency for WDS should be $2 \times 1600 \times$ rated speed ± 0.25 percent.
9. Write odd parity data immediately following the preamble by generating WDS pulses together with the appropriate data on WDP, WD0-WD7 for each data character to be written on tape.
10. Generate postamble. The postamble is written by generating WDS pulses together with the appropriate inputs on WDP, WD0-WD7.
11. Generate a postrecord delay for Write Normal in accordance with Table 5-1A, item 2. This delay begins when the last zero byte of the postamble is written on dual-stack head systems, the postrecord delay begins when the last zero byte of the postamble has passed the read head. This delay ensures that tape comes to rest further into the IRG than it would after a read operation. This prevents the possibility of unerased gap areas occurring in a Write, Read Reverse, Read Forward, Write sequence of commands.
12. Set SFC false after the appropriate postrecord delay. Tape decelerates and comes to rest in the time specified in Table 5-1A, item 8.
13. WSEL/ remains set and will continuously erase tape until any subsequent SWS/ false command, REWIND, or OFFLINE command is given (or the transport interlock is broken).

5.2.2 WRITE FORWARD COMMAND

The following is the sequence of events which will take place when writing a record in the PE format utilizing series 9X00 tape transport with one of the standard tape speeds. Typical waveforms are shown in Figure 5-6.

1. Wait for tape motion to cease, set SWS true.
2. Set SFC true starting tape motion. The WSEL/ flip-flop will set true shortly after SFC is set true.
3. Generate a prerecord delay for Write Normal in accordance with Table 5-1A, item 2.
4. Follow the sequence of events as specified in paragraph 5.2.1 for Write First Record From BOT, beginning at step 8.



NOTES:

1. CUSTOMER GENERATES THE WAVEFORM MARKED*
2. PRE-RECORD DELAY FOR WRITE ID BURST FROM BOT SHOULD BE IN ACCORDANCE WITH TABLE 4-1A, ITEM 1.
3. WDS HAS A MINIMUM PULSE WIDTH OF 1 μ SEC. WDP MUST BE HELD STEADY DURING, AND FOR, 0.5 μ SEC EITHER SIDE OF WDS.
4. WDO-7 ARE HELD RESET FOR WRITE ID BURST ONLY.
5. SFC MUST BE HELD TRUE FOR DURATION OF DELAYS AS SPECIFIED IN TABLE 4-1.
6. THE SWS LINE IS HELD TRUE FOR WRITE COMMANDS ONLY. THIS WAVEFORM IS SAMPLED BY SFC (OR SRC) AND MUST BE HELD TRUE FOR 20 μ SEC AFTER THE LEADING EDGE.
7. INTERFACE WAVEFORMS ARE SHOWN LOW-TRUE, AS THEY APPEAR ON THE INTERFACE.

Figure 5-5. Write First PE Record from Load Point

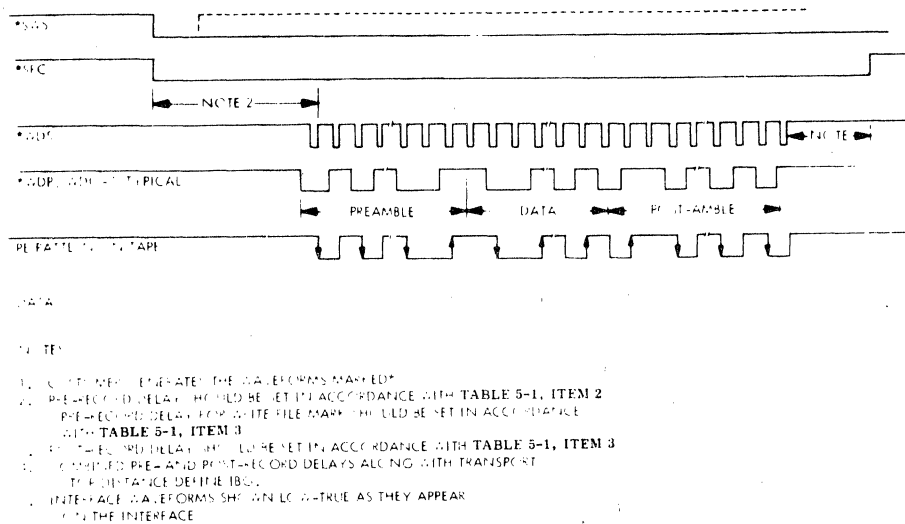


Figure 5-6. PE Write Forward, Typical Waveforms

5.2.3 OVERWRITE (EDIT)

The overwrite (EDIT) function is normally employed when it is desired to change a record located in the midst of other records. To successfully overwrite a given record, the tape must first be positioned at the same place from which the original record was written. After writing the new record, the write current must be turned off while tape is in motion. This is done to eliminate the inherent noise transient associated with a collapsing magnetic field. The provision for current turn-off while the transport is in motion is provided by the overwrite (OVW) interface line.

The following procedure should be used when overwriting a record at one of the standard tape speeds. This procedure applies only to those transports which have the Overwrite interface line.

1. Locate the record to be changed.
2. Wait for tape motion to cease, then set SWS false.
3. To read the record in reverse, set SRC true; tape motion will begin and the transport will be in the Read mode.
4. Generate a postrecord delay for Read Reverse (EDIT) as specified in Table 5-1A, item 7. This delay ensures that the tape comes to rest nominally at the same place from which the original record was written.
5. Wait for tape motion to cease, then set SWS true.

6. Set overwrite (OVW) true.

7. Set SFC true, starting tape motion. The transport will be in the Write mode.
8. Generate a prerecord delay for Write Normal as specified in Figure 5-1A, item 2, according to speed.
9. Generate preamble. Preamble is written by generating WDS pulses together with the appropriate inputs on WDP, WD0-WD7. (The frequency for WDS should be $2 \times 1600 \times$ rated speed ± 0.25 percent.)
10. Write data immediately following the preamble by generating WDS pulses together with the appropriate data on WDP, WD0-WD7 for each data character to be written on tape. (The new record length must be the same length as the original record in order to maintain the integrity of the IRG.)
11. Generate postamble. Postamble is written by generating WDS pulses together with the appropriate inputs on WDP, WD0-WD7. Write Amplifier Reset (WARS) must be set true at the completion of the last zero byte of the postamble. This ensures that the write current and erase current will be turned off at the appropriate time.
12. Generate a postrecord delay for Write Normal in accordance with Table 5-1A, item 2. This delay begins when the last zero byte of the postamble has passed the read head. With the overwrite line

Table 5-1
Pre-Record and Post-Record Delays at 25 ips*

Function	Pre-Record Delays (milliseconds)		Post-Record Delays (milliseconds)	
	9-Track	7-Track	9-Track	7-Track
1. Write From BOT	226	226	3	3
2. Write Normal				
Single Stack	23	28	3	3
Dual Stack	17	22	3	3
3. Write File Mark	150	150	3	3
4. Read From BOT	60	60	0	0
5. Read Forward (Normal)	12	12	0	0
6. Read Reverse (Normal)	12	12	3	8
7. Read Reverse (Edit)	12	12	8	13
8. Start/Stop Time	15	15	15	15

*To calculate delays for other tape speeds, scale inversely to tape speed as follows:

$$\text{New Delay} = \frac{25}{\text{New Speed}} \times 25 \text{ ips Delay}$$

e.g.; Write From BOT at 75 ips = $\frac{25}{75} \times 226 = 75.5$

Table 5-1A

**Time Delays, Read and Write First Record From
BOT at 25 ips (Phase Encoded Format)**

Function	Delay Before Writing ID	ID Duration	Remainder of Delay
1. Write First Record From BOT	15	100	135
	Delay Before ID Sample		ID Sample
2. Read First Record From BOT	54	3	

Table 5-1. Delay Times

true, the write current in transports will be turned off, when the WARS signal is given.

13. Set SFC false after the appropriate postrecord delay. Tape decelerates and comes to rest in the time specified in Table 5-1A, item 8.
14. Subsequent operations can now be performed as desired.

5.2.4 WRITE FILE MARK COMMAND

The following is the sequence of events that will take place when writing a file mark onto tape in the PE format.

1. Wait for tape motion to cease, then set SWS true.
2. Set SFC true, starting tape motion. The WSEL/flip-flop will set true shortly after SFC is set true.
3. Generate a prerecord delay for Write File Mark in accordance with Table 5-1A, item 3.
4. Generate a file mark. The file mark for PE format is 32 to 128 zero bits at 3200 frpi in channels P, 0, 2, 5, 6 and 7 with channels 1, 3 and 4 dc-erased. A channel may be dc-erased by holding the input line to that channel continuously false. (Writing the 40 zero bytes of the preamble with channels 1, 3 and 4 reset will satisfy this requirement.)
5. Generate a postrecord delay for Write File Mark in accordance with Table 5-1A, item 3. This delay ensures that the tape comes to rest further into the IRG than it would after a read operation.
6. Set SFC false. Tape will decelerate and come to rest in the time specified in Table 5-1A, item 8.
7. WSEL/ remains set and will continuously erase tape until some subsequent READ, REWIND or OFFLINE command is given (or the transport interlock is broken).

5.2.5 VERTICAL PARITY GENERATION

The vertical parity bit (VRC) recorded in channel P is generated so that the total number of one bits in each data character is always odd (excluding Preamble, Postamble and File Mark).

5.2.6 ERASING

Erasing is only required when it is necessary to abandon a specific area of tape after repeated write errors. This can be accomplished by using any one of the following methods.

1. Backspace over the erroneous record, issue a command to move tape a file mark distance with write lines reset.
2. Erased gaps of any length can be generated by executing a dummy write command with the WDS/line suppressed.

5.3 PHASE ENCODED READ OPERATION

The transport must be on line and ready before a read operation can take place. When only read operation is desired, removal of the write enable ring ensures that tape is not inadvertently erased.

5.3.1 READ DATA

The output of the transport read head is amplified and peak detected. The output of the nine peak detectors is individually gated with the output of a threshold detector associated with each channel. The output signals on the transport interface lines are replicas of the PE waveform used to drive the write amplifier.

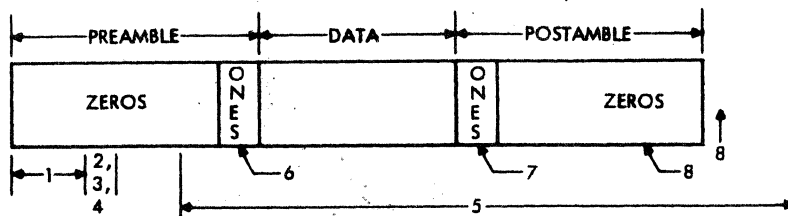
The data output of the transport must be decoded and buffered before it can be used. The preamble and postamble must be removed and, through use of dropout detectors, track-in-error information can be provided and used for single track on-the-fly error correction.

The zeros of the preamble are employed to establish the direction of the zero signal transitions and provide electronic synchronization for data decoding. At the interface, a negative-going transition at the center of a PE bit cell is defined as a zero. The controller is synchronized and timed with this pattern.

The beginning of the PE data block is defined by a byte of all ones at the end of the preamble. A one is defined as a positive signal transition at the center of a PE bit cell. (The signal transitions at a bit cell boundary are required to establish proper polarity.)

The controller should be configured to lock onto the zeros of the preamble and should also determine the end of the preamble by decoding the all-ones byte. Each channel must be decoded independently due to the associated skew; therefore, the "eggerate" buffer is used to assemble the data into parallel form. The data block is decoded utilizing the principles outlined above.

The postamble detection is accomplished when an all-ones byte followed by one or more bytes of all zeros is detected. The postamble must be removed from the data block; therefore, the technique of postamble detection employed must allow for detection of the postamble prior to the transfer of the last data byte.



1. TRACKING OSCILLATOR ACQUIRES SYNC.
2. LOCK-ON
3. FALSE PREAMBLE TEST
4. FM TEST
5. DROPOUT DETECTION
6. END OF PREAMBLE
7. POSTAMBLE
8. FALSE POSTAMBLE DETECTION

Figure 5-7. Decoding Sequence

Although the individual bits of each data character are recorded with a total skew of less than 625 microinches, they are read back from tape over a finite period of time, hence additional skew. The total skew introduced for both write and read is less than 1.8 characters on Kennedy transports. This skewing effect is caused by phenomena which occur on all transports due to tape edge irregularities, mechanical tolerances of the tape path and the effect of bit crowding.

In the Kennedy transports, the total skew introduced is less than the allowable skew with respect to IBM and ANSI specifications for PE tapes. In order to provide for system compatibility, it is recommended that the customer utilize at least a three-stage egerate deskewing register for assembling and outputting the data.

Tracking oscillator(s) are provided to compensate the data rate due to variations in tape speed. The tracking oscillator should be able to handle at least ± 10 percent variation in data rates measured over 35 cell periods. A single tracking oscillator can be used to provide all timing required provided the oscillator frequency is high enough and each channel is timed independently. It is important that the center track 2 should be used for a reference point. If the track being used for reference is lost, the track input to the oscillator can be switched to track 0 or 3. This method provides for single track error correction in that, once a track is lost, the time relationship for that channel cannot be reacquired. Error correction is accomplished through utilization of parity information.

One commonly seen decoding technique uses the tracking oscillator in conjunction with a counter to establish a three-quarter bit cell time. This three-quarter cell time then is used to distinguish each bit

cell from the next. Since there is a signal transition at the center of each bit cell, regardless of whether it is a one or a zero, this center transition is used to trigger the three-quarter cell time and block out the phase transition. A negative signal transition at the center of the cell defines a zero and positive signal transition at the center of the cell defines a one. (Refer to ANSI Standard X3.B.1 for proper tolerances.)

Alternatively, nine individual tracking (phase lock) oscillators can be used, one for each track. This method can be used to reacquire tracks which have experienced dropouts, provided the dropout does not exceed the time constant of the oscillator. The choice of methods is a tradeoff between increased cost for additional circuitry against expected data reliability. Statistics have shown that single-track dropout durations are in excess of 10-12 bit periods and therefore the incorporation of tracking oscillators in each data channel does not provide any significant benefits. (This method is very expensive to implement and is not recommended.)

5.3.2 DATA DECODING

In reading PE data, certain functions must be performed in order to assure proper decoding. The sequence of events which should be performed are as follows. Figure 5-7 illustrates the sequence of events.

1. Tracking oscillator begins tracking. When no data are present, the tracking oscillator will be operating at its center frequency. When the preamble arrives, the tracking oscillator should achieve data rate synchronization within the first half of the preamble. It should be noted that the first four (approximately) bits of the preamble

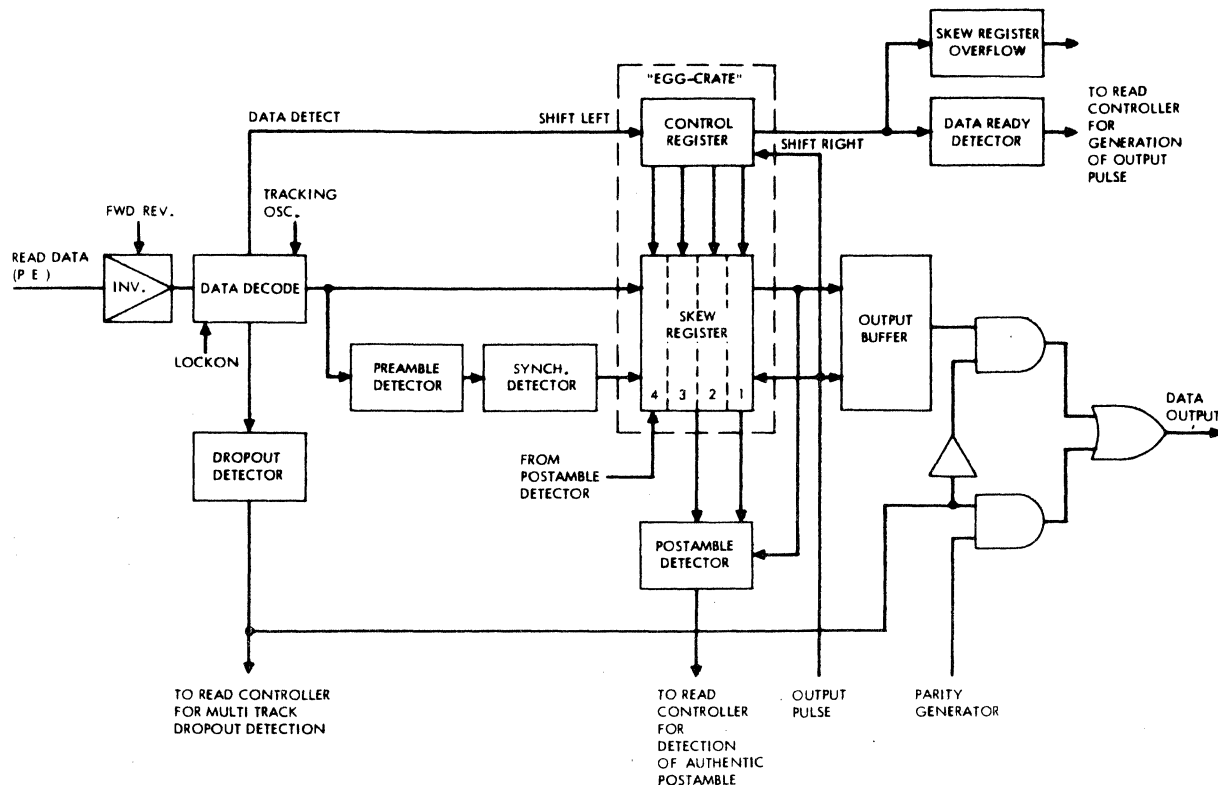


Figure 5-8. Read Recovery Block Diagram (One Channel Shown)

- will be lost in the transport due to the time constant of the transport threshold detector.
2. Lock-on. When the tracking oscillator is synchronized with the data rate, the next function is to lock on to the all-zeros signal transitions. This can be achieved by disabling the ones detector. Lock-on should be achieved after synchronization, approximately halfway through the preamble.
 3. False preamble test. After lock-on, a test should be performed to check for the presence of any ones in the preamble. If there are ones present at the middle of the preamble, some error condition has occurred and no attempt to read the record should be made. A search should then be made for the IRG.
 4. File mark test. After a test for a false preamble is made, a test should be performed to determine whether or not the controller has locked on to a file mark. Each record should be considered a file mark until proven otherwise. A file mark will have no flux reversals in channels 1, 3 and 4. If a file mark is detected, this should be indicated and a search made for the next IRG.
 5. Dropout detection. Each channel containing data records should be monitored to determine if a transition had occurred at the center of each bit cell. If no transition occurs in a given channel, decoding of that channel should be abandoned. The transport incorporates a threshold detector which requires the absence of two data transitions before gating the data off. Once a single track drop-out occurs that channel is ignored for the balance of the record and an appropriate bit is inserted by determining the parity of the remaining 8 channels. Single track dropout correction is performed while outputting data from the eggcrate, thereby effectively eliminating the two cell periods lost by the delay in shutting down the threshold detector. For the decoding scheme using nine oscillators, the channel experiencing the dropout can be reacquired provided the duration of the dropout does not exceed the time constant of the phase locked oscillator.
 6. End of preamble. The "one" bit ending the preamble in each channel enables the eggcrate register to assemble the subsequent bits into parallel form.

7. **Postamble detection.** Once the preamble is detected, a continuous test for postamble should be made. The test is performed for an all-ones byte followed by one or more all-zeros bytes. When error correction is being performed on a channel, that channel should not be used for postamble detection.
8. **False postamble test.** Once the postamble has been detected, a test should be performed to ensure that no ones are being decoded and that all signals are lost after a minimum of 41 character periods. It is recommended not to test for the full 40 characters of the postamble, since most peak detectors used in PE transports allow extraneous pulses to be observed prior to the threshold detector turning off.

5.3.3 PHASE DECODING

Illustrated in Figure 5-8 is a simplified block diagram of a phase decoder which outlines the functions that must be performed when decoding PE data. Only one channel of read recovery logic is shown although a total of nine is required.

5.3.4 AUTOMATIC CLIPPING LEVELS

The purpose of the clipping levels is to eliminate spurious baseline noise pulses, requiring the analog signal supplied from the read preamplifier to exceed a certain amplitude before it is detected by the read amplifier stages. Different clipping levels are used during different modes of operation. The lowest

clipping threshold occurs during read only NRZI mode. This level is increased during read after write operations. During the gap the clipping levels are raised even higher to reduce the probability of detecting random noise. When an error is detected in a read only mode and the transport is commanded to backspace over the erroneous block and reread it, the clipping levels are switched automatically to maximize the recoverability of marginally recorded data. First the clipping levels are lowered to recover possible partial dropouts, and if the error is still detected the clipping levels are raised to eliminate possible high baseline noise spikes.

5.3.5 ID BURST DETECTION

When reading from BOT, a test can be made for an ID burst. This test should be for data in channel P and absence of data in the other channels at the time the BOT tab passes the read head. Refer to Table 5-1A and 5-1B for timing employed in this test. This test can be used to flag tape incompatibility the reason being that NRZI tapes do not have this ID burst. (On PE systems, the test for ID is not a critical function since reading a NRZI tape would give continuous parity errors and erroneous data.)

5.3.6 DATA DETECTION

The sequence of events for a read operation is as follows (typical waveforms are illustrated in Figure 5-9):

1. Set SFC true.

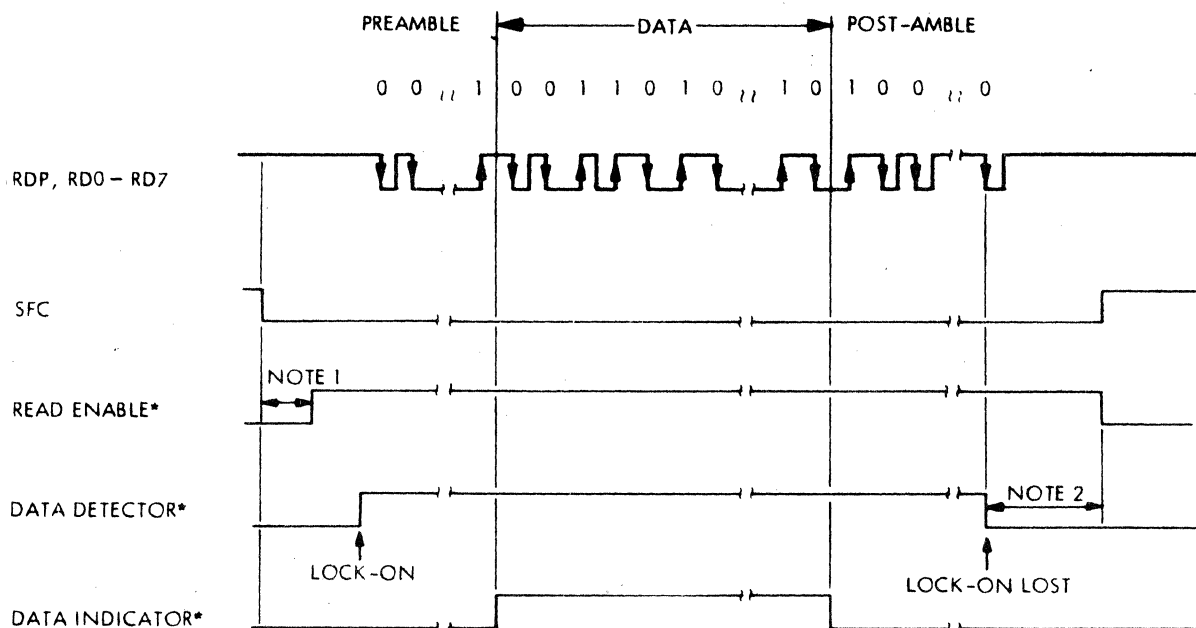


Figure 5-9. PE Read Forward Waveforms

2. Generate a prerecord delay according to Table 5-1A (item 5) which suppresses read data while the tape is accelerating and the IRG is being traversed.
3. The preamble arrives and the tracking oscillator should lock on to the signal transitions.
4. The end of preamble is detected when the first one bit of each channel arrives.
5. Each character should then be processed in one or more of the following ways.
 - a. Check for vertical parity error.
 - b. Check for bit dropout.
 - c. Correct the data on the track which has experienced dropout utilizing parity information.
 - d. Generate a read strobe for data.
 - e. Assemble data into words or send directly into memory.
 - f. Detect the postamble.
 - g. When the end of the record is detected (absence of data), set SFC false causing tape motion to stop.

5.3.7 FILE MARK DETECTION

The file mark detection according to IBM and the ANSI standard is accomplished by detecting the presence of data in channels 2, 6 and 7 or the presence of data in channels P, 0 and 5 with the absence of data in channels 1, 3 and 4.

5.3.8 READ REVERSE (An optional automatic feature)

The read reverse function can be implemented in a manner similar to read forward, except that the levels on the nine data lines from the transport must be inverted to properly decode ones and zeros.

A postrecord delay, in accordance with Table 5-1A, item 6, is required between the detection of the end of the preamble and the stopping of tape motion (setting SRC false). This will bring tape to rest in the optimum position in the IRG for subsequent read or write commands.

5.4 NRZI WRITE OPERATION

A write operation is one in which tape motion takes place with write current flowing in the read/write heads. Writing normally occurs in the forward

direction for commands such as Write Record, Write File Mark, or Erase.

An interface line, Set Write Status (SWS), under control of the customer, specifies whether a read or write command is required. Shortly after a forward or reverse command (SFC/ or SRC) is given at the beginning of each data transfer, the condition of SWS is sampled and stored in a control flip-flop (WSEL/) in the transport logic. If a write command is required, WSEL/ is set true and turns on write current in the heads. For read commands, WSEL/ is set false, turning off the write current.

WSEL/ retains the present read/write status until it is overwritten at the beginning of the next command, or is forcibly reset to the false state by one of the following.

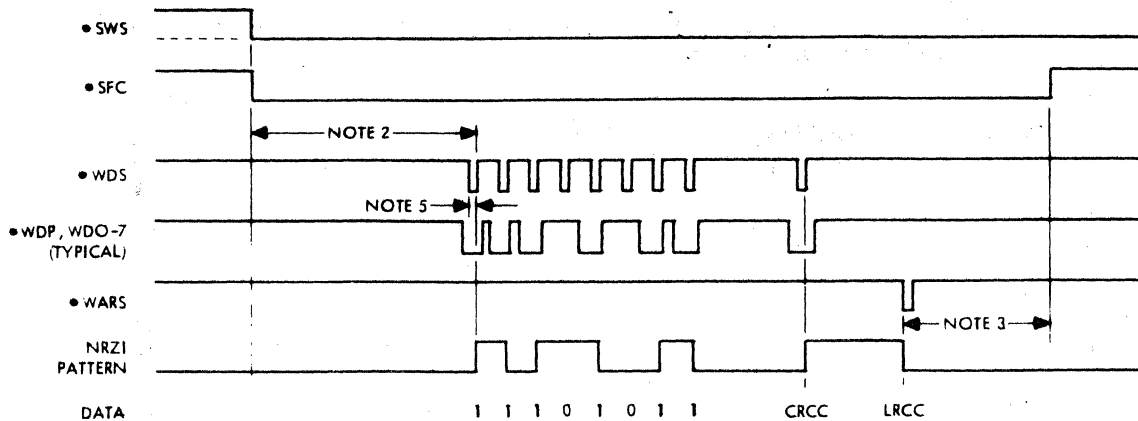
- a. Rewind command (RWC) or synchronous reverse command (SRC).
- b. Switching to the off line mode, either by an OFFLINE command (OFFC) or by pressing the illuminated ONLINE pushbutton.
- c. Loss of interlock.

A command that involves a change of read/write status should not be given until tape motion has ceased.

5.4.1 WRITE FORWARD

The following sequence of events will take place when writing a record in the NRZI format. Typical waveforms are illustrated in Figure 5-10.

1. Wait for tape motion to cease. Set SWS true.
2. Set SFC true, starting tape motion; the WSEL/ flip-flop will set true shortly afterward.
3. Generate a prerecord delay as specified in Table 5-1A according to speed.
4. Generate WDS pulses together with appropriate data on WDP, WD0-WD7 (9-track) or WDC, WD1-WD8 (7-track) for each data character to be written onto tape. This frequency is equal to density multiplied by speed. The tolerance is +/-0.25 percent. (For a Write File Mark command, a single character is written. For 9-track formats, a 1 bit is written in channels 3, 6 and 7; for 7-track formats, a 1 bit is written in channels 4, 5, 6 and 7.)
5. Nine-track only: Leave a three-character gap, then generate an extra WDS pulse together with CRCC data on WDP, WD0-WD7. (CRCC is suppressed for Write File Mark.)



NOTES

1. CUSTOMER GENERATES THE WAVEFORMS MARKED *.
2. PRE-RECORD DELAY SHOULD BE SET IN ACCORDANCE WITH TABLE 5-1
3. POST-RECORD DELAY SHOULD BE SET IN ACCORDANCE WITH TABLE 5-1
4. THE COMBINED PRE- AND POST-RECORD DELAYS DEFINE THE INTER-RECORD GAP.
5. WDS HAS A MINIMUM PULSE WIDTH OF 1 μSECOND. WRITE DATA LINES WDP, WDO-7 MUST BE STEADY DURING, AND FOR 0.5 μSECOND EITHER SIDE OF WDS.
6. THE SWS LINE IS SET TRUE FOR WRITE COMMANDS ONLY. THIS WAVEFORM IS SAMPLED BY THE TRANSPORT LOGIC AT THE BEGINNING OF EACH DATA TRANSFER, AND MUST BE HELD STEADY FOR AT LEAST 20 μSECONDS AFTER THE LEADING EDGE OF SFC (OR SRC).
7. INTERFACE WAVEFORMS ARE SHOWN LOW-TRUE, AS THEY APPEAR ON THE INTERFACE CABLE.

Figure 5-10. Write Operation Waveforms

6. Leave a three-character gap, then generate a pulse on WARS. The leading edge of this pulse resets the write register in the transport, thus writing the LRCC onto tape.
7. Generate a postrecord delay as specified in Table 5-1A according to speed. This delay ensures that tape comes to rest further into the IRG than it would after a read operation; this prevents the possibility of unerased gap areas in a Write, Read Reverse, Read Forward, Write sequence of commands.
8. Set SFC false. Tape decelerates and comes to rest as specified in Table 5-1A according to speed.
9. WSEL/ remains set and will continuously erase tape until some subsequent Read, Rewind, SRC, or OFFLINE command is given (or the loss of interlock occurs).

5.4.2 OVERWRITE (EDIT)

The Overwrite (Edit) function is normally employed when it is desired to change a record located among other records. To successfully overwrite a given record, tape must first be positioned at the same place from which the original record was written. After writing the new record, write current must be

turned off while tape is in motion; this is done to eliminate the inherent noise transient associated with a collapsing magnetic field. The provision for current turn-off while the transport is in motion is provided by the Overwrite (OVW) interface line.

The following procedure should be followed when overwriting a record on those transports which have the Overwrite interface line.

1. Locate the record to be changed.
2. Wait for tape motion to cease, then set SWS false.
3. To read the record in reverse, set SRC true. Tape motion will start and the transport will be in the Read mode.
4. Generate a postrecord delay for Read Reverse (Edit) as specified in Table 5-1A, item 7. This delay ensures that tape comes to rest nominally at the same place from which the original record was written.
5. Wait for tape motion to cease, then set SWS true.
6. Set Overwrite (OVW) true.
7. Set SFC true, starting tape motion. The transport will be in the Write mode.

8. Generate a prerecord delay for Write Normal as specified in Table 5-1A, item 2, according to speed.
9. Generate WDS pulses together with appropriate data on WDC, WD1-WD8 for each data character to be written onto tape. This frequency is equal to density multiplied by speed. The tolerance is +/-0.25 percent. (The new record length must be the same length as the original record in order to maintain the integrity of the interrecord gap.)
10. On 9-track systems, leave a three-character gap and write the CRCC in the fourth character slot.
11. Leave a three-character gap, then generate a pulse on WARS. The leading edge resets the write register in the transport, thus writing the LRCC onto the tape in the fourth character slot after the last character is written.
12. Generate a postrecord delay as specified in Table 5-1A according to speed.
13. Subsequent operation can now be performed as desired.

5.4.3 VERTICAL PARITY GENERATION (generated in controller)

The vertical parity bit (VRC) recorded in channel P on 9-track systems is generated so that the total number of 1 bits in each data character (not the CRCC or LRCC) is always odd. On 7-track systems, even parity is used when writing BCD (BCD-10 correction is required so that there is no all zero character).

5.4.4 CRCC GENERATION (9-Track Systems Only) (generated in controller)

The CRCC is based on a modified cyclic code and provides a more rigorous method of error detection than using the VRC or LRC checks only. When reading it can also be used in conjunction with the VRC and LRCC checks for error correction, provided that the errors are confined to a single channel.

The CRCC can be generated according to the following rules.

1. Each data character is added to the contents of a CRC register (CRCR) without carry — each bit being exclusively ORed to the corresponding bit of the CRCR.
2. This information then undergoes a circular shift right of one place, such that each bit is copied into the adjacent CRCR flip-flop:

(CRCP CRC0, etc.)

3. If the bit entering CRCP is a 1, the bits entering CRC2, CRC3, CRC4 and CRC5 are inverted.
4. Steps 1 through 3 are repeated for each data character of the record.
5. The contents of all CRCR positions, except CRC2 and CRC4, are inverted and the resultant character is written onto tape.

Figure 5-11 shows a block diagram of a CRCR. Note that this circuit requires one clock pulse for each data character, and that no extra shift is required after the last data character.

If it is required to regenerate the CRCC during a Read Reverse command, the significance of the data bits entering the CRCR must also be reversed.

The CRCC has the following properties.

1. It can be an all-zeros character.
2. Its value is such that the LRCC always has odd parity (therefore the LRCC can never be all-zeros).
3. It has odd parity if there are an even number of data characters, or even parity for an odd number of data characters.

For compatibility reasons, the correct CRCC should always be written onto tape even though it is not to be used for read error checking.

5.4.5 ERASING

Erasing is required only when it is necessary to abandon a specific area of tape after repeated write errors. This can be accomplished by using any one of the following methods.

1. Backspace over the erroneous record and rewrite. For each iteration, the new record will be written approximately 0.125 inch further down the tape, leaving a longer IRG behind it.
2. Backspace over the erroneous record, issue a command to move tape a file mark distance with write lines reset.
3. Erased gaps of any length can be generated by executing a dummy write command with the WDS line suppressed.

5.5 NRZI READ OPERATION

The transport must be Online and Ready before a read operation can take place. When it is desired to perform only a read operation, removal of the write enable ring ensures that the tape is not inadvertently erased.

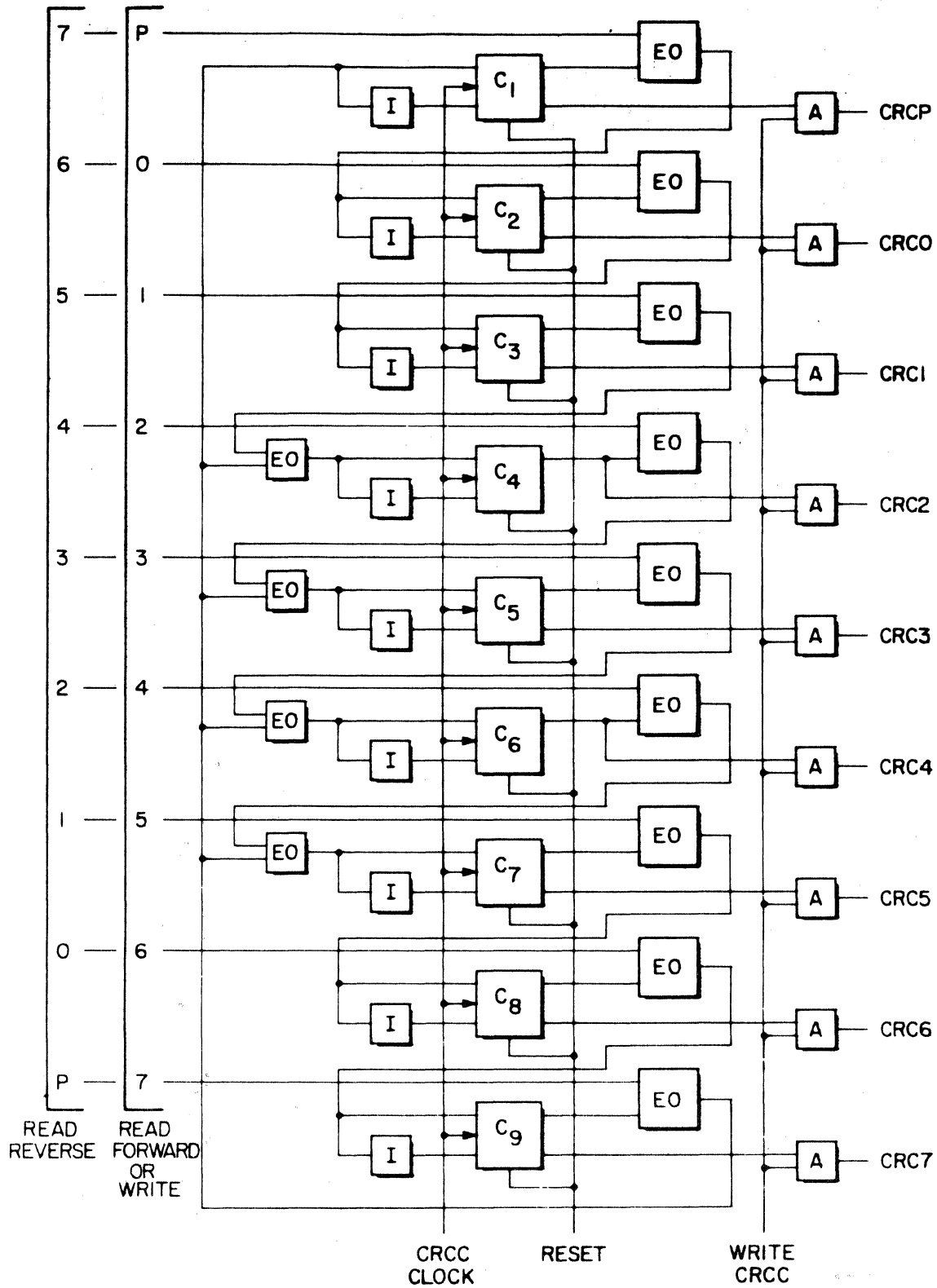
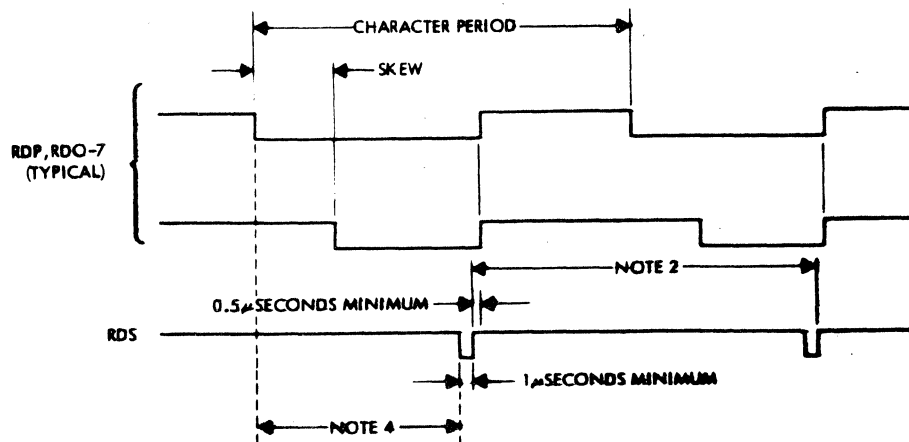


Figure 5-11. Cyclic Redundancy Check Register



NOTES

1. RDP, RD0-7 SHOULD BE SAMPLED ON THE TRAILING EDGE OF EACH RDS PULSE.
2. CHARACTER PERIOD AVERAGES $\frac{1}{BV}$, WHERE B=DENSITY AND V=TAPE VELOCITY. HOWEVER, THIS CAN VARY CONSIDERABLY DUE TO THE COMBINED EFFECTS OF BIT CROWDING AND SKEW.
3. THESE WAVEFORMS ARE SHOWN LOW-TRUE, AS THEY APPEAR ON THE INTERFACE CABLE.
4. RDS OCCURS NOMINALLY 46% OF CHARACTER PERIOD.

Figure 5-12. Read Data Waveforms

5.5.1 AUTOMATIC CLIPPING LEVELS

The purpose of the clipping levels is to eliminate spurious baseline noise pulses, requiring the analog signal supplied from the read preamplifier to exceed a certain amplitude before it is detected by the read amplifier stages. Different clipping levels are used during different modes of operation. The lowest clipping threshold occurs during read only NRZI mode. This level is increased during read after write operations. During the gap the clipping levels are raised even higher to reduce the probability of detecting random noise. When an error is detected in a read only mode and the transport is commanded to backspace over the erroneous block and reread it, the clipping levels are switched automatically to maximize the recoverability of marginally recorded data. First the clipping levels are lowered to recover possible partial dropouts, and if the error is still detected the clipping levels are raised to eliminate possible high baseline noise spikes.

5.5.2 READ DATA

Although the individual bits of each data character are recorded simultaneously, they are read back from tape over a finite band of time. This skewing effect is caused by small static or dynamic misalignments of

the tape path, tape edge irregularity caused during slitting, and by the effects of bit crowding.

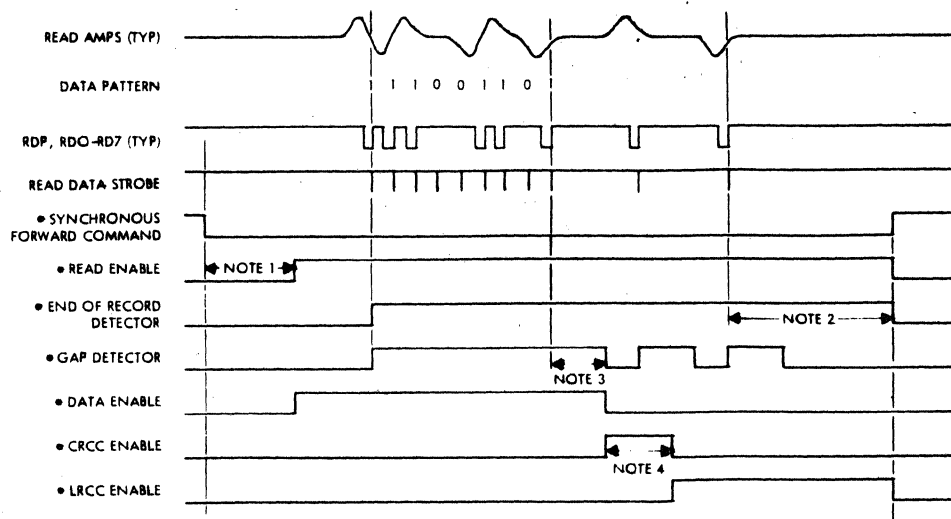
In Kennedy transports, the static skew has been reduced to such a degree that individual deskew logic and adjustments for each track becomes unnecessary.

The transport read electronics amplifies first, then peak detects the read data from each track. This information is then copied into a skew register which assembles the 9 (or 7) bits of each character into parallel form. See Figure 5-12. The outputs from the skew register are transmitted to the user's equipment on interface lines RDP, RD0-RD7 (or RDC, RD1-RD8).

Another interface line, Read Data Strobe (RDS), is used to sample RDP, RD0-RD7 (or RDC, RD1-RD8). This waveform consists of a pulse for each character read from tape, and the trailing edge of each pulse should be used to sample the data lines.

5.5.3 READ FORWARD

One of the simplest and safest ways of implementing the read control logic is to make use of two "missing pulse detector" circuits. The first circuit continually looks for the gap between the last data character and



NOTES

1. THE PRE-RECORD DELAY SHOULD BE 120 MILLISECONDS WHEN AT BOT, OR 24 MILLISECONDS OTHERWISE. THIS GATES OUT UNWANTED READ DATA WHILE THE TRANSPORT IS ACCELERATING AND TRAVERSING THE IRG.
2. TAPE MOTION IS STOPPED AND THE READ CIRCUITS DISABLED WHEN A GAP OF 16 CHARACTER PERIODS IS DETECTED.
3. GAP DETECTOR DELAY IS 2-1/2 CHARACTER PERIODS.
4. THIS IS A FIXED DELAY OF 3 CHARACTER PERIODS. THE CRCC WILL OCCUR DURING THIS TIME.
5. CUSTOMER GENERATES THE WAVEFORMS MARKED*.
6. INTERFACE WAVEFORMS ARE SHOWN LOW-TRUE, AS THEY APPEAR ON THE INTERFACE CABLE.

Figure 5-13. Read Forward Operation Waveforms

the CRCC or LRCC and has an optimum setting of $2\frac{1}{2}$ character periods. The second circuit searches for a 16 character gap at the end of record. When this is found, the read circuits are disabled and a half command is given to the transport. The second circuit ensures that (except for the most massive dropout) the transport will always come to rest in a genuine IRG.

Typical read waveforms for such a scheme are shown in Figure 5-13. The sequence of events are as follows.

1. Set SFC true.
2. Generate a prerecord delay as specified in Table 5-1A, according to speed. This suppresses read data while the tape is accelerating and the IRG is being traversed.
3. Read data arrives and read data strobes are generated. The first strobe pulse activates both the gap detector and the end of record detector.
4. Each character is processed in one or more of the following ways.
 - a. Check for vertical parity error.
 - b. Copy into the LRC check register.
 - c. Copy into the CRC check register.
 - d. Assemble into words or copy directly from memory.
5. A gap of $2\frac{1}{2}$ character periods is detected. This triggers a delay of 3 character periods. Any character occurring during this time can be treated as a CRCC (9 track) and will be checked against the regenerated CRCC now held in the CRCC.
6. All succeeding characters can be treated as a LRCC and will be checked against the contents of the LRC check register.
7. A 16 character gap is detected. This disables the read logic and sets SFC false, stopping tape motion.

5.5.4 READ REVERSE

This can be implemented in a manner similar to read forward, except that special provision must be made because the LRCC and CRCC occur first. In

addition, the significance of data bits entering the CRCR for check purposes must be reversed (see Figure 5-11).

A postrecord delay as specified in Table 5-1A according to speed is required between the detection of end of record and stopping of tape motion (setting SRC false). This will bring tape to rest in the optimum position in the IRG for subsequent read or write commands.

5.5.5 FILE MARK DETECTION

Since it is generally required to detect a file mark in either the forward or reverse direction, no use can be

made of the $3\frac{1}{2}$ inch gap that separates it from the previous record on tape.

To qualify as a file mark, a record should meet the following conditions.

1. It must consist of a single data character with an identical LRCC.
2. The data character has the required pattern (0 0 0 1 0 0 1 1 for 9 track; 0 0 0 1 1 1 1 for 7 track).
3. There is no CRCC check character for 9 track.

SECTION VI

MULTIPLE TRANSPORT CONNECTION

6.1 MULTIPLE TRANSPORT CONFIGURATION

A single transport connected to a controller is normally all that is required. The cable length between the transport and the controller must not exceed 20 feet. Only one select line is utilized and line termination resistors are provided in the transport for all interface lines.

Up to four transports may be connected to a system provided the total cable length does not exceed 20 feet. When this configuration is required, the Multiple Transport Adapter (MTA) should be used. The MTA facilitates the connecting of up to four transports to a single controller. Also, the MTA board is used to convert two 44 pin edge connectors on Model 900X to industry standard three, 36-pin edge connectors. An MTA board must be used if unit select switch is utilized on Model 9100 or 9300. Table 6-1 describes the other use of MTA board (190-4147-xxx) with appropriate dash numbers.

To connect Model 9000 Transport to the controller a cable, control adapter and data adapter are required for each transport. Figure 6-1 illustrates the daisychain connection.

To connect Models 9100, 9300, 9700 and 9800 to the controller, one adapter board and two cables are required per transport. Figure 6-2 illustrates the daisychain connection. Data terminator and control terminator cards are installed only in the last deck of the daisychain.

The adapter board contains a tape unit address select switch. Thus, each deck in the chain can be assigned an address. (SWI ON = tape unit 2 ON, etc.) The tape unit address can also be controlled by the address select switch on the front panel of each transport. In this instance, all address switches on the adapter boards should be in the OFF position. An optional cable is used to connect the tape unit address switch to the adapter board.

Dash No.	USES	Dash No.	USES
001	A plug board (all components omitted) converts two 44-pin edge connectors to three industry standard, 36-pin edge connectors (Model 9000).		required per system) maybe installed in IC1 and IC6.
002	A "last transport" multiple transport adapter (MTA). Cables which are normally attached to three 36-pin edge connectors are omitted. This version may also be used for single transport systems (Model 9000).	004	Customer special (Model 9000).
003	Used to convert two 44-pin edge connectors to industry standard, three 36-pin edge connectors and also used to daisychain four tape transports (Model 9000).	005	Same as -003 but 15 feet of cable (Model 9000).
	Note:	006 and 007	Special MTA boards used together. Select lines are left open (Model 9000).
	A 5 foot cable is attached to the adapter. Signal terminator boards are in the transport and should be removed from all except the "last transport," if three 36-pin edge connectors are to go to the next transport. When the MTA is used an optional pushbutton address assembly must be installed in the transport. Provision is made for terminating signals from the transport, although these signals should properly be terminated in the formatter. If the formatter does not have proper terminations, terminating network (Kennedy Part Number 149-0043-002, two	009	Used with Kennedy recommended controllers (Model 9000).
		010	This is the same as -002 but ONLINE is locked. ONLINE remote controlled only (Model 9000).
		011	Customer special (Model 9000).
		501	This MTA board is used to convert existing edge connectors on Models 9100/9300 to industry standard, three 36-pin edge connectors.
		502	Last transport MTA. Cable attached to three 36-pin edge connectors is omitted. This version may also be used for single transport systems. The MTA board is equipped with industry standard dual density switch (Models 9100/9300).

Table 6-1A. 190-4147-xxx Multiple Transport Adapter Configurations

503 Multiple transport adapter with 5 foot cable attached.

Note:

Signal terminator boards are in the transports, and should be removed from all except the "last transport," if three 36-pin edge connectors are to go to the next transport. When the MTA is used an optional pushbutton address assembly must be installed in the transport. Provision is made for terminating signals from the transport, although these signals should properly be terminated in the formatter. If the formatter does not have proper terminations, terminating network (Kennedy Part Number 149-0043-002, two required per system) may be installed in IC1 and IC6.

This MTA board is equipped with industry standard dual density with switch (Models 9100/9300).

506 Special MTA used together. Select lines are left open (Models 9100/9300).

508 Same as 503 but comes with terminating network for proper signal termination (Models 9100/9300).

509 Used with Kennedy recommended controllers (Models 9100/9300).

510 Same as 503 with an additional hardware to hold it down firmly on transport. Mostly used in ruggedized tape transports (Models 9100/9300).

512 Same as 502.

531 Customer special (Models 9100/9300).

551 Customer special (Model 9000).

Table 6-1B. 190-4147-xxx Multiple Transport Adapter Configurations

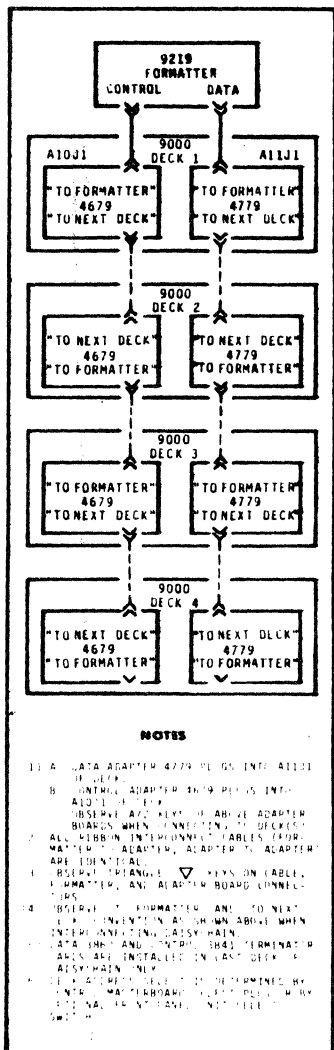


Figure 6-1. Model 9000 Daisychain Connection

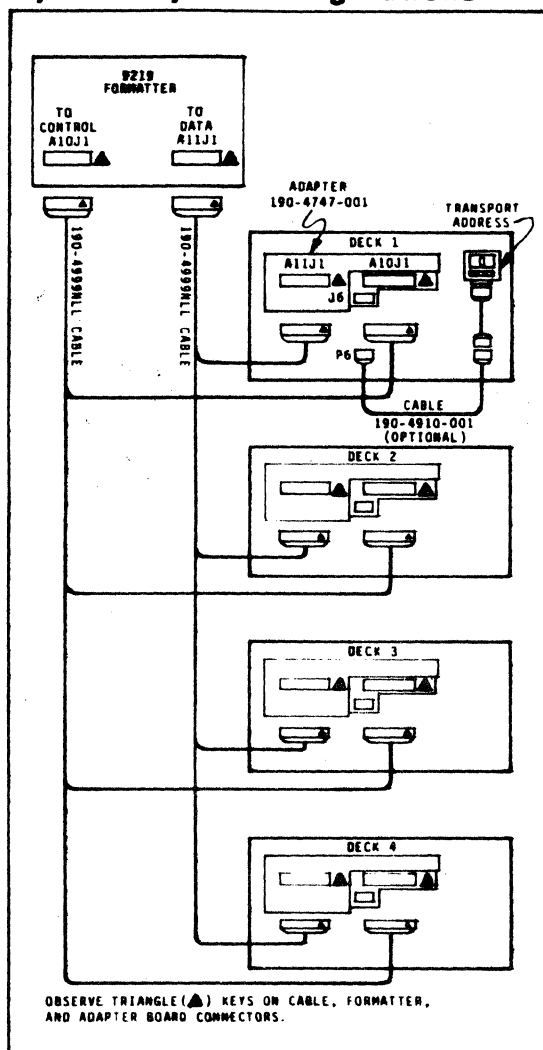


Figure 6-2. Models 9100/9300/9700/9800 Daisychain Connection

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