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MINIDEK

INTERFACE AND APPLICATION SUMMARY

FOR FORMATTED NRZI MODELS

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1. INTRODUCTION

The Digi-Data Model 1100 MINIDEK line of digital magnetic tape transports offers the systems user computer compatibility combined with ease of interfacing.

The formatted transports described here provide for the generation of all necessary IBM compatibility features, including inter-block gaps and check characters as well as buffering and error detection in read operations. The formatter handles all details of driving the tape transport, thereby simplifying the user's interfacing task. The tape generated is an IBM compatible NRZI 9-track format at 800 BPI. Data transfer rate is 10,000 chars/sec. (1 char. = 8 bits)

2. SPECIFICATIONS

REEL SIZE	7 inches (600 ft. of 1.5 mil tape)
TAPE SPECIFICATIONS	0.5 inches wide, 1.5 mil Computer grade
TAPE SPEED	12.5 ips (other speeds optional)
REWIND SPEED	50 ips (nominal)
START/STOP TIME	30.0 msec $\pm$ 2.0 at 12.5 ips
START/STOP DISTANCE	0.19 inches - 0.02
LONG TERM SPEED VARIATION	$\pm$ 1%
INSTANTANEOUS SPEED VARIATION	$\pm$ 3%
TAPE TENSION	6.5 ounces $\pm$ 0.5 ounce
RECORDING MODE	NRZI IBM compatible
DATA DENSITY	200, 556, 800 bpi
NUMBER OF TRACKS	7 or 9 (IBM compatible spacing)
ERASE HEAD	Full width IBM compatible
INTERCHANNEL DISPLACEMENT ERROR	150 microinches (max) at 800 bpi 200 microinches (max) at 556 bpi
BOT/EOT SENSORS	IBM compatible photoelectric sensors
ELECTRONICS	Solid State, Silicon
ELECTRICAL INTERFACE	DTL/TTL compatible (low true) Compatible with many existing controllers
POWER	105 to 125 VAC (220V optional) 50 to 400 Hz, 1.2 amps nominal current drain @ 115 VAC
COMMAND DELAY	Motion commands must be separated by at least 32 milliseconds (maximum stop time)
MOUNTING	Standard 19 inch rack (EIA standard), Slides optional
WEIGHT	35 lbs.
DIMENSIONS:	
WIDTH	19.00 inches
HEIGHT	8.75 inches
DEPTH (Behind panel)	9.00 inches
DEPTH (Total)	11.00 inches
OPERATING ENVIRONMENT	40 to 110° F., Humidity to 95% relative without condensation
ALTITUDE	0 to 10,000 Ft.
CONFIGURATIONS AVAILABLE	Write Only. Read Only. Write/Read (Single gap head) Read-after-Write (Dual gap Head)

3. OPERATOR CONTROLS AND INDICATORS

3.1 CONTROLS

POWER	A pushbutton switch that applies power to the transport.
LOAD	A pushbutton switch that initiates the tape loading sequence. Pressing the switch will cause the reels to apply tension to the tape. The tape will then advance to the BEGINNING OF TAPE (BOT) marker and halt.
REWIND	A pushbutton switch that initiates rewind operation. Pressing the switch will place the tape transport OFF LINE, and rewind the tape to BOT. Pressing the switch when tape is at BOT will cause tape to unload from the take-up reel at low speed.
ON/OFF LINE	A pushbutton switch that places the transport in the ON LINE mode (enabling remote control) if tape is loaded. The transport may be placed OFF LINE at any time by pressing the switch again.

3.2 INDICATORS

POWER ON	This indicator is illuminated when power is applied to the transport.
ON LINE	This indicator is illuminated when the transport is ON LINE status (under remote control).
RING IN	This indicator is illuminated when a write ring is on the supply reel, permitting writing or erasing of tape. If the indicator is not illuminated, no writing or erasing of tape is possible.

4. ELECTRICAL INTERFACE

All transport interface lines utilize DTL/TTL compatible zero volt true signals. All outputs are open collector gates which must be terminated with resistors at the associated receivers. All inputs are designed to be driven from open collector gates. Terminating resistors are included on the interface connector. If these resistors are removed each input presents a maximum of two DTL unit loads. The recommended interface circuit is shown in Fig. 1.

5. INTERFACE SIGNAL DESCRIPTION

Table 1 lists all transport input and output signals along with a brief description of their function.

The logic levels on all input/output lines are low true.

TRUE:	0 to +0.4 volt
FALSE	+2.5 to +5.5 volt

TABLE 1

FORMATTED NRZI INTERFACE SIGNALS

Signal Name	Description	Signal Type
FORWARD	A transition to true initiates forward motion of the tape. When in the write mode the transition to False initiates generation of the End-of-Block check characters followed by a halt. The transition to False must occur after the trailing edge of the last desired WRITE CLOCK pulse and prior to the leading edge of the first undesired WRITE CLOCK pulse. In the read mode the transition to False arms the transport's stop-in-IBG circuits. The FORWARD input is normally set False as soon as the END OF BLOCK output goes true.	Input Level
REVERSE	A transition to true initiates tape motion in the reverse direction and forces the transport into the READ mode. A transition to False arms the stop-in-IBG circuitry, causing the transport to stop in the first detected gap. The REVERSE command is suppressed if the transport backs into the BOT mark.	Input Level
WRITE MODE	This line must be held true during all write operations including write EOF. The transition to true may occur prior to or simultaneously with the FORWARD command. The Transport will not write while off line, rewinding or going in reverse. Transports equipped with the file protect ring option will not write unless a write ring has been installed on the reel.	Input Level
REWIND	A pulse on this input places the transport in the rewind to load point mode. A REWIND command will be ignored if the tape is already at the load point. The unit remains in ON LINE status.	Input Pulse
OFF LINE	A pulse on this line will disconnect the transport from remote control and extinguish the ON LINE indicator on the transport control panel. The transport will remain OFF LINE until the operator pushes the ON LINE button.	Input Pulse
END OF FILE	A true pulse on this input causes an END OF FILE mark to be written on the tape. The transport will return to READY approximately 320 msec. after receipt of an END OF FILE command.	Input Pulse
WRITE DATA (8 lines)	A true level spanning the write clock causes a "one" to be recorded on the tape. Data should be present prior to the write clock leading edge and remain stable until the trailing edge.	Input Level

SKIP WRITE	A true level or pulse at the leading edge of a FORWARD command causes the transport to erase 3-1/2 inches of tape prior to writing and is useful for skipping over defective areas of the tape.	Input Level
WRITE CLOCK INHIBIT	A true level prevents the write circuitry from receiving write clocks.	Input Level
READ DATA DISABLE	A true level sets all 8 READ DATA lines and the READ TRUE PARITY line to a false condition. This allows data to be suppressed at any time during a read or read-after-write operation.	Input Level
EXTERNAL WRITE CLOCK	This line is provided for use in interface schemes where it is desired to replace the transport's time base with an externally supplied oscillator.	Input Pulse
READ THRESHOLD	A true level on this input increases the playback amplifier threshold level. This feature may be employed to detect marginal records when performing read-after-write checks. The READ THRESHOLD input must be held constant during the entire record. Dual gap machines perform threshold switching automatically.	Input Level
SELECT 1 and SELECT 2	Each SELECT input enables a particular transport. A false SELECT line immediately terminates any tape motion except REWIND. Only one line can be enabled at a time.	Input Level
ON LINE	A true level indicates that the operator has placed the transport under remote control.	Output Level
LOAD POINT	A true level indicates that the tape is positioned at the BEGINNING OF TAPE (BOT) marker.	Output Level
END OF TAPE	This output will be true while the end of tape marker is being sensed. This signal may be noisy if the transport stops at the edge of the marker.	Output level
REWIND STATUS	A true level while the transport is in the REWIND to LOAD POINT mode.	Output Level
READ CLOCK	A true pulse with a nominal width of 2.0 usec. indicating that a character has been read and is available. The data is de-skewed and buffered and remains available until the leading edge of the next read clock. The read clocks corresponding to the END OF BLOCK check characters are normally suppressed. This feature may be disabled by changing a jumper wire. One read clock will occur when reading an END OF FILE	Output Pulse
READ DATA (8 lines)	The latest character read is de-skewed and buffered and available at the READ DATA outputs. The character is updated approximately 2 microseconds prior to the leading edge of READ CLOCK.	Output Level

READ TRUE PARITY	Odd parity bit computed from the READ DATA lines	Output Level
END OF BLOCK	A 500 microsecond pulse occurs on this output when the tape enters the IRG. FORWARD or REVERSE input must be set false during the END OF BLOCK pulse to stop the tape. In systems requiring access to the check characters an internal jumper is available which can convert this output to a level which goes true just prior to the first check character.	Output Pulse
EOF DETECT	A true pulse (nominal width 500 usec) prior to the END OF BLOCK pulse indicates that an END OF FILE mark has been read.	Output Pulse
PARITY ERROR	A true level coincident with the incorrect character indicates that the parity of the character read was incorrect.	Output Level
WRITE CLOCK	True pulses appear when transport is up to speed and ready to write. An input data character (8 bit) should be present at the leading edge and remain stable until the trailing edge of its corresponding clock pulse. The WRITE CLOCK output pulses are suppressed when the FORWARD command goes false. For 12.5 ips machines operating at 800 bpi, the WRITE CLOCK frequency is 20 Khz. with a nominal pulse width of 2 microseconds.	Output Pulse
WRITE DISABLED	A true level indicates that no write ring has been installed on the reel. The transport will not write when this output is true.	Output Level
READY	A true level means tape is loaded on the transport and is at rest. No motion command should be initiated unless READY is true.	Output Level

6. APPLICATION INFORMATION

6.1 WRITE OPERATIONS

A typical write operation is illustrated in Fig. 2. The sequence of events is as follows:

1. After verifying that READY is true and WRITE DISABLED is false, a write command will be initiated by setting the FORWARD and WRITE MODE input true. The READY output will go false approximately 2 microseconds later.

2. The tape will be up to speed in 30 milliseconds. An additional delay is created by the formatter to maintain IBM-compatible gaps. Table 2 lists the values of this predata delay for the various transports and modes.

3. Following the predata delay the WRITE CLOCK output generates 2 microseconds pulses at 10.0 Khz (±0.25%). The WRITE DATA character must be present at the transport inputs prior to the leading edge of each WRITE CLOCK pulse and remain present for the duration of the pulse.

4. After the last data character has been recorded, the FORWARD command must be set false. The transition to false must occur prior to the scheduled arrival of the next WRITE CLOCK pulse.

5. The write clocks will stop appearing and the transport will automatically write the required check characters and come to a stop. The transport READY output will go true when the tape is at rest. The time required for the transport to go READY after removing the FORWARD command is listed in Table 2.

6.2 READ-AFTER-WRITE

During a write operation transports equipped with the dual gap head option read the data after it is recorded and check all characters except the CRCC for proper vertical parity.

All transport outputs associated with a read operation are enabled. In applications where re-writing is feasible, the PARITY ERROR output should be monitored continuously. The occurrence of a parity error while writing generally indicates a defective area on the tape. Any of the following procedures may be employed to re-write the record.

1. Backspace over the defective record and then write it again. This procedure will completely erase the erroneous record and begin the new one about one-eighth of an inch further down the tape.

2. Backspace over the defective record and then write it again in the "skip write" mode. This is accomplished by holding the SKIP WRITE input true for a minimum of 2 microseconds (maximum of 200 milliseconds) following initiation of the FORWARD command. This procedure will completely erase the erroneous record and generate a 3.5 inch erased area before writing the record.

3. The necessity for a separate skip write command may be eliminated by backspacing over the erroneous record, writing an EOF, backspacing over the EOF and then re-writing the record. This procedure will completely erase the erroneous record (and the EOF) and generate a four inch erased area ahead of the re-written record.

NOTE: The creation of extended gaps as outlined above is a standard technique on large computers and does not impair IBM compatibility.

4. Transports with single gap write/read heads do not produce any read outputs while writing. Read-after-write checking can be accomplished by backspacing over each record after it is

written and then reading it in the forward direction while monitoring the PARITY ERROR output. Procedures for re-writing an erroneous record are the same as those outlined above. The READ THRESHOLD input may be held true during the forward read. This will raise the read amplifier threshold level so that a marginally written record will cause parity error. The READ THRESHOLD input should be held false during normal read operation to provide maximum sensitivity. The various time delays provided by the Formatter assure that no unerased areas of tape will remain between records after any sequence of forward write, forward read and backspace commands.

6.3 READ OPERATIONS

A typical read operation is illustrated in Fig. 3. The sequence of events is as follows:

1. After verifying that READY is true, the operation is initiated by setting FORWARD true with WRITE MODE false. The READY output will go false approximately 2 microseconds later.

2. The tape will be up to speed in 30 milliseconds. The first READ CLOCK pulse may arrive at any time after that. Each READ CLOCK pulse indicates that a new data character is available at the READ DATA outputs. The READ TRUE PARITY, READ DATA and PARITY ERROR outputs all change simultaneously, approximately 2 microseconds before the leading edge of each READ CLOCK PULSE. The pulse-to-pulse spacing of the read clock may vary as much as 20%.

Read Operation -- continued

3. After the last data character the transport detects the END OF DATA gap and suppresses the END OF BLOCK check character. This suppression may be deleted by removing an internal jumper wire.

4. After the last check character the transport detects the Inter-Block Gap (IBG) and generates a 500 microsecond pulse at the END OF RECORD output.

5. The FORWARD command must be set false prior to or during the END OF BLOCK pulse to stop the tape. If this does not occur the tape will continue in motion reading successive records until FORWARD is false during an END OF BLOCK pulse.

6. After the stop condition is met the tape will stop and READY will go true when the tape is at rest. The time required to return to a READY status is listed in Table 2.

   Errors will generally occur when reading in reverse due to the check characters suppression circuit. If this circuit is deleted, then provision must be made externally for dealing with the check characters.

   If the FORWARD or REVERSE input is set false prior to the end of the record, the READ CLOCK, READ DATA, READ TRUE PARITY and PARITY ERROR outputs will remain false and all data transfer will cease. The tape will continue to the IBG and stop in a normal manner. Thus a backspace operation can be performed by applying a brief pulse (2 microseconds minimum) to the REVERSE input. If an error occurs while reading in the forward direction, the tape should be backspaced and re-read. Several re-reads may be required. Persistant errors indicate excessively dirty or worn tape.

6.4 END OF FILE MARKS

The formatted MINIDEK includes hardware for the generation and detection of END OF FILE (EOF) marks on the tape. An EOF is a special record on the tape which separates different files of data. Two EOF marks in succession generally indicate the end of data on the tape.

An EOF is written by verifying that READY is true and WRITE DISABLED is false, setting WRITE MODE true and then pulsing the END OF FILE input. The pulse width must be between 2 microseconds and 200 milliseconds. READY will go false approximately 2 microseconds after receipt of the command and return true after approximately 280 milliseconds.

An EOF will be detected by the transport while reading in either the forward or reverse direction. The EOF DETECT output will produce a 500 microsecond pulse just ahead of the associated END OF BLOCK pulse when an EOF has been detected. Prior to the EOF DETECT pulse the transport will generate one READ CLOCK pulse when reading an EOF.

6.5 MISCELLANEOUS FEATURES

6.5.1 Multiple Units

The MINIDEK formatter option consists of a printed circuit card installed in the transport. With minor changes on the formatter card, two transports can share a single formatter card. Two SELECT inputs are provided at the interface, one associated with each transport. One SELECT input at a time is held true. The SELECT lines may be changed only when

the READY or REWIND STATUS outputs are true. All other aspects of the interface are unchanged. Thus it is possible to economically construct systems performing tape-to-tape transfers or to switch immediately to a new reel while the other deck is rewinding and being reloaded. Systems requiring more than two tape decks require the formatter option to be located in a separate chassis which includes a power supply.

6.5.2 External Clock

The internal oscillator in the formatter may be replaced with an externally applied free running clock of the proper frequency. The applied pulses must be 2 microseconds in width, low going. The pulses are applied to the EXTERNAL WRITE CLOCK input and a jumper wire on the formatter must be changed.

6.5.3 Write Clock Inhibit

The WRITE CLOCK INHIBIT input must be held false (high) for normal operation. When true, this line blocks the transport's internal write clock. The WRITE CLOCK output still occurs. This input may be useful with some interface designs to suppress the internal write clocks until the data is available.

6.5.4 Read Data Gating

The READ DATA DISABLE input must be held false in normal operation. When this input is true the READ DATA and READ TRUE PARITY outputs will be forced high. These outputs are

open-collector gates and may be tied directly to many computer I/O busses, in which case the READ DATA DISABLE input would be employed to strobe the data onto the I/O bus. Propagation delay from READ DATA DISABLE to the read outputs is approximately 200 nano seconds.

7. CABLING INFORMATION

The interface connector for the formatted MINIDEK is a 44 pin PC board which provides facilities for the connection of all interface signals, twisted pair grounds and line terminating resistors.

Table 3 lists all interface signals and their pin numbers on the interface plug. Cabling to the recorder should be composed of #22 or #24 wire twisted pairs. All ground leads should be terminated as close as possible to the associated line driver or receiver.

TABLE 2

TYPICAL TIME DELAYS

	7 TRACK				9 TRACK			
	Single Gap		Dual Gap		Single Gap		Dual Gap	
	Predata	Postdata	Predata	Postdata	Predata	Postdata	Predata	Postdata
Write from BOT	280	41	280	66	280	41	280	55
Skip Write	280	41	280	66	280	41	280	55
Write EOF	280	41	280	66	280	41	280	55
Write Normal	56	41	32	66	46	41	34	55
Read from BOT	280	36	300	36	280	36	290	36
Read EOF	280	36	300	36	280	36	290	36
Read Normal	60	36	60	36	50	36	50	36
Read Reverse	37	51	37	51	37	42	37	42

NOTES:

1. All times in milliseconds.
2. Predata delay is interval between receipt of command and occurrence of first data character.
3. Postdata delay is interval between last character in a block and READY going true.
4. Above times applicable to 12.5 ips, 800 bpi transports.

TABLE 3

FORMATTED MINIDEK

INTERFACE CONNECTOR

	Read Clock	1	23	
	Parity Error	2	24	Read Data Disable
	P	3	25	Write Clock
	0	4	26	Forward
	1	5	27	Reverse
Read Data	2	6	28	Skip Write
	3	7	29	Ready
	4	8	30	Write Mode
	5	9	31	Load Point
	6	10	32	EOT
	7	11	33	On Line
		12	34	Rewind
	7	13	35	Read Threshold
	6	14	36	Write Disabled
	5	15	37	Off Line
Write Data	4	16	38	Rewind Status
	3	17	39	Select 1
	2	18	40	Select 2
	1	19	41	End of Block
	0	20	42	EOF Detect
	External Write Clock	21	43	Write Clock Inhibit
		22	44	End of File

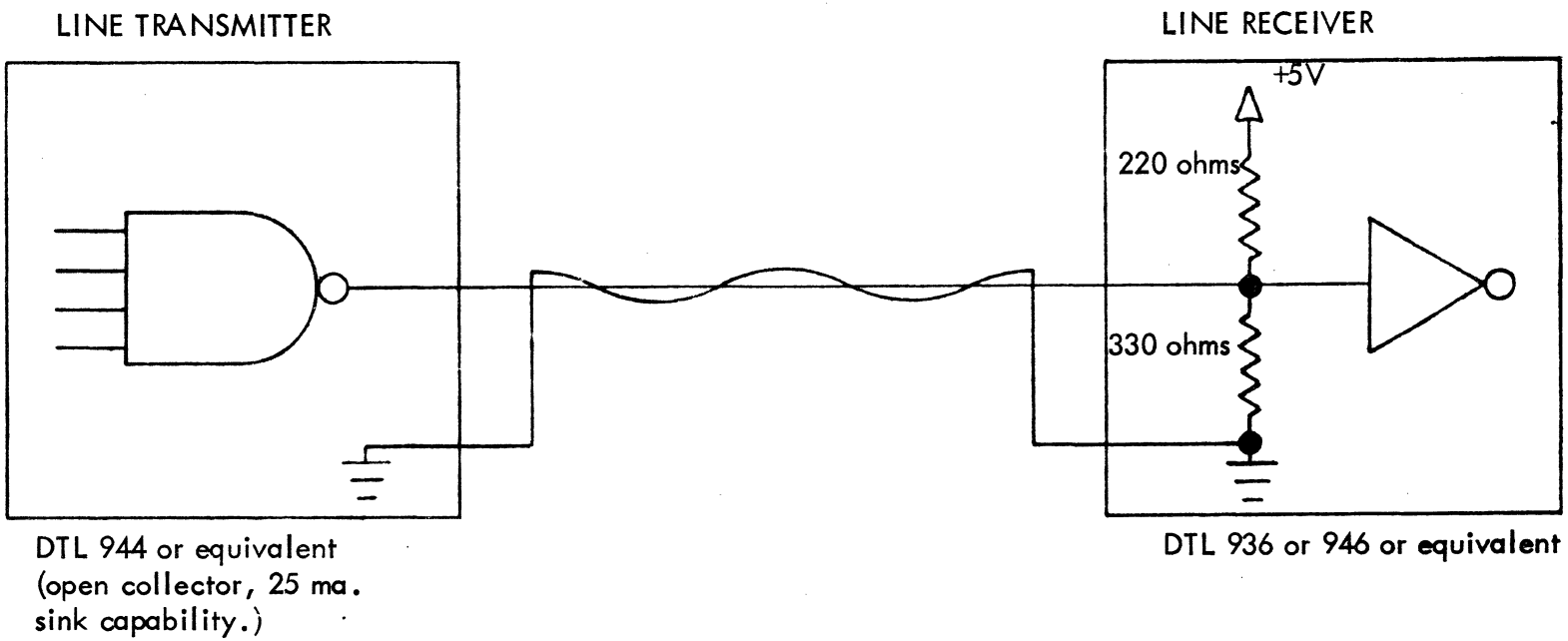

Figure 1. Transport/Controller Interface Circuit

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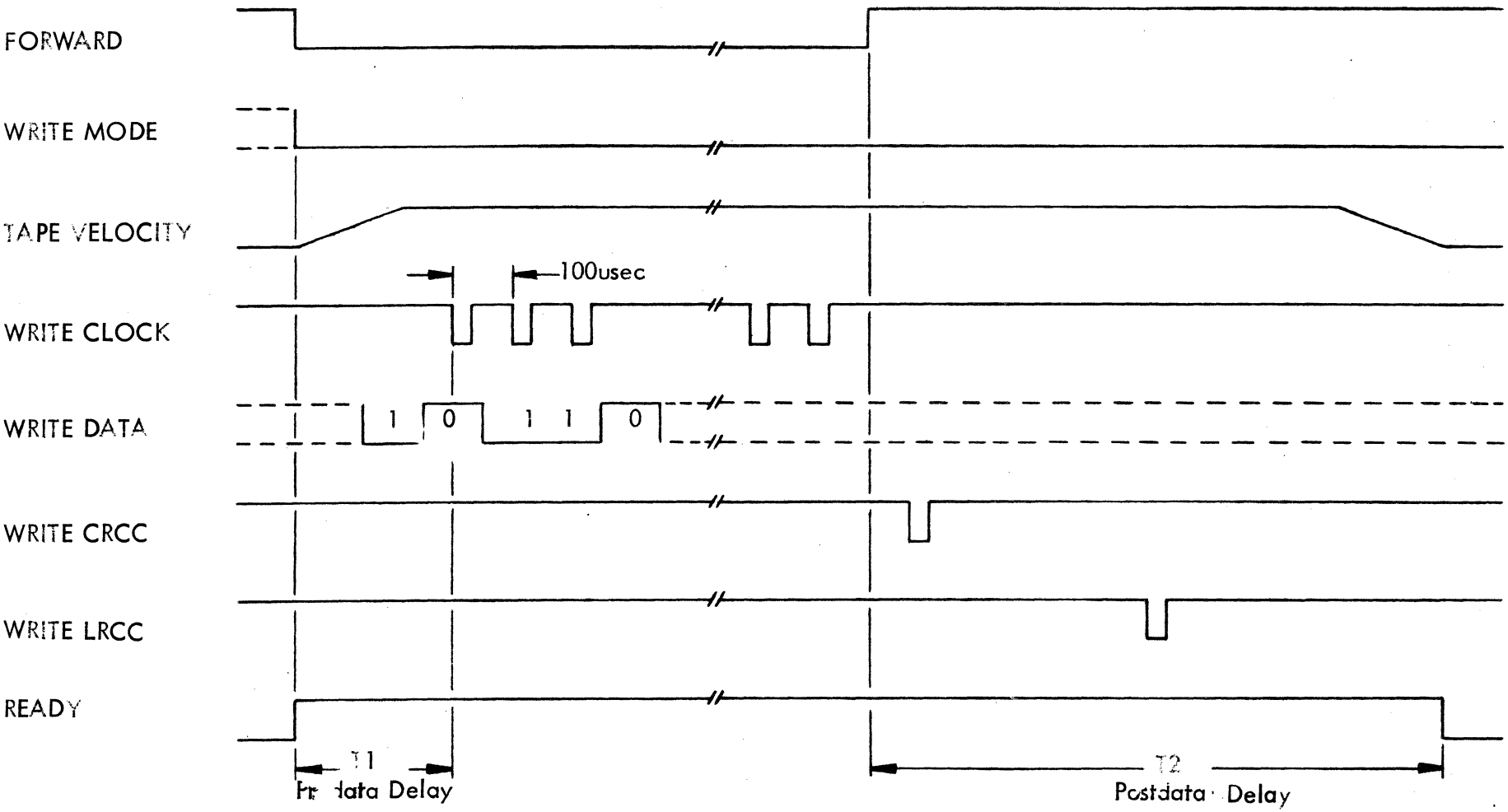

Figure 2. Write Operation Timing Diagram

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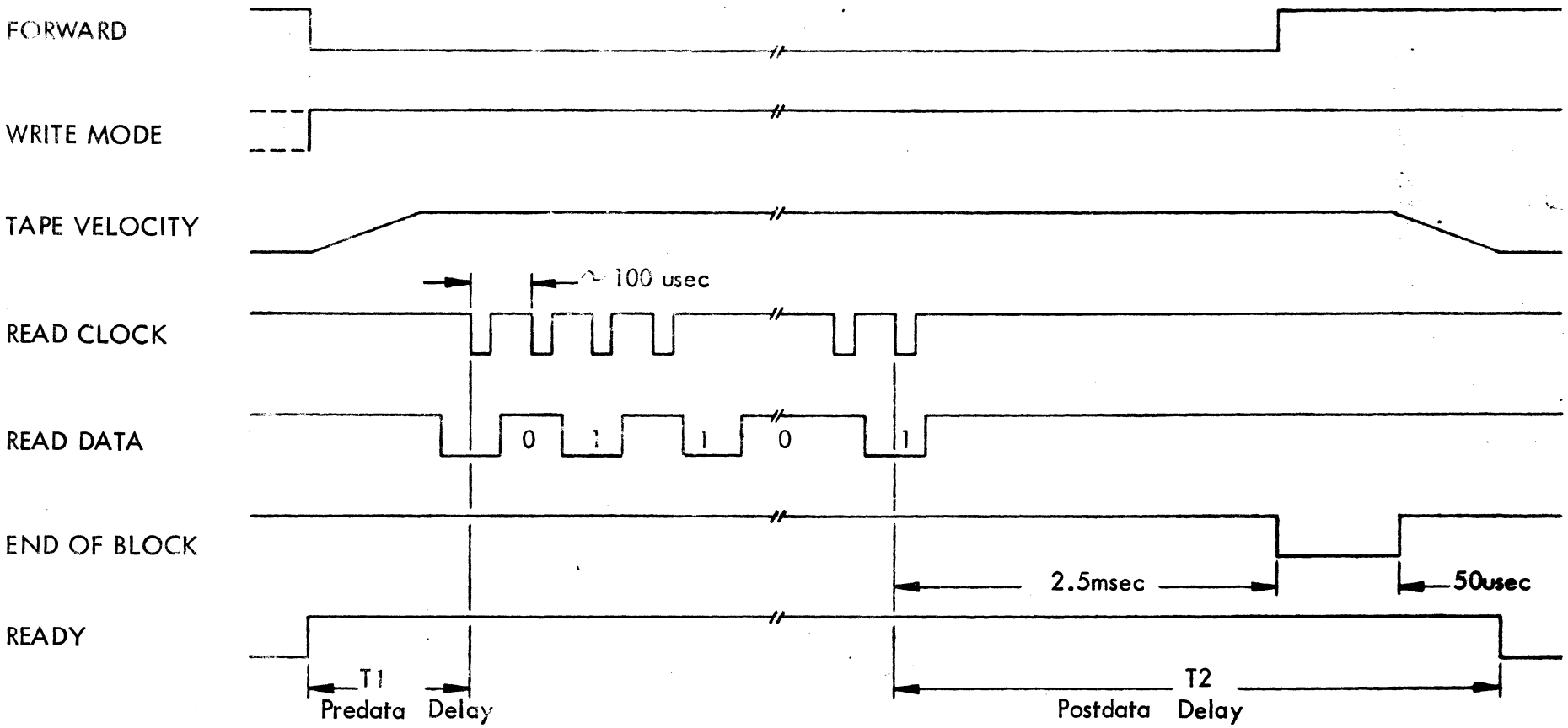

Figure 3. Read Operation Timing Diagram

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