PRELIMINARY
INTERFACE AND APPLICATION
SUMMARY FOR
DIGI-DATA
NRZI/PHASE ENCODED FORMATTERS

11/71

FORMATTER/TRANSPORT CONFIGURATION

CUSTOMER _____

FORMATTER _____

FORMATTER ADDRESS _____

TRANSMIT CRCC & LRCC _____

WRITE LAST WORD _____

DENSITY

LOW _____

HIGH _____

SPEED

LOW _____

HIGH _____

TRANSPORTS

	SERIAL #	HEAD	MODE	DENSITY	SPEED
TAD 1					
TAD 2					
TAD 3					
TAD 4					

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1. INTRODUCTION

Digi-Data formatters offer the systems user computer compatibility combined with ease of interfacing. The formatters enable the generation and full read recovery of IBM compatible magnetic tapes in addition to handling the details of interfacing the transport.

2. SPECIFICATIONS

RECORDING MODE	NRZI/PE
DATA DENSITY	7T 200 BPI (NRZI) 7T 556 BPI (NRZI) 7T 800 BPI (NRZI) 9T 800 BPI (NRZI) 9T 1600 BPI (PE)
OPERATING SPEEDS	6.25 to 45 IPS
ELECTRONICS	Solid State, Silicon
ELECTRICAL INTERFACE	DTL/TTL compatible (low true), compatible with many existing controllers.
POWER	105 to 125 VAC (220 VAC optional) 50 to 400 Hz
MOUNTING	Standard 19" rack mount (EIA Standard), slides optional (NRZI Formatter also available mounted in tape transport)
OPERATING ENVIRONMENT	40 to 110°F, humidity to 95% relative without condensation
ALTITUDE	0 to 10,000 feet
CONFIGURATIONS	Write only, read only, Write/Read (Single gap head), Read after write (Dual gap head)

3. OPERATOR CONTROLS AND INDICATORS*

POWER	A switch that applies power to the formatter
POWER ON	This indicator is illuminated when power is applied to the formatter

* These not available when NRZI Formatter is mounted in Minidek. (Minidek controls and indicators apply.)

4. ELECTRICAL INTERFACE

All formatter 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. If these resistors are removed each input presents a maximum of two DTL unit loads. The recommended interface circuit is shown in Figure 1.

5. INTERFACE SIGNAL DESCRIPTION

Table 1 lists all formatter input and output signals. Table 2 gives a brief description of the signal functions.

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

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

Minimum input pulse width: 0.5 usec unless otherwise specified.

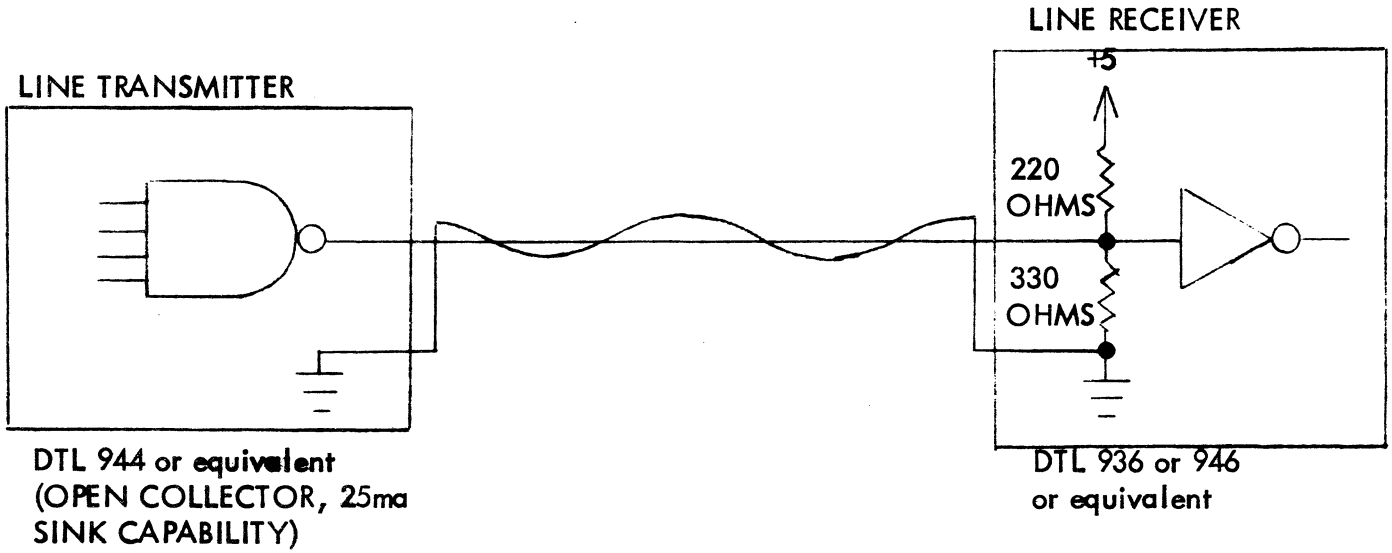

FIGURE I CONTROLLER/FORMATTER INTERFACE CIRCUIT

DIGI-DATA CORPORATION

SHEET OF

CONTROLLER TO FORMATTER

Signal Name	Description
SELECT 1	Select 1 of 4 Transports
SELECT 2	
REVERSE/FORWARD	CONTROLS LATCHED BY "GO"
WRITE/READ	
WRITE END OF FILE	
EDIT MODE	
ERASE MODE	
READ THRESHOLD 1	
READ THRESHOLD 2	
EVEN/ODD PARITY(NRZI)	
HIGH/LOW DENSITY(NRZI)	
REWIND	DIRECT COMMANDS
GO OFF LINE	
FORMATTER ENABLE	STATIC CONTROL LINES
SELECT EXTERNAL PARITY	
FORMATTER ADDRESS	
0	WRITE DATA
1	
2/B	
3/A	
4/8	
5/4	
6/2	
7/1	
P/C(External)	
LAST WORD	WRITE TERMINATION PULSE OR LEVEL
GO	INITIALIZATION PULSE

FORMATTER TO CONTROLLER

Signal Name	Description
FORMATTER BUSY	FORMATTER STATUS
DATA BUSY	
HARD ERROR	
EOF DETECTED	
ID BURST (PE)	
CORRECTED ERROR(PE)	
READY STATUS	TRANSPORT STATUS
ON LINE STATUS	
REWIND STATUS	
WRITE DISABLED	
LOAD POINT	
END OF TAPE	
DENSITY STATUS(NRZI)	
LOW SPEED STATUS	
SINGLE/DUAL GAP	
7 - 9 TRACK (NRZI)	
NRZI	
WRITE CLOCK	TIMING CLOCKS
READ CLOCK	
CR WINDOW	
0	READ DATA
1	
2/B	
3/A	
4/8	
5/4	
6/2	
7/1	
P/C	

TABLE 1

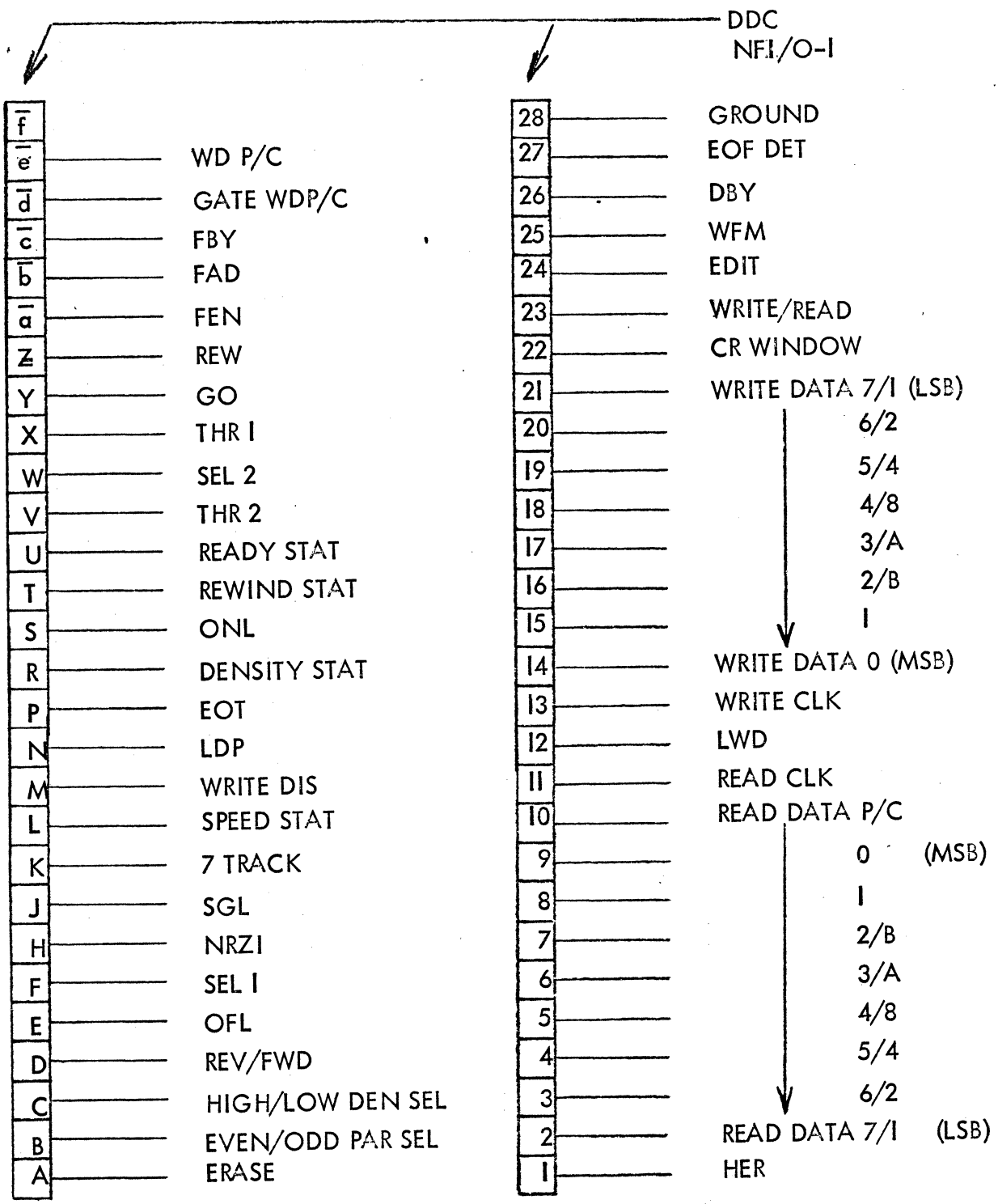

TABLE 2

DIGI-DATA CORPORATION

SHEET OF

CUSTOMER/NRZI FORMATTER
I/O CONN. (FM INSIDE 1100)

DIGI-DATA CORPORATION

SHEET OF

CUSTOMER/FORMATTER I/O CONN. (OUTRIGGER BOX)

A	GND	1	GROUND
B	GND	2	GROUND
C	EVEN/ODD PAR SEL (*)	3	DENS STAT (*)
D	HIGH/LOW DENS SEL (*)	4	
E		5	
F	WRITE DATA P/C	6	FBY
H	WRITE DATA 0 (MSB)	7	DBY
J	1	8	IDENT (**)
K	2/B	9	HER
L	3/A	10	CER (**)
M	4/8	11	EOF DET
N	5/4	12	READY STAT
P	6/2	13	ONL
R	WRITE DATA 7/1 (LSB)	14	REWIND STAT
S	THR 2	15	WRITE DIS
T	THR 1	16	LDP
U	ERASE	17	EOT
V	EDIT	18	NRZI
W	WFM	19	SGL
X	WRITE/READ	20	SPEED STAT
Y	REV/FWD	21	WRITE CLK
Z	OFL	22	READ CLK
a	REW	23	READ DATA 0 (MSB)
b	SEL 2	24	1
c	SEL 1	25	2/B
d	LWD	26	3/A
e	FEN	27	4/8
f	FAD	28	5/4
h	GO	29	6/2
j	GATE WDP/C	30	7/1 (LSB)
k		31	READ DATA P/C
l		32	7 TRACK (*)
m		33	CR WINDOW (*)
n		34	
p		35	
r		36	

* NRZI Formatter Only
** PE Formatter Only

TABLE 2A

TABLE #3
FORMATTER SIGNAL DESCRIPTION

SIGNAL NAME	DESCRIPTION
SELECT 1 SELECT 2	(Input Level) These two lines select one of the four transports which may be bussed onto the formatter. These lines are decoded by the formatter and transmitted to the FORMATTER/TRANSPORT interface as follows:

SELECT 1	SELECT 2	TRANSPORT ADDRESS
0	0	1
0	1	2
1	0	3
1	1	4

REVERSE/FORWARD	(Input Pulse or Level) This line specifies forward or reverse tape motion: TRUE = REVERSE
WRITE/READ	(Input Pulse or Level) This line specifies WRITE or READ mode: TRUE = WRITE
WRITE EOF	(Input Pulse or Level) This line will specify an END OF FILE to be written on the tape, if WRITE/READ is also TRUE, and ERASE is FALSE.
EDIT MODE	(Input Pulse or Level) This line is used in two ways: (a) Read Reverse. Modifies read reverse post-record delay to optimize head positioning when editing tapes. (b) Write. Activates internal logic such that the associated transport operates in the edit mode.
ERASE MODE	(Input Pulse or Level) If ERASE and WRITE/READ are TRUE the formatter is conditioned to execute a dummy write command. The formatter will go through the motions of a normal write operation except that no data can be recorded. The controller will receive WRITE CLOCK and may count the desired length of record to be erased. This operation is terminated by transmitting LAST WORD. Alternatively, if ERASE, WRITE/READ, and WRITE END OF FILE command lines are TRUE, the formatter is conditioned to execute a dummy write file mark command. A fixed length of tape of approximately 3.75 inches will be erased.
READ THRESHOLD 1	(Input Pulse or Level) This line instructs the selected transport to operate in NORMAL or HIGH read threshold mode: TRUE = HIGH THRESHOLD FALSE = NORMAL THRESHOLD (See MINIDEK OEM specifications for Dual-Gap considerations.)

TABLE 3 (Cont.)
FORMATTER SIGNAL DESCRIPTION

SIGNAL NAME	DESCRIPTION
READ THRESHOLD 2	(Input Pulse or Level) This line is used with transports which have an extra low read threshold capability. TRUE=LOW THRESHOLD FALSE=NORMAL THRESHOLD This input may be made TRUE when it is desired to recover very low amplitude data.
EVEN/ODD PARITY (NRZI)	(Input Pulse or Level) This line is used to select EVEN or ODD vertical parity for the formatter parity generation and checking circuitry. TRUE=EVEN PARITY FALSE=ODD PARITY This line is ignored and ODD parity is forced internally if the selected transport is a 9 Track unit.
HIGH/LOW DENSITY (NRZI)	(Input Pulse or Level) This line is used with 7 Track transports which have dual density capabilities. TRUE=HIGH DENSITY FALSE=LOW DENSITY Jumpers on the formatter timing card allow the following choices of densities: LOW DENSITY = 200 or 556 BPI HIGH DENSITY = 556 or 800 BPI This line is ignored and 800 BPI is forced internally if the selected transport is a 9 Track unit.
REWIND	(Input Pulse) This line causes the selected transport (provided it is READY) to rewind to LOAD POINT. This pulse is routed directly to the transport and does not cause the formatter to become BUSY. Min width 2 usec.
GO OFF LINE	(Input Pulse) This line causes the selected transport to go OFF LINE. This pulse is routed directly to the transport and does not cause the formatter to become BUSY. Min width 2 usec.
FORMATTER ENABLE	(Input Level) This line must be held TRUE during all formatter operations. A FALSE level on this line clears the formatter and holds it in a clear state.
SELECT EXTERNAL PARITY	(Input Level) This line instructs the formatter to write the data presented on the WRITE DATA P Line in the parity track, and disables the internal parity generation circuitry. TRUE=EXTERNAL PARITY FALSE=GENERATE INTERNAL PARITY

TABLE 3 (Cont.)
FORMATTER SIGNAL DESCRIPTION

SIGNAL NAME	DESCRIPTION
FORMATTER ADDRESS	(Input Level) This line informs the formatter that it is to respond to commands on the formatter/controller bus. A jumper on the formatter will respond to a TRUE or FALSE on this line.
WRITE DATA	(Input Level) These lines transmit write data from the controller to the formatter. WRITE DATA may be changed only during the half character period following the trailing edge of WRITE CLOCK, and must be stable at all other times, to ensure fidelity of data written. Processing continues upon WRITE DATA presented until LAST WORD is received by the formatter.
LAST WORD	(Input Pulse or Level) This input operates in one of two ways to indicate that the last desired character has been transmitted on write operations: (1) Synchronous - In this mode, LAST WORD must be presented to the formatter coincident with the last desired character, spanning the last desired WRITE CLOCK in the same manner as specified for WRITE DATA. (2) Asynchronous - In this mode, LAST WORD must be presented AFTER the trailing edge of the last desired WRITE CLOCK, but may be presented at any time during the half character period following the trailing edge of the last desired WRITE CLOCK.
GO	(Input Pulse) This input command initiates the action specified by CONTROL lines, listed in Table I. These lines are copied into corresponding flip-flops in the FORMATTER, and on the trailing edge of GO, FORMATTER BUSY is set TRUE. The COMMAND lines, as well as the STATIC CONTROL lines and the SELECT lines, should be stable at least .5 usec before the leading edge of GO. The COMMAND lines must remain stable for at least .5 usec after the trailing edge of GO. The STATIC CONTROL lines and the SELECT lines must be stable throughout the operation.
FORMATTER BUSY	(Output Level) This line will become TRUE on the trailing edge of GO, and normally remains true until tape motion has ceased after execution of the commanded operation.
DATA BUSY	(Output Level) This line will become TRUE when the transport has reached operating speed and is about to begin a WRITE or READ data

TABLE 3 (Cont.)
FORMATTER SIGNAL DESCRIPTION

SIGNAL NAME	DESCRIPTION
	transfer. This line will remain TRUE until the data transfer is completed, and the appropriate post-record delay is completed. At this time, when DATA BUSY returns to a FALSE state, a "window" is created, during which a GO pulse may be issued. If a GO pulse is received during this window, the tape remains at operating speed and continues with another data transfer of the same type as the previous one (the same WRITE/READ and REVERSE/FORWARD status). If no GO pulse is received by the end of the window, GO is locked out, and deceleration of the tape begins, GO will remain locked out until FORMATTER BUSY goes FALSE.
HARD ERROR (NRZI)	(Output Pulse or Level) This line indicates an uncorrected read error has been detected: (a) Vertical Parity in error. (b) Longitudinal Parity in error. Vertical parity errors will be indicated by this line coincident with the data of the character(s) in error, and specified exactly as the READ DATA for the character. A READ CLOCK will always accompany a character which has been read, and this READ CLOCK may be used, in conjunction with HARD ERROR, to store vertical parity error, if desired. Longitudinal Parity errors will be indicated by this line approximately 12 character periods after the last READ CLOCK has been transmitted. No READ CLOCK will accompany the HARD ERROR pulse in the case of longitudinal parity error. This pulse will be approximately 3 ½ character-periods in width, and will return to the FALSE state slightly prior to DATA BUSY going FALSE.
HARD ERROR (PE)	(Output Pulse or Level) This output indicates an uncorrectable read error has been detected by the formatter for one or more of the following reasons: (a) False premable detection (b) False postamble detection (c) Buffer overflow (d) Multichannel dropout (e) Parity error without associated channel dropouts With the exception of a parity error, the formatter will cease transmission of further read data and search for the IBG. For a parity error only, the erroneous character will be transmitted and labelled by a pulse on HARD ERROR at the READ CLOCK.

TABLE 3 (Cont.)
FORMATTER SIGNAL DESCRIPTIONS

SIGNAL NAME	DESCRIPTION
CORRECTED ERROR (PE)	(Output Pulse) This output indicates that a single track dropout has been detected and that the formatter is performing error correction. NOTE: When performing a read-after-write operation, to verify that information has been correctly recorded onto tape, the record should be rewritten if either a HARD ERROR or CORRECTED ERROR is detected.
EOF DETECT	(Output Pulse) This line indicates that the formatter read logic has detected a file mark. EOFs are detected in both the forward and reverse directions.
READY STATUS	(Output Level) This line is TRUE only when all of the following conditions exist in the selected transport: the initial load or rewind sequence is complete, and the transport is ON LINE and not rewinding. That is, the transport is ready to receive an external command.
ON LINE STATUS	(Output Level) This line is TRUE if the selected transport is under remote control. When FALSE the transport is off-line and cannot be operated externally.
REWIND STATUS	(Output Level) This line is TRUE when the selected transport is in a REWIND or advance to LOAD POINT mode.
WRITE DISABLED	(Output Level) This line is TRUE when no write ring has been installed on the supply reel of the selected transport. The transport will not write when this output is true.
LOAD POINT	(Output Level) This line is TRUE when the selected transport detects the BOT marker.
END OF TAPE	(Output Level) This line is TRUE when the selected transport detects the END OF TAPE marker.
DENSITY STATUS (NRZI)	(Output Level) This line is TRUE when the selected transport has responded to a HIGH density command.
LOW SPEED STATUS	(Output Level) This line is TRUE when the selected transport is a LOW SPEED unit. For example, if a 12.5 ips transport and a 37.5 ips transport are to be operated by the same formatter, the LOW SPEED jumpers are set to select 12.5 ips, and the HIGH SPEED jumpers are set to select 37.5 ips. The 12.5 ips transport will then be wired to generate LOW SPEED STATUS when selected.

TABLE 3 (Cont.)
FORMATTER SIGNAL DESCRIPTION

SIGNAL NAME	DESCRIPTION
SINGLE/DUAL GAP	(Output Level) This line indicates whether the selected transport is a single or dual gap device. TRUE=Single Gap FALSE=Dual Gap
NRZI	(Output Level) This line indicates whether the selected transport is an NRZI transport. TRUE=NRZI
WRITE CLOCK	(Output Pulse) This line indicates that the information currently presented on the WRITE DATA lines is being written on the tape. The trailing edge may be utilized to initiate data line changes.
READ CLOCK	(Output Pulse) This line should be used to sample the READ DATA lines. Individual pulses will be generally equally-spaced, with some variations due to skew and bit-crowding effects.
CR WINDOW(NRZI)	(Output Pulse) This line will become TRUE during the time the CRC character is expected from the tape. It will overshadow the READ CLOCK associated with the CRC character by at least 1/2 character-period on each side. NOTE: The CRC character may be zero, and thus have no READ CLOCK. This line will not become true at any time if the selected transport is a 7 Track device.
7/9 TRACK	(Output Level) This line, when true, indicates that the selected tape unit is 7 Track.
READ DATA (NRZI)	(Output Level) These lines transmit data read from the tape. READ DATA will be stable prior to the leading edge of READ CLOCK and will remain stable for approximately the full character period, $\pm$ variations due to skew and bit-crowding effects.
READ DATA(PE)	(Output Level) These nine lines transmit read data from the formatter to the controller, Each character read from tape is available by sampling these lines in parallel by the READ CLOCK. Data remains set on the lines for a full character period. The corresponding READ CLOCK is 1/3 character period wide, in the center of the data cell.
ID BURST (PE)	(Output Pulse) When reading forward from BOT, the formatter inspects the parity channel for the presence or absence of the identification burst which distinguishes PE tapes. If the burst is detected this line is set true for a short time as the BOT marker passes over the read head.

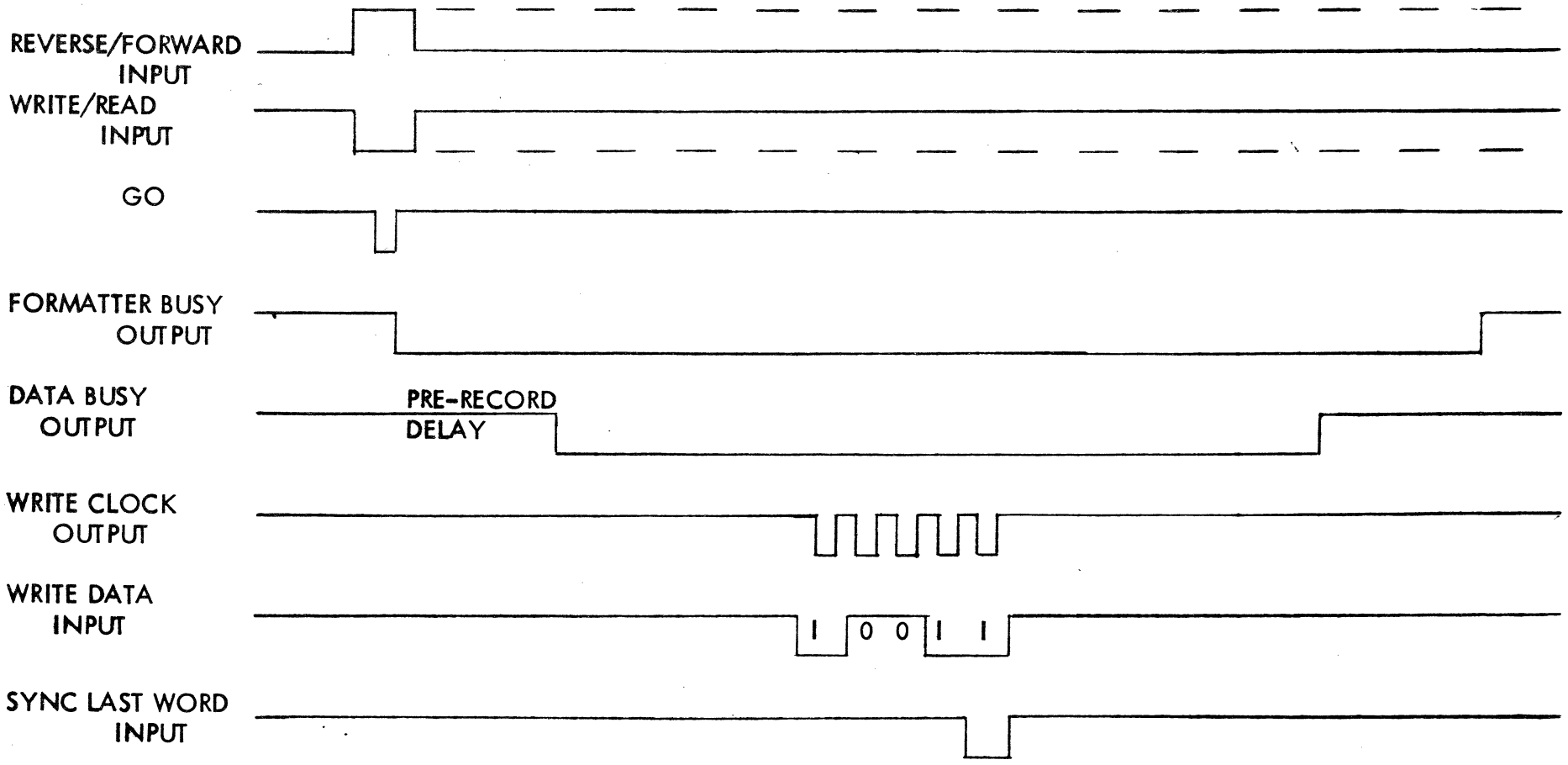

Figure 2 Write Operation Timing Diagram

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SHEET OF

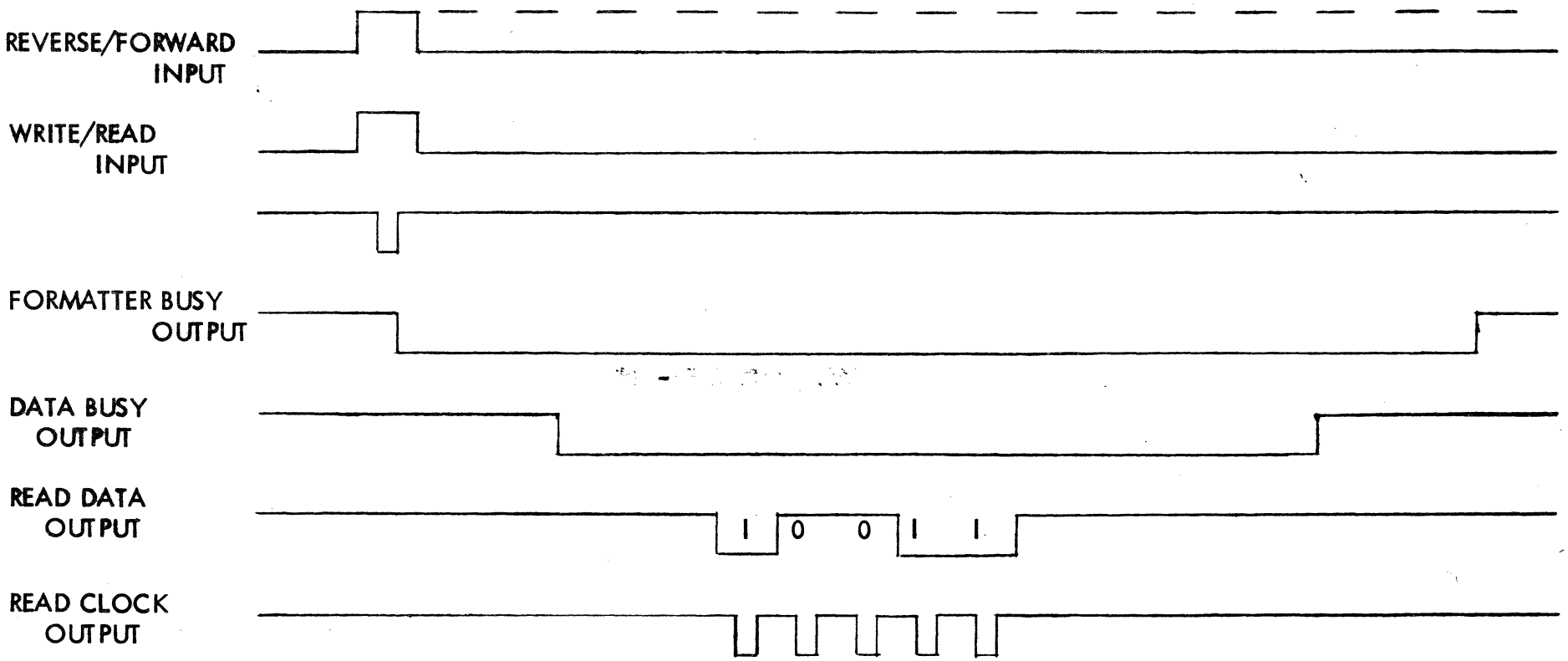

Figure 3 Read Operation Timing Diagram

DIGI-DATA CORPORATION

SHEET OF

TABLE 4

TYPICAL NRZI FORMATTER TIME DELAYS AT 12.5 IPS(Time in Milliseconds)

FUNCTION	REFERENCE	TIME			
		7 T		9T	
		Single Gap	Dual Gap	Single Gap	Dual Gap
WRITE					
1. Write from BOT	Trailing edge of GO to DATA BUSY true.	280	280	280	280
2. Write EOF		280	280	280	280
3. Write NORMAL		68	32	46	34
4. First WRITE CLOCK	DATA BUSY true to first WRITE CLOCK.	5 us	5us	5 us	5us
5. Data ON LINE	Data must be on line and stable for 1/2 character period before WRITE CLOCK.				
6. Post Record Delay	Last WRITE CLOCK to DATA BUSY going false.	8	8	8	8
7. Stay at speed window	Trailing edge of DATA BUSY.	250 us	250 us	250 us	250 us
8. Transport stopping	Trailing edge of DATA BUSY to trailing edge of FORMATTER BUSY.	35	35	35	35
READ					
1. Read from BOT	Trailing edge of GO to DATA BUSY true.	150	150	150	150
2. Read normal		24	24	24	24
3. First READ CLOCK	DATA BUSY true to first READ CLOCK	44		22	
4. Post Record Delay (FWD)	Last READ CLOCK to DATA BUSY going false.	2.0	2.0	2.5	2.5
REV (NORMAL)		17	17	7.4	7.4
REV (EDIT)		37	37	17	17
5. Stay at speed window	Trailing edge of DATA BUSY.	250us	250us	250 us	250us
6. Transport Stopping	Trailing edge of DATA BUSY to trailing edge of FORMATTER BUSY.	35	35	35	35

TABLE 4A

TYPICAL PE FORMATTER TIME DELAYS AT 12.5 IPS (Time in Milliseconds)

FUNCTION	REFERENCE	TIME
WRITE		
1. Write from BOT	Trailing edge of GO to DATA BUSY going true.	512
2. Write Normal	Trailing edge of GO to DATA BUSY going true.	44.8 (Single gap) 33.6 (dual gap)
3. First WRITE CLOCK	DATA BUSY true to first WRITE CLOCK.	2.050
4. Data On Line	Data must be on line and stable for one-half a character period before WRITE CLOCK.	25 usec
5. Postamble & Post Record Delay	LAST WORD to DATA BUSY going false.	8.8 (single gap) 21.4 (dual gap)
6. Transport Decelerating	DATA BUSY going false to FORMATTER BUSY going false.	38.4
7. END OF FILE	Trailing edge of GO to DATA BUSY going true.	308
READ		
1. Read from BOT	Trailing edge of GO to DATA BUSY going true.	128
2. Read Normal	Trailing edge of GO to DATA BUSY going true.	25.6
3. Transport Decelerating	DATA BUSY going false to FORMATTER BUSY going false.	38.4

6.0 APPLICATION INFORMATION

6.1 WRITE OPERATION

Writing normally occurs in the forward direction for commands such as Write Record, END OF FILE, EDIT, or ERASE. It is possible to write in the reverse direction (i.e., reverse erase), but this is not a recommended procedure.

An interface line, WRITE/READ under control of the customer specifies whether a write or read operation is required. This line may be either a pulse or level which envelops the GO command. The interface line, REVERSE/FORWARD conditioned by the customer, selects the direction of tape travel. This line envelops the command and may either be a pulse or a level.

As a general rule, all interface lines are sampled by GO and latched at the formatter.

The formatter will retain the previously established WRITE/READ and REVERSE/FORWARD function until the next GO command. At that time, new conditions may be established. The formatter will be reset by a false level or pulse on the FORMATTER ENABLE line.

6.2 WRITE FORWARD COMMAND

The following sequence of events will take place when writing a record. Typical waveforms are shown in Figure 2 for the Write operation.

(1) Transport must be READY.

(2) Establish Write conditions.
   (a) Set WRITE/READ true.
   (b) Set REVERSE/FORWARD false.

(3) Initiate GO command. On the trailing edge of this pulse, the write conditions established in Step (2) are initiated. FORMATTER BUSY is set true.

   When writing from Load Point, the PE formatter will automatically write the ID Burst and then proceed with writing the first block. In order to ensure correct positioning of the ID Burst, the tape should be positioned at Load Point through either a Load command or a Rewind command.

(4) (NRZI) Set up data on the WRITE DATA lines. The NRZI formatter allows either internal or external parity generation. DATA BUSY goes true just before the first WRITE CLOCK is issued.

Data must be present on these lines a minimum of one-half a character period before the first WRITE CLOCK is present. The next character of information must be placed on these lines within one-half of a character period after the trailing edge of the first WRITE CLOCK. This sequence is followed until all data characters of the record have been transmitted. A write operation can be abandoned if WRITE DATA is not ready when the first WRITE CLOCK is issued by the controller. To abandon a Write operation, LAST WORD is set true. This will write a one-character record. The user should then backspace (Read Reverse) and start Write operation again.

(PE) When DATA BUSY goes true, the PE formatter automatically begins to write the preamble.

Set up data on the WRITE DATA lines. The PE formatter allows either internal or external parity generation. DATA BUSY goes true 4l character periods before the first WRITE CLOCK is issued. Data must be present on these lines a minimum of one-half a character period before the first WRITE CLOCK is present. The next character of information must be placed on these lines within one-half of a character period after the trailing edge of the first WRITE CLOCK. This sequence is followed until all data characters of the record have been transmitted. A Write operation can be abandoned if WRITE DATA is not ready when the first WRITE CLOCK is issued by the controller. To abandon a Write operation, LAST WORD is set true. This will write a one-character record. Backspace (Read Reverse) and start Write operation again.

(5) Set LAST WORD true at the same time that the last data character is transmitted to the formatter. When the last character is recorded, the NRZI formatter will automatically generate the check character(s). The PE formatter will automatically generate the postamble.

(6) When the check character(s) postamble are completed, and after a small postrecord delay, DATA BUSY goes false.

DATA BUSY going false may be used to trigger the next GO command. This can be used for writing "on-the-fly".

(7) This "on-the-fly" operation should only be used when performing the same operation (i.e., writing or reading in the same direction).

(8) FORMATTER BUSY goes false when tape motion has ceased.

(9) When Write Checking for either a single or dual gap system, and a HARD ERROR or CORRECTED ERROR occurs, the record should be re-written. In dual gap systems, data will be sent to the controller while

6.0 APPLICATION INFORMATION

6.2 WRITE FORWARD COMMAND (Cont.)

the Write Operation is being performed. To rewrite a record, perform a Reverse Read operation. The system will automatically stop in the proper place for a Rewrite operation.

6.3 VERTICAL PARITY GENERATION

The vertical parity bit recorded in Channel P is generated so that the total number of "1" bits in each data character is always odd for 9 Track and PE transports, and may be selected as odd or even for 7 Track transports.

When EXTERNAL PARITY is selected, the parity may be even or odd as generated externally (7 Track only).

6.4 END OF FILE GENERATION

The following sequence of events will take place when writing on End of File:

(1) Transport must be READY.
(2) Establish WRITE END OF FILE conditions:
    (a) Set WRITE/READ true.
    (b) Set REVERSE/FORWARD false.
    (c) Set END OF FILE true.
(3) Initiate GO command. On the trailing edge of the pulse, the conditions established in Step 3 are initiated. FORMATTER BUSY is set true.
(4) DATA BUSY goes true, and the FILE MARK is automatically written onto tape. For dual gap Read After Write systems, EOF DETECT will also go true during the writing of the END OF FILE record.
(5) DATA BUSY goes false when the writing of the END OF FILE is completed.
(6) Tape motion ceases and FORMATTER BUSY goes false. The next operation may now be performed.

6.5 ERASING

Erasing is required when it is necessary to abandon a specific area of tape after repeated Write errors or to delete a specific record from tape. This can be accomplished by using one of the following methods:

(1) Fixed Length Erase
    (a) Set up interface for END OF FILE.
    (b) Set ERASE True.

6.0 APPLICATION INFORMATION

6.5 ERASING (Cont.)

(c) Initiate GO. A fixed length of tape of approximately 3.75 inches will be erased.

(2) Variable Length Erase

(a) Set up conditions for Write Forward.

(b) Set ERASE true.

(c) Initiate GO. Determine length to be erased by counting WRITE CLOCKS(no data will be written when ERASE is true).

(d) Set LAST WORD true when desired length is reached. Formatter will complete erase function and stop transport.

(3) To delete a specific record on tape, the following sequence should be followed:

(a) Set EDIT true.

(b) Read the record in reverse (follow the sequence for Read Reverse) and determine the length of the record by counting READ CLOCKS (if the record length is not known).

(c) Set up conditions for Write Forward (EDIT true).

(d) Set ERASE true.

(e) Initiate GO. Determine length to be erased by counting WRITE CLOCKS (no data will be written when ERASE is true).

(f) Set LAST WORD true when desired length is reached. Formatter will complete erase function and stop transport.

6.6 EDIT

Editing is required when it is desired to change a particular record in the midst of many records. This function is a desirable feature for key-to-tape systems and for primary storage media. The Edit function serves two basic purposes, one of which is correct head positioning in the gap. The second is to slow the write current turn-off/turn-on to prevent a "glich" or noise transient in the gap. When performing an Edit function, the selected record must first be read in the reverse direction. This provides for optimum head positioning for the subsequent Write operation. The new record to be written must be of the same length to ensure maintenance of IBM compatible IBGs.

To perform an EDIT function, the following procedure should be followed:

(1) Read Forward over the record to be edited.

6.0 APPLICATION INFORMATION

6.6 EDIT (Cont.)

(2) Set EDIT true.
(3) Set WRITE/READ false.
(4) Set REVERSE/FORWARD true.
(5) Initiate GO. Determine the length of the record by counting READ CLOCKS (if the record length is not known).
(6) Set WRITE/READ and EDIT true (when FORMATTER BUSY goes false).
(7) Set REVERSE/FORWARD false.
(8) Initiate GO.
(9) Set LAST WORD true when the last character of the new record is set up. Formatter will complete function and stop.
(10) Subsequent operations can be performed as desired.

6.7 READ OPERATION

Reading can take place in either the forward or reverse direction. Remotely selectable read thresholds ensure that no write errors have occurred during a previous write operation. As an example, for single gap transports, READ THRESHOLD 1 under the customer's control is used to select the high threshold when it is desired to read a record that has just been written. For dual gap transports, the threshold selection is an automatic function. On all systems, the capability of an extra low read threshold for data recovery is provided through the interface line READ THRESHOLD 2.

Read threshold levels are set to ensure that when data is written on tape, its remanence is above 30 percent nominal amplitude. On subsequent read operations, the threshold or clip level is reduced to 10 percent to ensure data recovery. The extra low threshold for data recovery selects 5 percent as the read level.

The PE formatter provides three-character deskewing capability, automatic data correction for a single track dropout, removal of the preamble and postamble, END OF FILE detection, and forward/reverse Read capability. The data output of the formatter is decoded and is presented in parallel form to the interface. This data is transmitted to the user's equipment on READ DATA interface lines.

Another interface line, READ CLOCK samples the READ DATA lines. This waveform consists of a pulse for each data character read from tape.

6.0 APPLICATION INFORMATION

6.8 READ FORWARD

The following sequence of events will take place when reading a record. Typical waveforms are shown in Figure 3.

(1) Transport must be Ready.

(2) Establish Forward Read conditions.
   (a) Set WRITE/READ false.
   (b) Set REVERSE/FORWARD false.

(3) Initiate GO. Conditions established in Step 2 are initiated on the trailing edge of the GO pulse. FORMATTER BUSY is set true.

(4) DATA BUSY goes true when the tape has reached approximately 80 percent of rated speed. DATA BUSY can be used to gate READ CLOCKS.

(5) Read data should be sampled by the READ CLOCKS. HARD ERROR/CORRECTED ERROR indicates that a data error has occurred and normal read recovery techniques should be used (i.e., re-read, change threshold levels, etc.).

(6) DATA BUSY goes false when the check character(s)/postamble is past the read head and the post record delay has been completed.

   DATA BUSY going false can be used to trigger the next GO command and can be used for reading "on-the-fly". This technique should be used only when repeating the same operation (i.e., writing or reading in the same direction).

(7) FORMATTER BUSY goes false when tape motion has ceased.

6.9 READ REVERSE

Read Reverse is implemented in a manner similar to Read Forward. However, the order of the data characters will be reversed. The only difference between Read Forward and Read Reverse operations is that REVERSE/FORWARD is set true.

6.10 FILE MARK DETECTION

The formatter detects file marks in both the forward and reverse directions. The presence of a File Mark is indicated on the status line EOF DETECT.