PRELIMINARY SPECIFICATION

NRZI 1100 NOVA INTERFACE

1. INTRODUCTION

The Digi-Data NOVA Interface is designed to provide plug-to-plug compatible read/write magnetic tape drives, with industry compatible NRZI format, using the MINIDEK line of reader/recorders with NRZI formatting electronics.

From one to four MINIDEK transports may be operated, under program control, with this single interface card.

2. ELECTRICAL INTERFACE

The interface conforms to all electrical interface specifications for the MINIDEK series, and for the NOVA I/O bus.

3. LOGIC LEVELS

A. Internal

All TTL High True

1 = True = +2.5 to +5.5 volts

0 = False = 0.0 to +0.4 volts

B. External

All TTL/DTL Compatible defined by interface specifications for NOVA and MINIDEK bus.

4. PHYSICAL AND ENVIRONMENTAL

The interface consists of a single printed-circuit card approximately 15 x 15 inches (see figure 1, Appendix A), which resides inside the NOVA mainframe or extender module, and cables out the NOVA backpanel to interface with the NRZI formatter.

Plus 5.0 volts is obtained from the NOVA I/O bus.

5. GENERAL DESCRIPTION

The magnetic tape equipment handles seven inch reels of half-inch tape that are standard throughout the industry. A tape system consists of a control and up to four tape transports. The control is connected to the data channel, so the program need only set up the tape for a particular operation and all transfers to and from memory are then handled automatically. To operate with the data channel the control has an address counter and a word counter as well as data buffers.

General Description - continued

The program communicates with the tape control, which in turn governs all tape transports but operates only one at a time. Reading and writing (recording) can occur only when tape is moving forward (from supply reel to takeup reel), but the control can space the tape (i.e. move it to a new position) in either direction. Although only one transport can be reading, writing or spacing at a time, rewinding the entire tape onto the supply reel at high speed requires only initiation by the control, and the transport then proceeds automatically while the control can operate another.

The control writes lateral characters, i.e. it writes transverse lines on tape with nine bits of information per line, one bit in each track. Every character is in either a data record or a file mark. A data record contains both data characters and error-checking characters: every data character consists of a data byte and a parity bit, which the control generates so that the number of 1s in the line is odd. The data bytes in a record taken together correspond to a block of words sent from memory to the control. To separate adjacent records the control automatically erases a segment of tape, a record gap, between them. The control always stops tape in a gap.

Transfers between memory and control are of full words even though the tape characters contain 8-bit data bytes. The minimum length of a record is two words (four data characters), the maximum length is 4096 words. To write, the control divides the words into data bytes, and when reading, it reassembles them, as two characters, each containing an 8-bit data byte.

FIRST CHARACTER								SECOND CHARACTER							
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

To facilitate tape processing the program can group sets of data records into files. The end of a file is indicated by a 3-inch gap followed by a file mark, which is a special record containing a single, special data character and its (equivalent) LRCC. A space command automatically terminates when a file mark is encountered.

Every tape has two physical markers to indicate its extremities. These markets are reflective strips that are sensed by photoelectric cells in the transport. At least ten feet in from the beginning of the reel is the loadpoint marker, which is the logical beginning of tape (BOT).

General Description - continued

Reverse commands stop automatically at this marker. A loadpoint gap of at least three inches preceeds the first record on the tape. The end-of-tape marker (EOT) is at least fourteen feet from the physical end of the tape; the final ten feet of tape should be left for trailer, i.e. the program should not record more than a few feet beyond the EOT (this is more than enough for a record of maximum length.) A status bit indicates when the tape is beyond the EOT.

An annular groove is molded into the back of every reel. The control cannot write on the tape unless the supply reel has a plastic (write enable) ring in this groove. By leaving the ring out, the operator can protect the data on the tape from accidental destruction (overwriting or erasure).

While the control is actually processing the data part of a record, the data transfer rate is fixed. But in a lengthy tape run the effective (average) transfer rate depends on record length, which determines the percentage of tape taken up by gaps (at 500 bpi density each record gap could hold an additional 240 words). The effective transfer rate is therefore a function of record length as well as tape speed and density.

6. PROGRAMMING

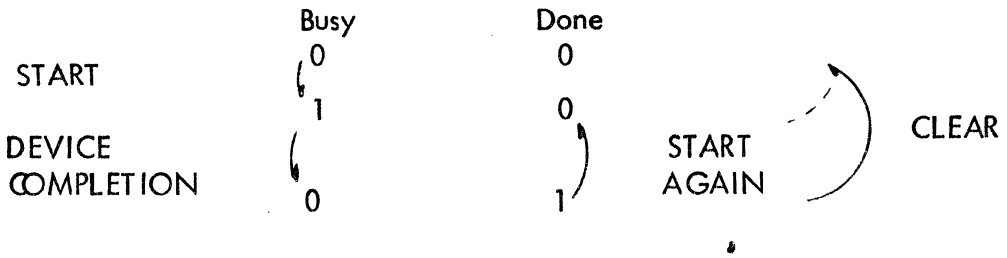
The interface has a 6-bit device selection network, an Interrupt Disable flag, and Busy and Done flags. The selection network decodes bits 10-15 of the instruction so that it is the only device which responds to signals sent by the processor over the in-out bus. The Busy and Done flags together denote the basic state of the device. When both are clear the device is idle. To place the device in operation, the program sets Busy. If the device will be used for output, the program must give a data-out instruction that sends the first unit of data - a word or character depending on how the device handles information. (The word "output" used without qualification always refers to the transfer of data from the processor to the peripheral equipment; "input" refers to the transfer in the opposite direction). When the device has processed a unit of data, it clears Busy and sets Done to indicate that it is ready to receive new data for output, or that it has data ready for input. In the former case the program would respond with a data-out instruction to send more data in the latter with a data-in instruction to bring in the data that is ready. If the Interrupt Disable flag is clear, the setting of Done signals the program by requesting an interrupt; if the program has set Interrupt Disable flag is clear, the setting of Done signals the program by requesting an interrupt; if the program has set Interrupt Disable, then it must keep testing Done or Busy to determine when the device is ready.

Programming - continued

In all in-out instructions bits 8 and 9 either control or sense Busy and Done. In those instructions in which bits 8 and 9 specify a control function, the mnemonics and bit configurations and the functions they select are as follows:

Mnemonic	Bits 8-9	Control Function
	00	None
S	01	Start the device by clearing Done and setting Busy
C	10	Clear both Busy and Done, idling the device
U	11	Unused

The overall sequence of Busy and Done states is determined by both the program and the internal operation of the device.



The data -in or data-out instruction that the program gives in response to the setting of Done can also restart the device. When all the data has been transferred the program generally clears Done so the device neither requests further interrupts nor appears to be in use, but this is not necessary. Busy and Done both set is a meaningless situation.

Bits 5-9 specify the complete function to be performed. If there is no transfer (bits 5-7 all alike), bits 3 and 4 are ignored and bits 8 and 9 may specify a control function or a skip condition.

NIO No IO Transfer

0	1	1	0	0	0	0	0	F		D					
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Perform the control function specified by F in device D.

SKPBN Skip if Busy is Nonzero

0	1	1	0	0	1	1	1	0	0	D					
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Skip the next instruction in sequence if the Busy flag in device D is 1.

Programming - continued

SKPBZ Skip if Busy is Zero

0	1	1	0	0	1	1	1	0	1	D					
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Skip the next instruction in sequence if the Busy flag in device D is 0.

SKPDN Skip if Done is Nonzero

0	1	1	0	0	1	1	1	1	0	D					
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Skip the next instruction in sequence if the Done flag in device D is 1.

SKPDZ Skip if Done is Zero

0	1	1	0	0	1	1	1	1	1	D					
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

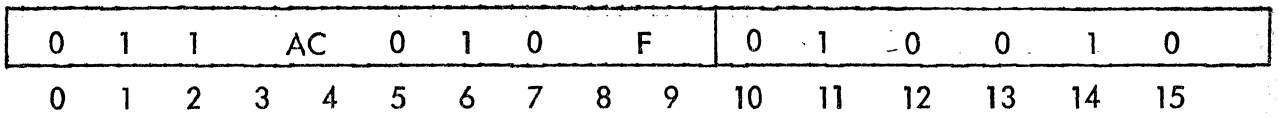
Skip the next instruction in sequence if the Done flag in device D is 0.

To run the tape, the program must select a transport and a command; most of the latter also require specification of an initial address (to the 15-bit address counter) for data channel access, and the (twos complement) negative of a word count. Space commands use the 12-bit word counter for counting records.

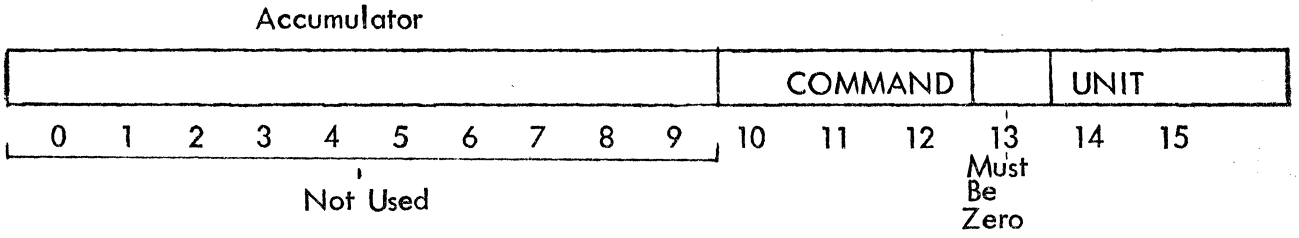
The tape system uses five of the IO transfer instructions. Busy and Done are controlled or sensed by bits 8 and 9 in all IO instructions with device code 22, mnemonic MTA. Interrupt Disable is controlled by interrupt priority mask bit 10. A second tape system connected to the bus would have device code 62. The Clear function (F = 10) clears Busy and Done and also clears the command register and the status flags in the control. Start (F = 01) clears Done, sets Busy, clears many of the flags, and places the control and the selected transport in operation.

Programming - continued

DOA MTA Data Out A, Magnetic Tape



Load the contents of AC bits 9-15 into the tape command register as shown, and perform the function specified by F.

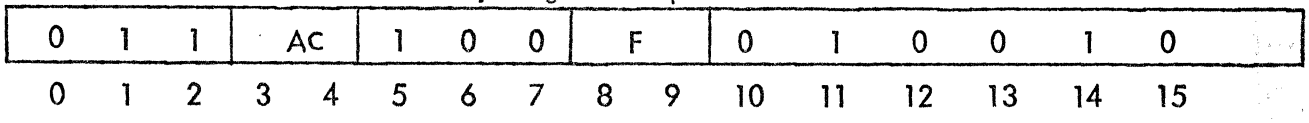


10-12 These bits select the command as follows

0 Read
1 Rewind
2 Go Offline
3 Space Forward
4 Space Reverse
5 Write
6 Write End of File
7 Write w/extended Gap

13-15 Numbers 0-3 address transports 0-3.

DOB MTA Data Out B, Magnetic Tape



Load the contents of AC bits 1-15 into the address counter (AC bit 0 should be 0), and perform the function specified by F.

DOC MTA Data Out C, Magnetic Tape

0	1	1	AC				1	1	0	F							0	1	0	0	1	0
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15							

Load the contents of AC bids 4-15 into the word counter, and perform the function specified by F.

DIA MTA Data In A, Magnetic Tape

0	1	1	AC				0	0	1	F							0	1	0	0	1	0
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15							

Read the status of the tape system into AC as shown, and perform the function specified by F.

Error	Data Late	Re-wind ing	Ille-gal	High Den sity	Parity Error	End Of Tape	End of File	Load Point	9 Track	Bad Tape	Send Clock	First char	Write Lock	Odd char.	Unit Ready
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Bits 11,12 are for maintenance only and are not discussed further here. Start clears Error, Data Late, Parity Error, End of File and Bad Tape; Clear clears these plus Illegal; the remaining flags are supplied by the addressed transport (which is automatically unit 0 after Clear is given).

0 Bit 1,3,5,6,7,8 or 14 is 1.

1 The data channel has failed to respond in time to a request for access (e.g. because of a long indirect addressing chain or preemption of the channel by faster devices).

2 The addressed transport is now rewinding.

3 This bit sets if the program gives Start when any of the following conditions holds:
The command is Write, Write with Extended Gap, or Write End of File, and Write Lock (bit 13) is 1.
The command is Space Reverse or Rewind and Loadpoint (bit 8) is 1.
Busy is 0 but Unit Ready (bit 15(is also 0.
The setting of Illegal prevents the tape control from going into operation and sets Done, requesting an interrupt if Interrupt Disable is clear. The program must give Clear before proceeding (Start does not clear Illegal).

Programming - continued

4. The addressed transport is set to high density. (This bit is hardwired to "1" for Nova compatibility).

5 In Read or Write the control has encountered a data character whose lateral parity differs from that specified with the command or has discovered a track with odd parity the length of a record. Incorrect parity in a CRC or LRCC does not set this bit.

6 The addressed tape is beyond the EOT marker. (Reverse motion clears this bit).

7 The control has written a file mark or has encountered one in reading or spacing. If there is an error in a file mark it is not recognized as such, i.e. the control interprets it as a very short data record.

8 The addressed tape is at loadpoint.

9 The addressed transport handles 9-track tape. (This bit is hardwired to "1" for Nova compatibility).

10 Not used

13 The write enable ring is not in the supply reel on the addressed transport.

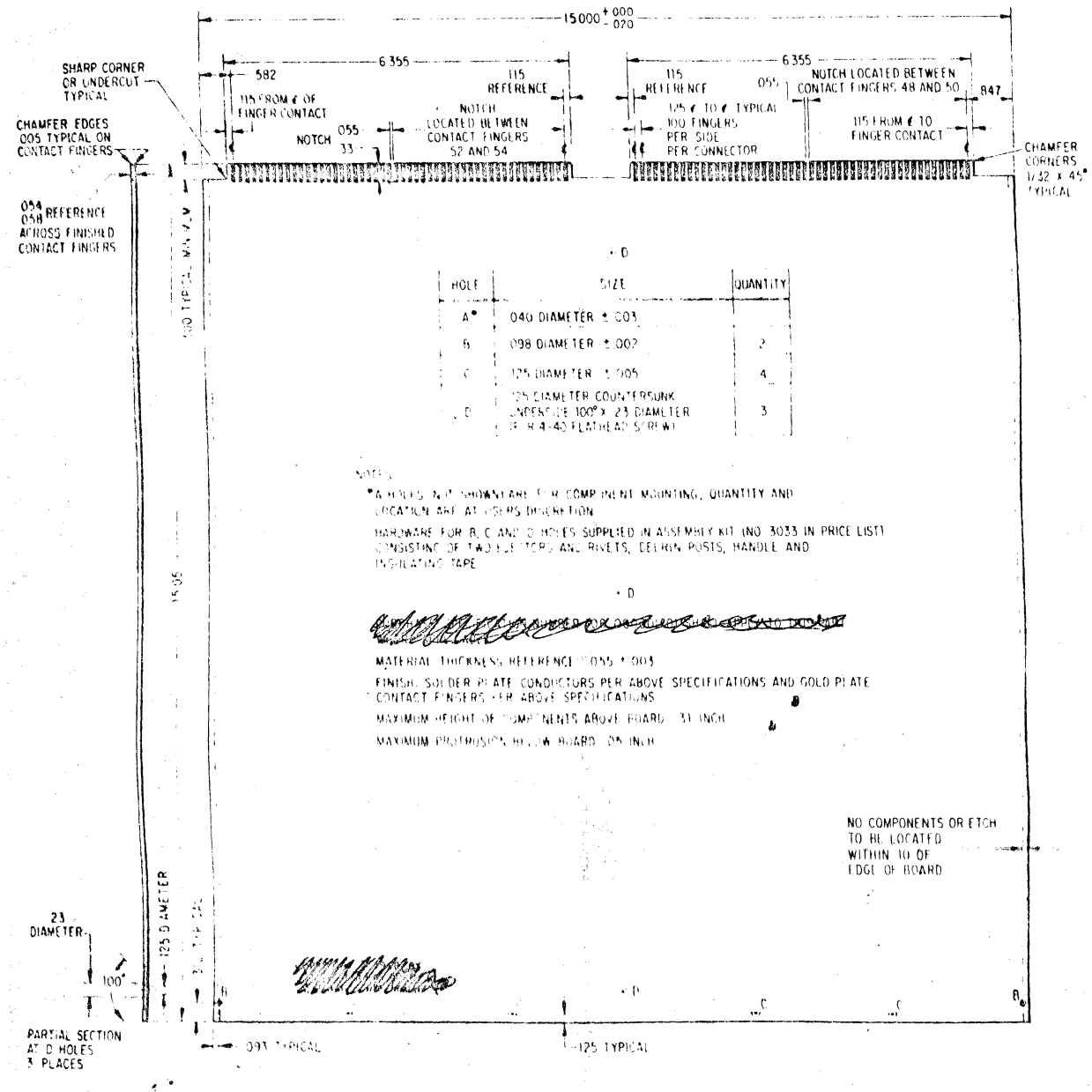
14 An odd number of characters were detected while reading or writing.

15 The addressed transport is ready for operation by the program.

DIB MTA Data in B, Magnetic Tape

0	1	1	AC		0	1	1	F		0	1	0	0	1	0
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

APPENDIX A



HOLE	SIZE	QUANTITY
A*	.040 DIAMETER ± .003	
B	.098 DIAMETER ± .002	2
C	.125 DIAMETER ± .005	4
D	.125 DIAMETER COUNTERSUNK UNDERSIDE 100° X .23 DIAMETER FOR 4-40 FLATHEAD SCREW	3

*A HOLES N.P. SHOWN ARE FOR COMPONENT MOUNTING, QUANTITY AND LOCATION ARE AT USER'S DISCRETION

CIRCUIT BOARD SPECIFICATIONS

FIGURE 1