DWG NO 98A0945

REVISIONS			
SYM	DESCRIPTION	APPROVED	DATE
A	PRODUCTION RELEASE PER EN 82248	[illegible]	[illegible]

Note: Unless otherwise specified:

This document also applies to the:

E-2993, 300 CPM Card Reader Special Option

E-2747, 600 CPM Card Reader Special Option

E-2382, 1000 CPM Card Reader Special Option

Addendum 1	Describes 600 CPM spec and timing differences (E-2747)
Addendum 2	Describes 1000 CPM spec and timing differences (E-2382)
Addendum 3	Described 300 CPM Mark Sense Option (E-2993)

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TITLE

ENGINEERING DESCRIPTION (MAINTENANCE AID)
CARD READER CONTROLLER
MODEL 620-28

CODE IDENT NO.	SIZE	DWG NO.	REV
21101	A	98A0945	A

SCALE

SHEET 1 OF 32

98A0153-V06

ENGINEERING DATA FORM

OPTION	300 CPS Card Reader Controller
MODEL	620-28
NO. OF LOGIC CARDS REQ'D.	1
NO. OF CARD SLOTS REQ'D.	3
LOCATION OF SLOTS (NUMBERING)	Any
CONNECTORS REQ'D. (EXCLUDING I/O)	1
KEYING	None
ST'D. DEVICE ADDRESS	30
WIRELIST NUMBER	95W0998
MANUAL PUBLICATIONS NUMBER	This document
PERIPHERAL EQUIPT. REQ'D	Card Reader
MFG'R.	Documation, Inc.
MODEL	M200
GEN'L. SPECS	300 cards per minute

NOTES:

Drawings:	
Option Drawing	01P1533
Assy., Controller	44P0684
Procurement Spec.	35A0106
Cable Drawing	53P0735
Logic Diagrams	91C0455
Test Specification	98A0946
Test Program	92A0107-012 *

Note: Unless otherwise specified, the timing and general information in this drawing pertains to the 620-38 card reader system.

*Use rev. D or C reader if initialize is to be tested.

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ILLUSTRATIONS

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TABLES

SECTION 1
GENERAL DESCRIPTION

1.1 INTRODUCTION

The Varian Data Machines model 620-28 Card Reader Controller is a special peripheral computer option that interfaces the 620 or 7X computer to the card reader specified by Procurement Specification 35A0106.

The controller is packaged on a wire wrapped plug in module which can be installed in a 620 peripheral controller chassis. The controller is compatible with the 620 Buffer Interlace Controller (BIC) and the Priority Interrupt Module (PIM).

1.2 FUNCTIONAL DESCRIPTION

References: Logic Diagram 91C0455
VDM Computer Manual 620 or V7X Series
Documation Instruction Manual

The controller performs the timing and logical functions required to transfer 80 twelve bit columns of data from the card reader to the CPU at a speed of 300 cards per minute (CPM) ± 10%.

1.2.1 Device Address

The assigned device address is 30. The address is decoded from EB00 thru EB05 and signal IUAX (Computer Interrupt Acknowledge). Signals EB00 thru EB02 are made available on the wire wrap connectors at the backplane. This allows the desired device address to be hand wired on the backplane connector and provides the capability of easily changing the device address to any address between 30 and 37, if needed.

1.2.2 External Control Commands (EXC)

There are three external control (EXC) commands: Initialize Controller, Read One Card, and Continuous Feed. These commands are mechanized as follows:

The device address and EB11 allows the Computer Function Ready (FRYX) pulse to be applied to the function decode gates. Lines EB06 thru EB08, which contain the function code, are also applied to these gates. The decoded function lines enable the applicable function control circuits.

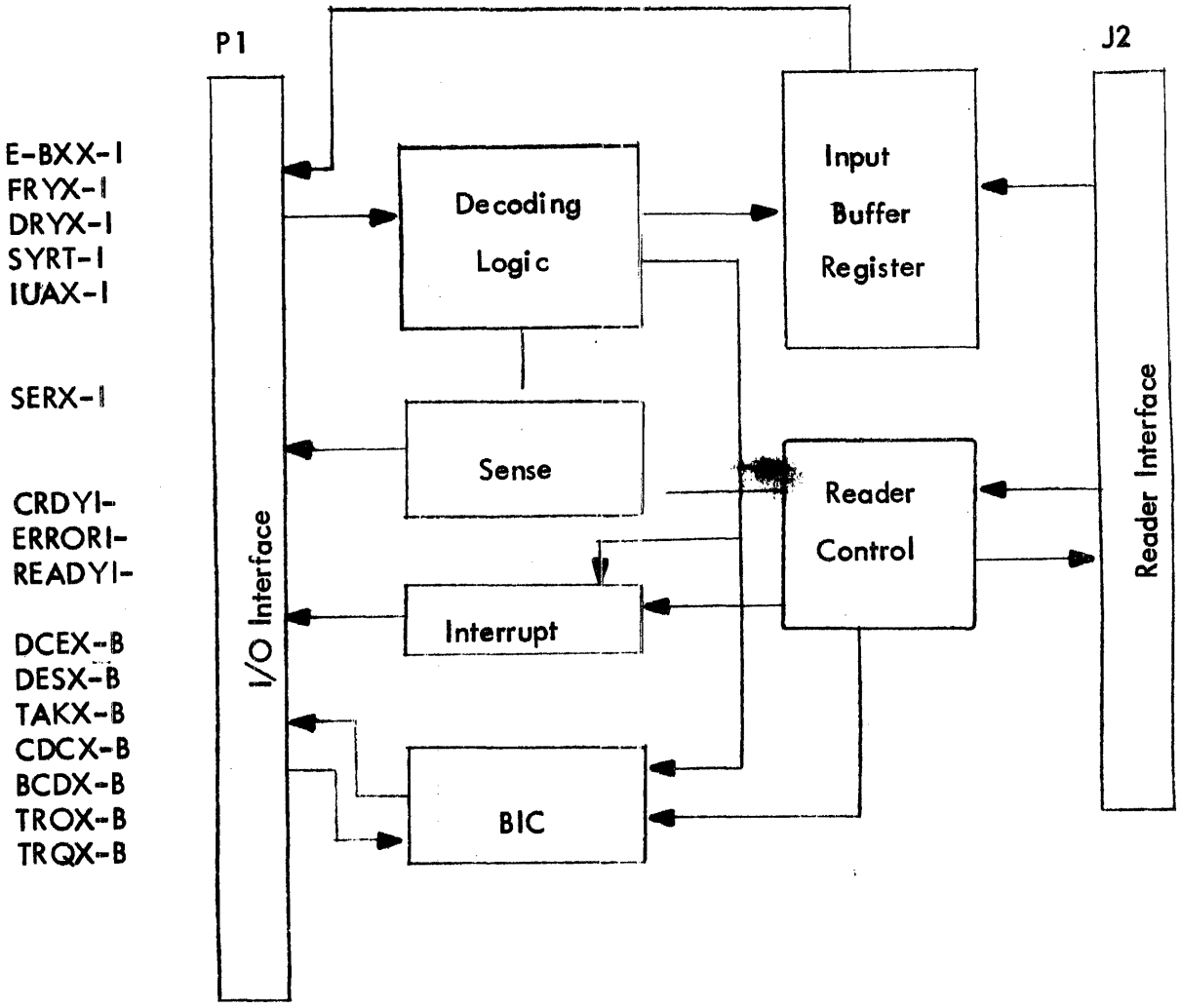


FIGURE 1.1 - CONTROLLER BLOCK DIAGRAM

1.2.3 Data Transfer In (CIA, CIB, INA, INB, IME)

A 12 bit data word is clocked into the input register (DIXX) by INDEX+ pulse from the reader. Data is then transferred to the CPU as follows:

The control logic may be activated from the BIC signal BCIE or from the computer signal DTIE. Either of these terms arms the data transfer in flip-flop DTIX. This flip-flop is then set by the trailing edge of FRYX+ and reset by the trailing edge of DRYX+. DTIX then strobes in the 12 bit data DIXX onto the E-Bus.

1.2.4 BIC Control Logic

Once the BIC is connected to the computer, it sends out signal DCEX+, which enables the set gate of flip flop CDCX. EXC read one card will then set flip flop CDCX. Term CDCX is then returned to BIC, indicating that data transfer is under control of the BIC.

When a data word is ready (BRDY) to be transferred to the computer, term TRQX-B is forced to a logic 0. The BIC responds by forcing the transfer acknowledge term TAKX-B to a logic 0. The BIC acknowledge term BICE- then goes to a logic 0. This signal is then used to enabled data transfer in flip flop DTIX.

1.2.5 Sense Response Logic (SEN)

There are five sense responses to the computer: Character Ready, Read Error, Hopper Empty, Reader Ready, and Card Image.

The sense response that the computer is looking for is enabled by decoding E-Bus lines EB06 thru EB08, the device address, and EB12+. SERX-I will go true (logic zero) if the indicated response is true.

1.2.6 Interrupts

There are three interrupts made available at the backplane, pin P1-75, 77, and 79. These interrupts are the integrated leading edge of Character Ready (CRDYI-), Card Reader Error (ERRORI-), and Card Reader Ready (READYI-), respectively. Card Reader Ready Interrupt also designates end of card image. (ready for EXC2 command).

1.3 LOGICAL DESCRIPTION

The listed program will generate the timing sequences shown in Figure 1.3.

Location	Description	Code
0	EXC Initialize	100030 *
1	Sense Reader Ready	101630
2	5	000005
3	Jump	001000
4	1	000001
5	EXC Feed One Card	100230
6	Sense Character Ready	101130
7	14	000014
10	Sense Reader Error	101230
11	Exit	-
12	JMP	001000
13	6	000006
14	Data Transfer In	102130
15	Sense Character Ready	101130
16	14	000014
17	Sense Card Image	101030
20	15	000015
21	JMP	001000
	0	000000

*Assumes device address 030.

1.3.1 Initialize and Feed One Card

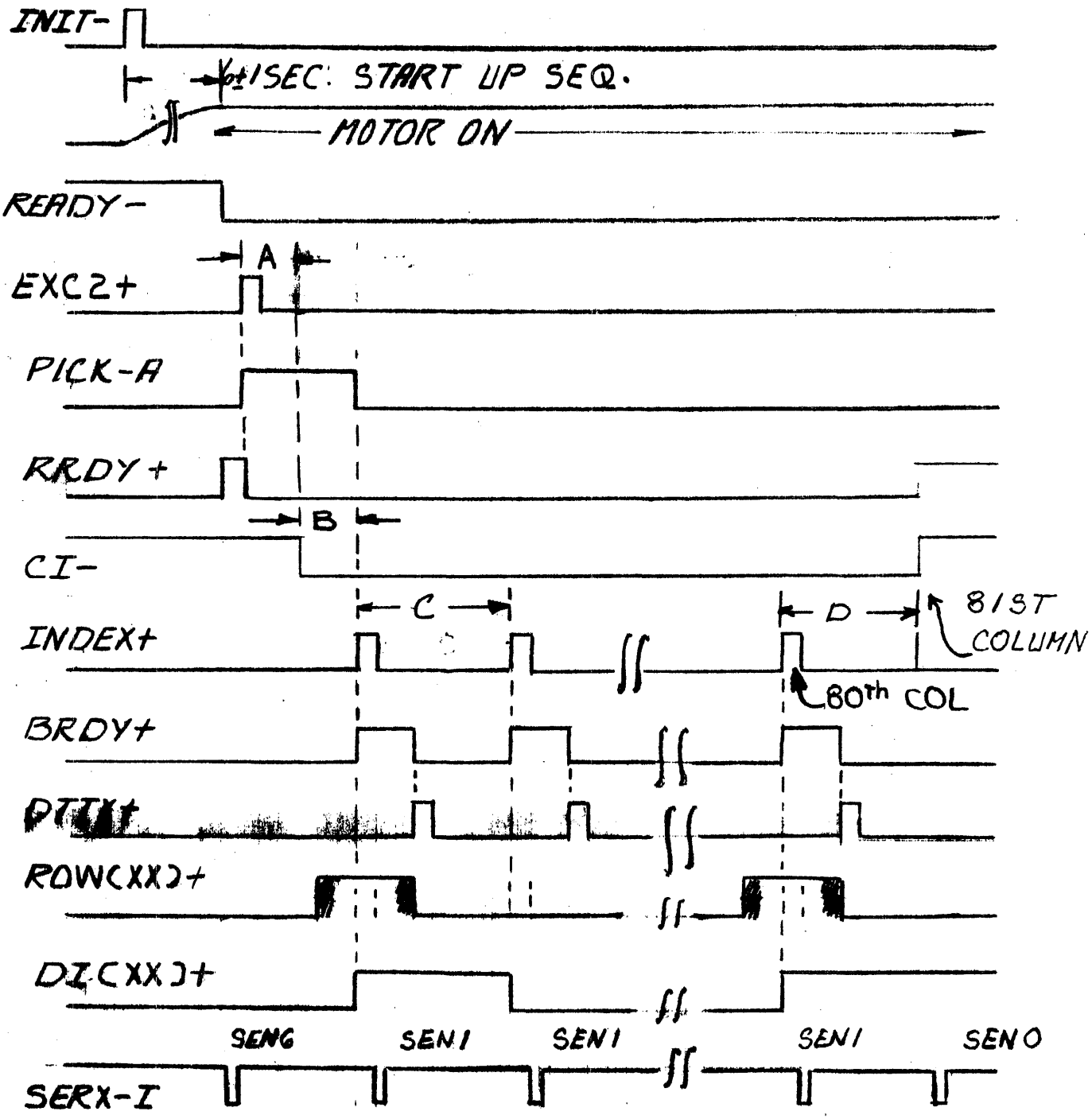
The initialize command (INIT+) resets the controller logic and the reader (CLEARA-). It will also turn on the reader motor if the motor is not already on. If the reader is in a Ready State, the program will feed one card as follows: An EXC 2 is program generated. The logic develops and presents the feed pulse PICK-A to the reader connector. EXC 2 also disables the sense logic during the time the card is being fed into the read station. The first character ready strobe (INDEX+) then sets the character ready flip flop (BRDY) which, in turn, resets the read a card flip flop, PICK+.

1.3.2 Read the Data in Sense Mode

As the card passes into the read station, the leading edge detector is covered which causes the card image (CI) line to go to a logic zero. As the first column of data appears over the read station, a data strobe (INDEX-) is sent by the reader, coincident with the data, which sets the character ready flip flop (BRDY)

The data strobe also strobes data (ROWXX) into the data register (DIXX).

FIGURE 1.2 DATA TRANSFER TIMING.



MODEL	A(MSEC	B(USEC)	C(USEC)	D(USEC)	CARD PICK CYCLE
620-28	24	6250	2014	2014	200
E2747	24	2600	870	870	100
E2382	15	1860	478	478	60
E2993	24	6250	2014	2014	200

The program senses the character ready condition and performs a "Data Transfer In". Flip flop DTIX is set by the FRYX pulse. DTIX is then used to strobe data onto the E-Bus and reset BRDY. All 80 columns are sequentially read in this way:

As the card completes its pass over the read station, the trailing edge of the card uncovers the trailing edge detector and returns CI- to a logic high. The program senses this condition and branches out of the data transfer loop. A ready interrupt is also generated at this time.

1.3.3 Read The Data in BIC Mode

Once the BIC has been initialized, EXC 2 (read one card) sets the controller connected for BIC flip flop CDCX. When data is ready (BRDY) TRQX-B goes to a logic zero which initiates a transfer request. TAKX-B transfer acknowledge is returned to the controller. This term arms flip flop DTIX which is then set by the function ready pulse FRYX. Data is then strobed onto the E-Bus and another BIC transfer is initiated by the next strobe from the reader which sets BRDY. BIC operation may be terminated by counting the 80 columns of data and ending the transfer at the end of the 80th column.

1.4 SYSTEM GENERAL SPECIFICATIONS

1.4.1 Controller

Characteristic	Specification
Organization	Consists of timing and control select and de-select logic, driver, and receivers.
Control Capability	Reads 80 column punched card with no information content restrictions at up to 300 cards per minute. The controller reads 12 bits at a time and transfers the word to the CPU.
Output Capability	Three external control commands, five input commands, five sense conditions, three interrupts, BIC capability.
Logic Levels	Negative Logic: 0.0V to +0.5V = true +2.5V to +5V = false Positive Logic: +2.5V to 5V = true 0.0V to +0.5V = false
DC Power	+5VDC @ .5 amps

Characteristic	Specification
I/O and B Cables	Negative Logic
Internal	Positive Logic
Reader Cable	Negative Logic

1.4.2 Reader General Specifications, Model M200

Machine Characteristics

Media Processed

Standard 80-Column Cards as defined by ANSI X3.11 - 1969

Operating Rates:

300 cards per minute ±10%

Card Capacity

Input Hopper	550 Cards
Output Stacker	550 Cards

Feeding

Asynchronous, via a vacuum picker in conjunction with "riffled" air

Reading: Infrared light emitting diodes

Card Read Time:

80-Column 200 msec

General Specifications

Dimensions

Overall Dimensions
Height - 11 in.
Depth - 14 in.
Width - 19-1/4 in.

Weight

Complete Unit
Less than 60 lbs.

Temperature

Operating	40° to 110°F
Non-Operating	25° to 135°F

Input Power

Voltage	115V - 60HZ, 115V - 50HZ 220V - 50HZ
Frequency	Single Phase
Current	Less than 5 AMPS
Power	Less than 300 WATTS

TABLE 1.1 - CONTROLLER MNEMONICS

MNEMONIC	DESCRIPTION
BCDX-B	BIC Disconnect
BRDY+	Character Ready Flip Flop
CDCX+	Controller connected for BIC flip flop
CI-	Card image level from reader reset
CLEARA-	Reset line to reader. Also turns on reader motor.
COD(X)+	E-Bus decodes
CRDYI-	Character Ready Interrupt
DA3X+	Device Address Decode
DCEX-B	BIC Device Connect
DESX-B	BIC Device Stop
DI(XX)+	Data Register Outputs
DRYX-I	CPU Data Ready Pulse
DTIX+	Data Transfer In Flip Flop
EB(XX)-I	CPU E-Bus Bits 0 thru 15
ERRORI-	Card Reader Error Interrupt
EXC2-	External Control Decode to "Feed a Card" and Clock "On" CDCX (BIC) flip flop
EXC3-	External control decode to set continuous feed flip flop
FRYX-I	CPU function ready flip flop
INDEX+	Data strobe from reader
IHE-	Hopper empty level from reader

TABLE 1.1 (con't)

MNEMONIC	DESCRIPTION
INIT+	Initialize Pulse
IPF-	Machine alert from reader (i.e., power off)
ITR-	Reader Error Alert from reader (i.e., photocell failure)
PICK-	Feed a card flip flop output
PICK-A	Feed a card pulse or level in continuous mode
READY I-	Card reader ready or end of card image interrupt
READY-	Level from reader indicating reader conditioned to accept card feed pulse
SERX-I	Sense line to CPU
SYRT-I	CPU Console System Reset
TAKX- I	BIC Transfer Acknowledge
TROB+	OR'D Reader Alerts
TRQX-B	BIC Transfer Request

SECTION 2
PROGRAMMING

2.1 GENERAL

The card reader may be programmed in a multi-peripheral invironment by the external interrupt structure or by programmed response loops. EXC instructions control the operations, and data transfers are performed by means of the BIC option, or by program "data transfer in" sequences.

2.2 DESCRIPTION OF COMMANDS

There are a total of 13 instructions reserved for use by the card reader controller. These include three external control functions, five sense, five data transfer in commands. These reserved instructions are listed and described in the paragraphs that follow. It is assumed here that the card reader controller has been assigned device address 030.

2.3 INSTRUCTION SET SUMMARY (DA=30)

2.3.1 External Control

EXC 030	Initialize controller and reader and turn on reader motor
EXC 0230	Read one card (also connects BIC in BIC mode)
EXC 0330	Feed cards continuously (reset by initialize command or system reset)

2.3.2 Data Transfer

IME 030	Transfer 12 bit word to memory
INA 030	Transfer 12 bit word to A register
INB 030	Transfer 12 bit word to B register
CIA 030	Transfer 12 bit word to A register, cleared
CIB 030	Transfer 12 bit word to B register, cleared

2.3.3 Sense

SEN 030	Sense Card in reader station (card image)
SEN 0130	Sense character ready
SEN 0230	Sense reader error
SEN 0330	Sense hopper empty
SEN 0630	Sense reader ready

2.3.4 Interrupts

Three interrupts are available: Character Ready, Error, and Reader Ready (End of Card).

2.3.4.1 Character Ready Interrupt

Character ready generates an interrupt when a character is in the input buffer and ready to be inputted to the CPU. This character must be taken within a maximum of 2.014 milliseconds after the interrupt is generated.

2.3.4.2 Error Interrupt

Error interrupt is generated for the following conditions:

1. Failure of the light or dark check (read error). Requires operator intervention.

2. Motion check (pick or stack check) requires operator intervention. This error signal will occur within 300 milliseconds of the initiation of an unsuccessful pick attempt or in time to inhibit the picking of the second card after the stacker sensor detects that a card is not completely clear of the card track.

Both error conditions are displayed on the front panel indicator and may be reset by the reset button on the reader, by CPU system reset, or the initialize command.

2.3.4.3 Ready Interrupt

A ready interrupt is generated under the following conditions:

1. Power is applied and the 6 second run up is completed (motor up to speed).

2. Input hopper has been loaded and run up completed.

3. Card reader cleared of error conditions and is ready to accept a pick command from the external program.
4. The card has completed its pass through the read station (End of Card Image).

2.4 INSTRUCTION SET DESCRIPTION

2.4.1 EXC Commands

2.4.1.1 EXC Initialize (EXC 0)

Clears the controller and reader as follows:

1. Non-continuous mode
2. Character not ready
3. BIC disconnected
4. Reader logic reset to "RESET" condition
5. Reader motor "ON".

2.4.1.2 EXC Read One Card (EXC 2)

This command causes the controller to initiate a card read cycle and, if data transfer is under control of BIC, sets the BIC connect flip flop.

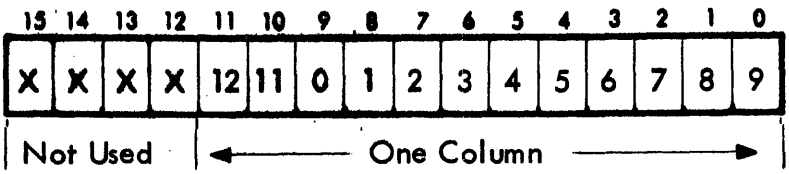
A single card is picked and transported to the read station. As each column passes through the read station, the strobe signal received from the reader sets the character ready sense, generates a character ready interrupt, and strobes a 12 bit data character into the input register. For pertinent timing information, refer to Section 2.3.2, "Data Transfer In" Commands.

2.4.1.3 EXC Continuous Feed (EXC 3)

This command holds the card feed line to the reader at a continuous feed level. Cards will be fed at a maximum rate of 300 CPM $\pm$ 10% until the EXC initialize command is generated or the CPU system reset is activated.

When continuous feed is to be stopped, an initialize command must be sent within 8 milliseconds after the receipt of the eightieth column of data of the previous card to prevent an extra card from being fed through the reader.

2.4.2 Input Transfer Commands (CIA, CIB, INA, INB, INM)



Card column VS E-Bus bit are as shown:

Pertinent timing relationships from initiation of card feed to end of card are categorized below: (300 CPM card reader only)

Card feed initiation to first character ready	=	30.3 milliseconds minimum
Character ready to next character ready	=	2.014 milliseconds minimum
1st column to 80th column	=	161.12 milliseconds minimum
Total card feed cycle (card image)	=	200 milliseconds minimum

Once a card feed cycle has been initiated, the CPU must perform a "data transfer in" operation within 32.2 milliseconds maximum for the first column and within 2.014 milliseconds maximum between columns or data will be lost. See Figure 1.2 for 600 CPM and 1000 CPM timing relationships).

2.4.3 Sense Commands

2.4.3.1 Sense End of Card (Card Image)

This sense answers in the affirmative when no card feed operation is in progress. As the card enters the read station, the leading edge detector is covered.. This causes the card image line to go low. As the card leaves the read station, the trailing edge detector is uncovered. This causes the card image line to go high. The program may sense this condition after the reading of data has been started to sense the end of card as an option to counting 80 columns of data to determine end of card.

2.4.3.2 Sense Character Ready

This sense answers in the affirmative when a column of data is present at the output of the buffer register and is ready for transfer to the computer. An input transfer should follow the leading edge of "Character Ready" within 2.014 milliseconds.

2.4.3.3 Sense Reader Ready

This sense answers in the affirmative when the previous card read cycle has been completed satisfactorily and the controller is ready to receive the next EXC "Read

One Card" command.

2.4.3.4 Sense Reader Error

This sense answers in the affirmative when an error condition has occurred during a previous or the present card read cycle. The "Reader Error" sense remains true until the error condition is corrected. The error conditions are: Light/Dark Check Error, Card Motion Error, Pick Failure, and Hopper Empty. When the controller is being operated in conjunction with a BIC, the error conditions are used to cause an "Abnormal Device Stop" thus, possibly resulting in the incomplete reading of a card. Pressing the RESET button on the reader, pressing CPU SYSTEM RESET, or doing an EXC initialize will reset the error line, if the error condition has been corrected.

2.4.3.5 Sense Hopper Empty

This sense answers in the affirmative when the reader input hopper contains no cards. This sense is provided to allow the distinction between a "normal" reader error and an "abnormal" reader error.

2.5 COMMAND SEQUENCES

The flow chart shown in Figure 2.1 is meant to aid programmers in determining the proper sequence of commands required to input a card of data in sense mode. Figure 2.2 is a typical BIC flow diagram.

The end of data is shown as being determined by counting columns. It is also possible to determine end of data by sensing the card image line (SEN 0). In the latter case, the column count blocks in the flow chart may be replaced by a SEN 0.

2.6 MOTOR CONTROL

Normally, the card reader motor is externally turned on by the "RESET" button on the card reader console, assuming the card reader power switch is in the "ON" position. The motor may, however, be turned on by issuing an initialize command (EXC 0). A minimum of 4 seconds start up time is required, after the initialize command, before the reader READY line becomes true and card feeding may be initialized.

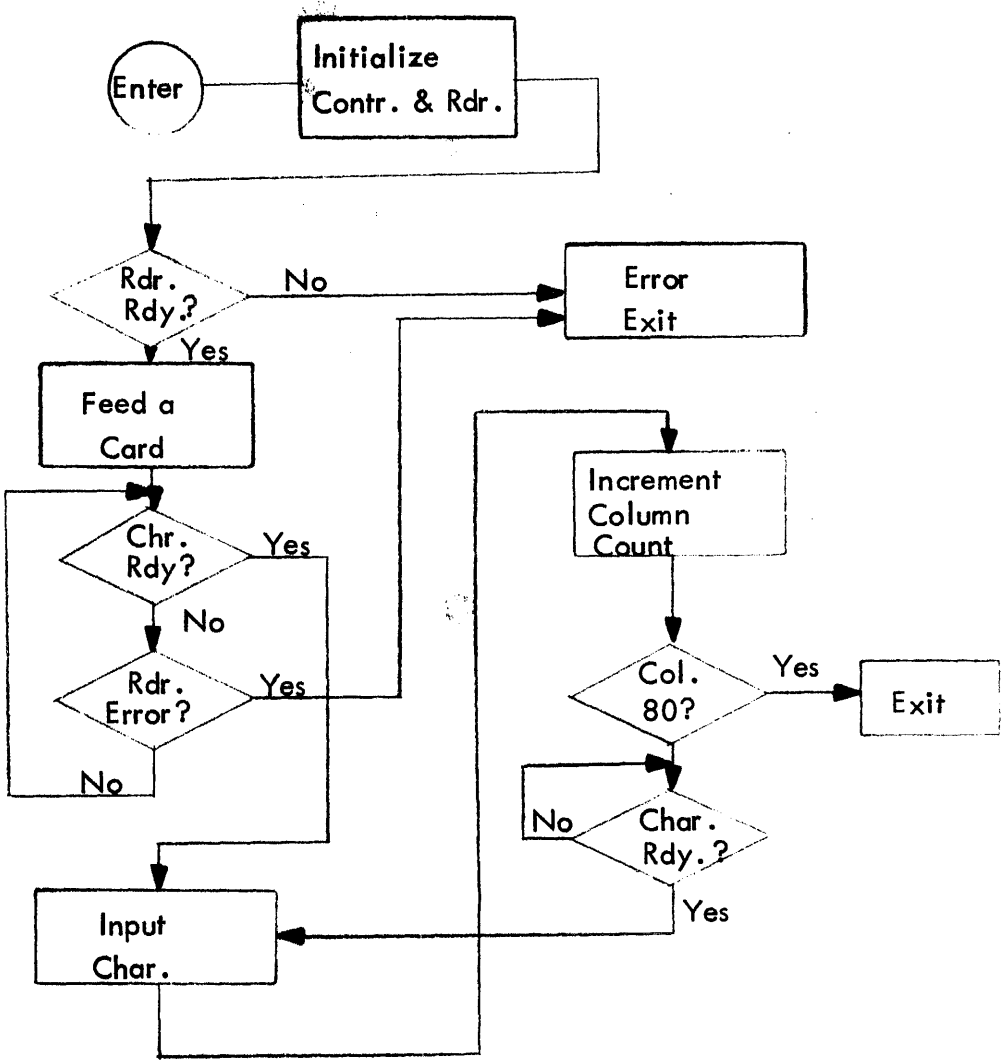


FIGURE 2.1 - COMMAND SEQUENCE FLOW CHART

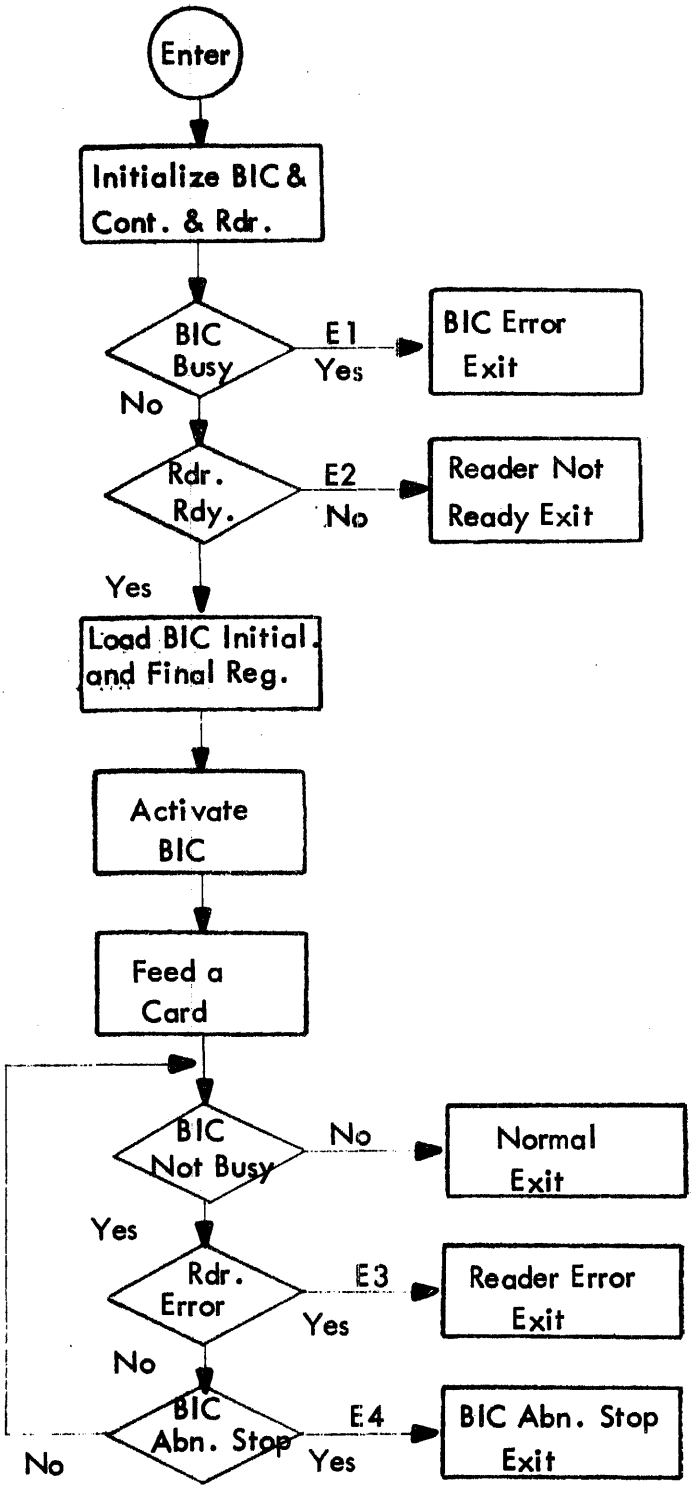


FIGURE 2.2 - TYPICAL BIC FLOW DIAGRAM

SECTION 3
INSTALLATION

3.1 GENERAL

Installation of the card reader system in the field is normally accomplished by Varian Data Machines Customer Service Engineers. Logic diagrams, assembly layout, and wiring information are provided at the time of purchase. The following installation data is provided for planning purposes.

3.2 PRE-INSTALLATION REQUIREMENTS

Prior to the installation of the system, proper operation of the computer should be assured through use of the diagnostic test routines described in the 620 Maintenance Manual. An Expansion/Peripheral Controller Chassis must be installed in close proximity to the computer. The chassis is connected to the I/O bus by means of the I/O cable which is attached to the Expansion Chassis. The termination shoe provided must be connected on the end of the I/O bus.

3.3 WIRING REQUIREMENTS

3.3.1 Controller Backplane Wiring

The controller card requires the space provided by three card slots. It uses the standard backplane I/O bus and power wiring used with the Expansion Chassis. (See Table 3.1).

3.3.2 Cabling

There is one cable connecting the controller card to the card reader. All lines are twisted pair lines. Pin assignments are shown in Table 3.2. A standard length 20 foot cable is supplied with the card reader option.

3.4 DEVICE ADDRESS SELECTION

The device address is normally wired for address 30_8. The available addresses are from 30_8 to 37_8. Connector pins (64, 65) (67, 68) and (70, 71) provide the true and complement outputs of the I/O bus address bits respectively. Pins 66, 69 and 72 are the input pins to the device address decoding gates. Table 3.3 lists wiring connections required for each of the available device addresses.

TABLE 3.1 - CONTROLLER CARD, P1 PIN ASSIGNMENTS

PIN	MNEMONIC	PIN	MNEMONIC
1	GND	50	BCDX-B
2	EB00-I	52	BCDX-B
4	EB01-I	54	CDCX-B
6	EB02-I	56	DCEX-B
8	EB03-I	58	TAKX-B
10	EB04-I	60	DESX-B
11	EB05-I	64	EB00+
12	EB06-I	65	EB00-
13	EB07-I	66	EB01+
14	EB08-I	67	EB01+
15	EB09-I	68	EB01-
16	EB10-I	69	EB11+
17	EB11-I	70	EB02+
18	EB12-I	71	EB02-
19	EB13-I	72	EB21+
20	EB14-I	75	CRDYI-
27	FRYX-I	77	ERRORI-
29	DRYX-I	79	READYI-
31	SERX-I	100	GND
43	SYRT-I	118	+5V
44	IUAX-I	121	+5V
48	GND	122	GND
49	TRQX-B		

TABLE 3.2 - J2PIN ASSIGNMENTS

PIN	MNEMONIC	DESCRIPTION	SOURCE
1	ROW09-		
2	R		
3	ROW08-		
4	R		
5	ROW07-		
6	R		
7	ROW06-		
8	R		
9	ROW05-		
10	R	Data	Device
11	ROW04-		
12	R		
13	ROW03-		
14	R		
15	ROW02-		
16	R		
17	ROW01-		
18	R		
19	ROW00-		
20	R		
21	ROW11-		
22	R		
23	ROW12-		
24	R		
25	CLEARA-	Initialize	User
26	R	(Motor Start)	
27	PICK-A	Feed	User
28	R		
29	ITR-	Read Alert	Device
30	R		
31	IPF-	Machine Alert	Device
32	R		
33	IHE-	Input Hopper Empty	Device
34	R		
35	READY-	Reader Ready	Device
36	R		
37	CI-	Card Image	Device
38	R		
39	INDEX-	Data Strobe	Device
40	R		
41	SPARE		
42	R		
43	SPARE		
44	R		

TABLE 3.3 - DEVICE ADDRESS WIRING LIST

Device Address	Jumper Pins	Device Address	Jumper Pins
30	65 to 66 68 to 69 71 to 72	34	65 to 66 68 to 69 70 to 72
31	64 to 66 68 to 69 71 to 72	35	64 to 66 68 to 69 70 to 72
32	65 to 66 67 to 69 71 to 72	36	65 to 66 67 to 69 70 to 72
33	64 to 68 67 to 69 71 to 72	37	64 to 66 67 to 69 70 to 72

3.5 CARD READER INSTALLATION AND OPERATION

3.5.1 General

A complete description and instructions in operation of the card reader will be found in the Card Reader Maintenance Manual that is delivered with the system.

SECTION 4
MAINTENANCE

4.1 GENERAL

This section defines the appropriate equipment, diagnostic routines, and required tests to insure the card reader controller's proper performance. Maintenance requirements for the card reader are called out in the card reader instruction manual, section 3.

4.2 MAINTENANCE OF THE CONTROLLER

The following are standard hardware and software devices used for checkout. Addition and/or deletion of these devices may be made in the future, if necessary.

4.2.1 Test Equipment

The Tektronix 545 Oscilloscope or one of similar performance specifications is required.

4.2.2 Tools

A standard extender board allows for easy access to the card reader controller board during the test.

4.2.3 Software (Diagnostic)

The following tests on paper tapes are recommended for diagnosis and troubleshooting of the card reader controllers:

a. Maintain II 92A0107-001
b. Test Program 92A0107-012
c. Software Performance Specification 89A0180

4.3 MAINTENANCE OF THE CARD READER

Maintenance procedures are simple, straight-forward, and easy to perform. They are completely defined in the card reader instruction manual.

ADDENDUM #1

E-2747, 600 Card Per Minute Card Reader

General Specifications

Card Rate	600 card per minute	
Card Type	Standard 80-column card	
Hopper/Stacker	1000 card capacity	
Light Source	M-infrared light emitting diodes OM-Fiber Optics, 13 channel	
Read Station	M-photo transistor, 12 bits simultaneously OM-photo transistors, 12 data rows and one clock row.	
Electronics	7400 series TTL integrated circuit logic	
Internal Clock	M-Crystal Oscillator	
Power	1600 VA Starting load, 600 VA Running load	
Height	16-1/4 in.	41.2 cm
Width	23-1/16 in.	58.6 cm
Depth	18 in.	45.7 cm
Weight	77 lbs.	
Shipping	88 lbs.	

For card feed and data timing relationships, see Figure 1-2.

ADDENDUM #2

E2382, 1000 CPM Card Reader

General Specifications

Card Rate	1000 cards per minute	
Card Type	Standard 80-column card	
Hopper/Stacker	1000 card capacity	
Light Source	M-infrared light emitting diodes OM-Fiber Optics, 13 channel	
Read Station	M-photo transistor, 12 bits simultaneously OM-photo transistors, 12 data rows and one clock row	
Electronics	7400 series TTL integrated circuit logic	
Internal Clock	M-Crystal Oscillator	
Power	1600 VA Starting load, 600 VA Running load	
Height	16-1/4 in.	41.2 cm
Width	23-1/16 in.	58.6 cm
Depth	18 in.	45.7 cm
Weight	83 lbs.	
Shipping	94 lbs.	

For card feed and data timing relationships, see Figure 1-2.

ADDENDUM #3

E2993, 300 CPM Mark-Sense Card Reader

General Specifications

Please refer to paragraph 1.4.2 for the 300 CPM card reader general specifications and to Figure 1-2 for timing relationships.

Card and data specifications are as follows:

Mark Sense Data - A mark must be a vertical line using a #2 pencil or equivalent marking material.

The minimum dimensions are: width, .015", length, .125" centered within data row area.

The maximum dimensions are: width, from trailing edge of previous clock mark to leading edge of next clock mark; length, .240" centered within data row area.

The mark must have an average reflectance that is less than or equal to 28% of the reflectance of that portion of the card immediately adjacent to the mark. Single stroke marks with a #2 pencil will meet this specification.

An erasure must have an average reflectance that is greater than or equal to 75% of the reflectance of the portion of the card immediately adjacent to the erasure.

Card Design - Because the Mark Sense cards image field is determined and tailored by the customer to meet a particular application, the following is presented to aid in the design of a Mark Sense Data Card.

The shaded portions of Figure A3-1 show the areas in which data and clock marks can be placed.

Data columns are constructed by a clock mark immediately preceding the data column, the data column area, and then another clock mark. Figure A3-2 shows a typical data column and the read area for each data row.

Any pencil mark or punched hole meeting the data specification and lying in the shaded area between the clock marks may be read as data.

Any black column or rwo number which is commonly found on standard 80 column punched cards may also be read as data.

A marking constraint with mark identifier is normally used to place and identify a data mark in the data field. Figure A3.3 depicts a data mark in the data field. Figure A3.3 depicts a typical marking constraint. To indicate a list, a vertical pencil mark would be placed within the constraint.

An example of a general purpose, 40 column Mark Sense Card is shown in Figure 3-4.

Punched Cards

80 column punched cards may also be read with the E2993 Mark/Sense Reader. The cards must, however, be free of reflective marks in the data fields. Green or red markings on the card typically are not reflective. The punched cards must also have a clock row on the bottom as on the Mark/Sense Card (see Figure A3-1).

Mixing Cards

Since both punched and Mark/Sense Cards must have a clock row, both can be used inter-changeably providing the two card types are designed properly.

Test Program

Only 80 column cards can be used with the 620-28 (E2993) test program.

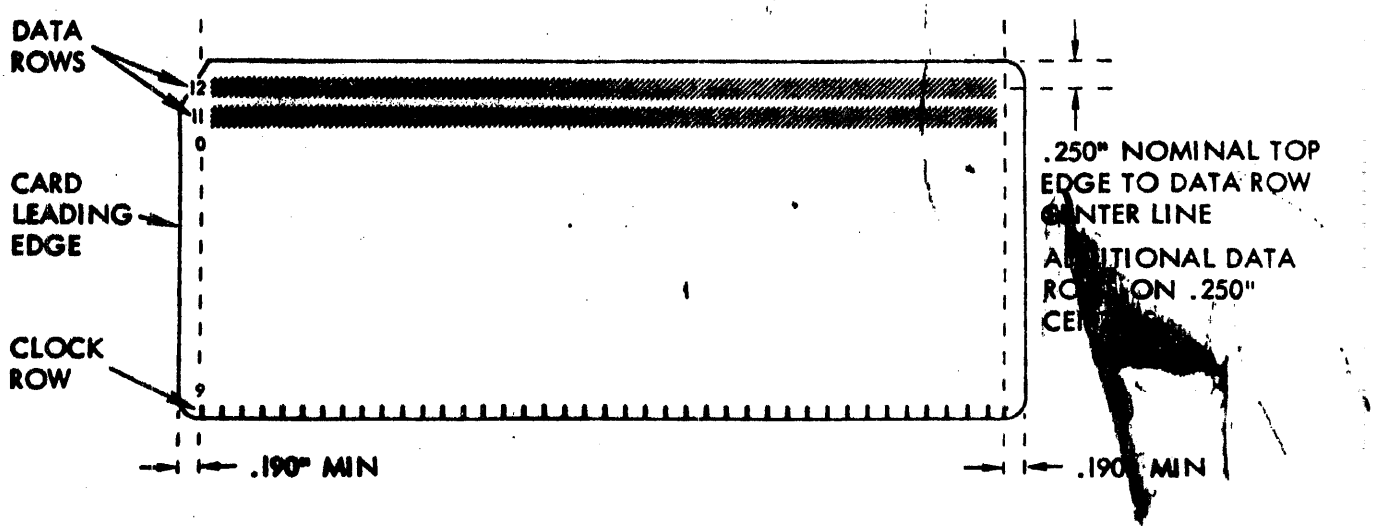


Figure A3-1 – Marking Areas

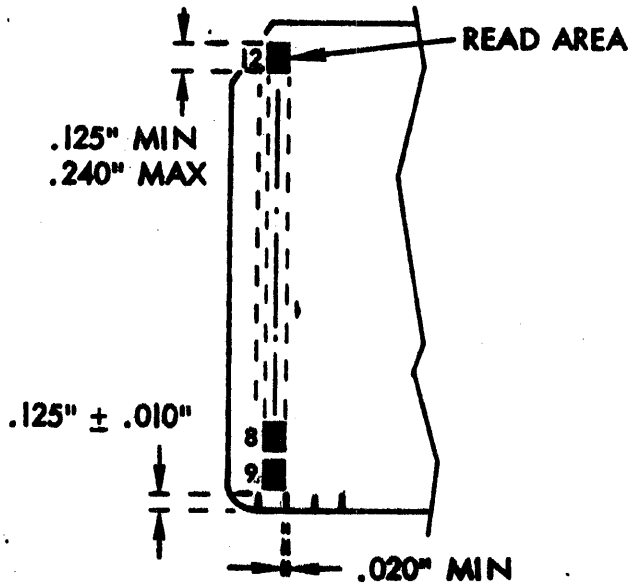


Figure A3-2 – Data Column

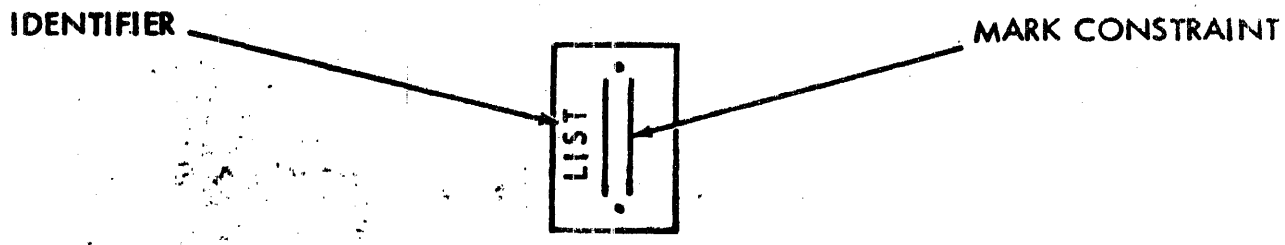


Figure A3-3 - Mark Constraint

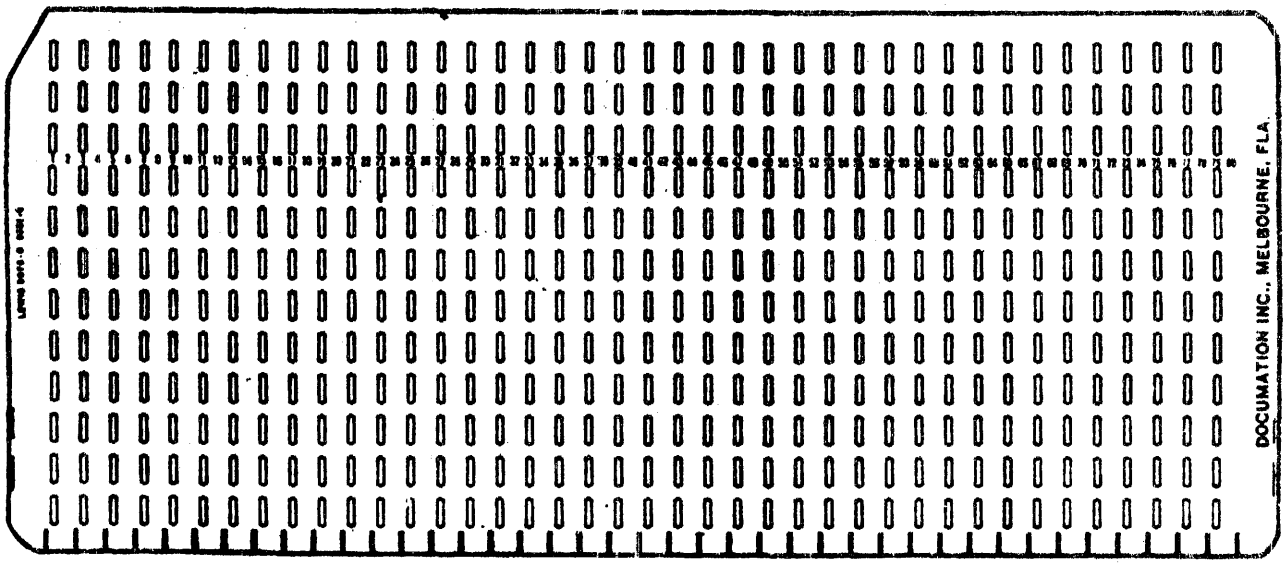


Figure A3-4 - Mark Sense Card