Microdata Interface

Card Reader System

GENERAL DESCRIPTION

The Microdata card reader system provides a means for reading data from punched cards into Micro 800 and Micro 1600 series computers. The system consists of a card reader, an interface controller and all necessary interconnecting cables and mounting hardware. The system allows standard 80-column punched cards to be read at speeds up to 300 cards per minute.

The main advantage of punched card reading capability in a Microdata computer system is that source programs can be maintained on a unit record basis. Cards (records) can be added and deleted from a source deck, and assemblies can be rerun without lengthy paper tape operations.

The card reader system for Micro 800 series computers is Model 8971; for Micro 1600 series computers, Model 2720.

STANDARD FEATURES

- Continuous (free-run) operation at 300 cards per minute.
- Demand-read operation at rate determined by computer.
- Binary or Hollerith coded cards.
- Transfer modes:
  - Concurrent I/O (automatic block transfer)
  - Programmed I/O
  - Programmed I/O with interrupt
- Simplicity of reader design and construction.
- Reliability of reader operation.

CONTROLLER

The interface controller contains the logic and interface circuitry for computer control of the card reader and for transfer of data between the computer and the reader. Cards can be read individually on demand or continuously with the computer accepting the data at the maximum, free-running rate of the reader.

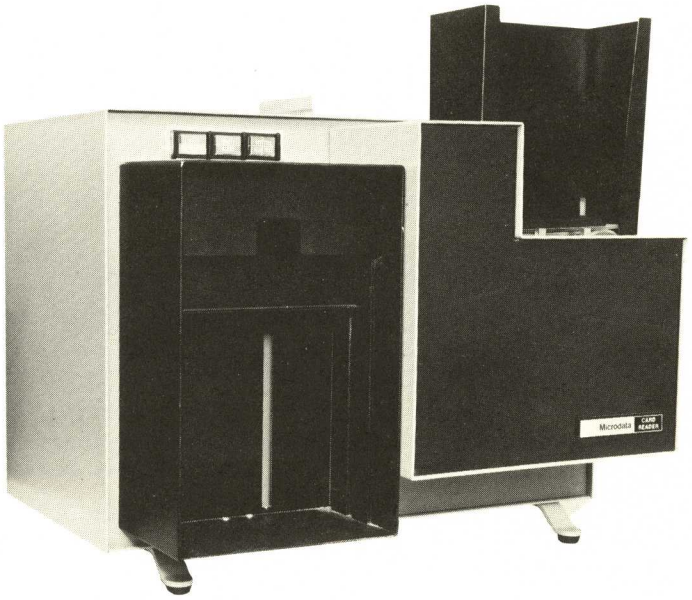
The controller can input data to the computer in either the binary mode or the EBCDIC mode. In the binary mode, any or all of the 12 card rows in a given column can be punched. The 12 data bits are transferred exactly as punched by inputting two bytes to the computer with 6 data bits in each byte. Rows 12, 11 and 0 thru 3 are input as byte 1 and rows 4 thru 9 are input as byte 2.

BINARY INPUT FORMAT

BIT	7	6	5	4	3	2	1	0
BYTE 1	x	x	12	11	0	1	2	3
BYTE 2	x	x	4	5	6	7	8	9

The EBCDIC mode is generally used when the cards are punched using Hollerith code. In this mode, the 12-bit Hollerith code is converted by hardware in the controller to an 8-bit EBCDIC code, which is then transferred to the computer in a single byte. Hollerith code can be input using the binary mode, with conversion to any other code accomplished by software.

The controller operates in the EBCDIC mode unless binary operation is selected by the program. Once the binary mode is selected, it continues until either a disconnect code is sent to the controller or a master reset occurs.



Operating and Programming the Controller

There are three operating modes in which data transfers between the card reader and the computer can occur:

- Programmed mode.
- Programmed mode with interrupt when each column has been read.
- Concurrent I/O mode for automatic block transfers.

In the programmed mode, the data is transferred using I/O instructions. A program sense loop determines when the controller has data from the reader ready for transfer into the computer. In the programmed mode with interrupt, the need for the sense loop is eliminated. The controller interrupts the computer to an input subroutine when each card column has been read and the data is ready for transfer to the computer. The computer then affects the transfer using program instructions. In the concurrent I/O mode (discussed in detail later), one or more cards can be read automatically and the data transferred automatically by the computer firmware – not software.

In the programmed modes of operation, four basic I/O commands of the Micro 800 and Micro 1600 computers are used for control of the reader, for status testing and for data transfer. The assembler mnemonics for these commands are:

OBA	–	Output Byte from A Register
IBA	–	Input Byte to A Register
IBB	–	Input Byte to B Register
IBM	–	Input Byte to Memory

When writing these commands in assembly language, the instruction is followed by a 3-bit function code (f), a 5-bit device address (d), and in the case of the IBM instruction, a 15-bit memory address (addr). The formats for writing these commands are:

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OBA    f,d
IBM    f,d,addr
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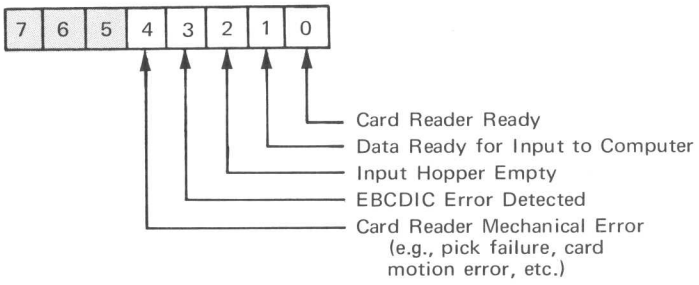
The device address (d) is used to identify which peripheral device is being addressed. Device address 04 is normally assigned to the card reader controller.

The 3-bit function code (f) specifies a function to be performed by the controller and/or the card reader. This function code provides all required control of the card reader system. The functions which can be specified are listed below:

Value of f	Input Instruction	Output Instruction
0	Input Data Byte	----------
1	Input Status Byte	----------
2	----------	Enable Concurrent I/O Mode & Interrupt
3	----------	Arm Data Ready Interrupt
4	----------	Stop/Disconnect Card Reader
5	----------	Disarm Data Ready Interrupt
6	----------	Read One Card (for programmed operation)
7	----------	Select Binary Mode

Bytes input to the computer from the controller contain either data or status information. Status bytes are tested by the computer program to determine the status of the card reader and/or the controller. Status bytes input to the computer (by executing an input command with function code 1) contain the following information:



Concurrent I/O operation is the name given to the automatic block transfer technique used in the Micro 800 and Micro 1600 computers. The software program sets up the starting and ending memory addresses of the transfer in dedicated memory locations. The firmware then controls the data transfer automatically at the maximum rate of the card reader until the entire data block has been transferred.

When a concurrent transfer is initiated, the reader is started. When each card column has been read, the controller issues a Concurrent I/O Request. This stops the computer at the end of the operation in process, and one or two bytes are transferred to computer memory under firmware control. After the byte transfer, the computer resumes program execution until the next Concurrent I/O Request occurs when the next card column is read. Cards are automatically read and the data transferred until the block transfer is complete.

The concurrent I/O operation is automatically terminated when either the block transfer is completed or a reader malfunction is detected. Either of these conditions will cause the controller to generate an end-of-block interrupt which traps the computer to a subroutine stored in core memory. The location of the subroutine is specified at an interrupt address, which is actually two sequential memory locations reversed for this purpose. The dedicated memory locations for the card reader are listed below:

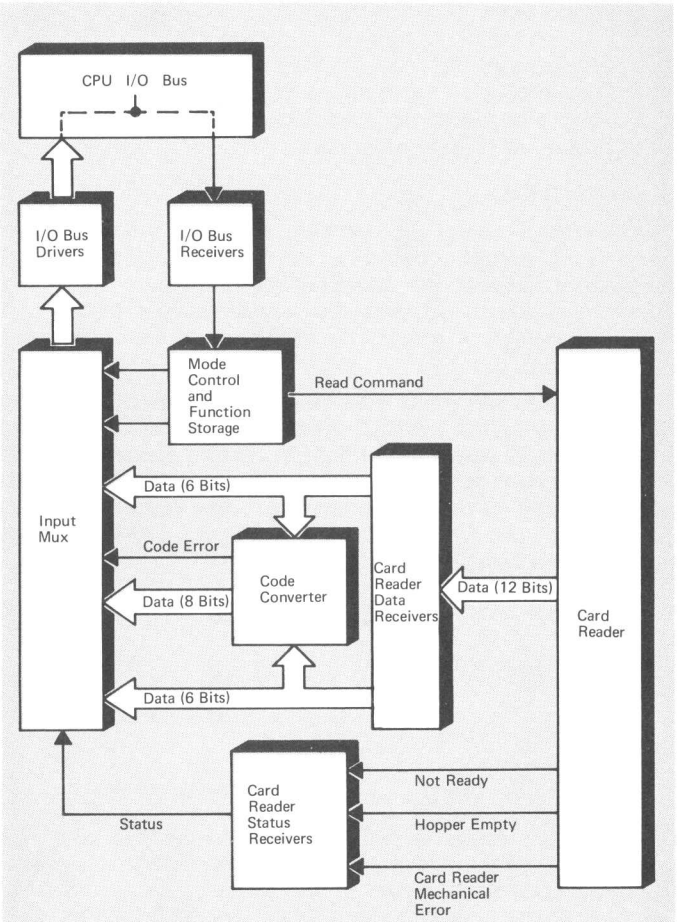
Starting Address:	0010_{16}, 0011_{16}
Ending Address:	0012_{16}, 0013_{16}
Interrupt Address:	0108_{16}, 0109_{16}

Functional Description

The card reader controller performs the following functions:

- Initiates card pick on command.
- Receives data from the card reader and stores each column in a 12-bit register.
- In binary operation, 12 bits are input to the computer in two bytes, six bits per byte, right justified. The first byte contains rows 12 through 3 and the second byte contains rows 4 through 9.
- In EBCDIC operation, 12-bit Hollerith characters are automatically converted to 8-bit EBCDIC characters which are input to the computer in one byte.
- Provides data transfer in any one of three modes (programmed, programmed with interrupt, and concurrent).
- Decodes function code from computer and initiates appropriate action in card reader system.
- Transfers card reader system status to computer on command.

A simplified functional block diagram of the controller is shown below.



Card Reader Controller Block Diagram

Physical Construction

The card reader controller is constructed on one printed circuit board which mounts in any available I/O card slot in the computer mainframe or an expansion chassis. The cable to the card reader connects to the printed circuit edge connectors on the rear of the controller board.

CARD READER

The Microdata photoelectric card reader incorporates a new, uncomplicated card drive mechanism which results in economy and very high reliability. Standard 80-column punched cards are read under computer control at rates up to 300 cards per minute.

A unique clutchless friction drive roller feeds cards from the bottom of the input stack. The cards are moved past the photoelectric read sensors by two sets of high-friction drive wheels that prevent card slippage. The conventional reciprocating knife pick mechanism has been replaced by a simplified device which requires no adjustments and which reduces the possibility of card mutilation.

Data is read in character-column serial format. Twelve parallel sensors read each character column and the data is stored in a 12-bit buffer ready for sampling by the controller. Each column of data is individually synchronized by a strobe signal to the controller, indicating that data is ready.

After an entire card is read, the reader sends an end-of-card signal to the controller. Cards are positively driven (not drop stacked) into the output stacker. The input hopper and the output stacker each have a 1000-card capacity.

Manual Controls

POWER ON/OFF – AC power to the card reader is controlled by a circuit breaker and a switch at the rear of the unit.

AUTO/STOP – A momentary-action switch/indicator which switches the reader between the on-line and stopped conditions. When power is turned on, the card reader is in the stopped condition and the STOP indicator is lit. When the AUTO/STOP switch/indicator is pressed, the reader is switched on-line and the AUTO indicator lights.

READY/ALERT – A momentary-action switch/indicator that provides two functions; indicates card reader status and controls card feed operation. READY indicator lights only in the AUTO mode to indicate that the unit is on line with the computer and no card reader errors have occurred. Pressing the STOP switch causes the READY indicator to go out. ALERT indicator lights in the AUTO mode to indicate that the unit is on line with the computer but has stopped due to a card reader error.

Pressing the switch in the AUTO mode places the card reader in the on line condition. Pressing the switch in the STOP mode initiates a continuous card feed.

Indicators

HPR – Indicates that the input hopper is empty.

STKR – Indicates that the output stacker is full.

READ – Indicates that a read error has been detected.

FEED – Indicates that a pick failure has occurred.

Construction and Mounting

The card reader is a compact table or desk-top unit, 20.5 inches high, 21.5 inches wide, and 18 inches deep. A single cable connects the card reader to the interface controller.

SOFTWARE

Standard Micro 800 and Micro 1600 software permits the card reader system to operate as the input device for the MAP800 and MAP1600 symbolic assemblers. Source programs prepared on punched cards can be input to the assembler at relatively high speed and can be easily changed or corrected by simply adding, removing, or replacing cards.

The TOS800/1600 debugging packages allow loading of formatted hexadecimal cards using a card reader overlay program.

Card Reader Operation with TOS

The TOS800/1600 card reader overlay introduces an additional TOS control directive – C. The C operator causes TOS to load a program card deck through the card reader. The card format must be as described in the appropriate Microdata Assembly Program manual. Card loading is started by pressing C on the teletype.

The card reading operation is terminated by any of the following:

- Reading a card with characters in columns 1 through 4 only.
- Reading a blank card.
- A card reader malfunction.

Loading is terminated when a card is read containing characters in columns 1 through 4 and column 5 is blank. This four digit hexadecimal address is treated as an execution address if it is non-zero; otherwise, control will return to the teletype operating system (TOS). If a blank card is read, any character other than a hexadecimal character is read, or a card reader malfunction occurs, message ERR is typed and control returns to TOS.

If an error condition occurs, loading can be resumed by correcting the error, backing up one card, and typing the C control directive. It is not necessary to back up one card when reading is stopped by a blank card or a pick failure since no information is transferred through the reader.

Instruction List

The command set used with the card reader system is listed in the following table:

CARD READER COMMAND SET

Mnemonic	Machine Code (Hex)	Description
Data Transfer		
IBA 0,4	3104	Input data byte from controller to A Register.
IBB 0,4	3204	Input data byte from controller to B Register.
IBM 0,4	3304	Input data byte from controller to Memory.
Status Transfer		
IBA 1,4	3124	Input status byte from controller to A Register.
IBB 1,4	3224	Input status byte from controller to B Register.
IBM 1,4	3324	Input status byte from controller to Memory.
Function Transfer		
OBA 2,4	3944	Enable concurrent I/O mode and interrupt.
OBA 3,4	3964	Arm data ready interrupt.
OBA 4,4	3984	Stop/disconnect card reader.
OBA 5,4	39A4	Disarm data ready interrupt.
OBA 6,4	39C4	Read one card (programmed operation)
OBA 7,4	39E4	Select controller binary operations.

SPECIFICATIONS

Controller

General . . An input controller which operates one card reader
Modes of Operation . . . . . Programmed, Programmed with interrupt on character, Concurrent I/O
Device Address . . . . . 04_{16} (normal)
Dedicated Memory:
- Interrupt Address . . . . . 0108_{16}, 0109_{16}
- Starting Address . . . . . 0010_{16}, 0011_{16}
- Ending Address . . . . . 0012_{16}, 0013_{16}

Construction . . . . . One printed circuit board (8.5 inches by 10.5 inches)
Mounting . . . . . Mounts in any available I/O card slot in computer mainframe or expansion chassis
Operating Power . . . . . +5Vdc @ 750 milliamperes (supplied by computer power supply)
Operating Temperature . . . . . $0^{o}C$ to $50^{o}C$
Humidity . . . . . 0% to 90% relative (no condensation)

Card Reader

Speed . . . . . Up to 300 cards per minute
Operating Modes . . . . . Demand-read and continuous (free running)
Card Type . . . . . Standard 80-column punched cards
Card Capacity . . . . . Input hopper and output stacker each hold 1000 cards
Error Rate . . . . . Less than 1 in 300 X 10^{6}
Mean Time Between Failure (MTBF) . . . . . Greater than 1000 operating hours
Mounting . . . . . Reader is a free-standing unit designed for table or desk top mounting
Dimensions . . . . . 20.5 inches deep, 21.5 inches wide, 18 inches deep
Input Power . . . . . 117Vac (nominal), 60 Hz (50 Hz optional)
Operating Temperature . . . . . $60^{o}F$ to $95^{o}F$
Humidity . . . . . 25% to 90% relative (no condensation)

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