# Microdata Peripheral

## Line Printer Systems, Models 2731, and 2732

### GENERAL DESCRIPTION

Microdata line printer systems, Models 2731 and 2732, are available for use with Microdata 1600 series computers whenever high speed data printing is required. Both models are complete systems consisting of an 80 or 132-column printer, a plug-in interface controller, and interconnecting cable.

Model 2731 features a tabletop or pedestal mounted printer with an 80-column print line and operating speed printings ranging from 1110 lines per minute, for 20-column, to 356 lines per minute at 80 columns. The Model 2732 printer is a larger, floor-standing unit with a full 132-column print line. Speeds of the 2732 printer range from 1110 to 254-lines per minute (for 132 columns).

A Vertical Format Unit (VFU), which simplifies printing operations on preprinted forms, is available as an option with Model 2732, The vertical format tape loops can be made of standard one inch 8-channel paper tape.

### FEATURES

- Fully interfaced systems include controller and cable
- High speed — to 110 lines per minute
- Choice of formats — 80 or 132-column print lines
- Eight-channel Vertical Format Unit — optional with Model 2732
- Programmed and concurrent I/O operations with interrupt

### CONTROLLER

The interface controller contains the logic and interface circuitry for operation of one line printer. Data can be transferred on a character-by-character basis in the programmed mode of operation, or entire blocks of data can be transferred automatically using the concurrent I/O channel of the computer.

#### Operating and Programming the Controller

There are three operating modes in which data transfers between the computer and the line printer occur:

1. Programmed mode
2. Programmed mode with interrupt on character
3. Concurrent I/O mode for automatic block transfer

In the programmed mode, data is transferred using I/O instructions. A program sense loop determines when the printer data buffer is ready to accept a character. In the programmed mode with interrupt, the need for the sense loop is eliminated. The controller interrupts the computer to a subroutine when the printer buffer is ready. The subroutine then affects the transfer using program instructions. In the concurrent I/O mode (discussed in detail later), entire blocks of data are transferred into the printer buffer under firmware control.

In the programmed modes of operation, the six basic I/O commands of a Microdata computer are used for control of the printer, for status testing, and for data transfer. The assembler mnemonics for

FIGURE 1 MODEL 2732 LINE PRINTER

these commands are:

OBA — Output Byte from A Register
OBB — Output Byte from B Register
OBM — Output Byte from Memory
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 mnemonic is followed by a 3-bit function code (f), a 5-bit device address (d), and in the case of the OBM and IBM instructions, a 15-bit memory address (addr). The formats for writing these commands are:

OBA f, d IBM f, d, addr

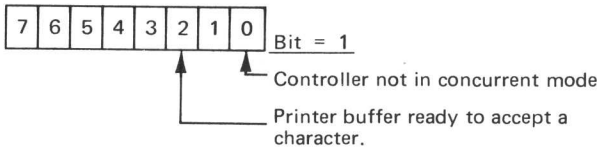
The device address (d) is used to identify which peripheral device is being addressed. Device address 5 is normally assigned to the line printer.

The 3-bit function code (f) specifies a function to be performed by the controller. This function code provides all required control of the printer system. Line printer function codes which can be specified are as follows:

| Value of F | Input Instruction | Output Instruction |
|---|---|---|
| 0 | . . . . . | Output Data Byte |
| 1 | Input Status Byte | . . . . . |
| 2 | . . . . . | . . . . . |
| 3 | . . . . . | Arm Interrupt |
| 4 | . . . . . | Disconnect/Concurrent Mode |
| 5 | . . . . . | Disarm Interrupt |
| 6 | . . . . . | Enable Concurrent I/O Mode & Interrupt |
| 7 | . . . . . | . . . . . |

Additional function command information (for advancing the paper) is sent to the printer in the form of specially coded data characters. Specific codes are listed in the description of the printers.

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




**Concurrent I/O Operation** is the name given to the automatic block transfer technique used in Microdata 1600 computers. The software program sets up the starting and ending core addresses of the transfer in dedicated memory locations and executes an I/O instruction to enable the concurrent mode. The computer firmware then controls the data transfer automatically at the maximum rate of the printer until the entire data block has been transferred.

Once the controller has been enabled for concurrent mode operations, the controller issues a *Concurrent I/O Request* as soon as the printer is ready to accept data. This momentarily stops instruction execution at the end of the operation in process and causes one byte to be transferred from memory under firmware control. The controller issues successive Concurrent I/O Requests each time the buffer becomes ready, until the entire block is transferred. Each time the printer buffer is filled, or each time a format control character is transferred, the contents of the buffer are printed and the concurrent transfers continue.

Upon completion of a concurrent block transfer, the controller generates an *end-of-operation* interrupt which traps the computer to a user subroutine stored in memory. The location of the subroutine is specified at an *interrupt address* which is actually two sequential memory locations reserved for this purpose.

The dedicated memory locations for the line printer are as follows:

| | |
|---|---|
| Starting Address: | $0014_{16}$ |
| | $0015_{16}$ |
| Ending Address: | $0016_{16}$ |
| | $0017_{16}$ |
| Interrupt Address: | $010A_{16}$ |
| | $010B_{16}$ |

**Functional Description**

Figure 2 shows a simplified functional block diagram of the line printer controller. The major functional elements shown in the figure are described in the following paragraphs.

**Data Receivers** – The receivers provide buffering of the data, control information, and device addresses sent from the computer.

**Control Decoder** – This section decodes various control terms from the computer.

**Device Address Decoder** – This section checks the device address of every I/O command executed by the computer. If it matches the printer device address, this section causes the controller to respond to the command.

**Function Decoder** – Logic in this section decodes the 3-bit function code (f) of the I/O command.

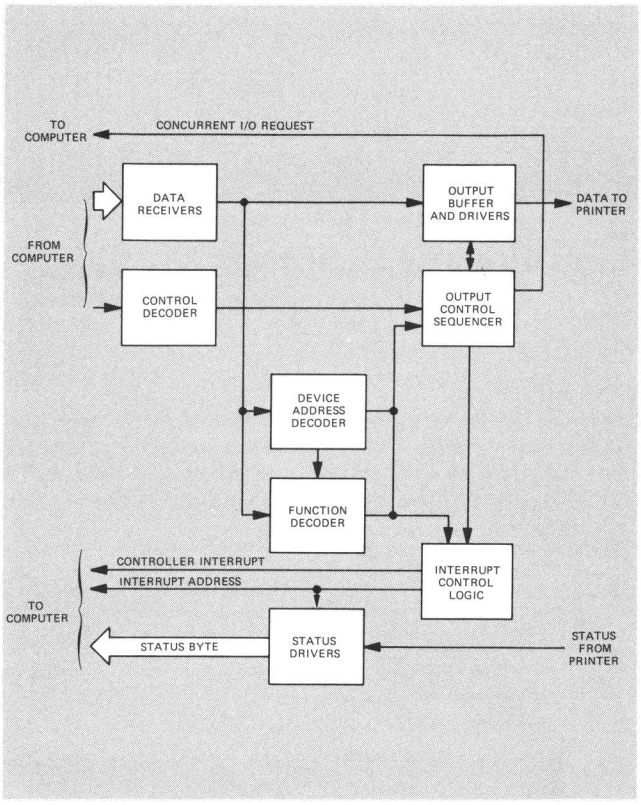



Figure 2. CONTROLLER SIMPLIFIED BLOCK DIAGRAM

**Output Control Sequencer** – This section controls the transfer of data from the computer to the printer in the programmed and and concurrent I/O modes. It also monitors the printer status for transfer to the computer.

**Output Buffer and Drivers** – The parallel data from the computer is set into the output buffer for transmission to the printer. The drivers provide the actual connections to the printer via the interface cable.

**Status Drivers** – These drivers place the printer controller status bits on the computer I/O bus in response to program input commands.

**Physical Construction**

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

## LINE PRINTERS

### Model 2731

The 80-column printer, Model 2731, is a compact unit designed for economical, high-speed printing where mounting space is limited. It measures 23 inches high by 24 inches wide by 22 inches deep, and may be mounted on a pedestal or table top. Model 2731 uses a variety of single-and multi-copy fanfold paper sizes ranging from 4 to 9.9-inches-wide and 11 inches high. Using the 9.9-inch paper, the printout format is identical to that produced by a teletype, but printing occurs at up to 1110 lines per minute. The unit contains a 20-character print buffer and 20-hammer drivers to print an 80-

column line in four 20-column zones.

### Model 2732

Model 2732 is a floor standing printer with a full 132-column print line. Adjustable pin-feed tractors can be set as easily as changing margins on a typewriter to accommodate single-and multi-copy fanfold paper from 4 to 14.9 inches wide and 11 inches high. The print buffer in Model 2732 is 24-characters long, and 132-column lines are printed in five 24-column zones and one 12-column zone. The optional Vertical Format Unit (VFU) is available with Model 2732 and allows use of paper with less than 11 inches between folds.

### Operating Principles

Operating principles of both the 2731 and 2732 printers are identical. The paper and inked ribbon pass between a row of hammers and a continuously rotating metal drum, the surface of which is etched with all the print characters. Data to be printed is received and stored in the 20- or 24-character print buffer. Printing is accomplished by scanning these stored characters in synchronism with the rotating drum characters and actuating the appropriate hammer as the desired character moves into the print position opposite the hammer. One drum revolution or less is required per zone.

Both printers use a 64-character print drum and receive data in standard ASCII code. Each time the print buffer is filled, the current zone is printed, the buffer is cleared, and the hammer drivers are connected for printing in the next zone. The buffer contents may also be printed by transfer of a format control code to the printer. This causes the line to be printed and the column register to be cleared, returning it to the leftmost print position. These codes consist of a carriage return, line feed, form feed, or the VFU codes.

The carriage return causes no spacing, the line feed slews one line, the form feed slews to the top of the next form. The VFU codes slew the specified number of lines or to the indicated channel.

### Manual Controls and Indicators

Complete manual controls and indicators are provided on both printers to facilitate convenient operation and maintenance. The following operator switches and indicators are located on the top of the unit.

| Switches | Indicators |
|---|---|
| TOP OF FORM | POWER |
| PAPER STEP | READY |
| ON LINE/OFF LINE | ON LINE |

The following switches and indicators are normally used during checkout and maintenance and are located under a lift-up panel.

| Switches | Indicators |
|---|---|
| PRINT INHIBIT | PRINT INHIBIT |
| MASTER CLEAR | PAPER FAULT |
| ON/OFF (power) | DRUM GATE |

## VERTICAL FORMAT UNIT

The optional Vertical Format Unit (VFU) available for Model 2732 provides added capabilities and increased efficiency in vertical page formatting. An 11-inch loop of 8-channel punched paper tape corresponding to the 11-inch high fanfold forms will be supplied with the printer. Special tapes can be prepared with a hand punch or by using a computer program to drive either the teletype or high speed paper tape punch.

The VFU also interprets special *step count* advance codes which allow the user to advance from 0 to 15 vertical lines. The VFU codes and step count codes are listed in Table 1.

**Table 1. Vertical Format Unit Control Codes**

| CODE (HEX) | DEFINITION |
|---|---|
| **VFU Codes** | |
| 80 | Advance to channel 0 |
| 81 | Advance to channel 1 |
| 82 | Advance to channel 2 |
| . | . |
| . | . |
| . | . |
| 87 | Advance to channel 7 |
| **Step Count Advance Codes** | |
| 90 | No advance |
| 91 | Advance 1 line |
| 92 | Advance 2 lines |
| 93 | Advance 3 lines |
| 94 | Advance 4 lines |
| 95 | Advance 5 lines |
| . | . |
| . | . |
| . | . |
| . | . |
| 9D | Advance 14 lines |
| 9E | Advance 15 lines |

## INSTRUCTION LIST

The I/O commands used with the line printer systems are listed in Table 2.

**Table 2. Line Printer Instruction List**

| MNEMONIC | MACHINE CODE (HEX) | DESCRIPTION |
|---|---|---|
| **Data Transfer** | | |
| OBA 0, 5 | 3905 | Output data byte from A Register |
| OBB 0, 5 | 3A05 | Output data byte from B Register |
| OBM 0, 5 | 3B03 | Output data byte from memory |
| **Status Transfer** | | |
| IBA 1, 5 | 3125 | Input status byte to A Register |
| IBB 1, 5 | 3225 | Input status byte to B Register |
| IBM 1, 5 | 3325 | Input status byte to memory |
| **Function Transfer** | | |
| OBA 3, 5 | 3965 | Arm controller interrupt |
| OBA 4, 5 | 3985 | Disconnect/concurrent mode |
| OBA 5, 5 | 39A5 | Disarm controller interrupt |
| OBA 6, 5 | 39C5 | Enable concurrent I/O mode with interrupt |

## SPECIFICATIONS

### Controller

Capabilities ..... Complete control of one printer

Modes of Operation ..... Programmed
Programmed with interrupt on character concurrent I/O

Device Address ..... $05_{16}$

Dedicated Memory ..... Interrupt address: $010A_{16}$, $010B_{16}$
Starting address (concurrent I/O): $0016_{16}$, $0017_{16}$

Construction ..... One printed circuit board

Mounting ..... Plugs into any available I/O card slot in computer mainframe or expansion chassis

Interface Cable ..... 20 foot cable with mating connectors for both controller and printer. Cable is identical for both printer models.

Operating Power ..... +5VDC @ 1.5 amperes (provided by computer power supply)

Operating Environment ..... 0°C to 50°C (32°F to 122°F) @ 0% to 90% relative humidity (no condensation)

### Line Printers

Print Rate:

| | | | |
|---|---|---|---|
| Model 2731 ..... | 356 | lpm | – 80 columns |
| | 460 | lpm | – 60 columns |
| | 650 | lpm | – 40 columns |
| | 1110 | lpm | – 20 columns |
| Model 2732 ..... | 245 | lpm | – 132 columns |
| | 290 | lpm | – 120 columns |
| | 356 | lpm | – 96 columns |
| | 460 | lpm | – 72 columns |
| | 650 | lpm | – 48 columns |
| | 1110 | lpm | – 24 columns |

Line Length:
Model 2731 ..... 80 Columns
Model 2732 ..... 132 columns

Number of Characters ..... 64

Type and Size of Characters ..... ASCII, open Gothic print characters with printed symbols typically 0.095 inches high, 0.065 inches wide

Print Buffer (one print zone):
Model 2731 ..... 20 characters
Model 2732 ..... 24 characters

Drum Speed ..... 1760 rpm

Line Advance Time ..... 20 milliseconds (maximum)

Paper Slew Speed ..... 13 inches per second

Paper Type:
Model 2731 ..... Standard fanfold edge-punched paper 4 to 9.9 inches wide. Single-copy, 15 pound bond minimum weight. Multi-copy up to six parts, 11 pound bond with 6.5 to 8 pound carbon.

Model 2732 ..... Standard fanfold edge punched paper 4 to 14.9 inches wide. Single-copy, 15 pound bond minimum weight, Multi-copy up to six parts, 12 pound bond with single-shot carbon.

Print Area:
Model 2731 ..... 8 inches wide, left justified
Model 2732 ..... 13.2 inches wide, left justified

Format ..... Top-of-form control, single-line advance and perforation step-over. Six lines per inch.

Vertical Format Unit ..... Optional on Model 2732

Mounting:
Model 2731 ..... Table top or pedestal mount
Model 2732 ..... Floor standing

Dimensions and Weight:
Model 2731 ..... 23 inches high, 24 inches wide, 22 inches deep; 185 pounds.
Model 2732 ..... 46 inches high, 48.5 inches wide, 24.5 inches deep; 575 pounds.

Power (Single Phase) ..... Model 2731 – 330 Watts; Model 2732 500 Watts. 117 VAC ± 10%, 60 Hz ± 3 Hz or 230 VAC ± 10%, 50 Hz ± 3 Hz.

Operating Environment ..... 10°C to 44.4°C (10°F to 110°F) @ 30% @ 30% to 80% relative humidity (no condensation)

Microdata™

Microdata Corporation
17481 Red Hill Avenue
Irvine, California 92705
Telephone (714) 540-6730
TWX 910-595-1764