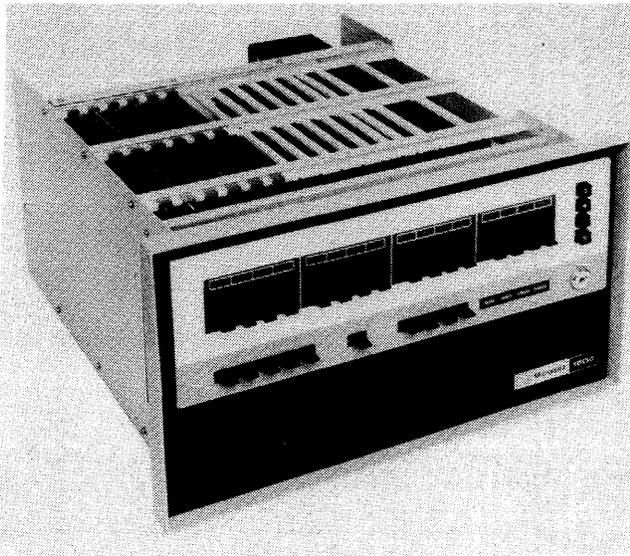


Microdata 1600 Series and Micro-One



The Microdata 1600 is rack-mountable or, with the proper cover, may be placed on a desk or table top. The processor features the capability for emulating other systems as well as for developing new ones through microprogramming by the manufacturer or the user.

MANAGEMENT SUMMARY

The 1600 Series is the compatible successor to Microdata's 800 Series, a successful early minicomputer family that can still be found in OEM applications even though it has been off the market for several years. Deliveries of the 1600 Series began in November 1972. The 1600 follows previous Microdata product lines in the ability of the processor to be tailored to the specific needs of the user through firmware. Users may choose to implement Microdata's firmware, augment that firmware, or develop their own.

The various configurations available in the eight-bit Microdata Series 1600 constitute an economical set of microprogrammed architectures based on the basic 1600 CPU. The Micro-One is a newer, single-board version of the original 800. The 1600 and the Micro-One are modular in concept and system architecture, thereby permitting custom versions which can be tailored to fit virtually any application.

When originally introduced, the 1600 Series was a price and performance improvement over Microdata's successful 800 line (over 3,000 installations). In storage cycle time and CPU add time, the 1600 Series is 10 percent faster than the 800 family. Additionally, the 1600 is expandable to 65K, versus 32K for the 800's, and at the same time is 5 to 20 percent lower in cost than the 800's. The Micro-One operates at the same speed as the 1600 Series but does not provide all of the microprogram features of the 1600. Microdata has also incorporated as standard in its 1600 Series and Micro-One processors features such as Power Fail/Auto Restart and Real-Time Clock, which were extra-cost options in the 800 Series. ➤

Introduced in 1972, the Microdata 1600 Series and the Micro-One are microprogrammable OEM computers available with firmware that provides stack processing, string manipulation, and variable-precision operations. Additionally, the 1600 forms the basis for the Reality Series systems sold by Microdata to end users through a dealer network.

CHARACTERISTICS

MANUFACTURER: Microdata Corporation, 17481 Red Hill Avenue, Irvine, California 92705. Telephone (714) 540-6730.

Microdata is a manufacturer of microprogrammable minicomputers for business and scientific applications. The current product line includes the Reality Series, a line of 1600-based business computer systems sold to end users through a dealer network, and Express III, a multi-user system for OEM customers with system programming capabilities. The company also manufactures tape drives, disc drives, and CRT display terminals. Microdata currently employs about 600 persons and maintains manufacturing facilities in Irvine and Santa Ana, California, in Barbados, and in Puerto Rico. Sales offices are located in western Europe, Canada, South Africa, and South America.

MODELS: 1600, 1600/21, 1600/30; Micro-One/13, /20, and /21.

DATA FORMATS

BASIC UNIT: 8-bit byte; a word is two bytes.

FIXED-POINT OPERANDS: 8, 16, 24 or 32-bit operands.

FLOATING-POINT OPERANDS: 32-bit operands, each composed of a two's complement 24-bit mantissa and a two's complement 8-bit exponent.

INSTRUCTIONS: One, two, three, or four bytes in length. In all formats, the operation code is one byte in length. The one-byte formats are largely used for control instructions and inter-register instructions. The two-byte formats are primarily for conditional jump instructions, shift instructions, and byte I/O transfers to/from registers. The three-byte formats are used for binary multiply and divide, two-byte literal instructions, and call and return instructions. The four-byte formats are used only for byte I/O transfers to/from memory.

In the two-byte instructions, the second byte is either an effective address, a shift count, or (in the case of an I/O byte instruction) a three-bit order code and a four-bit device number. In the three-byte instructions, bytes two and three are an address word; the high-order bit indicates indexing. In the four-byte instructions, used exclusively for I/O, byte two includes three-bit order code and four-bit device number; bytes three and four specify an address as described for three-byte instructions.

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: In the 1600 series, magnetic core main memory and MSI and LSI control memory. The Micro-One uses either magnetic core or semiconductor main memory. Control memory is available in either BROM or PROM form. ➤

Microdata 1600 Series and Micro-One

▷ The 1600 Series and the Micro-One are aimed primarily at the OEM market. With the exception of the 1600-based Reality Series (Report M11-633-301), Microdata is still largely oriented toward the OEM market.

The 1600 Series has been sold to several universities for instruction in computer sciences and experimentation, but the primary effort, as stated before, has been OEM sales. Microdata's sales approach is divided between a direct sales force that sells to OEM customers and a direct dealer network, composed mostly of service bureaus with application software skills. For fiscal 1977, Microdata states that total sales for all of its products were 60 percent OEM and 40 percent end user. The dealer network for the company's Reality system is carrying the bulk of new end-user sales. Currently, there are more than 10,000 Microdata 1600's installed. The number of Micro-Ones installed is not available from Microdata at this time.

Primary applications for which the 1600 Series computers have been used by the OEM market include: general accounting functions for small business, such as payroll processing, accounts receivable and payable, inventory control, and budgetary analysis; remote batch and time-sharing systems wherein a user can preprocess and manipulate data at locations distant from large systems; information retrieval systems in which the 1600 is coupled with microform equipment to provide customer inquiry information; and numerical control in industrial machinery for milling machines, lathes, and drills, in which the computer directs the machinery operations using instructions encoded on paper tape.

The market for the Micro-One includes applications in time-division multiplexers, communications concentrators, phototypesetters, process controllers, medical data acquisition, traffic control, and a host of similar projects.

The 1600 Series currently consists of three models: the basic 1600, the 1600/21, and the upward-compatible and 40 percent faster 1600/30. Besides the microprogrammability mentioned before, the series is characterized by variable-precision operations, character string manipulation, limited stack processing, and a one-microsecond cycle time.

Main memory varies from 8K to 64K bytes in most members of the series, with 8K- and 16K-byte increments available for expansion. Control memory is available as masked read-only memory (BROM), electrically programmed read-only memory (PROM), and writeable control memory. Maximum control memory size is 4096 16-bit words. ▶

▶ **CYCLE TIME:** 1 microsecond throughout the 1600 and Micro-One Series main memory; 200-nanosecond micro-command execution speed in control memory. All times are based on an 8-bit fetch from main memory and a 16-bit fetch from control memory.

CAPACITY: The 1600/30 and Micro-One/13 and /20 all have a maximum main memory capacity of 65K bytes. The maximum size for the 1600/21 and Micro-One/21 is 32K bytes. All processors have a minimum main memory capacity of 8K bytes. In all systems, core memory is expandable in either 16K or 8K increments. A no-cost bank select option permits incorporating up to 128K bytes in a configuration.

CHECKING: None.

STORAGE PROTECTION: None.

RESERVED STORAGE: A total of 384 bytes in low-order memory are dedicated to interrupt, DMA status, and DMA control information.

CENTRAL PROCESSOR

GENERAL: The 1600 Series and Micro-One processors all come with a real-time clock, power fail/auto restart, and teletypewriter (TTY) controller. The 1600/21 and 1600/30 processors include standard firmware that offers variable-precision operations, character and character-string manipulation, and stack processing.

The Micro-One is a single-board CPU that can be used to emulate general and special-purpose computers, as does the 1600. This discussion will, however, limit itself to the Micro-One's emulation of the 1600/21. The firmware supplied by Microdata gives the Micro-One the attributes of the 1600/21, including variable-precision operations, characters and character-string manipulation, and stack processing.

CONTROL STORAGE: The 1600/21 and the Micro-One accommodate 1024 words of control memory, while the 1600/30 has 1792 words. A word is 16 bits long. The two types available are masked program read-only memory (BROM) and electrically programmed read-only memory (PROM). The 1600 Series increment of control memory is 256 words, while the Micro-One increment is 512 words.

REGISTERS: The Micro-One/21, 1600/21, and 1600/30 all contain 16 eight-bit file registers called the primary file. The 1600 Series also contains a secondary bank of 16 eight-bit file registers which are user-accessible. The secondary bank is unused in the 1600/21, but in the 1600/30 a portion of the file is used for concurrent I/O and condition flags. The primary file contains all operational registers that are utilized in user programming, and is also used for other functions not accessible to the user, including storage of condition codes and operand address.

The three 16-bit operational registers include the A register, which functions as an accumulator for most operations and holds the upper portion of 24- or 32-bit data words and all of the 8- and 16-bit data words. The B register functions as ▶

SUMMARY DATA FOR MICRODATA 1600 SERIES

	1600	1600/10	1600/20	1600/21	1600/30	1600/40	1600D	1600/60	Micro-One
Announced	3Q 1971	3Q 1971	3Q 1971	3Q 1971	3Q 1972	3Q 1971	1Q 1972	1Q 1972	2Q 1974
First Delivery	11/72	11/72	11/72	11/72	1/73	11/72	1/73	3/73	12/74
Typical Purchase Price*	\$6,000	***	***	\$6,600	\$7,000	***	***	***	\$2,200
Number Installed**	Over 10,000 total								NA

*CPU plus 8K bytes of main memory.

**As of December 1977.

***No longer marketed.

Microdata 1600 Series and Micro-One

PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
MAGNETIC TAPE EQUIPMENT		
2815, 2825	Nine-track, 800 bpi, 25.0 ips, NRZI, 10.5-inch; 20 KBS	Microdata
LINE PRINTERS		
2733	132 columns, 64-char. set; 300 lpm	Dataproducts
2734	132 columns, 96-char. set; 200 lpm	Dataproducts
2737	132 columns, 64-char. set; 165 cps (60 lpm)	Centronics
Scribe	132 columns, 96-char. set; 120 or 165 cps	Microdata
CARD EQUIPMENT		
2721-1	Reader, 1000-card I/O hopper and stacker; 300 cpm	True Data
PAPER TAPE EQUIPMENT		
2710	Fanfold, 8-channel reader and punch; 300 cps, read, 75 cps punch	Remex
2710-1	Roll, 8-channel reader and punch; 300 cps	Remex
2711	Fanfold, 8-channel reader; 300 cps	Remex
2712	Fanfold, 8-channel punch; 75 cps	Remex
TERMINALS		
2751	CRT/keyboard, 24 lines x 80 char./line, 64 ASCII chars., refresh rate 60 frames/sec.; switchable rates 300 to 9600 bps	Prism by Microdata

➤ The single-board Micro-One was introduced in 1974 and is available with firmware to emulate the 1600/13, 1600/20, and 1600/21. Its basic configuration occupies one 8½-by-11-inch board. Microdata achieved this small size by utilizing ROM for the control logic of the central processor. Advanced features and operating characteristics of the Micro-One include bipolar circuitry, processor and command control ROM on one board, memory addressing to 65K bytes, compatibility with either MOS or core memory modules, 1.0-microsecond full-cycle memory, and an 8-bit arithmetic/logic unit.

Basic prices for the 1600 Series processors without main memory range from \$3,600 to \$4,600, while the Micro-One processor is priced at \$810. Prices quoted are for table-top enclosed processors with firmware and power supplies. Discounts of up to 25 percent are available in quantity.

Software is somewhat limited. The 1600 Series and the Micro-One have one operating system, TOS (Teletype Operating System); a micro assembler; a simulator and a cross-assembler written in FORTRAN to be used on a large system; a set of diagnostic tests; and a utilities group. The 1600 and Micro-One additionally support single-user BASIC.

USER REACTION

Datapro talked with representatives of two systems houses that buy Microdata 1600's on an OEM basis, add proprietary software packages, and market the resulting systems to end users. Both of these users market their systems to selected industries, and they have collectively installed more than 400 systems in a little over three years.

Both of these users stated that one of the key reasons they selected the Microdata computer for use in their systems was its microprogramming capability. Both have ➤

➤ an auxiliary accumulator; its prime task is to hold the lower 16 bits of 24- and 32-bit data items. The X register is the single index register. The P register is 15 bits long and serves as the program counter. The 2-bit W register is loaded by a control instruction with the word length mode; the mode sets the byte length of the operand for all variable-length instructions. The O register holds the overflow flag and is one byte long; the flag is set by arithmetic or control instructions and reset by any instruction which tests for overflow condition.

In addition, the 1600/30 contains two special-purpose 1-bit registers. The flag in the Power Fail register is automatically set by the firmware when a power failure is detected to prevent servicing of interrupts during the condition. The GAI register is used with the General Alternate Interrupt instruction, which functions when the 1600/30 is used in a dual-processor configuration. The other CPU registers are not accessible to the user.

PUSH-DOWN STACK: The stack is a reserved area of memory with a maximum size of 255 bytes, completely located in a single 256-byte page of memory. The stack works on a last-in, first-out (LIFO) principle. The instruction set contains the instructions for storing and loading the A, B, and X registers individually or as a group from the stack. All internal and external interrupts, except the console, power restart, and stack overflow interrupts, cause all operational registers to be pushed into the stack and a jump made to the applicable service routine.

INDIRECT ADDRESSING: One-level.

ADDRESSING: Eight operand addressing modes are available: direct and indirect to page 0 for the first 256 bytes of memory; direct and indirect to the P register for a range of ±128 bytes from the next instruction; indexed, where the effective address is given by the X register; indexed with displacement, where the displacement is given by the instruction operand; extended address, enabling effective operand addressing with or without indexing; and immediate (literal) operands of one to four bytes length.

INDEXING: Yes, using the X register.

INSTRUCTION REPERTOIRE: All processors implement a minimum of 107 instructions. The instruction set contains ➤

Microdata 1600 Series and Micro-One

➤ developed firmware to perform specific functions normally handled by software. One user has elected to microcode only operating system functions, while the other has made use of firmware in both the operating systems and compilers available with its systems.

Both users appeared well satisfied with the Microdata systems, particularly the reliability of the processors. Neither user had any specific complaints, and both felt that the 1600 was the best system currently available for their purposes.

The 1600 has been a very successful product for Microdata, and is apparently still selling well despite the fact that it has remained largely unchanged since its introduction. While this obviously indicates that Microdata used foresight in the design of the 1600, you have to wonder how long it can stand the pressure from the continuing stream of new products from competitive vendors. It's true that you can't argue with success, but Datapro feels that the 1600 still has a lot of untapped potential and deserves more attention from Microdata. □

➤ 16 control, 12 multi-bit arithmetic and logical shift, 17 conditional jump, 6 I/O, 19 inter-register, 8 stack control, 5 character/string manipulation, 2 multiply/divide, 2 decimal arithmetic, and 20 memory reference instructions. The 1600/30 instruction set is enhanced by the addition of one control, and one return jump.

INSTRUCTION TIMINGS: Timings are shown in microseconds for full-word, fixed-point operands:

	1600/30	1600/21	Micro-One
Load/Store	4.6/5.4	5.4/5.4	5.9/5.9
Add/Subtract	4.6/4.6	4.8/5.2	5.3/5.7
Multiply/ Divide	56/74*	66.5/92.7*	73.2/1020*
Compare and Branch	5.6/4.0	4.8/7.4	5.3/8.3

*Average.

INTERRUPTS: There are from 2 to 128 interrupts available in the 1600 Series and the Micro-One. The system is based upon priority interrupts for internal processor interrupts, I/O peripheral device interrupts, and groups of individual external interrupts. Each such interrupt has its own unique memory address and priority assignment. External interrupts occur at device controllers or interrupt modules on the Byte I/O bus. This system of external interrupts contains a signal line, a priority line, and a select line. Internal interrupts have priority over external ones and are dedicated to console interruption, power fail/restart, real-time clock, and user-selectable, optional interrupts.

PHYSICAL SPECIFICATIONS: The 1600 Series processor, as a desk-top unit, is 10.5 inches high, 19 inches wide, and 20.5 inches deep. The expansion chassis is of the same size. In a rack-mount configuration with front panel, the processor and expansion chassis fit into a single-bay cabinet 23.09 inches wide, 25.50 inches deep, and 62.06 inches high. A double-bay cabinet has the same depth and height but is 46.06 inches wide. Power requirements are 115/230 volts AC ±10 percent, 50 or 60 Hz.

The Micro-One cabinet is 19 inches wide, 5.25 inches high, and 15 inches deep; power requirements are the same as for the 1600 Series, although the wattage drawn will be much less.

An average configuration will require 25 square feet for operation and maintenance. The operating temperature range is 32 to 120 degrees Fahrenheit. No special air conditioning above normal office facilities is required.

INPUT/OUTPUT CONTROL

I/O CHANNELS: Interfaces are available to handle serial I/O, parallel byte I/O, and a direct memory access (DMA) port. I/O operations can take place via the DMA at speeds up to one million bytes/second. The I/O bus for Parallel byte I/O will handle speeds up to 20,000 bytes/second, dependent on the firmware installed. Capability for both concurrent I/O and programmed I/O is present.

SIMULTANEOUS OPERATIONS: Both concurrent I/O and direct memory access are initialized by programmed I/O operations. Both can proceed without further program intervention once started. Concurrent I/O operations take priority over instruction execution, forcing a break in long operations such as multiply, divide, and shifts. This ensures that servicing delays will not be excessively long for this type of I/O.

CONFIGURATION RULES: The 1600 Series processors all have 14 slots available in the main chassis with integral power supply or 18 slots with external power supply. An expansion chassis provides an additional 20 slots. The CPU is contained on two printed-circuit boards, the core memory on one to eight boards, the control memory on one board, power supply distribution on one board, and the expansion chassis bus coupler on one board. The other slots are available for I/O use.

The Micro-One has four slots available for I/O and memory.

Restrictions do exist. Only one multiplexer or selector channel (DMA) is allowable, and each of these channels can handle up to four I/O devices. The magnetic tape controller (two allowed) will accommodate up to four drives and requires two slots. The disc controller (two allowed) also will accommodate up to four drives and requires two slots. All printers, card readers, and paper tape equipment require one slot each. Asynchronous communication controllers are available to handle up to eight channels, but require only one slot each.

MASS STORAGE

2954 DISC SYSTEM: The 2954 and the companion add-on drive, the 2961, are top-loading, moving-head disc drives with one fixed and one removable IBM 5440-style cartridge. Storage capacity is 5 megabytes per drive. Density is 100 tracks per inch, and rotational speed is 1500 rpm. The data transfer rate is 200K bytes/second. Average head positioning time is 35 milliseconds, with an average rotational delay of 20 milliseconds. The manufacturer is Microdata.

2956 DISC SYSTEM: The 2956 and the companion add-on drive, the 2963, are top-loading, moving-head disc drives with one fixed and one removable IBM 5440-style cartridge. They are dual-density versions of the 2954 drives. Storage capacity is 10 megabytes per drive. Density is 200 tracks per inch, and rotational speed is 1500 rpm. The data transfer rate is 200K bytes/second. Average head positioning time is 35 milliseconds, with an average rotational delay of 20 milliseconds. The manufacturer is Microdata.

INPUT/OUTPUT UNITS

See Peripherals/Terminals table.

COMMUNICATIONS CONTROL

2600 FULL-DUPLEX SYNCHRONOUS INTERFACE AND CONTROL: Provides for a data transfer rate of up to 9600 bps. The 2600 has two modes of operation: programmed, concurrent I/O; and interrupt data transfer. The interface is EIA Standard RS-232C.

2610 ASYNCHRONOUS COMMUNICATIONS CONTROLLER: Designed for the Bell 103 and 202 modems, Teletype 20-ma current loop, or equivalents. The controller offers a single channel that is full-duplex and programmable ➤

Microdata 1600 Series and Micro-One

for rates from 75 to 9600 bps. Also included are programming provisions for stop bits, parity error checking, and character lengths.

2613 ASYNCHRONOUS MODEM INTERFACE: Provides for simultaneous operation of eight full-duplex asynchronous channels for Bell 103 and 202 or equivalent modems. Each channel is programmable for rates from 75 to 9600 bps; character lengths of 5, 6, 7, or 8 bits; 1 or 2 stop bits; and parity checking.

2613-1 ASYNCHRONOUS MODEM INTERFACE: Same as the 2613 except that it provides for the operation of four full-duplex asynchronous channels.

2614 ASYNCHRONOUS COMMUNICATIONS CONTROLLER: Provides for simultaneous operation of eight full-duplex asynchronous channels. Each channel has the individual capability for one of 8 rates from 110 to 9600 bps, character lengths of 8, 9, 10 or 11 bits, 1 or 2 stop bits, and parity checking. The interface is EIA Standard RS-232C or Teletype 20-ma current loop. A two-level interrupt feature is available.

2614-1 ASYNCHRONOUS COMMUNICATIONS CONTROLLER: Same as the 2614 except that it provides for the operation of four full-duplex asynchronous channels.

SOFTWARE

OPERATING SYSTEM: Only one operating system is available with the 1600 Series and the Micro-One, the *Teletype Operating System (TOS)*. It is an elemental I/O control system that supports program development and includes console control of program debugging, load, and dump operations. TOS resides in the last 896 bytes of main memory.

A special routine, called the *Alterable Control Operating System*, loads and verifies the contents the control memory. It accepts output from the Micro Assembly Program and provides dynamic checkout of microcode after simulation. On the 1600 Series it is referred to as AROS, while on the Micro-One it has the acronym of ACOS. The program resides in the last 3365 bytes of main memory below TOS. Up to 1000 words of microcode can be handled.

LANGUAGES: At present only two programming languages, BASIC and Micro Assembly Program, are supported on the 1600 Series and the Micro-One.

Single-User BASIC is a version of the BASIC programming language for use on the 1600/21 and 1600/30 and Micro-One. It requires a processor with at least 8K bytes of main memory and an attached teletypewriter.

Micro Assembly Program (MAP 1600) is a two-pass symbolic assembly program for translating Microdata 1600 and

Micro-One microprograms into absolute binary card output format. An assembly listing is provided. A processor with a minimum of 8K bytes of main memory and a parallel teletypewriter interface is required. MAP 1600 resides in the first 3620 bytes of memory, not including the symbol table.

Cross Assembler (AP 1600) allows microprograms for the 1600 Series to be assembled on machines such as the IBM System/360, Univac 1108, Control Data 6600, or Honeywell 635. The required configuration includes a card reader/punch, line printer, five magnetic tape units, and a processor with a minimum 64K main storage. The program is written in FORTRAN IV. *Cross Micro Assembler* is the Micro-One version of AP 1600.

UTILITIES: In this category are the following: diagnostic programs for main and control memory, peripherals, and instruction set; two simulators of the 1600 Series to run on large systems such as the Control Data 6600; an I/O Executive for General I/O handling; and loaders.

APPLICATIONS SOFTWARE: Not available from Microdata.

PRICING

POLICY: Microdata offers the 1600 Series and the Micro-One on a purchase basis only. Systems software is bundled. Volume discounts vary depending on the quantity purchased, with a maximum discount of 25 percent for purchases with a dollar value over \$90,000. Prices for modifications are quoted upon request.

MAINTENANCE: Hardware maintenance is available on a per-call basis. This maintenance is provided on a per-diem basis for time, materials, and travel expenses from Irvine, California.

EQUIPMENT: The following typical system purchase prices include all required control units and adapters.

TYPICAL 1600 OEM CONFIGURATION: Includes basic processor with Power Fail/Auto-Restart, Real-Time Clock, power supply, desk enclosure, basic panel, TTY controller, and 8K bytes of 1.0-microsecond main memory. Purchase price is \$5,550.

TYPICAL BATCH CONFIGURATION: Includes 1600/21 processor with 16K bytes of 1.0-microsecond memory, programmer's console, 2710 paper tape system, (300/75 cps), 2751 CRT, 2720 card reader (300 cpm), one 2733 line printer (300 lpm), 2514 selector channel, and 2854 disc system (5 megabytes). Purchase price is \$36,880.

TYPICAL SINGLE-USER BASIC SYSTEM: Includes 1600/30 processor with 16K bytes of 1.0-microsecond memory, programmer's console, real-time clock, 2954 disc system (5 megabytes), and 2751 CRT. Purchase price is \$18,375. ■

EQUIPMENT PRICES

		Purchase Price
PROCESSORS		
1600	Microdata 1600 basic CPU with power-fail/auto-restart, real-time clock, teletypewriter controller, and card cage with 10 available assembly slots; requires ROM control memory	\$ 3,600
1506	Microdata Micro-One microprocessor with real-time clock, power-fail/auto-restart, and serial TTY controller	810
1600/21	Microdata 1600/21 CPU with power-fail/auto-restart, 1024 words ROM control memory, real-time clock, teletypewriter controller, and card cage with 9 available assembly slots	4,150
1600/30	Microdata 1600/30 CPU with power fail/auto-restart, 1792 words ROM control memory, real-time clock, teletypewriter controller, and card cage with 9 available assembly slots	4,600

Microdata 1600 Series and Micro-One

EQUIPMENT PRICES

**Purchase
Price**

CONTROL MEMORY

Programmed Read-Only Memory (PROM) assembly with customer-supplied firmware:*

2310	For all 1600 systems—	
	256 words	550
	512 words	950
	768 words	1,350
	1024 words	1,750
	1280 words	2,150
	1536 words	2,500
	1792 words	2,950
	2048 words	3,350
	For Micro One—	
1561-2xx	512 x 16 bits	230
1561-4xx	1024 x 16 bits	460

Control memory assembly for Programmed Read-Only Memory (BROM) with customer-supplied firmware:*

2320	For all 1600 systems—	
	256 words	300
	512 words	450
	768 words	600
	1024 words	750
	1280 words	900
	1538 words	1,050
	1792 words	1,200
	2048 words	1,350
	For Micro One—	
15512xx	512 x 16 bits	90
1551-4xx	1024 x 16 bits	175
2380-512	Alterable Control Memory (ACM); 512 words; requires 2384	1,800
2380-1024	Alterable Control Memory (ACM); 1,024 words; requires 2384	2,500
2384	ACM control panel, cooling unit and 20-amp remote power supply to provide power for up to two 2380 ACM modules	1,000
2384-1	ACM control panel, cooling unit and 40-amp remote power supply to provide power for up to four 2380 ACM modules	1,350

*Customer-supplied firmware to be submitted to Microdata in the form of card deck output, AP1600 or paper tape output, MAP 1600 assembly programs. PROM and BROM may be intermixed within systems and on a single control memory assembly. A one-time charge for production set-up of each module of PROM or BROM control memory is applied.

MAIN MEMORY

2208	For all 1600 systems—	
2216	8,192-byte core memory module	1,400
	16,384-byte core memory module	2,250
	For Micro One—	
2208	8,192 byte core memory module	1,400
2216	16,384-byte core memory module	2,250
1501-1	1K x 8, 1-microsecond MOS memory	380
1501-2	2K x 8, 1-microsecond MOS memory	455
1501-3	3K x 8, 1-microsecond MOS memory	530
1501-4	4K x 8, 1-microsecond MOS memory	600
1501-5	5K x 8, 1-microsecond MOS memory	675
1501-6	6K x 8, 1-microsecond MOS memory	750
1501-7	7K x 8, 1-microsecond MOS memory	825
1501-8	8K x 8, 1-microsecond MOS memory	900

FIRMWARE

	For Micro One—	
1551-413	Firmware Set 13; 1K words semiconductor read-only memory; supports serial TTY controller on 1506	205
1551-420	Firmware Set 20; 1K words semiconductor read-only memory; does not support serial TTY controller on 1506	205
1551-421	Firmware Set 21; 1K words semiconductor read-only memory; does not support serial TTY controller on 1506	205
	For all 1600 systems—	
2331-4	Firmware Set 21; 1,024 words bipolar read-only memory (BROM)	750
2332-1	Firmware Set 30; 1,792 words bipolar read-only memory (BROM); for 1600D	1,200
2335-1	Firmware; floating-point option for 1600/30; factory installation only; add-on for other firmware set	950
2335-2	Firmware; floating-point option for 1600/21; factory installation only; add-on for other firmware set	950
2310-4	Diagnostic firmware for 1600 Series	1,750

PROCESSOR OPTIONS

2410	Expansion chassis for standard Microdata 1600 computers, including 20-amp remote power supply and I/O bus extension interface with cable; provides 20 I/O assembly slots	1,550
2410-1	Expansion chassis; same as 2410, but with 40-amp remote power supply	2,250
1058-2	Extender printed circuit board for 1600 Series	250

Microdata 1600 Series and Micro-One

EQUIPMENT PRICES

		<u>Purchase Price</u>
MASS STORAGE		
	Each disc system includes a controller and one with fixed and one removable cartridge; the controller can accommodate a mix of 100 and 200 track/inch (tpi) densities if rotational speeds are the same; DMA channel is included:	
2854	For all 1600 systems and Micro-One— 100 tpi, 5 million bytes, 1500 rpm, controller	8,625
2856	For 1600 systems only— 200 tpi, 10 million bytes, 1500 rpm, format protect, controller	9,325
2861	100 tpi, 5 million bytes, 1500 rpm add-on drive	5,025
2863	200 tpi, 10 million bytes, 1500 rpm add-on drive	5,725
MAGNETIC TAPE EQUIPMENT		
	Magnetic tape, 9-track, 800 bpi, NRZ:	
2815	For Micro-One— 10.5-inch reel, 25.0 ips, 20K bytes/sec., drive and controller	7,100
2815	For all 1600 systems— 10.5-inch reel, 25.0 ips, 20K bytes/sec., drive and controller	7,100
2825-x	10.5-inch reel, 25.0 ips, 20K bytes/sec., add-on drive	4,100
LINE PRINTERS		
2733	For all 1600 systems— Line printer, 132 columns, 64-character set, 300 lpm, controller	9,500
2734	Line printer, 132 columns, 96-character set, 200 lpm, controller	10,500
2733-1	12-channel vertical format unit (VFU) for 2733 or 2734	400
2737	For Micro-One and 1600— Line printer, 165 cps, 132 positions, 64-character set, controller	6,500
PUNCHED CARD EQUIPMENT		
2721	300-cpm, 80-column card reader and controller; for 1600 Series and Micro-One	3,750
2721-1	Same as 2721, but can also read mark-sense cards	5,250
PAPER TAPE EQUIPMENT		
2710	For all 1600 systems and Micro-One— 300 cps/75 cps, 8-channel, fanfold paper tape reader/punch and controller	3,955
2710-1	For all 1600 systems— 300 cps/75 cps, 8-channel, spooled paper tape reader/punch and controller	3,955
2711	300 cps, 8-channel, fanfold paper tape reader and controller Spooler,	2,500
2711-1	Spooler, for roll tape	250
2712	75 cps, 8-channel, fanfold paper tape punch and controller	2,800
2712-2	Spooler, for roll tape	250
COMMUNICATIONS		
2600	Full-duplex synchronous modem interface and control operating in programmed, concurrent I/O, and interrupt data transfer modes	900
2610	Asynchronous communications controller for Bell System 103 and 202 modems or Teletype 20-ma current loop	500
2615-8	Asynchronous communications controller; provides simultaneous operation of 8 full-duplex asynchronous channels, 2612 for 1600 series only	1,600
2615-4	Asynchronous communications controller; provides simultaneous operation of 4 full-duplex asynchronous channels; 2612-1 for 1600 series only	1,000
2613	Asynchronous modem interface; provides simultaneous operation of 8 full-duplex asynchronous channels for Bell System 103 or 202 modems or equivalent	2,000
2613-1	Asynchronous modem interface; provides simultaneous operation of 4 full-duplex asynchronous channels for Bell System 103 and 202 modems or equivalent	1,400
I/O INTERFACES & CONTROLLERS		
2514	Selector channel (operates via Direct Memory Access) for alternate operation of up to four I/O devices	850
2515	Multiplexer channel (operates via Direct Memory Access) for simultaneous operation of up to four I/O devices; for 1600 Series	500
2510	Byte I/O controller; provides both independent input controller and output controller with 8-bit data transfers operating in programmed, concurrent I/O, or interrupt mode	500
2511	Full-word I/O interface; provides 32 input lines and 32 output lines; data transfers under program control	700
2910	IBM Selectric Typewriter controller; 24 volt operation, includes power supply; for 1600 series	1,550
2929	Card reader controller; for 1600 series	900
2930-1	Magnetic tape controller for up to 4 magnetic tape units, 25 ips, 800 bpi, 7- or 9-track; for 1600 Series	2,000
2950	Disc system controller for up to 4 disc drive units; operates with 2515 DMA/multiplexer, accommodates 100 tpi, and 200 tpi drives for 1600 Series	3,300
TERMINALS		
2751	Microdata Prime CRT display terminal; 24 lines by 80 char., ASCII keyboard, 300 to 9600 bps	2,500

Microdata 1600 Series and Micro-One

EQUIPMENT PRICES

		<u>Purchase Price</u>
ENCLOSURES		
	For 1600 Series—	
2001	Standard 19-inch rack-mountable enclosure for cabinets 24 to 30-inches in depth; has single fan for use with integral power supply	170
2001-4	Standard 19-inch rack-mountable enclosure for cabinets 24 to 30 inches in depth; has two fans for use with remote power supply	220
2002	Table-top enclosure with single fan for use with integral power supply	250
2002-1	Table-top enclosure with two fans for use with remote power supply	300
2003	Standard 19-inch rack-mounting hardware for nonenclosed card cage in cabinets 24 to 30 inches in depth; used for 2384 and CPU on 1600 series	50
2008	Cooling Unit for standard 19-inch rack mounting with 4 fans; unit includes 5/4-inch front-panel	280
2006	Single-bay computer cabinet providing 49 inches of vertical mounting space, 19-inches wide, and 30 inches deep	950
2007	Double-bay computer cabinet providing 49 inches of vertical mounting space, 19 inches wide, and 30 inches deep in each bay	1,600
	For Micro-One—	
1510	Standard 19 by 5.25 inch rack-mount chassis with 4-slot backplane, 12-amp power supply, and cooling	660
1510-1	Same as 1510 above except with table-top enclosure and air filters	760
2006	Single-bay equipment cabinet; provides 52.25 inches of vertical mounting space	700
	Power supplies—	
1112	Internal, standard plug-in 20-amp power supply; for 1600 Series	675
1112-1	External, remote 20-amp power supply; for 1600 Series	875
0800	External, remote 40-amp power supply; for 1600 Series	1,570
1520	Internal, 12-amp power supply for Micro-One	335
CONTROL PANELS		
2101	Basic panel; includes run-halt indicators, 4 sense switches, 6 control switches, and keylock power switch; for 1600 Series	300
2102-2	System panel; includes run-halt indicators, 4 sense switches, 6 control switches, keylock power switch, register display, and 16-bit switch register	600
1515	Micro-One control panel; includes run-halt indicators, 4 sense switches, 6 control switches, and power on/off switch	325