Cincinnati Milacron CIP/2200B

MANAGEMENT SUMMARY

The CIP/2200B has as much application in Cincinnati Milacron's own products as it has to outside OEM's and end users. From continuing research efforts, the company has developed such interesting minicomputer-controlled applications as an industrial robot that can move mechanical components at up to 3000 inches per minute and the Variable Mission Manufacturing Center (VMMC), which automatically moves parts to and from a machining station where automatically selected cutting tools do their jobs under computer control.

To satisfy its internal requirements, Cincinnati Milacron began manufacturing a minicomputer in the early 1970's under a license acquired from Microdata; the early computers were essentially Microdata 800's. The current product line was designed in-house and is not manufactured under license.

A rather recent announcement has indicated a new direction for the CIP/2200B. In April 1975, Cincinnati Milacron announced the availability of four packaged systems to provide communications protocol compatibility with Control Data, IBM, Univac, and Honeywell systems. These products, labeled the CIP/220, CIP/240, CIP/260, and CIP/280, package a processor, cabinet, console, and power supplies with separately priced software and modem controllers.

The CIP/2200B is characterized by a maximum main memory of 64K bytes. The memory may either be MOS or core. Further, ROM microprogramming can be augmented by user routines using up to 512 sixteen-bit words. The interrupt system is capable of handling up to 32 peripherals. The instruction set is composed of 122 ▷

Cincinnati Milacron has designed the CIP/2200B to be configured as an intelligent terminal, a process control system, or a general business system using RPG II. It is the immediate successor to the CIP/2200, and features improved throughput and a slightly augmented instruction set.

CHARACTERISTICS

MANUFACTURER: Cincinnati Milacron, Process Controls Division, Morrow/Milgrove Rd., Lebanon, Ohio 45036. Telephone (513) 494-1200.

Cincinnati Milacron is a 91-year-old manufacturer of machine tools, process controls, computers, specialty chemicals, plastics machinery, and abrasives. Currently there are 32 manufacturing plants, half of which are located overseas. Marketing facilities are located in over 60 countries around the world. The company is divided into six major divisions, one of which, the Process Controls Division, manufactures minicomputer systems, machine control systems, and semiconductor materials.

MODEL: CIP/2200B.

DATE ANNOUNCED: January 1974 for the CIP/2200B; January 1972 for the original CIP/2200.

DATE OF FIRST DELIVERY: June 1974 for the CIP/2200B; February 1972 for the original CIP/2200.

NUMBER INSTALLED: 1700 (all models) as of July 1975.

DATA FORMATS

BASIC UNIT: 8-bit byte (half word).

FIXED-POINT OPERANDS: 8-bit (half word), 16-bit (full word), 24-bit (extended word), and 32-bit (double-word) ▶

The CIP/2200B system at left consists of a 16K-byte processor, a 600-cpm card reader, a 300-lpm printer, and a CRT console. This configuration represents the CIP/2200B being used as a remote batch terminal.

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▷ instructions, some of which are quite powerful. Other standard features include an interval timer, power fail/auto restart, and the facility for up to two DMA channels. The peripheral line covers a fairly wide range of equipment.

The CIP/2000 series of minicomputers was originally announced in January 1970 with the Model 2100, at the same time that its vendor, The Cincinnati Milling Machine Company ("The Mill") changed its name to Cincinnati Milacron ("mil," a unit of precise measurement; "acron," from the Greek word meaning highest). At least part of the reason for the name change was to reflect the fact that this leading producer of machine tools and process controls since 1884 had become diversified into the computer business as well as into numerous abrasive, chemical, plastic, and cutting fluid markets. The growth into minicomputers arose naturally as the company's computer-controlled automation of large lathes, turning centers, profiling and milling machines, etc., reached greater heights each year.

In this respect, Cincinnati Milacron's approach toward turning the machine tool industry's increasing involvement with minicomputers to its maximum advantage differed from that of its competitors. While firms such as Gardner-Denver incorporated off-the-shelf OEM mini's from DEC and others into their end-user machine tool systems, Cincinnati Milacron decided to produce its own minicomputer and make it available for direct purchase as well as build it into finished end-user tool systems to replace earlier hard-wired (direct) controllers. This, then, is the *raison d'etre* for the CIP/2000 Series; and, as can well be imagined, the CIP systems are designed to function well in a factory automation environment.

Surprisingly enough, the earliest uses of the CIP/2000's were in a variety of special applications (e.g., the "Comp-acct" point-of-sale terminal for McDonald hamburger stands, the Mergenthaler typesetting system, the Asyst Insurance proposal service, and the Hardy concrete mixing control system), although it was always intended that the CIP's be amenable to incorporation in numerical control systems produced by "The Mill."

The CIP/2200, announced in January 1972, differs from the earlier CIP/2100 primarily in having a more sophisticated instruction set that is better suited to more generalized applications (list/word/data processing). The CIP/2200B, announced in January 1974, is a further enhancement of the CIP/2200, adding better throughput and three instructions to the set. To date, more than 1700 CIP/2200's and CIP/2200B's have been installed.

In view of Cincinnati Milacron's Process Control Division background in computer numerical control (CNC), the presence of an effective, high-speed I/O control system and flexible external interrupt structure is understandable. What is not as readily attributable to the CNC heritage of the CIP/2200 is the comprehensive CiMOS operating system—a powerful general-purpose disk-based system with good sort capability and file handlers. The ▷

▶ lengths. Byte-string manipulation up to 256 bytes is also available. Decimal numbers appear in memory as byte strings up to 16 digits in length.

FLOATING-POINT OPERANDS: Provided by software subroutines (up to 15 decimal digits).

INSTRUCTIONS: One to eight bytes in length, depending on the number of memory addresses specified, the addressing mode used, and other pertinent information required. Control and register instructions can be as short as one byte, while memory-to-memory instructions are up to eight bytes long.

INTERNAL CODE: ASCII.

MAIN STORAGE

STORAGE TYPE: Core or optional MOS (metal oxide semiconductor).

CYCLE TIME: 1.1 microseconds for an 8-bit half word, for core or MOS main memory.

CAPACITY: 8K to 64K eight-bit bytes of main memory. MOS is available in 16K or 32K-byte increments; core is available in 8K-byte increments. MOS and core memories cannot be mixed.

CHECKING: Optional, 1 bit per byte.

STORAGE PROTECTION: User programs may not utilize the up to 32K bytes of storage assigned to the supervisor and its related programs; a check is made by firmware for violations.

RESERVED STORAGE: Approximately 256 bytes for vectored interrupts, DMA start and end addresses, and DMC buffer pointers, plus about 144 bytes for system save areas, etc.

CENTRAL PROCESSOR

GENERAL: The CIP/2000B processors are built around the 2003 bare-bones ("strippable mini") OEM parallel CPU, a general-purpose byte-oriented minicomputer with user-accessible control storage. The processor uses TTL logic with some MSI circuitry and has a 4.55-MHz clock rate. A push-down control stack is standard for automatic state switching; the control stack occupies the 256-byte memory page indicated by the control stack pointer. Also included are power fail/automatic restart, facilities for up to two DMA channels, interrupt, enable/disable, and an interval timer. Memory parity is optional.

CONTROL STORAGE: ROM (read-only memory) includes 1795 16-bit words. It has an access time of 220 nanoseconds and is divided into 7 pages of 256 words each. Users may design custom firmware to be entered on pages 6 and 7 (2319 ROM) or on page 7 only (2320 ROM). User-defined firmware is useful for adding application-dependent software instructions or I/O operations. Special microcode can also be added to perform processing functions based on commands from the front panel. Standard features implemented by microprogramming include serial I/O controller, disk IPL (2320 ROM), and a high-speed Direct Memory Channel block feature.

REGISTERS: There are three 16-bit hardware registers: Accumulator (A), Accumulator Extension (B), and Index register (X). The A register is the operand source for all binary arithmetic and logical instructions. The B register extends the accumulator for variable-length binary arithmetic and logical operations. Byte-mode I/O operations can transfer data to or from the low-order eight bits ▶

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION AND SPEED	MANUFACTURER
MAGNETIC TAPE EQUIPMENT		
2061, 2062, 2063-X	9-track, 800 bpi, 25 ips, read after write; 20K bytes/sec.	Pertec
LINE PRINTERS		
5000	Impact, 5 x 7 dot matrix, 63 character set, 132 positions, 6 lines/inch; 165 cps	Centronics 101
5001	Impact, 9 x 7 dot matrix, 64-character set, 132 positions, 6 lines/inch, two print heads, bidirectional; 330 cps	Centronics 102A
3046/3052	Impact, ASCII 64-character set, 10 characters/inch, 132 positions, 6 or 6/8 lines/inch, 8-channel vertical format unit, 132-character buffer; 300 lpm	Data Printer Corp.
3055	Impact, ASCII 64-character set, 10 characters/inch, 132 positions 60 or 78 lines/inch, 8-channel vertical format unit, 132-character buffer; 600 lpm	Data Printer Corp.
PUNCHED CARD EQUIPMENT		
3040	Card Reader; 80-column, hopper and stacker—1000 cards each; 600 lpm	Documation M600L
3050	Mark Sense Card Reader; 80-column, hopper and stacker—1000 cards each; 600 cpm	Documation M600L
3019	Card Reader/Punch; 96-column, 600-card primary and 400-card secondary hoppers, two 400-card stackers, 384-character buffer; reads 300 cpm, punches and interprets 60 to 120 cpm	Decision Data 9645
PAPER TAPE EQUIPMENT		
3034	Reader; 5, 6, 7, or 8-track tape; 150 cps	Cincinnati Milacron
3035	Punch; 5 or 8-track tape; 75 cps	Remex
TERMINALS		
7301, 7302, 7307	CRT/keyboard; 12 or 24 lines by 80 characters, upper or upper and lower case, 10-key numeric pad; 100, 300, 1200, 2400 bps	Hazeltine/Cincinnati Milacron

▷ availability of CiMOS at no additional charge must be viewed as a measure intended to increase the commercial attractiveness of the CIP's for stand-alone processing and remote terminal use, in addition to the use of the systems as dedicated processors.

Maintenance is provided by five Cincinnati Milacron offices and 16 Sorbus offices throughout the United States. Standard one-year contracts are available, along with coverage for up to 24 hours, 7 days a week if desired.

USER REACTION

The material in this section has been drawn from Datapro's interviews with five users representing six installed systems. The earliest installation was in November 1973 and the latest was in May 1975. Four of the six systems were being used strictly for business processing of accounting and scheduling functions. One system was dedicated as a remote job entry terminal in emulation of the CDC 200 User Terminal. The final system was being utilized for on-line inquiry with special software to handle the needs of 18 field-installed CRT's.

All systems were operating under CiMOS 22. Virtually all programming except for the RJE terminal installation was being done in RPG II. The typical installation consisted of ▷

▶ of the A or B register. The X register is used for address modification and base relative addressing; several specialized instructions are provided for index value modification.

In addition, there are two other registers: P and S. The 16-bit P Register (Program Counter) contains the address of the next machine instruction to be executed. The S Register (Status) is an eight-bit register containing the CPU internal status indicators; these include word length indicators for variable-length binary operations, overflow, interrupt system disable, arithmetic and logical result status, and user supervisor state. The contents of all registers can be stored in the control stack.

INDIRECT ADDRESSING: One level.

ADDRESSING: There are nine addressing techniques available to the programmer. *Direct to Page 0* allows direct addressing of the first 256 locations in memory; technique is useful for sharing data such as system parameters between programs. *Direct Relative* addressing permits addressing from 127 bytes ahead to 128 bytes behind the first byte of the next instruction. *Indirect Page Zero* addressing uses the eight-bit absolute address from the instruction's second byte to access a two-byte word in page zero which is the effective address; indexing may be used. In *Indirect Relative* addressing, the Direct Relative address yields the address of a word which contains the effective address; this method provides a means of returning from a subroutine by an indirect jump, and indexing may be used. ▶

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▷ a 32K-byte processor, a 300-lpm printer, a 600-cpm card reader, a five-megabyte disk drive, an 800-bpi, 25-ips, 9-track tape drive, and a console CRT.

The following table summarizes the ratings given by these users. No ratings are shown for packaged application programs, because Cincinnati Milacron does not supply them for the CIP/2200B.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	4	1	0	0	3.8
Reliability of mainframe	2	3	0	0	3.4
Reliability of peripherals	3	2	0	0	3.6
Maintenance service:					
Responsiveness	4	1	0	0	3.8
Effectiveness	2	2	0	0	3.5
Technical support	1	0	0	0	4.0
Manufacturer's software:					
Operating system	0	4	0	0	3.0
Compilers and assemblers	1	1	0	0	3.5
Ease of programming	1	0	0	0	4.0
Ease of conversion	0	1	0	0	3.0
Overall satisfaction	2	3	0	0	3.4

*Weighted Average on a scale of 4.0 for Excellent.

User comments were very complimentary toward the company, its maintenance service, and its product. Cincinnati Milacron seems to have bent over backward to keep its customers happy. Specific comments included: "Really worked to keep us satisfied." "The system is reliable and trustworthy." "The system is cost-effective—in two years it will pay for itself over service bureau costs."

Two of the systems have had apparent power supply problems, resulting in virtually every board in the processor being replaced at one time or another. In one installation, the CIP/2200 was replaced to keep the customer happy. The other installation has had all the bad boards replaced. Apparently the problem causing the bad boards has been corrected to the satisfaction of the users, as any negative feelings do not show in the ratings.

One user involved in scheduling as well as accounting would like CiMOS to handle Write From in indexed sequential files; we understand that this is currently being developed. The same user commented on the almost complete compatibility of RPG II under CiMOS with RPG II on the IBM System 3—a fact that Cincinnati Milacron has not stressed but certainly should. □

► For processing a table or string of data, *Base addressing* is provided; the effective address is provided by the contents of the index register. In the *Base Plus Displacement addressing* mode, the effective address is given by the sum of the contents of the X register and the eight-bit unsigned displacement obtained from byte two of the instruction. *Extended addressing* develops the effective address from bytes two and three of the instruction plus the X register, if indexing is requested; this mode can address up to 65K bytes in supervisor mode or 32K bytes in user mode. The *Literal addressing* mode provides up to four bytes of immediate data coded directly following the first byte of the instruction.

Finally, there is the *Extended Indirect addressing* mode, in which an address constructed in the fashion of the Extended addressing mode points to a word containing the effective address. This mode is used for Jump and Return Jump instructions only and offers a means for utilizing jump tables outside of page zero; indexing is permitted.

INSTRUCTION REPERTOIRE: 122 instructions are standard in the CIP/2200B. Of these, 16 are arithmetic, 3 are moves, 41 are register-operate, 12 are shifts, 8 are I/O, 19 are transfer of control, 16 are character string, 1 is supervisor call, 13 are control, and 7 are memory-immediate. The basic repertoire is extendable through microcode and an increment (page) of ROM control storage. Decimal arithmetic instructions are standard.

INSTRUCTION TIMING: All times are for full-word, fixed-point operands in microseconds.

Load/Store	11.8 (avg.)/11.3 (avg.)
Add/Subtract	12.43
Add/Subtract (Decimal)	53.9 + 7.26 per digit
Multiply/Divide	*
Compare/Branch	9.0

*Subroutine only.

INTERRUPTS: Internal interrupts include console, interval timer, memory parity failure, control stack under/overflow, power failure, and illegal instruction interrupts. There are 64 vectored external interrupts, which are maskable by the interrupt enable/disable feature.

PHYSICAL SPECIFICATIONS: The CIP/2200B with 64K bytes of memory can be housed in a cabinet 31.4 inches high, 25.2 inches wide, and 34.6 inches deep or a cabinet 74 inches high, 26.8 inches wide and 34.5 inches deep. The processor itself is 19 inches wide, 10.5 inches high, and 20.7 inches deep. Power requirements are 110 or 220 volts AC ±10 percent, at 50 or 60 Hertz. The CIP/2200B dissipates 2730 BTU's of heat per hour. No special air conditioning above normal office levels is required. Operating temperature range is 32 to 122 degrees F. Operating humidity level is 10 to 90 percent, noncondensing.

INPUT/OUTPUT CONTROL

I/O BUS: The I/O Bus allows a microprogram-controlled Direct Memory Channel (DMC) to transfer data at up to 30,300 bytes/second (eight-bit parallel transfer) to or from a single synchronous device concurrently with program execution without affecting response to internal interrupts. Data transfer rates up to an aggregate of 73K bytes/second for 31 devices can proceed over the DMC from buffered I/O devices with some delay to internal interrupts; this rate can be maintained only if requests arrive at less than 13.5-microsecond intervals. Rates above 30,300 bytes per second can be supported only on asynchronous devices.

One or two optional Direct Memory Access (DMA) channels can be attached to handle data transfers at up to 909K bytes/second, with each DMA channel providing an interface for up to ten external devices.

In the Byte I/O mode, the I/O Bus can support up to 32 device controllers. The serial I/O facility can support programmable data rates from 110 to 9600 bits per second.

SIMULTANEOUS OPERATIONS: DMA data transfers take precedence over the CPU for memory operations. DMC data transfers also have a higher priority than instruction execution. The DMC and DMA operate essentially on a memory cycle basis, but may force short breaks in the execution of long instructions. ►

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► **CONFIGURATION RULES**

The basic chassis provides 17 slots, with an 18-slot I/O expander chassis available if required. Also available is a memory expansion chassis providing six I/O slots and four slots for memory. The DMA, each peripheral controller, and each memory board use one chassis slot. The maximum configuration of the system is 64K bytes of memory, 32 I/O devices, and two DMA channels.

MASS STORAGE

3037 FIVE-MEGABYTE CARTRIDGE DISK DRIVE: A front-loading drive with one fixed and one removable disk cartridge of the IBM 2315 type. Average head positioning time is 55 milliseconds, and average rotational delay is 20 milliseconds. Rotational speed is 1500 rpm. The data transfer rate is 195K bytes/second. There are 200 tracks per surface plus 6 spares. Bit density is 2200 bpi while track density is 100 tpi. Each track is divided into 24 sectors with 256 bytes per sector for a track capacity of 6144 bytes. The total capacity is 4.92 million bytes. The manufacturer is Iomec.

3038 TEN-MEGABYTE CARTRIDGE DISK DRIVE: This is the dual-density version of the 3037 drive. All specifications are the same except that the track density is increased to 200 tpi for 400 tracks per surface. The total capacity is 9.83 million bytes. The manufacturer is Iomec.

INPUT/OUTPUT UNITS

See Peripherals/Terminals table.

COMMUNICATIONS CONTROL

ASYNCHRONOUS COMMUNICATIONS CONTROLLER: Provides an interface for eight RS-232 full-duplex lines with odd or even parity at 14 different rates from 75 to 9600 bps. Character length is selectable at 5, 6, 7, or 8 bits. Either one or two stop bits are selectable. A one-bit output buffer is optional.

SYNCHRONOUS COMMUNICATIONS CONTROLLER: Provides an interface for one half- or full-duplex, leased or telephone line service at 1200 to 9600 bps. Complete error-checking capabilities are standard. More than one controller may be installed per system.

BISYNCHRONOUS COMMUNICATIONS CONTROLLER: Provides for communications between the CIP/2200B and binary synchronous devices. Transmission speeds up to 10,00 bps are possible. Hardware for 16-bit CRC checking is included. For ASCII transmission, 8-bit LRC and VRC checks are used. Both the transmit and receive sections have buffer storage for up to 65 characters. The controller operates in both DMC and interrupt modes.

COMMUNICATIONS SOFTWARE: Remote Job Entry (RJE) Programs enable a CIP/2200B to communicate with large systems under several disciplines. For IBM 360 or 370 computers, the CIP/2200B communicates under HASP line discipline, using leased or dial-up lines at speeds from 2000 to 4800 bps. Running under Control Data EXPORT/IMPORT line disciplines, a CDC 6000 Series computer can receive and send to the CIP/2200B. For Univac 1100 Series computers, the RJE program interfaces with the EXEC 8 Operating System. For Honeywell computers, the interface is with GERTS, and a disk unit is required.

SOFTWARE

OPERATING SYSTEM: One operating system, the Cincinnati Milacron Operating System (CiMOS-22), is provided with the CIP/2200B minicomputer.

CiMOS-22 is a batch-oriented, disk-based operating system for use on a 16K minimum CIP/2200B system; 8K bytes are used for CiMOS and 8K bytes for language processors. In addition to assembler and RPG II program development support, CiMOS includes an extensive range of utility packages such as a sort program (requires 24K bytes when sorting 4K-byte records), a linkage editor, text editor, library maintenance program, disk initializer program, disk reorganization program, a volume/catalog list program, and file copy utilities. Multiprogramming support is provided for two partitions only.

The minimum peripherals required by CiMOS-22 are a five-megabyte cartridge disk drive, a printer, and a CRT with keyboard to act as a console device.

LANGUAGES: Two languages are offered under the CiMOS-22 Operating System: a relocating assembler and RPG II.

RPG II requires a 24K-byte CIP/2200B, a CRT with keyboard, and a 5-megabyte cartridge disk drive. Features include array handling; look-ahead fields; communication with external subroutines; sort processor; sequential, random, and indexed sequential files; bit setting and testing; and fetch overflow.

The *Relocating Assembler* provides conditional assembly capabilities in addition to the standard assembly-type pseudo-operations. Output is in relocatable format acceptable either to the Library Maintenance Program or the Linkage Editor. No cross assembler is available.

APPLICATIONS PROGRAMS: No applications programs are provided directly by Cincinnati Milacron, and the user must develop his own programs using the assembler or RPG. A nationwide network of systems houses does, however, supply complete turnkey systems.

PRICING

POLICY: Cincinnati Milacron provides the CIP minicomputers on a purchase basis, with an OEM discount available. Prices are FOB Lebanon, Ohio, and are net 30 days from date of invoice. A 90-day warranty on all equipment is made; system installation is at no additional charge. Cincinnati Milacron will help to arrange a third-party lease if requested.

OEM discount schedules for packaged business systems and packaged remote job entry terminal systems vary from 28 percent for 1 to 4 systems to 40 percent for 50 to 99 systems. For nonpackaged systems, the discount is 25 percent for purchase dollar values up to $99,999.99, and the maximum discount is 37.5 percent for purchase dollar values from $800,000 to $999,999.99.

SUPPORT: The initial maintenance agreement is for a term of one year. Termination after this period is permitted with one month's notice by either party. Prime maintenance hours are between 8 AM and 5 PM Monday through Friday, except holidays. A one-hour grace period until 6 PM is allowed if the field engineer working on a problem judges that the problem can be resolved within that hour. The following table shows additional charges in terms of percent of the minimum monthly maintenance charge (MMMC) to be added for optional maintenance periods.

	8 AM-5 PM	8 AM-Midnight	24 Hours
Mon. through Fri.	0	65	95
Sat. or Sun.	15	23	29

For legal holidays, a minimum rate of two hours will be charged including travel time plus travel expenses incurred. ►

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Cincinnati Milacron maintains service centers in Houston, Texas; Woodbury, New York; San Francisco and Los Angeles, California; and Lebanon, Ohio. Sorbus, the maintenance division of MAI, Inc., services the CIP/2200B in Dallas, Austin, and Fort Worth, Texas; Greenville, South Carolina; Memphis, Tennessee; Philadelphia and Allentown, Pennsylvania; Kansas City and St. Louis, Missouri; Boston, Massachusetts; Rochester, New York; New Orleans, Louisiana; Chicago, Illinois; and Hartford, Connecticut.

Two man-weeks of training are allowed with the purchase of each system. Additional training is available at the rate of $375 per man-week. All training classes are in Lebanon, Ohio.

EQUIPMENT: The following typical purchase prices include controllers and adapters.

SMALL OEM SYSTEM: Consists of 8K-byte processor in open frame, ROM, system control panel, and DMA. Purchase price is $7,325.

PACKAGED SYSTEM: Consists of CIP/2200B with 32K bytes of MOS memory, power fail/auto restart, interval timer, and 32 external interrupts in 60-inch cabinet with basic front panel. Peripherals include two 5-megabyte cartridge disk drives and controller, 600-lpm printer and controller, and 600-cpm card reader and controller. Also included are a power supply and the Ci-MOS-22 Operating System. Purchase price is $60,300. ■

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSORS			
2003	CIP 2200B in open frame	$ 2,750	$ 20
2065	CIP 2200B in 30-inch cabinet	5,400	31
2070	CIP 2200B in 60-inch cabinet	5,500	31
	Packaged System: includes CIP 2200B in 60-inch cabinet, 32K bytes of MOS memory, basic front panel, DMA channel, disk drive, two-drive controller, CRT console and interface, power supplies, and CiMOS-22 Operating System with RPG II; requires line printer.		
2072-1	Packaged system with 5-megabyte cartridge disk drive	25,000	197
2072-2	Packaged system with 10-megabyte cartridge disk drive	28,500	247
	Remote Terminal System: includes CIP/2200B, 16K bytes of MOS memory, basic front panel, CRT console and interface, and power supplies. Requires separately priced RJE software package and one printer (either 3046, 3052, or 3055) and one card reader (either 3040 or 3050). The 2063-1 Magnetic Tape System is optionally available with the CDC UT 200 Emulation Package.		
2073	RJE Terminal in 30-inch cabinet	11,750	83
2074	RJE Terminal in 60-inch cabinet	11,950	83
MEMORY AND PROCESSOR OPTIONS			
2214	8K-byte core memory module (not for packaged systems)	2,250	20
2215	8K-byte core memory module with parity (not for packaged systems)	2,450	22
2216	32K-byte MOS memory module	5,000	40
2217	32K-byte MOS memory module with parity (not for packaged systems)	5,750	40
2218	16K-byte MOS memory module	3,500	25
2319	1792 16-bit words of ROM	1,050	6
2320	1972 16-bit words of ROM with disk IPL	1,125	7
2602	Memory Expansion Chassis	1,400	4
2603	I/O Expansion Chassis	1,150	4
2906	I/O Extender Card	300	—
2519	Basic Panel	450	3
2518	System Panel	650	4
2721	DMA	625	6
MASS STORAGE			
3037	5-megabyte cartridge disk drive	8,000	70
3038	10-megabyte cartridge disk drive	11,500	120
3042-2	Controller for two drives	3,000	25
3042-4	Controller for four drives	4,500	30
2075-1	5-megabyte cartridge disk drive, 60-inch cabinet, disk controller expansion kit for drives 3 and 4 (for packaged systems only)	11,000	85
2075-2	10-megabyte cartridge disk drive, 60-inch cabinet, disk controller expansion kit for drives 3 and 4 (for packaged systems only)	14,500	135
3004	Front-loading cartridge disk pack	170	—
MAGNETIC TAPE EQUIPMENT			
2061	Tape drive, formatter, and controller; 800 bpi, 25 ips	12,000	90
2062	Add-on drive	9,300	65
2063-1	Tape drive, formatter, controller and cabinet (for packaged systems only); 800 bpi, 25 ips	12,500	90
2063-2	Two drives and controller	21,800	180

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
MAGNETIC TAPE EQUIPMENT (Continued)			
2063-3	Three drives and controller	$ 31,100	$ 270
2063-4	Four drives and controller	40,400	360
2597	Magnetic tape controller	1,200	12
LINE PRINTERS			
5000	165-cps Printer with stand and interface	5,600	55
5001	330-cps Printer with stand and interface	7,500	65
3046	300-lpm Printer and interface	14,950	124
3052	300-lpm Printer with 6 or 8 lines/inch option and interface	15,150	130
3055	600-lpm Printer with 6 or 8 lines/inch option and interface	19,950	170
2699	GP Line Printer Controller	950	10
2707	Composite Printer Controller	950	10
PUNCHED CARD EQUIPMENT			
3040	Card Reader, 80-column; 600 cpm	5,600	50
3050	Mark Sense Card Reader, 80-column; 600 cpm	7,600	60
2698	Controller for 80-column card readers	800	8
3019	Card Reader/Punch, 96-column	13,000	104
2819	Controller for 96-column card reader/punch	1,200	12
PAPER TAPE EQUIPMENT			
3034	Reader, 150 cps	2,000	18
3035	Punch, 75 cps	4,225	39
2067	Controller for reader and/or punch in cabinet	1,325	5
TERMINALS			
7301	CRT, 12 x 80, upper case only	2,100	24
7302	CRT, 12 x 80, upper case only with 10-key pad	2,400	24
7307	CRT, 12 x 80, upper/lower case with 10-key pad	2,550	24
2724	Interface for up to eight CRT's	1,200	12
2722	Eight-Channel Asynchronous Controller	1,000	10
COMMUNICATIONS			
2801	Synchronous Modem Controller, 1200 to 9600 bps	1,000	6
2818	Bisynchronous Modem Controller	1,400	12
2804	Asynchronous Modem Controller	500	5
2908	103 Type Modem	600	4
2909	202 Type Modem	950	6
CABINETS			
3021	30-inch Cabinet	700	—
3023	60-inch Cabinet	800	—
3024	74-inch Cabinet	850	—
3027	27-inch Data Desk	250	—
3044	Desk top for 30-inch Cabinet	150	—

SOFTWARE PRICES

		Purchase Price	Monthly Maint.
3151	Item Package 240; emulates Multileaving HASP Workstation; includes 201 Synchronous Modem Controller	$ 1,700	$ 6
3152	Honeywell Package 280; emulates 2780 Workstation; includes Bisynchronous Modem Controller; requires disk system	2,200	12
3153	CDC Package 220; emulates 200 User Terminal for use with CDC 6600; includes 201 Synchronous Modem Controller	1,700	6
3154	Univac Package 260; emulates Exec 8 Workstation; includes Bisynchronous Modem Controller	2,200	12