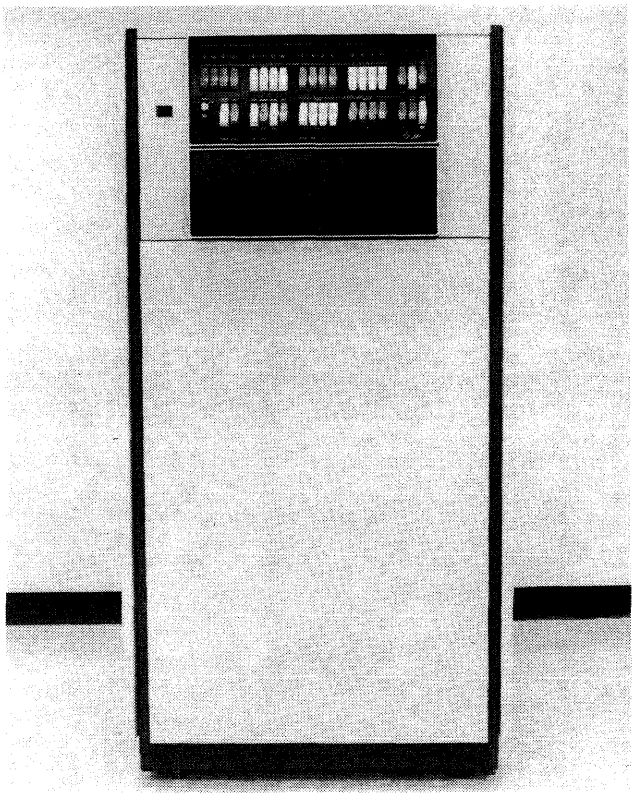
Modcomp Systems II and IV



The Modcomp IV features a 32-bit-wide data path, memory addressing capacity of 1024K bytes, 2048 address mapping registers divided into 8 equal files of 256 each, and 32 direct memory processor channels. Double-density 600-nanosecond parity core memory modules are available.

Modcomp's Systems II and IV series of modularly constructed computers consists of seven models (including three communications processors) and five packaged configurations. Prices range from $16,750 for a basic Modcomp II/12, to $69,250 for the Modcomp IV/35/CP-B.
MAIN MEMORY: 64K to 512K bytes
DISK CAPACITY: 512K to 167M bytes
WORKSTATIONS: Up to 64
PRINTERS: 64 lpm to 1000 lpm
OTHER I/O: Card equipment, magnetic tape, binary I/O devices

MANAGEMENT SUMMARY

The Mocdomp II and IV computers, introduced in 1971 and 1973 respectively, are two of the oldest and most time-proven series of computers on the scene today that are still actively marketed, joining such other notables as Computer Automation's Naked Mini series (1971), DEC's PDP-11 family (1970), and Microdata's 1600 series (1972). Modular Computer Systems (Modcomp) is also among the select few minicomputer manufacturers producing products ranging in size from traditional minicomputers to the very large systems known as megaminis. The Modcomp System II and IV product line includes models beginning with the 64K-byte II/12 and ranging up to the 1024K-byte IV/35-B. In between are compatible models, including the II/26 and II/45 standard processors and the II/26/CP2, II/45/CP2, and IV/35/CP-B communications processors. All of the models in the line use core memory.

Modcomp also offers five packaged configurations designated the Modcomp II/201, II/221, II/233, II/325, and II/326. The II/233 is based on the Modcomp II/26/CP2, and the other four configured systems are based on the II/26. These packaged systems include as ▷

CHARACTERISTICS

MANUFACTURER: Modular Computer Systems, Inc., 1650 West McNab Road, Fort Lauderdale, Florida 33310. Telephone (305) 974-1380.

Modcomp is a manufacturer of real-time computer systems ranging from small, single-processor configurations to large-scale multiprocessor systems used primarily in measurement and control applications, power generation, petrochemical and metals processing, nuclear control, traffic control, and building control systems. Modcomp provides service from 45 U.S. locations plus offices in England, France, Belgium, Germany, Japan, Norway, El Salvador, Korea, Spain, Sweden, Switzerland, and the British Virgin Islands.

DATE ANNOUNCED: Modcomp II, October 1971; Modcomp IV, June 1973.

DATE OF FIRST DELIVERY: Modcomp II, December 1972; Modcomp IV, September 1974.

NUMBER INSTALLED TO DATE: 2600 Modcomp II's and 470 Modcomp IV's.

MODELS: The II/12, II/26, II/45, and IV/35-B models form the basis of the Modcomp line, but there are several variations and configured packages with similar model numbers. A set of communications processors based on the II/26, II/45, and IV/35-B are respectively called the Modcomp II/26/CP2, II/45/CP2, and IV/35/CP-B. These processors are identical to the basic versions with the addition of specialized communications macro instructions implemented in control storage and a direct memory interface for the Universal Communications Subsystem Model 2.

There are also five configured packages with model numbers II/201, II/221, II/233, II/325, and II/326. The II/233 is based on the II/26/CP2, while the other four are based on the II/26. The II/201 and II/221 are similar except that II/221 has a 5.2-million-byte cartridge disk drive. The II/325 and II/326 differ in the size and speed of memory.

DATA FORMATS

BASIC UNIT: 16-bit word in all models. (A 32-bit word mode of operation is available for the Modcomp IV's.)

FIXED-POINT OPERANDS: 16-bit words, single bits, or 8-bit bytes for all systems; also limited use of 32-bit double words for Modcomp II's. The Modcomp IV's have an ▶

Modcomp Systems II and IV

CHARACTERISTICS OF THE MODCOMP PROCESSORS

	II/12	II/26	II/26/CP2	II/45	II/45/CP2	IV/35-B	IV/35/CP-B
Processor word size, bits	16	16	16	16	16	16 or 32*	16 or 32*
Processor cycle time, nanoseconds	267	267	267	267	267	160	160
Standard memory type	Core	Core	Core	Core	Core	Core	Core
Memory cycle time, microsec./word	1.067	1.067	1.067	0.8	0.8	1.067	1.067
Memory access time, microsec./word	0.4 or 0.6	0.4 or 0.6	0.4 or 0.6	0.4	0.4	0.4 or 0.6	0.4 or 0.6
Memory ports	1	1	1	4	4	4	4
Memory interleaving/overlapping	Opt. 2-way	Opt. 2-way	Opt. 2-way	—	—	Opt.; 2- or 4-way	Opt.; 2- or 4-way
Memory size in bytes	64K to 128K	64K to 128K	64K to 128K	32K to 128K	32K to 128K	128Kto1024K	128Kto1024K
Memory module sizes	32K	32K	32K	8K, 16K	8K, 16K	128K	128K
Memory parity (1 bit per byte)	Std.	Std.	Std.	Std.	Std.	Std.	Std.
Memory protection	Opt.	Opt.	Opt.	Opt.	Opt.	Std.	Std.
Memory management	—	—	—	—	—	Std.	Std.
Instruction set size	186	186	199	186	199	303	313
Internal interrupts	11 (8 std.)	11 (8 std.)	11 (8 std.)	11 (8 std.)	11 (8 std.)	11 std.	11 std.
External interrupts	5 opt.	5 opt.	5 opt.	5 opt.	5 opt.	5 std.	5 std.
Interrupt sublevels	128	128	128	128	128	128	128
Power fail/auto restart	Std.	Std.	Std.	Std.	Std.	Std.	Std.
Hardware multiply/divide	Std.	Std.	Std.	Std.	Std.	Std.	Std.
Hardware floating point	—	Opt.	Opt.	Opt.	Opt.	Opt.	Opt.
Hardware communications macros	—	—	Std.	—	Std.	—	Std.
Direct memory processor; channels	Opt.; 8	Opt.; 8	Opt.; 8	Opt.; 8	Opt.; 8	Std.; 16	Std.; 16
Modular bus control	—	Std.	Std.	Std.	Std.	Std.	Std.
Ext. direct mem. proc.; channels	—	—	—	Opt.; 4	Opt.; 4	—	—
Secondary I/O proc.; channels	—	—	—	—	—	Opt.; 160 or 32	—
General register file	Std.; 15	Std.; 15	Std.; 15	Std.; 15	Std.; 15	Std.; 15	Std.; 15
Context register file	—	—	—	—	—	Std.; 240	Std.; 240
Hardware stack registers	—	—	—	—	—	Std.	Std.
Operator's console & hardware fill	Std.	Std.	Std.	Std.	Std.	Std.	Std.
Control storage, words	512	512	512	512	512	768	768
Maximum I/O rate:							
Input, megawords/sec.	1.98	1.98	1.98	1.98	1.98	2.5	2.5
Output, megawords/sec.	1.53	1.53	1.53	1.53	1.53	2.5	2.5
Data path width, bits	16	16	16	16	16	32	32

*Refers to dual-axis structure of data transfer path only; see "Data path width."

standard equipment certain peripherals and core memory variations that are optional on other Modcomp systems.

In mid-1978, Modcomp introduced the Classic series, a more powerful family of processors that will eventually replace the Modcomp II and IV line. The Classic systems are more powerful, MOS memory systems that feature fully compatible software and use the same line of peripherals available for the Modcomp II and IV line. Modcomp will continue to market the older line, but the price and performance capabilities of the Classic systems, coupled with the fact that they are fully compatible, make it obvious that the Systems II and IV have a limited life span.

Modcomp was founded in 1970 to produce computer systems based on the architectural idea of "macro-modular" design. This method, or philosophy, of computer design is really what nearly all CPU manufacturers aim toward, but Modcomp appears to

expanded capability for 32-bit double words and the facility to handle 48-bit triple words and 64-bit quad words. Files up to eight words in length can be accessed in memory by a single instruction. Negative numbers are represented in two's complement format.

FLOATING-POINT OPERANDS: For Modcomp II's, either single-precision format using a 9-bit exponent and signed 22-bit fraction, or double-precision format using a 9-bit exponent and signed 38-bit fraction. For Modcomp IV's, a single-, double-, or triple-precision format consisting of a 9-bit exponent and signed 22-bit, 38-bit, or 54-bit fraction, respectively, can be employed.

Floating-point operands are represented by the sign in bit 0 of word one, followed by the exponent in bits 1 through 9. The fraction occupies the remaining bits of word one and all the bits of the next consecutive words up to a maximum of four words, depending on the precision required. The exponent is represented as an unsigned binary number with a value of -256 through +255; the exponent is biased by +256. The binary point is assumed to be between the exponent and the fraction. All negative numbers are represented as the two's complement of the absolute value.

Modcomp Systems II and IV

PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION AND SPEED
MAGNETIC TAPE EQUIPMENT	
4148/4151	Industry-compatible, 45 ips, 9-track, 10.5-inch reels, 800 bpi, NRZI, 150 ips rewind speed; 4151 is add-on drive; 36 KBS
4155/4156	Industry-compatible, 45 ips, 9-track, 10.5 inch reels, 1600 bpi, PE, 150 ips rewind speed 4156 is add-on-drive, 72 KBS
4157/4158	Industry-compatible, 45 ips, 9-track, 10.5-inch reels, 800/1600 bpi, NRZI/PE, 150 ips rewind speed; 4158 is add-on drive; 72 KBS
4164/4165	Industry-compatible, 75 ips, 9-track, 10.5-inch reels, 800 bpi, NRZI, 200 ips rewind speed; 4165 is add-on drive; 60 KBS
4168/4169	Industry-compatible, 75 ips, 9-track, 10.5-inch reels, 1600 bpi, PE, 200 ips rewind speed; 4169 is add-on drive; 120 KBS
4170/4171	Industry-compatible, 75 ips, 9-track, 10.5-inch reels, 800/1600 bpi, NRZI/PE, 200 ips rewind speed; 4171 is add-on drive; 120 KBS
PRINTERS	
4211-2	Chain/train; 132 positions, 64 ASCII character set, 10 characters per inch, 3.5 to 19.5-inch paper, 6 lines per inch, vertical format control, one-line buffer; 600 lpm
4214-2	Same as 4211-2 but 300 lpm
4216-1	Electrostatic; 7 x 9 dot matrix; 132 positions, 64 character set, 12.5 characters per inch, 11-inch paper, 6.6 lines per inch, programmable VFU, 1000 lpm
4217-1	Same as 4216 but with plotting capability at 0.010 inch
4226	Serial matrix; table-top, 132 positions, 64 ASCII character set, bidirectional, 256-character buffer, 64-440 lpm
4227	Line Printer; 132 positions, 63 ASCII character set, solid character impact printing, 280 lpm
CARD EQUIPMENT	
4426	Key Punch/On-line Card Punch/Automatic Interpreter; 35-60 cpm
4411-2	Reader; 80-column, table-top mounting, 1000-card input hopper and output stacker; 300 cpm
4412-2	Reader; 80-column, table-top mounting, 1000-card input hopper and output stacker; 1000 cpm
BINARY INPUT/OUTPUT DEVICES	
4513	Paper tape reader, 625 cps, rack mountable
4521	Floppy disk; 315,392 byte storage capacity, controller included
4522-1	Dual floppy disk; 630,784 byte storage capacity, controller included
4206	Data communications printer, table-top model, keyboard send and receive, 120 cps, 120 print columns, external forms tractor
3740	Programmable Power On/Off for 4206 printers
4233	ASR-33 console teletypewriter
3747	Programmable Power On/Off control for the 4233 teletypewriter
4250	ASR-33TU to 4233 modification kit
PERIPHERAL CONTROLLER INTERFACES	
4903	Peripheral controller interface for 4 controllers; includes rack mountable enclosure including power supplies and connector panel and mounting space for six standard controller locations
4905	Peripheral controller interface for 4 controllers plus a console device controller
4906	Peripheral controller switch for programmed switching of up to 4 controllers between 2 Modcomp computers; computer can be any combination of Modcomp II, IV or CLASSIC central processors
TERMINALS	
4805-1	General purpose 16-bit data terminal; computer interface includes I/O interrupts, DMP interface Low true TTL interface, or electronics switch output

have made a particularly strong commitment toward its realization.

The term modularity, when applied to Modcomp CPU's, means that each element of the processor—arithmetic-logical unit, I/O control section, etc.—is implemented in isolatable, asynchronous blocks, or modules, which are largely independent of each other and can be removed and replaced quite easily. This permits upgrading without total redesign or extensive engineering changes. As noted previously, most manufacturers aim toward this design method but do not pursue total replaceability to the point achieved by Modcomp.

The key elements in the asynchronous Modcomp systems that permit implementation of this design are the Modular

INSTRUCTIONS: One- or two-word instruction formats with an eight-bit operation code and eight bits for operand register, index register, bit address within a word, displacement address (up to 16 locations) with respect to a base address, shift count, interrupt level or peripheral drive address, and (for two-word direct, indirect, and indexed address instructions format) one bit to specify indirect addressing. Two-word immediate instructions are like the one-word types plus a 16-bit immediate operand; and two-word direct, indirect, and indexed address instructions are like the one-word types plus a 16-bit memory address. All register-to-register, shift, input/output, and control instructions use the single-word format. Many memory reference instructions also use this format and obtain a 16-bit operand address through short displaced, short indexed, or immediate addressing techniques.

INTERNAL CODE: ASCII.

Modcomp Systems II and IV

Bus and a read-only-memory (ROM) controller module. In addition to each module's discrete physical self-containment and standard module-to-module plug connections, an independent timing capability is present in each module. Each module also processes, stores, and/or transfers a uniform width of data with uniform signal characteristics. Additional important attributes of such a modular design strategy (apart from allowing easy and rapid response by the vendor for implementation of technical advances) are the upward compatibility of the software, and, through the trapping of unimplemented instructions, the *downward* compatibility of the software, as well as configuration flexibility.

The Modcomp family started with the Modcomp III, introduced in July 1970. It was followed by the Modcomp I and II, both announced in October 1971, and by the Modcomp IV, brought out in June 1973.

The Modcomp III was only moderately successful due to some early design problems and the newness of the company—then only slightly more than a year old. But it served to introduce Modcomp to the world and call attention to its modular design ideas.

The Modcomp I, which is no longer marketed, was a lower-performance version of the II and was oriented toward OEM users. The Modcomp I and II contributed largely to Modcomp's becoming profitable in 1972, the year after their introduction. Along with the new minicomputers, Modcomp also delivered the industry's first single-board 8K-word core memories.

Not long after the announcement of the I's and II's, in February 1972 the manufacturer also offered Modcomp II and Modcomp III Communications Processors, designed for data collection and front-end use with larger host systems. These communications processors were versions of the standard II's and III's with enhanced instruction sets implemented in ROM (read-only memory) to support more complex data manipulation.

The Modcomp IV, with its 32-bit-wide data path, was announced in June 1973. This minicomputer offered upward compatibility with the Modcomp I's, II's, and III's. With the introduction of the Modcomp IV, the III was discontinued.

In October 1974, Modcomp announced a 32K-word single-board memory and six new minicomputer models using the memory. The 32K-word memory is slightly slower (1.06 microseconds) than the earlier 16K-word memories (0.8 microseconds), but the difference in speed is considered a worthwhile sacrifice in view of the memory expansion possible without adding extra chassis and support hardware. These models are simply standard Modcomp processors with a different memory substituted.

The Modcomp IV/35 is an upward extension of the original but no longer actively marketed Modcomp IV/25. The IV/35 has four significant enhancements over the

MAIN STORAGE

TYPE: Core.

CYCLE TIME: For Modcomp II's: 0.8 microsecond or 1.067 microseconds. For Modcomp IV's: 1.067 microseconds. The Modcomp IV's with 2-way interleaved 64K-byte memory modules have an effective cycle time of 0.6 microseconds for 16 bits, 1.1 microseconds for 32 bits and 2.1 microseconds for 64 bits.

Access time for the 0.8-microsecond core memory is 0.4 microseconds; and for the 1.067-microsecond core memory, 0.6 microseconds.

CAPACITY: See the "Characteristics" table.

CHECKING: One parity bit per byte is standard. Parity is generated during writing and checked during reading.

STORAGE PROTECTION: On the Modcomp II's, and for the sake of compatibility on the Modcomp IV's, an option provides three 9-bit protect boundary registers which establish protection boundaries in memory, so that a program stored between two of the boundaries cannot write beyond those boundaries. The third register defines the lower boundary for protected "common" high memory. As an alternative on the Modcomp II's, a single 5-bit protect boundary register is available that allows the protection boundary to be assigned at any 2K-word increment from 2K to 64K words of memory.

On the Modcomp IV, four levels of protection (read-only, read-execute, read-write-execute, and no-access) are provided for 256-word pages as part of the memory management option. Two-bit positions in the 1,024 13-bit map registers provide the basis for this protection method.

RESERVED STORAGE: For Modcomp II's, the first 256 words in memory are reserved for the bootstrap loader and interrupt vector storage. For the Modcomp IV, locations 32 through 767 are reserved for interrupt vectors, an operating system map image, and memory allocation blocks. If memory allocation and memory management are not used, only locations 32 through 511 need be reserved.

CENTRAL PROCESSOR

GENERAL: All Modcomp processors provide parallel operation for arithmetic, logical, compare, and shift functions. Each of the Modcomp processors is upward-compatible with the family's larger, more powerful models and has a modular bus control interface, general register file, and a priority interrupt system. Other features include a 5-millisecond real-time clock (standard on the IV/35's), multiple controllers, programmer's control panel (IV/35's), operator console, hardware multiply/divide, power fail/restart, memory parity, stall alarm, and memory management system. Further available features include hardware fill (which causes transfer of a bootstrap loader to memory), extended arithmetic unit (hardware floating-point), storage protection, more interrupts, a remote console, a direct memory processor, and a secondary I/O processor. The availability of these features on the various Modcomp processor models can be found in the "Characteristics" table.

The Modcomp IV can operate in a 16-bit or 32-bit word mode, giving rise to the term "dual-word" processor and permitting full upward compatibility from earlier 16-bit Modcomp processors.

The accompanying "Characteristics of the Modcomp Processors" table summarizes the significant differences between the various Modcomp II and IV models.

Modcomp Systems II and IV

IV/25: the memory addressing capacity has been extended from 512K to 1024K bytes; there are now 2048 address mapping registers divided into eight equal files of 256 each (whereas the IV/25 had 1024 mapping registers divided into seven unequal files); the number of direct memory processor channels has been increased from 16 to 32; and double-density 600-nanosecond parity core memory modules are available for the IV/35. These modules can accommodate up to 65,536 16-bit words, but they are about 20 percent slower than the core memories provided with the IV/25.

A communications-oriented model of the Modcomp IV/35, the IV/35/CP-B, is also available. This version is essentially the same as the IV/35 but includes a special set of macro routines for communications functions, implemented in firmware. These operations include code set translations; CRC and LRC character calculations; data packing and unpacking; special character detection; automatic character insertion, deletion, or replacement; and several sophisticated data move operations.

As in the IV/25, all IV/35 memory controllers have four ports that permit simultaneous access to both the CPU and I/O subsystems. Memory modules connected to these controllers can be either two-way or four-way interleaved.

Also announced during 1976 was Memory+, a bulk core memory system aimed at replacing head-per-track swapping disks in high-performance systems. This memory system, developed jointly with Dataram, operates as an I/O device, with track and sector addressing and controller commands the same as those issued to a head-per-track disk controller. Each Memory+ device can accommodate up to 4 million bytes of memory.

Software for the Modcomp systems consists of the MAX II, III, IV, and MAXCOM operating systems with MAXNET extension and support programs. MAX III was originally offered in April 1972 for the Modcomp III, but it gained its real popularity on the Modcomp II's. The new version offers I/O improvements, time-slice task execution, core partitioning, multiple batch operations, and improved background processing. A new MAX II operating system was also introduced, which combines the functions separately performed by several smaller software packages plus the older, now-retired MAX I. In addition, the MAXCOM specialized operating system for the Modcomp communications processors was announced.

MAX IV, a superset of MAX III, provides multiple task capabilities at each of the 256 priority levels, re-entrant executive services, and improved resource allocation. This operating system is designed specifically to exploit the capabilities of the Modcomp IV.

Program development support consists of assembler language, FORTRAN IV, COBOL, and CORAL 66.

In addition to a comprehensive range of conventional peripherals, an unusually flexible range of options for

CONTROL STORAGE: For Modcomp II's, control storage consists of 256 68-bit words plus 256 40-bit words of 267-nanosecond MOS ROM. For Modcomp IV's, control storage consists of 256 24-bit words plus 512 68-bit words of 160-nanosecond MOS ROM.

REGISTERS: Modcomp II's and IV's have fifteen 16-bit general-purpose registers plus one control panel switch register which is program-accessible. On both II's and IV's, seven of the 15 registers can be used as index registers. On the Modcomp IV, there is a block of 240 16-bit context switching registers (16 sets of 15 registers) which receive the contents of the 15 general-purpose registers whenever it is desired to switch processor tasks and save all present active parameters. The Modcomp IV operates on 32-, 48-, or 64-bit operands through the floating-point hardware by using groups of registers. All models have one 16-bit program register.

Additional registers are provided for storage protection and memory management, and a number of special-purpose transfer registers are multiplexed onto and out of the bus structure to provide the required buffer storage and holding registers needed to implement the CPU, I/O, and memory operations.

Last-in, first-out (LIFO) memory stacks are implemented in the Modcomp IV. They are useful to order list-structured precedence operators and operands and to control re-entrant and/or recursive task execution. For each separate stack, a user task establishes a stack pointer table in memory to define and maintain pointers to the low, current, and high stack address, plus a stack underflow/overflow error return address. Separate hardware PUSH and PULL instructions are provided to allocate/deallocate memory stack space and to move specified stack contents from/to the general-purpose registers. These stack processing instructions address the appropriate stack pointer table and supply the number of words to allocate or deallocate the beginning register number and the number of registers to transfer to/from the beginning of the allocated/deallocated stack space. Register wrap-around through R0 occurs when R15 is accessed and the number of registers remaining to transfer is not zero.

ADDRESSING: All memory is directly addressable. For the Modcomp II's and IV's, there are seven addressing modes, including direct, immediate, indirect, indexed, indexed-direct (pre-indexing), short displaced, and short indexed modes. In addition to the seven addressing modes described, the II's and IV's can also address individual bytes through a variation of the short indexed addressing mode and can address individual bits in either memory or general-purpose registers through certain instructions, employing any addressing mode except immediate operand.

Indexed and indexed-indirect addressing are performed in the conventional manner, adding the address field to the contents of a specified general purpose register. In short indexed addressing, a specified general-purpose register contains the *complete* effective address. No modification is performed.

In short displaced addressing, a displacement field in the instruction is added to the contents of a register. Short displaced addressing permits processing lists of up to 16 operands stored in adjacent locations anywhere in memory. Short indexed addressing is useful when the operand address requires generation, loading, or manipulation in a general register. In immediate addressing mode, the operand is contained in the memory location following the instruction location.

One instruction, HOP, employs indexing by the contents of the program register (program-relative). This instruction permits short branches of up to 64 locations in either direction on the Modcomp IV and up to 7 locations

Modcomp Systems II and IV

sensor-based attachments and communications lines is available for the Modcomp computers.

Competition for the various Modcomp models comes from all the major minicomputer vendors. The Modcomp II finds itself in competition with the DEC PDP-11/34A, Data General Nova, Honeywell Series 60 Level 6, and other hefty large-end members of 16-bit minicomputer families. The Modcomp IV is a somewhat different breed of cat that fits in between 16-bit and 32-bit systems in competition with systems such as DEC's PDP-11/45; Data General's Eclipse S/100, S/200, and S/230; Perkin-Elmer's 7/32 and 8/32; and Systems Engineering Laboratories' 32/57. Modcomp's major markets have traditionally been measurement/control (where most of the sales have been for laboratory automation, process control, traffic systems monitoring, industrial data acquisition) and communications in time-sharing networks as front-end processors and remote concentrators.

Modcomp offers training courses in both maintenance and programming. Currently available for presentation at Modcomp's training locations or at users' sites are 12 programming courses and 21 maintenance courses.

System are provided on a purchase-only basis, and maintenance is provided by Modcomp through a national network of field offices.

USER REACTION

Four users representing 6 Modcomp System II computers responded to Datapro's 1980 user survey. All the systems were purchased and the average life span of each was approximately 35 months. Principal applications included engineering/scientific, accounting, education, payroll/personnel, and service bureau. The main source of application programs came from in-house personnel.

Memory capacities ranged from 64K bytes to 128K bytes and disk capacities from 5M bytes to as high as 200M bytes. A total of 14 workstations were in use among the six systems. The principal operating system is MAX III, and only one data base management system (DATA-MAX) had been installed. The primary programming language is FORTRAN. One user planned to replace the system in 1980, but with the same manufacturer; three said they did not expect to replace in 1980.

The results of Datapro's 1980 survey are summarized in the table below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	1	1	0	2	2.3
Reliability of mainframe	3	1	0	0	3.8
Reliability of peripherals	2	1	1	0	3.3
Maintenance service:					
Responsiveness	1	1	2	0	2.8
Effectiveness	1	2	0	1	2.8
Technical support:					
Trouble-shooting	1	2	0	0	3.3
Education	1	2	1	0	3.0
Documentation	1	0	3	0	2.5

forward on the Modcomp II. There is no other program-relative addressing in any Modcomp processor.

MEMORY MAPPING AND ALLOCATION: On the Modcomp IV, a memory management paging scheme is used to address the full 1024K bytes of memory. Dual 3-bit map register fields called map select registers are included in the 32-bit program status word. Four complete maps or three complete maps and four partial maps (up to 16K words each) are available. Each map contains 256 13-bit words called page select registers, each containing 10 address bits to select any of 1024 pages (1024 bytes each), a 2-bit system protect/access control code, and 1-bit shared-code field.

Four 64-bit memory management registers are hardware bit pointers to the memory allocation block (MAB), which has one bit for every 512-byte page existent in actual memory or 128 bytes (1024 bits). If a bit is zero, then the corresponding page is not allocated, while if a bit is one, then the corresponding page is either allocated or unavailable.

INSTRUCTION REPERTOIRE: For the Modcomp II's: 18 load, store, and transfer instructions; 33 arithmetic instructions; 9 shifts; 32 logical, compare, and test instructions; 36 bit manipulation instructions (2 load; 10 arithmetic; 24 logical, compare and test); 5 byte manipulation instructions; 5 unconditional branches; 6 control instructions; 10 privileged interrupt and call instructions; and 16 hardware floating-point instructions. In addition, the communications processors have 13 more instructions for processing byte-oriented communications data.

For the Modcomp IV's: 28 load, store, and transfer instructions; 40 arithmetic instructions; 13 shifts; 41 logical, compare, and test instructions; 38 bit manipulation instructions (2 load; 10 arithmetic; 26 logical, compare, and test); 7 byte manipulation instructions; 7 unconditional branches; 30 control instructions (23 privileged); 13 privileged interrupt and call instructions, 17 privileged I/O instructions; 27 hardware floating-point instructions; and 42 unconditional branches. The IV/35/CP-B Communications Processor has 10 additional instructions for processing byte-oriented communications data. The large number of instructions can be partially explained by Modcomp's use of separate operation codes for various forms of addressing with the same instruction.

For further details on instruction totals per model, see the "Characteristics" table.

INSTRUCTION TIMINGS: All times are for 16-bit word, fixed-point operands in *microseconds*.

	Modcomp II	Modcomp IV
Load/Store	1.6	1.28
Add/Subtract	0.8	0.64
Multiply/Divide	6.1/8.8	3.5/8.6
Compare & Branch	3.2	2.56

INTERRUPTS: Modcomp II's and IV's have a minimum of 8 interrupts and a maximum of 16 interrupts. Common among all models are standard internal interrupts for unimplemented instructions, two for I/O, and three for the Executive Features Group. The two I/O interrupts can each have up to 64 reduced sublevels. The Executive Features Group consists of interrupts for the 5-millisecond real-time clock, task scheduler, and floating-point overflow. All processors add an additional interrupt to the Executive Features Group for the console and one for power fail/auto restart.

Modcomp Systems II and IV

	Excellent	Good	Fair	Poor	WA*
Manufacturer's Software:					
Operating system	1	3	0	0	3.3
Compilers and assemblers	1	3	0	0	3.3
Applications programs	0	1	1	0	2.5
Ease of programming	1	0	2	0	2.7
Ease of conversion	1	0	2	0	2.7
Overall satisfaction	1	1	2	0	2.8

*Weighted Average on a scale of 4.0 for Excellent.

Negative comments directed at the system include delivery and/or installation of equipment was late and delivery of required software was late. On the positive side, users stated terminals/peripherals were compatible as the vendor had promised; programs/data were compatible as the vendor promised; users were happy with response times; the system was easy to expand/reconfigure; and the system costs less than expected. When asked if they would recommend the system to another user, 3 said yes.□

Two other groups of four interrupts each are either standard or optional, depending on the model. One of these groups contains four external interrupts, while the other one is for systems protection. The systems protection group consists of a memory parity interrupt, system protect interrupt, multiprocessor communications interrupt, and an external interrupt.

Each level is assigned a pair of memory locations and can be selectively enabled or disabled under program control.

For a breakdown of optional and standard internal and external interrupts on the various models, see the "Characteristics" table.

PHYSICAL SPECIFICATIONS: The Modcomp II/12 processor is 8¾ inches high, 19 inches wide, 24 inches deep, and weighs 70 pounds. Power requirements for the II/12 are 108 to 132 VAC, 48 to 62 Hz, single-phase 50-ampere service; the units consume 600 watts. The operating environment for all Modcomp systems should be 32 to 131 degrees F. and between 0 and 90 percent relative humidity, noncondensing.

The Modcomp II/26 and II/45 are packaged in a cabinet which is 29¾ inches deep, 19 inches wide, 21 inches high, and weighs 160 pounds. Power requirements for these minicomputers are the same as for the smaller II/12, except that power consumption is 1800 watts.

The Modcomp II Communications Processors with all power supplies and memory expansion to 128K bytes are normally housed in a standard systems cabinet 62½ inches high, 25½ inches wide, and 30¼ inches deep. The cabinet weighs 220 pounds empty and 450 pounds fully loaded. Power requirements are 108 to 132 VAC, 58.8 to 61.2 Hz, 50-ampere service, single phase, with a dissipation of 1200 watts.

The Modcomp IV/35-B and IV/35/CP-B cabinet is 62.44 inches high, 27.25 inches wide, and 29.75 inches deep and weighs 400 pounds fully loaded. Power requirements are the same as for the Modcomp II Communications processors. Maximum power consumption is 4100 watts.

The units dissipate approximately 18,435 to 22,532 BTUs of heat per hour. An alternate power supply of 207 to 253 VAC, 48 to 52 Hz, single phase is available for all Modcomp processors and most peripherals.

INPUT/OUTPUT CONTROL

MODULAR BUS: The modular bus on all models provides a "party line" data access path to/from the computer (register file) that can transfer data under external control and can also manipulate that data under external control. This latter capability is made possible because the Modular Bus Control physically brings the internal micro-control signals to a set of externally accessible connectors, allowing external logic to be attached for the purpose of driving the system and controlling system resources. On all Modcomp processors, the modular bus can transfer data at up to 1,250,000 words per second from up to 64 peripheral interfaces as well as perform arithmetic and logical operations on data and perform special microcoded operations. A dual-axis structure on the Modcomp IV provides a 32-bit data transfer path.

DIRECT MEMORY PROCESSOR: The DMP provides for automatic block transfers to/from eight peripheral devices on most Modcomp II's, up to 16 on the II/45's, and up to 32 on the IV/35's. Block transfers occur concurrently at an aggregate data rate of 312K input and 278K output words per second on the Modcomp II's and 1000K input and 950K output words per second over the PIOP on the IV/35's. The IV/35 has four-ported memory so that all I/O transfers occur on a non-cycle-stealing basis.

Each of the DMP channels contains a pair of 16-bit registers which hold the memory or virtual address for the next block transfer and the number of words in the current block.

On the Modcomp IV's, provision for the first 16 peripheral devices is through an internal DMP called the primary I/O processor (PIOP), and provision for the second 16 peripheral devices is through an external DMP called the secondary I/O processor (SIOP).

Employing the PIOP, up to 64 addressable peripheral devices can be connected to the I/O bus, with up to 16 of the device controllers operating concurrently via 16 separate DMP channels. Device controllers normally transfer 16 bits during one device input or output function. Register transfers may include fewer than 16 device bits. DMP transfers may be expanded to 32 bits with the doubleword transfer option. The 32-bit DMP input data transfers are performed by the PIOP at 1000K bytes per second. The 32-bit output data transfers occur at 950K bytes per second.

The SIOP performs both Register I/O and DMP I/O operations in the same manner as does the PIOP, except at a higher priority and faster rate of speed for DMP I/O. The 32-bit DMP data transfers by the high-speed SIOP occur at 1.25 megabytes per second for input and 1.54 megabytes per second for output. Aggregate data rates for the SIOP are the same as for the PIOP.

For multiport memories on the II/45's, the external DMP can be attached to a separate memory port, providing an aggregate data rate of 834K input and 625K output words per second, all on a non-cycle-stealing basis. The external DMP is also connected to the modular I/O bus to provide program compatibility with the internal DMP/PIOP.

CONFIGURATION RULES

The Modcomp chassis are described in terms of "planes," where one plane is equivalent to two chassis slots. Generally speaking, Modcomp II's have nine planes, four for memory, one for the four-port interface, and four for options. The Modcomp IV has 25 planes with five for the CPU, 16 for memory, one for the four-port interface, and three for options.

Modcomp Systems II and IV

For all models, peripherals are attached to either a 4903 or 4905 Peripheral Controller Interface (PCI); up to eight 4903's can be attached to a Modcomp system. Each 4903 and 4905 consists of an enclosure, a power supply interface to the modular bus and DMP, and six slots for up to four peripheral controllers. The 4905 also includes a 375X Console Device Controller. The PCI is a four-phase chassis.

Requirements within the 490X PCI are as follows: Controllers for hard disk, two or four positions; controller for floppy disk, one position; controllers for printers or plotters, one position; and controllers for punched card readers or punched tape reader/punches, one position. The CRT console device controller requires two positions; the teletypewriter controller, one position. All communications systems use one position in the 490X PCI except the 1907A-X, which employs three.

All devices housed in the 1930-XX Universal Communications Chassis require one slot.

WORKSTATIONS: See above.

DISK STORAGE: See above.

MAGNETIC TAPE UNITS: See above.

PRINTERS: See above.

MASS STORAGE

4190 MEMORY+ SYSTEM: This is a bulk core memory system designed to replace head-per-track swapping disks in high-performance systems. The bulk core subsystem operates as an I/O device and can accommodate up to 4 million bytes in 16 256K-byte increments. Addressing is organized into tracks and sectors, and Memory+ controller commands are the same as those issued to a head-per-track controller. One significant exception, however, is that Memory+ permits data transfers of as little as one word.

There are 128 words (256 bytes) per sector, 32 sectors or 4096 words (8192 bytes) per track, 32 tracks or 131,072 words (262,144 bytes) per module, 8 modules or 1,048,576 words (2,097,152 bytes) per file, 2 files or 2,097,152 words (4,194,304 bytes) per 4190, and up to four 4190's per CPU. Each Memory+ bulk core module is a continuous 128K by 18-bit array that is folded around the four surfaces of two printed circuit boards. The two boards are hinged together for easy access to any core area.

Each file can have its own dual-access interface, which permits the addition of a second device controller, allowing overlapped file access within a single-CPU system or shared access from another CPU. A self-test capability is present in each file, allowing either file in the Memory+ system to be taken off-line for testing or repair.

The controller operation is comparable to that of Modcomp's peripheral fixed-head disk systems, but there are significant performance differences. Access to a Memory+ device can occur within 1 microsecond following service initiation, and data can be tranferred at rates of 3 to 4 megabytes per second using currently available Modcomp IV models. Should a main memory port be unavailable, data will be transferred via the I/O bus at its normal rate. Data buffering is not required since there are no overflow implications in the core memory modules.

The controller utilizes standard virtual-mode addressing for management of data transfers between Modcomp IV main memory and Memory+. Standard Modcomp II and IV main memory protect features are also implemented.

With two controllers connected to a single file, dual access to that group of up to eight core modules is time-shared. When two controllers are connected to two files, however, one controller may access one file while the other controller accesses the other file. Either controller can lock out the other from accessing either file.

The 4190 has a data transfer rate of 1.32 to 4.58 megabytes per second, average. Up to four-way block address interleaving using more than one 256K-byte module yields a transfer rate of 3.7 million bytes per second. Cycle time for the bulk core memory is 1500 nanoseconds with an access time of 600 nanoseconds.

410X SERIES FIXED-HEAD DISKS: Three models, the 4103-1, 4104-1, and 4106-1, respectively provide storage capacities of 524,288 bytes, 1,048,576 bytes, and 2,097,152 bytes. Each disk drive has its own controller and contains 64, 128, or 256 tracks, 32 sectors per track, and 128 16-bit words per sector. Average rotational delay is 8.7 milliseconds, and the data transfer rate is 512K bytes (256K words) per second. The 4100 Series disk drives are manufactured by Data Disc, Inc.

4120 SERIES MOVING HEAD DISKS: Models 4126/4127 provide storage for up to 2,598,400 bytes, while Models 4128/4129 provide storage for up to 5,196,800 bytes. Model 4126 consists of a controller for one to four drives and one 4127 drive. Model 4127 is the add-on drive for the 4126 subsystem. Model 4128 includes a controller for up to two drives; each drive includes two disk cartridges (IBM 1315-type), one of which is removable. Model 4129 is a dual-cartridge add-on for Model 4128. Both units attach to the processor via the direct memory processor (DMP) channel, and the controller interface requires two slots in the peripheral controller interface. Write lockout is provided to insure track protection. Both models store data with 100 words per sector, 32 sectors per track, and 200 tracks plus 3 spares per surface. There are a total of 406 tracks on the 4126/4127 and 812 tracks on the 4128/4129. Data transfer rate is 97,800 words per second, and average access time is 90 milliseconds (including a 20-millisecond average rotational delay). Head positioning time is 15 milliseconds track-to-track and 135 milliseconds across all tracks. The drives rotate at 1500 rpm. The 4120 Series drives are manufactured by Diablo (Models 31 and 33).

4136 SERIES MOVING-HEAD DISKS: The subsystem consists of a controller and up to four disk drives, providing a total of up to 40 megabytes of storage. The Model 4136 is the master drive and is provided with the controller. The Model 4137 is the add-on drive. The 4136 and 4137 each provide 10,027,008 bytes of formatted storage. The subsystem connects to the processor by means of a direct memory processor channel and occupies two slots on the peripheral controller interface. Data is stored at 2200 bpi on the disk packs, which have 4 tracks per cylinder, 24 sectors per track, and 128 words per sector. There are 408 cylinders per pack. The drives have an average rotational delay of 12.5 milliseconds. Track-to-track, average, and across-all-tracks head movement times are 10, 35, and 70 milliseconds, respectively. Data transfer rate is 312.5K bytes per second. The drives are rack-mountable and require 8¾ inches of vertical height. The 4136/4137 drives are manufactured by Wangco (Model T 2222).

4138 SERIES DISK DRIVES (IBM 3330-type): There are four models offered in this series. The 4138-1 includes one 83,962,368-byte disk drive and a controller for up to four drives. Model 4138-2 is the add-on disk drive. The 4138-5 is the double-density version of the 4138-1 and includes one 167,924,656-byte disk drive and a controller for up to four drives. The 4138-6 is the double-density version of the 4138-2.

Modcomp Systems II and IV

The 4138 disks have either 404 cylinders plus 7 spares, or, in the double-density version, 808 cylinders plus 7 spares; 19 tracks per cylinder; and 5,376 words (10,752 bytes) per track. Physical layout specifications for the 4138 include 128 words (256 bytes) per sector, 42 sectors per track, and 102,114 words (204,228 bytes) per cylinder. Also included in the 4138 subsystems are features such as error checking on an individual sector basis, overlapped seeks for two to four drives, and buffering of a full track of data. Average head positioning time is 28 milliseconds, and average rotational delay is 8.35 milliseconds. Track-to-track and across-all-tracks head movement times are 10 milliseconds and 55 milliseconds, respectively. The 4138 controller occupies four slots in the peripheral controller interface. The 4138 disk drives are supplied by Ampex (Models 9100 and 9200).

4521/4522 FLOPPY DISK: Models 4521 and 4522 are binary input/output devices. Model 4521 includes a single floppy disk drive and a controller; Model 4522 includes dual up to two drives and connects to the direct memory processor through one slot in the peripheral controller interface. The drive automatically unloads the heads 600 milliseconds after each transaction to minimize disk surface wear. Storage capacity is 157,696 words (315,392 bytes) per drive, with 128 words (256 bytes) per sector, 16 sectors per track, and 77 tracks per drive. Average rotational delay is 83.3 milliseconds with a disk rotational speed of 360 rpm, and average seek time over 28 tracks is 290 milliseconds. Track-to-track head positioning time and head settling time after the last step are both 10 milliseconds. Head load time is 80 milliseconds. The 4521/4522 floppy disk drives have a data transfer rate of 157,696 words (315,392 bytes) per second and are manufactured by Shugart.

INPUT/OUTPUT UNITS

See Peripherals/Terminals table. In addition to the traditional I/O peripherals, Modcomp offers an extensive and comprehensive line of analog/digital interfacing units and special generalized digital interfaces to enable users to implement nearly all process control or instrumentation application. Due to their specialized nature, these units have not been included in this report. Consult Modcomp for descriptions and prices.

COMMUNICATIONS CONTROL

GENERAL: There are two aspects to communications control within the Modcomp processor line: the normal interface units, which connect data channels to the I/O bus, and an additional set of macro instructions supporting communications and implemented in control storage in the Modcomp II/26/CP2, II/45/CP2, and IV/35/CP-B. The latter are also supported by direct memory interface (DMI) hardware, which provides a separate path for up to 256 full-duplex channels between the Universal Communications Subsystem Model 2 and memory. The special communications instruction set includes eight DMI instructions and six data manipulating instructions.

UNIVERSAL COMMUNICATIONS SUBSYSTEM: This subsystem contains two separate communications components and permits interfacing up to 256 full-duplex synchronous or asynchronous lines to any Modcomp II or IV processor. The two elements employed in this subsystem are the 1907A-X Universal Communications Controller Model 2 Computer I/O Interface and the 1930-xx Dual Port Communications Chassis. These units are described in separate paragraphs below.

1907A-X UNIVERSAL COMMUNICATIONS CONTROLLER MODEL 2 COMPUTER INTERFACE: The UCC controls up to 256 full-duplex lines in any mix of synchronous or asynchronous lines through storage of line parameters in a 64-bit by 256-word RAM. The status of each line is recorded in a 64-bit word which is alterable by the program. Line scanning is controlled by an internal processor, with the scanning algorithm implemented in programmable read-only memory. The scanning algorithm can be either standard factory-supplied or user-specified, enabling optimum servicing of any mix of low- and high-speed data lines. Line interfaces are provided through line interface adapters mounted in the 1930-xx Universal Communication Chassis. Up to eight chassis can be accommodated, with each chassis providing up to 32 full-duplex channels. The 1907A-x UCC plugs into three slots in a 4903 or 4905 Peripheral Controller Interface. Specific versions of this product include the 1907A-2 UCC for 32 lines, the 1907A-3 UCC for 64 lines, the 1907A-4 UCC for 128 lines, the 1907A-5 UCC for 192 lines, and the 1907A-6 UCC for 256 lines.

1930-XX UNIVERSAL COMMUNICATION CHASSIS: This unit serves as a housing, power source, clock source, and general interface for up to 16 193x dual-line interfaces. All necessary power for the line interfaces is provided, as well as 15 standard clock frequencies. The asynchronous line interface module can select any of the 15 clock frequencies under program control. The universal communications chassis is available in a single-port (1930-1x) or dual-port (1930-2x) model. The x in the model indicates whether the chassis is equipped with terminators (1930-1A, 1930-2A) or not (1930-1B, 1930-2B). The dual-port models have connections for two different 1907 controllers connected to two different computer systems or to two 1907's in the same system for redundant paths. The 1930-xx Chassis mounts individually and is connected to the 1907A-x Controller by cables.

193x DUAL-LINE INTERFACE MODULES: Five models of dual-line interface modules are offered to connect various data communications lines to the 1930 Communication Chassis. All models accommodate two full-duplex lines and have full modem controls. Three of the five handle asynchronous lines at 15 standard data rates up to 19.2K bits per second, differing only in the line interface. The asynchronous channels also provide for a frame size of 5, 6, 7, or 8 bits; parity selection of odd, even, or none; 1, 1.5, or 2 stop bits; break detect and break transmit; busy out; rate select; secondary channel; echo; wrap-around; and split speed (different input and output rates on one full-duplex channel). Model 1931 is for RS-232C lines, while Models 1932 and 1933 offer 20/60-milliampere current loop interfaces, the former with 40 volts maximum isolated and the latter with a 17-volt battery. Transmit and receive rates need not be the same on full-duplex applications. Models 1934-I and -2 are for synchronous operation and respectively feature data rates of up to 9600 and 230.4K bits per second. Model 1934-1 is used with standard RS-232C modems, while Model 1934-2 is used with Bell System 301/303 or equivalent wideband modems. The sync character may be different for each of the two lines and is software-selectable.

The channel will strip leading sync characters from input messages and insert six leading sync characters into output messages under program control. The secondary channel is supported by the interface as well as a programmable frame size of 5, 6, 7, or 8 bits; parity selection of odd, even, or none; rate select; busy out; and wrap-around.

1910 ASYNCHRONOUS COMMUNICATIONS SUBSYSTEM: Provides economical interfacing for up to 128 full-duplex asynchronous lines at one of 11 rates from 75 to 9600 bps for low-speed line concentration, store-and-forward message switching, and interactive time-sharing. The 1910 subsystem consists of a 1905 Asynchronous Communications Multiplexer (ACM) Controller, up to four 1910 multiplexers, and a combination of up to 32 Model 1912 or 1914 full-duplex subchannels.

Modcomp Systems II and IV

OPERATING SYSTEM REQUIREMENTS/SUPPORT

	MAX II				MAX III			MAX IV	
Residence	Core	Core	Disk	Disk	Core	Disk	Disk	Disk	Disk
Minimum memory capacity, bytes	32K	48K	32K	48K	32K	48K	64K	96K	192K
Multiply/divide	X	X	X	X	X	X	X		
Executive features**	X	X	X	X	X	X	X		
Direct memory processor			X	X		X	X	X	X
System protection						X	X		
Minimum disk capacity, bytes			256K	256K		512K	512K		
Binary I/O devices	X	X	X	X		X	X	X	X
Console	X	X	X	X	X	X	X	X	X
Assembly	X	X	X	X	*	X	X	*	X
Macro assembly, non-overlay	X	X		X	*		X	*	X
Macro assembly, overlay			X		*	X		*	
FORTRAN, non-overlay		X			*		X	*	X
FORTRAN, overlay			X		*	X		*	
System processors	X	X	X	X	*	X	X	*	X

*Dedicated application
**Executive features include a real-time clock, console interrupt, external level and task scheduler interrupts.

The ACM controller is responsible for scanning each of the subchannels and detecting/generating data and/or service interrupts as required by the subchannels. The 1910 multiplexer provides the power source, controller interface, clock generator, and card cage for up to 32 full-duplex channels. Each multiplexer may be configured with 5 of the 11 available rates.

The subsystem has provisions for 1 or 2 programmable stop bits; a programmable frame size of 5, 6, 7, or 8 bits; programmable character parity generation and checking, which may be either odd, even, or not present; and double-character buffering.

The 1912 and 1914 subchannels have the same functional characteristics, differing only in external signals and levels for interfacing. The 1912 is RS-232C-compatible and is limited to directly connected terminals or dedicated lines. The 1914 is designed for 20-mA current loop interfaces and has an isolated solid-state interface.

481X COMMUNICATIONS CHANNELS: Provides both asynchronous and synchronous channels for remote terminal/computer interfacing. Half- or full-duplex operation at up to 9600 bps is supported with double-character buffering, programmable hardware wrap-around, programmable character parity (odd, even, or none), asynchronous hardware echo, a programmable frame size of 5, 6, 7, or 8 bits, 1 or 2 programmable stop bits for asynchronous operation, automatic sync character generation and deletion, and hardware CRC generation. Each of the channels occupies one slot position. The various channels offer asynchronous rates of 75 to 9600 bps (4810 and 4811) or synchronous rates of 110 to 9600 bps (4812, 4813, and 4815).

The 4810 and 4811 are dual asynchronous interfaces offering two full-duplex channels with a 20-mA current loop (4810) or RS-232C-compatible interface (4811).

Both the 4812 and 4813 are designed for asynchronous operation, offer one full-duplex channel, and are provided with hardware fill capability. The 4812 is supplied with a current loop interface, while the 4813 has an RS-232C interface. The 4815 offers two full-duplex channels through a dual synchronous interface and is RS-232C-compatible.

4820 MODCOMP-TO-MODCOMP COMPUTER LINK: Provides a link for any combination of Modcomp II or IV computers. The 4820 provides both I/O bus and DMP interfaces. Transfer rate for the 4820 is 100K words per second.

SPECIAL COMMUNICATIONS PRODUCTS: These are products which are offered for customized applications and are not available from standard product lines. Included in this category are the Modcomp 1941 CDC Satellite Coupler, which provides a bidirectional path for data transfers to and from Control Data 3000 or 6000 CPU's and a Modcomp processor; the 1950 Modcomp-IBM Channel Interface, which provides a bidirectional, parallel data path between an IBM 360/370 selector or multiplexer channel and a Modcomp processor; the 5950 IBM Selector Channel Emulator; and the 4819 Auto Call Unit Controller. For further information on these products, consult a Modcomp local sales representative.

SOFTWARE

OPERATING SYSTEMS: The Modular Application Executive (MAX) system provides three levels of system capability: MAX II, MAX III, and MAX IV.

MAX II and MAX III are compatible operating systems; MAX III is a superset of MAX II. They share common executive services, peripheral handlers, and software.

MAX II is designed for batch processing with limited real-time requirements. It is a multiprogramming system that can execute multiple core-resident tasks concurrently with one batch job stream. MAX II is available in a core version and a batch version. The core version includes a taskmaster which allocates time slices to any number of core-resident tasks. It supports up to 256 unique execution priority levels. The batch version supports both moving-head and fixed-head disks and magnetic tape.

The MAX II core version includes re-entrant floating-point simulation and re-entrant FORTRAN IV run-time packages; re-entrant executive services for I/O operations; execution control, byte string syntax analysis, code conversions, and utilities; and a device-independent I/O system. The batch version adds nonresident background and batch processing services to the real-time services of the core version.

MAX III is a real-time multiprogramming system with foreground/middleground/background capabilities. It is task-oriented and can have any number of tasks active in up to 256 priority levels. MAX III is useful in medium-to-large Modcomp II multi-user configurations.

MAX III exists in three versions: a core version, a batch version, and an extended version. The core version executes resident foreground tasks contained entirely within fixed areas of memory. It also includes a clock-driven CPU

Modcomp Systems II and IV

control executive, re-entrant executive services, queued I/O services that can be performed concurrently with task execution or with the calling task suspended, an off-line system generation program for configuring the resident elements and tasks of the system, and services for allocation of core not used by resident elements. Also included in the core version are a real-time clock for maintaining the time-of-day, timing task delays, and updating system watchdog timers; an option allowing the execution of more than one task at each priority level, and a feature allowing important or frequently used library subroutines to be declared resident at system generation time. Re-entrant library subroutines, memory tables, and variables may be made global. The system generation package permits generation of large core-resident systems in small core configurations.

The batch version of MAX III is a foreground/background system which adds the capabilities of a full-service loader for overlay programs catalogued on either sequential or direct-access devices. An optional background task may be added which uses a nonresident job control overlay to control batch processing operations. This version does not contain middleground or batch checkpointing capabilities.

The extended version of MAX III provides a full foreground/middleground/background system, which permits establishment of one or more core pools for foreground and middleground execution. Core is dynamically allocated to each task on a priority basis. The extended version also permits one or more background areas to support batch processing. These areas can be stored on a disk when higher-priority nonresident foreground programs require the memory space. The system allows background and middleground core area sizes to be changed by the operator and spooling of low-speed printing devices. Active tasks can request additional core blocks for use at run time. These blocks are automatically deallocated.

Foreground, middleground, and background tasks may be either privileged or unprivileged. The unprivileged mode is the user mode, where the task has absolute control within its own memory boundaries only. Round-robin tasks scheduling is an optional feature, allowing all tasks of equal priority to have their execution times shared on a cyclic basis.

MAX IV is a disk-oriented, real-time, communications-oriented multiprogramming system specifically designed for medium-to-large Modcomp IV systems. The operating system utilizes the Modcomp IV hardware relocation capabilities, map protection, memory allocation/deallocation instructions, multiple register sets, and multi-ported memories to reduce system overhead. In addition to most of the capabilities of MAX III, including a clock-driven CPU executive, MAX IV offers 256 task priority levels with the capability to execute multiple tasks at each level; re-entrant executive services for execution control, byte string syntax analysis, and code conversion; dynamic allocation of system resources; assigning privileged and unprivileged status to tasks; and the option of core residency or disk residency for tasks, if memory is to be conserved.

The basic executive services and functional capabilities of MAX II and III are included in MAX IV as a subset. Tasks and overlays developed under MAX II or III will operate normally under MAX IV provided that the interface to the operating system is via Modcomp macro calls, executive services, or standard FORTRAN call subroutines.

The MAX IV operating system generally makes more efficient use of disk storage than MAX III, permitting such additional functions as rollin/rollout of tasks between core and disk as priorities dictate. MAX IV also has the same re-entrant FORTRAN run-time package and output spooling capabilities as MAX III.

A file manager system is available as an extension to the MAX IV operating system which can be used by any task concurrently with MAX IV's basic I/O system. The file manager organizes, maintains, and services multi-level files in any size and number. Nesting of named data files and file directories to any level while maintaining file security at each level is permitted. Up to four levels of volume and file access protection are provided using locks and keys. Both volume and file disposition functions based on user expiration dates are available. Volume and file access are device-independent. The file manager provides both direct and sequential access methods, as well as the ability for the user to develop his own access method through the MAX IV basic I/O system. File names may be of variable length, controlled by the user. File space may be contiguous or noncontiguous and is automatically allocated and deallocated.

MAX II/III and MAX IV provide a wide selection of support software for program development and communications, including:

MAXNET Network extensions,
Multiple batch processing job streams,
Job Control Language to set up job steps,
On-line multi-terminal job control,
FORTRAN IV with real-time extensions,
Macro assembler and cross-assembler,
File utility processor for sequential and direct-access files,
Sort/Merge with exits for user coding,
Source Editor for sequential or random line/field modification,
Object Library Update,
Link Editor,
Load Module Cataloger,
Link Loader,
Utility Job Control Procedures for software-development,
Program Debug Executive,
Binary Synchronous Subsystem,
IBM 2780 Emulator,
CDC 200 UT Emulator,
HASP Workstation,
COBOL and CORAL 66,
Timesharing Executive transaction processor,
Infinity, Data Base Management System, and
TOTAL, Data Base Management System, single- and multi-task.

LANGUAGES: For the Modcomp II or IV, a 4K assembler or 16K macro assembler (6K resident requirement) are available, as is a FORTRAN-coded cross assembler for use on an IBM System/360 or 370 (DOS, 65KB) or a Control Data 6000 Series system. Also available for the Modcomp II or IV are ANSI FORTRAN IV.

The *Assembler* operates in two-pass fashion and requires a minimum batch processing area of 8K bytes, which can handle up to 200 symbol names. With additional available memory, the symbol table can be expanded at the rate of one symbol for every three words of memory.

Featured in the Assembler are both absolute and relocatable object format; free-field assembly format; a set of directives for aiding in expressing constants, allocating storage, inter-program communications, and listed output formatting; error diagnostics; an object listing including source and object code; symbolic addressing; the ability to define new instructions implemented in the ROM controller; and the capability to accept symbolic constants both as operands in an immediate instruction and in data statements.

The Macro Assembler is a free-format language processor that contains all of the assembler capabilities, plus additional features which include the generation of nested macros, recursive macro calls, assembly-time branches, and macro exits.

Modcomp Systems II and IV

The Macro Assembler is a two-pass processor that generates relocatable and absolute object format and requires a minimum batch processing area of 24K bytes. This language processor contains directives which allow the definition of macro prototypes, conditional assembly, custom hardware macros, symbol definition, plus local and global label processing. The user can define COMMON blocks for communication between FORTRAN and assembly-language programs and subroutines.

The Modcomp *FORTRAN IV* compiler meets the specifications of the American National Standards Institute (X.39, 1966). Real-time extensions are provided which make FORTRAN a useful data acquisition and control language.

Modcomp FORTRAN IV is designed to produce efficient code through subscript optimization, block-level optimization, and the utilization of all Modcomp II or Modcomp IV machine capabilities, such as all general registers and the full instruction set.

Direct-access I/O to disk files is provided through DEFINE FILE statements. A file manager provides the utility functions for the creation and deletion of disk files to be used with the FORTRAN direct access I/O system. READ and WRITE may be free-format.

The programmer using the Modcomp FORTRAN IV compiler can write source code incorporating in-line assembly-language coding, including macro directives. The user can also call all the MAX executive services through in-line assembly-language coding for maximum run-time efficiency.

A set of CALL subroutines which are compatible with ISA Standard 61.1 has been added to the MAX IV System Library. They provide real-time capabilities for execution control of real-time tasks, status testing, and interrupt utilization. Array extensions provide the user with the freedom to use any arithmetic expression as an array subscript. Arithmetic capabilities include 16-bit and 32-bit (Modcomp IV) integers, plus 32-, 48-, and 64-bit (Modcomp IV) floating-point operations. The Modcomp floating-point hardware unit is fully supported by the compiler.

The FORTRAN I/O Run-Time Package is written in a re-entrant format, allowing a single copy to be shared by all programs.

A comprehensive diagnostic capability provides assistance in the form of error printouts indicating the types and number of errors that exist in any line of coding.

Modcomp *COBOL* is a low-intermediate implementation of ANSI standard X3.23 1974 with additional Level 2 features such as full implementation of table handling, all standard forms of PERFORM, a substantial subset of the debugging module, complete Level 2 STRING and UNSTRING, compute statements with multiple receiving fields, accept from DATE/DAY/TIME, and all data level numbers 01-49, 66, 77, 88.

The COBOL compiler operates under the MAX III and MAX IV operating systems and requires a minimum of 30K bytes of memory. For extremely large COBOL programs, additional memory should be reserved for the extra symbol table area.

For compilation and execution, the Modcomp II requires 64K bytes of memory, 5 million bytes of moving head disk storage, and a console; the IV requires 256K bytes of memory, 5 million bytes of moving head disk storage, and a console.

CORAL 66 is a general-purpose high-level programming language particularly suited for real-time applications and system software development. MAX III and MAX IV versions are compatible with the official definition of the CORAL 66 language Type D with recursion. Extensions to the language include byte arrays, shift operators, hexadecimal constants, and multiple-named common and FORTRAN interfaces.

COMMUNICATIONS SOFTWARE: Modcomp has produced several specialized communications software packages, including MAXCOM and MAXNET.

MAXCOM is a demand-driven operating system for dedicated communications applications. It does not support background system processors. MAXCOM can support up to 256 tasks, each with a separate priority level. Drivers are included for TTY, IBM Bisync, and CDC 200 UT terminals as well as for CDC 6000 and IBM 360/370 host processors. The operating system provides queued I/O services with the option of immediate return to interrupted tasks, deferred return to interrupted tasks, or no return. System generation is accomplished through the Modcomp macro assembler or the CDC and IBM cross assemblers. Generally, MAXCOM offers all the features of MAX II plus the enhancements gained through the addition of the communication macros to any Modcomp II CPU. The minimum configuration needed to run MAXCOM is any Modcomp II/CP processor with 8K words of core. To generate MAXCOM, however, a minimum of 16K words is required.

The following are special-order communications software products.

MAXNET III is an extension of the MAX III operating system that permits linking multiple Modcomp II or IV processors to form a distributed network which operates as an integrated system. Each system in the network has all the capabilities of the extended version of MAX III plus the capabilities of the designated host system to exercise control over all satellite systems. The system permits such functions as establishment, activation, holding, and killing of remote tasks, default assignments if current tasks are nonexecutable, task resumption, and file assignment to both assembly language and FORTRAN users.

There are five specialized tasks to support network operations. These are the link task to interface the I/O system and allow device-independent I/O transfers through the network; a loader task for transferring other tasks from the host system disk to a satellite system; a linking loader that is specifically designed for network applications and will receive binary inputs from the host system, perform checksum validity checks, and request a predetermined number of retries under error conditions; and a software buffer management package which permits establishment of buffers in other systems' global or common areas.

The configuration needed for a MAXNET III host system is a Modcomp II or IV with 128K bytes of memory and all peripherals required by MAX III, extended version. Satellite systems require 48K bytes of memory as a minimum and any Modcomp communications interface to the host system.

MAXNET IV is an extension of MAX IV with all of its real-time multiprogramming capabilities and provision for a mechanism to communicate with MAXNET III. The MAXNET IV host system requires a Modcomp IV processor with 256K bytes of memory and the peripherals required by MAX IV. A satellite MAXNET IV system requires 128K bytes of memory.

Modcomp Systems II and IV

The *CDC 200 User Terminal Emulator* provides a means for either a Modcomp II or IV to communicate with a remote Control Data 6000 or 7000 Series computer. The emulator operates under MAX II, III, or IV, performing its task concurrently with other real-time or background tasks. The features of the CDC 200 User Terminal provided by the emulator include interleaved I/O transmissions, switched or dedicated point-to-point operation at 2000 to 9600 bps, space and zero character compression, external BCD transmission code, ANSI or IBM 26 punched card input codes, and full double-buffering. Input may be from cards, disk, or magnetic tape; output may be to printer, disk, magnetic tape, or spooler.

The emulator requires a Modcomp processor with at least 7K words above the resident systems or tasks; one duplex channel of a 4815 Interface; an appropriate dial or dedicated communications line and Bell 201A, 201B, 208, or 209-type modem; and access to a CDC 6000 or 7000 Series computer operating under Export/Import, Cybernet, etc.

The *IBM 2780/3780 Terminal Emulator* enables a Modcomp II or IV to communicate with a remote IBM System/360 or 370 computer. The emulator operates under MAX II or III as either a foreground or background task. Provided with the emulator are these features of the IBM 2780/3780: multiple record transmission, horizontal format control, EBCDIC transmission code, transparent text transmission, 3780 space compression, extended ENQ or error retry, variable-length records, and switched or dedicated point-to-point operation at 2000 to 9600 bps. Input may be from cards, disk, or magnetic tape; output may be to printer, disk, magnetic tape, punched cards, or spooler. The emulator may be nonresident and can perform its operations with other batch or foreground tasks.

Minimum requirements for operation of the emulator include a Modcomp processor with 5K to 8K words of memory above the resident tasks or systems; other requirements specified for the CDC 200 User Terminal Emulator above; and access to an IBM 360 or 370 computer under OS/VS, OS/HASP, DOS/VS, DOS/Power, etc.

The *IBM HASP Workstation Terminal Emulator* operates under MAX III or IV on either a Modcomp II or IV with 8K to 10K words of memory above the resident tasks or systems. Additional requirements include a duplex channel of a 4815 Interface; a dial or dedicated communications line, a Bell 201A, 201B, 208, or 209-type communications modem; and access to an IBM 360 or 370 computer under OS/VS, OS/HASP, or OS/ASP.

The HASP emulator includes these features of the workstations: multi-leaved I/O transmission, EBCDIC transmission code, transparent or nontransparent transmission, space and duplicate character transmission, switched or dedicated point-to-point operation at 2000 to 9600 bps; file insertion; input from punched cards, disk, or magnetic tape; and output to punched cards, disk, magnetic tape or printer. The emulator may be nonresident and can operate with other batch or real-time tasks.

DATA BASE MANAGEMENT SYSTEMS: *Infinity* provides a general-purpose data base management system for Modcomp II or IV computer systems. Compatible versions are available for the MAX III and MAX IV operating systems and for the MAXNET extensions. Infinity supports multiprogram, multiprocessor access to data base files through the standard operating systems' logical I/O structure. Infinity operates as a resident symbiont task processing queued user requests. Nonresident system data base processors are included for general-purpose data entry, retrieval, and file maintenance. Schema-driven files are created using a data description language (DDL) describing data record items, access structures, and other attributes. A set of callable routines provides a convenient data manipulation language (DML) interface with system I/O functions. Infinity is language-independent, supporting FORTRAN, COBOL, CORAL 66, and Assembler interfaces, and is utilized in Modcomp's own MIS system.

TOTAL, a general-purpose data base management system, is made available as a Modcomp software product through an agreement with CINCOM Systems, Inc.

TIME SHARING & TRANSACTION PROCESSING: *TSX* is a general-purpose Timesharing Executive & Transaction Processor for Modcomp computer systems. Versions of TSX are available on MAX III and MAX IV operating systems. TSX is transparent to standard Modcomp system processors and to most user-written, terminal-oriented programs. TSX dynamically schedules memory usage, allowing a large number of interactive users to perform concurrent processing.

Transaction processing applications are particularly easy to develop under TSX with the aid of the CRT Forms Processor. This capability facilitates the generation of complex CRT screens for fill-in-the-blanks operation.

UTILITIES: Modcomp provides a set of functions to maintain source, object, and load modules on disk storage; a file maintenance processor for files processed by the file manager; a direct-access maintenance processor for FORTRAN-defined direct-access data files; and a sort/merge routine with a standard control language.

PRICING

POLICY: The manufacturer offers Modcomp systems on a purchase-only basis, with separately priced maintenance and software.

Delivery will be made FOB Modcomp's plant. The warranty period is 90 days after delivery. Modcomp provides one-time, no-charge, on-site installation at the purchaser's location within the contiguous United States. Installation facilities including electrical power and connector requirements are the responsibility of the user and must be completed prior to installation. If a system is purchased with software, an additional $300 software service charge is billable. The software service charge includes delivery of the operating system (either MAX II, III, or IV), support software (system languages) in object or load module form, and one set of software documentation. Additional copies of the software are available at prices specified in the equipment price list.

Software is supplied only with systems that have at least one disk drive or magnetic tape unit/disk drive combination. Software is always provided on the least costly medium that is compatible with the system configuration. Diagnostics and utilities are provided at no charge.

Modcomp provides software training for users with a basic knowledge of programming and maintenance training for those with at least two years of related technical training. Training courses will be provided at the customer's site for ten students on a prearranged basis. Charges are $4500 per week ($300 for each additional student over the basic ten), $70 per diem portal to portal, plus round-trip air fare. Custom courses will be developed for $50 per hour of development time, with a minimum of $400. Currently offered are 12 software courses varying in length from two days to two weeks and 21 maintenance courses varying in length from one to three weeks. The software course list includes: basic programming, one week; assembly language programming, one week; MAX II/III

Modcomp Systems II and IV

operating systems, two weeks; MAX II/III technical course, one week; MAXNET III user's course, one week; MAXCOM operating system, one week; Modcomp IV programming concepts, one week; MAX IV operating system, two weeks; MAX IV technical course, one week; MAXNET II user's course, one week; MAX IV file manager user's course, three days; and MAX IV file manager technical course, two days.

Full-service maintenance is provided under one of four plans. VIP service guarantees a response time of eight hours or less during prime time. Prime Time is defined as 8 a.m. to 5 p.m. Monday through Friday excluding Modcomp holidays. The VIP service also includes 12 preventive maintenance calls per year on a monthly schedule, unlimited remedial maintenance calls, six months to one year duration of contract with a 30-day termination clause after the initial six-month period, and no travel expenses if the customer is within a 50-mile radius of the service center.

Real-time service is a variation of VIP service offering four-hour response time. This service is billed at 1.25 times the rate of VIP service.

IP service is another variation of VIP service that offers the same features but without a guarantee as to response time. Pricing is available on a special-quote basis.

Extended service offers coverages which can range from a guaranteed two-hour response time up to and including coverage 24 hours a day, 7 days a week. Rates for this service are on a special-quote basis. A customer may not mix types of service within a single system configuration.

EQUIPMENT: The following typical system includes all necessary controllers in its purchase price.

BASIC MODCOMP II SYSTEM: The II/12 consists of a general purpose 16-bit digital computer with 64K bytes of memory and options to support MAX III; arithmetic unit; read only control memory; 3670 64K byte memory module, 1.067 microsecond cycle time with parity; memory expansion to 131,072 bytes; general register file (15 hardware registers); register I/O and 3 interrupts (2 I/O, unimplemented instruction traps); operator console; rack mountable enclosure and power supplies; hardware fill; multiply/divide; power fail safe/auto start; priority interrupts for executive features; and executive features. Purchase price is $16,750, with a monthly maintenance charge of $130.

BASIC MODCOMP IV SYSTEM: The IV/35-B includes a 32-bit parallel bus and arithmetic unit; 3675 128K byte 1.067 microsecond core memory; memory expansion to 1024K bytes; four-port memory interface; 15 general purpose registers and a context switching file with 240 registers; memory management system including 2048 memory mapping registers consisting of eight files of 256 registers each, automatic memory allocation hardware, and memory protect on a 512 byte basis; 16 interrupt levels including extended interrupt group; power fail safe/auto start; direct memory processor; control console; memory parity; cabinet. Purchase price is $60,250, with a monthly maintenance charge of $390.■

Modcomp Systems II and IV

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
MODCOMP II PROCESSORS			
II/12	Basic 16-bit CPU with arithmetic unit; read only control memory; 3670 64K byte memory module, 1.067 micro second cycle time with parity; memory expansion to 131,072 bytes; general register file (15 hardware registers); register I/O and 3 interrupts (2 I/O, unimplemented instruction traps); operator console; rack mountable enclosure and power supplies; hardware file; multiply/divide; power fail safe/auto restart; priority interrupts for executive features; executive features; and options to support MAX III.	$16,750	$130
II/26	Basic 16-bit CPU with arithmetic control; read only control memory; modular bus control interface; 3670 64K byte memory module, 1.067 microsecond cycle time with parity; memory expansion to 131,072 bytes; general register file (15 hardware registers); register I/O and 3 interrupts (2 I/O, unimplemented instruction traps); operator console; rack mountable enclosure and power supplies; hardware file; 375X console device controller; multiply/divide; power fail safe/auto start; interrupts levels for executive features; executive features; and options to support MAX III.	20,500	150
II/26/CP2	Communications Processor; same as II/26 except includes communication macros and direct memory interface logic for universal communications subsystem Model 2.	27,000	194
II/45	Same as II/26 except includes 32K byte memory modules and four-port memory interface providing four concurrent access paths to memory with an 800 nanosecond memory cycle.	24,500	176
II/45/CP2	Communications Processor; same as II/45 except includes communication macros and direct memory interface logic for universal communications subsystem Model 2.	30,250	235
II/201	Computer System contains a 11/26 CPU with 64K bytes of memory; CPU options to support MAX III; 4903 peripheral controller interface (PCI); memory expansion to 131,072 bytes; direct memory processor; executive features (including interrupts); system protect (including interrupts); multiple/divide; hardware file; power fail safe/auto start; 375X console device controller; and 0001 cabinet.	21,250	150
II/221	Same as II/201 except includes 5.2M byte memory head disk (4128-1) mounted in two standard cabinets	38,500	275
II/233	Communications System containing a II/26/CP2 with options to support the MAXCOM software system; operator console; 64K bytes of core memory, 1.067 microsecond cycle time with parity; memory expansion to 131,072 bytes; direct memory processor; executive features (includes interrupts); multiply/divide; hardware file; power fail safe/auto start; 4903 peripheral controller interface; 375X console device controller; 1907-A-3 universal communications controller, Model 2; 1930-1A universal communications chassis; and two 0001 cabinets.	39,250	263
II/325	Computer System containing a II/26 CPU with 64K bytes of core memory; options to support MAX III; memory expansion to 131,072 bytes; direct memory processor; executive features (including interrupts); system protect (including interrupts); multiply/divide; hardware file; power fail safe/auto start; 4903 peripheral controller interface; 375X console device controller; 10M byte moving head disk (4136); and two 0001 cabinets.	38,500	289
II/326	Computer System containing a II/26 CPU with 131,072 bytes of memory; options to support MAX III; direct memory processor; executive features (including interrupts); system protect (including interrupts): multiply/divide; hardware file; power fail safe/auto start; 4903 peripherals controller interface; 375X console device controller; 10M byte moving head disk (4136); 4190 memory plus subsystem with 256K bytes core memory (expandable to 2M bytes); and two 0001 cabinets.	67,500	549
MODCOMP IV PROCESSORS			
IV/35-B	General purpose 32-bit digital computer includes 32-bit parallel bus and arithmetic unit; 128K bytes of core memory; memory expansion to 1024K bytes; four-port memory interface; 15 general purpose registers and a context switching file with 240 registers; memory management system including 2048 memory mapping registers consisting of eight files of 256 registers each, automatic memory allocation hardware, and memory protect on a 512 byte basis; 16 interrupt levels including extended interrupt groups; power fail safe/auto start; direct memory processor; control console; memory parity; and cabinet	60,250	390
IV/35/CP-B	32-bit Digital Communications Processor; same as IV/35-B except includes communications macros and direct memory interface for universal communications subsystem Model 2	69,250	443
INSTRUCTION OPTIONS			
3512	Hardware floating point; for Modcomp II only	5,150	42
3515-1	Extended arithmetic unit provides 32-bit, 48-bit and 64-bit floating point hardware arithmetic and conversion capabilities; for Modcomp IV only	7,095	40
MEMORY OPTIONS			
3608	Read/write core memory, 16,384 bytes, 0.8 microsecond cycle time; for Modcomp II	5,400	43
3609	Same as 3608 except 32,768 bytes	8,375	40
3618	Read/write multiport core memory, 16,384 bytes 0.8 microsecond cycle time; for Modcomp II	6,700	38
3619	Same as 3618 except 32,768 bytes	10,300	50
3670	Read/write core memory, 65,536 bytes, 1.067 microsecond cycle time includes parity; for Modcomp II	10,300	50
3675	Core memory module, 128K bytes of 1.067 microsecond core memory; for Modcomp IV only	22,450	108
3646-B	Memory expansion unit includes four-port memory interface, mounting space for 512K bytes of core memory, power supplies and cabinet; for Modcomp IV	10,300	50
I/O AND INTERRUPT OPTIONS			
3704	Direct memory processor for automatic block transfer to and from 8 peripheral devices concurrently; for Modcomp II	1,950	10
3708	External direct memory processor for automatic block transfer to and from 4 peripheral devices with concurrent memory access; for Modcomp II	5,150	51
3731	Priority interrupt group, levels 1, 2, 3 and 7; for Modcomp II	650	4
3629	System protect feature for Modcomp II	1,300	5
3732	External priorty interrupt group, levels 8, 9, A and B; for Modcomp II	650	4

Modcomp Systems II and IV

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
3135-1	Diagnostic panel control and display panel which extends the capabilities of the basic Modcomp IV/35-B control panel for both hardware and software problem diagnosis; for Mocomp IV	3,225	25
3631-1	System protect provides Modcomp II compatible system protect features and interrupt; for Modcomp IV	1,940	10
3713-1	Secondary I/O processor provides concurrent I/O bus capability and direct memory access for 16 peripheral device controllers; for Modcomp IV	5,150	69
PERIPHERAL CONTROLLER INTERFACES			
4903	Peripheral controller interface for 4 controllers	2,200	12
4905	Peripheral controller interface for 4 controllers plus a console device controller	2,760	21
4906	Peripheral controller switch for programmed switching of up to 4 controllers between 2 Modcomp computers	3,300	31
MEMORY PLUS			
4190	Memory Plus file includes full-plane controller, 256K bytes of memory; dual port device file capable of accommodating 2M bytes and associated cabling	22,000	250
4191	Memory Plus expander file includes dual port 256K byte memory device file capable of accommodating 2M bytes	16,500	148
4192	256K byte Memory Plus storage module	11,000	80
4193	Memory Plus controller	5,500	45
4194	Memory Plus cable to MCIV memory port	600	—
BINARY INPUT/OUTPUT DEVICES			
4513	Paper tape reader, 625 cps	2,300	17
4521	Floppy disk, 315,392 byte storage capacity	4,300	42
4522-1	Dual floppy disk, 630,784 byte storage capacity	6,600	64
4206	Data communication printer, keyboard send and receive, 120 cps, 120 print columns, interface is EIA standard RS-232-C	8,600	90
3740	Programmable power on/off for 4206 printers	330	35
4233	ASR-33 console teletypewriter	3,100	96
3747	Programmable power on/off control for the 4233 teletypewriter	500	42
4250	ASR-33TU to 4233 modification kit	390	—
CARD EQUIPMENT			
4411-2	Punched card reader, 300 cpm	5,700	64
4412-2	Punched card reader, 1000 cpm	8,600	74
4426	Key punch/on-line card punch/automatic interrupter, 35-60 cpm	24,200	—
PRINTERS			
4211-2	Line Printer, 600 lpm, 132 columns, 64 ASCII character set	21,250	145
4214-2	Line Printer, 300 lpm, 132 columns, 64 ASCII character set	18,000	125
4216-1	Electrostatic printer, 1000 lpm, 132 columns	17,250	135
4217-1	Electrostatic printer/plotter, 1000 lpm, 132 columns	18,000	163
4226	Serial matrix printer, 64-440 lpm, 132 columns, 64 ASCII character set, smart bidirectional printing, 256 character buffer, pin feed tractor	5,300	53
4227	Line Printer, 280 lpm, 132 columns, 63 ASCII character set, solid character impact printing	8,700	76
MASS STORAGE			
4103-1	Fixed head disk, 524,288 bytes, 470K bps	19,900	185
4104-1	Fixed head disk, 1,048,576 bytes, 470K bps	22,000	206
4106-1	Fixed head disk, 2,097,152 bytes, 470K bps	44,000	245
4126-1	Moving head disk, 2,598,400 bytes, 70 millisecond average head positioning time, 20 millisecond average latency, 195.6K bps transfer rate	12,250	90
4127	Same as 4126-1 except controller not included	9,030	58
4128-1	Moving head disk, 5,196,800 bytes, 70 millisecond average head positioning time, 20 millisecond average latency, 195.6K bps	16,125	148
4129	Same as 4128-1 except controller not included	11,875	116
4136	Moving head disk, 10,027,008 bytes, 35 millisecond average head positioning time, 12.5 millisecond average latency, 312K bps; controller included for up to 3 additional disk drives	15,500	148
4137	Same as 4136 except controller not included	9,925	95
4138-A-1-E3	Moving head disk, 83,962,368 bytes, 28 millisecond average seek time, 8.33 millisecond average latency; requires a dedicated PCI	41,250	295
4138-A-2-E3	Same as 4138-A-1-E3 except controller not included	32,200	230
4138-A-5-E3	Moving head disk, 167,924,656 bytes, 28 millisecond average seek time, 8.33 millisecond average latency; requires a dedicated PCI	46,500	370
4138-A-6-E3	Same as 4138-A-5-E3 except controller not included	37,500	300
4139	Disk pack for Models 4136, 4137 and 3765-XX moving head disks	225	—
4140	Disk cartridge for Model 4126-4129 moving head disks	225	—
4142-A	Disk pack for 4138 (84MB) Series moving head disk	925	—
4142-B	Disk pack for 4138 (168MB) Series moving head disk	1,600	—

Modcomp Systems II and IV

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
MAGNETIC TAPE			
4148-1	Magnetic Tape Unit, 9-track, 45 ips, 800 bpi, 10.5 inch reel, controller included	11,300	110
4151	Magnetic Tape Unit, 9-track, 45 ips, 10.5 inch reel, 800 bpi IBM compatible	8,850	93
4155-1	Magnetic Tape Unit, 9-track, 45 ips, 1600 bpi, IBM compatible phase encoding, 10.5 inch reel; formatter, controller included	19,000	160
4156	Same as 4155-1 except controller not included	11,000	138
4157-1	Magnetic Tape Unit, 9-track, 45 ips, 800/1600 bpi-NRZI/phase encoded; formatter and controller included	21,200	223
4158	Same as 4157-1 except controller not included	11,600	191
4164-1	Magnetic Tape Unit, 9-track, 75 ips, 800 bpi, including controller	14,700	143
4165	Same as 4164-1 except controller not included	12,200	127
4168-1	Magnetic Tape Unit, 9-track, 75 ips, 1600 bpi phase encoded; formatter and controller included	23,700	223
4169	Same as 4168-1 except controller not included	13,700	191
4170-1	Magnetic Tape Unit, 9-track, 75 ips, 800/1600 bpi-NRZI/phase encoded; formatter and controller included	26,000	244
4171	Same as 4170-1 except controller not included	14,500	212
CONTROLLERS			
3751	Controller for teletype and paper tape reader	940	9
3752-X	Controller for asynchronous RS-232-C compatible console device and for paper tape reader	940	9
3753-X	Controller for asynchronous 420X console device and paper tape reader	940	9
4100-1	Controller for 410X-1 fixed head disk	4,400	47
4123	Controller for 4136, 4137 moving head disk	7,000	59
4124-1	Controller for 4126-1, 4127, 4128-1, 4129 moving head disk	4,900	40
4143-A-E3	Controller for Series 4138-A, 417X moving head disk	9,950	99
4145-1	Controller for 4148-1, 4151 magnetic tape units	4,400	45
4146-1	Controller for 4155-1, 4156, 4157-1, 4158, 4168-1, 4169, 4170-1, 4171 magnetic tape units	6,600	65
4147-1	Controller for 4164-1, 4165 magnetic tape units	4,400	45
4209	Controller for 4228 line printer	2,750	21
4210-1	Controller for 4211-2 (600 lpm) or 4214-2 (300 lpm) line printers	3,860	31
4218	Controller for 4216-1 Electrostatic printer (1000 lpm) or 4217-1 Electrostatic printer/plotter	3,300	31
4410-1	Controller for 4411-X (300 cpm) or 4412-X (1000 cpm) card readers	2,200	21
4520	Controller for 4521 (single) or 4522-1 (dual) floppy disks	2,200	21
4701-X	Interval timer 16-bit counter; can be set and interrogated under program control	1,100	10
4801-1	General purpose controller module; includes computer I/O bus interface logic	1,700	—
4805-1	General purpose 16-bit data terminal; interface incudes I/O interrupts, DMP interface Low true TTL interface or electronic switch output	2,500	24
COMMUNICATIONS INTERFACES			
4807-X	Asynchronous terminal controller provides control and multiplexing for 16 asynchronous full duplex non-switched, terminal lines	5,000	38
4810-XX	Asynchronous Communications interface, 75-9600 baud, 20mA current loop	1,800	14
4811-XX	Asynchronous communications interface; two full duplex channels, 75-9600 baud, RS-232-C compatible interface	1,800	14
4812-X	Serial asynchronous interface; remote file hardware; 110-9600 baud current loop interface, one full-duplex channel	2,000	16
4813-X	Same as 4812-X except includes RS-232-C compatible interface	2,000	16
4815	Synchronous communications interface; two full-duplex channels, 110-9600 baud, RS-232-C compatible interface	1,800	14
4820	Modcomp-Modcomp computer link for any combination of Modcomp II, IV or CLASSIC computers	5,100	60
4824-X	High speed serial coax link controller includes I/O bus; DMP interface utilizes one controller location	2,500	40
4826-1	Remote file option and cable compatible with IB/35-B and CLASSIC	280	5
4826-2	Remote file option and cable compatible with II/25, II/26, II/45 and II/2XX	450	5
1905	Controller for asynchronous communications multiplexor; controls up to 4 multiplexers	1,550	12
1912-XX	Asynchronous communications channels; two full-duplex lines, RS-232-C compatible interface	650	6
1914-XX	Asynchronous communications channel; two full-duplex lines, isolated solid state interface, 20mA current loop Universal communications controller Model 2 computer I/O interface, buffering and control for universal line interface modules, block data transfer supported on communication processors only; uses two standard controller locations	650	6
1907-A-2	32-Line Controller	4,600	58
1907-A-3	64-Line Controller	6,400	58
1907-A-4	128-Line Controller	10,300	82
1907-A-5	192-Line Controller	*	82
1907-A-6	256-Line Controller	*	82
1930-1X	Single-port chassis for 193X line units; requires 1907-A-X	3,870	35
1930-2X	Dual-port chassis for 193X line units; requires 1907-A-X	4,750	41
1931	Asynchronous line interface module; two full-duplex RS-232 compatible modem interfaces, 15 program selectable baud rates	550	10
1932	Asynchronous line interface module; two full-duplex current loop line interfaces	550	10
1933	Same as 1932 except with 12V power supply	550	10
1934-1	Byte synchronous line interface module; two full-duplex RS-232-C modem interfaces; program-selectable sync character	610	10
1934-2	Byte synchronous line interface module; two full-duplex WE 301/303 compatible wideband modem interfaces; program-selectable sync character	720	10
1934-3	Byte synchronous line interface module; two full-duplex CCITT V.35 compatible interfaces (40K bps); program-selectable sync character	640	10

Modcomp Systems II and IV

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
1939-1	Bit synchronous line interface module; two full-duplex RS-232-C compatible with interface for SDLC, HDLC or ADCCP frame formats	880	13
1939-2	Bit synchronous line interface module; two full-duplex WE 301/303 compatible interfaces for SDLC, HDLC or ADCCP frame formats	970	13
1939-3	Bit synchronous line interface module; two full-duplex CCITT V.35 compatible interfaces for SDLC, HDLC or ADCCP frame formats	910	13
CABINETS			
0001	Standard 19 inch cabinet including counter weight, and 2 circuit breakers—AC power distribution	1,325	0
0005	Cabinet prepared for mounting one tape unit; includes two counterweights, brackets and special hardware plus an AC distribution panel	1,550	0
0009	Lifting Eye Kit; eyebolts and mounting hardware for standard 19 inch cabinet	72	0

*Requires home office quote; configuration dependent

SOFTWARE PRICES

		Purchase Price**
MC II/IV/CLASSIC SOFTWARE—OBJECT		
	MAX II/III Operating System/Support	800-2500
	MAX II Operating System-Memory Resident	600
	MAX IV Operating System/Support	900-2600
	MC II/IV CLASSIC Diagnostics/Utilities	400-1325
MC II/IV CLASSIC SOFTWARE—SOURCE		
	MAX II/III Operating System	600-2300
	MAX II/III Support	600-2300
	MAX II/III Operating System/Support	1000-3000
	MAX IV Operating System	700-2400
	MAX IV Support	700-2400
	MAX IV Operating System/Support	1100-4000
	MC II/IV CLASSIC Diagnostics	500-2200
	MC II/IV CLASSIC Utilities	200-1900
	MC II/IV CLASSIC Diagnostics/Utilities	600-2300
MC II/IV/CLASSIC SOFTWARE—OBJECT		
	IBM 2780/3780 Terminal Emulator	250-1950
	CDC 200 User Terminal Emulator	250-1950
	Sort/Merge Package	250-1950
	X-Y Plotter Package	250-1950
	IBM 3271 Emulator	250-1950
	MODACS III Software	250-1950
	MODACS III Remote DAX Package	250-1950
	MAXNET III	1400-3100
	MAXNET IV	1500-3200
MC II/IV/CLASSIC SOFTWARE—SOURCE		
	MAX II/III Symbiont Skeleton	100-1950
	IBM 2780/3780 Terminal Emulator	100-1950
	CDC 200 User Terminal Emulator	100-1950
	Sort/Merge Package	100-1950
	X-Y Plotter Package	100-1950
	DAX Dummy Task	100-1950
	IBM 3271 Emulator	100-1950
	MODACS III Software Subsystem	150-1950
	MODACS III Remote DAX Package	250-1950
	MAXNET III	1000-2700
	MAXNET IV	1100-2800
	MAXCOM	500-2200
8801	COBOL	7,500
8802	TOTAL-Single task	10,000
8803	TOTAL-Multi Task	10,000
8804	VERSAPLOT	1,500
8805-2	INFINITY	10,000
8806-X	TSX	5,000
8807-X	CORAL 66	6,000

**Price ranges reflect different recording media