IBM System/7

MANAGEMENT SUMMARY

The IBM System 7, introduced in October 1970, is a 16-bit minicomputer that was not intended for use in the ways most users think of a minicomputer system. It was announced as a 16-bit *sensor-based* system, and has been used more as a "smart controller" or front-end subsystem since that time. This could be deemed unfortunate, because the 5010 processor, the heart of the System/7, is a very capable processor with fast 400-nanosecond semiconductor memory and a good, substantial interrupt and I/O structure. The instruction set is adequate for most purposes, although users would greatly appreciate the addition of multiply, divide, and compare instructions.

The name "sensor-based" has interesting origins, beginning in 1961 with the introduction of the IBM 1710, a repackaged IBM 1620 system with an industrial housing and sensor I/O capability for process control applications. Most of the approximately 100 1710's (and its limited-availability 1720 upgrade) were placed in refineries and other control environments, at typical system rentals from about $4,000 to $10,000 per month. The 1700's never really became popular, however, and with release of the IBM 1800 late in 1964, IBM addressed a somewhat larger "data acquisition" marketplace with considerably greater success.

The 1800 featured an elegant interrupt structure and a powerful I/O interface capable of handling an extensive complement of analog and digital devices arrayed in major configurations. (The IBM 1130 (Report M11-491-701), released the following year, is an 1800 without the elegant interrupts and minus a couple of compare instructions.)

Despite continuing early concern among IBM's small and medium-scale systems marketing managers that the 1800 might turn out to be too strong in relation to other available IBM computers, the 1800 gradually grew to have a full range of peripherals and a strong complement of ➢

IBM's 16-bit minicomputer is gradually attaining the status of a full-fledged general-purpose computing system. Initially limited to sensor-based functions, the System/7 can now be equipped with a card reader, line printer, and high-performance 3340 disk drives. Users praise the system's reliability but criticize its limited instruction repertoire and software facilities.

CHARACTERISTICS

MANUFACTURER: IBM Corporation, General Systems Division, 875 Johnson Ferry Road N.E., Atlanta, Georgia 30342.

MODELS: System/7, Models A, B, and E.

DATA FORMATS

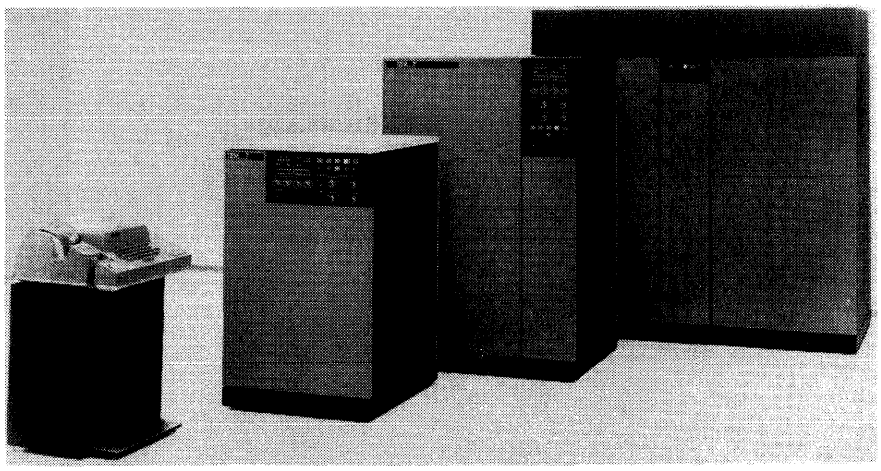
BASIC UNIT: 16-bit word (two bytes) plus two parity bits per word (one per byte).

FIXED-POINT OPERANDS: 16-bit words are used in both single- and double-operand instructions.

FLOATING-POINT OPERANDS: None in hardware.

INSTRUCTIONS: Single-word and double-word. The single-word instruction format consists of a five-bit operation code that specifies the instruction to be performed; a three-bit register field that indicates whether the accumulator, instruction address register, or one of the index registers is to be used; and an eight-bit displacement field that can contain data to be used for generating an effective address, data to be manipulated by the instruction, or data that modifies the operation code. Each memory reference instruction operates on a base-register-displacement principle for storage references, and combines the displacement value with the contents of a register to develop an effective address. The displacement can be either positive or negative with respect to the current contents of the designated register. Since the register, to which the displacement field is added, is 16 bits long, the full 65K-addressing can be performed.

The first word of a long (double-word) instruction is identical to that of the single-word instruction; the second ➢



Components of the IBM System/7 sensor-based real-time computing system appear in this IBM publicity photo. Three models of the 5010 processor are shown, along with a 5028 operator console at left. The first system is housed in a 5026 Model A2 enclosure which can accommodate the CPU, memory, and one I/O module; the A2 cabinet is the smallest available in the System/7 line, but it can accommodate the full 64K maximum memory. Next in line is an S/7 in a 5026 Model C3 enclosure, housing a 5010 CPU, memory, and two I/O modules. The third cabinet is a 5026 Model D6 expansion enclosure with the 4621 Internal Air Isolation unit mounted on top; the model D6 cabinet can house up to six I/O modules.

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system software, including the TSX supervisor and the MPX Multiprogramming Executive. MPX remains one of the finest pieces of control software available from any source, and still contributes to the viability of the 1800 more than a decade after the system's initial release.

Six years later, the System/7 was announced. In keeping with IBM's process control "tradition," it was a 16-bit, word-oriented machine, originally announced without a peripheral complement. Only analog and specialized digital interfaces were intially offered for the system, with the exception of a teletypewriter console with an integral paper tape reader and punch.

In the original configurations, the System/7 offered no real threat to other IBM product lines. But when the 5022 disk drives were added to the system, fears (or hopes) began to mount that the line was going to have its own show. Those fears or hopes were raised further when IBM later announced the 5024 line printer/card reader attachment and also made other disks and magnetic tape capabilities available on an RPQ (special non-standard order) basis.

Another significant enhancement of the System/7 came at the end of July 1973, when IBM announced a new processor model with a memory expansion from 16K to 65K words, seven new instructions (three for the newly available storage protection capability), optional binary synchronous communications, native System/7 FORTRAN IV and other program development support (AML/7), and new analog sensing subsystems for up to 384 sensors (triple the number previously available).

The System/7 still does not have the complement of peripherals worthy of being called a "full line," but the movement in this direction has been clearly established. More recently, a peripheral control unit (feature 4115) linking the System/7 to IBM System/3 computers was announced. In addition, enhancements to the S/7 System Control Program which take advantage of the new capabilities will be released during the third quarter of 1975, along with modifications to FORTRAN IV, the Application Program Generator/7 (APG/7), and the Transfer Generator System/7 (TGS/7), which also support the System/3 connection.

Another significant step in System/7 independence was marked when IBM introduced a stand-alone version of the S/7 System Control Program, MSP/7, with foreground/background capabilities. The enhanced version will support 16-way partitioning including one background partition. Along with the enhanced control program, stand-alone versions of FORTRAN, APG/7, TGS/7, and access for 360/370 systems through BTAM and QTAM were announced.

Probably the most significant enhancement of the System/7 was IBM's June 1975 announcement of the availability of the high-performance 3340 disk drives, which should firmly establish the system as a versatile,

word contains the address of a memory reference or an I/O module and/or device address plus modifiers for I/O instructions.

INTERNAL CODE: EBCDIC.

MAIN STORAGE

STORAGE TYPE: Bipolar semiconductor memory.

CYCLE TIME: 400 nanoseconds.

CAPACITY: 2K-16K words in 2K increments for basic 5010 Models A and B. The 5010 Model E can have 16K-65K words in 4K increments.

CHECKING: On all models, odd parity for each eight-bit byte is generated on memory writes and checked on memory reads.

STORAGE PROTECTION: None on Models A and B; Standard write protection of 512-word blocks on Model E; input from cycle-stealing devices is not hardware-protected.

RESERVED STORAGE: The first 19 locations in memory are reserved for the IPL (initial program load, i.e., bootstrap) program. Two to 68 locations, depending on the number of interrupt priority levels and sublevels used, should be reserved for interrupt table pointers and service routine vectors.

CENTRAL PROCESSORS

GENERAL: The 5010 processor is available in three models, each of which offers a different set of communications configuration alternatives. The basic Model A is intended for stand-alone system operation, and can contain an optional Asynchronous Communication Control for communication to an IBM 1800, System/360 Model 25 or larger, or System/370. Model B is communications-oriented, and houses a standard IBM 1130 interface that allows direct connection of the System/7 to the 1130 Storage Access Channel for storage-to-storage data transfer. Except for the attachability of different host processors (and the corresponding host processor interface considerations) the two System/7 processors (Models A and B) are identical to one another, and both provide two program-controlled 50-microsecond hardware timers (16-bit binary counters) for program interrupts etc.; I/O operation completion codes; a thermal warning device with automatic shutdown; optional Internal Air Isolation for industrial environments; standard 5028 operator station attachment; power failure detection/automatic restart; and dynamic condition codes to simplify logical operations.

Model E provides all the functions of the Model A plus a larger instruction repertoire, storage protection, and an interface for a read-only cassette tape recorder. The latter is used for IPL or field engineering purposes. Recent improvements have also added interface capabilities to all models of IBM's System/3 computers.

The application of IBM's small-scale computer "processor state" philosophy has been carried into the System/7 with the availability of four complete sets of dedicated registers, one for each of four interrupt levels. With this architecture, the System/7 can rapidly switch between multiple programs sharing a common memory.

REGISTERS: Four identical sets, each of which includes seven 16-bit index registers, one 16-bit accumulator, one 16-bit instruction address register, and six arithmetic/logical indicators (one bit each).

The six arithmetic/logical indicators show positive, negative, zero, or even (equal) status on memory reference or arithmetic operations, as well as overflow and carry flag for arithmetic operations. Register-to-register operations occur in 400 nanoseconds, while direct storage accesses to any memory location can be made from each interrupt level with no delay for indexing. Register-to-storage operations require 800 nanoseconds.

INDIRECT ADDRESSING: None.

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full-barreled minicomputer system, not just an also-ran. The 3340 disk drives use the sealed 3348 "Winchester" modules which provide 17.5 million or 34.9 million words of storage, depending on the module used. As a direct replacement for the smaller and slower 5022 disk drives, each module can store a maximum of 29.4 million words, the equivalent of 12 5022's. IBM also announced NDAM-7 (Native Direct Access Method-7), which permits using the full 34.9-million-word capabilities. But it appears that IBM still is not ready to let the System/7 "fly solo" with its impressive new-found mass storage capability, since no new applications programs supporting the 3340 disks accompanied the June 1975 announcement.

In keeping with its "sensor-based system" image (a carefully chosen generic term that doesn't constrain the System/7 to its earlier process control or data acquistion roles), the System/7 has been sold and supported primarily for event-driven, real-time applications where external stimuli initiate computation processes and logical responses. System/7 installations for other than sensor-based applications have been largely confined to "unconventional" situations where the System/7 cannot be construed as limiting the marketability of a larger IBM system, such as where the customer either insists upon the System/7 by name or upon a minicomputer in general.

Typically, 8K to 16K-word systems range in price from about $1,500 to as much as $5,000 per month, and from about $55,000 to $150,000 purchase. The System/7 is well suited for a great variety of sensor-based applications (shop automation, laboratory monitoring/analysis, etc.), either as a stand-alone computing system or as a satellite processor linked to remote IBM "host" processors. At the time of its introduction, the System/7 with its bipolar semiconductor memory was one of the fastest control systems available, and it possessed the undeniable advantage (in addition to the IBM nameplate) of having standard interfaces to other IBM systems, including the 1130, 1800, System/370, and System 360 Model 25 and larger. Data compatibility with the System/3 was announced about a year later, and recently, an interface unit was announced for linking the System/3 and System/7.

The System/7 currently finds itself in competition with other popular 16-bit minicomputers such as DEC's PDP-11 family, General Automation's SPC Series, Data General's Nova Series, Hewlett-Packard's 21MX Series, etc. Against this broad-based competition, the System/7 is frequently chosen for data communications duties (line concentration, polling, auto-calling) and data entry functions (order entry, badge input, local point-of-sale network support), in addition to traditional monitoring and control applications (hospital patient analysis, apartment house security control, chemical process control, etc.).

Many users seem to feel that the System/7's relatively high price is justified by the huge IBM service and support organization that stands behind it. Other significant

INDEXING: Displacement values can be indexed by each of the seven index registers for a specific interrupt level, and by the contents of the instruction address register (program-relative).

INSTRUCTION REPERTOIRE: 40 standard instructions on Models A and B, all but four of which are short format (16-bit), with four long format instructions (32-bits). These include six Load and Store instructions (one long), six arithmetic instructions, six logical instructions, four shift instructions, four branch instructions (two long), eight register-to-register instructions, three state control, one I/O instruction (long format), and a supervisor call instruction. Model E has seven additional instructions: read/write instruction address register backup, store indicators, branch and unmask long, and three storage protection instructions.

INSTRUCTION TIMES: Times are given in *microseconds* for full-word operands.

Load/Store	0.8
Add/Subtract	0.8
Multiply	*
Divide	*
Compare and Branch	0.8

***Operation performed by subroutine; timing not available.**

INTERRUPTS: Four priority interrupt levels are standard, with 16 sub-levels each, permitting up to 64 independent interrupt servicing routines to be specified. In addition to the external interrupts, three internal interrupts are also provided; program check, power failure/overheat, and machine check. The 5010 processor can switch between interrupt levels, including complete register change, in 800 nanoseconds.

PHYSICAL SPECIFICATIONS: The 5026 Model A2 enclosure is 46 inches high, 31½ inches deep, and 27 inches wide, weighing 225 pounds. The 5026 Model C3 and D3 enclosures are 60 inches high, 31½ inches deep, and 38 inches wide, weighing 565 pounds. The 5026 Model C6 and D6 enclosures are 60 inches high, 31½ inches deep, and 67¼ inches wide, weighing 855 pounds.

Power requirements for the System/7 are 208 VAC, single-phase, at 10.1 KVA for a fully populated system including a 5010 processor, 11 I/O modules, and a 5028 operator station.

Operating environment for the System/7 is 40 to 122 degrees Fahrenheit and 8 to 85 percent noncondensing relative humidity. The 5028 operator station can operate in environments of 40 to 110 degrees Fahrenheit and 8 to 95 percent noncondensing relative humidity.

INPUT/OUTPUT CONTROL

I/O CHANNELS: A basic direct control channel is standard on the System/7 to transfer 16-bit words of data between I/O devices or modules and the processor by means of separate I/O instructions via a direct program control (DPC) mode of operation, at an aggregate data transfer rate of about 2 million words per second. An optional cycle stealing (CS) feature can be attached to the direct control channel that permits disk storage direct memory access (DMA) operations, for 1130 or System/3 host processor applications (1130 DMA or System/3 interface on System/7 is under host processor control). In DPC mode, the direct control channel can transfer data at a rate of 500K words/second.

SIMULTANEOUS OPERATIONS: In the basic DPC mode, no processing can take place while data channel operations are in progress. (DPC disk operation imposes a processor loading factor of 33%.) With the optional CS feature, cycle stealing can occur during data transfer operations. (Disk operation imposes a processor loading factor of four percent under cycle stealing.)

CONFIGURATION RULES: Any model of the System/7 processor can have from 1 to 11 sensor-based I/O modules consisting of the 5012 Multifunction Module, 5013 Digital I/O Module, 5014 Analog Input Module, 5022 Disk Storage Module, or any of a variety of "semi-standard" or non-standard System/7 I/O RPQ's (special modifications). In order to accommodate the processor plus an operator

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reasons for choosing the System/7 are its comparatively high speed and the fact that it can be rented on a short-term lease, whereas most of the competitive minicomputers are offered only on a purchase or long-term lease basis.

USER REACTION

This section reports the experience of 36 System/7 users with a total of 56 systems. These user reactions were gleaned from two different sources. First, we conducted telephone interviews with 5 users who had a total of 10 System/7's installed. Second, the early returns to our 1975 mail survey of computer users included responses from 31 System/7 users who collectively accounted for 46 systems.

The 56 systems had been in use for periods ranging from one month to three years, and the average was about 20 months. All were being rented from IBM. Usage was divided about equally between data communications systems and real-time control systems, while three of the System/7's were being used for business data processing. Main storage capacities ranged from 6K to 64K words, and the average was between 16K and 20K. Among the 46 systems represented in our mail survey, 24 included interactive or batch terminals, and the number of terminals per system ranged from 1 to 57.

The combined ratings assigned by these 36 users are tabulated below. It should be noted that the responses for several of the rating categories do not total 36 because not all of the users answered every question.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	7	18	10	1	2.9
Reliability of mainframe	18	14	4	0	3.4
Reliability of peripherals	6	21	3	2	3.0
Responsiveness of maintenance service	11	17	5	2	3.1
Effectiveness of maintenance service	10	17	6	3	2.9
Technical support	3	19	7	7	2.5
Operating systems	2	7	9	4	2.3
Compilers and assemblers	0	13	10	6	2.2
Applications programs	1	7	6	4	2.3
Ease of programming	1	9	8	10	2.0
Ease of conversion	1	7	7	5	2.2
Overall satisfaction	7	17	10	0	2.9

*Weighted Average on a scale of 4.0 for Excellent.

Thus, the users were generally well satisfied with the System/7's reliability and IBM's maintenance service, but they clearly felt that the programming and software aspects of the system left much to be desired.

The five users interviewed by Datapro included a pharmaceutical company, two manufacturers of industrial control components, a small city newspaper, and a major transportation and freight handling company—all of which point up the diversity of applications in which the System/7 can be employed. Most of their systems were

console and provide housing for the I/O Module(s), one or more 5026 Enclosures must be used. The 5026 Model A2 houses the processor and one I/O module; Model C3 houses the processor and up to two I/O Modules and has an optional I/O Module expander attachment; Model C6 houses the processor and up to five I/O Modules plus an optional I/O Module expander attachment; Models D3 and D6 Expanders provide space for three and six additional I/O Modules, respectively, at locations up to 200 feet from the Model C to which they are attached. All Model A configurations are also supported by Model E. An interface connection to the IBM System/3 is with Model E.

MASS STORAGE

5022 DISK STORAGE MODULE: Models 1 and 2 each contain two disks, one above the other, for a maximum data storage capacity of 2,457,600 words (approximately 4.9M bytes). The upper disk is removable and contained in a separate cartridge for off-line storage; the lower disk is non-removable. Models 3 and 4 each contain one non-removable disk for a maximum data storage capacity of 1,228,800 words (approximately 2.4M bytes). Models 1 and 3 have an average head movement time of 269 milliseconds, while Models 2 and 4 have an average head movement time of 126 milliseconds. Average rotational delay for all models is 20 milliseconds. Data is stored in 200 tracks on each side of the disk; each track is organized into 24 sectors containing 128 words each. Maximum data transfer rate over the direct control channel for both models is 99,500 words/second. With cycle stealing, up to 3,072 words can be transferred by a single I/O command. The 5022 attaches to the processor via an I/O Module.

3340 MODULE DISK SYSTEM: Each 3340 "Winchester" drive accommodates one 3348 Data Module, either Model 35, Model 70, or Model 70F, at a time. The data module is a self-contained unit that includes not only the magnetic disks, but also the associated access arms and read/write heads. Since the same heads always serve the same tracks, head alignment problems should be reduced and data reliability enhanced. Each data module is a sealed unit 8 inches high, 16 inches wide, 18 inches long, and 16 pounds (Model 35) or 18 pounds (Model 70) in weight. Loading of the data module is an automatic process; the operator simply places the data module on a drive, closes the drive cover, and turns on a switch. Processing can begin in less than 20 seconds.

The 3348 Model 35 Data Module has 348 cylinders and a total storage capacity of 34.9 million bytes. Model 70 has 696 cylinders and a total storage capacity of 69.8 million bytes. Both models have 12 tracks per cylinder and can store up to 8368 bytes in each track. Both models exhibit the same performance: average head movement time is 25 milliseconds, average rotational delay is 10.1 milliseconds, and data transfer rate is 885,000 bytes/second.

The 3348 Model 70F Data Module provides 502,080 bytes of fixed-head disk storage and 69.3 million bytes of storage accessed by moveable heads. The Model 70F data module can be used on a 3340 Model A2 or Model B2 disk drive that is equipped with the 4301 fixed head feature, and can be intermixed and interchanged on a 3340 Model A2 or B2 with other 3348 data modules. The first five logical cylinders on the Model 70F are accessed by a fixed read/write arm, while the remaining cylinders are serviced by moving read/write heads. The performance characteristics of the 3348 Model 70 and Model 70F data modules are compared below:

	3348 Model 70	3348 Model 70F	
	Cylinders 0-695	Cylinders 1-5	Cylinders 0 & 6-695
Average seek time (ms)	25	0	25
Average rotational delay (ms)	10.1	10.1	10.1
Data rate (K bytes/sec)	885	885	885
Bytes per track	8,368	8,368	8,368
Data cylinders	696	5	691
Tracks per cylinder	12	12	12
Capacity (bytes)	69,889,536	502,080	69,387,456

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small configurations, the smallest using 6K words of memory. Only the transportation company varied from the pattern, with five systems, three with 22K-word memories and two with 32K-word memories. Two systems were employed in scientific calculations: laboratory analysis and hydraulic machine testing. Six were being used as data collection systems, one connected to IBM 2790 series data collection terminals and another three in a data communications network with a mixture of IBM and non-IBM CRT terminals.

The newspaper was using two independent S/7's to perform editing and formatting of news articles, classified advertisements, and other items to be published in the daily editions. When in its final form, this material is either recorded on paper tape for mechanical typesetting or transmitted directly to a phototypesetting system. Datapro learned that IBM has been very successful in applying the System/7 to this market.

The five users we interviewed had generally good comments about their S/7's, with a few reservations and qualifications. With respect to mainframe reliability and the responsiveness and effectiveness of IBM's maintenance service (when required), nearly all of these users had the highest regard for the System/7.

Negative, or less-than-enthusiastic, comments came in response to peripheral reliability (although still generally good) and ease of programming. The peripheral reliability comments were passed on by three of the five users and were directed not so much at the disk drives but at IBM's A/D, D/A, and specialized digital interfaces that are used in the 5012, 5013, and 5014 I/O modules. All three expressed dismay about their early encounters with these units, due largely to misunderstandings on both their and IBM's part. The users felt that these interfaces could be more reliable, but said the problems did not seriously affect their overall evaluation of the System/7.

The other area that evoked user complaints was the System/7 instruction set. Nearly all those interviewed wished for a more useful instruction set that included multiply/divide and compare instructions—especially those utilizing the S/7 in its originally specified environment of sensor-monitored process control. These instructions would be especially useful in digital filtering and scaling and in set-point comparisons, both heavily used in these applications.

Users also complained about the limited complement of peripherals available for the System/7, but this problem has already been alleviated by the IBM announcements of a line printer and card reader for the system in January 1975 and addition of the 3340-type disk drives in June 1975.□

At present, no System/7 applications programs supporting the 3340-type disks are available from IBM.

INPUT/OUTPUT UNITS

Note that no individual I/O units other than the operator console, operator station, line printer and/or card reader are provided as standard items; but a great variety of non-standard System/7 interfaces to other peripherals are available as RPQ's from IBM on special order. These RPQ items, in fact, comprehensively extend the System/7's applicability to far more than sensor-based activities.

5024 I/O ATTACHMENT ENCLOSURE: This enclosure provides space, power, and logic to attach a printer, a card reader, or both to the System/7. This unit attaches to any 5010 Model E through the 5024 Attachment Feature. The card reader is rated at 300 cards per minute and the line printer at 155 lines per minute. Only one 5024 can be included in a System/7, and the unit cannot be employed in systems with IBM 5500 or 5501 1200-bps integrated modems.

5012 MULTIFUNCTION MODULE: Provides a general-purpose device interface for up to 128 digital inputs in groups of sixteen; up to 64 digital outputs in groups of four (maximum 20,000 points per second); up to two analog outputs; one 2790 Control (maximum about 110 words per second); and up to 32 process interrupts in two groups of sixteen each. The 2790 control will handle up to 16 2791/2793 area stations with a 1053 printer and up to 16 2795/2796/2797 Data Entry Units (DEU) per 2791. Each 2791 can also attach up to three 1035 Badge Readers. As many 5012 Modules can be attached to the System/7 as Module interfaces are available (11), but an overall limit of four 2790 Data Communications Subsystems can be attached to a System/7.

5013 DIGITAL I/O MODULE: Provides a digital device interface for up to 128 digital inputs in groups of sixteen; up to 64 digital outputs in groups of sixteen; one 2790 control (see 5012 Module above); and up to 32 process interrupts in two groups of sixteen each.

5014 ANALOG INPUT MODULE: Houses the analog input adapter, A/D Converter, Multiplexer, amplifier, and associated circuitry to provide a maximum of 128 two-wire inputs in groups of sixteen. Models B or D can be enhanced with two Model E's (128 points each) to handle a total of 384 analog input points. ADC resolution is 14 bits plus sign with overload bit on extended resolution, or 12 bits plus sign with three-bit overload and range indication on automatic operation. External synchronization is standard. The Model B has a scan speed of 200 points/second, a repetitive read speed of 4 to 15 samples/second, a maximum common mode voltage of 250 volts, and uses a mercury-wetted differential multiplexer. The Model C has scan speeds of 7,000-20,000 points/second, a repetitive read speed of 100 samples/second, a maximum common mode voltage of 10 volts, and uses a solid-state differential multiplexer. Model D has a scan rate of 100 analog input points per second and uses dry contact relays. One or two Model E1 (100 points/second) or E2 (200 points/second) modules can be added to Models B or D to share the A/D converter (ADC) and amplifier.

5028 OPERATOR STATION: This modified 10 cps Teletype Model 33 KSR is attached to the processor module. It includes a keyboard with keyboard request key, printer, and paper tape reader/punch. The paper tape reader is used as the initial program load station for stand-alone System/7 operation.

COMMUNICATIONS CONTROL

1610 ASYNCHRONOUS COMMUNICATIONS CONTROL ADAPTER: The optional ACCA allows the 5010 Model A only to communicate under DOS BTAM/QTAM or OS BTAM/QTAM/TCAM in start/stop mode through a line adapter with the IBM 1800 (1800 distributed system program under MPX running on a 24K-word system), System/360 Model 35 or larger, or S/370. (The System/7 looks like a 2740 Model 1 Communications Terminal.) Serial data rates for multidrop operation of 134.5 or 600 bits/second (14.8 or 66.7 characters/second) over switched or leased lines are supported. The ACCA permits remote

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IPL, and operates in half-duplex mode only using PTTC/EBCD code.

IBM 1130 DISTRIBUTED SYSTEM ADAPTER: Allows the 5010 Model B only, with a minimum of 4K words, to communicate through a Storage Access Channel with an 1130 Disk Monitor System (V2) operating under 1130 DSP in a minimum of 8K words. Remote IPL and FORTRAN programs are supported by the 1130 DSP.

2074 BINARY SYNCHRONOUS COMMUNICATIONS CONTROL: The BSCA is available for Models A and E to provide an interface for one bisynchronous communications adapter to facilitate communications with a System/370 via a 2701, 2703, 3704, or 3705 communications controller; or to an Integrated Communications Adapter on IBM/370 Models 115, 125, and 135; or with another System/7 (via another BSCA); or with a System/3 Model 6, 10 or 15 with BSCA. Half- or full-duplex EBCDIC or ASCII transmission is supported. Remote IPL is possible through the BSCA. A medium-speed (1200-7200 bps) and a high-speed (10K-50K bps) interface are available to attach external modems; the IBM 1200 bps integrated modem is available as an option.

The BSCA can be attached to a 6K Model A or larger or a 16K Model E or larger, and cannot be used in conjunction with the 1610 ACCA. By treating the System/7 (with BSCA) as a System/3, CICS and IMS/VS support of the System/7 as a BSC terminal is provided.

SOFTWARE

OPERATING SYSTEMS: System control programming is available through System/7 Modular Systems Programs. MSP/7 features 16-way partitioning, including one background partition, and includes a Disk Support System (DSS/7). DSS/7 resides on a 5022 Disk Storage Module and runs on a 16K-word or larger System/7 to permit loading and execution of disk-resident programs, including IBM-supplied utilities for disk initialization, automatic restart, data set definition/deletion (System/3-compatible Volume Table of Contents, VTOC), paper tape program load utility, and disk dump/copy/patch routines. SFS (Symbolic File Support) provides for association of symbolic file names to disk data sets or members at IPL time.

Originally, program preparation under MSP/7 was done exclusively in conjunction with IBM 1130, 1800, 360, or 370 systems through the Host Program Preparation Facility (HPPF), but recent enhancements to MSP/7 permit stand-alone operation. Minimum system requirements for MSP/7, with its associated program preparation facilities including ASM/7, AML/7, LINK/7, FORMAT/7, and PREP/7, are 12K words of memory, one 5022 Model 1 or 2 disk, and one operator station. Support is also included for a card reader and line printer.

Off-line HPPF program transfer is normally handled via punched paper tape. For System/7 users who do not have access to a suitable host computer, programming is accomplished through the System/7 Assembler, a no-charge, stand-alone system control program.

For users with host processors available to share the System/7 processing workload, Distributed System Program (DSP) support is available to support multisystem operation. An IBM 1130 (8K words) or System/3 can be interfaced via a storage channel for direct access, and a System/370 (60KB) or an 1800 (about 13K words) can be coupled with the System/7 through data communications links.

Other System/7 host processor (System/370 OS/VS and DOS/VS) System Control Programming support includes a relocatable macro assembler library (MACLIB/R), macro assembler (ASM/7), linkage editor (LINK/7), storage load formatting program (FORMAT/7), source preparation program (PREP/7), and Host FORTRAN IV compiler and library (40KB compiler, 95KB library, and about 6K words of resident main memory requirements on System/7). ASM/7, AML/7, LINK/7, and a FORTRAN IV compiler are also available for direct System 7 use.

It should be noted that numerous programming RPQ's are available from IBM; check with IBM for details.

LANGUAGES: The System/7 *Assembler Language* is a symbolic programming language that provides the programmer with a means of writing machine instructions, designating registers, and specifying format and addresses of storage areas, data, and constants.

The Assembler is a paper-tape-oriented, one-pass, one-for-one assembler that translates source programs written in the language into machine-loadable object programs on paper tape. Included with the assembler are four utility programs to assist the user in program maintenance and debugging on the System/7. These programs include a storage dump, storage patch, IPL loader, and storage initialization.

Minimum system configuration includes a System/7 with 4K words of memory and an operator station.

ASM/7, a macro assembler, translates symbolic instructions into machine language instructions, assigns storage locations, and performs auxiliary functions necessary to produce executable machine language programs. It is language-compatible with the stand-alone ASM/7. Features of the system include: generation of object modules suitable for input to the storage load formatting utility of the Linkage Editor, allowance for user macros, conditional assembly instructions, and support of new instructions for the System/7 Model E processor.

Minimum host system requirements for ASM/7 execution on a System/370 operating under DOS/VS are 14K bytes, 3 disk storage extents as work files, and 3 tape units. Minimum requirements under OS/VS include 44K bytes and disk space for system data sets.

The standard *FORTRAN IV* for the System/360 can be used on the System/7. For stand-alone operation, FORTRAN IV on the System/7 requires 24K bytes to compile and 12K bytes to execute. The minimum requirements for S/360 or S/370 FORTRAN systems must be met when preparing programs on host facilities.

APG/7 (Application Program Generator) provides high-level program support for many different sensor-based applications in the areas of plant automation, process control, and data acquisition. The program permits several different user programs to be executed concurrently. It will also allow random events to be handled in a prioritized sequence and several similar tasks to be run concurrently by one program. APG/7 reduces the programming effort required to install and maintain such applications. The system is made up of three major components: "fill-in-the-blanks" facilities, a high-level language compiler, and a series of System/7 subroutines.

The APG/7 compiler provides the user with a means for specifying operations that are more conveniently handled by language statements rather than by specification of tables for library subroutines. The language contains a compatible subset of PL/1. Special-purpose statements are provided to give ready access to sensor-based functions.

Minimum required configuration for APG/7 is a System/7 with 16K words of storage, an operator station, and one disk storage module.

UTILITIES: *Application Module Library (AML/7)* is a utility designed to improve System/7 installation productivity and acceptance; improve application development productivity; ease modification, extension, and transferability of applications using the high-level language characteristics of AML/7; and interface with other high-level System/7 languages such as APG/7, FORTRAN/7, and System/370 DPS. As a programming tool, it contains applications-oriented modules that simplify program orientation and coding of frequently used applications.

The AML/7 Scanning and Processing Monitor supplies a predesigned structure for organizing an application program. It also includes versatile processing facilities to handle common requirements of event-driven applications.

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Facilities include scheduling and processing of variables, analog and digital scan, engineering units conversion, measurement and linearization of transducer signals, and a user interface to the applications program.

Another feature of AML/7 is the group of four functional program modules which can be used independently of the Monitor to supply data access routines for convenient access and modification of data associated with input variables and their processing, arithmetic and data conversion facilities for easy data manipulation, simplified I/O via message formatting and I/O buffer routines, and pulse counting and pulse output.

To implement these functions, the programmer selects the appropriate macros from AML/7, defining them for each specific function by specifying the necessary parameters in a macro instruction. These macros, together with selected MSP/7 macros, are integrated with user-written programs to produce the complete application program.

The programs that constitute AML/7 are written using MSP/7 system macros and ASM/7 Assembler Language instructions. Programs using AML/7 were originally prepared on a System/360 or 370 Host Program Preparation Facility (HPPF-II) operating under OS (VS1 or VS2) or DOS (VS) or on a System/7 Program Preparation FAcility under DSS67. Under the stand-alone version of MSP/7, AML/7 can be used in System/7 configurations.

Disk Support System (DSS/7) is one of the System/7 Program Preparation facilities. The 8-12K-word version provides several extensions to the 4K DSS/7, including device independence, allowing the user to alter device assignments at execution time. In an 8K System/7, the user can execute service programs and user-written programs, which do not require device support beyond the 5022, 129, 7431, or 5028. In the 12K environment, the user can employ the stand-alone System/7 program preparation capability.

DSS/7 (8-12K) utilizes an enhanced command language which permits: loading and execution of the System/7 Program Preparation Facilities, loading and execution of user programs (non-real-time), loading and execution of a complete storage load (real-time), loading and execution of disk-resident service programs, accessing and execution of predefined catalog procedures, association of symbolic file names with physical devices, passing of parameter information, and selection of alternate command language input streams.

MSP/7 Service Programs, which support DSS/7 utilities, include: Device Independent Copy; Disk to Print; Disk Delete; Rename Data Set or Member; Define Data Set or Members; Disk Initialize; Disk Patch; Define Auto Restart; Service Program Monitor; and Load Module Formatting.

The stand-alone program preparation components execute as service programs in the 12K DSS/7 environment.

FORMAT/7 allows the System/7 user to generate loadable System/7 storage loads from ASM/7 output. The output storage load can be directed to disk for transmission via the ACCA connection or to cards for later conversion. For the DOS user with a 1018 paper tape punch, the storage load can go directly to paper tape.

Minimum system requirements for execution on a System/360 or 370 include 14K bytes exclusive of System Control and Basic IOCS under DOS, and 44K bytes exclusive of data mangement and supervisory services under OS. Under the stand-alone MSP/7, FORMAT/7 can be run in a System/7 with a minimum of 12K words of storage and one 5022 Model 1 or 2 disk.

LINK/7, one of the System/7 Program Preparation Facilities, combines separately assembled or compiled object modules into a load module suitable for input to FORMAT/7 and subsequent execution. It also combines previously edited load modules with each other or with object modules. In addition, the Linkage Editor incorporates program segments from a library into load modules, either automatically or upon request, aids in construction of overlay program segments, and aids program modification by replacing program segments.

Minimum host system requirements for execution on a System/370 operating under DOS/VS are 24K bytes plus auxiliary storage for at least 2 intermediate work areas. Under OS/VS, 44K bytes are required in addition to disk space for system input, 1 intermediate data set, printer output, and the output load modules.

PREP/7 prepares source programs written in the syntax of the MSP/7 Host Program Preparation Facility I for input into ASM/7. It accepts source code written for OS/DOS and 1800/1130 Facility I macro assemblers, flags instructions that may need programmer intervention for correct conversion, and punches new source decks.

Minimum host system requirements include 14K bytes exclusive of System Control and Basic IOCS for systems operating under DOS, and 44K bytes exclusive of data management and supervisory services for systems operating under OS.

COMMUNICATIONS SOFTWARE: *Communications Control Applications Program (CCAP/7)* is a store-and-forward message switching program that supports both start/stop and binary synchronous lines. It provides for the switching of administrative messages originating at remote terminal locations and destined for one or more terminal locations in the same network. It performs various checks to ensure against message loss or duplication.

CCAP/7 includes the following functions: time and date stamping, terminal polling and addressing, sequence checking, two levels of priority, system statistics, disable and enable terminals/lines, retrieve old messages, checkpoint and restart, and message broadcasting.

CCAP/7 is written in System/7 Assembler Language with extended mnemonics. Modifications to the system or assembly of CCAP/7 programs requires the Host Program Preparation Facility.

Minimum system configuration required includes 10K words; one disk for intermediate message storage, IPL, and program residence; and one operator station.

In addition to CCAP/7, communications between System/7 minicomputers and System/360 and 370 computers through existing S/7 communication adapters are now supported by the enhanced MSP/7. In remote terminal applications, the new software supports binary synchronous communications through both modems or Integrated Communications Adapters.

APPLICATIONS PROGRAMS: Program products for the System/7 include Automatic Telephone Call Monitoring (8K-word S/7), Energy Management System (44K S/7), Process Control Program (14K S/7), Transaction Generator System for data collection procedures (16K S/7), and Manufacturing Monitoring System (12K S/7). In addition, there are a large number of field-developed and installed-user programs available for the System/7.

PRICING

POLICY: IBM provides the System/7 on a purchase or monthly lease basis. The standard IBM Monthly Availability Charge (MAC) rental contract includes equipment maintenance and entitles the customer to 24-hour, 7-day-a-week maintenance service.

IBM also offers purchase options for the S/7 equipment. With this plan, users can accumulate up to 36 months of purchase option credits toward the purchase of the equipment. The total amount accrued cannot exceed 50 percent of the purchase price of the equipment at the date of purchase. At present, 60 percent of the S/7 rental fees are applicable to purchase options.

SUPPORT: For purchased systems, maintenance is provided on the processor for one year at no additional charge, and on most interfaces for 90 days at no additional charge. Thereafter, on-call maintenance is separately priced.

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For leased systems, on-call maintenance is included in the monthly charge.

Field Engineering rates for purchased System/7 equipment are $35.75 per hour for normal working hours and $46.50 per hour for non-standard working hours. Systems Engineering hourly rates are $28.00 for the Basic skill classification, $35.75 for the General skill classification, $44.75 for the Complex skill classification, and $33.25 for a group workshop.

EQUIPMENT: The following typical systems include all necessary controllers and adapters.

MINIMUM SYSTEM: Consists of a 5010A processor, 2K words, 5501 modem, operator station, and one 5012 multifunction I/O module. Purchase price is $24,530, and monthly rental is $735.

SMALL ACCA SYSTEM (FOR IBM 1130 HOST): Consists of a 5010B processor, 4K words, operator station, and two 5012 multifunction I/O modules with analog I/O. Purchase price is $34,980, and monthly rental is $967.

MEDIUM-SCALE STAND-ALONE SYSTEM: Consists of a 5010A processor, 8K words, operator station, and three 5012 multifunction I/O modules. Purchase price is approximately $42,070, and monthly rental is $1,184.

EQUIPMENT PRICES

		Purchase Price	Monthly Maintenance	Monthly Rental
PROCESSORS AND MAIN STORAGE				
General: Models A and E have asynchronous or binary synchronous communications adapters as options and are stand-alone systems. Model B has an interface for connection to IBM 1130 systems.				
5010	Central Processing Unit:			
	Model A2: 2K words	$ 8,670	$ 50.50	$ 199
	Model A4: 4K words	12,400	62.50	313
	Model A6: 6K words	16,100	74.50	426
	Model A8: 8K words	19,900	86.50	541
	Model A10: 10K words (requires 7401)	23,600	98.50	654
	Model A12: 12K words (requires 7401)	27,400	111.00	767
	Model A14: 14K words (requires 7401)	31,100	123.00	881
	Model A16: 16K words (requires 7401)	34,900	135.00	994
	Model B2: 2K words	12,700	59.50	307
	Model B4: 4K words	16,400	71.50	421
	Model B6: 6K words	20,200	83.00	534
	Model B8: 8K words	23,900	95.00	649
	Model B10: 10K words (requires 7401)	27,700	107.00	762
	Model B12: 12K words (requires 7401)	31,400	120.00	876
	Model B14: 14K words (requires 7401)	35,200	132.00	989
	Model B16: 16K words (requires 7401)	38,900	144.00	1,100
	Model E16: 16K words	35,400	247.00	1,010
	Model E20: 20K words	40,300	281.00	1,155
	Model E24: 24K words	45,100	313.00	1,295
	Model E28: 28K words	49,900	347.00	1,440
	Model E32: 32K words	54,700	379.00	1,590
	Model E36: 36K words	59,500	413.00	1,740
	Model E40: 40K words	64,400	446.00	1,875
	Model E44: 44K words	69,200	478.00	2,025
	Model E48: 48K words	74,000	512.00	2,175
	Model E52: 52K words	78,800	544.00	2,320
	Model E56: 56K words	83,600	578.00	2,470
	Model E60: 60K words	88,500	611.00	2,610
	Model E64: 64K words	93,300	644.00	2,755
PROCESSOR OPTIONS				
5731	Power fail detect	2,040	0.50	54
5028	Operator station	2,280	50.50	150
2798	Guidance Display Unit: 56-character keyboard, 16-position display, 48-instruction operator guidance panel, for interactive transactions	4,400	18.50	96
2662	Basic cycle steal for S/7 CPU's (requires min. Model A4, B4, or E16 CPU)	1,830	3.00	48
2664	Disk cycle steal for 5022 disk drives (requires 2662)	612	1.00	16
4703	Internal clock for Model A or E CPU's (requires 2074)	816	2.50	21
MASS STORAGE				
3340	Module Disk Drive ("Winchester"):			
	Model A2: two disk drives plus controller	40,000	80.00	1,059
	Model B1: one disk drive	22,000	43.00	592
	Model B2: two disk drives	28,000	69.00	747
3348	Module for 3340 disk drive:			
	Model 35: 34.9M-byte module	1,600	—	59
	Model 70: 69.9M-byte module	2,200	—	82
	Model 70F: 69.9M-byte module, 502K bytes of which are accessed by fixed heads	4,400	—	165
5022	Cartridge Disk Drive for System/7 (requires 2664 and 2662):			
	Model 1: one fixed and one removable disk, 2.46M words, 269 msec average access time	15,100	90.50	421

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EQUIPMENT PRICES

	MASS STORAGE (Continued)	Purchase Price	Monthly Maintenance	Monthly Rental
5022	Model 2: same as Model 1 except with 126 msec average access time	$16,500	$99.50	$492
	Model 3: one fixed disk, 1.23M words, 269 msec average access time	13,500	86.50	324
	Model 4: same as Model 3 except with 126 msec average access time	14,800	95.00	394
5440	Disk Cartridge for 5022 disk drives	612	—	16
4650	Integral Power Supply for each 5022 disk drive after the first	1,420	1.00	37
	I/O CONTROL MODULES			
5012	Multifunction I/O Module; for digital I/O, analog I/O, and control for 2790 Data Communications Systems	1,330	7.50	42
5013	Digital I/O Module; same as 5012 for digital I/O features only	1,830	7.50	42
5014	Analog Input Module; provides analog input facilities for various combinations of either relay-contact or solid-state multiplexers:			
	Model B1: provides amplification, A/D conversion, and addressing of 128 relay analog input points; can be combined with two model E2's to provide 384 input points	6,120	26.00	162
	Model C1: provides amplification, A/D conversion, and addressing of 128 solid-state input points	8,970	38.00	237
	Model D1: Same as Model B1 except expandable to 384 relay input points through two Model E1's	6,120	25.00	162
	Model E1: Expansion module for Model D1; provides 128 relay input points per module (max. of two)	1,590	0.50	41
	Model E2: Expansion module for Model B1; provides 128 additional relay input points per module (max. of two)	1,590	0.50	41
8195	2790 Control attachment for use in 5012 or 5013; max. one per 5012 or 5013 and four per system	4,080	7.50	108
1221	Basic Analog attachment for analog interfaces; max. one per 5012	1,220	1.50	32
1245	Analog Output Control for 1221; controls up to two 1246 Analog Output Points; max. one per 1221	1,220	8.50	32
1246	Analog Output Point for 1245; provides 0 to 10.24V output; max. two per 1245	2,040	5.50	42
1232	Analog Input Control Model B for 1221; provides control and A/D conversion for amplifier and 8 groups of relay multiplexers; max. one per 1221; cannot be used with 1213	4,990	26.00	108
1210	Amplifier B for 1232 or 5014; unity gain; high-level input, full-scale range ±5.12V; cannot be used with 1215	510	0.50	10
1215	Multirange Amplifier B for 1232 or 5014; fixed preset gain or autoranging; full-scale ranges of ±10mV, ±20mV, ±40mV, ±80mV, ±160mV, ±640mV, or ±5.12V preset or by program control; resolution with preset gain is 14 bits plus sign; resolution with autoranging is 12 bits plus sign; max. one per 1232; cannot be used with 1210	1,630	2.00	42
5246	MR4 Multiplexer for 4 relay multiplexer points; for use with 1210 or 1215; max. 8 per 1210 or 1215	448	2.00	11
1213	Analog Input Controller Mod C for 1221; same as 1232 for solid state multiplexers; max. one per 1221; cannot be used with 1232	6,930	34.00	183
1211	Amplifier C for 1213 or 5014; same as 1210 for solid-state multiplexers; cannot be used with 1216	2,040	5.00	54
1216	Multirange Amplifier C for 1213 or 5014: same as 1215 for solid-state multiplexers	3,260	2.00	86
5248	MS4 Multiplexer for 4 solid-state multiplexer points; for use with 1211 or 1216; max. 8 per 1211 or 1216	408	1.00	10
7830	Temperature Reference for 1221 or 5014; requires 1215, 1216, or 1217; max. one per 1221 or 5014	408	1.00	10
3284	Digital Input Control for 5012 or 5013; provides control for up to four 3289 or 3292 digital inputs; max. two per 5012 or 5013	550	2.00	13
3289	Digital Input Group for 3284; provides 16 input points, max. four per 3284; can be mixed with 3292	612	3.50	16
3292	Non-Isolated Digital Input Group for 3284; same specifications as 3289	306	1.00	8
5710	Process Interrupt for 3289; converts 3289 to a process interrupt group; max. two per 5012 or 5013; cannot be used with 3292	408	1.00	10
3296	Digital Output Control for 5012 or 5013; provides control for up to four groups of 3420, 3421, 3422, or 3424 digital outputs in any combination; max. one per 5012 or 5013	816	1.50	21
3420	Relay Output for 3296; 16 single-pole contacts	1,630	4.50	42
3421	Low Power Output for 3296; 16 output points, 6VDC @ 4mA	816	2.50	21
3422	Medium Power Output for 3296; 16 output points, 48VDC @ 450mA			
3424	Non-Isolated Medium Power Output for 3296; 16 output points, 52.8 VDC @ 450mA	612	1.50	16
1212	Amplifier D for 5014; unity gain, high-level input, full-scale range ±5.12V; for use with 5247; cannot be used with 1217	510	0.50	10
1217	Multirange Amplifier D for 5014; specifications as 1215; for use with 5247 or 5245; cannot be used with 1212	1,630	2.00	42

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EQUIPMENT PRICES

I/O CONTROL MODULES (Continued)

		Purchase Price	Monthly Maintenance	Monthly Rental
1230	Analog Input Adapter B for use with 5247; max. four per 5014 model B1; requires 1210 or 1215	$612	$1.00	$13
1231	Analog Input Adapter C for use with 5249, max. four per 5014 model C1; requires 1211 or 1216	612	1.00	13
1233	Analog Input Adapter D/E for use with 5247 or 5245; max. four per 5014 models D1, E1, or E2; requires 1212 or 1217 or 5014 model D1	612	1.00	13
1250	Analog Input Expander B for 5014 model B1; permits additon of up to two 5014 model E2's to a 5014 model B1; max. one per 5014 model B1; requires 1210 or 1215	1,020	5.00	27
5245	MD16 Multiplexer for 5014 models D1 and E1; provides relay inputs for 16 analog inputs; input voltage range -640mV to +5.12V; requires 1233; max. two per 1233	1,180	9.50	31
5247	MR16 Multiplexer for 5014 models B1, D1, E1, or E2; provides relay inputs for 16 analog inputs; input voltage range ±5.12V; requires 1233; max. two per 1233	1,790	7.00	47
5249	MS16 Multiplexer for 5014 model C1; same specifications as 5247; requires 1231; max. two per 1231	1,630	2.50	42

PERIPHERAL UNITS WITH CONTROL

5024	I/O Attachment Enclosure for CPU Model E (max. one per system):			
	Model 1: for line printing (40-155 lpm)	18,040	–	482
	Model 2: for card reading (up to 300 cpm)	10,340	–	276
	Model 3: for card reading and printing	22,500	–	640
4115	Attachment feature for 5204 (for Model E CPU's)	1,320	4.50	30

ENCLOSURES

5026	Enclosures:			
	Model A2: 2-position cabinet, for processor module and 1 I/O module	4,710	26.00	108
	Model C3: 3-position cabinet, for processor module and 2 I/O modules	10,200	30.50	248
	Model C6: 6-position cabinet, for processor module and 5 I/O modules	14,400	49.50	367
	Model D3: 3-position extension cabinet, for use with Model C3 or C6	10,200	39.50	248
	Model D6: 6-position extension cabinet, for use with Model C3 or C6	14,400	58.50	367
3715	Enclosure Attachment for 5026 Models C3 and C6 (max. one per system); connects other enclosures together for expansions	1,420	4.50	37
4621	Internal Air Isolation 3 for 5026 Models C3 and D3; provides air cooling and isolation	2,290	11.50	48
4622	Internal Air Isolation 6 for 5026 Models C6 and D6; provides air cooling and isolation	3,060	24.00	65
7401	Storage Power Addition for use on CPU Models A and B with memories above 8K words	652	1.00	17

SOFTWARE PRICES

		Monthly Charge
5707-LM-1	Application Module Library AML/7 (single use charge)	$661
5734-F04	FORTRAN IV Host Compiler and Library (OS version; 5736-F01 is DOS version)	137
5707-RC1	Communications Control Application (CCAP/7), Version 1	220
5707-RC2	Communications Control Application, Version 2	375
5707-F01	FORTRAN IV Stand-Alone Compiler and Library	86
5734-XC3	Applications Generator (OS version; 5736-XC3 is DOS version)	165
5707-XC1	Stand-Alone Applications Program Generator	153