

R 8175

IBM System/7



As a laboratory automation system, the IBM System/7 can handle readings from multiple measuring and testing devices. Other sensor-based applications range from apartment house security control systems to telephone network controllers, either in stand-alone operation or in conjunction with other IBM computers systems.

MANAGEMENT SUMMARY

On October 28, 1970, IBM unveiled the System/7—a sensor-based 16-bit minicomputer system with typical 8K-16K-word systems ranging in price from about \$1500 to as much as \$5000 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 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.)

The next significant enhancement to the System/7 came at the end of July 1973 when a new processor model was released 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).

IBM's entry into the sensor-based marketplace really began in 1961 with the introduction of the 1710, a

Although popularly billed as a small-scale sensor-based system with only a handful of publicly announced peripherals/processor options, the System/7 is capable of handling a wide variety of stand-alone or satellite processor applications through the attachment of numerous RPQ's (non-standard items). With a large and rapidly (but quietly) increasing number of users, the System/7 presents a major challenge to manufacturers of competitive process control minicomputers, albeit at somewhat higher prices than its numerous competitors. July '73 enhancements make it all the more potent.

CHARACTERISTICS

MANUFACTURER: IBM Corporation, Data Processing Division, 1133 Westchester Avenue, White Plains, New York, New York 10604. Telephone (904) 696-1900.

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 basic 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 increment or decrement the base register by 128 locations, and can indirectly address all of main memory.

The first word of long instructions is identical to that of the single-word instruction; the second 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 has 16K-65K words in 4K increments.

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▷ 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 had 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, released the following year, is an 1800 without the elegant interrupts and minus a couple of compare instructions).

Despite continuing early concern within IBM by small and medium-scale systems marketing managers that the 1800 might turn out to be too strong in relation to other available IBM computers, a veritable shark in the fish tank, the 1800 gradually grew to have a full range of peripherals, and a strong complement of system software including the TSX supervisor and the MPX Multiprogramming Executive. MPX today remains one of the finest pieces of control software available from any source and still contributes to the viability of the 1800 almost nine years after the system's initial release.

About a thousand IBM 1800's have been delivered to date, and it is interesting to note that some six years passed before announcement of the next sensor-based system, the System/7. In keeping with IBM's process control tradition, the System/7 was a 16-bit word-oriented machine, originally announced *sans* peripherals (other than a console punched paper tape reader). Also in keeping with tradition, some IBM marketeers once again fought down the uneasy feeling that a shark had been lowered among the placid small- and medium-scale general-purpose members of the IBM computer fish tank. When the 5022 Direct Access Storage device was announced about a year later, and in view of the fact that a comprehensive variety of punched card, line printer, and magnetic tape and disk peripherals had become available on an RPQ (special non-standard) basis for the System/7, the shark/fish tank fears seemed well founded.

But the System/7, to an even greater extent than the earlier 1800, has been the subject of some of the industry's most carefully thought out and administered market strategy, and confrontations with the "classic" line of System/3's and System 360/370's have been practically nonexistent.

In keeping with its "sensor-based system" image (a carefully chosen generic term that doesn't constrain the System/7 to earlier process control or data acquisition roles), the System/7 has been sold and supported almost

► CHECKING: Standard.

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.

CENTRAL PROCESSORS

GENERAL: The System/7 central 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 represents a significant enhancement to the earlier System/7 processors providing all of the functions of the Model A plus a larger instruction repertoire, standard storage protection and an interface for a read-only cassette tape recorder.

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 for each of four interrupt levels. With this architecture, the System/7 can rapidly switch context between multiple programs, sharing a common memory.

REGISTERS: Seven 16-bit index registers, six one-bit program indicators, one 16-bit accumulator and one 16-bit instruction address register for each of four interrupt levels (60 total).

The program indicator registers logically 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.

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. ►

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➤ exclusively 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 wholly 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.

Thus, the System/7, with its high performance processor and extensive hardware/software RPQ support, has carefully taken its place as one of the graceful piscine prizes in the IBM fish tank of products with narrowly defined and closely controlled territorial prerogatives and ambitions.

In fact, the System/7 finds itself (by design) most often 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 2100's etc., rather than against larger mainframes in the general-purpose data processing environment—as could easily occur. Against this broad based competition, the System/7 handles data communications duties (line concentration, polling, auto calling), data entry (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.).

Well over 1,000 System/7's have been delivered to date, and it is clear that the 7 has already achieved an acceptance far outstripping earlier IBM process control or “sensor-based” efforts; and that has happened within what is almost certainly only half of the product's life cycle.

Looking to the future, it can be expected that the System/7, like the earlier IBM 1800 system, will gradually reveal itself as a more flexible general-purpose small-scale problem solver. Thus, the user can reasonably expect that some of the now unheralded, semi-standard System/7 hardware RPQ's will receive liberal sprinklings of holy water and graduate to the status of full-fledged, standard offerings. Of course, it can also reasonably be expected that the System/7 will continue to avoid conflict with larger, more expensive IBM systems.

Among the potential System/7 “enhancements” may well be a System/3 interface (other than, as now, merely for data using the interchangeable 5440 disk), increased peripheral/terminal availability, and additional program development support—perhaps for RPG, BASIC, and COBOL as well as increased FORTRAN developments to further compatibility between the System/7 stand-alone and host-processor modes of operation.

While these speculations must remain hypothetical at this time, it is nonetheless clear that the System/7 has a great deal to offer contemporary and future minicomputer ➤

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. Three class interrupts in addition to external interrupts are recognized: program check, power/channel warning, and machine check. Level switch time is performed by hardware in 800 nanoseconds.

RESERVED STORAGE: The first 19 locations in memory are reserved for restart instructions, interrupt handling routing addresses, etc. An additional two to 68 words must be reserved for level displacement tables whose number and size depend upon the overall number of priority levels used, and the number of priority and subpriority levels assigned per device.

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 via 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 host processor applications (1130 DMA interface on System/7 is under 1130 control). In DPC mode, the direct control channel can transfer data at a rate of 500K words/second.

SIMULTANEOUS OPERATIONS: In a 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 one to eleven 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 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 provides 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 1130 system is not offered 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 ➤

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➤ users (albeit at a relatively higher hardware-only cost than many competitive systems) through RPQ's. Prospective minicomputer users are well advised to persist (doggedly if necessary) through what will undoubtedly be strong IBM marketing "considerations" to determine for themselves to what extent the powerful yet largely hidden System/7 can satisfy their data processing needs.

System/7 users contacted by Datapro rate the system as excellent to good, with particularly strong approvals to the application program support. Other comments indicated that the system tends to be rather expensive, and some users expressed a degree of difficulty with the limited instruction repertoire and the communications control software. □

▶ storage capacity of 2,457,600 words (approximately 4.9 M 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.

INPUT/OUTPUT UNITS

Note that no individual I/O units other than the operator console and Operator Station 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.

5012 MULTIFUNCTION MODULE: Provides 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 as 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 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/P Converter, Multiplexor, 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 four to 15 samples/second, a maximum common mode voltage of 250 volts, and uses a Mercury-wetted differential multiplexor. 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 multiplexor. 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) can be added to Models B or D to share the A/D converter (ADC) and amplifier.

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5028 OPERATOR STATION: This modified 10 cps Teletype 33/~~KSB~~ is attached to the processor module, and includes a keyboard with keyboard request key, printer, and paper tape reader/punch. The paper tape reader is used as the initial program loads 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 25 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 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 interface for one bisynchronous communications adapter to facilitate communications with the System/370 via a 2701, 2703, 3704, or 3705 communications controllers; or to the 4640 Integrated Communications adapter on IBM/370 Models 115, 125, and 135; or with another System/7 (via another BSCA); or with a System/3 Models 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 bps-7200 bps) and a high-speed (10K-50K bps) interface will be 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, CICSN's and IMS/VS support of the System/7 as a BSC terminal is provided. First customer shipment of the BSCA is scheduled for December 1973. ▶

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► SOFTWARE

OPERATING SYSTEMS: None. A primitive level of system control programming is available through System/7 Modular Systems Programs. MSP/7 features program preparation on an IBM host computer (Host Program Preparation Facility-HPPF), or direct System/7 program preparation, and includes a Disk Support System (DSS/7) that resides on a 5022 Disk Storage Module and runs on a 4K-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. Off-line HPPF program transfer is normally handled via punched paper tape or System/7 users who do not have access to a 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. The IBM 1130 (8K words) can be interfaced via a storage channel for direct access, and the System/370 (60KB), the 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 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 considerable programming RQP's are available from IBM, Check IBM for details.

PROGRAMMING: For stand-alone operation, the System/7 must be programmed in Assembler or FORTRAN IV (24KB to compile, 12KB to execute); with a host processor, the most generally accepted programming method is to use FORTRAN to develop programs on the host processor for subsequent execution on the System/7. In

some cases the "RPG-like" Application-Programs Generator (APG/7) is used on host System/360 or 370 systems.

APPLICATIONS: Program products for the System/7 include the Application Program Generator (80K partition or region under OS or VS; 52K partition under DOS or DOS/VS), Automatic Telephone Call Monitoring (8K-word S/7); and about 34 Field Developed and Installed User Programs (FDP and IUP).

PRICING

POLICY: IBM provides the System/7 on a purchase or monthly lease basis (except for the 5028 Operator Station which is also available on the extended term plan). Applications programs for the System/7 are separately priced. (See Equipment prices.)

SUPPORT: For leased systems on-call maintenance is provided at no additional charge. For purchased systems maintenance is provided on the processor for one year at no additional charge; on most interfaces for 90 days at no additional charge, and for thereafter (as well as the 5022 disk and 5028 console) eight hours per day, five days per week on-call maintenance is separately priced.

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

MINIMUM SYSTEM (REQUIRES HPPF): Consists of a 5010A processor, 2K words, Operator Station, and one 5012 multifunction I/O module. Purchase price is \$17,160, and monthly rental is \$465.

SMALL ACCA SYSTEM (FOR IBM 1130 HOST): Consists of a 5010B processor, 4K words, operator station, and two 5012 multifunction I/O modules. Purchase price is \$32,095, and monthly rental is \$840.

MEDIUM-SCALE STAND-ALONE SYSTEM: Consists of a 5010A processor, 8K words, operator station, and three 5012 Multifunction I/O modules. Purchase price is \$50,865, and monthly rental is \$1328.

LARGE-SCALE SYSTEM WITH HOST INTERFACE: Consists of a 5010B processor, 16K words, operator station, 5022-2 disk, and five 5012 Multifunction Module and two 5014C Analog Input Modules. Purchase price is \$126,590, and monthly rental is \$3,336. ■

EQUIPMENT PRICES

PROCESSORS AND MEMORY

5010 A	Central Processor with 2K words
5010 B	Central Processor with 2K words
	Each additional 2K words
5010 E	Central Processor with 16K words
-	Each additional 4K words

PROCESSOR FEATURES

1610	ACCA
2074	BSCA
5500	Integrated Modem (1200 bps) leased
5501	Integrated Modem (1200 bps), switched
2165	Common Carrier Adapter
2662	Cycle Steal
4703	Internal Clock for BSCA
4750 1,2	Line Adapter
4800	Line Interface 1D
4805	Line Interface 1G
5026 A2	Enclosure (2 I/O)
5026 C3	Enclosure (3 I/O)
5026 C6	Enclosure (6 I/O)
5026 D3	Enclosure Extension (3 I/O)
5026 D6	Enclosure Extension (6 I/O)
3715	Attachment for D3/6 to C3/6
4621	Air Isolation C3 D3
4622	Air Isolation C6/D6

Purchase Price	Monthly Maint.	Monthly Rental
\$8,500	\$46	\$185
12,500	54	285
3,675	44	105
34,800	935	225
4,725	135	30
3,000	15	75
7,200	54	180
525	2.50	15
700	3.00	20
400	2.50	10
1,800	3	45
800	2.50	20
1,200	14	25
1,000	2.50	25
2,000	.50	50
4,620	24	100
10,080	28	230
14,280	45	340
10,080	36	230
14,280	53	340
1,400	4.50	35
2,250	11	45
3,000	22	60

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PROCESSOR FEATURES (continued)		Purchase Price	Monthly Maint.	Monthly Rental
5731	Power Failure Detect	\$2,000	\$ 50	\$50
7401	Addon power (5010A 10K and larger)	640	1	16
5028	Operator Station	2,240	40	144*
MASS STORAGE				
5022 1	Disk Storage Module, 2.45 million words	14,870	83	390
5022 2	Disk Storage Module, 2.45 million words	16,225	91	455
5022 3	Disk Storage Module, 1.23 million words	13,245	79	300
5022 4	Disk Storage Module, 1.23 million words	14,600	87	365
2664	Cycle Steal	600	1	15
4650	Add-on 5022 power supply	1,400	1	35
I/O MODULES				
5012	Multifunction Module	1,800	7	40
1210	Hi Level B Amplifier	500	50	10
1211	Hi Level C Amplifier	2,000	5	50
1215	Multirange B Amplifier	1,600	2	40
1216	Multirange C Amplifier	3,200	2	80
1221	Basic Analog	1,200	1.50	30
1232	Analog Input B	4,900	24	100
1213	Analog Input C	6,800	31	170
1245	Analog Output Control	1,200	8	30
1246	Analog Output Point	2,000	5.50	40
5246	Multiplexor/MR4	440	2	11
5248	Multiplexor/MS4	400	1	10
7830	Temperature Ref.	400	1	10
3284	Digital Input Control	540	2	12
3289	Digital Input Group	600	3.50	15
3296	Digital Output Control	800	1.50	20
3420	D.O. Contact Group	1,600	4.50	40
3421	D.O. Low Power Group	800	2.50	20
3422	D.O. Medium Power Group	1,200	5	30
5710	Process Interrupt	400	1	10
8195	2790 Control	4,000	7	100
5013	Digital I/O Module	1,800	7	40
3292	Digital Input Non Isolated (5012 or 5013)	300	1	8
3424	Digital Output Medium Power Non Isolated (5012 or 5013)	600	1.50	15
5014 B1	Analog Input Module	6,000	24	150
5014 C1	Analog Input Module	8,800	35	220
5014 D1	Analog Input Module	6,000	23	150
5014 E1	Analog Input Module	1,560	50	39
5014 E2	Analog Input Module	1,560	50	39

*\$120 on Extended Term Plan

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SOFTWARE PRICES

SYSTEM/7	Monthly License Fee
Apartment Complex Monitor*	\$ 150
Application Module Library	600**
Arithmetic/Data Subroutines*	60
Asynchronous Comm Control Attach (ACCA) Master Terminal Control*	85
Auto Call Monitoring	150
Auto Hematology Analyzer*	85***
Automatic Production Reporting*	190
Clinical Lab Automation*	85
Clinical Lab Control Program*	170***
Communications Control Applications Program (CCAP)	200
Controlled Access Subset*	110
Dairy Machine Monitor*	325
Expanded Gas Chromatograph Monitoring Program*	335
Gas Chromatograph*	225
Graphics Package*	115
Health Care Support/Admissions*	245
Input Output Support for IBM Selectric I/O Writer*	50
Luncheon Meat Slicing Control*	185
Natural Gas Monitoring & Control (Basic) Program*	425
Order Entry/Inventory Allocation Via Touch Tone (TM) Telephone*	310
Package Filling Control System*	225
Paper Tape Modification*	35
Peak Type Analyzer*	90***
Plastic Injection Molding*	200
Plateau Type Analyzer*	80***
Processing Event Recording Translation System*	215
Programmable Terminal & Data Link*	45
Pump Monitor & Control System	110
Remote Contact Monitor System*	185
Remote Measurement Monitoring Program*	170
Shop Floor Data Call & Reporting*	260
Tensile Tester Monitoring Program*	290
Textile Machine Monitoring*	280
Touch Tone (TM) Remote Order Entry for Sys Friendly Ice Cream*	175
2790 Data Entry System Bendix*	175
2790 Library Circulation Control*	275***
2790 Transaction Processor Sys.*	200
HOST PROCESSOR	
System/360 Application Prog. Generator	150
System/360 FORTRAN IV	125

*Field Developed Program (FDP) or Installed User Program (IUP). Monthly license payments end after one year unless otherwise noted.
**One time charge.
***Monthly license payments end after two years.