

# IBM Series/1

## MANAGEMENT SUMMARY

IBM has, in the past year, enhanced the Series/1 system with the addition of new processors, which reportedly provide up to twice the amount of storage and up to a 50 percent increase in internal performance. The 60D model was introduced as an integrated package for the 4954 and 4956 processors and the 4965 storage and I/O unit. IBM further expanded the capabilities of the Series/1 with the introduction of the 4956 Models E and 60E. While in the process of adding new models, however, IBM also withdrew several Series/1 models from the market, including the 4952 A, B, C, and 30D models, and the 4954 A model. The 4955 models were dropped from the market the previous year. IBM has also announced enhancements to both operating systems, the Event Driven Executive (EDX) and the Realtime Programming System (RPS).

The Model 60D for the 4954 and 4956 processors and the 4965 storage and I/O unit incorporates two major auxiliary devices, one 60MB disk, and an optional 1.2MB diskette drive. An optional 64KB microprocessor-driven cache is also available, which, according to IBM, has disk throughput acceleration potential of 50 to 200 percent, depending upon the application. Model 60D also features error correcting capabilities, including correction of any error of 9 bits or less, the correction of any error of 16 bits or less within a 2-byte boundary, and detection of up to two 2-byte errors within any 256-byte block.

The Series/1 4956 Model E is an extension of the 4956 Model B and reportedly offers internal performance approximately 50 percent greater than the 4956 B model. The basic 4956 Model E processing unit contains: the processor; 512K bytes basic storage, plus optional 256K-byte and 512K-byte additional storage cards for a maximum of 2MB storage; 13 I/O slots; error checking and correcting; en-

The IBM Series/1 minicomputer systems is a modular system offering open-ended architecture and two operating systems. The Series/1 presently offers two processors with a total of 10 models, and provides for data processing, data communications, distributed data processing, and sensor-based applications such as process control.

**MODELS:** 4954, Models B, C, 30D, and 60D; 4956, Models B, C, E, 30D, 60D, and 60E.

**MAIN MEMORY:** 64K to 2MB.

**DISK CAPACITY:** Up to 800MB per disk subsystem.

**WORKSTATIONS:** Up to 256.

**PRICE:** \$8,500 to \$27,600.

## CHARACTERISTICS

**MANUFACTURER:** International Business Machines Corporation (IBM), Old Orchard Road, Armonk, NY 10504. Contact your local IBM representative.

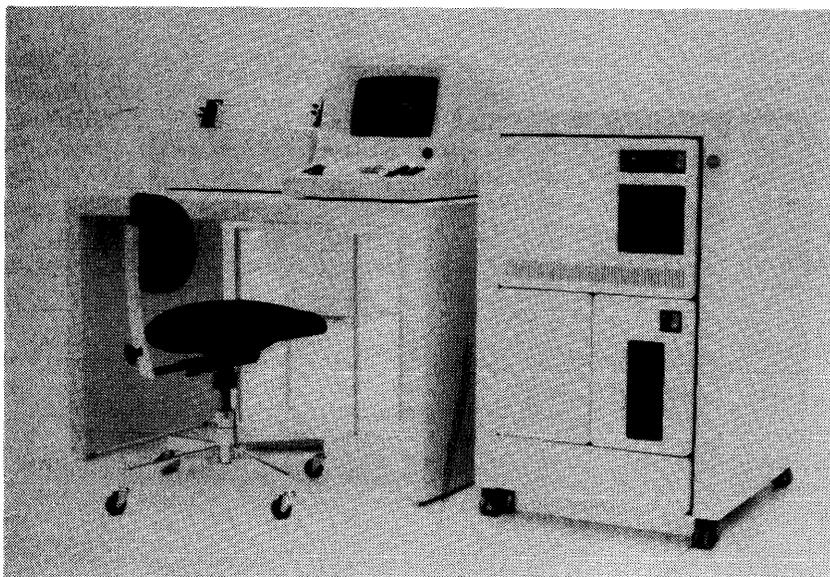
**CANADIAN ADDRESS:** IBM Canada Limited, Markham, 3500 Steeles Avenue East, Markham, Ontario, L3R 2Z1 Canada. Contact your local IBM representative.

## DATA FORMATS

**BASIC UNIT:** 16-bit word or 8-bit byte.

**FIXED-POINT OPERANDS:** 16-bit words can be interpreted as signed or unsigned binary numbers, logical words, memory addresses, or portions of decimal character strings.

**FLOATING-POINT OPERANDS:** 32-bit single-precision operands with a 7-bit exponent and signed 24-bit fraction; and 64-bit double-precision operands with a 7-bit exponent



*This small Series/1 configuration includes a low-boy rack enclosure housing the processor and a 4964 diskette unit. The table-top, 120 cps 4974 printer is shown at left. The display station in the photo is the 4979, one of two 1920-character display units offered with the Series/1.*

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CHART A. SYSTEM COMPARISON

MODEL	4956 Models B&C	4956 Model 60D	4956 Model E	4954 Models B&C
<b>SYSTEM CHARACTERISTICS</b>				
Date of introduction	—	July 1984	October 1984	February 1982
Date of first delivery	—	September 1984	December 1984	—
Operating system	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS
Upgradable from	1954	4954-60D	4954	4952
Upgradable to	4956-E	4956-60E	—	4956
MIPS	—	—	—	—
Relative performance (based on a rating of the 4954 at 1.0)	2.0	2.0	4.0	1.0
<b>MEMORY</b>				
Minimum capacity, bytes	256K	256K	512K	64K
Maximum capacity, bytes	1024K	1024K	2MB	256K
Type	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS
Cache memory	None	64K	None	None
Cycle time, nanoseconds	550 ns	—	—	1.4 ms
Bytes fetched per cycle	—	—	—	—
<b>INPUT/OUTPUT CONTROL</b>				
Number of channels	—	—	—	—
High-speed buses	—	—	—	—
Low-speed buses	—	—	—	—
MINIMUM DISK STORAGE	9.3MB	60MB	9.3MB	9.3MB
MAXIMUM DISK STORAGE	800MB	800MB	800MB	800MB
NUMBER OF WORKSTATIONS	256	256	256	256
COMMUNICATIONS PROTOCOLS	SDLC; BSC; ACC; Synch.	SDLC; BSC; ACC; Synch.	SDLC; BSC; ACC; Synch.	SDLC; BSC; ACC; Synch.

A dash (—) in a column indicates that the information is unavailable from the vendor.

sure; and power. Error checking and correcting (ECC) corrects all single-bit errors and detects double bit-errors. A storage address translation function, 16 KB address spaces (twice the number in other 4956 models), and communications power are included. Other features include a rich instruction set, four interrupt levels, power failure detect/auto restart, eight general purpose registers per level, byte-addressable storage, and a clock/comparator on the processor card with a single 32-bit register, which is incremented in one-millisecond intervals and runs continuously when power is on. Timers are also available. The 4956 Model E is field-upgradable from the 4956 Model B.

The 4956 Model 60E is an integrated package for the 4956 processor, and contains the new processor and storage provided in the Model E; it is reportedly 50 percent faster than the 4956 Models 30D and 60D. The 60E is an extension of the Model 60D and offers a 60MB integrated disk, maximum storage of 2MB (1MB is directly addressable and 1MB is secondary), 6 I/O slots, an optional 1.2MB diskette, and an optional 64KB microprocessor-controlled cache for the disk. The 4956 Model 60E is field upgradable from the 4956 30D or 60D.

On the software side, the Realtime Programming System (RPS) operating system has been enhanced with the release of Version 6.2. The enhancements include programmable two-channel switch support; 4968 autoloading streaming magnetic tape unit support; 1250 multidrop workstation attachment/4980 display station support; 5640 printer attachment/5224, 5225, 5219 support; 3101 distributed support; Command Language Facility (CLF) enhancements; and X.25 SNA support.

and signed 56-bit fraction. The hardware floating-point capability is optional on the 4954 and 4956 processors. It provides single (32-bit) and double (64-bit) precision arithmetic plus conversion between binary and floating-point data. The 4956 features a pluggable floating point with both single- and double-precision arithmetic.

**INSTRUCTIONS:** Microcoded set of over 160 individual instructions (additional 30 floating-point instructions are optional on the 4954 and 4956 processors). Series/1 instructions operate on bit, byte, word, doubleword, and variable field length byte operands. Most instructions are one word in their basic format; expanded address modes use two or three words, as required. Series/1 instructions use 11 possible combinations of addressing modes; a maximum of four can be implemented for any one instruction. **INTERNAL CODE:** EBCDIC and binary.

**MAIN STORAGE**

**TYPE:** MOSFET (Metal Oxide Semiconductor Field Effect Transistor); SAMOS (Silicon and Aluminum Metal Oxide Semiconductor); and NMOS (N-Channel Metal Oxide Semiconductor).

**CYCLE TIME:** 1.4 microseconds for the 4954, and 0.55 microseconds for the 4956 is applicable.

**CAPACITY:** Main memory on the Series/1 ranges from 64K bytes to 2 megabytes. See Chart A for memory sizes for particular models. **CHECKING:** Parity checking on main storage and the channel data bus. Error checking and correction (ECC), correcting single bit errors and detecting double bit errors, is also available on the 4956-E models.

**STORAGE PROTECTION:** None on the 4952 and 4954; standard on the 4956.

**RESERVED STORAGE:** Information not available from vendor.

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CHART A. SYSTEM COMPARISON

MODEL	4954 Model 30D	4954 Model 60D	4956 Model 60E
<b>SYSTEM CHARACTERISTICS</b>			
Date of introduction	—	July 1984	October 1984
Date of first delivery	—	September 1984	December 1984
Operating system	EDX; RPS	EDX; RPS	EDX; RPS
Upgradable from	—	4954	4954-30D and 60D
Upgradable to	4954-60D	4956-60E	—
MIPS	—	—	—
Relative performance (based on a rating of the 4954 at 1.0)	1.0	2.0	4.0
<b>MEMORY</b>			
Minimum capacity, bytes	64K	256K	512K
Maximum capacity, bytes	256K	1024K	2MB
Type	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS
Cache memory	64K	64K	64K
Cycle time, nanoseconds	1.4 ms	—	—
Bytes fetched per cycle	—	—	—
<b>INPUT/OUTPUT CONTROL</b>			
Number of channels	—	—	—
High-speed buses	—	—	—
Low-speed buses	—	—	—
<b>MINIMUM DISK STORAGE</b>			
	30MB	60MB	60MB
<b>MAXIMUM DISK STORAGE</b>			
	800MB	800MB	800MB
<b>NUMBER OF WORKSTATIONS</b>			
	256	256	256
<b>COMMUNICATIONS PROTOCOLS</b>			
	SDLC; BSC; ACC; Synch.	SDLC; BSC; ACC; Synch.	SDLC; BSC; ACC; Synch.

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➤ Certain programs running under RPS have also been enhanced. These include the Program Preparation Subsystem to provide SYSGEN support for new devices; the Multiple Terminal Manager, to provide programmable two-channel switch support, terminal backup, pass-through enhancements, and asynchronous I/O support; and the Indexed Access Method, to provide asynchronous I/O support.

The Event Driven Executive (EDX) operating system has also been enhanced to provide X.21 circuit switched support, cross partition supervisor support for disk/tape management, and session manager extensions.

IBM continues to maintain the previous 4954 and 4956 models. The 4954 Model B is a full-rack unit with 13 I/O feature slots; Model C is a full-rack unit with an integrated floppy disk drive and three I/O feature slots. The 4954 Model C offers an integrated 1.2MB floppy disk drive; a second drive is optional. The Model C is also available as a standalone unit designed for use only with peripheral devices that interface to the Series/1 (printers and display terminals, among others) via external cabling. The 4954 models feature a CPU, 64K bytes of main memory, a storage address translation function (eight 64K-byte address spaces), a basic console, a clock/comparator, and a power supply that includes communications power. Storage is expandable to 256K bytes in 64K-byte increments. Optional features include a plug-in floating-point capability and a programmer console which is mounted in the front of the unit to provide data entry/display functions to the programmer.

The 4956 Models B and C reportedly provide twice the internal speed of the 4954 through a channel speed of ➤

➤ **CACHE MEMORY:** The IBM Series/1 Model 30D, 60D, and 60E can include an optional microprocessor-controlled 64KB cache. Cache functions are transparent to application and systems programming. During a write operation, data is first placed in the cache, or updated if already existing in the cache. Data is then written to disk from cache.

#### CENTRAL PROCESSOR

**GENERAL:** The Series/1 is available in two processor models: the 4954 with Models B, C, 30D, and 60D, and the 4956 with Models B, C, E, 30D, 60D, and 60E. All versions are 19-inch rack-mountable processors with optional data processing I/O, sensor I/O, and communications capabilities. An I/O feature attachment card provides the attachment between the Series/1 processors and the I/O devices. Multiple feature cards can be used in a system, and each card may address from one to 16 I/O devices, depending on the type of card being used.

The 4954 models are full width models offering 64K bytes of basic storage, expandable to 256K bytes in 64K-byte increments by adding storage addition modules. The 4954 Model B has 13 card sockets available for data channel features. The 4954 Model C has three card sockets and provides a 1.2MB diskette drive. A second 1.2MB diskette drive is optional. The 4954-30D has six card sockets, a 30MB disk, and an optional 1.2MB diskette drive and a 64KB cache. The 4954-60D provides a 60MB disk and an optional 1.2MB diskette drive and a 64KB cache.

The 4956 models are all full width and offer either 256KB or 512KB of basic storage with error checking and correcting. Models B, C, 30D, and 60D are expandable to 1024KB. Models E and 60E are expandable to 2MB, in 256KB or 512KB increments with 512KB directly addressable. The storage address translator, communications power, and a clock/comparator are standard features. The 4956 Model B has up to 13 card sockets available for data channel features, depending on storage size. The 4956-C has up to three card ➤

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CHART B. MASS STORAGE

MODEL	4962	4963	4964	4965	4966	4967
Type	fixed	fixed	diskette	diskette	diskette magazine	fixed
Controller model	4962 unit attachment	4963 disk attachment	4959 I/O unit, 4965 I/O unit	diskette attachment card	4966 diskette magazine attachment	4967 high performance disk subsystem attachment
Drives per subsystem/controller	2	4	1	2	23	4
Formatted capacity per drive, megabytes	9.3/13.9	23/29/58/64	606KB	246KB to 1.2MB	1.2	200
Number of usable surfaces	—	—	2	2	2 per diskette	—
Number of sectors/tracks per surface	60 sectors/track	—	77 tracks	77 tracks	77 tracks	—
Bytes per sector or track	256/sector	256/sector	—	256, 512, or 1024	—	256/sector
Average seek time	29.9 ms	27 ms	40 ms	40 ms	40 ms	25 ms
Average rotational/relay time	10.1 ms	9.6 ms	83.4 ms	83.4 ms	41.6 ms	10.1 ms
Average access time	40 ms	36.6 ms	123.4 ms	123.4 ms	81.6 ms	35.1 ms
Data transfer rate	889KB/sec.	1MB/sec.	31KB/sec.	62.5KB/sec.	125K bps	1.5MB/sec.
Supported by system models	all models	all models	all models	all models	all models	all models
Comments	Models 2, 2F, and 4 include 0.5MB diskette. Models 1F and 2F have additional 122.8MB of fixed storage.					Includes disk coding feature.

A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ 2.4MB per second. Error checking and correcting (ECC) memory is standard. Maximum storage is one megabyte. Directly addressable storage is 512KB. Storage over 512KB is available for use as high performance secondary storage. An optional full function console with lock and segmentation register display/store is also offered. Other features of the 4956 include full program compatibility, storage address translation for up to eight address spaces, and pluggable floating point with both single and double precision arithmetic. The 4956 processor is designed for mounting on support rails (fixed) in an IBM 4997 or EIA standard 19-inch rack enclosure. The Model C provides a built-in 1.2MB diskette with provisions for an optional second built-in 1.2MB diskette, and can be mounted in a stand-alone enclosure.

The Model 30D is an integrated package offered for two processors (the 4954 and 4956) and one expansion unit (the 4965 Storage and I/O Expansion Unit). It includes a 30MB disk, an optional 1.2MB diskette, and an optional 64KB cache. The Model 30D also features extensive error recovery procedures, self-diagnostics, and pluggable high-frequency power supply. Any attachment card or feature that can be plugged into the 4954 or 4956 processor, or the 4959 or 4965 expansion units can also be plugged into the Model 30D. Main storage capacity is 512KB to 1024KB.

The Series/1 is considered a modular "mix and match" system with the user determining the modules required—equipment, programming, and service. All Series/1 units, with the exception of printers and display stations, fit into an IBM 4997 rack enclosure or EIA standard 19-inch rack. I/O device attachment is supported by means of I/O feature cards that are installed in available slots either in the processor or an I/O expansion unit. Up to 256 individual devices, both standard and custom built, may be addressed by the Series/1.

➤ sockets, one 1.2MB diskette drive, and an optional second 1.2MB diskette drive. The 4956-30D provides a 30MB disk with six card sockets, the 4956-60D and the 4956-E provides a 60MB disk, with an optional 1.2MB diskette drive and 64KB cache. The 4956-E offers 13 card sockets, the 4956-60E offers 6 card sockets. According to IBM, the 4956 Model E's internal performance and storage is approximately 50 percent greater than those of the 4956-B model.

**CONTROL STORAGE:** Information not available from vendor.

**REGISTERS:** Each Series/1 processor has one Interrupt Mask Register (IMR) and one Processor Status Word (PSW). Each of the four priority interrupt levels has eight general-purpose registers, one Instruction Address Register (IAR), and one Level Status Register (LSR).

The IMR is used for control of interrupts, while the PSW reports the specific condition that caused an exception interrupt. The IAR contains the leftmost byte of the next instruction to be executed, and the LSR contains information about the status of an interrupt level. The AKR contains three address keys and an address key control bit associated with address space management and the storage protection mechanism. Separate 3-bit fields contain an address key for the instruction address space, the operand 1 address space, and the operand 2 address space.

**ADDRESSING:** All storage addresses are 16-bit, unsigned, binary integers. The direct address range of the system is 64K bytes. The addressable unit of main storage is the byte, and all references to storage locations are byte addresses. Instructions refer to bits, bytes, words, doublewords, or fields as data types. Addressing modes include direct, indirect, indexed, and indirect indexed. The 4956 features a storage address translation for up to 16 address spaces.

➤ **INTERRUPTS:** Series/1 processors have four priority interrupt levels. Associated with each level is a bank of hardware registers (16 bits each), an instruction address register, an address key register, and a level status register that includes a set of result indicators. If floating point is installed, there are also four 64-bit floating-point registers per level. When switching between levels, the hardware

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➤ Up to 16 processors can be connected on a high-speed ring. In addition to local ring-connected processors, many of the Series/1 capabilities can be provided to geographically distributed Series/1s by using communication lines. Series/1 capabilities provide the ability to utilize packet switched networks. Communications features are contained in feature cards that plug into the processor I/O channel or the 4987 programmable communications unit. The communications attachment feature cards include a synchronous (SDLC adapter), binary synchronous (BSC) adapter, Asynchronous (ACC) adapter, X.25 network communications adapter, and feature-programmable communications adapter.

The Series/1, as previously noted, offers two operating systems: the Realtime Programming System (RPS), or the Event Driven Executive (EDX).

The Realtime Programming System provides for development of applications and mixes of applications with moderate to high complexity. It also contains many system management features generally associated with operating systems on larger processors. RPS can support numerous separately packaged, supplemental programs offering program development tools, languages, commercial, communications, and sensor input/output support. RPS also supports a broad range of applications, including commercial use (distributed or standalone), communications applications (such as network management), and sensor-based functions (such as process control).

The Event Driven Executive operating system is adaptable to a low-entry, diskette-based production systems as well as larger, disk-based development or production systems of moderate complexity. In keeping with the Series/1 modular concept, the functions of EDX are available through a number of individual licensed programs which allow users to select from these offerings to provide for the support of a particular installation. EDX is an interactive, interpretive, response-oriented system appropriate for distributed processing and standalone environments in both business and industrial applications, which include data entry and remote job entry, as well as sensor-based functions such as data acquisition, material and component testing, machine and process control, and shop floor control. Language capabilities include Cobol, PL/1, Pascal, Assembler, Fortran IV, and Event-Driven Language.

In addition to the two operating systems, standalone program support is available for those who wish to develop an application without using either of the two Series/1 operating systems. This alternative is most often used to create a highly-tailored and specialized solution where the application and system control functions are integrated by the programmer. Included are a set of standalone utilities providing a basic set of hardware support functions; a base program preparation facility allowing a programmer to translate Assembler language source statements into Series/1 object code; and a group of separately-packaged programming modules, known as Control Program Sup-

➤ automatically preserves the information contained in the interrupted-from level. Level switching can occur automatically upon acceptance of an I/O interrupt request or under program control.

The processor uses the device address to find the service routine for a given device; thus, there are 256 direct interrupt entry points. The I/O instruction assigns an interrupt level to an I/O device.

The processor enters the supervisor state when it has accepted all priority interrupts. When the processor accepts an interrupt on a given level, that level remains active until a level exit instruction is executed. If a higher-priority interrupt is accepted before the level exit instruction is executed, the processor switches to the higher level, completes execution at that level, and automatically returns to the interrupted-from level, provided no higher-priority interrupts are pending. If an interrupt is pending on the currently active level, it is not accepted until the level exit instruction has been executed. When no levels are active and no interrupts are pending, the processor enters the wait state.

**OPERATING ENVIRONMENT:** The Series/1 processors are housed in a 14-inch high chassis, and can be either rack-mounted or housed in a standalone enclosure. Most units are designed for mounting on support rails (fixed) in an IBM 4997 or EIA standard 19-inch rack enclosure. If a system requires space for modular units beyond the capacity of a single rack, multiple racks can be bolted together to form a multibay enclosure.

The 4954 and 4956 models are 14 inches high and 19 inches wide, and weigh from 50 to 126 pounds.

#### INPUT/OUTPUT CONTROL

The processor I/O channel directs the flow of information between I/O devices and main storage, and contains the facilities for control of the I/O operations. The I/O channel is an asynchronous, multidropped channel that links the processor to its external resources. It consists of address, control, and data lines. Device service through the processor I/O channel can occur as a cycle steal or as a Direct Program Control (DCP) operation.

Direct program control input/output operations involve a separate I/O command from the processor for each data item transferred across the channel. The data can consist of one byte or one word. The operation might or might not terminate in an interrupt.

Under DCP, an immediate data transfer is made to, or from, the device for each Operate I/O instruction. The data can consist of one byte or one word. The operation may or may not terminate with an interrupt.

In the cycle steal mode, each Operate I/O instruction can initiate multiple data transfers (maximum of 65,535 bytes). I/O operations are overlapped with processing operations. The I/O device must be able to operate in the cycle steal mode, and always interrupts upon termination of a cycle steal operation.

The 4959 I/O Expansion Unit provides additional I/O capability to supplement the I/O feature locations provided within the Series/1 processors. A maximum of 14 I/O feature locations are contained in the 4959. Any user attachment features, integrated communications features, data processing I/O attachment features, and the sensor I/O unit attachment feature may be installed in each 4959 I/O Expansion Unit.

## IBM Series/1

CHART C. WORKSTATIONS

MODEL	3101	4978	4979	4980	5251-011
<b>DISPLAY PARAMETERS</b>					
Max. chars./screen	1,920	1,920	1,920	1,920	1,920
Buffer capacity	—	—	—	—	—
Screen size (lines x chars.)	24 x 80	24 x 80	24 x 80	24 x 80	24 x 80
Tilt/swivel screen	No	No	No	Yes	Yes
Symbol formation	—	4 x 6 dot matrix	4 x 6 dot matrix	—	dot matrix
Character phosphor	Green on black or black on green	—	—	—	Green on black
Total colors/no. simult. displayed	None	None	None	None	None
<b>KEYBOARD PARAMETERS</b>					
Style	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter
Character/code set	EBCDIC	EBCDIC	EBCDIC	EBCDIC	188 character
Detachable	Yes	Yes	No	Yes	Yes
Program function keys	—	35	—	24	24
<b>TERMINAL INTERFACE</b>					
	RS-232-C; RS-422-A	—	Integrated	—	—

A dash (—) in a column indicates that the information is unavailable from the vendor.

port, providing components from which users can build their own tailored operating system and application environment.

Series/1 software provides a wide range of communications support, including X.21, X.25, SNA, and RJE. It can also act as a network node, a communications controller, a distributed processing system, as well as a standalone system. Applications include manufacturing, energy management, telephone listing management, automated office management, remote job entry, batch entry, sales and distribution, and more.

### COMPETITIVE POSITION

The introduction of the new Series/1 high-end processors will be instrumental in helping the Series/1 maintain its place in the market. According to an IBM spokesperson, IBM is installing as many Series/1s as they can make. The IBM spokesperson also identified the Series/1 as "The best communication facility of all IBM systems." An IDC report, in agreement, stated that the IBM Series/1 is enjoying its best year ever, and by May of this year, had received more orders for the Series/1 than its total sales in 1983. The IDC report further stated that the Series 1 remains IBM's most popular system for communications environments, and holds approximately 35 percent of IBM's U.S. installed base for mid-range systems. IDC also stated that 85 percent of the Series 1 users make use of at least one of the 20 available communications adapter cards. IDC further confirmed IBM's communication's claim with the statement, "The Series/1 under EDX has some 400,000 lines of communications code, any radical shift away from the product seems unlikely, especially if IBM can keep pushing the costs down. This, then, explains the reason why IBM is placing renewed emphasis on the Series/1.

The Series/1, however, is not lacking in competition from other manufacturers. Since its strengths spread across several marketing areas, including distributed processing, manufacturing, and sales/distribution, as well as communications, competing systems would include the Honeywell DPS 6 systems, the Texas Instruments Business Systems, the low end of the Wang VS Series, and the Hewlett Packard 3000.

Optionally, Channel Repower (feature 1565) may be added. This feature repowers the I/O channel along a chain of I/O expansion units. A maximum of five channel repower features can be installed. The 1565 must be installed on the 4954 and 4956 processors for any 4959 Expansion Units attached; and on all 4959 units when another 4959 follows.

The 4959 is a full-width module. I/O cables, for the processor I/O channel, are used to attach the 4959 to the processor.

The 4965 Diskette Drive and I/O Expansion Unit provides one or two diskettes and four available I/O channel feature positions. The Two-Channel Switch enables switching of all features in this unit between two processors. The diskettes, one standard and the second an optional feature, provide the multiple functions of diskette writing and reading, including input of data and programs generated offline, output of programs, output of data for personal use of offline storage, journaling, and recording an audit trail, checkpoints, or system errors.

The 1310 Multifunction Attachment Feature is a single-card unit that provides four independent attachment addresses. The first port can be used for both local and remote attachments, while the remaining three ports are designed for local attachments only. Both local and remote interfaces allow data rates of up to 9600 bits per second.

The 1310 provides interfaces for the 3101 Display Terminal Models 13 or 23, and the 4975 Printer Models 01L or 02L (local). For remote devices, asynchronous or bisynchronous communications can be selected through device initialization software in the operating system, and a single communications line is made available to the applications programs.

The 4982 Sensor I/O Unit consists of a power supply, terminator card, and slots for eight sensor I/O feature cards. Any of the following cards can be used:

- Digital input/processor interrupt nonisolated
- Digital input/processor interrupt isolated
- Digital output nonisolated
- Analog input control
- Amplifier multirange
- Multiplexer—reed relay
- Multiplexer—solid state
- Analog output

## IBM Series/1

CHART D. PRINTERS

MODEL	4973	4974	4975	5219
Type	impact	wire-matrix	wire-matrix	impact
Speed	155 or 414 lpm	to 120 cps	40/80/160 cps	40/60 cps
Bidirectional printing	no	yes	yes	yes
Paper size	up to 15 inches	up to 14.5 inches	up to 14.5 inches	up to 14.5 inches
Character formation	—	dot matrix	dot matrix	—
Horizontal character spacing (char./inch)	10	10	10 or 15	10/12/15
Vertical line spacing (lines/inch)	6 or 8	6 or 8	6 or 8	varies
Character set	48/64/96 EBCDIC	64 EBCDIC	—	96
Controller/Interface	4973 line printer attachment	4974 line printer attachment	RS-232-C	5200 series printer attachment
No. of printers per controller/interface	one	—	—	—
Printer dimensions, in. (h x w x d)	42.5 x 27 x 28.9	12 x 22.25 x 25.5	8.7 x 20.8 x 16.5	7.9 x 26 x 23
Graphics capability	no	no	no	no
Comments				

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▶ The Hewlett Packard 3000, like the Series/1, rates high in the communications and manufacturing and distribution areas. It is a 16-bit system and offers up to 3MB memory versus the Series/1 2MB, up to 3.2GB disk storage, and up to 92 workstations versus the Series/1's 256. A greater growth path is provided by the HP 3000 which has four processor models to expand through, whereas the Series/1 presently only provides two processor models. However, the Series/1 cost factor is a real issue and the reduction in processor costs recently introduced by IBM, will be hard to beat in cost effectiveness by any of the Series/1's competitors.

#### ADVANTAGES AND RESTRICTIONS

According to Series/1 users, the greatest advantages offered by the Series/1 are the reliability of the system, the low cost (IBM had a recent price reduction on the Series/1 processors), and the modularity of the system (each component is offered on an individually priced basis and can be added only when needed). The system is strong in communication capabilities with support of various networking capabilities, and in manufacturing applications such as automatic instrument control and process control.

The introduction of the new Series/1 4956 processor models will make the Series/1 more appealing with the increase in main memory and in internal performance. Users of the new processors should not have the same complaints about slow response time as users of the older models. The new 4956 models can also be upgraded at the customer's site, another plus for the Series/1.

IBM recently saw fit to reduce the price of its previous models. For example, the 4954 B was reduced from \$10,105 to \$8,500; the 4954 C was reduced from \$12,845 to \$11,800; and the 4956 B was reduced from \$14,150 to \$12,500. As everyone knows, cost plays a big part in the purchase decision of a system, and the Series/1 definitely has the advantage in this area.

A good growth path is provided throughout the Series/1 family, but to expand out of the family would entail the expense of reconfiguration of systems and applications software.

▶ The 4982 attaches sensor user processes to the IBM Series/1 computers via the 4982 attachment feature, which may be either in the Model 3 or Model 5 processor or in the I/O expansion unit. Together, the sensor I/O unit and the attachment feature provide a broad base for general digital and analog I/O applications.

The 5250 *Information Display System Attachment* consists of two cards that plug into a Series/1 processor or I/O expansion unit. The attachment provides four ports to which 5250 units are attached by means of twinax or coax cabling. The maximum length of the twinax cable is 5,000 feet; for the coax cable, 2,000 feet. A maximum of seven printer units, in any combination can be attached to any single port. The maximum number of 5250 units that may be connected to the attachment feature is eight; each 5251 and 5256 counts as one, the 5252 counts as two.

The 1200 *System/370 Channel Attachment* provides memory-to-memory communications between a Series/1 processor and any System/370 processor, Model 135 and above, including the 303X processors. Up to eight attachments can be connected to any selector or block multiplexer channel except the 2780 channel used on 370/168 systems. An optional feature allows the host system to IPL an attached Series/1 processor.

The 7400 *Two-Channel Switch* is a feature for the 4959 I/O Expansion Unit provides the capability for switching a set of common I/O devices between two Series/1 processors. The 7900 feature card is plugged into the 4959 and is connected by cable to the I/O channels of two Series/1 processors. Upon failure of the primary processor, the secondary or backup processor receives an interrupt and can be programmed to switch the common I/O. Manual intervention is required when switching back to the primary processor. Manual switching in either direction can be done by the operator.

The Two-Channel Switch console, located on the front panel of the 4959 I/O Expansion Unit, is provided as part of this feature, and provides indicator lights, switches, and keys that allow unit power on/off, manual or backup selection, manual processor selection, manual processor interrupt, channel reset, manual error recovery, and unit status. As a unit, the 7900 is field-installable.

The 7777 *Programmable Two-Channel Switch* provides the Series/1 with the capability of bidirectionally switching the 4959 and/or 4965 Model 1 I/O expansion units and their attached devices between processors. Switchover can be accomplished by manual operator intervention or under program control. Program controlled switchover can occur on a scheduled basis or an emergency basis. The two processors communicate with each other via a pair of read and

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CHART D. PRINTERS

MODEL	5224	5225	5256
Type	wire-matrix	wire-matrix	Impact matrix
Speed	140/240 lpm	280/400/490/560	up to 120 cps
Bidirectional printing	yes	yes	yes
Paper size	up to 17.7 inches	up to 17.7 inches	—
Character formation	dot matrix	dot matrix	dot matrix
Horizontal character spacing (char./inch)	10 or 15	10 or 15	10
Vertical line spacing (lines/inch)	6 or 8	6 or 8	6 or 8
Character set	—	—	96/187 char. set
Controller/Interface	5200 series printer attachment	5200 series printer attachment	5250 attachment
No. of printers per controller/interface	—	—	eight
Printer dimensions, in. (h x w x d)	11 x 28 x 23	39.5 x 43.75 x 29.5	—
Graphics capability	no	no	—
Comments			

A dash (—) in a column indicates that the information is unavailable from the vendor.

### ➤ USER REACTION

Fifteen users representing 19 Series/1 systems responded to Datapro's 1984 User Survey. The systems had an average life of 47.8 months. Ten of the respondents polled were first-time computer users, 5 converted from other manufacturers' systems. The types of industries represented in the survey include manufacturing (5 responses), retail/wholesale (4 responses), banking and finance (4 responses), engineering (1 response), and health care/medical (1 response). The principal applications performed on the systems were order processing/inventory control (9 users), accounting/billing (6 users), sales distribution (4 users), manufacturing (3 users), health care (2 users), payroll/personnel (2 users), education (1 user), engineering (1 user), mathematics (1 user), and petroleum (1 user). The main source of applications programs came from in-house personnel (9 users), followed by contract programming (6 users), proprietary software packages (3 users), and independent suppliers (3 users).

All of the users polled used local workstation/terminals on their Series/1s, while 53% also employed remote workstation/terminals. Forty percent of the respondents were using a data base management system. Only 3 of the users were presently using integrated office automation functions, and only 1 planned to add integrated office automation functions in the near future. The programming languages used on the systems were Cobol (2 users), Assembler (2 users), Fortran (1 user), and the balance used other languages such as Basic, EDL, and RPL. When asked if they have a disaster recovery plan, 8 users said no, 5 users said yes, and 2 users said they planned to acquire a system in 1984. Only 7 of the users plan to acquire expansions to their present hardware in 1984. The 15 users polled rated the Series/1 as follows:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	3	10	1	1	3.00
Reliability of mainframe	8	7	0	0	3.53
Reliability of peripherals	5	8	1	1	3.29
Maintenance service:					
Responsiveness	6	9	0	0	3.40
Effectiveness	9	6	0	0	3.60

➤ write registers on the Programmable Two-Channel Switch feature. A scheduled switchover occurs when the nonconnected processor requests the switchover and the connected processor agrees. Emergency switchover occurs when either processor senses a problem in the connected processor and causes the switchover. The Programmable Two-Channel switch resides in the I/O channel cable position of the 4959 or 4965 expansion unit and does not use an I/O position.

The 5200 Series Printer Attachment plugs into a Series/1 processor or I/O expansion unit. Up to a maximum of eight printers can be connected to the attachment.

### CONFIGURATION RULES

**GENERAL:** Attachment feature cards provide for the attachment of user equipment and input/output devices to a Series/1 processor. The feature cards mount in the I/O feature locations of a Series/1 processor, 4959 I/O Expansion Unit, or 4965 Diskette drive and I/O Expansion Unit. Series/1 I/O devices are attached to the processor through the processor I/O channel. The Series/1 I/O channel accommodates up to 256 devices, with each device having a unique address. The actual number of devices that can be attached to a processor depends on the available number of slots in the basic chassis and the number of I/O expansion units employed. The Series/1 processors occupy three slots, and the floating-point and storage relocation transfer features occupy one I/O slot each.

**WORKSTATIONS:** One to eight are supported per I/O attachment. Additional workstations can be added through various I/O expansion devices such as the 4959 I/O Expansion Unit, the 4965 Diskette Drive and I/O Expansion Unit, the 1310 Multifunction Attachment Feature, the 4982 Sensor I/O unit, and the 5252 Information Display System Attachment. Specific detail on each of these units is provided above in the Input/Output Control section.

**DISK STORAGE:** Users can choose from a variety of disk storage units. The 4962 Disk Storage Unit requires the 4962 disk storage unit attachment feature to attach to the Series/1. The models with a diskette unit require both the 4962 attachment and the 4964 diskette unit attachment feature, which can be plugged into either a processor unit or an I/O expansion unit.

The 4963 disk subsystem is attached to the Series/1 through one disk subsystem attachment (feature 3590) installed in a processor feature location space, a 4959 I/O expansion unit, or 4965 storage and I/O expansion unit. Each subsystem has one primary drive and may have up to three expansion drives. Multiple subsystems may be attached.

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CHART E. MAGNETIC TAPE EQUIPMENT

MODEL	4968	4969
TYPE	streaming	
FORMAT		
Number of tracks	9	9
Recording density, bpi	1600/3200	800/1600
Recording mode	IBM/ANSI	NRZI/PE
CHARACTERISTICS		
Controller model	1220	1215
Drives per controller	one	one
Maximum storage capacity, bytes	up to 80M	—
Tape speed, ips	50/100	45/75
Data transfer rate, bps	—	36-120K
Streaming technology	yes	no
Start/stop mode; speed	25 ips	—
Switch selectable	—	yes

A dash (—) in a column indicates that the information is unavailable from the vendor.

	Excellent	Good	Fair	Poor	WA*
Technical support:					
Troubleshooting	3	8	3	0	3.00
Education	2	9	3	0	2.93
Documentation	3	7	4	0	2.93
Manufacturers software:					
Operating system	3	7	4	0	2.93
Compiler & assemblers	2	7	3	0	2.92
Application programs	3	4	6	0	2.77
Ease of programming	3	6	3	1	2.85
Ease of conversion	2	8	2	0	3.00
Overall satisfaction	3	10	1	0	3.14

\*Weighted Average on a scale of 4.0 for Excellent.

To further evaluate the performance of the Series/1, we conducted the following telephone interviews with four respondents in November 1984.

The first user represented a Midwest manufacturing firm with a Series/1 Model 4955F providing up to 1MB memory and supporting 12 local workstations. The applications consisted of inventory control, purchasing, bills of material, materials requirement planning, routings, standard cost accounting, and a shop calendar. This user converted from a Microdata system in December 1982 and prior to converting, considered such systems as the System/34, System/38, and the HP 3000, but stated his organization choose the Series/1 because of the system's ease of use and cost effectiveness. When asked what he liked best about the Series/1, the user stated, "Reliability, the system just sits in a corner and works." The user had no complaints with the system and said it met all his organization's requirements. One very interesting sidelight came up in this user's conversation—they are using the Pick operating system rather than one of the Series/1's operating system and feels this allows more of a growth path as the organization's needs expand. He said that because the Pick operating system is basically machine independent, it is possible to migrate up to a 4300 without the added cost or inconvenience of changing the operating or applications software.

The second user contacted represented a retail/wholesale company on the West Coast with a Series/1 Model 4955E providing 256KB main memory, 4MB disk storage, and

▶ The 4964 is a diskette unit that can be plugged into either a processor unit or an I/O expansion unit.

The 4965 storage and I/O expansion unit is a direct-access storage device that retrieves and records data on removable magnetic diskettes, and also contains additional I/O feature locations that allow for the connection of other Series/1 devices.

The 4967 disk subsystem provides the Series/1 with direct access storage capacities and offers two models: the 2CA is the primary disk unit and the 2CB is an expansion unit. Multiple subsystems may be attached to a Series/1. Each subsystem requires the microprocessor-based 4967 disk subsystem attachment (3595), one 4967 Model 2CA primary disk unit, and can have up to three 2CB expansion units.

**MAGNETIC TAPE UNITS:** Up to eight per I/O attachment. The 4968 autoloading streaming magnetic tape unit and the 4969 magnetic tape subsystem are available for the Series/1. The 4968 attaches to the Series/1 through a tape attachment feature (feature 1220), which can be plugged into either a processor or an I/O expansion unit. The 4969 subsystem attaches to the Series/1 through a microprocessor-based 4969 magnetic tape subsystem attachment feature, which can be plugged into either the processor or an I/O expansion unit. One attachment feature, which allows for cycle-steal tape read/write operations, is required for each subsystem.

**PRINTERS:** Up to eight per I/O attachment. Additional printers can be added through various I/O expansion devices such as the 5200 Series Printer Attachment, the 4959 I/O Expansion Unit, the 4965 Diskette Drive and I/O Expansion Unit, the 1310 Multifunction Attachment Feature, the 4982 Sensor I/O unit, and the 5252 Information Display System Attachment. Specific detail on each of these units is provided above in the Input/Output Control section.

**MASS STORAGE**

Please refer to the Chart B for disk storage devices.

**INPUT/OUTPUT UNITS**

See Chart C for workstations, Chart D for printers, and Chart E for tape devices.

**COMMUNICATIONS CONTROL**

▶ **GENERAL:** The following communications devices are available for the Series/1. ▶

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▷ supporting nine local workstations. The system has been installed since 1981 and is used for applications which include order processing, purchasing, and sales and distribution. The user stated the advantage of this system is that it is a modular system and can be easily expanded to add more terminals or storage by just changing the processor. However, on an overall basis, the user was most unhappy with the performance of the Series/1 and stated the reason as poor response time. One should note here though that the user was not sure if this is the system's fault or that of the organization's own custom designed applications software and felt it could very well be the fault of the software. This user also wonders, "Just how far IBM will go in further development of the Series/1 or is it a dead issue with IBM"? The user plans to expand to an IBM system 36 or 38 in the near future.

The third user contacted was employed at a manufacturing firm located in the Northeast and utilized a Series/1 Model 4955E with 256KB memory and 64MB disk storage, and supports seven local workstations and two remote workstations. The system was installed in 1977 and was chosen mainly because of price, but the fact that it was a turnkey system offering both the system and software as a total package was also a deciding factor. The applications being processed in-house include receivables, inventory, sales, and a financial package. The Series/1 is also used to access the corporate host computer (IBM 3033) for processing of accounts payables. The user feels their organization has definitely outgrown the Series/1 as the processing time is too slow and not enough disk storage is provided, and will be expanding to the System 36 in the near future.

The fourth user we talked to represented a Northeast pharmacy retail company with a 4952 processor installed. This was a fairly small system with 64K bytes of memory and three local workstations supported. The system is used to run pharmacy programs, inventory control, prescription records, reports, and accounts payable applications. The system was installed in 1980 and other systems considered for purchase were from Digital Equipment and Wang. The user chose the Series/1 over the other systems because the operating system and software he was most interested in (not IBM's) ran on the Series/1 only. The user was also influenced by the IBM name and the reputation applied to IBM's hardware. He felt IBM would be around for a long time. The user is very happy with the system and could list no problems—he has had only 45 minutes of downtime in four years. He said that the system is running 98 plus hours a week and does the job he wants. □

▶ **The 1400 Local Communications Controller** provides a high-speed, local interconnection of up to 16 Series/1 processors (all models), resulting in the configuration of a Distributed Data Processing (DDP) system. Each unit of the cluster or "ring" is capable of directing messages at 2,000,000 bits per second to any other unit within the interconnected configuration without the need for a master controlling station. A microcontroller and associated circuitry provide for cycle stealing, control buffers, and error handling. The "peer-to-peer" full-duplex protocol is transmitted via twinaxial cable, connecting processors at a maximum distance of 5,000 feet.

**The 1610 Asynchronous Single-Line Control** provides circuitry for controlling one half-duplex line, operating at a speed of up to 9600 bits per second. It can be used as either a primary station or a secondary station. The 1610 makes no provision for station-address recognition; therefore, when used as a secondary station on a multipoint network, the software must provide the ability to recognize station addresses. No IPL capability is provided.

**The 2091/2092 Asynchronous 8-Line Control and 4-Line Adapter** can control a maximum of eight lines operating in half-duplex mode. Each of these lines can operate at up to 2400 bits per second. No IPL capability is provided.

**The 2074 Binary Synchronous Single-Line Control (Medium-Speed)** provides circuitry for controlling one half-duplex line, operating at a speed of up to 9600 bits per second. It can be used as either a primary (control) or a secondary (tributary) station, and has the ability to IPL the processor from a host system.

**The 2075 Binary Synchronous Single-Line Control (High-Speed)** provides circuitry for controlling one half-duplex line, operating at a speed of up to 56,000 bits per second. It can be used as either a primary or secondary station, and has the ability to IPL the processor from a host system. This feature is for use in leased-line applications only.

**The 2090 Synchronous Data Line Control (SDLC) Single-Line Control** provides circuitry for controlling one half-duplex line, operating at a speed of up to 9600 bits per second. It operates as either a primary or secondary station. The ability to IPL from a host system is not provided.

**The 2093/2094 Binary Synchronous 8-Line Control and 4-Line Adapter** control up to eight half-duplex lines. The maximum aggregate bit rate is achieved by running two lines at 9600 bits per second and six lines at 2400 bits per second. The ability to IPL from a host system is not provided.

**The 2095/2096 8-Line Controller/4-Line Adapter** are also available. The 2095 provides the control circuitry for up to two 4-line communications. This 8-line control includes point to point or multipoint operations which are supported with an aggregate controller throughput of 64,000 bytes per second. The 2096 feature is a 4-line adapter and provides speeds of 37.5 bytes per second (BPS) to 1,200 bps, or 300 bps to 19,200 bps. Choice of synchronous or asynchronous operation. Included are Echo-plex operation; choice of 5, 6, 7, or 8 bits per character; odd, even, or no parity checking/generation; stop-bit length of 1 or 2; and change-of-direction (COD) character recognition.

**The 4987 Programmable Communications Subsystem** consists of the subsystem unit, up to two controller features, and device attachment features. It accommodates up to 32 lines per subsystem at data rates of 45 to 9600 bps. The 4987 supports point-to-point leased and switched lines or multipoint lines and handles the communications requirements for standard IBM protocols and nonstandard protocols. A special communications-oriented instruction set allows many communications functions to be performed outside the Series/1 processor.

**The Network Routing Facility** is designed to provide users of Advanced Communication Function/ Network Control Program (ACF/NCP/VS) with a 3705-based message routing facility. The Network Routing Facility resides in an IBM 3705 Communication Controller with ACF/NCP/VS and routes messages between supported devices without the use of host processor resources. The Network Routing Facility features support for the 3650 Data Communications Terminal; multiple message routing options selectable by the user; user exits allowing customized routing, editing, and error

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▷ processing; continuation of terminal routing in the event of a host failure; and detection of abnormal conditions with reporting to the host ACF/VTAM.

## SOFTWARE

**OPERATING SYSTEMS:** The Series/1 supports two operating systems: the Event Driven Executive (EDX) and the Realtime Programming System (RPS). A standalone program support option is also available.

The *Event Driven Executive (EDX)* supports multiple, independent, time-dependent, and/or event driven applications with a minimum of interaction. The EDX supervisor overhead can range from 15KB of storage for small production systems, to over 64K bytes for a complex interactive communications system. The system supports multiple programming language options, including Series/1 Assembler, Cobol, Fortran, and PL/1. EDX also provides online utilities to support production operations and assist program development such as text editors, debugging aids, screen format builders, remote management, and remote job entry facilities. Highlights of the system include the following:

- Initiation of application programs from a user terminal, by another program, or by outside events such as IPL or a sensor-input interrupt.
- Execution of job streams of applications in a batch-like manner
- Concurrent use of programs
- Spooling
- Allows an application program use of any available main storage area at the time of invocation
- Storage is managed in eight partitions with crosspartition services provides for information transfer
- X.21 Circuit Switched support

The *Realtime Programming System (RPS)* operating system provides a full-function operation system to users who wish to develop applications and mixes of applications with moderate- to high-complexity. It provides operating system functions to support realtime operations concurrently with the execution of other batch and online programs. RPS also supports multiple processors and provides a multiprocessing feature system that consists of multiple (2 to 16) Series/1 processors connected by the local communications controller. Highlights include the following:

- Storage management and task set management
- Data management
- Timer services
- Interrupt handler
- Event services
- Queuing services
- Command language processor
- Device management
- Communications support
- SNA support
- X.25 SNA support

▶ A *Standalone Program Support* program is also offered for users who wish to develop an application without using either of the two Series/1 operating systems. This provides the option of creating a highly tailored and specialized solution where the application and system control functions are integrated by the program. A base program preparation facility allows a programmer to translate Assembler language source statements into Series/1 object code. A group of control program support packages provide components from which a tailored operating system and application environment can be built.

**DATABASE MANAGEMENT SYSTEMS:** None is provided by the manufacturer for the Series/1.

**LANGUAGES:** The Series/1 provides a choice of multiple high-level languages for use with both the EDX and RPS operating systems, which include Cobol, PL/1, Pascal, and Fortran language options. Cobol and Basic compilers developed using Control Program Support modules are also available as standalone systems.

*Cobol* is supported by both the EDX and RPS operating systems, and provides a high-level programming language oriented toward commercial applications. Series/1 Cobol is offered as two licensed programs: the Compiler and Resident Library for compilation and building of user programs, and the Transient Library for execution of user programs. It allows the user to construct, compile, debug, and execute Cobol programs on Series/1 hardware. The Series/1 Cobol has a high degree of compatibility with Cobol on other IBM systems allowing the programmer, with reasonable guidelines, to transfer source programs between the Series/1 and other IBM systems. Program development and productivity aids include symbolic debug, flow trace, extensive error checking and error message at five severity levels.

The *Virtual Cobol Control Program Support* system provides a multiple workstation system designed to allow Cobol users to compile, debug, and execute their programs on a Series/1 without the need for interfacing to an operating system. It provides virtual storage (each program may be up to 2.5MB); support of up to 20 interactive workstations; a text editor for source input; a job command facility; batch partition for execution; and interface to other control program support based programs such as sort/merge, indexed access method, remote job entry, and binary synchronous communications.

The *Host Cobol* system allow users with access to a system/370 to compile their Cobol programs on special compilers that execute on the System/370 under control of OS/VS2 (MVS).

*PL/1* is available as a separate product for each operating system. It is a problem-oriented, high-level language that can be used for programming realtime, scientific, problem-solving, and traditional data processing applications as well as advanced applications, such as transaction processing and data base handling. PL/1 supports multitasking applications and also allows options for optimized object code, list-directed and edit-directed stream I/O, indexed access method support, sort/merge, full screen 4978 and 4979 terminal support, and communications support.

The *Host PL/1* program allows users with access to a System/370 to compile their programs on special compilers that execute on the System/370 under the control of OS/VS2 (MVS).

*Fortran IV*, supported by both EDX and RPS, is a high-level, mathematically-oriented language. A compiler and object support library program is available for either of the operating systems. Series/1 Fortran requires a complementary set of subroutines for including in execution modules ▶

## IBM Series/1

called the Mathematical and Functional Subroutine Library. In addition, an optional Realtime Subroutine Library, which is support by RPS only, is available. Series/1 Fortran IV provides multiple program support, logical and relational operations, bit-level operations, direct access I/O, additional read/write parameters, device-independent I/O, list-direct I/O, single and double precision, six-character names, and expanded character set.

The *Fortran IV Realtime Subroutine Library* offers two versions designed to work with the RPS and the Fortran IV compiler to provide realtime system support. The five basic functional areas these subroutines are grouped into are executive functions with ability to start, stop, or delay execution; process I/O subroutines that access analog and digital points for input and output; system service interface subroutines that make services available to the problem programmer; time subroutine; and date subroutine. Version 2 includes all functions of Version 1 plus ISA subroutines and use of additional IBM Series/1 RPS interface services.

The *Mathematical and Functional Subroutine Library* contains subroutines commonly used for mathematical and data conversion functions, and is utilized primarily by Fortran IV application programs on the Series/1. Included in the library are mathematical functions, a commercial subroutine package, subroutine library services, and error-checking routines.

The Series/1 *Pascal* is a compatible subset of System/370 Pascal/VS. Two programs are available: the EDX Pascal Compiler and Object Library, and the RPS Pascal Compiler and Object Library. Series/1 Pascal I/O support includes sequential and random files, display to user terminals, formatting facilities, and many I/O extensions to Standard Pascal. Each system provides a compiler and object library. The compilers interface with the EDX session manager and the RPS command language facility. Pascal includes execution time debugging aids, messages, and tracing. Object code is reentrant. Pascal programs can interface with user programs written in assembler or Event Driven Language.

The *EDX Macro Assembler* provides for the assembling of application programs or program modules written in both Series/1 EDX Assembler and Event Driven Language. The program supports converting source code into object modules; and the expansion of Series/1 Assembler macros as well as Event Driven Language macroinstructions. The Macro Assembler can operate concurrently with the execution of other programs. It converts text data sets containing machine instructions and macroinstructions into object modules to be processed by the linkage editor. Through the use of the Macro Library, applications coded in the Event Driven Language can also be processed by the Macro Assembler, including the reconfiguring or customizing of the EDX supervisor. User-generated macroinstructions for commonly used routines can be incorporated into the Macro Library. The Macro Assembler also provides the user with the facility for generating device support or specific routines in support of user exits or customized supervisory functions. These routines can be link-edited with user applications generated in Cobol, the EDX Language, Fortran, Pascal, and PL/1.

*Virtual Basic* provides two programs that combine to provide the Basic development and execution capability: the Basic Supervisor and the Waterloo Virtual Basic. The virtual Basic program provides an integrated editor for source preparation; special statements for structured programming; commercial language facilities; an immediate mode command set; a help command; system security functions; print spooling; optional batch compilation from a diskette file; and the capability to support up to 18 active terminals.

Basic is used for developing applications in education, problem solving, and scientific environments. Statements are compiled one-at-a-time as they are entered at the terminal. A paging mechanism is built into the system so that the program size is limited only by secondary disk storage space.

**COMMUNICATIONS:** The following communications support programs are provided by IBM and are supported by either the RPS or EDS operation systems:

The *EDX X.25/HDLC Communications Support* extends the IBM Series/1 EDX to provide read/write level X.25/HDLC support for the DLC adapter, SDLC single-line control, and the synchronous communications single-line control/high speed. Typical functions of user applications based on the EDX X.25/HDLC Communications support are protocol conversion (to enable nonpacket mode terminals on a Series/1 to communicate with a packet switched data network), and networking (where X.25 or HDLC is being used as the communication protocols between Series/1s).

The *EDX Communications Controller for System/38* is a resident program that allows a System/38 to communicate to a variety of systems and devices through a Series/1. Functions include SDLC link from System/38 to Series/1; BSC links from Series/1 to other devices and systems; support for System/38 to communicate with other systems.

*EDX Communication Facility:* Manages the flow of information throughout a configuration that may include one or many Series/1, host computers, plus terminals and printers. The Communications Facility is oriented toward minimal-storage, low-cost Series/1s. It can be used for communication between Series/1 terminal operators and host programs to which the Series/1 appears as an IBM 3270 Information Display System. It includes aids for the development of application programs, which can communicate with terminal operators or host programs, or supply other functions required in an installation. Communication with a host may be over a leased or switched BSC line operating in multipoint mode; an SNA connection; or a channel attachment. Communications between Series/1s may be over a leased or switched BSC line operating in point-to-point or multipoint mode, or over a local communications controller. The Communications Facility's message management functions include message delivery, priority messages according to a sender-assigned priority, queueing messages in processor storage according to priority for each destination, handling undeliverable messages, handling transactions, and handling log messages that report communications facility errors and activities.

*System/370 Channel Attach Program* is provided for both the RPS and EDX operation systems. This program provides the Series/1 user with the ability to communicate with a System/370 (Models 135 through 168) or 303X processor over a selector or block multiplexer channel, when used in conjunction with the 4933 Model 1 Series/1 System/370 Termination Enclosure and the Series/1 System/370 Channel Attachment Feature 1200. The program provides the Series/1 user with the ability to transfer data, under joint consent, between user application programs in the Series/1 and the System/370.

*EDX Systems Network Architecture (SNA)* executes as a separate program within the EDX operating system and coordinates all user application programs requests for SNA/SDLC communications. The basic operations of the systems network architecture (SNA) support involves establishing communications with the host subsystem, including message recovery/resynchronization assistance; transmitting mes-

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► sages to and receiving messages from the host subsystem; and terminating communications with the host subsystem.

The *EDX Systems Network Architecture Remote Job Entry (RJE)* program is a workstation program for the Series/1 in an SNA network environment. The program enables the user, who has created a job stream via the EDX edit features, to transmit that job stream to a host system for processing. Upon completion, the output from the job stream is normally sent back to the workstation for printing and/or punching. The workstation program also allows the user to query the host computer for system status reports.

The *EDX Advanced Remote Job Entry* program supports both BSC and SNA/SDLC host connections, and allows the Series/1 installation to conform to the protocol required by the host system. The BSC option provides a multileaving RJE (MRJE) workstation over a point-to-point (switched or nonswitched) connection, appearing to the host as an IBM System/3 with console support. The SDLC option provides an SNA RJE workstation over a point-to-point (switched or nonswitched) or multipoint connection.

The *Programmable Communications Subsystem Preparation Facility* is a macro library that is used to support the generation of controller storage image programs for the Series/1 Programmable Communications Subsystem. This macro library is used with either the Base Program Preparation Facility or the Program Preparation Subsystem. It provides the user with the capability of defining and customizing the total protocol for his subsystem. Facilities are provided for implementing communications applications, using communications macro instructions and communications definition macros.

The *Programmable Communications Subsystem Execution Support* runs under control of RPS and provides the user with an interface to the 4987 Programmable Communications Subsystem. The support consists of execution support macros and a loader utility to load the controller storage image program into controller storage.

The *Remote Manager* program is available for both the EDX and RPS operating systems and allows the Series/1 networks to be managed and operated through the Communications and Systems Management programs available on IBM host processors (System/370, 30XX, and 43XX). The Remote Manager on each Series/1 in the network is designed to support centralized control and problem determination using the following host Communications and System Management programs: Network Communications Control Facility (NCCF); Network Problem Determination Application (NPDA); Host Command Facility (HCF); and Distributed Systems Executive (DSX).

The *RPS Communications Manager* supports the line concentration, message routing, terminal control, and distributed processing. One or more Series/1s using the program can be installed to manage the flow of information through the network. The Communications Manager supports a variety of terminals and other I/O devices. Support for non-IBM devices can be incorporated through the use of the 4987 programmable communications subsystem. The Communications Manager also allows users to add applications of their own to the network control base support.

The *RPS Remote Job Entry* provides the ability to transmit jobs and receive their output from a host System/370 having OS/VS2 with JES2 installed. The program can communicate over a point-to-point switched or nonswitched line using BSC protocol.

The *RPS Advanced Remote Job Entry (ARJE)* provides the Series/1 user with RJE support in an SNA/SDLC or BSC environment. The program allows the Series/1 to conform to the protocol required by the host system. The BSC option

features the Series/1 as a multitasking RJE (MRJE) workstation over a point-to-point (switched or nonswitched) connection. The SDLC option features the Series/1 as an SNA RJE workstation over a point-to-point or multipoint connection. Users can place advanced RJE commands in a direct access data set, and the program will read the commands as if they were entered via a display terminal. The ARJE also allows Series/1 users to query the host system as to the status of the previously submitted jobs. Configuration requirements for the ARJE program include either a 4954 or 4955 processor with 192KB of main storage, a Series/1 direct access device, a 4978, 4979 or 3101 display, an SDLC or BSC communications feature, and the RPS operating system.

The *RPS Remote Management Utility* consists of two programs, the RPS Remote Management Utility (BSC protocol) and the RPS SNA Remote Management Utility (SDLC protocol), facilitate the operation of a remote Series/1 in a distributed data processing system. As a network management tool, the programs can access a Series/1 from a System/370 or another Series/1 and issue RPS operator commands, including transmit, receive, create, reset, or delete a data set on the remote Series/1; and schedule programs on a Series/1 for execution, including utilities, storage dumps, and other remote management environment diagnostic aids. This program also includes a Virtual Telecommunications Access Method (VTAM) application program to provide the controlling code on a System/370.

The *5259 Information Display System Attachment Support* program provides definition and execution time facilities to assist the user in the control of 5250 information display system units. Functions provided are attachment initialization, verification test facilities, screen formatting macros, and utility functions.

UTILITIES: A variety of utility programs are supported by both the EDX and RPS operating systems.

The *EDX Program Preparation Facility* allows the user to compile and link edit application programs (using EDX language macros) concurrently with the execution of other programs (including other program preparation partitions). The user can also reconfigure, compile, and link edit custom supervisors online.

The *EDX Macro Library/Host* is a set of libraries and procedures that reside on a System/370 and includes a macro library containing Series/1 instructions, and a data set containing sample Job Control Language (JCL). It provides the capability to assemble application programs written in the Event Driven Language and/or the Series/1 instruction set on a host System/370.

The *EDX Macro Library*, in conjunction with the EDX Macro Assembler, can be used to build a basic supervisor and emulator or to assemble application programs written in the EDX instruction set and/or the Series/1 instruction set.

This licensed program is a set of libraries and procedures that provide the capability to assemble application programs written in the EDX instruction set and/or Series/1 instructions on a host System/370 using the System/370 Program Preparation Facilities for Series/1 FDP. Communications with the host System/370 is supported by either the System/370 EDX Host Communications Facility IUP or the Remote Job Entry capability of the EDX utilities.

The Series/1 Data Collection Interactive is an individually licensed PRPQ that provides additional function for the EDX and consists of a set of functional modules that interface with, and require, the EDX. It supports the attachment of up to thirty-one 5234 Time Entry Stations and 5235 and/or 5236 Data Entry Stations in any combination. The 5235

## IBM Series/1

► and 5236 Data Entry Stations may also have the 5239 Value Read Module attached. Some of the functional capabilities are: personalization prompting on the Series/1 console, configuration modification, program selectable time of day option, on-line test initialization, audible alarm initiation, error handling, and data routing to storage or to disk/diskette. Some potential applications could include time and attendance, data base inquiry, shop floor control, and inventory updating.

The *RPS Native Application Load Facility* provides a means of transmitting programs to and from the System/370 for host preparation. Key features include commands to initiate and control data transfer; a transparent data scheme to permit the transfer of load modules and data from System/370 to Series/1; and error features for detecting machine check, communication failure, and program check interrupts.

The *RPS Host Preparation Facility* provides the following support for the Series/1: translation of Series/1 source programs written in Assembler language into machine language instructions, producing Series/1 object modules; printed output, including program listing, symbol dictionaries, cross-reference, and diagnostic messages; an application builder that prepares object modules for execution by building load modules or task sets that can execute on the Series/1; a host application load facility that can be invoked through TSO to transmit Series/1 object code from the System/370 to the Series/1 for execution across BSC lines.

The *RPS Program Preparation Subsystem* provides a group of components that assist in developing and executing user programs. The components include a text editor, a macro assembler, an application builder, a macro preprocessor, a job stream processor, a command language facility, and a system facility that provides the ability to generate a customized operating system.

The *Job Stream Processor* is provided for those who require only the Job Stream Processor portion of the Program Preparation Subsystem. This program invokes programs and supplies control information to the system in production job streams.

The *RPS Query* program provides interactive user-friendly access to data stored in Series/1 an Indexed Access Method or sequential file. This program is for use with the Realtime Programming System Multiple Terminal manager and can also be used in a batch processing mode by a user application program. Query permits users to access their data in the form of tables consisting of rows (representing records) and columns (representing data fields). Users can create table descriptions which describe how information from a user file is presented. These table descriptions are then used by Query to allow information retrieval from Indexed Access Method or sequential files. Record update, delete and insert, and request journaling are also available using an Indexed Access Method file.

Using the Query interactive interface, users can specify ad hoc queries or executive predefined queries. The results of a query can be displayed at a terminal, printed, or written to an output file for subsequent processing. A menu-driven Query utility interface is provided to define the physical layout of fields in user files, create table descriptions, predefine queries, and assign passwords. This interface utilizes prompt-response menu screens. Maintenance routines are provided to perform copy, update, delete, and rename functions for file descriptions, table descriptions, and predefined queries.

*EDX Query* provides interactive, user-friendly access to data stored in an Indexed Access Method or sequential file. This program is for use with the Event Driven Executive

Multiple Terminal Manager and can also be used in background mode by a user application program. EDX Query offers the same functions as RPS Query.

*EDX Multiple Terminal Manager*: A licensed program that provides a set of high-level functions designed to simplify development (design and implementation) of transaction oriented applications. High-level language programs (Cobol, Fortran IV, or Event Driven Executive language) can execute in an interactive environment where one or more applications run concurrently using one or more display devices. Full screen support for the IBM 4978 and 4979 display stations includes write variable data (scatter write), read unprotected data from screen, set tone alarm, and PF key support.

Screens designed using an EDX Utility can be used with Multiple Terminal Manager transaction applications written in Cobol, Fortran IV, or the EDX language.

*RPS Sort/Merge*: The Sort/Merge program handles sorting and merging of records from eight input data sets into one output data set in either ascending or descending order. The user specifies one or more control fields in the records to be sorted; the program then compares the control fields to determine the relative sequence of the records. Sort/Merge can execute either as a batch job under the job stream processor or in a foreground partition under the Realtime Programming System.

*EDX Sort/Merge* handles the sorting and merging of records from up to eight input data sets into one output data set in either ascending or descending order. The user specifies one or more control fields in the record to be sorted. EDX Sort/Merge accepts fixed length or variable-length records in unblocked or blocked formats (variable-length records are only supported by the Series/1 EDX Cobol Compiler and associated libraries); initiates program execution either as a batch job or from a user routine written in Series/1 Assembler language, Series/1 Cobol, or EDX language; permits userwritten exit routines to handle I/O errors and process records during Sort/Merge execution; permits deviation from the standard EBCDIC or ASCII collating sequence at program execution; allows multiple sorts to be invoked from the same application; and routes messages to the operator workstation or printer. Output from the EDX Sort/Merge program is limited only by output data set size and can be one of four types: address sort, record sort, record summary sort, or merge.

The *RPS Indexed Access Method* provides keyed access to user data to support applications ranging from batch processing to multiuser, interactive applications. The data file organization is designed to provide efficient random and sequential processing of files. The access method design supports files which have high add/delete activity, minimizing performance degradation. This is accomplished by distributing free space for additions throughout the file, by updating and inserting additions in place, and by dynamically reclaiming space after deletions. The Indexed Access Method also supports multiple tasks sharing the same data files. In a shared environment, data integrity is maintained by record level locking, preventing multiple concurrent updates of the same record.

The Indexed Access Method program includes the following functions: required DSD name referencing, generating a free pool area for reserved blocks, key modification verification, selectable write/verify option, automatic index file closing and freeing of access method resources, a macro for obtaining information about a file, and a utility program for creating an indexed file. It also supports a secondary index support feature; a data paging function that utilizes unmapped storage; and a set of enhanced utilities that have simplified procedures in file definition/creation, file load/unload, and file organization. ►

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► **EDX Indexed Access Method** program provides data management facilities supporting indexed file operations for the Series/1 EDX. It allows the user to build, access, and maintain user-defined records in indexed data sets via a predetermined field called a key. The Indexed Access Method builds an index of keys that provides fast access to records in a data set. The access method supports a high degree of insert/delete activity, providing both direct and sequential access to the data from multiple programs concurrently accessing the same or different indexed data sets. A single copy of the Indexed Access Method supports multiple programs and tasks sharing the same data files. In a shared environment, data integrity is maintained by record and block level locking to prevent access to an indexed or data record while the record is being modified.

Applications that use the Indexed Access Method support can be programmed in the EDX language, Series/1 Assembler, PL/1, or Cobol. The Indexed Access Method is also supported by the Series/1 EDX Sort/Merge licensed program, which will accept Indexed Access Method data sets as input files.

In addition to the utilities supported by the EDX and RPS operating systems, Standalone Programs Support is also offered to allow users to develop an application without using either of the two operating systems. A list of these programs follows:

The **System Control Program** is a set of standalone facilities to provide the programmer with the most commonly used facilities in a standalone environment. The characteristics of the program include an operator station for interactive utility operation, utilities loaded from diskette by name, and unrecoverable errors return control to operator. Separate utilities functions within the SCP program provide disk and diskette IPL bootstraps, disk and diskette initialization, disk and diskette printer dumps, disk and diskette copy programs, disk and diskette patch programs, storage dumps to diskette or printer, automatic system build and verification utilities, and error logging facilities.

The **3101 Full Screen Support** program provides programming support for the IBM 3101 Models 20, 22, and 23 display stations.

The **Base Program Preparation Facilities** provides the programmer with the tools needed to create, enter, edit, compile, and link edit application programs. The package consists of three subsystems: a text editor, macro assembler, and linkage editor.

The **Control Program Support** provides task management and input/output support for application programs. It also includes facilities for timer support, error logging, and installing the disk bootstrap and loader program.

The **Address Relocation Translator** provides users with the capability to address storage above 64KB. It also provides multiple address space management support and program debugging support for systems using the storage address relocation feature.

The **Commercial Arithmetic** program consists of a set of macros that perform add, subtract, multiply, divide, and compare operations for up to 15 packed decimal digits per operand.

The **Binary Synchronous Communications Control Program Support** extends Control Program Support to provide read/write support for the IBM 2074, 2075 and 2093 communications features.

The **Sort/Merge** routine can create a sorted tag-along output file from key fields contained in from one to seven input files

on disk or diskette. Sorting on EBCDIC, signed binary, or single-precision floating-point key fields is provided.

**OFFICE AUTOMATION:** A variety of office systems programs are available for the Series/1, which include the following:

The **Department Office Control System** is an EDX program designed to enhance the operations and management of an environment that has multiple IBM Personal Computers installed. This program offers a range of automated office functions, similar to the Professional Office System (PROFS), including electronic mail, note and document management, personal scheduling/calendaring, personal computer file archiving/sharing, document printing, access to 3270 host-base applications (optional), and batch file transfer to/from host (optional).

The **Subscript** program offers functions under the EDX operating system for word processing. This product is designed for the preparation of letters, documents, manuals, and other text material on a Series/1 using an upward-compatible subset of the Script/VS IBM program product. The entry of text is accompanied by the entry of control characters which instruct the Subscript formatter how to process the text.

The **Audio Distribution System** is a Series/1-based voice store-and forward message system. It provides direct support for a network of business principals, such as managers, professionals, sales personnel, and other key operating personnel, in their daily communications activities. The system supports up to 3,000 subscribers, up to 16 telephone ports, online subscriber maintenance, up to four languages, host message notification, additional message retention granularity, remote support link, enhanced security options, increased message storage capacity, subscriber-selectable "no call" option, and expanded hardware support.

**Letter Writer:** Executes in conjunction with the RPS Multiple Terminal Manager. The system uses a full-screen display terminal to provide word processing capability. The Letter Writer provides the basis for word processing applications that execute with data processing applications. Other unrelated programs can operate concurrently with the Letter Writer, and data files can be merged with text files if desired. Uses of the Letter Writer program include the preparation of correspondence documents for such uses as mass mailings, letters, and proposals.

**Text Routing System:** A standalone program that allows the Series/1 to act as a communications controller for a local or a remote office systems network. This field-developed program allows sharing of non-Series/1 devices in an office systems environment; provides for additional online storage of information for an office system workstation; allows high-speed transfer of data to a Series/1 for rapid availability by a receiving station; and provides an interface to a Telex network. The program allows the IBM 6640 Document Printer, the IBM Magnetic Card II Typewriter, the IBM 6670 Information Distributor (binary synchronous only), and a full range of IBM Office System 6 Information Processors to act as workstations and communicating terminals.

**APPLICATIONS:** For users interested in minimizing their development effort, IBM offers Series/1 applications software that addresses range of uses including, but not limited to, the following:

- Energy management
- Pharmacy systems
- Videotex
- Text entry and editing
- Telephone listing management
- X-Ray analysis

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- Audio distribution
- Data collection
- Data entry
- Automobile dealer/heavy equipment management
- Remote job entry
- Batch entry
- Word processing
- Publishing
- Insurance
- Manufacturing
- Sales and distribution
- Accounting

With the standalone program support programs, users can also develop their own software to meet their individual needs (see the Utilities portion of the Software section for more information).

In addition to the IBM-developed and individually-developed programs, a large array of applications software is available for the Series/1 through third party vendors.

### PRICING

**POLICY:** The Series/1 is offered on a purchase-only basis, at prices ranging from approximately \$8,500 to over \$100,000 depending on configuration. Purchase prices include installation and a three-month parts and labor warranty. On-site physical planning is separately priced. On-site support for the Standalone Utilities is provided by a Customer Engineer at no additional charge.

The discount schedule for Series/1 processors is as follows:

Quantity of Eligible Machines	Volume Purchase Discount Percent
5-9	7%
10-19	10%
20-34	17%
35-49	22%
50 or more	28%

The majority of Series/1 programs are offered with an option of a continuous monthly charge or a one-time charge with future payments waived. Under either payment option, the licensed program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs. For most Series/1 software offerings, there is a one-time process charge to cover the cost of distribution of basic machine-readable material, including service updates.

**SUPPORT:** The Series/1 is supported nationwide by trained IBM Customer Service Representatives who will install the Series/1 and perform extensive tests and diagnostics. The Customer Service Representatives are backed by a country-wide parts distribution network, and are equipped with a variety of portable diagnostic tools to pinpoint trouble areas. Customer Service Representatives are available 24 hours a day, 7 days a week to help solve any problems that may occur during or after installation.

Programming support and advice and assistance in the development and writing of tailored operating systems and applications programs are provided as available under a systems engineering contract.

**TRAINING:** IBM offers a variety of self-study and classroom training courses on the operation of the Series/1 system. The courses are geared for different levels of personnel, including systems support, programming, and operations staff.

### TYPICAL CONFIGURATIONS: Small Distributed Commercial System

Hardware	Purchase Price (\$)
4954 Model B Processor with 64K bytes of storage	8,500
6307 2 Storage Addition Modules, 64K bytes of storage	625
4520 Stand-Alone Enclosure	371
1310 Multifunction Attachment	2,040
5770 3 Multifunction Local Attachment Cables	306
2057 EIA Dataset Cable	87
3101 2 Model 13 Display Terminal	3,250
4975 Model 01L Printer (80 cps)	2,860

Software	Monthly Charge (\$)
5719-XS4 Event Driven Executive Basic Supervisor and Emulator (V4)	132

### Multifunction Work Station Application #1

Hardware	Purchase Price (\$)
4954 Model C Processor 64K bytes of storage	11,800
6307 3 Storage Additions 192K bytes of storage	1,875
5655 Programmer Console	820
1310 2 Multifunction Attachments	4,080
5770 6 Multifunction Local Attachment Cables	612
2057 EIA Dataset Cable	87
3101 6 Model 23 Display Terminals	9,750
4963 Model 64A Disk Subsystem (64M)	13,340
3590 4963 Disk Subsystem Attachment	1,920
4966 Diskette Magazine Unit	6,160
1205 4966 Diskette Magazine Unit Attachment	2,520
4973 4973 Model 2 Printer (400 lpm)	14,910
5630 4973 Line Printer Attachment	1,125
4997 Model 2B Rack Enclosure	1,715

Software	Monthly Charge (\$)
5719-XS4 Event Driven Executive Basic Supervisor and Emulator (V3)	132
5719-UT5 Event Driven Executive Utilities (V3)	38
5719-CB7 Event Driven Executive Cobol Compiler and Resident Library Version 2	163
5719-CB8 Event Driven Executive Cobol Transient Library Version 2	20
5719-MS2 Event Driven Executive Multiple Terminal Manager Version 2	24
5719-AM4 Event Driven Executive Indexed Access Method (V2)	52
5719-SM2 Event Driven Executive Sort/Merge	12

### IBM Series/1

▶ Multifunction Work Station Application #2		5225	Model 4 Printer (560 lpm)	16,940
		5640	Printer Attachment—5200 Series	3,035
		5780	20-foot Attachment Cable	125
		4997	Model 2B Rack Enclosure	1,715
<b>Hardware</b>	<b>Purchase Price (\$)</b>			<b>Monthly Charge (\$)</b>
4956	Model B Processor 256K bytes of storage	14,150		
6330	Storage Addition 256K bytes of storage	2,500	<b>Software</b>	
1250	Multidrop Workstation Attachment	3,200	5719-XS4 Event Driven Executive Basic Supervisor and Emulator (V3)	124
4980	8 Display Stations	23,800	5719-CB5 Event Driven Executive Cobol Compiler and Resident Library (V2)	163
5780	2 20-foot Attachment Cables	250	5719-CB6 Event Driven Executive Cobol Transient Library Version 2	20
2074	Binary Synchronous Communication Single-Line Control	1,490	5719-MS2 Event Driven Executive Multiple Terminal Manager Version 2	27
2057	EIA Dataset Cable Terminals	87	5719-AM4 Event Driven Executive Indexed Access Method (V2)	52
4967	Model 2CA Disk Subsystem (200MB)	24,000	5719-SM2 Event Driven Executive Sort/Merge	12
3595	4967 Disk Subsystem Attachment	6,000		
4966	Diskette Magazine Unit	6,160		
1205	4966 Diskette Magazine Unit Attachment	2,520		

### EQUIPMENT PRICES

		<b>Purchase Price (\$)</b>	<b>Monthly Maint. (\$)</b>
<b>PROCESSORS AND MAIN STORAGE</b>			
4954A	Processor; half-width module, 64K bytes basic memory, 4 I/O feature slots	7,800	41.00
4954B	Processor; full-width module, 64K bytes basic memory, 13 I/O feature slots	8,500	45.00
4954C	Processor; full-width module, 64K bytes basic memory, 3 I/O feature slots	11,800	65.00
4956B	Processor; full-width module, 256KB basic memory and 13 I/O feature slots	14,150	37.00
4956C	Processor; full-width module, diskette drive, 256KB basic memory and 3 I/O feature slots	16,855	57.00
4956E	Processor, full-width module, 512KB basic memory, 13 I/O slots	16,500	59.00
495430D	4954 Model 30D, full-width module, 32KB basic memory, 6 I/O feature slots, disk	17,800	79.00
495630D	4956 Model 30D, full-width module, 256KB of memory, 6 I/O slots, disk	23,360	75.00
485460D	4954 Model 60D	19,800	98.00
495660D	4956 Model 60D	23,700	102.00
495660E	4956 Model 60E, 512 KB of memory, 6 I/O feature slots	27,600	126.00
6307	64KB Storage Addition Card for the 4954 processor	625	2.50
6330	256KB Storage Addition Card for the 4956 processor	2,500	16.00
6331	512KB Storage Addition Card for Model 30D	5,000	48.00
6332	512KB Basic Storage Expansion for Model 30D	2,500	32.00
6333	512KB Storage Addition Card for the 4956 processor	3,750	48.00
<b>PROCESSOR FEATURES</b>			
4959	Input/output expansion unit	3,290	36.00
4965	Model 1 Diskette Drive and I/O Expansion Unit	6,635	38.00
4965	Model 30D Storage and I/O Expansion Unit	13,500	58.00
4965	Model 60D Storage and I/O Expansion Unit	16,100	88.00
6400	Cache option	2,880	14.00
3925	Floating-point; 4954 and 4956 processor	635	2.00
1590	Customer access panel	225	1.50
1593	Customer access panel—integrated digital I/O output cable	484	1.00
1594	Customer access panel—customer direct program control adapter cable	339	1.00
1595	Channel socket adapter	90	1.00
4540	Rack mounting fixture	68	NC

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	Purchase Price (\$)	Monthly Maint. (\$)
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### PROCESSOR FEATURES (Continued)

4997-1A	Rack enclosure, Model 1A	1,130	2.00
4997-1B	Rack enclosure, Model 1B	1,335	2.00
4997-2A	Rack enclosure, Model 2A	1,510	5.00
4997-2B	Rack enclosure, Model 2B	1,715	5.00
4999-1	Battery backup, Model 1	2,470	15.00
4999-2	Battery backup, Model 2	2,440	16.00
5430	Customer direct program control adapter	830	8.50
5655	Programmer console; 4954 and 4956 processors	820	3.00
7777	Programmable Two-Channel Switch	6,775	9.00
7840	Timers	716	4.00
7900	Two-channel switch; plugs into 4959 and 4965 expansion units	3,330	8.50

### MAGNETIC TAPE EQUIPMENT

1215	4969 Magnetic Tape Subsystem attachment	1,640	3.00
4968-1AS	Automatic Stream Mag Tape Unit	8,250	23.00
1220	Attachment feature for 4968	3,250	10.00
1545	4969 Magnetic Tape Subsystem Controller, 1600 bpi	5,690	53.50
1550	4969 Magnetic Tape Subsystem Controller; dual density	5,955	60.50
4969	Magnetic Tape Subsystem; Model 4P, 45 ips, PE	12,250	83.50
	Magnetic Tape Subsystem; Model 7P, 75 ips, PE	16,170	108.00
	Magnetic Tape Subsystem; Model 7D, 75 ips, dual	16,960	111.00

### MASS STORAGE

4962-1	Disk Storage Unit; 9-megabyte capacity, nonremovable disk	9,025	53.50
4962-1F	Disk Storage Unit; 9-megabyte capacity on nonremovable disk, 123K additional bytes on fixed-head disk	10,160	72.50
4962-2	Disk Storage Unit; combination disk/diskette unit, 9-megabyte capacity on nonremovable disk, 606K-byte capacity on removable diskettes	11,230	72.50
4962-2F	Disk Storage Unit; combination disk/diskette unit, 9-megabyte capacity on nonremovable disk, 123K-byte capacity on fixed-head disk, 606K-byte capacity on removable diskettes	12,360	92.50
4962-3	Disk Storage Unit; 14-megabyte capacity, nonremovable disk	11,250	75.50
4962-4	Disk Storage Unit; combination disk/diskette unit, 14-megabyte capacity on nonremovable disk, 606K-byte capacity on removable diskettes	13,450	103.00
4963-23A	Disk Storage Subsystem; primary disk unit with 23-megabyte capacity on nonremovable disk and an additional 131K bytes under fixed heads	12,560	56.00
4963-23B	Disk Storage Subsystem; expansion drive, same characteristics as 4963-23A	10,390	53.00
4963-29A	Disk Storage Subsystem; primary disk unit with 29-megabyte capacity on nonremovable disks	11,780	41.00
4963-29B	Disk Storage Subsystem; expansion drive, same characteristics as 4963-29A	9,610	38.00
4963-58A	Disk Storage Subsystem; primary disk unit with 58-megabyte capacity on nonremovable disk and an additional 131K bytes under fixed heads; up to three 4963-58B or 4963-64B disk units can be attached	14,120	66.00
4963-58B	Disk Storage Subsystem; expansion drive, same characteristics as 4963-58A	11,950	63.00
4963-64A	Disk Storage Subsystem; primary disk unit 64-megabyte capacity on nonremovable disk; up to three 4963-58B or 4963-64B disk units can be attached	13,340	51.00
4963-64B	Disk Storage Subsystem; expansion drive, same characteristics as 4963-64A	11,170	48.00
4964	Diskette Unit; 606K-byte capacity on removable, 2-sided diskettes	3,005	17.00
4965	Diskette Unit and I/O Expansion Unit; 1.2M-byte capacity on removable 2-sided diskettes; 4 additional feature locations	6,635	36.00
4966	Diskette Magazine Unit; provides random access to 23 diskettes contained in two 10-diskette removable magazines and three individual diskettes; up to 27.8-megabyte capacity	6,160	76.50
4967-2CB	High performance disk subsystem	19,900	61.00
3595	Attachment Feature for the 4967	6,000	26.00
1205	4966 Diskette Magazine Attachment	2,520	4.00
3580	4962 Disk Storage Unit Attachment	1,025	7.00
3581	4964 Diskette Unit Attachment	875	6.00
3590	4963 Disk Subsystem Attachment	1,920	4.00
4100	4965 Second Diskette Drive	1,830	10.00

### PRINTERS

4973-1	Line Printer; 132 columns; 48-, 64-, or 96-character set; 150 lpm	10,350	85.00
4973-2	Line Printer; 132 columns, 48-, 64-, or 96-character set; 400 lpm	14,910	143.00
4974	Printer; wire-matrix print head, 132 columns, EBCDIC 64-character set; 120 cps	3,470	44.00
4975-01L	Printer (local); 80 cps, 184-character set, 6 or 8 lpi, 10 or 15 cpi	2,860	31.00
4975-02L	Printer (local); 160 cps (draft), 40 cps (letter), 184-character set, 6 or 8 lpi	4,175	38.00
4975-01R	Printer (remote); 80 cps, 184-character set, 6 or 8 lpi, 10 or 15 cpi	2,860	38.00
4975-02R	Printer (remote); 160 cps (draft), 40 cps (letter), 184-character set, 6 or 8 lpi	4,175	46.00

IBM Series/1

PRINTERS (Continued)		Purchase Price (\$)	Monthly Maint. (\$)
5219	Model B1 Impact Printer; 40 cps	5,265	42.00
	Model B2 Impact Printer; 60 cps	5,680	46.50
	Model D1 Impact Printer; 40 cps	5,420	54.00
	Model D2 Impact Printer; 60 cps	5,835	58.50
5224	Model 1 Line Printer; 95/140 lpm	6,395	48.00
	Model 2 Line Printer; 170/240 lpm	7,280	57.00
5225	Model 1 Line Printer; 195/280 lpm	12,075	109.00
	Model 2 Line Printer; 290/400 lpm	13,945	152.00
	Model 3 Line Printer; 35/490 lpm	15,495	188.00
	Model 4 Line Printer; 420/560 lpm	16,940	224.00
5256	Model 1 Impact Printer; 40 cps	4,145	49.00
	Model 2 Impact Printer; 80 cps	4,340	53.00
	Model 3 Impact Printer; 120 cps	4,535	60.00
5620	4974 Printer Attachment	1,110	3.50
5630	4973 Line Printer Attachment	1,125	5.00
5640	5200 Series Printer Attachment	3,035	9.00

TERMINALS

3101	Display Terminal; 1920 character display	1,405	—
4704	Display terminal	1,034	12.00
4978	Display Station; 80 characters by 24 lines, cycle-steal operations and buffered microprocessor control	1,570	17.00
D02038	4978 Display Station Attachment	1,665	14.00
D02056	4978 Keyboard; typamatic mode keys (cursor, space, and all other than fixed-function keys); extended	1,030	11.00
D02057	4978 Keyboard; typamatic space key; basic	1,000	11.00
4979	Display Station; 80 characters by 24 lines, integrated keyboard, cycle-steal operations and buffered microprocessor control	2,265	19.50
4980	Display Station; 80 characters by 24 lines; 1,920 character display	2,985	260.00
5251	Model 11 Display Station; 1,920 character display	2,135	18.50
3585	4979 Display Station Attachment	1,200	7.00

COMMUNICATIONS

1300	Programmable communications subsystem controller	2,495	26.00
1400	Local communications controller	3,365	14.50
1610	Asynchronous communications single-line control	1,360	9.50
2000	Communications indicator panel	314	3.00
2010	Communications power; 4955 only	150	3.00
2074	BSC single-line control	1,265	11.50
2075	BSC single-line control/high-speed	1,730	11.50
2080	Synchronous Single Line Control/High speed	3,310	25.00
2090	SDLC single-line control	1,510	11.50
2091	Asynchronous communications 8-line control	1,220	9.50
2092	Asynchronous communications 4-line adapter	1,260	19.50
2093	BSC 8-line control	1,520	9.50
2094	BSC 4-line adapter	1,565	24.50
2095	Feature-programmable multiline communications; 8-line control	1,300	7.00
2096	Feature-programmable multiline communications; 4-line adapter	1,225	20.00
4730	Half-duplex DCE attachment	426	2.50
4731	Full-duplex DCE attachment	419	2.50
4734	TTY-current attachment	700	4.00
4736	Data-Phone digital service adapter	1,132	4.50
4739	Asynchronous local attachment	467	1.50
4740	Synchronous local attachment	492	2.00
4743	Autocall attachment	432	2.50
4746	1200 bps asynchronous modem, switched network	1,200	7.50
4747	1200 bps asynchronous modem, leased line SNBU	1,330	8.00
4748	1200 bps asynchronous modem, leased line	1,205	7.50
4751	1200 bps synchronous modem with clock, switched network	1,235	7.50
4752	1200 bps synchronous modem with clock, leased line SNBU	1,370	8.00
4753	1200 bps synchronous modem with clock, leased line	1,240	7.50
4940	Multiplexer, reed relay	850	12.00
4950	Multiplexer, solid state	934	7.00
4987	Programmable communications subsystem, Model 1	5,205	45.00
4990	Communications console, Model 1	975	2.00
7850	Teletypewriter adapter	705	6.00
7880	Telecommunications controller	2,960	7.00
7881	Telecommunications adapter	3,960	48.50

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		Purchase Price (\$)	Monthly Maint. (\$)
<b>USER ATTACHMENT FEATURES</b>			
1060	Analog input control	1,045	4.50
1065	Analog output	687	5.00
1070	Amplifier, multirange	1,190	5.00
1200	System/370 channel attachment	2,130	10.50
1210	5250 Information Display System Attachment	3,705	9.50
1310	Multifunction Attachment; for 4 device attachments (local or remote) for 3101 Display Terminal or 4975 Printer	2,400	9.00
1560	Integrated digital I/O, nonisolated	1,035	11.50
1565	Channel repower	655	2.50
3525	Digital input/process interrupt, nonisolated	535	4.00
3532	Digital input/process interrupt, isolated	908	3.00
3535	Digital output, nonisolated	462	4.00
4982	Sensor I/O unit	2,155	11.00
4993	Series/1-System/370 termination enclosure, Model 1	3,290	23.50
6305	4982 Sensor I/O attachment	818	6.50

## SOFTWARE PRICES

		Monthly Charge (\$)	One-Time Charge (\$)
<b>LICENSED PROGRAMS</b>			
5719-PC1	Realtime Programming System, Version 1	30	1,320
5719-PC2	Version 2	38	1,650
5719-PC3	Version 3	48	2,090
5719-PC4	Version 4, with Command Language Facility	74	3,230
5719-PC5	Version 5, with Command Language Facility	175	4,940
5719-PC6	Version 6, with Command Language Facility	476	7,500
5719-AM1	RPS Indexed Access Method, Version 1	24	990
5719-AM2	Version 2	52	1,150
5719-AM3	EDX Indexed Access Method, Version	26	1,135
5719-AM4	Version 2	52	1,500
5719-AS1	Program Preparation Subsystem, Version 1	27	1,210
5719-AS2	Version 2	30	1,325
5719-AS3	Version 3	33	1,450
5719-AS4	Version 4	36	1,580
5719-AS5	Version 5	166	4,675
5719-AS6	Version 6	256	5,265
5719-ASA	EDX Macro Assembler	21	888
5719-CA1	System/370 Channel Attachment	33	1,305
5719-CB1	Cobol Compiler and Resident Library	108	4,680
5719-CB2	Cobol Transient Library	9	379
5719-CB5	EDX Cobol Compiler and Resident Library, Version 2	163	4,710
5719-CB6	EDX Cobol Transient Library, Version 2	20	601
5719-CB7	RPS Cobol Compiler and Resident Library, Version 2	163	4,710
5719-CB8	RPS Cobol Transient Library, Version 2	20	601
5719-CF1	EDX Communications Facility	63	2,200
5719-CM1	Communications Monitor for Series/1	174	5,515
5719-CM2	Communications Manager	361	5,550
5719-CR1	Structured Program Facility MVX/VTAM	318	—
5719-CR2	Structured Facility MVS/TCAM	318	—
5719-CS0	Program Communications Subsystems Preparation Facility	12	523
5719-CS1	Program Communications Subsystem Execution Support	9	351
5719-CS2	Program Communications Subsystem Extended Execution Support	32	1,200
5719-CX1	EDX System/370 Channel Attachment	105	2,820
5719-FO1	Fortran IV Compiler and Object Support Library	21	950
5719-FO2	Fortran IV Compiler and Object Library	21	950
5719-FO3	Fortran IV Realtime Subroutine Library, Version 1	8	316
5719-FO4	Version 2	9	351
5719-HD1	X.25/HDLC Communication Support	148	2,500

## IBM Series/1

LICENSED PROGRAMS (Continued)		Monthly Charge (\$)	One-Time Charge (\$)
5719-LM1	Math and Functional Subroutine Library (MFSL)	10	448
5719-LM2	Math and Functional Subroutine	12	502
5719-LM3	EDX Math and Functional Subroutine Library	12	502
5719-LM5	EDX Macro Library, Version 1	44	1,910
5719-LM6	Version 2	58	2,575
5719-LM7	Version 3	80	2,665
5719-LM8	Version 4	216	2,665
5719-MS1	EDX Multiple Terminal Manager, Version 1	24	937
5719-MS2	Version 2	27	727
5719-MT1	Realtime Programming System Multiple Terminal Manager, Version 3	34	750
5719-PA1	Base Program Preparation Facility	135	2,375
5719-PL1	PL/1 Compiler and Resident Library, Version 1	70	3,060
5719-PL2	Version 2	189	7,425
5719-PL3	PL/1 Transient Library, Version 1	8	316
5719-PL4	Version 2	35	1,370
5719-PL5	PL/1 EDX Compiler and Resident Library	189	7,425
5719-PL6	PL/1 EDX Transient Library	35	1,370
5719-RJ1	EDX Advanced Remote Job Entry	62	1,050
5719-RJ6	RPS Advanced Remote Job Entry	34	1,050
5719-RM1	EDX Remote Manager	125	2,000
5719-RM6	RPS Remote Manager	125	2,000
5719-SC2	Standalone Disk Utilities	N/C	N/C
5719-SF1	RPS Screen Format Design Aid Utility	20	865
5719-SF2	RPS Screen Format Presentation Support	30	1,220
5719-SM1	Sort/Merge	10	315
5719-SM2	EDX Sort/Merge	12	360
5719-SN1	RPS Version 5 SNA Extended Support	103	2,905
5719-SX1	EDX System Network Architect (SNA)	71	2,005
5719-SX2	System Network Architect (SNA) RJE	32	1,000
5719-TA1	5250 Info Display System Attachment Support	33	1,290
5719-TA4	4969 Mag Tape Subsystem Support	32	1,220
5719-UT3	EDX Utilities, Version 1	19	792
5719-UT4	Version 2	22	1,135
5719-UT5	Version 3	38	1,165
5719-U11	FC/PM 1	196	6,515
5719-U12	FC/PM 2	283	9,430
5719-U13	FC/PM 4	390	12,980
5719-U14	FC/PM 2M	139	4,610
5719-U15	FC/PM 4M	172	5,765
5719-U20	IBM Audio Distribution System	449	12,700
5719-U21	Audio Distribution System, Version 2	950	15,200
5719-XR1	Event Driven Executive Query	27	792
5719-XR2	Realtime Programming System Query	27	792
5719-XS1	EDX Supervisor and Emulator, Version 1	26	1,055
5719-XS2	Version 2	33	1,368
5719-XS3	Version 3 (Basic)	47	1,440
5719-XS4	Version 4	132	1,900
5719-XX2	EDX Program Preparation Facilities, Version 1	25	990
5719-XX3	Version 2	31	1,360
5719-XX4	Version 3	46	1,410
5719-XX5	EDX Preparation	174	2,925
5740-LM2	EDX Macro Library/Host, Version 1	133	1,332
5740-LM3	Version 2	181	1,812
5740-LM4	Version 4	226	2,268
5740-LM5	EDX, Version 4, Macro Library/Host	357	5,010
5796-NPP	Series/1 Debugging Aid	—	189
5796-NPW	Virtual Cobol Computer	356	—
5796-NQE	Waterloo Interactive Direct Job Entry Terminal System	166	—
5796-NRD	Distributed Processing System	195	—
5796-NTP	Program Executive System Preparation Support	52	—
5796-NTQ	Program Executive System Execution Support	52	—
5796-NWZ	Heavy Equipment Dealer Parts Order Entry and Inventory Support System	575	—
5796-NZT	EDX Retail Pharmacy System	195	—
5796-RAL	Waterloo Virtual Basic	98	—
5796-REE	PXS-V3 Development Support	85	—
5796-REF	PXS-V3 Operational/Application Support	85	—
5798-DQG	Department Office Control System	—	1,800
5798-NLG	Intelligent Terminal Subsystem	126	—
5798-NNB	EDX Macro Library	28	1,635
5798-NNC	EDX Utilities	10	575
5798-NND	EDX Basic Supervisor and Emulator	13	747
5798-NPY	Intelligent Data Entry System	63	—
5798-NPZ	Remote Job Entry for Controller Program Support	29	—
5798-NQJ	Controlled Access System 1	166	—
5798-NRR	EDX Basic Supervisor and Emulator, Version 2	16	920

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LICENSED PROGRAMS (Continued)		Monthly Charge (\$)	One-Time Charge (\$)
5798-NTH	EDX Supermarket Energy Management	115	—
5798-NXQ	Intelligent Data Entry System II	109	—
5798-NXX	Audio Support for Touch-Tone Telephone	201	—
5798-NYA	Point-of-Sale Data Collection Distribution System	258	—
5798-NYG	Central Toll Data Collection	185	—
5798-NYH	Remote Toll Data Collection	100	—
5798-NYJ	Automated Instrument Control	15	—
5798-NYK	X-Ray Fluorescence Analysis	150	—
5798-NYL	X-Ray Polycrystalline Diffraction	120	—
5798-NZZ	Telephone Listing Management System	180	—
5798-RAB	EDX Energy Conservation System	149	—
5798-RAR	Text Entry and Edit Facility	276	—
5798-RBL	EDX File Create and Maintenance Utility	46	—
5798-RBR	Series/1 Native Application Load Facility	172	—
5798-RBY	Virtual Basic Supervisor	29	—
5798-RBQ	Specialized Terminal Interactive Processor	120	—
5798-RCG	X-Ray Search/Math	460	—
5798-RCX	Series/1 Data Collection Interactive Edit and Transmit	138	1,656
5798-RCZ	Series/1 General Purpose Automation Executive	250	6,000
5798-RFC	Communicating Job Stream Processor	—	650
5798-RFF	3101 Full Screen Control Program Support	—	282
5798-RHB	Laboratory Automation Software	300	3,600
5798-RRD	Programming Services for Multimedia Industrial Terminals	—	1,800
5798-ZZB	Virtual Cobol Control Program Support	58	—
5798-ZZC	EDX Communication Facility	40	—
5798-ZZF	Series/1 Communication Controller for System/38	250	—
5799-AXL	Intelligent Remote Station Support	114	—
5799-BEW	ACS Series/1 Support	1,660	—
5799-TAA	Control Program Support	20	480
5799-TAE	Display Station CPS	2	48
5799-TAF	BSC Control Program Support	5	120
5799-TAH	Indexed Access Method CPS	6	144
5799-TAJ	4991-201 M/S Card Reader CPS	14	336
5799-TAK	4978/4979 Display Station CPS	7	168
5799-TAL	CPS Extension 1	2	55
5799-TAQ	CPS Extension II	2	55
5799-TAT	CPS Sort/Merge	6	138
5799-TAW	CPS Disk Table of Contents	1	28
5799-TAY	CPS Disk Spooling	3	72
5799-TBA	CPS Format/Print	3	72
5799-TBB	CPS Operator Station/Debug Package	10	240
5799-TBC	CPS Auto-Call Interface	6	144
5799-TBD	CPS Commercial Arithmetic	2	55
5799-TBE	CPS 4978/4979 Display Map	5	120
5799-TBK	Remote Job Entry	38	2,280
5799-TBQ	CPS Extended Function	3	83
5799-TBT	CPS Address Translator Support	7	144
5799-TBY	RPS Address Translator Support, Version 3	3	180
5799-TCB	Indexed Access Method, Version 3	7	420
5799-TCE	RPS 4978 Display Support, Version 3	3	207
5799-TCH	RPS Disk Spooling, Version 3	3	207
5799-TCX	Communication Monitor for Series/1	100	4,960
5799-TCY	RPS Multiple Terminal Manager	921	11,052
5799-TCZ	CPS 4963 Subsystem	15	312
5799-TDE	Data Collect Interactive	29	1,425
5799-TDG	RPS Transient Activity Tool, Version 1	6	300
5799-TDH	RPS Remote Management Utility	7	420
5799-TDK	CPS 4963/4966 Save/Restore	15	358
5799-TDR	Site Universal Billing	84	1,875
5799-TDT	Host Universal Billing	205	4,580
5799-TDW	CPS 4969 Mag Tape Subsystem	56	1,350
5799-TDX	RPS Multiple Terminal Manager, Version 2	1,550	18,630
5799-TEC	RPS Job Stream Processor	13	535
5799-TEF	SNA Remote Management Utility	9	220
5799-TEK	CPS 4965 Support	42	1,000
5799-TEL	370 Host Cobol for Series/1 EDX	1,435	—
5799-TEP	370 Host Cobol for Series/1 RPS	1,435	—
5799-TER	Pascal Compiler and Object Library	195	3,900
5799-TEY	Series/1 Letter Writer, Version 2	100	1,200
5799-TFY	Telephone Message Management System, Version 1.2	—	19,800