IBM Series/1

MANAGEMENT SUMMARY

Announced in 1976, the IBM Series/1 is a family of small general purpose computers that can be used for a variety of data processing applications. The Series/1 represents a departure from tradition for IBM in that it is offered unbundled, is available on a purchase-only basis, and is offered on an OEM as well as an end-user basis.

Initially offered with a minimal amount of system software, IBM has since been making licensed programs, programming RPQ's, field-developed programs, and installed user programs available. Currently, the Series/1 is supported by a very respectable array of software products from IBM in addition to a raft of packages from software houses across the country.

Avoiding the term "minicomputer," IBM calls the Series/1 "a family of powerful and versatile computers that you can apply to virtually any computing task: sensor-based applications, traditional data processing, scientific computing, distributed data processing." The same company literature goes on to say that the Series/1 has attachment features that allow the user "to link equipment you may already have—both IBM and non-IBM terminals, plotters, teletypewriter units, sensor-type devices, and more."

Currently, there are eleven members of the Series/1 family of 16-bit general-purpose processors. The eleven minicomputers (or in IBM's terms "small computers") are based on three microprocessor-based CPU's, the 4952 (Models A and B), the 4953 (Models A, B, C, and D), and the 4955 (Models A, B, C, D, and E). Cycle time for the 4952 is 2.1 microseconds; for the 4953, 800 nanoseconds; and for the faster 4955, 600 nanoseconds. According to IBM, the average instruction execution time (weighted) is 11.8 microseconds for the 4953 and 3.9 microseconds for the 4955. ▷

The IBM Series/1 minicomputer systems are offered as unbundled system components on a purchase-only basis. There are currently 3 processors and a total of 11 models in the Series/1 family.

MAIN MEMORY: 16K to 256K
DISK CAPACITY: Up to 256MB per I/O attachment
WORKSTATIONS: Up to 8 per I/O attachment
PRINTERS: 120 cps; 80 to 414 lpm
OTHER I/O: Magnetic tape, sensor, data collection

CHARACTERISTICS

MANUFACTURER

International Business Machines Corporation, General Systems Division, 5775 Glenridge Drive N.E., Atlanta, Georgia 30301. Telephone (404) 256-7000.

MODELS: Series/1 4952, Models A and B; 4953, Models A, B, C, and D; 4955, Models A, B, C, D, and E.
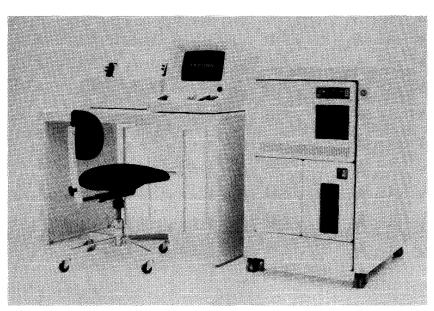
DATE ANNOUNCED: 4953 and 4955, November 1976; 4952, February 1979.

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-screen units offered with the Series/1.

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▷ Each processor also contains a power supply, basic storage, and space for storage additions, processor features, and I/O attachment features. A basic console is standard with either processor, and a programmer's console is available as an optional feature.

The 4952 processor, introduced in February, 1979, includes 32K-bytes of main storage, expandable to 128K bytes, eight general-purpose registers for each of four priority interrupt levels, and up to 256 I/O devices can be directly addressed. Model A is a half-width unit with 5 I/O feature locations. The Model B is a full-width processor with 14 I/O feature locations. Models A and B, with the basic 32K-bytes, sell for $4,600 and $6,150, respectively.

The 4953 Models A and C processors are housed in a half-width chassis (one-half the width of a standard rack), and each has four slots for either memory modules or I/O interfaces. The Models B and D processors are housed in a full-width chassis, and both have 12 memory or I/O slots. With 16K bytes of memory each, Models A and B are priced at $4,360 and $5,190, respectively. With 32K bytes of memory each, Models C and D are priced at $5,370 and $6,200, respectively.

In the 4955 processors, unlike the 4953's, memory and I/O controller modules cannot be intermixed; previously configured slots are required for each type. The Model A comes with eight I/O slots and three memory slots, while the Model B has only three I/O slots and seven add-on memory slots. The remaining slot in the Model B is for the storage address relocation translator (map). The Model C comes with 10 I/O feature slots. Models D and E each come with seven I/O feature slots.

As in the 4953's, the basic configuration of each 4955 system includes one 16K-byte memory module. The price for either the basic Model A or Model B is $6,165. The Model C and D are both priced at $7,400, and the Model E at $11,000. Additional 660-nanosecond, 16K-byte memory modules cost $1,580 each, and 64K-byte memory modules for the Model E cost $3,800 each. The map module for addressing above 64K bytes is priced at $805, and the floating-point feature costs $1,190.

The 4953 computers can address up to 64K bytes of memory, while the 4955 computers can support up to 256K bytes through optional mapping hardware. Storage protection is included on the 4955, and optional floating-point hardware is also available. Neither of these features is offered for the 4952 or 4953 units.

Configurations requiring additional I/O slots can be implemented through 14-slot I/O expansion units. On systems delivered after March 31, 1977, five I/O expansion units can be accepted. Systems previously delivered will be altered at no charge.

Peripherals for the Series/1 systems include 9.3-megabyte, Winchester-type disk storage modules with a 123K-byte fixed-head option; diskette drives; disk storage subsys- ▷

▶ and signed 56-bit fraction. The hardware floating-point capability is optional only with the Series/1 Models 5A and 5B.

INSTRUCTIONS: Microcoded set of over 160 individual instructions (additional 30 floating point instructions are optional on the 4955 processor). 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. Using a maximum of four from the possible 11 combinations of addressing modes can be implemented for any one instruction.

INTERNAL CODE: EBCDIC and binary.

MAIN STORAGE

TYPE: MOSFET (Metal Oxide Semiconductor Field Effect Transistor).

CYCLE TIME: 2.1 microseconds for the 4952, 800 nanoseconds for the 4953, and 600 nanoseconds for the 4955.

CAPACITY: For the 4952 Models A and B, 32K to 128K in 32K-byte increments; for the 4953 Models A and B, 16K to 64K bytes in 16K-byte increments, Models C and D, 32K to 64K bytes in 16K- or 32K increments. For the 4955 Models A, 16K to 64K in 16K-byte increments, Model B, 16K to 128K in 16K-byte increments, Model C, 32K to 64K in a 32K-byte increment, Model D, 32K to 128K bytes in 32K-byte increments, and Model E, 64K to 256K bytes in 64K-byte increments.

CHECKING: Parity checking on main storage and channel data bus.

STORAGE PROTECTION: None on the 4952 and 4953; standard on the 4955.

CENTRAL PROCESSORS

GENERAL: The Series/1 family is available in three processor models: the 4952 with Models A or B versions; the 4953 with Models A, B, C, and D versions; and the 4955 with Models A, B, C, D and E versions. 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 1 to 16 I/O devices, depending on the type of card being used.

The Series/1 4952 processor model A is a half-width unit with 5 I/O feature locations, Model B is a full-width unit with 14 I/O feature locations. The 4953 processor Models A and C are half-width units with 4 I/O feature locations and Models B and D are full-width modules with 13 I/O feature locations. The 4955 processors are all full-width units and vary in the amount of the main storage and the number of I/O feature locations. Models A, B, C, D, and E have 8, 3, 10, 7, 7 I/O feature locations or slots, respectively. Also, Models C and D may include one 16K-byte storage card; Model E may include one 32K-byte card.

Optional features for the 4952 processor include a programmer console and 32K-byte storage addition modules. For the 4953 processor, optional features include the programmer console and a choice of 16K-byte or 32K-byte storage addition units.

The 4955 processor's optional features package includes storage address relocation translator (Models B and D only), floating point, programmer console, and storage addition unit in 16K-byte (Model A, B, C, and D), 32K-byte ▶

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED
MAGNETIC TAPE	
4969 Model 4N	Magnetic tape drive; 45 ips; 800 nrzi; 36,000 bps
4969 Model 4P	Magnetic tape drive; 45 ips; 1600 pe; 72,000 bps
4969 Model 4D	Magnetic tape drive; 45 ips; 800 nrzi or 1600 pe; 36,000 or 72,000 bps; dual density
4969 Model 7N	Magnetic tape drive; 75 ips; 800 nrzi; 60,000 bps
4969 Model 7P	Magnetic tape drive; 75 ips; 1600 pe; 120,000 bps
4969 Model 7D	Magnetic tape drive; 75 ips; 800 nrzi or 1600 pe; 60,000 or 120,000 bps; dual density
PRINTERS	
4973 Model 1	Line Printer; 132 columns; 48, 64, or 94 character set; 80 to 155 lpm
4973 Model 2	Line Printer; 132 columns; 48, 64, or 94 character set; forms stand; 235 to 414 lpm
4974	Serial Printer; 132 columns, 64 or 94 character set; 120 cps
TERMINALS	
4978 Model 1	CRT Display Station; 1920 characters, 24 lines by 80 characters, 4 x 6 dot matrix, local editing, detached keyboard
4979	CRT Display Station; 1920 characters, 24 lines by 80 characters, 4 x 6 dot matrix, local editing, integrated keyboard

tems; CRT display stations; dot-matrix and line printers; eight different synchronous or asynchronous communications interfaces; and eight different sensor I/O modules for data logging or process control applications.

The disk units for the Series/1 systems deserve particular attention. The basic 4962 Model 1 disk subsystem includes a nonremovable 9.3-megabyte disk storage module with heads and medium contained in an integral protected assembly. Model 1F adds 122,880 bytes of fixed-head storage to the basic 9.3-megabyte storage capacity. Model 2 starts with the 9.3-megabyte storage module and also incorporates a diskette (floppy disk) drive in the same cabinet. Model 2F simply adds the 122,880 bytes of fixed-head storage to the Model 2 storage module. Model 3 contains a basic fixed-disk capacity of 13.9 megabytes. Model 4 consists of a Model 3 plus a removable diskette having a 606,208-byte storage capacity. Separate attachment modules are required for disk storage modules and diskette units. Each attachment module (controller) can support one unit.

The Model 4963 Disk Subsystem consists of four types of fixed-media disk drives, a 23-megabyte version, a 29-megabyte version, a 58-megabyte version, and a 64-megabyte version. The 23 and 58 megabyte drives include fixed heads that add 128K bytes of fast-access storage. Each subsystem consists of a primary drive and up to three expansion drives. All versions connect to the Series/1 channel through a 3590 Disk Subsystem Attachment, which can attach up to four drives. Any mix of units can be used.

Diskette devices available for the Series/1 include the 4964 Diskette Unit and the 4966 Diskette Magazine Unit. The 4964 mounts in half the width of a 19-inch rack enclosure and has a maximum storage capacity of 606,208 bytes.

(Model C, D, and E), or 64K-byte (Model E only) increments. All processors include a basic console, power failure detect/auto restart, self-contained power supply, and four priority interrupt levels.

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 4955 processor also has one Address Key Register (AKR). All of the above are 16-bit registers. Optionally, the 4955 processor can also have four 64-bit floating-point registers installed per level.

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 three-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.

INSTRUCTION REPERTOIRE: The Series/1 4952 processor has 179 instructions available; the 4953 has 168 instructions; and the Model 4955 has 177 instructions. All instructions are implemented in microcode. The floating-point processor option, available on the 4955 only, adds 30 instructions to the basic instruction set to handle single- and double-precision floating-point arithmetic.

INSTRUCTION TIMINGS: The instruction timings shown below are typical execution times. When address modification is used, two words are appended to the instruction and

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▷ One- or two-sided diskettes can be used. The 4964 can be designated as either the primary or alternate system IPL device. A microprocessor located in the diskette unit attachment feature controls cycle-steal read/write operations and supports multiple-sector transfers. Extensive microdiagnostics and cyclic redundancy checking are standard.

The 4966 Diskette Magazine Unit, announced in June 1978, provides random access to 23 diskettes contained in two 10-diskette removable magazines and three individual diskettes. The 4966 is a full-width module that mounts in a standard 19-inch rack enclosure and has a maximum storage capacity of 27.8 million bytes. It uses either the two-sided IBM Diskette-2 or Diskette-2D, or the one-sided IBM Diskette-1.

There are two printers currently available for the Series/1. The 4973 Printer is a free-standing, impact-type line printer that provides medium- to high-speed hard-copy output on continuous-forms paper. Print speed is dependent on the printer model and the length of the character set. The two models of the 4973 provide for 80 to 155 lines per minute (Model 1) and 235 to 414 lines per minute (Model 2) with character set lengths of 48, 64, or 96 characters.

The 4974 Printer is a table-top printer with a wire-matrix print head. Printing is bidirectional at a speed of 120 characters per second. The print line length is 132 characters, at 10 characters per inch. Print operations, controlled by a microprocessor located in the printer attachment feature, are buffered and operate in a cycle-steal mode. The buffer can be initialized, under program control, to a standard 64-character EBCDIC character set.

Both of the Series/1 display stations are table-top units that serve as communications links between the system and its users. They provide image displays of data transmitted to and from the processor and enable the user to enter, modify, or delete data on the display. The 4978 Display Station features a movable keyboard, while the 4979 Display Station is a single unit consisting of the display screen and integrated keyboard. The display screen on both models has a capacity of 1920 characters arranged in a format of 24 lines of 80 characters each. Both display stations operate in a cycle-steal mode and attach to the Series/1 via a display attachment feature.

Series/1 communications interfaces include asynchronous, binary synchronous (bisync), and SDLC single-line units, asynchronous 4-line and 8-line multiplexers, and synchronous 4-line and 8-line multiplexers.

The Series/1 sensor input/output unit is housed in a "half-width" chassis and contains space for up to eight sensor input/output feature attachment cards. These cards can provide a variety of digital and analog input and output capabilities. The sensor unit enables analog input, analog output, digital input/process interrupt, and digital output. ▷

▶ contain a displacement to be added to a base register. Register-to-storage instruction times assume the destination is a register, and no indirect addressing or Storage Address Relocation Translator usage is assumed. Execution times are in microseconds for 16-bit, fixed-point operands.

	4952	4953	4955
Load/store	N.A.	5.40	2.42
Add	N.A.	8.40	2.64
Subtract	N.A.	9.00	2.64
Multiply	N.A.	13.20	10.78
Divide	N.A.	15.60	17.16
Branch on condition	N.A.	4.20	1.54
Move byte field	N.A.	5.40+CT*	1.45+CT*

*CT is the count of the last byte moved. For the Model 4953 add 8.40 microseconds to each value in this instruction, and for the Model 4955 add 1.54.

INTERRUPTS: Series/1 processors have four priority interrupt levels. Associated with each level is a bank of general registers and status registers. Each bank consists of eight general registers, a Level Status Register (LSR), an Instruction Address Register (IAR), and, for the Model 4955 processor only, an Address Key Register (AKR). When switching between levels, the hardware 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.
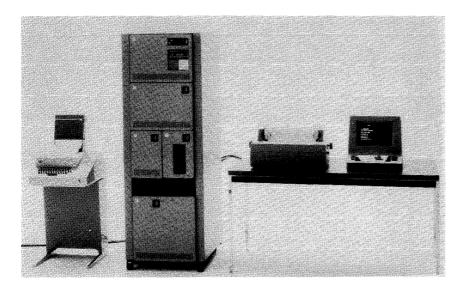
The processor enters the supervisor state when it has accepted all priority interrupts. When the processor accepts an interrupt on a given level, that level remains active until a level exit instruction is executed. If a higher-priority interrupt is accepted before the level exit instruction is executed, 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.

PROCESSOR MODES: The Series/1 models recognize either a user mode of program execution or a supervisor mode. The supervisor mode is entered when a Supervisor Call (SVC) instruction is executed, when a console or class interrupt occurs, when an I/O interrupt is accepted, and at IPL time.

PHYSICAL SPECIFICATIONS: The Series/1 processors are housed in a 14-inch-high chassis. The 4952 Model A is 8.5 inches wide by 22.5 inches deep and weighs 52.9 pounds; the Model B is 19 inches wide by 18.75 inches deep and weighs 50 pounds. For the 4953 Models A and C are 8.5 inches wide by 20.75 inches deep and weigh 30 pounds; Models B and D are 19 inches wide by 18.75 deep, weighing 50 pounds. All models of the 4955 processor are 19 inches wide, 18.75 inches deep, and weigh 50 pounds.

INPUT/OUTPUT CONTROL

INPUT/OUTPUT CHANNELS: The Series/1 I/O devices are attached to the processor through the processor I/O channel. The I/O channel accommodates a maximum of 256 I/O devices, with each device having a unique address. Four pre-emptive priority interrupt levels can be used to facilitate device service. ▶

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This Series/1 configuration includes a 4997 rack enclosure with a 4955 processor mounted at the top and a 4959 input/output expansion unit below. The bottom half of the enclosure houses a 4962 disk storage unit, with a 4982 sensor I/O unit above and to the left, and a 4964 diskette unit to the right of the sensor unit. Also shown are the 4974 printer, 4979 display station, and a teletypewriter.

▷ Programming support for the Series/1 consists of the Realtime Programming System, the Event Driven Executive, Base Program Preparation Facilities, Structured Programming Facility, System/370 Channel Attach Program, FORTRAN IV compiler and Realtime Subroutine Library, PL/1 compiler, and COBOL compiler. The Realtime Programming System is designed to give the user flexibility and control over system and applications programs, and is offered in four versions. The Base Program Preparation Facilities include a text editor, macro assembler, application builder, and job stream processor, and feature routines for such functions as disk and diskette initialization, copy, dump, patch, automatic system build, and system verification. The Structured Programming Facility provides a programming editor in a Series/1 that communicates with a companion MVS/VTAM or MVS/TCAM application program in a System/370 computer. The System/370 Channel Attach Program, running under the Realtime Programming System, allows user communication with any System/370 through a selector or block multiplexer channel. The Realtime Subroutine Library provides realtime support for FORTRAN IV programs. PL/1 support consists of a PL/1 compiler and resident library, and a transient library. Series/1 PL/1 is a subset of ANS PL/1 X3.53-1976 plus additional extensions. COBOL programs are compiled, built, and executed under two licensed program libraries, the resident and the transient, which greatly enhance the functions supported by Series/1 COBOL. In addition, Control Program Support is available to provide supervisory services for program control, as well as selected peripheral support at the read/write level.

The Event Driven Executive (EDX), upgraded from a Field Developed Program to a licensed program in January 1979, is designed as a performance oriented system for business, industrial, and laboratory uses. EDX supports EDX COBOL, EDX FORTRAN IV, EDX Sort/Merge, EDX Macro Assembler, EDX Indexed Access Method, EDX Mathematical and Functional Subroutine Library, and EDX Multiple Terminal Manager. ▷

▶ 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.

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.

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.

CONFIGURATION RULES

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. (See the Central Processor section for additional configuration details.)

WORKSTATIONS: 1 to 8 per I/O attachment.

DISK STORAGE: Up to 256MB per I/O attachment.

MAGNETIC TAPE UNITS: Up to 8 per I/O attachment.

PRINTERS: Up to 8 per I/O attachment.

MASS STORAGE

4962 DISK STORAGE UNIT: There are six models of the 4962. Models 1, 1F, 2, and 2F all have a basic storage capacity of 9.3 million bytes under movable read/write heads. Model 1 has this basic capacity alone, on a fixed disk, accessed by two movable heads. Model 2 consists of a Model 1 plus a removable diskette with a maximum formatted storage capacity of 606,208 bytes; the diskette is accessed by two movable heads. Model 1F contains ▶

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▷ All data transfers to and from the Series/1 systems are on a cycle-steal basis. The communications features allow for manual dialing and manual or automatic answering on switched lines. The Binary Synchronous Communications Single-Line Control provides the ability to IPL the processor from a remote system. The Asynchronous Communications Single-Line Control and Asynchronous Communications 4-Line Adapter can be locally attached to appropriate asynchronous terminals by means of the appropriate attachment cables.

Other attachment feature cards can be mounted in the I/O slots of the processor or the I/O expansion unit to provide for the attachment of user equipment to the Series/1. These include:

● A teletypewriter adapter that provides the means to attach a serial I/O device such as a Teletype ASR 33/35 or equivalent.

● An integrated digital I/O adapter that contains 32 points of DI/PI and 32 points of DO, with external sync and ready lines for each 16-bit group.

● A timer feature that provides 16-bit timers with selectable internal or external time bases for use as interval timers, pulse counters, or pulse duration counters.

● A customer direct program control adapter that permits attachment of up to 16 customer-supplied input/output devices or subsystems.

The Series/1 is being marketed by a dedicated sales force working in conjunction with IBM's Data Processing Division and General Systems Division marketing organizations. As IBM has stated, the target market for the Series/1 computers is sophisticated, large-volume end users who can develop their own software. Industry experts interpret this to mean primarily the growing distributed processing market, toward which a number of large corporations are already moving and which many more are investigating. One recent industry study predicts that the market for distributed computing systems in the U.S. will exceed $5.6 billion by 1980—17 percent of the total quantity of U.S. computer system shipments.

Numerous peripheral equipment manufacturers, systems houses, and software vendors obviously feel that there is a large market for the Series/1 and are wasting no time attempting to gain a share of it. Announcements heralding a new software package or a new peripheral unit for use on the Series/1 are being made almost every week, and systems houses are introducing packaged systems based on the Series/1 at a rapid rate. Most notable among the peripheral manufacturers is Control Data, which has introduced a broad line of Series/1-compatible peripherals called the Certainty Series. IBM has taken an unusual stance in this regard in that it appears to be encouraging these vendors. This, of course, may not continue to be true if and when IBM itself offers a full line of hardware ▷

▶ a fixed disk that is accessed by two movable heads and eight fixed heads; the maximum formatted storage capacity is 9.3 million bytes for the movable heads and 122,880 bytes for the fixed heads. Model 2F adds to the Model 1F a removable diskette with a maximum formatted storage capacity of 606,208 bytes, accessed by two movable heads.

The 4962 Model 3 contains a fixed disk with a maximum formatted storage capacity of 13,962,240 bytes, accessed by three movable heads. Model 4 is a combination disk and diskette unit, containing both a fixed disk with the Model 3 characteristics plus a removable diskette with a maximum formatted storage capacity of 606,208 bytes; the diskette is accessed by two movable heads.

Disk units in all models of the 4962 are functionally identical. Disk access time is 10 milliseconds (cylinder to cylinder). The data transfer rate is 889,000 bytes per second. The 4962 operates in a cycle-steal mode and supports multiple-sector transfers. The diskette unit in Models 2, 2F, and 4 is functionally identical to the 4964 Diskette Unit.

4963 DISK SUBSYSTEM: There are eight models of the 4963 Disk Subsystem, providing the Series/1 with 23 to 256 megabytes per subsystem. These subsystems include various combinations of 4963 disk storage units—a primary drive is requisite, to which a maximum of three expansion units may be attached. The primary unit contains a disk and control unit. The control unit provides control and attachment facilities for up to three other disk units in the subsystem. Disk storage units are full-width modular units designed for rack mounting. All models of the 4963 make use of multiple, nonremovable magnetic disk with movable heads for recovering and retrieving data. Four models are primary units; four are expansion units.
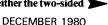
4963 Model	Disk Capacity (bytes)	
	Movable Heads	Fixed Heads
23A	23,461,888	131,072
23B	23,461,888	131,072
29A	29,327,360	
29B	29,327,360	
58A	58,654,720	131,072
58B	58,654,720	131,072
64A	64,520,192	
64B	64,520,192	

XXA = Primary unit
XXB = Expansion unit

The subsystem attaches to the Series/1 through a microprocessor-based disk subsystem attachment feature. The attachment feature offers high-speed cycle-steal access to the subsystem. Models 23 (A and B) and 58 (A and B) provide 131,072 bytes of additional storage that is accessed by fixed heads. These heads have 256 bytes per record capacity which equals the movable-head storage capacity. The data transfer rate is 1,030,000 bytes per second, and average seek time is 27.0 milliseconds.

4964 DISKETTE UNIT: Features a removable, two-sided, flexible diskette that can be used to transfer data or to load programs into the system. The 4964 uses dual-head recording and has a capacity of 492K, 568K, or 606K bytes, depending on the data format used. Track-to-track access time is 40 milliseconds, and data transfer rate is 31,250 bytes per second. The 4964 operates in a cycle-steal mode and supports multiple-sector transfers. All operations are controlled by an I/O microprocessor. Extensive diagnostics, along with the cyclic redundancy checking, are standard on this half-width modular unit.

4966 DISKETTE MAGAZINE UNIT: Provides access to data recorded on up to 23 diskettes, using either the two-sided ▶

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▷ and software products for the Series/1. In the meantime, however, some of these vendors are certain to get a fair share of the Series/1-generated dollars.

USER RATINGS

Forty-five users with a total of 119 IBM Series/1 systems installed responded to Datapro's 1980 survey of computer users. Main memory capacities of these systems ranged from 16K to 256K and averaged 128K bytes, and the average disk storage capacity was 38.3 million bytes. Thirty nine users reported printers configured into their systems, and the average number installed was three. The average number of workstations on line per system was 2.5.

Twenty-eight of these users reported using EDX while 6 said they were using RPS. Ten users reported the use of a data base management system and 8 were using a data communications monitor. Nine users reported that their primary programming language was COBOL while two said theirs was FORTRAN. Almost all of these users reported the use of some software other than that available from IBM.

The results of the ratings assigned by these users are tabulated below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	16	19	7	1	3.2
Reliability of mainframe	29	15	1	0	3.6
Reliability of peripherals	20	19	3	1	3.3
Maintenance service:					
Responsiveness	17	20	4	4	3.1
Effectiveness	15	23	6	1	3.2
Technical support:					
Trouble-shooting	9	21	7	6	2.8
Education	5	16	17	4	2.5
Documentation	6	14	14	8	2.4
Manufacturer's software:					
Operating system	6	20	12	4	2.7
Compilers & assemblers	7	15	12	4	2.8
Applications programs	3	13	10	0	2.7
Ease of programming	4	16	14	6	2.5
Ease of conversion	3	10	9	4	2.5
Overall satisfaction	9	27	7	2	3.0

*Weighted Average on a scale of 4.0 for Excellent.

When questioned about specific problems encountered with their Series/1 systems, 11 of these 45 users said that the delivery and/or installation of the equipment was late; 7 said that the software was delivered late; 7 felt that all of the promised software was not provided; 6 said that the system proposed by the vendor was too small; 6 felt that program/data compatibility was not what the vendor promised; and 5 said the total system costs exceeded their expectations. Ten users offered additional comments, and six of these were software related.

On the positive side, 26 users said the system was easy to expand/reconfigure; 23 were happy with the system's response time; 11 felt it was power/energy efficient; 10 felt ▷

▶ IBM Diskette-2 or Diskette-2D, or the one-sided IBM Diskette-1. Diskette type 1 or 2 may be initialized for a maximum of 512-byte sectors, while type 2D may be initialized for a maximum of 1024-byte sectors. The 4966 features a five-slot carriage assembly, with three slots storing individual diskettes and two containing magazines storing 10 diskettes each. Diskettes can be inserted in or removed from the magazines by the operator, and will typically be processed in sequential fashion. The 4966 provides a maximum on-line storage capacity of 27.8 megabytes, with a maximum data transfer rate of 125,000 bytes per second. Diskette-to-adjacent-diskette access time is under three seconds, and the maximum access time to any diskette is five seconds. All diskettes on the 4966 are compatible with existing IBM diskette drives. The 4966 attaches to a Series/1 channel via the Diskette Magazine Attachment, feature 1205.

INPUT/OUTPUT UNITS

4959 I/O EXPANSION UNIT: The 4959 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.

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: 1) on 4953 Processors for any 4959 Expansion Units attached; 2) on all 4959 units when another 4959 follows; and 3) on 4955 Processors with both a 4959 unit and a 4999 Battery Backup Unit installed, and for the second and following 4959 units attached.

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.

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

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.

5250 INFORMATION DISPLAY SYSTEM ATTACH-MENT: 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.

1200 SYSTEM/370 CHANNEL ATTACHMENT: Provides memory-to-memory communications between a Series/1 processor and any System/370 processor, Model 135 and ▶

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▷ that the productivity aids offered by IBM helped keep their programming costs down; and 6 said that the database language was efficient. Five users included additional positive comments that were complimentary to both the hardware and software available for the Series/1.

Based on the response from these users, it is apparent that the Series/1 is not the answer to everyone's problems, but is certainly a very viable system in the marketplace. An indication of this lies in these users response to the question "Would you recommend this system to another user in your situation." Thirty-eight users answered affirmatively and only seven said no.□

▶ 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.

7400 TWO-CHANNEL SWITCH: This 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.

See the Peripherals/Terminals table for additional Series/1 I/O devices.

COMMUNICATIONS CONTROL

1610 ASYNCHRONOUS SINGLE-LINE CONTROL: Provides circuitry for controlling one half-duplex line, operating at a speed of up to 9600 bits per second. Can be used as either a primary station or a secondary station. 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.

2091/2092 ASYNCHRONOUS 8-LINE CONTROL AND 4-LINE ADAPTER: A maximum of eight lines operating in half-duplex mode can be controlled by these features. Each of these lines can operate at up to 2400 bits per second. No IPL capability is provided.

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. 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.

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. 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.

2090 SYNCHRONOUS DATA LINK CONTROL (SDLC) SINGLE-LINE CONTROL: Provides circuitry for controlling one half-duplex line, operating at a speed of up to 9600 bits per second. Operates as either a primary or secondary station. The ability to IPL from a host system is not provided.

2093/2094 BINARY SYNCHRONOUS 8-LINE CONTROL AND 4-LINE ADAPTER: These features 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.

2095/2096 8-LINE CONTROLLER/4-LINE ADAPTER: The 2095 feature 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.

4987 PROGRAMMABLE COMMUNICATIONS SUBSYSTEM: Consists of the subsystem unit, up to two controller features, and device attachment features. 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.

SOFTWARE

OPERATING SYSTEM

REALTIME PROGRAMMING SYSTEM (RPS): A control system through which a user can install, operate, and maintain system programs, application programs, and data. RPS is multiprogramming, multitasking, event-driven, and disk-based. It allows multiple concurrent task operations in the same or different partitions with synchronization and communication between them. Re-entrant programs can be used by more than one task. Announced in April 1977, RPS manages all physical resources—processor, storage, and devices. Its supervisor and data management services provide a controlled interface between application programs and Series/1 hardware.

RPS Version 2 provides all the facilities of Version 1 plus system support for the IBM Disk Storage Unit Models 3 and 4 with a capacity of 13,926,240 bytes. This permits more program and data storage for users with large program libraries and/or data files. RPS Version 2 also provides storage support beyond 64K bytes using storage overlays, automatic device backup for printers and a teletypewriter, IPL and dumping of a remote Series/1 by a host Series/1 using BSC communications, and use of the basic level for communications operations.

Version 3 further enhances RPS capabilities. This licensed program provides all the facilities of Versions 1 and 2 operating in a multiple address space environment. In addition, it provides support for up to 256K bytes of ▶

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▶ storage, up to 15 user partitions, relocatable task sets, support for instructions/data split in the supervisor which allows maximum size to exceed 64K bytes, and dynamic partitions that are created on demand.

Programs that run on RPS Versions 1 and 2 may require source modifications to enable Version 3 to compile and execute. Program Preparation Subsystem Version 3 is required on RPS Version 3.

Version 4 of RPS provides all facilities found on Versions 1, 2, and 3, and in addition support the following: attachment of a Series/1 as a cluster controller in a System/370 systems network architecture (SNA) network; additional binary synchronous and asynchronous terminals on multipoint lines; 4963 Disk Subsystem; 4966 Diskette Magazine Unit; single or multiple address space environment; dynamic transient pool management, the Command Language Facility; and ease-of-use features including simplified systems and installation, dynamic control block allocations, and dynamic device configuration.

The Realtime Programming System SNA support controls the management of sessions and the flow of data in an SNA network between a System/370 user program or IMS/VS and a Series/1 user program. This support provides for system definition services, network attachment activation/deactivation services, session activation/deactivation and message exchange, and activation of a Series/1 task set from the host.

RPS provides a data flow control level interface for support, as a multiple logical unit cluster controller, on an SNA network controlled by a System/370 using OS/VS2 (SVS or MVS) and ACF/VTAM or ACF/TCAM. This allows multiple user program to be in session with multiple System/370 user programs.

Through a simplified interface to RPS based services, the Command Language Facility provides on line programming development and production system support to multiprogramming users. Commands are processed in realtime by an interpretive compiler that establishes the necessary execution environment prior to invoking requested services, such as the IBM Series/1 text editor, application builder, or PL/1 compiler.

As defined by systems network architecture, the Realtime Programming System SNA support provides SNA physical unit type 2 support, SNA function management profile 3 and 4 support, SNA transmission subsystem profile 3 and 4 support, and SDLC secondary station support.

Programs run on RPS Version 1, 2, or 3 may require source modifications to compile and execute on RPS Version 4. Program Preparation Subsystem Versions 3 or 4 is required to prepare programs to execute on RPS Version 4.

RPS has debugging aids to help users to find and correct errors in problem and supervisory programs. Through the interactive debug package, users can display and modify registers, processor storage, disk, and diskette contents, as well as set address stops to monitor the status of executing programs.

EVENT DRIVEN EXECUTIVE (EDX): Consists of five licensed programs that together provide a flexible operating system for the Series/1. These licensed programs include the EDX Basic Supervisor and Emulator, EDX Utilities, EDX Program Preparation Facility, EDX Macro Library, and EDX Macro Library/Host. EDX can apply to a broad range of applications such as data entry, remote job entry, distributed processing, and other commercial applications, as well as typical sensor-based functions such as data acquisition, material and component testing, machine and process control, and shop floor control.

EDX is a multiprogramming, multitasking supervisor that offers a high-level, user-oriented instruction set; direct access, multiple terminal, and sensor input/output support; a flexible operating environment-storage resident only, disk- or diskette-based; high level programming languages, including FORTRAN IV and COBOL; online utilities including source entry and editing interactive debugging aids, screen format builder, remote job entry; online program preparation facility, system generation, and application development; and a session manager that provides a menu of functions with automatic allocation of user work files.

The EDX Basic Supervisor and Emulator is a multiprogramming system supervisor controlled by a user-oriented instruction set. This supervisor supports multiple, independent, time dependent, and/or event driven applications with minimum interaction. This support includes:
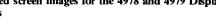
● The ability to initiate an application program from a terminal or another application program and to pass parameters to the new program

● Multiple copies of the same program can run concurrently

● Multiple independent applications can run concurrently

● Multitasking within each application program, with preemptive task switch

● Multiple terminal support so terminals may be dynamically assigned to each application as required

● A relocating loader so an application program may use any available main storage area at the time of invocation

Typical supervisor size is from 10K to 30K bytes and application instructions typically average from 6 to 8 bytes of storage.

The Basic Supervisor and Emulator also provides an operating environment for other licensed programs, including FORTRAN IV and COBOL, the Indexed Access Method and Sort/Merge, the Multiple Terminal Manager, and the Event Driven Executive Macro Assembler.

The EDX Utilities are a set of programs that provide productivity aids for Series/1 program development, program maintenance, and distributed processing functions to a host System/360/370. These programs are independent program load modules capable of running concurrently with other application programs on a Series/1 having the Basic Supervisor and Emulator. The utilities are:

● Data Set Management

● Distributed Processing/Communications Control

● Source Program Entry and Editing

● Interactive Program Debugging

● Program Library Update

● Sensor I/O Test Functions

● Graphics Display Processor

● A full screen editor for source program entry and editing

● The Screen Format Builder utility for use in designing formatted screen images for the 4978 and 4979 Display Stations ▶

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▶ • The Job Stream Processor utility, a batch job processing facility that can be invoked concurrently with other programs. Allows user to execute a series of programs that are defined in disk/diskette procedure data sets without operator intervention

• Remote Job Entry (2780- and 3870-like work station) utilities for interface with System/370 HASP, JES2, JES3 remote job entry

• Terminal Configuration utility for modifying an Event Driven Executive terminal configuration after IPL

• Binary Synchronous Communications Trace to provide a means of tracing the I/O activity on a given BSC line

• Message Routing Utility to provide a simple means of sending messages to any terminal on the system

• A Copy utility that dynamically allocates and copies data set members in single or multiple copy mode

• An online disk/diskette initialization facility to provide sector formatting, labelling, and alternate sector identification

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 compiler can provide productivity improvements through the availability of all EDX supervisor functions, symbolic file addressing, selection of any terminal device for listing output, and greater compilation speeds than the EDX Macro Assembler. The compiler can operate on a disk- or diskette-based system.

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 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, online 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.

EDX was initially released as a field-developed program. This FDP is available in two versions. The licensed programs available under Version 1 are: Event Driven Executive Basic Supervisor and Emulator, Event Driven Executive Utilities, and Event Driven Exeuctive Macro Library.

Version 2 of the EDX FDP consists of the four following programs: EDX Basic Supervisor and Emulator Version 2, EDX Utilities Version 2, EDX Program Preparation Facility, and EDX Macro Library/Host.

EDX SUPPORT SOFTWARE

EDX FORTRAN IV COMPILER AND OBJECT SUPPORT LIBRARY: Executes under the EDX Basic Supervisor and Emulator and used in conjection with the EDX Program Preparation Facility, EDX FORTRAN IV produces relocatable object code that is suitable for subsequent execution under EDX. With the prerequisite EDX Mathematical and Functional Subroutine Library this program conforms to the ANS FORTRAN X3.10-1966 with some extensions from ANS FORTRAN X3.9-1966.

EDX MATHEMATICAL and FUNCTIONAL SUBROUTINE LIBRARY: A library of common-usage subroutines for mathematical and data conversion functions. It runs under the control of the EDX Basic Supervisor and Emulator and depends upon this operating system to be its complete and only interface to hardware. Some of the features are mathematical functions including sine, cosine, logarithms and exponentiation functions, maximum and minimum functions, modular arithmetic and others; a commercial subroutine package containing a library of subroutines that will meet most requirements for decimal data handling. These subroutines, similar to those offered on other IBM systems, provide comprehensive facilities for editing, decimal arithmetic, and data compaction; and conversion subroutines for data manipulation; subroutine library services allow assembler language users to initialize and release a library work area and to specify an abnormal termination processing routine that returns control to the user on program interrupts or abnormal execution of system macro instructions; MFSL routines are modular in design and can be easily replaced by user-written routines; error-checking routines to detect error conditions during processing of mathematical and conversion routines, including checking of illegal arguments and invalid conversion data inputs, testing floating-point divide exceptions, and testing floating-point overflow and underflow conditions.

EDX COBOL: Offered as two licensed programs, the EDX COBOL Compiler and Resident Library for compiling and building user programs and the EDX COBOL Transient Library for executing user programs. EDX COBOL is designed according to specification for the ANS COBOL X3.23-1974 as understood and interpreted by IBM as of March 1979, with the exception of the RERUN clause. Some of the features above the low intermediate level include support of merge and various extensions of the nucleus features.

The EDX COBOL Compiler operates in the environment of the EDX Basic Supervisor and Emulator. The COBOL-generated object code is combined with library routines by the EDX linkage editor and can run as a program under the control of the EDX system. The EDX utilities provide powerful program editing and source program management capabilities for the COBOL development process.

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 user-written exit routines to handle I/O errors and process records ▶

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▶ 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 work station 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.

EDX INDEXED ACCESS METHOD: A licensed program that 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 or COBOL. It is also supported by the Series/1 EDX Sort/Merge licensed program, which will accept Indexed Access Method data sets as input files.

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. User-written transaction programs using predetermined screen formats could be used for order entry, inventory file update, and inquiry-type applications. 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 then be used with Multiple Terminal Manager transaction applications written in COBOL, FORTRAN IV, or the EDX language.

EDX MACRO ASSEMBLER: A licensed program that allows the user to assemble application programs or program modules concurrent with the execution of other programs operating under the control of the EDX Basic Supervisor and Emulator.

The Macro Assembler converts text data sets containing machine and macro instructions into object modules to be processed by the supplied linkage editor. In conjunction with the EDX Macro Library, applications coded in the Series/1 EDX language can also be processed by the Macro Assembler, including the reconfiguring or customizing of the EDX supervisor. User-generated macros for commonly used routines can be incorporated into the macro library.

The assembler also provides the user with the facility for generating device support modules or specific routines in support of user exits or customized supervisory functions. These routines can be link edited with user applications generated in the EDX language, FORTRAN IV, and/or COBOL.

LANGUAGES

COBOL: 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. Series/1 COBOL executes under Version 3 or Version 4 of RPS and Version 3 of the Program Preparation Subsystem. COBOL applications can execute under RPS or the Program Preparation Subsystem batch environment.

Series/1 COBOL is a compatible subset of IBM's OS/VS COBOL compiler and library, release 2. Programs can be developed on larger systems for use on Series/1 provided they do not use any language or hardware features the Series/1 product does not use. For compilation, a minimum 28K-byte partition is required. For execution, a minimum 12K-byte partition is required for the COBOL library routines, while the actual partition size is a function of the COBOL source program.

The COBOL Resident Library consists of commonly used re-entrant subroutines which are combined with a user's program through the Application Builder to form a task set for subsequent execution on the Series/1.

The Transient Library is used in conjunction with the execution of COBOL user programs. Transient Library routines are loaded only when needed, allowing for more efficient utilization of primary storage. These routines are re-entrant and can be executed from a shared task set.

FORTRAN IV: A licensed program that includes the compiler and object support library, Series/1 FORTRAN IV is a subset of ANS FORTRAN X3.9-1966 and includes ANS Basic FORTRAN X3.10-1966, with the exception of object-time formats, adjustable dimensions, COMPLEX data type, G-format specifications, and two-level FORMAT parentheses. In addition to the basic subset, IBM extensions are also provided.

A separate licensed program, the FORTRAN IV Realtime Subroutine Library (RSL), provides additional extensions to facilitate real-time systems support. These subroutines conform to the Instrument Society of America (ISA) standard S61.1-1976. They are available to the user via the CALL statement.

The Mathematical and Functional Subroutine Library is a prerequisite to the FORTRAN IV compiler.

Series/1 FORTRAN IV permits input and output of both formatted and unformatted data and, through the FORTRAN IV RSL, permits byte manipulation. In addition to the basic FORTRAN IV branching capabilities, Series/1 FORTRAN also offers logical and relative operations that can be used for program control.

Three FORTRAN IV statements (Program, Invoke, and Global) permit optimal use of the interrupt scheme. These three statements help the programmer to model his programming modules according to the interrupt configurations and allow the system to pass information and control between various program elements as conditions warrant. Series/1 FORTRAN IV statements may be written so that assignment of physical devices to many data sets can be deferred until execution time. These assignments can be changed as required for subsequent use without recoding and recompiling the program.

FORTRAN IV REAL TIME 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.

PL/1: Consists of two licensed programs: the PL/1 Compiler and Resident Library, and the PL/1 Transient Library. Series/1 PL/1 is a subset of ANS PL/1 X3.53-1976 plus additional language functions to support the coding of real-time applications. A program written in PL/1 is processed under control of Series/1 RPS and the Program Preparation Subsystem (PPS). Input to the PL/1 compiler can be prepared conversationally, using the text editor of the Program Preparation Subsystem.

The PL/1 compiler operates in the batch environment of the PPS under RPS. The PL/1-generated object code, after processing by the Application Builder, runs either in a batch environment or directly under RPS. When the floating-point feature is not installed and floating-point operations are required, the PL/1-generated object code uses the floating-point emulator of RPS.

PL/1 does not directly support any Series/1 hardware. It will run under the complete control of RPS and the PPS, and depends upon RPS to be its complete and only interface to the hardware.

The PL/1 Resident Library contains frequently used routines that are included in the user's task set during execution of the Application Builder. As a result, performance of a user's application is significantly enhanced by eliminating loading of these functions during execution time.

The PL/1 Transient Library contains infrequently used routines, such as I/O transmission, error handling, and low-usage conversion routines. These functions are dynamically loaded into a user's shared task set at execution time, thus permitting storage savings in a user's partition with minimal impact on performance.

APPLICATIONS DEVELOPMENT SOFTWARE

CONTROL PROGRAM SUPPORT (CPS): Provides a basic control package and separate compatible functional extensions. CPS and its extensions provide facilities for task and data management, device support, and services. The CPS modules are programming RPQ's, and all use the Series/1 Base Program Preparation Facilities (described below).

PROGRAM PREPARATION SUBSYSTEM (PPS): Provides a general-purpose batch environment and software tools for developing the application programs that run under RPS. The PPS licensed program consists of a Job Stream Processor, Text Editor, Macro Assembler, and Application Builder. These programs execute in the batch partition as task sets under control of RPS.

The Job Stream Processor provides the Series/1 user with a batch processing facility. This program executes in the batch partition and is a convenient and easily modified method of invoking programs, communicating with these programs, and defining or creating the data sets the programs will use. The facilities of this program are used to run the other three PPS programs.

The Text Editor provides the capability for creating and editing text modules. These text modules can be source programs for input to the Macro Assembler, the FORTRAN IV compiler, or the PL/1 compiler. Job streams for batch processing or data sets for user-written programs can also be created and edited in this fashion.

The Macro Assembler processes the user's source statements consisting of machine, assembler, and macro instructions coded in the Series/1 assembler language. This assembler

program produces a machine-language object module that requires link editing prior to use. The assembler program accepts input from either the job stream or a predefined data set and compiles it into one or more object modules that are stored on disk. These modules will later be processed by the Application Builder into executable code.

The Application Builder converts one or more object modules to either an executable load module or a task set. The executable load module is intended for use with a user-provided operating system. The task set is intended for execution under control of RPS and contains the various tables and control blocks required for this specific environment. In addition to these user task sets, the Application Builder can also be used to create a special module (shared task set) consisting of programs and data areas that are shared by several user task sets.

Version 2 of PPS provides all the facilities of Version 1 plus system support for the IBM 4962 Disk Storage Unit Models 3 and 4, program preparation for storage overlay capability, new Job Stream Processor functions (display jobs, cancel jobs, restart jobs), and eight additional Text Editor commands.

Version 2 can prepare applications to execute under the Realtime Programming System (RPS) Version 1 and 2.

Version 3 of PPS provides all the facilities of Version 1 and Version 2 plus support for multiple address space management environments. Version 3 contains the ability to prepare applications for the RPS Versions 1, 2, 3, and 4.

Version 4 of PPS is a licensed program containing of facilities of Version 1, 2, and 3 plus a new macro pre-processor to improve Assembler performance, support for 4952 processor instructions assembler, and usability enhancements. The Version 4 can compare to the RPS Versions 1, 2, 3, and 4.

BASE PROGRAM PREPARATION FACILITIES: A set of stand-alone programs designed to facilitate the preparation and coding of Series/1 programs. The four BPP facilities are the Text Editor, Macro Assembler, Application Builder, and Job Stream Processor.

The Text Editor enables the user to create, modify, list, and save text modules. These modules can consist of job input streams, source statements, or input data to a batch program. The Text Editor can be used in an interactive mode to enter text and commands from an operator station, or in a batch mode.

The Macro Assembler is used to translate symbolic source statements into a relocatable object module and program listing. The assembler source input is read from the diskette (except for user-defined macros, which can reside in a macro source file on the disk). The object module produced by the assembler is placed on disk at the location specified by the user.

The Application Builder combines object modules produced by language translators with system and application information to produce task sets for execution by the Realtime Programming System. The three-step application building process enables the user to meet application needs.

The Job Stream Processor offers control statements through which the user specifies all batch executions and data sets, reads these statements, and through them controls the processing of batch jobs.

SORT/MERGE: The Series/1 Sort/Merge program executes with the Realtime Programming System, Version 3 or 4, as either a batch job under the Job Stream Processor ►

IBM Series/1

▶ or in a foreground partition under the Realtime Programming System. The program product handles the sorting and merging of records from up to eight input data sets whose members have random or consecutive organization into one output data set in either ascending or descending order. Data sets with other organizations, such as indexed, can be processed through user exit routines. The user specifies one or more control fields in the records to be sorted, and the program then compares the relative sequence of the records.

STRUCTURED PROGRAMMING FACILITY (SPF): A program operating with the System/370 Time-Sharing Option (TSO), SPF is designed to provide off-loading of TSO/SPF work to one or more Series/1's. The Series/1 communicates with the Sytem/370 via a binary synchronous link using IBM 3271 protocol. The Series/1 SPF editing facilities are very similar in function to the editing facilities of the System/370 SPF.

SYSTEM/370 CHANNEL ATTACH PROGRAM: A licensed program which runs under control of the Realtime Programming System (RPS) Version 3 or 4, 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.

INTELLIGENT DATA ENTRY SYSTEM and REMOTE JOB ENTRY FOR CPS: These field-developed programs support data entry and transmission in distributed data processing environments. The systems' supervisory functions of file management, storage management, and system integrity provide control for data entry while co-residing with other business and communications applications.

The main focus of the Intelligent Data Entry System is enhanced operator productivity. Operators can key at higher speeds because data is captured stroke by stroke, with logical and syntactical data checking and editing performed on the fly.

The Remote Job Entry for CPS program provides transmission to and from host processors via a subset of IBM 3780 BSC line protocol. Emulating a 3780, the Series/1 operates point-to-point on either switched or leased lines.

INTELLIGENT TERMINAL SUBSYSTEM: Provides a productivity tool to assist the user in establishing distributed processing systems. This field-developed program aids users by supplying programming for the first step: the connection to host processors through binary synchronous communications lines. The Intelligent Terminal Subsystem is designed to provide increased accessibility to multiple applications using IBM 3270 protocol to communicate with one or more host processors.

When installed on the Series/1, this program allows the Series/1 to have the appearance of one or more 3270 subsystems to host processors. Through this programmed emulation, the Series/1 can communicate concurrently with multiple host processors, each with its own BSC line.

In addition, the Intelligent Terminal Subsystem, using IBM 4978 and 4979 Display Stations, emulates most of the functions of an IBM 3277 Display Station. This feature allows an operator to use the 4978 and 4979 in a manner similar to that of a 3277, with the added capability to select the host processor connection directly from the display station and keyboard. The user can, optionally, establish connections to multiple host system concurrently with any or all terminals. This allows access to multiple data base systems for inquiry and updating from a single terminal.

PROGRAMMABLE COMMUNICATIONS SUB-SYSTEM PREPARATION FACILITY: 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.

PROGRAMMABLE COMMUNICATIONS SUB-SYSTEM 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.

MATHEMATICAL AND FUNCTIONAL SUB-ROUTINE LIBRARY (MFSL): A licensed program library of common-usage subroutines for mathematical and data conversion functions. Version 1 of MFSL provides mathematical functions for the application programmer, including sine, cosine, logarithms, and exponentiation functions, maximum and minimum functions, modular arithmetic, and other; conversion routines to convert numerical data between EBCDIC format and Series/1 internal format; error-checking routines to detect error conditions during processing of mathematical and conversion routines, including checking of illegal arguments and invalid conversion of data inputs, testing floating-point divide exceptions, and testing floating-point overflow and underflow conditions; and subroutine library services that allow assembler-language users to initialize and release a library work area and to specify an abnormal termination processing routine which allows a user to receive control on program interrupts or abnormal executions of system macro instructions.

MFSL routines are re-entrant, which can result in more efficient storage utilization. Through the application build process, users can link MFSL routines into the auto-call area of a user's task set or into a shared task set, making a single copy of the routines accessible to multiple programs or partitions.

MFSL Version 2 provides all the facilities described above plus a commercial subroutine package that offers Series/1 users a library of subroutines designed to meet most requirements for decimal data handling. The commercial subroutine package provides comprehensive facilities for editing, decimal arithmetic, data compaction, and conversion subroutines for data manipulation. These subroutines are similar to the commercial subroutine packages offered on other IBM computer systems.

STAND-ALONE UTILITIES: The stand-alone utilities allow the user to maintain his program preparation system. The utilities and their functions follow:

● Diskette IPL Bootstrap—loads a program, which is one diskette track in length, into the high end of main storage.

● IPL Bootstrap/Loader Disk—loads programs from the disk into main storage.

● Diskette Initialization—initializes the diskette, writing ID records and checking for defective sectors. This utility formats each track into 128-byte sectors and assigns alternate cylinders if it detects a defective sector. ▶

IBM Series/1

➤ ● Disk Initialization—initializes the disk, verifying sector ID's and checking for defective sectors. This utility assigns alternates for defective sectors and also lets the user assign them.

● Diskette to Disk Copy—copies data from a specified diskette file to a specified disk file.

● Disk to Diskette Copy—copies data from a specified disk file to a specified diskette file.

● Diskette to Printer Dump—dumps the contents of a specified location on the diskette to the printer.

● Disk to Printer Dump—dumps the contents of a specified location on the disk to the printer.

● Diskette Patch—applies a patch entered at the operator station to a specified location on the diskette.

● Disk Patch—applies a patch entered at the operator station to a specified location on the disk.

● Create Diskette HDR1—takes information supplied by the user and creates a header (HDR1) record for a diskette data file.

● Delete Diskette HDR1—deletes a header (HDR1) record for a diskette data file.

● Storage to Diskette Dump—dumps the contents of main storage to the diskette. The dump begins at storage address 256 and continues until all storage has been dumped.

● Storage to Printer Dump—dumps the contents of main storage to the printer. The dump begins at storage address 256 and continues untill all storage has been dumped. If a programmer console is available, start and stop dump addresses can be specified.

● Automatic System Build—copies to disk the diskette(s) the user receives from IBM. (The program product requires two diskettes and the SCP requires one.) A copy of this program resides on each diskette. Each build program loads the contents of its diskette, in succession, to a predefined area of the disk. Multiple diskettes can be loaded in any sequence.

● System Verification—ensures that the system is built properly by cross-checking each module on the initial-program-loaded system disk against a table containing expected module names. If a module is missing a message is printed to indicate which program is not at its expected disk address. If the system is correct, a system map containing header record data for each load module is printed on the printer and a message verifying that the system was built correctly is printed at the operator station.

PRICING

The Series/1 is offered on a purchase-only basis, at prices ranging from approximately $9,500 to $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 Stand-Alone Utilities is provided by a GSD CE at no additional charge.

In December 1979, IBM announced an OEM discount plan for the Series/1, and at the same time lowered the minimum order quantity from 50 units to 20. The discount schedule is as follows:

    20 to 49 units, 5%
    50 to 99 units, 10%
    100 or more units, 15%

Program products for the Series/1 are available on a 24-month paid-up license basis. The program product license fee includes central APAR processing for 24 months from the date of first customer availability. For the Base Program Preparation Facilities, central APAR processing is available through December 31, 1978. One month of program test allowance is included.

EQUIPMENT: The Series/1 is not currently available in "packaged" or specially configured systems. Each component is offered on an individually priced basis; thus, the actual price for any particular system is the sum total of every configured unit. The following configurations are offered as guidelines to show a price range, and are not necessarily "typical" systems.

SERIES/1 SMALL ENERGY CONSERVATION SYSTEM: Includes 4953A processor, 16K bytes of memory, rack enclosure and rack mounting fixture, 4964 diskette unit and attachment, timers, integrated digital I/O nonisolated, teletypewriter adapter, customer access panel, customer access panel with integrated digital input/digital output cable, and customer access panel with teletypewriter cable. Purchase price is $11,415, and monthly maintenance charge is $119.

SERIES/1 COMMUNICATIONS CONCENTRATOR: Includes 4955C processor, 64K bytes of memory, rack enclosure, 4962 Model 1 disk storage unit and attachments, timers, programmer console, teletypewriter adapter, asynchronous communications 8-line control, binary synchronous communications 8-line control, two asynchronous communications 4-line adapters, two binary synchronous communications 4-line adapters, communications power, communications indicator panel. Purchase price is $27,158, and monthly maintenance charge is $262.■

EQUIPMENT PRICES

PROCESSORS AND MAIN STORAGE

		Purchase Price	Monthly Maint.
4952A	Processor; half-width module, 32K bytes of memory, 5 I/O features or storage slots	$4,600	23
4952B	Processor; full-width module, 32K bytes of memory, 14 I/O features or storage slots	6,150	50
4953A	Processor; half-width module, 16K bytes of memory, 4 I/O feature or storage slots	4,800	76
4953B	Processor; full-width module, 16K bytes of memory, 13 I/O feature or storage slots	5,715	70
4953C	Processor; half-width module, 32K bytes of memory, 4 I/O feature or storage slots	5,915	84
4953D	Processor; full-width module, 32K bytes of memory, 13 I/O feature or storage slots	6,835	79
4955A	Processor; full-width module, 16K bytes of memory, 8 I/O feature slots	6,790	73
4955B	Processor; full-width module, 16K bytes of memory, 3 I/O feature slots	6,790	73
4955C	Processor; full-width module, 32K bytes of memory, 10 I/O feature slots	8,155	83

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSORS AND MAIN STORAGE (Continued)			
4955D	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	8,155	83
4955E	Processor; full-width module, 64K bytes of memory, 7 I/O feature slots	12,120	127
6306	Storage addition, 4952 processor; 32,768 bytes	450	1
6315	Storage addition, 4953 processor; 16,384 bytes	1,285	6
6316	Storage addition, 4953 Model C and D processors only; 32,768 bytes	1,715	15
6325	Storage addition, 4955 processor; 16,384 bytes	1,055	6
6326	Storage addition, 4955 Model C and D processors only; 32,768 bytes	1,570	13
6327	Storage addition, 4955 Model E processor only; 65,536 bytes	2,535	39
PROCESSOR FEATURES			
1590	Customer access panel	198	1
1593	Customer access panel—integrated digital I/O output cable	423	.50
1594	Customer access panel—customer direct program control adapter cable	297	.50
1595	Channel socket adapter	79	.50
3920	Floating point	1,305	8
4540	Rack mounting fixture	59	NC
4959	Input/output expansion unit	2,770	37
4997-1A	Rack enclosure, Model 1A	955	2
4997-1B	Rack enclosure, Model 1B	1,125	2
4997-2A	Rack enclosure, Model 2A	1,275	5
4997-2B	Rack enclosure, Model 2B	1,445	5
4999-1	Battery backup, Model 1	2,080	15
4999-2	Battery backup, Model 2	2,060	16
5430	Customer direct program control adapter	727	9
5650	Programmer console	507	3
6335	Storage address relocation translator	887	8
7840	Timers	627	4
7900	Two-channel switch; plugs into 4959 expansion unit	2,805	8
MAGNETIC TAPE EQUIPMENT			
1215	4969 Magnetic Tape Subsystem attachment	1,440	3
1540	4969 Magnetic Tape Subsystem Controller, 800 bpi	4,350	42
1545	4969 Magnetic Tape Subsystem Controller, 1600 bpi	4,790	44
1550	4969 Magnetic Tape Subsystem Controller, dual density	5,010	50
4969	Magnetic Tape Subsystem; model 4N	10,960	69
	Magnetic Tape Subsystem; model 4P	9,860	69
	Magnetic Tape Subsystem; model 4D	10,300	69
	Magnetic Tape Subsystem; model 7N	14,260	92
	Magnetic Tape Subsystem; model 7P	13,160	90
	Magnetic Tape Subsystem; model 7D	13,600	90
MASS STORAGE			
4962-1	Disk Storage Unit; 9-megabyte capacity, non-removable disk	7,595	44
4962-1F	Disk Storage Unit; 9-megabyte capacity on non-removable disk, 123K additional bytes on fixed-head disk	9,445	60
4962-2	Disk Storage Unit; combination disk/diskette unit, 9-megabyte capacity on non-removable disk, 606K-byte capacity on removable diskettes	9,470	62
4962-2F	Disk Storage Unit; combination disk/diskette unit, 9-megabyte capacity on non-removable disk, 123K-byte capacity on fixed-head disk, 606K-byte capacity on removable diskettes	11,320	85
4962-3	Disk Storage Unit; 14-megabyte capacity, non-removable disk	8,550	60
4962-4	Disk Storage Unit; combination disk/diskette unit, 14-megabyte capacity on non-removable disk, 606K-byte capacity on removable diskettes	10,400	76
4963-23A	Disk Storage Subsystem; primary disk unit with 23-megabyte capacity on non-removable disk and an additional 131K bytes under fixed heads	10,980	56
4963-23B	Disk Storage Subsystem; expansion drive, same characteristics as 4963-23A	9,110	53
4963-29A	Disk Storage Subsystem; primary disk unit with 29 megabytes capacity on non-removable disks	10,200	41
4963-29B	Disk Storage Subsystem; expansion drive, same characteristics as 4963-29A	8,330	38
4963-58A	Disk Storage Subsystem; primary disk unit with 58-megabyte capacity on non-removable disk and an additional 131K bytes under fixed heads; up to three 4963-58B or 4963-64B disk units can be attached	12,540	66
4963-58B	Disk Storage Subsystem; expansion drive, same characteristics as 4963-58A	10,670	63
4963-64A	Disk Storage Subsystem; primary disk unit with 64-megabyte capacity on non-removable disk; up to three 4963-58B or 4963-64B disk units can be attached	11,760	51
4963-64B	Disk Storage Subsystem; expansion drive, same characteristics as 4963-64A	9,890	48
4964	Diskette Unit; 606K-byte capacity on removable, 2-sided diskettes	2,530	17
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	5,185	60

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
MASS STORAGE (Continued)			
1205	4966 Diskette Magazine Attachment	2,205	4
3580	4962 Disk Storage Unit Attachment	897	7
3581	4964 Diskette Unit Attachment	766	6
3590	4963 Disk Subsystem Attachment	1,685	4
PRINTERS			
4973-1	Line Printer; 132 columns; 48-, 64-, or 96-character set; 80 to 155 lpm	9,055	85
4973-2	Line Printer; 132 columns, 48-, 64-, or 96-character set; 235 to 414 lpm	13,040	143
4974	Printer; wire-matrix print head, 132 columns, EBCDIC 64-character set; 120 cps	2,925	32
5620	4974 Printer Attachment	976	3.50
5630	4973 Line Printer Attachment	987	5
TERMINALS			
4978	Display Station; 80 charactrers by 24 lines, cycle-steal operations and buffered microprocessor control	1,385	13
DO2038	4978 Display Station attachment	1,460	13.50
DO2056	4978 Keyboard; typamatic mode keys (cursor, space, and all other than fixed-function keys)	903	8
DO2057	4978 Keyboard; typamatic space key	876	8
4979	Display Station; 80 characters by 24 lines, integrated keyboard, cycle-steal operations and buffered microprocessor control	1,910	16
3585	4979 Display Station Attachment	1,050	7
COMMUNICATIONS			
1300	Programmable communications subsystem controller	3,120	27
1610	Asynchronous communications single-line control	1,195	10
2000	Communications indicator panel	275	3
2010	Communications power	132	3
2074	BSC single-line control	1,305	12
2075	BSC single-line control/high-speed	1,515	12
2090	SDLC single-line control	1,560	12
2091	Asynchronous communications 8-line control	1,070	10
2092	Asynchronous communications 4-line adapter	1,105	20
2093	BSC 8-line control	1,335	10
2094	BSC 4-line adapter	1,370	25
2095	Feature-programmable multiline communications; 8-line control	1,515	7
2096	Feature-programmable multiline communications; 4-line adapter	1,725	21
3600	Programmable communications subsystem expansion scanner	1,940	15
4700	Half duplex DCE attachment	551	3.50
4701	Full duplex DCE attachment	456	3
4704	TTY current attachment	705	5
4706	Data-Phone digital service adapter	1,055	5
4709	Asynchronous local attachment	578	2.50
4710	Synchronous local attachment	600	3
4713	Autocall attachment	556	3.50
4716	1200-bps asynchronous modem, switched network	1,110	8
4717	1200-bps asynchronous modem, leased line SNB4	1,275	9
4718	1200-bps asynchronous modem, leased line	1,110	8
4721	1200-bps synchronous modem with clock, switched network	1,140	8
4722	1200-bps synchronous modem with clock, leased line SNBU	1,305	9
4723	1200-bps synchronous modem with clock, leased line	1,140	8
4940	Multiplexer, reed relay	716	12
4950	Multiplexer, solid state	787	7
4987	Programmable communications subsystem, Model 1	4,375	41
4990	Communications console, Model 1	821	2
7850	Teletypewriter adapter	617	6
USER ATTACHMENT FEATURES			
1060	Analog input control	882	4.50
1065	Analog output	578	5
1070	Amplifier, multirange	1,005	5
1200	System/370 channel attachment	2,390	11
1210	5250 Information Display System Attachment	3,245	10
1560	Integrated digital I/O, nonisolated	909	12
1565	Channel repower	573	2
3525	Digital input/process interrupt, nonisolated	451	4
3532	Digital input/process interrupt, isolated	765	3
3535	Digital output, nonisolated	390	4

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
USER ATTACHMENT FEATURES (Continued)			
4982	Sensor I/O unit	1,820	11
4993	Series/1-System/370 termination enclosure, Model 1	2,890	17
6305	4982 Sensor I/O attachment	716	6

SOFTWARE PRICES

		Monthly Charge	One-Time Charge
LICENSED PROGRAMS			
5719-PC1	Realtime Programming System, Version 1	$20	$1,200
5719-PC2	Realtime Programming System, Version 2	25	1,500
5719-PC3	Realtime Programming System, Version 3	32	1,900
5719-PC4	Realtime Programming System, Version 4	38	2,250
5719-PC4	Realtime Programming System, Version 4 with Command Language Facility	49	2,900
5719-AS1	Program Preparation Subsystem, Version 1	18	1,104
5719-AS2	Program Preparation Subsystem, Version 2	20	1,208
5719-AS3	Program Preparation Subsystem, Version 3	22	1,320
5719-AS4	Program Preparation Subsystem, Version 4	24	1,440
5719-CB1	Realtime Programming System COBOL Compiler and Resident Library	62	3,700
5719-CB2	Realtime Programming System COBOL Transient Library	5	300
5719-PL1	PL/1 Compiler & Resident Library	46	2,784
5719-PL2	PL/1 Transient Library	5	288
5719-F01	FORTRAN IV Compiler & Object Support Library	14	864
5719-F02	FORTRAN IV Compiler & Object Support Library (Event Driven Executive)	14	864
5719-F03	FORTRAN IV Realtime Subroutine Library	5	288
5719-F04	FORTRAN IV Realtime Subroutine Library, Version 2	6	336
5719-LM1	Mathematical & Functional Subroutine Library, Version 1	7	408
5719-LM2	Mathematical & Functional Subroutine Library, Version 2	8	480
5719-LM3	Event Driven Executive Mathematical and Functional Subroutine Library	8	480
5719-CSO	Programmable Communications Subsystem Preparation Facility	8	500
5719-CS1	Programmable Communications Subsystem Execution Support	6	336
5719-CS2	Programmable Communications Subsystem Extended Execution Support	20	1,150
5719-U11	Facility Control/Power Management 1	130***	6,240
5719-U12	Facility Control/Power Management 2	188***	9,024
5719-U12	Facility Control/Power Management 3	52***	2,496
5719-U13	Facility Control/Power Management 4	225***	10,800
5719-U14	Facility Control/Power Management 2M	80***	3,840
5719-U15	Facility Control/Power Management 4M	100***	4,800
5719-PA1	Base Program Preparation Facilities	90†	12,160
5719-XS1	Event Driven Executive Basic Supervisor and Emulator	16	960
5719-UT3	Event Driven Executive Utilities	12	720
5719-XX2	Event Driven Executive Preparation Facility	15	900
5719-LM5	Event Driven Executive Macro Library	29	1,740
5719-LM2	Event Driven Executive Macro Library/Host	80	—
5719-CB1	Event Driven Executive COBOL Compiler and Resident Library	62	3,700
5719-CB2	Event Driven Executive COBOL Transient Library	5	300
5719-AM3	Event Driven Executive Indexed Access Method	15	900
5719-ASA	Event Driven Executive Macro Assembler	14	840
5719-MS1	Event Driven Executive Multiple Terminal Manager	13	780
5719-SM2	Event Driven Executive Sort/Merge	7	400
5719-SM1	Sort/Merge	7	400
5719-AM1	Indexed Access Method	15	900
5719-CS2	Programmable Communications Subsystem Extended Execution Support	20	1,150

*Charges
All licensed programs will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. 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.

If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Paid-up license credits are not transferrable to other customers or between licenses whether they are for programs that have a different program number or the same program number.

Payment Period
For most programs the customer may choose to pay a continuous monthly charge until the Licensed Program is discontinued or, in lieu thereof, a one-time charge to obtain a paid-up license.
***Future charges waived after 48 consecutive months.
†Future charges waived after 24 consecutive months.

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SOFTWARE PRICES

		Monthly Charge*	One-Time Charge*
LICENSED PROGRAMS (Continued)			
5719-CA1	Series 11—System/370 Channel Attach Program	21	1,250
5719-TA4	4969 Magnetic Tape Subsystem Support	17	1,020
5719-TA1	5250 Information Display System Support	18	1,080
5719-ED1	Structured Programming Facility	210†	5,040
5719-CR1	Structured Programming Facility MVS/VTAM Application	210†	5,040
5719-CR2	Structured Programming Facility MVS/TCAM Application Program	210†	5,040
PROGRAMMING RPQ's			
5799-TBN	Series/1 Indexed Access Method, Version 1	6	360
5799-TCA	Series/1 Indexed Access Method, Version 2	6	360
5699-TCB	Series/1 Indexed Access Method, Version 3	6	360
5799-TBP	Series/1 Basic Sort	2	20
5799-TBM	Series/1 IBM Display Support, Version 1	3	174
5799-TCD	Series/1 IBM Display Support, Version 2	3	174
5799-TCE	Series/1 IBM Display Support, Version 3	3	174
5799-TCY	Series/1 Realtime Programming System Multiple Terminal Manager	790	9,480
5799-TBL	Series/1 Disk Spooling	3	150
5799-TCG	Series/1 Disk Spooling, Version 2	3	150
5799-TCH	Series/1 Disk Spooling, Version 3	3	150
5799-TBK	Series/1 Remote Job Entry	31	1,842
5799-TBW	Series/1 Address Translator Transient, Version 1	2.50	150
5799-TBX	Series/1 Address Translator Transient, Version 2	2.50	150
5799-TBY	Series/1 Address Translator Transient, Version 3	2.50	150
5799-TLC	Visual Info Presentation	35	2,065
5799-TCK	Interactive IPL Loader	2	80
5799-TDG	Series/1 Transient Activity Tool Version 1	4	240
5799-TDE	Series/1 Data Collection Interactive	20	1,200
5799-TAA	Control Program Support	15.50	372
5799-TAL	Control Program Support Extensions I	1.50	36
5799-TAQ	Control Program Support Extensions II	1.50	36
5799-TBQ	Control Program Support Extended Function	3	72
5799-TAH	Indexed Access Method Control Program Support	5	120
5799-TBD	Control Program Support, Commercial Arithmetic	2	48
5799-TAF	Binary Synchronous Communication Control Program Support	3.50	84
5799-TAE	4979 Display Station Control Program Support	1.50	36
5799-TAK	4978 Display Station Control Program Support	6	144
5799-TBT	Control Program Support Address Relocation Translator	5	120
FIELD-DEVELOPED PROGRAMS			
5798-NLG	Series/1 Intelligent Terminal Subsystem	110	1,320
5798-NND	Series/1 Event Driven Executive Basic Supervisor and Emulator	11	650
5798-NNC	Series/1 Event Driven Executive Utilities	8.50	500
5798-NNB	Series/1 Event Driven Executive Macro Library	24	1,425
5798-NRR	Series/1 Event Driven Executive Basic Supervisor and Emulator, Version 2	13.50	800
5798-NRQ	Series/1 Event Driven Executive Utilities, Version 2	10	600
5798-NRK	System/370 Event Driven Executive Macro Library/Host	119**	1,428
5798-NRP	Series/1 Event Driven Executive Program Preparation	12.50	750
5798-NNQ	System/370 Program Preparation Facilities For Series/1	520	6,240
5798-NNR	Series/1 Native Application Load Facility	60	720

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If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Paid-up license credits are not transferrable to other customers or between licenses whether they are for programs that have a different program number or the same program number.

Payment Period
For most programs the customer may choose to pay a continuous monthly charge until the Licensed Program is discontinued or, in lieu thereof, a one-time charge to obtain a paid-up license.
**Future charges waived after payment of 12 consecutive months.

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SOFTWARE PRICES

FIELD-DEVELOPED PROGRAMS (Continued)

		Monthly Charge*	One-Time Charge*
5798-NPY	Series/1 Intelligent Data Entry System	55**	660
5798-NPZ	Series/1 Remote Job Entry for Control Program Support	25**	330
5798-NQJ	Series/1 Controlled Access System-1	45**	1,740
5798-NTH	Series/1 Event Driven Executive Supermarket Energy Management	100**	200
5798-NTF	Series/1 Virtual COBOL Subsystem Runtime Monitor	40**	480
5798-NWB	Series/1 Facilities Control Multiplexer Subsystem	120**	1,440

*Charges
All licensed programs will be licensed under the Agreement for IBM Licensed Programs for a monthly charge or, in lieu thereof, a one-time charge. 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.

If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Paid-up license credits are not transferrable to other customers or between licenses whether they are for programs that have a different program number or the same program number.

Payment Period
For most programs the customer may choose to pay a continuous monthly charge until the Licensed Program is discontinued or, in lieu thereof, a one-time charge to obtain a paid-up license.
**Future charges waived after payment of 12 consecutive months.

INSTALLED USER PROGRAMS

		Monthly Charge*	One-time Charge
5796-NPP	Series/1 Debugging Aid	—	$165†
5796-NPW	Series/1 Virtual COBOL Subsystem Compiler	310**	3,720
5796-NQC	Series/1 Supermarket Energy Management	78**	936
5796-NQE	Series/1 Waterloo Interactive Direct Job Entry Terminal System	145**	1,740
5796-NRD	Series/1 Champion Distributed Processing System	170**	2,040
5796-NTP	Series/1 Program Executive System Preparation Support	45**	540
5796-NTQ	Series/1 Program Executive System Execution Support	45**	540
5796-NTY	Series/1 Multileaving Remote Job Entry	125**	1,500

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Payment Period
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†One-time charge.
**Future charges waived after 12 consecutive months.