# IBM Series/1

## MANAGEMENT SUMMARY

When IBM announced it in November 1976, the Series/1 had a stone-in-the-water effect that sent ripples of excitement throughout the minicomputer industry. This excitement was not caused by any technological breakthrough, but by the fact that IBM's General Systems Division (GSD) broke a number of marketing traditions that opened up new markets not only for IBM itself but also for systems houses, software firms, and peripheral manufacturers.

The Series/1 announcement marked the first time that IBM offered a series of minicomputers as unbundled system components, rather than in the company's traditional packages, and available on a purchase-only basis— both practices traditionally used by competitive minicomputer makers but heretofore avoided by IBM. In another departure from tradition, the company announced that the Series/1 would be sold on an OEM as well as an end-user basis, but that it would continue its policy of not offering volume discounts. Another aspect of the announcement that was definitely not typical of IBM was the software repertoire initially offered with the Series/1— system software was minimal, and applications software was nonexistent.

In April 1977, just five months after introducing the Series/1, IBM unveiled the systems software that had been missing from the product line as originally announced. New software products included an operating system, FORTRAN IV, PL/1, and several systems software and Control Program Support (CPS) program products. Simultaneously, IBM added four additional processor models, a printer, and a display station to the Series/1 hardware complement. ▷

Born as a bare-bones minicomputer noted more for what it lacked than what it offered, the IBM Series/1 has gone through some significant changes. Main memory has been doubled, disk capacity has been increased, and the software repertoire has grown extensively. There are currently nine models in the Series/1 family.

## CHARACTERISTICS

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

**MODELS:** Series/1 Models 3A, 3B, 3C, 3D, 5A, 5B, 5C, 5D, and 5E.

**DATE ANNOUNCED:** November 1976.

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

**INSTRUCTIONS:** One- or two-word instructions. There are 10 different types of instructions available, categorized as ▶

*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.*
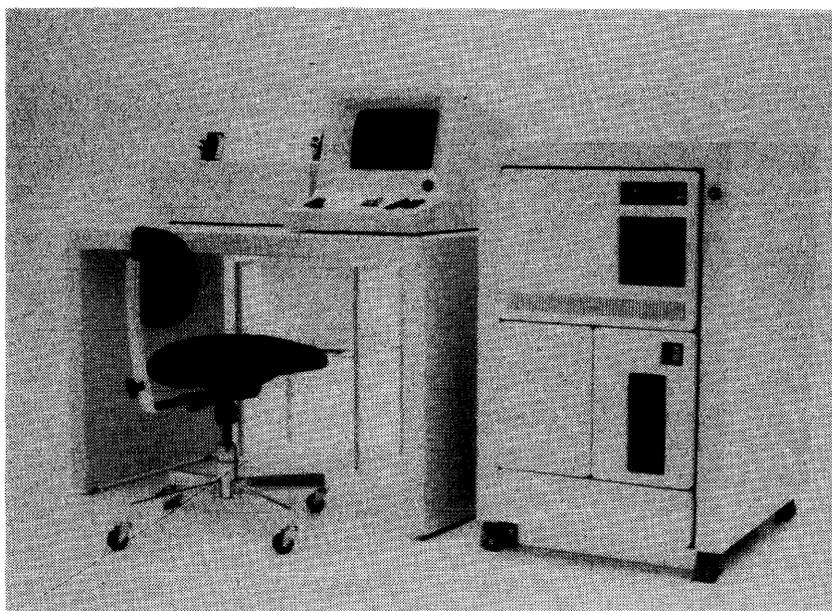
# IBM Series/1

▷ 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."

There are nine current members of the Series/1 family of 16-bit general-purpose processors. The nine minicomputers (or, in IBM's terms, "small computers") are based on two microprocessor-based CPU's, the 4953 (Model 3) and the faster 4955 (Model 5). The 4955 is about three times faster than the 4953, due to more and improved microcoding and faster memory (660 nanoseconds for the 4955 and 800 nanoseconds for the 4953). According to IBM, the average instruction execution time (weighted) is 11.8 microseconds for the 4953 and 3.9 microseconds for the 4955.

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.

Model 3 computers can address up to 64K bytes of memory, while Model 5 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 Model 3.

The Model 3A and Model 3C 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 Model 3B and 3D processors are housed in a full-width chassis, and both have 12 memory or I/O slots. With 16K bytes of memory each, Models 3A and 3B are priced at $4,360 and $5,190, respectively. With 32K bytes of memory each, Models 3C and 3D are priced at $5,370 and $6,200, respectively.

In the Model 5 processors, unlike the Model 3's, memory and I/O controller modules cannot be intermixed; previously configured slots are required for each type. The Model 5A comes with eight I/O slots and three memory slots, while the Model 5B has only three I/O slots and seven add-on memory slots. The remaining slot in the Model 5B is for the storage address relocation translator (map). The Model 5C comes with 10 I/O feature slots. Models 5D and 5E each come with seven I/O feature slots.

As in the Model 3's, the basic configuration of each Model 5 system includes one 16K-byte memory module. The price for either the basic Model 5A or Model 5B is $6,165. The Model 5C and 5D are both priced at $7,400, and the Model 5E at $11,000. Additional 660-nanosecond, 16K-byte memory modules cost $2,040 each, and 64K-byte ▷

▶ follows: Data Movement, Arithmetic, Branching, Shift, Stack, Compare, Logical, Processor Status, Privileged, and Floating-Point. In all instructions, bits 0 through 4 identify the specific function.

INTERNAL CODE: EBCDIC and binary.

## MAIN STORAGE

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

CYCLE TIME: Model 3 processor—800 nanoseconds; Model 5 processor—660 nanoseconds.

CAPACITY: Model 3—16K to 64K bytes in 16K- and 32K-byte increments; Model 5—16K to 256K bytes in 16K-, 32K-, and 64K-byte increments.

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

STORAGE PROTECTION: None on Model 3; standard on Model 5.

## CENTRAL PROCESSORS

GENERAL: The Series/1 family is available in two processor models: the Model 3 with A, B, C, and D versions; and the Model 5 with 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 Model 3A processor is a one-half-width unit with four slots for either I/O feature or memory cards. The Model 3B is a full-width unit with 13 slots for either I/O feature or memory cards. The Model 3C processor is a one-half-width unit having 4 I/O feature or memory card slots, and the Model 3D is a full-width unit with 13 I/O feature or memory slots. All versions of the Model 5 processors are full-width modules. The Models 5A, 5B, 5C, 5D, and 5E have 8, 3, 10, 7, and 7 I/O feature slots, respectively. The differences between successive versions of these processors lie in memory capacity, with the Model A and B machines having 16K bytes each, the Model C and D machines 32K bytes each, and the Model E 64K bytes. Storage additions of 16K bytes are available for the Model A, B, C, and D processors; 32K bytes for the Model C and D; and 64K bytes for the Model 5E. 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 Model 5 processor also has one Address Key Register (AKR). All of the above are 16-bit registers. Optionally, the Model 5 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 ▶

# IBM Series/1

## PERIPHERALS/TERMINALS

| DEVICE | DESCRIPTION & SPEED |
|---|---|
| **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 |

▷ memory modules for the Model 5E cost $3,800 each. The map module for addressing above 64K bytes is priced at $805, and the floating-point feature costs $1,190.

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 subsystems; 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 Storage Subsystem, announced in June 1978, consists of two types of fixed-media disk drives, a 58-megabyte version and a 64-megabyte version. The 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. Both versions connect to the Series/1 channel through a 3590 Disk Subsystem Attachment, which can attach up to four drives. Any mix of 58- and 64-megabyte units can be used. ▷

▶ 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 Model 3 processor has 168 instructions available; the Model 5 has 177 instructions. The floating-point processor option, available on Model 5 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 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.

| | Model 3 | Model 5 |
|---|---|---|
| Load/store | 5.40 | 2.42 |
| Add | 8.40 | 2.64 |
| Subtract | 9.00 | 2.64 |
| Multiply | 13.20 | 10.78 |
| Divide | 15.60 | 17.16 |
| Branch on condition | 4.20 | 1.54 |
| Move byte field | 5.40+CT* | 1.45+CT* |

*CT is the count of the last byte moved. For the Model 3 add 8.40 microseconds to each value in this instruction, and for the Model 5 add 1.54.

**INTERRUPTS:** Series/1 processors have four pre-emptive 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 5 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. ▶

# IBM Series/1

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. 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 ▷

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 Model 3A and 3C processors are 8½ inches wide, 20¾ inches deep, and weigh 30 pounds. All other processor models measure 19 inches in width, are 18¾ inches deep, and weigh 50 pounds. All units require 115 to 230 VAC, +20 percent, at 47 to 63 Hz, and are usable internationally. Recommended operating environment is 75 degrees F.

## 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.

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.) ▶

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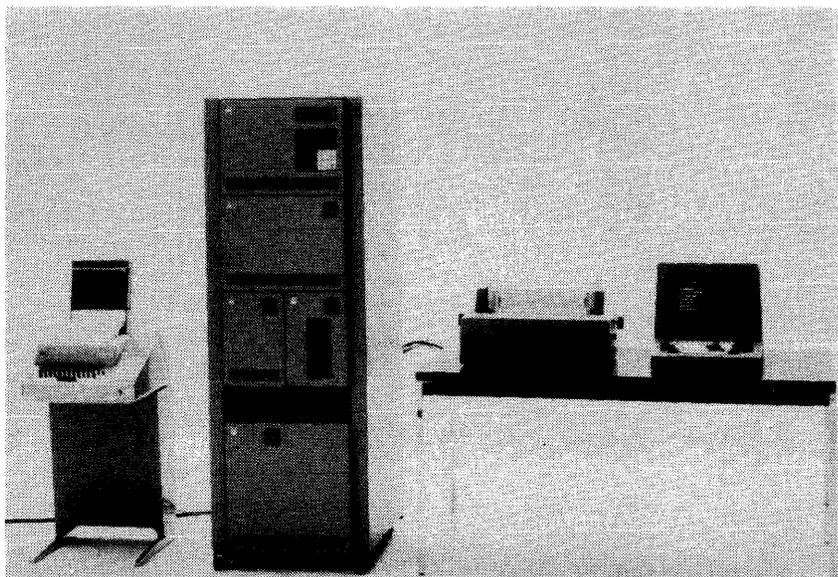


*This Series/1 configuration includes a 4997 rack enclosure with a 4955 processor mounted at the top and a 4959 input/output expansion unit below. The bottom half of the enclosure houses a 4962 disk storage unit, with a 4982 sensor I/O unit above and to the left, and a 4964 diskette unit to the right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

▷ 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.

Programming support for the Series/1 consists of the Realtime Programming System, 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.

All data transfers to and from the Series/1 systems are on a cycle-steal basis. The communications features allow for ▷

## ▶ 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 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 40 milliseconds (cylinder to cylinder). The data transfer rate is 89,000 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:** This system combines four models of direct-access, movable-head disk drives to offer capacities of 58 to 258 megabytes on non-removable disks. Model 58A is a primary drive having a 58-million-byte capacity. Model 58B is an expansion drive with the same capacity. Both these models offer an additional fixed-head capacity of 131,072 bytes. Model 64A is a primary drive having a 64-million-byte capacity, and the Model 64B is an expansion drive with the same capacity. A 4963 Disk Subsystem allows for the attachment of up to three expansion drives of either model—with or without fixed heads—to the primary drive. The primary drive itself attaches to the Series/1 channel via a microprocessor attachment that has extensive self-checking and diagnostic capabilities. Multiple 4963 Disk Subsystems can be attached to a Series/1 processor. ▶

# IBM Series/1

▷ 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 (*MiniNews,* July 1978). 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 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. ▷

▶ All models have a 24-millisecond average access time for the movable heads. Data transfer rate is 1.03 megabytes per second. All drives have an overlapped seek capability.

**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.

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

# IBM Series/1

▷ The Series/1 represents a new ball game for IBM, and indications are that the company is fully committed to it. Considering the reception the product line has gotten to date from those in the minicomputer industry as well as from users, it probably won't be long before the big minicomputer vendors such as DEC, Data General, and Hewlett-Packard feel a significant impact from the Series/1.□

▶ expansion unit. Together, the sensor I/O unit and the attachment feature provide a broad base for general digital and analog I/O applications.

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

**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.

**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.

Versions 3 and 4 of the Realtime Programming System further enhance its capabilities. Version 3 provides support for the Series/1 Program Preparation Subsystem (PPS). Version 4 (scheduled for release in February 1979) offers support for the 4963 Disk Subsystem and the 4966 Diskette Magazine Unit, plus communications support for additional terminals. Systems Network Architecture (SNA) support and the capability for either a single or multiple address space environment are also provided.

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. ▶

# IBM Series/1

## ► LANGUAGES

**COBOL:** Scheduled for availability in May 1979, 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.

**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).

**EVENT DRIVEN EXECUTIVE (EDE):** Consists of three licensed field-developed programs: an EDE Basic Supervisor and Emulator, EDE utilities, and an EDE macro library for assembling the supervisor and application programs. The EDE can be used in 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.

**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. ►

# IBM Series/1

➤ 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 3 of PPS provides all the facilities of Version 1 and Version 2 plus support for multiple address space management environments.

**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 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 SUBSYSTEM PREPARATION FACILITY:** A macro library ➤

# IBM Series/1

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 SUBSYSTEM EXECUTION SUPPORT: Runs under control of RPS and provides the user with an interface to the 4987 Programmable Communications Subsystem. The support consists of execution support macros and a loader utility to load the controller storage image program into controller storage.

MATHEMATICAL AND FUNCTIONAL SUBROUTINE 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.

- 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.

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.

# IBM Series/1

▶ **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 Model 1 diskette unit and attachment, timers, integrated digital I/O non-isolated, 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 $10,985, and monthly maintenance charge is $138.

**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, teletypewriter cable, and 16 EIA data set cables. Purchase price is $31,577, and monthly maintenance charge is $363.■

## EQUIPMENT PRICES

|  |  | Purchase Price | Monthly Maint. |
|---|---|---|---|
| **PROCESSORS AND MAIN STORAGE** | | | |
| 4953A | Processor; half-width module, 16K bytes of memory, 4 I/O feature or storage slots | $ 4,360 | $ 76.00 |
| 4953B | Processor; full-width module, 16K bytes of memory, 13 I/O feature or storage slots | 5,190 | 70.00 |
| 4953C | Processor; half-width module, 32K bytes of memory, 4 I/O feature or storage slots | 5,370 | 88.00 |
| 4953D | Processor; full-width module, 32K bytes of memory, 13 I/O feature or storage slots | 6,200 | 88.00 |
| 4955A | Processor; full-width module, 16K bytes of memory, 8 I/O feature slots | 6,165 | 73.00 |
| 4955B | Processor; full-width module, 16K bytes of memory, 3 I/O feature slots | 6,165 | 73.00 |
| 4955C | Processor; full-width module, 32K bytes of memory, 10 I/O feature slots | 7,400 | 87.00 |
| 4955D | Processor; full-width module, 32K bytes of memory, 7 I/O feature slots | 7,400 | 87.00 |
| 4955E | Processor; full-width module, 32K bytes of memory, 7 I/O feature slots | 11,000 | 127.00 |
| 6315 | Storage addition, 4953 processor; 16,384 bytes | 1,510 | 10.00 |
| 6316 | Storage addition, 4953 Model C and D processors only; 32,768 bytes | 2,425 | 22.00 |
| 6325 | Storage addition, 4955 processor; 16,384 bytes | 1,750 | 8.00 |
| 6326 | Storage addition, 4955 Model C and D processors only; 32,768 bytes | 2,850 | 14.00 |
| 6327 | Storage addition, 4955 Model E processor only; 65,536 bytes | 3,800 | 39.00 |
| **PROCESSOR FEATURES** | | | |
| 1590 | Customer access panel | 180 | 1.00 |
| 1593 | Customer access panel—integrated digital I/O output cable | 385 | 0.50 |
| 1594 | Customer access panel—customer direct program control adapter cable | 270 | 0.50 |
| 1595 | Channel socket adapter | 73 | 0.50 |
| 3920 | Floating point | 1,190 | 11.00 |
| 4540 | Rack mounting fixture | 55 | NC |
| 4959 | Input/output expansion unit | 2,515 | 37.00 |
| 4997-1A | Rack enclosure, Model 1A | 870 | 2.00 |
| 4997-1B | Rack enclosure, Model 1B | 1,160 | 5.00 |
| 4997-2A | Rack enclosure, Model 2A | 1,025 | 2.00 |
| 4997-2B | Rack enclosure, Model 2B | 1,315 | 5.00 |
| 4999-1 | Battery backup, Model 1 | 1,895 | 18.00 |
| 4999-2 | Battery backup, Model 2 | 1,875 | 18.00 |
| 5430 | Customer direct program control adapter | 660 | 11.00 |
| 5650 | Programmer console | 460 | 6.00 |
| 6335 | Storage address relocation translator | 805 | 9.00 |
| 7840 | Timers | 570 | 4.00 |
| 7900 | Two-channel switch; plugs into 4959 expansion unit | 2,550 | 8.00 |
| **MASS STORAGE** | | | |
| 4962-1 | Disk Storage Unit; 9-megabyte capacity, non-removable disk | 6,895 | 44.00 |
| 4962-1F | Disk Storage Unit; 9-megabyte capacity on non-removable disk, 123K additional bytes on fixed-head disk | 7,760 | 60.00 |
| 4962-2 | Disk Storage Unit; combination disk/diskette unit, 9-megabyte capacity on non-removable disk, 606K-byte capacity on removable diskettes | 8,575 | 60.00 |
| 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 | 9,440 | 76.00 |
| 4962-3 | Disk Storage Unit; 14-megabyte capacity, non-removable disk | 8,595 | 69.00 |
| 4962-4 | Disk Storage Unit; combination disk/diskette unit, 14-megabyte capacity on non-removable disk, 606K-byte capacity on removable diskettes | 10,275 | 89.00 |

# IBM Series/1

# EQUIPMENT PRICES

| | | Purchase Price | Monthly Maint. |
|---|---|---|---|
| **MASS STORAGE (Continued)** | | | |
| 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 4963-5813 or 4963-64B disk units can be attached | 11,420 | 66.00 |
| 4963-58B | Disk Storage Subsystem; expansion drive, same characteristics as 4963-58A | 9,720 | 63.00 |
| 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 | 10,700 | 51.00 |
| 4963-64B | Disk Storage Subsystem; expansion drive, same characteristics as 4963-64A | 9,000 | 48.00 |
| 4964 | Diskette Unit; 606K-byte capacity on removable, 2-sided diskettes | 2,410 | 17.00 |
| 4966 | Diskette Magazine Unit; provides random access to 23 diskettes contained in two 10-diskette removable magazines and three individual diskettes; up to 27.8-megabyte capacity | 4,705 | 60.00 |
| 1205 | 4966 Diskette Magazine Attachment | 2,000 | 4.00 |
| 3580 | 4962 Disk Storage Unit Attachment | 815 | 8.00 |
| 3581 | 4964 Diskette Unit Attachment | 730 | 8.00 |
| 3590 | 4963 Disk Subsystem Attachment | 1,530 | 4.00 |
| **PRINTERS** | | | |
| 4973-1 | Line Printer; 132 columns, 48-, 64-, or 96-character set; 80 to 155 lpm | 8,625 | 85.00 |
| 4973-2 | Line Printer; 132 columns, 48-, 64-, or 96-character set; 235 to 414 lpm | 12,425 | 158.00 |
| 4974 | Printer; wire-matrix print head, 132 columns, EBCDIC 64-character set; 120 cps | 2,790 | 34.00 |
| 5620 | 4974 Printer Attachment | 930 | 3.50 |
| 5630 | 4973 Line Printer Attachment | 940 | 5.00 |
| **TERMINALS** | | | |
| 4978 | Display Station; 80 characters by 24 lines, detachable keyboard, cycle-steal operations and buffered microprocessor control | RPQ | RPQ |
| 4979 | Display Station; 80 characters by 24 lines, integrated keyboard, cycle-steal operations and buffered microprocessor control | 1,735 | 25.00 |
| 3585 | 4979 Display Station Attachment | 955 | 10.00 |
| **COMMUNICATIONS** | | | |
| 1300 | Programmable communications subsystem controller | 2,835 | 27.00 |
| 1610 | Asynchronous communications single-line control | 1,090 | 17.00 |
| 2000 | Communications indicator panel | 250 | 3.00 |
| 2010 | Communications power | 120 | 3.00 |
| 2074 | BSC single-line control | 1,190 | 19.00 |
| 2075 | BSC single-line control/high-speed | 1,380 | 21.00 |
| 2090 | SDLC single-line control | 1,420 | 19.00 |
| 2091 | Asynchronous communications 8-line control | 975 | 13.00 |
| 2092 | Asynchronous communications 4-line adapter | 1,005 | 30.00 |
| 2093 | BSC 8-line control | 1,215 | 13.00 |
| 2094 | BSC 4-line adapter | 1,245 | 35.00 |
| 3600 | Programmable communications subsystem expansion scanner | 1,765 | 15.00 |
| 4700 | Half duplex DCE attachment | 500 | 3.50 |
| 4701 | Full duplex DCE attachment | 415 | 3.00 |
| 4704 | TTY current attachment | 640 | 5.00 |
| 4706 | Data-Phone digital service adapter | 960 | 5.00 |
| 4709 | Asynchronous local attachment | 525 | 2.50 |
| 4710 | Synchronous local attachment | 545 | 3.00 |
| 4713 | Autocall attachment | 505 | 3.50 |
| 4716 | 1200-bps asynchronous modem, switched network | 1,010 | 8.00 |
| 4717 | 1200-bps asynchronous modem, leased line SNB4 | 1,160 | 9.00 |
| 4718 | 1200-bps asynchronous modem, leased line | 1,010 | 8.00 |
| 4721 | 1200-bps synchronous modem with clock, switched network | 1,040 | 8.00 |
| 4722 | 1200-bps synchronous modem with clock, leased line SNBU | 1,190 | 9.00 |
| 4723 | 1200-bps synchronous modem with clock, leased line | 1,040 | 8.00 |
| 4940 | Multiplexer, reed relay | 650 | 16.00 |
| 4950 | Multiplexer, solid state | 715 | 8.50 |
| 4987 | Programmable communications subsystem | 3,975 | 41.00 |
| 4990 | Communications console | 745 | 2.00 |
| 7850 | Teletypewriter adapter | 560 | 11.00 |

# IBM Series/1

## EQUIPMENT PRICES

|  |  | Purchase Price | Monthly Maint. |
|---|---|---|---|
| **USER ATTACHMENT FEATURES** | | | |
| 1060 | Analog input control | 800 | 4.50 |
| 1065 | Analog output | 525 | 5.00 |
| 1070 | Amplifier, midrange | 915 | 5.00 |
| 1200 | System/370 channel attachment | 2,175 | NC |
| 1560 | Integrated digital I/O, nonisolated | 825 | 14.00 |
| 1565 | Channel repower | 520 | 2.00 |
| 3525 | Digital input/process interrupt, nonisolated | 410 | 4.00 |
| 3530 | Digital input/process interrupt, isolated | 695 | 46.00 |
| 3535 | Digital output, nonisolated | 355 | 4.00 |
| 4982 | Sensor I/O unit | 1,655 | 11.00 |
| 4993 | Series/1-System/370 termination enclosure | 2,625 | 17.00 |
| 6305 | 4982 Sensor I/O attachment | 650 | 11.00 |

## SOFTWARE PRICES

|  |  | Monthly Charge* | One-Time Charge* |
|---|---|---|---|
| **LICENSED PROGRAMS** | | | |
| 5719-PC1 | Realtime Programming System, Version 1 | $ 20.00 | $1,200.00 |
| 5719-PC2 | Realtime Programming System, Version 2 | 25.00 | 1,500.00 |
| 5719-PC3 | Realtime Programming System, Version 3 | 32.00 | 1,900.00 |
| 5719-PC4 | Realtime Programming System, Version 4 | 38.00 | 2,250.00 |
| 5719-AS1 | Program Preparation Subsystem, Version 1 | 18.00 | 1,104.00 |
| 5719-AS2 | Program Preparation Subsystem, Version 2 | 20.00 | 1,208.00 |
| 5719-AS3 | Program Preparation Subsystem, Version 3 | 22.00 | 1,320.00 |
| 5719-PL1 | PL/1 Compiler & Resident Library | 46.00 | 2,784.00 |
| 5719-PL2 | PL/1 Transient Library | 5.00 | 288.00 |
| 5719-F01 | FORTRAN IV Compiler & Object Support Library | 14.00 | 864.00 |
| 5719-F03 | FORTRAN IV Realtime Subroutine Library | 5.00 | 288.00 |
| 5719-LM1 | Mathematical & Functional Subroutine Library, Version 1 | 7.00 | 408.00 |
| 5719-LM2 | Mathematical & Functional Subroutine Library, Version 2 | 8.00 | 480.00 |
| 5719-CSO | Programmable Communications Subsystem Preparation Facility | 8.00 | 500.00 |
| 5719-CS1 | Programmable Communications Subsystem Execution Support | 6.00 | 336.00 |
| 5719-PA1 | Base Program Preparation Facilities | 90.00** | 2,160.00 |
| 5719-U11 | Facility Control/Power Management 1 | 130.00*** | 6,240.00 |
| 5719-U12 | Facility Control/Power Management 2 | 188.00*** | 9,024.00 |
| 5719-U12 | Facility Control/Power Management 3 | 52.00*** | 2,496.00 |

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**Charges waived after 24 months; paid-up cost, $2,160.00.

***Future charges waived after 48 consecutive months.

|  |  | Monthly Charge* | Paid-Up Cost |
|---|---|---|---|
| **PROGRAMMING RPQ's** | | | |
| 5799-TAA | Control Program Support | 15.50 | 372.00 |
| 5799-TAL | Control Program Support Extensions I | 1.50 | 36.00 |
| 5799-TAQ | Control Program Support Extensions II | 1.50 | 36.00 |
| 5799-TBQ | Control Program Support Extended Function | 3.00 | 72.00 |
| 5799-TAH | Indexed Access Method Control Program Support | 5.00 | 120.00 |
| 5799-TBD | Control Program Support, Commercial Arithmetic | 2.00 | 48.00 |
| 5799-TAF | Binary Synchronous Communication Control Program Support | 3.50 | 84.00 |
| 5799-TAE | 4979 Display Station Control Program Support | 1.50 | 36.00 |
| 5799-TAK | 4978 Display Station Control Program Support | 6.00 | 144.00 |

*These programs will be distributed under the Agreement for IBM Licensed Programs for a monthly fee. Upon billing for 24 consecutive months for a Licensed Program, IBM will waive all future monthly charges for that Licensed Program.

# IBM Series/1

## SOFTWARE PRICES

| | | Monthly Charge* | Paid-Up Cost |
|---|---|---|---|
| **PROGRAMMING RPQ's (Continued)** | | | |
| 5799-TAW | Control Program Support, Disk Table of Contents | 1.00 | 24.00 |
| 5799-TAT | Control Program Support, Sort/Merge | 5.00 | 120.00 |
| 5799-TAY | Control Program Support, Disk Spooling | 3.00 | 72.00 |
| 5799-TBA | Control Program Support, Format/Print | 3.00 | 72.00 |
| 5799-TBC | Control Program Support, Auto-Call Support | 5.00 | 120.00 |
| 5799-TBB | Control Program Support, Operator Station/Debug Package | 8.00 | 192.00 |
| 5799-TBE | Control Program Support, 4978/4979 Display Map | 4.00 | 96.00 |
| 5799-TBN | Series/1 Indexed Access Method | 6.00 | 360.00 |
| 5799-TBP | Series/1 Basic Sort | 2.00 | 120.00 |
| 5799-TBM | Series/1 IBM 4978 Display Support | 3.00 | 174.00 |
| 5799-TBL | Series/1 Disk Spooling | 3.00 | 150.00 |
| 5799-TBK | Series/1 Remote Job Entry | 31.00 | 1,842.00 |
| **FIELD-DEVELOPED PROGRAMS** | | | |
| 5798-NLG | Series/1 Intelligent Terminal Subsystem | 110.00 | 1,320.00 |
| 5798-NND | Series/1 Event Driven Executive Basic Supervisor and Emulator | 11.00 | 650.00 |
| 5798-NNC | Series/1 Event Driven Executive Utilities | 8.50 | 500.00 |
| 5798-NNB | Series/1 Event Driven Executive Macro Library | 24.00 | 1,425.00 |
| 5798-NNQ | System/370 Program Preparation Facilities For Series/1 | 520.00 | 6,240.00 |
| 5798-NNR | Series/1 Native Application Load Facility | 60.00 | 720.00 |
| 5798-NPY | Series/1 Intelligent Data Entry System | 55.00** | 660.00 |
| 5798-NPZ | Series/1 Remote Job Entry for Control Program Support | 25.00** | 330.00 |

*These programs will be distributed under the Agreement for IBM Licensed Programs for a monthly fee. Upon billing for 24 consecutive months for a Licensed Program, IBM will waive all future monthly charges for that Licensed Program.

**Future charges waived after payment of 12 consecutive months.