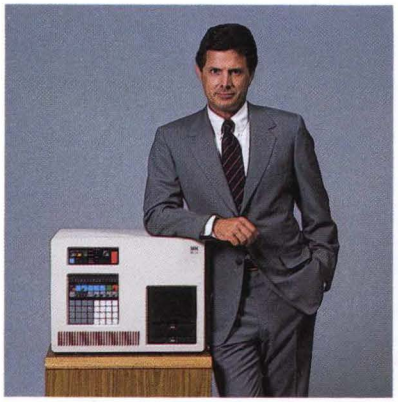
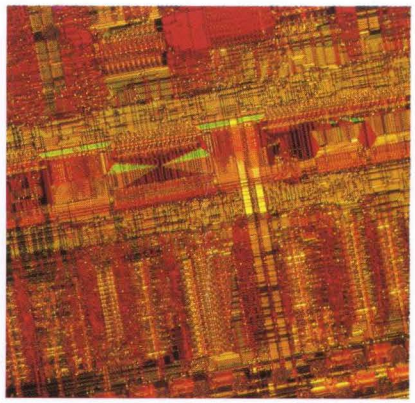
Series/1 Digest





Series/1 Digest

Thirteenth Edition (March 1990)

This is a major revision of, and obsoletes, G360-0061-11. Information for Series/1 products and services is included as of January 1990.

It is possible that this material may contain reference to, or information about, IBM products (machines and programs), programming, or services that are not announced in your country. Such references or information should not be construed to mean that IBM intends to announce such IBM products, programming, or services in your country.

Requests for IBM publications should be made to your IBM representative or to the IBM branch office serving your locality.

This publication could contain technical inaccuracies or typographical errors. Products listed in this publication may no longer be available.

A form for reader's comments is provided at the back of this publication. You may use this form to communicate your comments about this publication, its organization or subject matter with the understanding that IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you. If the form has been removed, address your comments to IBM Corporation, Department 4S5, Internal Zip 1218, P.O. Box 1328, Boca Raton, Florida 33429-1328.

© Copyright International Business Machines Corporation, 1977, 1978, 1979, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1990. All rights reserved.

Contents

Chapter 1. Executive overview 1-1

Chapter 2. Series/1 architecture 2-1

Chapter 3. Series/1 processors and features 3-1
4956 Processor (Model B10) 3-2
4956 Processor (Model E10) 3-4
4956 Processor (Models G10 and H10) 3-6
4956 Processor (Model J00) 3-8
4956 Processor (Model K00) 3-10
Attachment features 3-12
Integrated Digital Input/Output Non-Isolated 3-13
Timers 3-13
Teletypewriter Adapter 3-13
Programmable Cycle-Stealing Digital Input/Digital Output Attachment 3-13
Multifunction Attachment 3-14
Printer Attachment - 5200 Series 3-15
Configurations 3-15
GPIB Adapter 3-16
Multidrop Work Station Attachment 3-16
Programmable Subsystem Controller (RPQ D02761) 3-16
Communications features 3-17
Binary Synchronous (BSC) features 3-20
Synchronous (SDLC) feature 3-20
Asynchronous (ACC) features 3-21
Feature-Programmable Multiline Communications features 3-21
Synchronous Communications Single-Line Control/High Speed 3-22
Token-Ring Attachment Card 3-23
Multiline Communications Coprocessor 3-24
Other communications features 3-25
Communications support features 3-25

Chapter 4. Series/1 input/output and system support units 4-1
4959 Input/Output Expansion Unit 4-2
4963 Disk Subsystem 4-4
4964 Diskette Unit 4-6
4965 Storage and I/O Expansion Unit (Model E00) 4-8
4967 High-Performance Disk Subsystem 4-10
4968 Autoload Streaming Magnetic Tape Unit 4-12
4201 Proprinter 4-14
4202 Proprinter XL 4-16
4224 Printer 4-18
4234 Printer 4-20
5225 Printer 4-22
5262 Printer 4-24
3151 ASCII Display Station 4-26
3163 ASCII Display Station 4-29
3164 ASCII Color Display Station 4-31
4987 Programmable Communications Subsystem 4-33
Device Attachment features 4-35
4993 Series/1- System/370 Termination Enclosure specifications 4-36

4997 Rack Enclosure 4-38

Chapter 5. Series/1 programming support 5-1
Series/1 Event Driven Executive 5-2
Event Driven Executive - basic system functions 5-3
Basic Supervisor and Emulator (5719-XS6) 5-3
Event Driven Executive - program development 5-6
Program Preparation Facility (5719-XX7) 5-6
Macro Assembler (5719-ASA) 5-7
Macro Library (5719-LMA) 5-7
Host Preparation Facility (5799-BNA) 5-8
Macro Library/Host (5740-LM7) 5-8
Transaction Processing System (5719-TR1) 5-9
Event Driven Executive - communications support 5-10
Advanced Remote Job Entry (5719-RJ1) 5-10
Remote Manager (5719-RM1) (5719-RM1) 5-11
Communications Facility (5719-CF2) 5-12
Systems Network Architecture (5719-XX9), Version 2 5-13
Primary Systems Network Architecture (5719-XT4) 5-14
Network Definition Utility (5719-XT5) 5-15
Token-Ring Interface Program (5719-EAC) 5-16
Outboard Processing Tools Programming RPQ (5799-CJL) 5-18
X.25/HDLC Communications Support Program (5719-HD2) 5-19
Systems Network Architecture RJE Program (5719-SX2) 5-19
Event Driven Executive - device support 5-20
System/370 Channel Attach Support (5719-CX1) 5-20
Event Driven Executive - commercial support 5-21
Indexed Access Method (5719-AM4) 5-21
Sort/Merge (5719-SM2) 5-22
Event Driven Executive - application programming 5-23
General Purpose Automation Executive-Distributive GPAX-D (5798-FAS) 5-23
Series/1 Realtime Programming System 5-24
Realtime Programming System - basic system functions 5-25
Realtime Programming System (5719-PC7) 5-25
Realtime Programming System - program development 5-28
Program Preparation Subsystem (5719-AS7) 5-28
Transaction Processing System (5719-TR6) 5-29
Host Preparation Facility (5799-BNA) 5-30
Series/1 Realtime Programming System - communications support 5-31
Programmable Communications Subsystem Execution Support (5719-CS2) 5-31
Programmable Communications Subsystem Preparation Facility (5719-CS0) 5-32
X.25/HDLC Communications Support Program (5719-HD1) 5-33
Manufacturing Automation Protocol Communications Server (5719-XT2) 5-34
Advanced Remote Job Entry (5719-RJ6) 5-35
Realtime Programming System - device support 5-36
System/370 Channel Attach Support (5719-CA1) 5-36
Realtime Programming System - commercial support 5-37
Sort/Merge (5719-SM1) 5-37
Realtime Programming System - application programming 5-38
Series/1 Data Entry System (S1DES) (5796-ZDE) 5-38
Series/1 high-level language support 5-39
High-level language support - C 5-40
Host C Compiler for Series/1 Event Driven Executive (5740-EAA) 5-40
Series/1 EDX C Compiler (5799-TPC) 5-42
Series/1 EDX C Run-Time Library (5719-EAB) 5-43

High-level language support - COBOL 5-44
COBOL for Event Driven Executive and Realtime Programming System 5-44
Host COBOL for the Series/1 5-45
High-level language support - PL/I 5-46
Series/1 PL/I 5-46
High-level language support - FORTRAN 5-48
FORTRAN IV Compiler and Object Support Library (5719-FO2) 5-48
Mathematical and Functional Subroutine Library 5-49
FORTRAN IV Realtime Subroutine Library (5719-FO4) 5-50
High-level language support - Pascal 5-51
Series/1 Pascal 5-51
Additional system support 5-52
Series/1 Intelligent Work Station Version 2 (5799-TNG) 5-52
Series/1 program distribution, licensing, and support 5-53
Licensed Programs 5-53
Field-Developed Programs/Installed User Programs 5-53
Programming RPQs 5-53

Chapter 6. Series/1 Support Services 6-1
IBM customer engineer support 6-2
Maintenance 6-2
Other IBM customer engineer support 6-4
Additional IBM customer services 6-5
Special Product Engineering Services 6-5
Sensor-Based System Services 6-5
IBM Support Center 6-6
Series/1 education 6-7
IBM Series/1 Multiline Communications Coprocessor 6-8
3270 Operation and Design 6-9
ANS '74 COBOL Language Fundamentals 6-9
ANS '74 COBOL Programming 6-9
Using Event Driven Executive and Event Driven Language on the Series/1 6-9
SNA Fundamentals 6-9

Index X-1

Chapter 1. Executive overview

This publication presents a comprehensive view of the Series/1 computing family, its programming, and support services.

This overview introduces you to the Series/1 features and functions, and summarizes the information that is detailed in subsequent chapters.

Introduction

The IBM Series/1 is a family of low-cost, high-performance, small computers widely known for their price/performance, configuration flexibility, and communications capabilities. These computers are designed to handle general-purpose, commercial, and sensor-based applications in a multiprogramming environment.

Series/1 offers a modular approach to computing — an approach you can tailor to match your needs for equipment, programs, and services.

The Series/1 hardware menu offers a variety of standard rack-mounted and free-standing processing units, fixed and removable storage media, fast and efficient input/output attachments, plus attachment features that allow you to attach a wide range of non-IBM terminals and equipment.

With its powerful architecture, Series/1 can handle a variety of applications efficiently and effectively. This architecture includes:

- An efficient cycle-steal channel for servicing input/output devices
- Microprocessor device control for reducing the channel burden for most I/O units
- A comprehensive interrupt structure for high response and minimum overhead
- An extensive instruction set that provides flexibility for a variety of applications.

Series/1 I/O architecture contains a system interface of high functional content and integrity. Up to 256 individually addressable I/O devices (both standard and custom-built) may be attached to a Series/1 system.

Series/1 software offers an extensive choice of systems programs and productivity tools. Programmers can select and implement only those functions needed to meet their application needs.

You can choose from two primary full-function operating systems: the Realtime Programming System or the Event Driven Executive (EDX).

A wealth of application programs from both IBM and non-IBM sources is available to address many of your specific operational requirements. High-level languages can support diverse application requirements, such as transaction processing, commercial jobs, and sensor-based data handling.

Series/1 hardware and software are available to meet a broad range of requirements for communications with host systems, other Series/1s, printers, and terminals (including the IBM Personal Computer). A number of specific program tools are available for unique system requirements.

Whenever you acquire a Series/1 computer, you gain an added value — dependable, efficient service as required.

This service capability rests on IBM's commitment to reliability, availability, and serviceability. IBM service starts with the designer at the drawing board, and includes strict quality control procedures in product development and manufacture, plus a variety of training and diagnostic tools. In the event of a problem, skilled IBM Customer Engineers can provide service around the clock from a nationwide network of service support locations.

Series/1 architecture

Series/1 hardware and internal architecture have been designed to meet the performance and reliability levels necessary for demanding realtime and sensor-based operations.

Bipolar LSI[1] and CMOS[2] logic circuitry are used extensively in the Series/1. They consume little power and are fast, reliable, and compact. SAMOS[3], NMOS[4], or MOSFET[5] N-channel storage provides fast access and processing power comparable to much larger computers.

The 16-bit processor architecture provides a comprehensive range of instructions, multiple addressing modes, efficient use of storage and a powerful priority interrupt structure.

Series/1 logic cards offer considerable flexibility in the choice of terminal devices, and digital and analog connections to initiate and control activities and processes. The attachment cards plug into the data channel, allowing ease of change and servicing.

Series/1 processors and features

A choice of compatible processors, available in several models, allows for nondisruptive expansion of your computing facilities, and they are flexible enough to accommodate your requirements now and in the future.

All processors have a basic operator console, an optional programmer's panel, power failure/restart, base power, four priority interrupt levels, and a powerful instruction set. Using new technologies, the processor, storage, address relocation translator function, and clock/comparator are combined on a single processor card.

The 4956 processors are upward compatible with the 4954, with enhancements to support more demanding computing requirements. Additional processor features include *read-only* storage protection and floating-point (with 30 instructions and four 64-bit registers per level). The 4956 also provides single-bit correction and double-bit detection for storage errors (ECC).

---

1 Large-scale integration.

2 Complementary metal-oxide semiconductor.

3 Silicon aluminum metal-oxide semiconductor.

4 N-channel metal-oxide silicon.

5 Metal-oxide semiconductor field-effect transistor.

The processors offer a choice of storage size and attachment possibilities. Standard processor storage is available from a minimum of 1024 to 2048 kilobytes. Additional processor storage is available on selected models up to 12 MB. Processor average instruction times range from approximately 7.4 microseconds to 1.53 microseconds.

Processor selection depends on individual job requirements. For example, the more powerful and internally faster 4956 processor might be used to handle program development or complex operations when more than one program is active, or for fast data transfer operations. When maximum processor performance is required, a processor enhancement RPQ can be ordered, either as a new order (D02856) or an upgrade (D02857) on the Model J and K Processors. Although customer throughput is application dependent, installation of this processor enhancement RPQ may increase processor performance up to 50% over the current performance of the Model J and K processors. On the other hand, Series/1 processors might be used for remote computer installations in a distributed data processing environment, or where the emphasis is on batch or single application use.

I/O devices are attached through I/O feature cards installed in the processor or optional I/O expansion unit. Up to 256 individual devices, both standard and custom-built, may be addressed by the Series/1. With the exception of printers and display stations, all Series/1 units fit into an IBM 4997 Rack Enclosure or EIA[6] standard 19-inch rack.

An optional customer access panel provides quick-disconnect for a timer, a teletypewriter, and connectors for four integrated digital input/digital output or customer direct program control features.

Series/1 offers a choice of communication capabilities to allow wide flexibility. Communication features are contained in feature cards that plug into the processor data channel or the 4987 — a programmable communications unit. Three line disciplines may be used — binary synchronous communications (BSC), asynchronous communications control (ACC), and synchronous data link control (SDLC). In addition, a high-speed Local Communications Controller allows multiple Series/1's to be attached on a ring in a peer-to-peer relationship.

SDLC and BSC communication can support sophisticated communications links, including system-to-system and system-to-host-computer, with the Series/1 acting as a terminal or device network controller. BSC single line also allows the user to perform an initial program load (IPL) of the Series/1 from a remote host. ASCII communication is supported for connection of terminals like the IBM 3151, 3163 or 3164 ASCII Display Stations.

[6] Electronics Industries Association.

A customer-programmable Multiline Communications Coprocessor offers customers 1 MB coprocessor memory, and supports up to 4 communications channels.

Ring-connected processors offer the basis for a variety of applications including distribution of functions and sharing of data among autonomous applications.

IBM Token-Ring Network is available with the Series/1 Token-Ring Adapter Card, which is program-selectable for 4 or 16 Mbps.

The preceding communication capabilities can be used independently or simultaneously to enable the user to choose the processors, connection method, and devices best suited to a particular application.

Series/1 I/O and system support units

Series/1 I/O devices include disk and diskette units, magnetic tape units, line and matrix printers, and display stations. Many of the attachment features for these devices are equipped with cycle-stealing microprocessor controllers that permit device overlapping and reduce processor workload.

The versatility of the Series/1 configuration may be expanded through I/O feature locations in the 4959 Input/Output Expansion Unit and/or the 4965 Storage and I/O Expansion Unit.

Two types of direct access storage are available with Series/1: high-speed, large-capacity, fixed-disk storage and inexpensive, removable-diskette storage.

The 4963 Disk Subsystem and the 4967 High Performance Disk Subsystem offer storage capacity ranging from 64 million bytes up to 358 million bytes per unit. A cache feature offers the potential of significant disk throughput improvement. Cache is standard on the 4967, 4965 Model E00, and 4956 Models G10, H10, and J00; it is optional on the integrated disks of the 4956 Model 31D.

With the 4964 Diskette Unit and the 4965 Storage and I/O Expansion Unit, you have an easily usable and flexible means of storing and distributing data and programs.

The 4968 Autoload Streaming Magnetic Tape Unit is a high-performance, large-capacity, full-function streaming magnetic tape unit. The 4968 provides for fast, convenient save/restore of data on medium-to-large disks. A 200-megabyte disk can be saved on three reels of tape in approximately 30 minutes. The autoload function makes tape handling easy even for an inexperienced operator.

The 4201 Proprinter and the 4202 Proprinter XL are available for use as low-cost system printers for the Event Driven Executive.

The 4224 is a tabletop matrix printer capable of producing high-quality printouts and accepting multipart paper. The 4224 offers an option of printing correspondence-quality output including proportional spacing. You can define the character sets you need for particular jobs. Typical uses might include printed reports on the status of an operation, messages from a remote terminal, invoices, packing lists, and letters.

The 4234 is a heavy-duty, floor standing, impact-matrix line printer that provides medium-speed output and uses dot-print band technology.

The 5262 printers are line-impact printers that are especially suited for heavy duty printing requirements, such as the production of lengthy report listings, daily work status printouts, and batch listings of daily transactions.

Display station options underline the versatility of Series/1. The 3151 ASCII Display Station, as well as the 3163 and 3164 ASCII Display Stations, provide low-cost ASCII devices suitable for many applications requiring local or remote terminals. All are tabletop units, accommodating from 1920 to 3,300 characters on the display screen.

The 5230 Data Collection units record data, which can vary from time recording to a comprehensive system for cost and work status accounting.

The 4987 Programmable Communications Subsystem provides power and control facilities for expanded communications versatility in the Series/1. The subsystem has the capacity for multiple line disciplines in a single communications unit and can provide a cost alternative for the user of large numbers of communications lines.

The 4993 Series/1— System/370 Termination Enclosure and its companion channel attachment feature allow a Series/1 to be channel-attached to IBM System/370 for high-speed data transfer. Series/1 modular units may be mounted in the IBM 4997 Rack Enclosure or EIA standard 19-inch rack. IBM offers four models of rack enclosures, in two sizes, with either plain or decorative filler covers. A primary power-distribution system is included.

Until now, we've looked only at hardware — its power, modularity, and sophistication. But Series/1 hardware is complemented by programming support and high-level languages that emphasize efficient and productive use of your Series/1.

IBM Series/1 programming support

Programming that offers a wide range of support is available for the Series/1:

- Operating systems that support batch, transaction driven, communications, and realtime applications
- Programs for preparing application programs to execute under control of an IBM operating system or under a specialized operating system
- C, COBOL, FORTRAN, Pascal, and PL/I high-level language support
- Support for an EDX C Run-Time Library
- Modules that provide I/O device support and other supervisory control functions for building an operating system and applications
- Programming packages for such needs as energy management, intelligent data entry, and text entry.

IBM Series/1 support services

The IBM commitment to your equipment and programming does not end with a parts and labor warranty — it is just beginning.

You can choose one of several maintenance plans, matching your selection to your requirements and your budget.

Skilled IBM customer service representatives are backed by a country-wide parts distribution network that locates the nearest parts and gets them to you quickly. Customer engineers are equipped with a variety of portable diagnostic tools to help pinpoint faults rapidly. Programming support advice and assistance in development and writing of tailored operating systems and application programs are provided, as available under a systems engineering contract. IBM training courses are available to help you get the most from your Series/1 with the least delay.

Chapter 2. Series/1 architecture

The 16-bit processor architecture of the Series/1 provides a comprehensive range of instructions, multiple addressing modes, efficient use of storage, and a powerful priority interrupt structure.

With the Series/1, you have considerable flexibility in systems building, because the architecture is open-ended and not tied to any particular task, job, or device.

And the structural and logical stability enables you to adapt a system more easily to your changing requirements.

The Series/1 architecture supports either small or complex systems requirements. A modular computing system, it is a flexible base on which to build your system and achieve:

- High performance and rich function at an attractive price
- A high standard of reliability and serviceability through the use of proven technology.

System design overview

The Series/1 offers a variety of data processing I/O devices and attachment capabilities that include:

- Sensor I/O equipment
- Communication lines
- Customer devices.

High reliability is designed into the Series/1 through the use of proven technology such as bipolar LSI technology in the processor and MOSFET, SAMOS, and NMOS logic in main storage.

Suitable for applications ranging from conventional data processing to sensor-based applications like energy management, the Series/1 is a comprehensive computer — meeting the needs of installations requiring either a single computer or multiple small computers.

To achieve this flexibility, the Series/1 design is modular and compact — most units fit into an IBM 4997 Rack Enclosure or an EIA standard 19-inch rack. Series/1 components occupy either the full width or a half width in a rack enclosure. And if a system requires space for modular units beyond the capacity of a single rack, multiple racks can be bolted together to form a multibay enclosure. Included in an IBM 4997 Rack Enclosure is a primary power panel for distributing AC power to the individual units installed in the enclosure.

Another option available is a stand-alone unit. Instead of being rack-mounted, the 4956 processors with integrated disk units can be housed in a tabletop Stand-Alone Enclosure (feature 4521).

For greater flexibility, individual I/O attachment features, processor features, and some storage additions are constructed on multilayer printed-circuit cards. These circuit cards can be selectively plugged into sockets on the back panel of certain modular units. By selecting the desired units, and functions, you can tailor a system to your needs.

The processor unit contains the processor card, data channel, processor storage, basic console, a power supply, and card sockets for plugging in processor features, storage additions, and I/O attachment feature cards. When greater processing power is required in the 4956 Model J or K, a processor enhancement RPQ D02856 for new system orders (or D02857 for upgrades), can be ordered that may boost the performance up to 50% over the current Model J and K processors. When greater I/O capacity is needed, I/O expansion units are available. These units contain both a power supply and card sockets for additional data channel feature cards, and some models include additional disk and diskette capacity.

Expanding the capability of the Series/1 are various input/output devices and attachment features. Attachment feature cards allow attachment of:

- Data processing I/O devices
- Communications lines
- User I/O devices and instruments
- Sensor I/O units.

I/O attachment feature cards and integrated communications feature cards plug into the processor or input/output expansion unit. Attachment features are not necessarily limited to a single function. Some features offer multiple attachment combinations. A programmable communications subsystem also provides for attachment of communications features. Sensor I/O feature cards plug into the sensor I/O unit. In this way, individual devices are attached to the processor and main storage via the data channel, with the channel directing the flow of information.

Processor structure

Main storage

Main storage holds the data and instructions for applications to be processed on the Series/1. The basic unit of information is the byte (eight binary data bits plus an associated parity bit).

The 4956 has error checking and correcting storage; single-bit errors are corrected, and double-bit errors are detected.

On other processors, odd parity by byte is maintained throughout storage. On reads from storage, an even parity causes a machine check error. The Series/1 instruction set addresses bytes either separately or grouped together. Instructions can refer to bits, bytes, byte strings, words, or doublewords as data operands to allow efficient, flexible use of storage.

Addressing main storage: Each byte location in main storage is directly addressable. Byte locations in storage are numbered consecutively, starting with location 0; each number is considered to be the address of the corresponding byte. Storage addresses are 16-bit unsigned binary numbers, which give a direct addressing range of 0 to 65,535 bytes. The storage address relocation translator function is required to address storage above 65,536 bytes. With the translator function, a portion of the 16-bit address and an address key are used as a logical address to generate either a 19-bit, 20-bit, or 21-bit physical address.

Storage protection: When the translator is enabled, a *read-only* bit can be assigned to any given block of storage. This protection is from any problem state program. Supervisor state can write to any location in storage.

Storage mapping: In a multiprogramming system the storage address relocation translator function can provide the means to assign separate storage pages to individual programs and data and to prevent unauthorized access to this storage. Data or program sharing among separate tasks can also be accommodated, using the facilities of the translator. For example, users can share reentrant code or establish intertask communications. This allows the translator to support a flexible multiprogramming environment, while providing safeguards to prevent accidental or intentional destruction of application or system programs.

The relocation translator function permits addressing main storage locations beyond 64 kilobytes (KB) and facilitates dynamic storage relocation on a 2KB-block basis. When the translator function is enabled, the read-only protection is under control of the translator.

Using the translator function, tasks on each of the four Series/1 priority levels can address three separate storage maps through three address keys. For each priority level, one of these keys can be used to address a map for fetching instructions, a second key can be used to address a map for all data not defined by the first key, and a third key can address a map for source operands in storage-to-storage operations. In addition, each I/O device has an address key used in cycle-stealing operations that enables the user to directly assign a storage map to a given I/O device.

The three address keys point to stacks of hardware translator segmentation registers. On the 4956, eight stacks of segmentation registers are provided (16 on the 4956 E and H models, and 32 on the J and K models), each stack containing 32 segmentation registers, for a total of 256 and 512. Each of these segmentation registers defines a 2KB segment of storage. Once loaded, each stack of segmentation registers can contain a complete map of up to 64KB scattered in 2KB physical segments. Privileged supervisor instructions set or change the address space keys and the contents of the segmentation registers.

This arrangement allows programs to be scattered throughout storage. It also allows users to access common data or programs by loading more than one segmentation register with the same 2KB segment address. In a multitasking environment, the existence of a separate stack of segmentation registers for each address key value removes the need to save and restore the storage map and allows fast task switching.

The 4956 E, H, J, and K models also have eight stacks of *I/O* segmentation registers.

Instruction set

The Series/1 family of processors has microcode that permits a rich instruction set of up to 182 individual instructions. Additionally, 30 floating-point instructions are available with the optional floating-point feature of the 4956 Processors. Series/1 instructions operate on bit, byte, word, doubleword, and variable field-length byte operands. Many of the instructions operate in multiple operand types.

Instruction formats: Series/1 instruction formats allow the following types of address arguments, operand locations, and data types. These formats are intended to show function only and not assembler coding.

Address arguments:

R	The effective address is the register R.
(R)	The effective address is the contents of the register R.
(R)+	The effective address is the contents of the register R. After an instruction uses it, the contents of the register are increased by the number of bytes addressed by the instruction.
A	An address value.
A+(R)	The effective address is the contents of the register R added to the address A.
(R)*	The effective address is the contents of storage at the address defined by the contents of register R.
(A+(R))*	The effective address is the contents of storage at the address defined by the contents of register R added to the address A.
A*	The effective address is the contents of storage at the address defined by A.
D+(R)*	The effective address is the contents of storage at the address defined by the contents of R added to the value of the displacement D.
(D+(R))*	The effective address is the contents of storage at the address obtained by adding the contents of R to the value of the displacement D.
D2+(D1 +(R))*	The effective address is calculated as follows: the contents of the register R are added to the value of the displacement D1 to form an address. The contents of that storage location are added to the value of D2 to form the effective address.

Operand locations:

Register-immediate (R-I)
Storage-immediate (S-I)
Register-register (R-R)
Storage-register (S-R)
Register-storage (R-S)
Storage-storage (S-S).

Data types:

Bit
Byte
Byte field
Word
Doubleword

Function examples:

Move
Add
Subtract
Multiply
Divide
Test
Compare
AND
OR
Exclusive OR

Most instructions in their basic format are one word; expanded address modes use two or three words, as required. Series/1 instructions use 11 possible combinations of addressing modes; a maximum of four can be implemented for any one instruction.

The instruction set offers the programmer a wide choice of powerful instructions. For example, with variable field length instructions, up to 64KB of storage can be moved with one instruction.

Supervisor state: Series/1 instructions are executed in either supervisor state or problem state. This facility gives the Series/1 user another built-in feature to protect critical system functions. For example, privileged or supervisor state instructions are those that control input/output, interrupt level processing, storage protection, address space management, and other system resources and functions. Only when the processor enters the supervisor state as a result of an interrupt or immediately after initial program load can these sensitive types of instructions be run.

Registers: Series/1 has eight general-purpose registers for each of the four priority interrupt levels. These registers have no predefined or preassigned function and can be assigned dynamically by the programmer.* Any general-purpose register can be used as an accumulator, index pointer, or index register. In addition, the optional floating-point feature has four registers.

Stacking: The Series/1 stacking mechanism provides two types of stacking facilities — data stacking and linkage stacking. There is no restriction, except storage size, on the number of stacks the programmer can define. An interrupt condition signals a full or an empty stack, protecting the programmer against errors in managing stacks.

The *data stacking* facility provides an efficient and simple way to handle last-in/first-out stacks of data items, and/or parameters in main storage. The data items, or parameters, are stack elements. For a given queue or stack, each element is one, two, or four bytes wide. Instructions for each element size — byte, word, or doubleword — are provided to push an element into a stack (register to storage) and pop an element from a stack (storage to register).

Linkage stacking provides an easy method for linking subroutines to a calling program. A stack one word wide, is used for saving and restoring the status of general registers and for allocating dynamic work areas. The Store Multiple instruction stores the contents of the registers into the stack and reserves a designated number of bytes in the stack as a work area. The Load Multiple and Branch instruction reloads the registers, releases the stack element, and causes a branch back to the calling program.

Instruction set summary: For arithmetic operations the Series/1 includes hardware multiply/divide with byte, word, or doubleword operations. The floating-point feature includes separate instructions to perform single-precision (32 bit) and double-precision (64-bit) operations. A summary at the end of this section highlights the completeness of the Series/1 instruction set, which provides the programming flexibility usually found only in larger systems.

* Registers one and seven have special usages with certain instructions; consult the *IBM Series/1 Principles of Operation*, GA34-0152.

Instruction set

Number of instructions	Function	Operand types									
		I–R	I–R	I–S	R–R	S–R\R–S			S–S		
		Byte	Word	Word	Word	Byte	Word	Double–word	Byte	Word	Double–word
99	*Arithmetic, logical, data move*										
	Add	x	x	x	x	x	x	x		x	x
	Subtract		x	x	x	x	x	x		x	x
	Multiply					x1	x1	x1			
	Divide					x1	x1	x1			
	Add w\carry				x						
	Subtract w\carry				x						
	Add carry				x						
	Subtract carry				x						
	Reset bits (NAND)		x	x	x	x	x	x	x	x	x
	Set bits (OR)		x	x	x	x	x	x	x	x	x
	XOR		x		x	x	x	x			
	Test under mask		x	x							
	Compare	x	x	x	x	x1	x1	x1	x	x	x
	Complement				x						
	AND		x								
	Move	x		x	x	x	x	x	x	x	x
	Load		x								
	Store			x							
	Load address						x				
	Load and zero					x1	x1	x1			
	Interchange				x						
	Push\pop					x	x	x			
3	*Variable–field length*										
	Move					x2			x		
	Compare equal					x2			x		
	Compare not equal					x2			x		

		Computed			
18	*Shift*	Single–word	Double–word	Single–word	Double–word
	Left circular	x	x	x	x
	Left logical	x	x	x	x
	Right logical	x	x	x	x
	Right arithmetic	x	x	x	x
	Left logical–count			x	x

		R–R		R–S	
23	*System data*	Set	Copy	Set	Copy
	Current indicators	x	x		
	Mask			x	x
	Segment register			x	x
	Storage key			x	x
	Level status block			x	x
	In process flag				x
	PSW				x
	Address key	x	x	x	x
	Console data lights	x			
	Console data buffer		x		
	Clock	x	x		
	Comparator	x	x		

1 S\R only.

2 R\S only.

Instruction set (continued)

Number of instructions	Function	Single—precision (32—bits)	Double—precision (64—bits)
4	*Bit manipulation*		
	Test		
	Test an set		
	Test and reset		
	Test and invert		
2	*Multiple register*		
	Load multiple and branch		
	Store multiple		
7	*Control*		
	Supervisor		
	Level exit		
	Enable		
	Disable		
	Diagnose		
	Interchange operand key		
1	*I\O*		
	Operate I\O		
15	*Branch\jump*		
	Branch\jump unconditional		
	Branch\jump and link		
	Branch and link short		
	Branch\jump on(not) condition		
	Branch\jump condition code		
	Branch on(not) overflow		
	Branch indexed short		
	Jump on count		
	Address resolution with indirect branch		
30	*Floating point*		
	Load	x	x
	Store	x	x
	Add	x	x
	Subtract	x	x
	Multiply	x	x
	Divide	x	x
	Add register	x	x
	Subtract register	x	x
	Multiply register	x	x
	Divide register	x	x
	Move register	x	x
	Compare register	x	x
	Load integer[3]	x	x
	Store integer[3]	x	x
	Load level block		
	Store level block		

[3] Single-precision is 16 bits.
Double-precision is 32 bits.

Interrupt structure

Efficient operation of a processor depends on prompt response to both internal and external events. Series/1 recognizes two general types of interrupts, those from external events — input/output interrupts — and those from internal events — class interrupts

Priority interrupts: Series/1 architecture allows 16 preemptive priority interrupt levels. However, four priority interrupt levels are provided on the Series/1 processors. Associated with each level is a bank of hardware registers (16 bits each), an instruction address register, an address key register, and a level status register that includes a set of result indicators. This is the level status block. If floating-point is installed, there are also four 64-bit floating-point registers per level.

When switching between levels occurs, the information contained in the "interrupted-from" hardware level status block is automatically preserved; as a result, it is not necessary to store the status indicators and general-purpose registers in main storage. Automatic vectoring to the service routine for a given device is accomplished by the eight-bit device addresses, providing 256 direct interrupt entry points.

No program polling of devices is required to accept the interrupt or identify the device. Assignment of a given device to an interrupt level is under program control and can be dynamically reassigned in response to system conditions. Masking and acceptance of priority interrupts by the processor are under program control on the basis of all four levels, one or more individual levels, or one or more individual devices.

The Series/1 interrupt structure, with its separate register stacks and unique double-vectored interrupt addressing, greatly facilitates efficient interrupt handling. The preemptive interrupt structure, and particularly the replication of registers on a per-level basis, is a significant asset in applications requiring multitask structures.

Class interrupts: Class interrupts provide a means of alerting the system to the occurrence of certain classes of errors or exception conditions. Class interrupts may occur on any of the four priority interrupt levels; the class interrupts preempt operation of the system on the appropriate priority level until the class interrupt condition has been reset.

There are eight types of class interrupts:

- Machine check
- Program check
- Power/thermal warning
- Supervisor call
- Soft exception trap
- Trace
- Console
- Clock.

Only the power/thermal warning, console, and the clock class interrupts can be disabled under program control. Identification and status information about the exception or error is provided in the processor status word. With this information, the program may be able to recover in a manner that allows normal processing to continue with minimum disruption.

The trace class interrupt provides an instruction trace mechanism to ease program debugging. Instruction tracing may occur on any priority interrupt level. When trace is turned on, a unique class interrupt occurs prior to each instruction. Upon exit from the trace routine, the next instruction is run and the process repeats until the trace is turned off.

Special supervisor state instructions are available to control interrupt processing.

Data channel

Series/1 provides a data channel interface for all input/output devices; up to 256 devices can be addressed.

The data channel is asynchronous and multi-dropped, allowing the attachment of devices with various speeds and technologies. All Series/1 data channel signal lines are TTL (transistor-transistor logic) level compatible.

The processor data channel supports direct program control operations, cycle-steal operations, and interrupt servicing.

Direct program control operations: Direct program control input/output operations involve a separate I/O command from the processor for each data item transferred across the channel. The data can consist of one byte or one word. The operation might or might not terminate in an interrupt. Direct program control is an easy way to transfer data. It also allows the programmer to maintain data transfer in line with the program, for example, for conversational or slower speed operations.

Cycle-steal operations: Cycle-stealing, in contrast to direct program control, once initiated, involves no interaction on the part of the processor during the transfer of a block of information between main storage and a device. During a cycle-steal operation, the data channel and the I/O device handle many of the functions performed by the processor during a direct program-controlled operation. An Operate I/O instruction can initiate cycle-stealing data transfers of up to 65,535 bytes between main storage and a device. Cycle-steal operations are overlapped with processing operations. Word or byte transfers, command and data chaining, burst mode, and program-controlled interrupts can be supported. All cycle-steal operations terminate with an interrupt.

Burst mode involves the dedication of the channel for the entire time of the data transfer. In this case, all other devices are locked out of the channel, permitting high-speed data transfer at the maximum rate the main storage and the channel can accommodate.

Command chaining allows the programmer to sequence an I/O device through a set of operations. A processor interrupt occurs after the successful execution of the last operation or on an exception condition.

Cycle-steal devices include the disk, diskette, magnetic tape, display stations or terminals, printers, communications features and subsystem, System/370 channel attachment feature.

Interrupt servicing: Interrupt requests from the devices, along with cycle-steal requests, are presented and polled on the interface concurrently with data transfers.

The initial program load interrupt from a processor device or a binary synchronous communications line from a remote host computer is also supported.

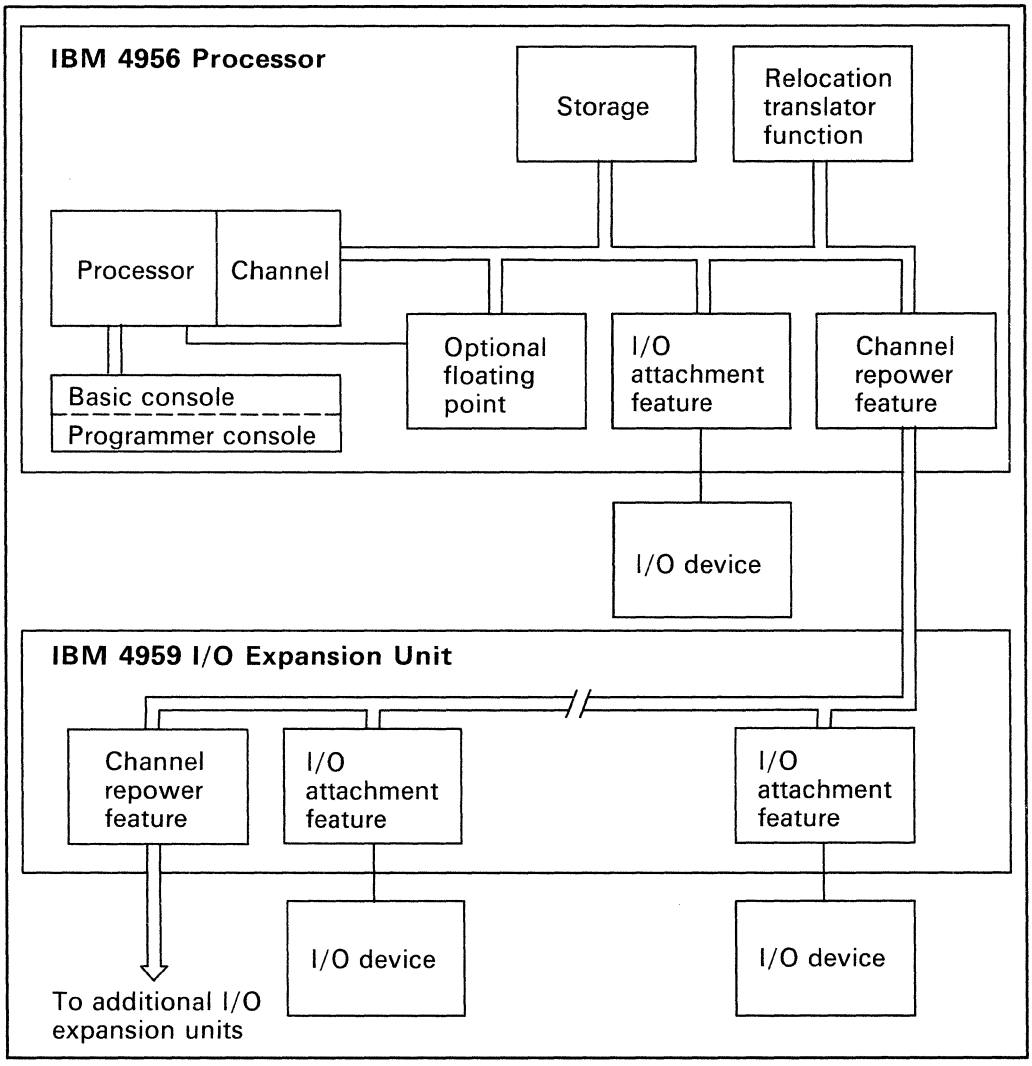
The channel provides comprehensive error checking, including time-outs, sequence checking, and parity checking. It consists of the following major line groups:

- Address bus — A bidirectional bus used for device selection and for passing commands to devices during Operate I/O instructions. The address bus is also used for passing main storage addresses from the devices to the channel during cycle-steal data transfers.
- Data bus — A bidirectional bus used for passing data and control information to or from devices during Operate I/O instructions. The data bus is also used for passing device addresses and an interrupt information byte to the processor during interrupt acceptance.
- Control lines — Unidirectional lines and buses used for (1) interrupt and cycle-steal requests, (2) condition code and status reporting, (3) resets, and (4) basic control of sequences.

In the Series/1, the data channel acts in a primary-secondary relationship with attached I/O devices; the data channel is always the primary. This significant characteristic gives the Series/1 positive control during I/O operations. The data channel verifies device attachment and the status of the device relative to the channel function to be performed. It ensures that the addressed device is installed and is capable of processing a command. The channel validates the device command and initiates the data transfer.

During data transfer, the channel checks data parity, both incoming and outgoing. Storage protection (if applicable), address translation (if applicable), and address validity checking are also operative during data transfer.

The parallel operation of the address bus, the data bus, and control lines allows polling concurrent with data transfer.



4956 Processor with a 4959 Input/Output Expansion Unit

Series/1 reliability, availability, and serviceability

Reliability, availability, and serviceability (RAS) are primary design objectives of IBM products and are part of the IBM development cycle from the earliest stages of product development. In the Series/1, IBM has used proven technology with known performance and serviceability characteristics.

In addition to using state-of-the-art technology, extensive checking circuits and microcode are built into the system to detect machine malfunctions. Microprocessors are employed in the processor and in each cycle-steal I/O adapter, except the 4962 disk attachment and the System/370 channel attachment. These small, stored program processors not only provide the logical control and coordination between the device and the processor but also provide a diagnostic capability to the system. Microdiagnostic routines have been built into the microprocessors to check the operational integrity of the processor, channel, and I/O adapters that contain the microprocessors.

The microdiagnostic routines operate automatically when the system is powered on. Various tests are activated, depending on which action invoked the test.

The microdiagnostic routines:

1. Validate integrity of processor data flow.
2. Write in and then read back a specified bit pattern in all of main storage.

   Note: The Realtime Programming System's bootstrap loader validates the integrity of all installed primary storage (up to 64KB). Those versions of Realtime Programming System that support storage above 64KB verify the presence of the storage address relocation translator function and validate secondary storage integrity (above 64KB).
3. Validate the integrity of the device controller by running through all the microinstructions in the microcontroller and then comparing an accumulated check digit to a pre-programmed check digit.
4. Validate the integrity of the data channel.

If an error is detected in the processor or data channel, the operator is alerted before an attempt is made to use the system. If a problem is detected in an I/O attachment feature, an error condition is presented to the user the first time the device is addressed.

Provided connections between modules pass this self-diagnostic test, the system link to IPL (initial program load) takes place. Self-diagnosis then passes from the hardware level to the program level where the operating system may monitor operations, detect errors and retry the operation, and log all detected errors to disk or diskette for later examination by maintenance personnel.

During system operation, an important reliability consideration is the integrity of data within the system. Parity checking of storage and channel, addressing-boundary restrictions, storage protection and a privileged instruction set help to ensure accurate processing of data. In addition, the Series/1 utilizes error checking and correcting storage (corrects all single-bit errors and detects all double-bit errors) on the 4956. If system errors or exception conditions do occur, a class interrupt could result.

Most 4956 processors contain an error log that provides a history of the 64 most current errors that have occurred since the power was switched on. This information is available to the customer engineer through the programmer's console or the Diagnose instruction and is useful in isolating the cause of a particular problem. At power-on, all 64 entries in the error log are cleared.

At the input/output level of the system, IBM has incorporated capabilities into the attachment features and into the devices themselves to help ensure reliability of the hardware and the data. The following are examples of checks that are built into the attachment features:

- Condition codes — Each time an Operate I/O instruction is issued, the device, controller, or channel immediately reports to the processor a condition code pertaining to processing of the I/O command.

  On devices that present interrupts, condition codes are again presented with the I/O interrupt to further define the exact status of the I/O operation.

- Interrupt status byte (ISB) — If an error condition exists after an I/O operation (for example, a channel parity check), detailed information on the nature of the error is presented in the ISB.

  Further residual parameters from the device are also available in the device status words, which can be brought into storage by doing a Start Cycle Steal Status operation.

- Redundancy checking — Vertical redundancy checking (VRC), longitudinal redundancy checking (LRC), and cyclic redundancy checking (CRC), as applicable, are done by the various I/O adapters. For example, the disk and diskette units both generate CRC characters by sector for both the sector ID fields and data fields.

  The ACC control features provide LRC and VRC checking on receive data — the BSC features offer CRC with EBCDIC and LRC/VRC with ASCII. The 4987 Programmable Communications Subsystem can provide VRC, LRC, or CRC.

The Series/1 processors contain circuitry to provide continuous power verification (that is, circuitry to monitor the source voltage and the output voltage of the power supply).

If the source voltage drops, a power/thermal warning class interrupt occurs, and if the voltage drops below a certain point (approximately 80 VAC or 160 VAC), the system shuts off. Upon restoration of the mainline voltage, the system automatically switches power back on and, if the IPL switch is set to auto-IPL, the system automatically performs another IPL. The IPL bootstrap program can be coded to reload a selected program and processing resumes. This automatic restart feature makes the system particularly viable for use in a remote or unattended location.

If the error occurs as a result of a failure in the power supply or its load, or as a result of a thermal condition, the system shuts off and remains off until it is manually restored.

Chapter 3. Series/1 processors and features

Series/1 offers many compatible processors — the 4956 processors which are available in several models. The processors differ mainly in storage size and speed, with the 4956 J and K models offering 2 megabytes of onboard storage and the greatest internal speed. Processor models also differ in the number of I/O features that may be attached.

A processor enhancement RPQ is available for the 4956 Models J/K processors which may increase processor performance up to 50% over the current performance of the Model J and K processors. Other features that enhance reliability and performance include power fail detect/auto restart, storage protection for complex application environments and program development, error checking and correcting storage, and optional floating-point feature for mathematical and scientific calculations.

Attachment features provide a wide range of device and system attachment to the Series/1. Specifically covered in this chapter are features for attaching 5200 Series printers, multiple work stations, and non-IBM devices.

Communications features provide a variety of communication options. Specifically covered in this chapter are the binary synchronous, synchronous, asynchronous, Token-Ring Attachment Card, the Multiline Communications Coprocessor attachment card, and miscellaneous communication features of less broad applicability.

Note: Programming support refers to the latest version and release level that was announced at the time this document was printed. Programming support is available under separate license.

4956 Processor (Model B10)

Operating characteristics

Storage cycle time	550 nanoseconds
Average instruction time (weighted)	2.3 microseconds
Storage read/write access time (typical)	400 nanoseconds
Maximum aggregate data rate for multiple cycle-stealing devices	2.42 megabytes per second

Physical characteristics

Height	356 millimeters (14 in.)
Width	483 millimeters (19 in.)
Depth	476 millimeters (18.75 in.)
Weight	22.7 kg (50 lb)
Shipping weight	42.2 kg (93 lb)

Environmental conditions

Heat output/hour	500 watts (2157 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

115 volts	6.0 amperes
120 volts	5.8 amperes
208 volts	3.3 amperes
230 volts	3.0 amperes
240 volts	2.9 amperes
Frequency	60±0.5 Hz
kVA	0.70
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

None required.

Standard features

- High-performance Series/1 processor
- 1024 kilobytes (KB) main storage
- Instruction set (179 instructions) implemented in microcode
- Four priority interrupt levels
- Eight general-purpose registers per level
- Byte-addressable storage
- Error checking and correcting storage
- Storage address relocation translator function
- Clock/comparator
- Error log
- Self-contained power supply that includes communications power
- Power failure detect/auto restart
- Eight address spaces available to software
- Data channel
  - Up to 256 I/O devices directly addressable
  - Direct program control or cycle-steal operation
  - Data transfer on byte or word basis
  - All data checked for parity on a byte basis
  - Data transfer at 2.42 megabytes per second (maximum aggregate).

The processor is a full-width unit with 13 I/O feature locations. It is a modular unit that mounts in a 4997 Rack Enclosure or an EIA standard 19-inch rack.

When an I/O expansion unit is added to the system, the required repower card uses one of the processor I/O feature locations.

Note: The Model B has been replaced by the Model B10, and can no longer be ordered.

Optional features

- Floating-point (feature 3925) — Both single- and double-precision arithmetics are available using 30 additional instructions and four 64-bit registers per priority interrupt level. It does not use a feature location and can be field-installed.
- Programmer Console (feature 5655) — Provides indicators and controls for operator-oriented systems where programs are tested or entered and run.

Model upgrade

A field-installed model upgrade is available to convert a Model B to a Model B10, E10 or K00. The Model B10 can also be converted to a Model E10 or K00. See your IBM representative for further information.

4956 Processor (Model E10)

Operating characteristics

Storage cycle time	550 nanoseconds
Average instruction time (weighted)	1.53 microseconds
Storage read/write access time (typical)	400 nanoseconds
Maximum aggregate data rate for multiple cycle-stealing devices	2.42 megabytes per second

Physical characteristics

Height	356 millimeters (14 in.)
Width	483 millimeters (19 in.)
Depth	476 millimeters (18.75 in.)
Weight	22.7 kg (50 lb)
Shipping weight	42.2 kg (93 lb)

Environmental conditions

Heat output/hour	500 watts (1705 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

115 volts	6.0 amperes
120 volts	5.8 amperes
208 volts	3.3 amperes
230 volts	3.0 amperes
240 volts	2.9 amperes
Frequency	60±0.5 Hz
kVA	0.70
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

None required.

Standard features

- High-performance Series/1 processor
- 1024KB of main storage (expandable to 2048K)
- Up to 1024KB of mapped main storage
- Instruction set (182 instructions) implemented in microcode
- Four priority interrupt levels
- Eight general-purpose registers per level
- Byte-addressable storage
- Error checking and correcting storage
- Storage address relocation translator function
- Clock/comparator
- Error log
- Self-contained power supply that includes communications power
- Power failure detect/auto restart
- Sixteen address spaces available to software
- Eight address spaces available to I/O
- Data channel
  - Up to 256 I/O devices directly addressable
  - Direct program control or cycle-steal operation
  - Data transfer on byte or word basis
  - All data checked for parity on a byte basis
  - Data transfer at 2.42 megabytes per second (maximum aggregate).
- Address Resolution and Indirect Branch (ARIB) instructions provide Event Driven Language (EDL) Acceleration capability.

The processor is a full-width unit with 13 I/O feature locations. It is a modular unit that mounts in a 4997 Rack Enclosure or an EIA standard 19-inch rack.

When an I/O expansion unit is added to the system, the required repower card uses one of the processor I/O feature locations.

Note: The Model E has been replaced by the Model E10, and can no longer be ordered.

Optional features

- Floating-point (feature 3926) — Both single- and double-precision arithmetics are available using 30 additional instructions and four 64-bit registers per priority interrupt level. Does not use a feature location. Can be field-installed.
- Programmer Console (feature 5655) — Provides indicators and controls for operator-oriented systems where programs are tested or entered and run.
- Storage Addition (feature 6330) — Provides additional processor storage in 256KB increments (maximum of three).
- Storage Addition (feature 6331) — Provides an additional 512KB of processor storage (maximum of two).
- Storage Addition (feature 6334) — Provides an additional 1024KB of processor storage (maximum of one).

Model upgrade

A field-installed model upgrade is available to convert a 4956 Model E to a Model E10 or K00, and convert a Model E10 to a Model K00. See your IBM representative for further information.

4956 Processor (Models G10 and H10)

Operating characteristics

Storage cycle time	550 nanoseconds
Average instruction time (weighted)	
Model G10	2.3 microseconds
Model H10	1.53 microseconds
Storage read/write access time (typical)	400 nanoseconds
Maximum aggregate data rate for multiple cycle-stealing devices	2.42 megabytes per second

Disk operating characteristics

Rotational speed	3600 RPM
Average latency (nominal)	8.3 milliseconds
Instantaneous data rate	625 kilobytes per second
Access times	
Cylinder to cylinder	8 milliseconds
Average seek	40 milliseconds
Total usable storage	40 megabytes
Cylinders	733
Tracks per cylinder	7
Sectors per track	32
Bytes per sector	256

Physical characteristics

Height	346 millimeters (13.75 in.)
Width	483 millimeters (19 in.)
Depth	576 millimeters (22.75 in.)
Weight	55 kg (121 lb)
Shipping weight	72.6 kg (160 lb)

Environmental conditions

Heat output/hour	600 watts (2040 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

115 volts	7.0 amperes
120 volts	6.7 amperes
208 volts	3.9 amperes
230 volts	3.5 amperes
240 volts	3.4 amperes
Frequency	50/60±3.0 Hz
kVA	0.81
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

None required.

Standard features

- High-performance Series/1 processor
- 1024KB of main storage (expandable to 2048KB in the Model H10)
- Model G10 has up to 512KB of mapped main storage, and implements 179 instructions in microcode
- Model H10 has up to 1024KB of mapped main storage, and implements 182 instructions in microcode
- Cache storage (400KB)
- One high-capacity (1.2 megabyte) 5.25-inch diskette drive
- One 40 or 72-megabyte fixed-disk drive
- Four priority interrupt levels
- Eight general-purpose registers per level
- Byte-addressable storage
- Error checking and correcting storage
- Storage address relocation translator function
- Clock/comparator
- Error log
- Self-contained power supply that includes communications power
- Power failure detect/auto restart
- Eight (Model G10) or sixteen (Model H10) address spaces available to software
- Eight address spaces available to I/0 (Model H10)
- Data channel
  - Up to 256 I/O devices directly addressable
  - Direct program control or cycle-steal operation
  - Data transfer on byte or word basis
  - All data checked for parity on a byte basis
  - Data transfer at 2.42 megabytes per second (maximum aggregate).
- Address Resolution and Indirect Branch (ARIB) instructions provide EDL Acceleration capability.

The 4956 Models G10 and H10 are full-width units with 6 I/O feature locations. They are modular units that mount in a 4997 Rack Enclosure, a stand-alone enclosure, or an EIA standard 19-inch rack.

When an I/O expansion unit is added to the system, the required repower card uses one of the processor I/O feature locations.

Optional features

- Floating-point for the Model G10 (feature 3925) and the Model H10 (feature 3926) — Both single- and double-precision arithmetic are available using 30 additional instructions and four 64-bit registers per priority interrupt level. Does not use a feature location. Can be field-installed.
- Programmer Console (feature 5655) — Provides indicators and controls for operator-oriented systems where programs are tested or entered and run.
- Storage Addition (feature 6334) — Provides an additional 1024KB of processor storage for the Model H10 only (maximum of one).
- Second Diskette Drive (feature 4110) — Provides a second high-capacity (1.2 megabyte) 5.25-inch diskette drive.
- Second Disk Drive (feature 4115/4172) — Provides a second 40 or 72-megabyte fixed-disk drive.
- Third Disk Drive (feature 4116/4173) — Provides a third 40 or 72-megabyte fixed-disk drive.
- Stand-Alone Enclosure (feature 4521) — Provides a tabletop enclosure that allows the processor to be installed without a rack.

Model upgrade

A field-installed model upgrade is available to convert a 4956 Model G10 to a Model H10 or J00, and convert a Model H10 to a Model J00. See your IBM representative for further information.

4956 Processor (Model J00)

Operating characteristics

Storage cycle time	360 nanoseconds
Average instruction time (weighted)	1.0 microsecond
Storage read/write access time (typical)	320 nanoseconds
Maximum aggregate data rate for multiple cycle-stealing devices	2.74 megabytes per second

Note: Although customer throughput is application dependent, installation of the Model J/K processor enhancement RPQ (D02856/D02857) may increase processor performance up to 50%.

Disk operating characteristics

Rotational speed	3600 RPM
Average latency (nominal)	8.3 milliseconds
Instantaneous data rate	625 kilobytes per second
Access times	
Cylinder to cylinder	8 milliseconds
Average seek	40 milliseconds
Total usable storage	40 megabytes
Cylinders	733
Tracks per cylinder	7
Sectors per track	32
Bytes per sector	256

Physical characteristics

Height	346 millimeters (13.75 in.)
Width	483 millimeters (19 in.)
Depth	576 millimeters (22.75 in.)
Weight	55 kg (121 lb)
Shipping weight	72.6 kg (160 lb)

Environmental conditions

Heat output/hour	600 watts (2040 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

115 volts	7.0 amperes
120 volts	6.7 amperes
208 volts	3.9 amperes
230 volts	3.5 amperes
240 volts	3.4 amperes
Frequency	50/60±3.0 Hz
kVA	0.81
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

None required.

Standard features

- High-performance Series/1 processor
- 2048KB of main storage (expandable to 14MB)
- Floating-point
- Cache storage (400KB)
- One high-capacity (1.2 megabyte) 5.25-inch diskette drive
- One 40 or 72-megabyte fixed-disk drive
- Four priority interrupt levels
- Eight general-purpose registers per level
- Byte-addressable storage
- Error checking and correcting storage
- Storage address relocation translator function
- Clock/comparator
- Self-contained power supply that includes communications power
- Power failure detect/auto restart
- Thirty-two address spaces available to software
- Thirty-two address spaces available to I/O
- Data channel
  - Up to 256 I/O devices directly addressable
  - Direct program control or cycle-steal operation
  - Data transfer on byte or word basis
  - ECC (single-error correction, double-error detection) done on a byte-basis
  - Data transfer at 2.74 megabytes per second (maximum aggregate).
- Address Resolution and Indirect Branch (ARIB) instructions provide EDL Acceleration capability.

The processor is a full-width unit with 7 I/O feature locations. They are modular units that mount in a 4997 Rack Enclosure, a stand-alone enclosure, or an EIA standard 19-inch rack.

When an I/O expansion unit is added to the system, the required repower card uses one of the processor I/O feature locations.

Optional features

- Programmer Console (feature 5655) — Provides indicators and controls for operator-oriented systems where programs are tested or entered and run.
- Second Diskette Drive (feature 4110) — Provides a second high-capacity (1.2 megabyte) 5.25-inch diskette drive.
- Second Disk Drive (feature 4115/4172) — Provides a second 40 or 72-megabyte fixed-disk drive.
- Third Disk Drive (feature 4116/4173) — Provides a third 40 or 72-megabyte fixed-disk drive.
- Stand-Alone Enclosure (feature 4521) — Provides a tabletop enclosure that allows the processor to be installed without a rack.
- Additional Processor Storage (feature 6340) — Provides 2MB additional processor storage (to a maximum of three cards).
- Additional Processor Storage (feature 6341) — Provides 4MB additional processor storage (to a maximum of three cards).

  Note: A maximum of 14MB of storage is possible on a model J, including 2MB of main storage, and up to 12MB of additional processor storage.

- Processor Enhancement RPQ (D02856 plant install, D02857 upgrade) — May improve Model J/K processor performance up to 50%, depending on the customer application.

4956 Processor (Model K00)

Operating characteristics

Storage cycle time	360 nanoseconds
Average instruction time (weighted)	1.0 microsecond
Storage read/write access time (typical)	320 nanoseconds
Maximum aggregate data rate for multiple cycle-stealing devices	2.74 megabytes per second

Note: Although customer throughput is application dependent, installation of the Model J/K processor enhancement RPQ (D02856/D02857) may increase processor performance up to 50%.

Physical characteristics

Height	356 millimeters (14 in.)
Width	483 millimeters (19 in.)
Depth	476 millimeters (18.75 in.)
Weight	23 kg (50 lb)
Shipping weight	40.6 kg (89 lb)

Environmental conditions

Heat output/hour	500 watts (1705 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

110 volts	6.3 amperes
115 volts	6.0 amperes
208 volts	3.3 amperes
230 volts	3.0 amperes
235 volts	2.9 amperes
Frequency	50/60±3.0 Hz
kVA	0.7
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

None required.

Standard features

- High-performance Series/1 processor
- 2048KB of main storage (expandable to 14MB)
- Floating-point
- Four priority interrupt levels
- Eight general-purpose registers per level
- Byte-addressable storage
- Error checking and correcting storage
- Storage address relocation translator function
- Clock/comparator
- Self-contained power supply that includes communications power
- Power failure detect/auto restart
- Thirty-two address spaces available to software
- Thirty-two address spaces available to I/O
- Data channel
  - Up to 256 I/O devices directly addressable
  - Direct program control or cycle-steal operation
  - Data transfer on byte or word basis
  - ECC (single-error correction, double-error detection) done on a byte-basis
  - Data transfer at 2.74 megabytes per second (maximum aggregate).
- Address Resolution and Indirect Branch (ARIB) instructions provide EDL Acceleration capability.

The processor is a full-width unit with 14 I/O feature locations. It is a modular unit that mounts in a 4997 Rack Enclosure or an EIA standard 19-inch rack.

When an I/O expansion unit is added to the system, the required repower card uses one of the processor I/O feature locations.

Optional features

Programmer Console (feature 5655) — Provides indicators and controls for operator-oriented systems where programs are tested or entered and run.

- Additional Processor Storage (feature 6340) — Provides 2MB additional processor storage (to a maximum of three cards).
- Additional Processor Storage (feature 6341) — Provides 4MB additional processor storage (to a maximum of three cards).

  Note: A maximum of 14MB of storage is possible on a model K, including 2MB of main storage, and up to 12MB of additional processor storage.

- Processor Enhancement RPQ (D02856 plant install, D02857 upgrade) — May improve Model J/K processor performance up to 50%, depending on the customer application.

Attachment features

The following attachment features are available with the Series/1:

- Integrated Digital Input/Output Non-Isolated
- Timers
- Teletypewriter Adapter
- Programmable Cycle-Stealing Digital Input/Output Attachment
- Multifunction Attachment
- Printer Attachment - 5200 Series
- GPIB Adapter
- Multidrop Work Station Attachment
- Programmable Subsystem Controller (RPQ D02761).

Programming support

Event Driven Executive and Realtime Programming System support:

- Integrated Digital Output Non-Isolated feature
- Timers feature
- Teletypewriter Adapter feature
- Multifunction Attachment feature
- Printer Attachment - 5200 Series
- Programmable Subsystem Controller (RPQ D02761)
- Multidrop Work Station Attachment.

Event Driven Executive support:

- GPIB adapter feature (RPQ D02118)
- Series/1-to-Series/1 Adapter (RPQs D02241 and D02242).

Realtime Programming System support:

- Programmable Cycle-Stealing Digital Input/Output Attachment.

Prerequisites

- Series/1 processor
- The appropriate attachment devices.

Cables

- Teletypewriter Adapter Cable (feature 2055) for the Teletypewriter Adapter feature.
- Teletypewriter Adapter Cable with EIA male connector (feature 2064) for the teletypewriter adapter feature.
- Teletypewriter Adapter cable with EIA female connector (feature 2065) for the teletypewriter adapter feature.
- GPIB adapter cable (RPQ D02119) provides a special 4-meter (13 foot) adapter cable that connects the GPIB adapter to a standard IEEE 488/IEC 66.22 device.

Attachment feature cards provide for the attachment of user equipment and input/output devices to a Series/1 processor. The feature cards mount in the I/O feature locations of a Series/1 processor, 4959 I/O Expansion Unit, or 4965 Diskette Drive and I/O Expansion Unit. Attachment cards for devices described in Chapter 4 are not included here.

Integrated Digital Input/Output Non-Isolated

The Integrated Digital Input/Output Non-Isolated (feature 1560) allows small numbers of digital sensor I/O devices to be attached in situations where the 4982 Sensor Input/Output Unit is not required. The feature contains 32 points (two 16-point groups) of non-isolated digital input/process interrupt (DI/PI) and 32 points (two 16-point groups) of digital output (DO). Each group of 16 points is separately addressable and has a 'ready' line and a 'sync' line for synchronizing its operation with attached devices.

Timers

The Timers (feature 7840) provides two 16-bit timers that are packaged on one printed-circuit card. Each timer can be used as an interval timer, pulse counter, or pulse duration counter with end-interrupt. The timers are separately addressable and are independently started, stopped, read, or set to any value under program control. The timers can be read without disturbing their operation; however, to set a timer's value or mode, it must be stopped.

Teletypewriter Adapter

In addition to providing one of the attachment options for the 3151, 3163 and 3164 ASCII Display Stations, the Teletypewriter Adapter (feature 7850) provides for the attachment of any of several I/O devices. The adapter operates in duplex mode at speeds up to 9600 bits per second (bps) and supports initial program load. DC current loop, TTL, and EIA interface options are offered.

Programmable Cycle-Stealing Digital Input/Digital Output Attachment

The Programmable Cycle-Stealing DI/DO Attachment (RPQ D02288) provides a general-purpose, high-speed, digital input/output interface for the attachment to Series/1 of non-IBM devices, such as printers, plotters, graphics terminals, scientific instrumentation, and sensor input/output front ends.

The attachment runs in programmable mode or cycle-steal mode. In programmable mode, the microprocessor, located in the attachment, controls the interface and can run smaller applications based on stored control logic loaded from the Series/1. In cycle-steal mode, the microprocessor is bypassed; this allows higher data rates of up to 800KB per second.

Multifunction Attachment

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

Communications power (feature 2010) is required when installed in a 4955 Model C or D processor or an input/output expansion unit.

Cables

- The Multifunction local attachment cable (feature 5770) is available as a 15.4 meter (50 foot) cable for RS-422-A attachment
- The Asynchronous local attachment cable (feature 2056) and EIA dataset cable (feature 2057) are available as 6.1-meter (20-foot) cables for RS-232-C attachment.

Highlights are:

- Provides four independent local attachments or, optionally, three local attachments and one remote attachment
- Allows local attachment of devices to be located up to 1219 meters (4000 feet) from a Series/1
- Has capabilities similar to other Series/1 remote attachment features.

The Multifunction Attachment (feature 1310) provides for the local or remote attachment of the many types of terminals and printers. The feature card also provides for the remote attachment to Series/1 of binary synchronous communications (BSC) input/output devices and BSC systems. The card mounts in an input/output feature location of a Series/1 processor, 4959 Input/Output Expansion Unit, or 4965 Storage and I/O Expansion Unit.

The card has four attachment ports. All four ports can provide asynchronous communications by means of the EIA RS-422-A (local) interface. Or, one port can be used for the remote attachment of a device through a modem by means of the EIA RS-232-C interface and the other three ports can be used for the local attachment of devices. Both interfaces allow data rates up to 9600 bps. However, allowable data rates are configuration sensitive.

The RS-422-A interface allows local attachment of terminals and printers up to 1219 meters (4000 feet) from a Series/1. The Multifunction Attachment provides for local attachment of 3151, 3163, and 3164 ASCII Display Stations, 4201 Proprinter, 4202 Proprinter XL, and the 4224 (all Models).

When a remote device is attached to a Series/1 through the RS-232-C interface, binary synchronous communications or asynchronous communications can be selected through device initialization software in the operating system.

For binary synchronous communications, the functions of the BSC Single-Line Control (feature 2074) are provided to the application program.

For asynchronous communications, a half-duplex single line is available to the application program. The line is equivalent to that of the Feature-Programmable Multiline 8-Line Communications Control (feature 2095) and the Feature-Programmable Multiline 4-Line Communications Adapter (feature 2096). Selected models of the 3151, 3163, and 3164 ASCII Display Stations are supported. Also, any non-IBM device that meets the interface standards of the feature-programmable adapter can be remotely attached.

Printer Attachment - 5200 Series

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

None required.

Cables

Feature 5780, 6.1 meters (20 feet) in length, or customer-supplied cable.

The Series/1 Printer Attachment — 5200 Series (feature 5640) plugs into a Series/1 processor or I/O expansion unit. The attachment has two ports that physically connect and logically adapt models of the 5219, 5224, 5225, or 5262 printers to the processor data channel.

Data can be transmitted and received up to a distance of 1524 meters (5000 feet). The attachment supports the transfer of data in data stream mode or 4975 emulation mode. The printer is connected to the attachment by a twinaxial cable.

Up to a maximum of eight printers can be connected to the attachment (no more than seven on one port).

Configurations

When all printers are the same type, the five possible configurations are:

- Up to eight 5219s
- Up to eight 5224s
- Up to four 5225s
- Up to two 5262s.

The following configurations illustrate the mix of printer types that can be connected:

- Any mix of up to eight 5219s or 5224s
- One 5225 and any mix of up to seven 5219s or 5224s
- Two 5225s and any mix of up to five 5219s or 5224s
- Three 5225s and any mix of up to three 5219s or 5224s
- Four 5225s and either one 5219 or one 5224
- One 5262 and up to five 5219s
- Two 5262s and up to three 5219s.

Note: When any mix of 5219, 5224, 5225, or 5262 printers are connected, only printers of the same type can be physically located within 30.5 meters (100 feet) of the attachment (feature 5640).

GPIB Adapter

The General Purpose Interface Bus (GPIB) Adapter (RPQ D02118) provides Series/1 attachment capability for original equipment manufacturers' (OEM) devices, instrumentation, and subsystems that conform to the IEEE Standard 488, 1975. The adapter is microprocessor-controlled and cycle-stealing. It provides for attachment of up to 14 addressable devices per adapter. Maximum adapter speed is 65KB per second.

Multidrop Work Station Attachment

Programming support

Event Driven Executive.

Prerequisites

None required.

Cables

- Feature 5780, 6.1 meters (20 feet) in length, or customer-supplied cable.
- Twinaxial cable-to-cable connector (part 7362203) may be used to connect feature 5780 to twinaxial cable assembly (part 7362267).
- A Berg connector (part 6095524) may be used with customer-provided twinaxial cables to attach directly to the Multidrop Work Station Attachment.

The IBM Multidrop Work Station Attachment (feature 1250) plugs into a Series/1 processor or I/O expansion unit, and provides four cable ports for multidrop of up to eight 4980 displays. Each port provides interfaces for up to a maximum total cable distance of 1219 meters (4000 feet). Speeds vary according to distance as follows:

- 100 kilobits per second to 1219 meters (4000 feet)
- 250 kilobits per second to 844 meters (1600 feet)
- 500 kilobits per second to 422 meters (800 feet).

The attachment responds to eight device addresses (one for each display). The attachment can transfer data to and from Series/1 storage using cycle-steal and Direct Program Control (DPC).

The maximum number of Multidrop Work Station Attachments installed in a Series/1 is determined by the number of available feature positions in the processor or I/O expansion unit.

Programmable Subsystem Controller (RPQ D02761)

The Programmable Subsystem Controller (RPQ D02761), with customer supplied programming, is used by itself as a communications coprocessor or as a controller for the Series/1 Subsystem Storage (RPQ D02762) or as a controller for the 4988 Communications Unit (RPQ D02764). The subsystem controller contains a microprocessor, which provides the interface between the Series/1 channel and the subsystem storage or communications unit. The controller contains 64KB of usable programmable read-only memory and 256KB of RAM for customer programmers.

Communications features

The following communications features are available with Series/1.

- Binary Synchronous
- Synchronous
- Asynchronous
- Feature-Programmable Multiline
- Synchronous Communications Single-Line Control/High Speed
- Token-Ring Attachment Card
- Multiline Communications Coprocessor
- Series/1- System/370 Channel Attachment
- Local Communication Controller
- Auto-Call Originate Attachment Card
- Series/1-to-Series/1 Attachment
- Direct BSC Attachment
- Asynchronous Direct 8-Line RS-422-A Adapter
- Communications Indicator Panel

Programming support

- Event Driven Executive
  - Support is provided in the base operating system for:
    - BSC features
    - ACC features
    - Series/1-to-Series/1 attachment
    - Series/1 Token-Ring
  - Specific device support has been validated for communications with the following:
    - Series/1
    - System/370 (BSC, SDLC, and Channel attachment)
    - 2741 Communication Terminal
    - 3101/3151/3163/3164 displays
    - 5100 Portable computer
    - 5110 Computer
    - Teletype[1] Model ASR 33/35 or equivalent
    - Tektronix[2] Model 4013 graphics terminal or equivalent.
  - Support is available in other Event Driven Executive based licensed programs for:
    - SDLC through the Support for Systems Network Architecture
    - System/370 Channel Attach through the System/370 Channel Attachment program
    - Token-Ring through the Token-Ring Interface Program
    - Multiline Communications Coprocessor through the Series/1 Outboard Processing Tools Programming RPQ (customer must provide protocol software).
- Realtime Programming System
  - Support is provided in the base operating system for:
    - BSC features
    - SDLC features
    - ACC features
  - Specific device support has been validated for communications with the following:
    - Series/1
    - IBM Personal Computer
    - System/3
    - System/32
    - System/34
    - System/36
    - System/38
    - System/370 (BSC, SDLC, and Channel attachment)
    - 2740/2741 Communication Terminal
    - 3101/3151/3163/3164 displays
    - 3271/3274/3275/3276 Control Unit (BSC)
    - 3684 Point-of-Sale Controller Unit
    - 3741 Data Station
    - 4701 Banking Machine Terminal
    - 5260 Retail System
    - 5280 Distributed Data Station
    - 6670 Information Distributor
    - Teletype Model ASR 33/35 or equivalent
  - Support is available in other Realtime Programming System based licensed programs for:
    - System/370 Channel Attach through the System/370 Channel Attachment program
    - Data Link Control Adapter through the Packet Network Support.

[1] Trademark of the Teletype Corp.

[2] Trademark of Tektronix, Inc.

Prerequisites

- Communications power (feature 2010) is required on the 4955 Models C and D processor and the 4959 input/output expansion unit (below serial number 22499, domestic):
  - Binary Synchronous Communications Single-line Control
  - Binary Synchronous Communications 4-line Adapter
  - Synchronous Data Link Control Single-line Control
  - Asynchronous Communications 4-line Adapter
  - Synchronous Communications Single-line Control/High speed
- Binary Synchronous Communications 8-line Control (feature 2093) is required for the Binary Synchronous Communications 4-line Adapter feature.
- Asynchronous Communications 8-line Control (feature 2091) is required for the Asynchronous Communications 4-line Adapter feature.
- Feature-Programmable Communications 8-line Control (feature 2095) is required for the Feature-Programmable Communications 4-line Adapter feature.
- 4993 Series/1-System/370 Termination Enclosure is required for each Series/1-System/370 Channel Attachment feature
- EIA-232-D/V.24 Interface Adapter (feature 2841) or V.35 Interface Adapter (feature 2843) are required with use of the Multiline Communications Coprocessor.

Cables

- The Asynchronous Local Attachment Communications cable (feature 2056), can be used with features 1310, 1610, 2092, and 2096.
- The EIA dataset cable (feature 2057), can be used with features 1310, 1610, 2074, 2090, 2092, 2094, and 2096.
- The BSC/High Speed cable (for Western Electric 303[3] interface) (feature 2058), can be used with feature 2075.
- The BSC V.35/High Speed DDN cable (feature 2060), (for EIA/CCITT V.35 interface), can be used with features 2075 and 2080.
- The Feature-Programmable Multiline Current Loop cable (feature 2061) can be used with feature 2096.
- The EIA Duplex cable (feature 2062) for pair of SDLC adapters, can be used with feature 2090.
- The X.21 cable (feature 2067), can be used with feature 2080.
- The Series/1 Twenty-Foot Token-Ring Cable (feature 2201) can be used with the Token-Ring Attachment Card (feature 2200).
- The Shielded EIA cable (feature 2944), can be used with features 1310, 1610, 2074, 2090, 2092, 2094, and 2096.
- The Auto-call Originate Attachment cable (feature D02014), can be used with feature D02013.
- EIA-232-D/V.24 Shielded Data Set Cable (feature 2842) or V.35 Shielded Data Set Cable (feature 2844) can be used with the Multiline Communications Coprocessor.

Limitations

- No more than 24 communications lines, of any combination, can terminate in any processor or input/output expansion unit.
- No more than eight Binary Synchronous Communications Single-Line Control/High Speed features (feature 2075) can be installed in any processor or input/output expansion unit.

[3] Product of Western Electric Company

Series/1 communications features provide a variety of communications options. Two types of communications features are available: features that plug into the processor data channel (discussed in this chapter) and features that plug into the 4987 Programmable Communications Subsystem (discussed in Chapter 4).

Processor data channel types of communication features provide communication with remote terminals and systems:

- Binary synchronous communications (BSC)
- Synchronous data link control (SDLC)
- Asynchronous communications control (ACC)
- Feature-programmable
- Synchronous Communications Single-Line Control/High Speed (SCSLC)
- Token-Ring Attachment Card
- Multiline Communications Coprocessor.

These features provide a choice of several single- and multiple-line data communications capabilities. In addition, there is a choice of line speeds, line configurations, clocking sources, and data codes. All communications features (except binary synchronous/high speed) are capable of automatic answering on switched lines.

Other features enhance the versatility of the Series/1 communications capabilities. For example, the Local Communications Controller feature provides access to other Series/1 processors connected on a high-speed ring. Also, the Series/1-System/370 Channel Attachment feature allows the Series/1 to be channel attached to a System/370.

Communication support features include the Communications Indicator Panel (feature 2000).

Binary Synchronous (BSC) features

- Binary Synchronous Communications Single-Line Control (feature 2074) — This feature provides circuitry for one half-duplex line at data rates up to 9,600 bps on a switched or non-switched basis. It also provides the ability to perform an initial program load (IPL) on the processor from a host system and can be used as either a primary or secondary station.
- Binary Synchronous Communications Single-Line Control/High speed (feature 2075) — This feature provides circuitry for one half-duplex line at speeds up to 56,000 bps on a non-switched basis only. It also provides the ability to perform an initial program load (IPL) on the processor from a host system and can be used as either a primary or secondary station.
- Binary Synchronous Communications 8-Line Control (feature 2093) — This feature provides control circuitry for up to two BSC 4-line adapters. Data rates are 9600 bps for lines 1 and 2 and up to 2400 bps on lines 3 through 8 when two adapters are used. When a single 4-line adapter is used, the data rates for each line can be up to 4800 bps. The 8-line control can be used as either a primary or secondary station.
- Binary Synchronous Communications 4-Line Adapter (feature 2094) — This feature provides circuitry for up to four half-duplex lines. Data rates are dependent on the number of lines and the line speeds used. Control circuitry is provided by the prerequisite BSC 8-line control feature.

Synchronous (SDLC) feature

The Synchronous Data Link Control Single-Line Control (feature 2090) controls the serial transfer of data to and from remote terminals or host systems by using modems and communication line facilities. The following communication characteristics apply to the SDLC feature:

- Communicates using EBCDIC or ASCII (or any other 8-bit) code
- Single-line, medium-speed, half-duplexed device that can operate on switched or nonswitched lines
- Operates in a duplex environment by installing two cards (one as a transmitter and one as a receiver) in adjacent feature locations
- Data rates up to 19,200 bps with external clocking
- Operates as a primary or secondary station
- Internal clocking is available with bit rates of 600 bps or 1,200 bps
- Nonreturn-to-zero-inverted (NRZI) and nonreturn-to-zero (NRZ) coding
- Provides answer-tone by installing a jumper.

Asynchronous (ACC) features

- Asynchronous Communications Single-Line Control (feature 1610) — This feature provides circuitry for one half-duplex line at data rates up to 9600 bps on a switched or nonswitched basis. It can be used as either a primary station or secondary station. This feature does not provide for recognition of station addresses. If the feature is to be used as a secondary station in a multipoint network, station address recognition must be provided by programming.
- Asynchronous Communications 8-Line Control (feature 2091) — This feature provides the control circuitry for up to two ACC 4-line adapters. It can be used as a primary or secondary station.
- Asynchronous Communications 4-Line Adapter (feature 2092) — This feature provides circuitry for up to four half-duplex lines. Each of these lines can operate at data rates up to 2400 bps. Control circuitry is provided by the ACC 8-line control.

Feature-Programmable Multiline Communications features

- Feature-Programmable Multiline 8-Line Communications Control (feature 2095) — This feature provides the control circuitry for up to two programmable 4-line communications adapters. Point-to-point or multipoint operations are supported with an aggregate controller throughput of 64,000 bps (based on a 12-bit character).
- Feature-Programmable Multiline 4-Line Communications Adapter (feature 2096) — This feature provides the circuitry to support up to four communications lines. Each line can be programmed to select:
  - Speed — 37.5 bps to 1200 bps, or 300 bps to 19,200 bps
  - Synchronous or asynchronous operation
  - 5, 6, 7, or 8 bits per character
  - Odd, even, or no parity checking/generation
  - Stop-bit length of 1 or 2
  - Synchronization character specification
  - Change-of-direction (COD) character recognition
  - Echo-plex operation
  - Break operation recognition/generation
  - Block check character reception (for 1 character).

Each line can also be jumpered for:

- EIA RS-232-C or current loop interface
- Modem controls for direct connect, switched line, and nonswitched line.

Synchronous Communications Single-Line Control/High Speed

Highlights are:

- BSC or SDLC/HDLC protocol
- Up to 56,000 bps line speed
- CCITT V.35 interface (leased)
- CCITT X.21 interface (switched or leased)
- Full or half duplex operation with SDLC/HDLC
- Remote initial program load (IPL) capability.

The Series/1 Synchronous Communications Single-Line Control/High Speed (feature 2080) provides the function required to attach the Series/1 to network interfaces conforming to the Consultative Committee International Telephone and Telegraph (CCITT) recommendation V.35 or X.21.

The hardware can operate with either of two protocols:

- Binary synchronous communications (BSC): Half duplex communications at speeds up to 56,000 bps by using V.35 interfaces (leased) or up to 48,000 bps using an X.21 interface (switched or leased). A local BSC connection supports speeds up to 48,000 bps.
- Synchronous data link control (SDLC): SDLC or high level data link control (HDLC) can operate in full-duplex mode with the same interfaces and speeds mentioned above. A local connection is available at speeds of 48,000 or 9,600 bps.

  Notes:

  1. The SDLC software will only support SDLC in half-duplex mode.
  2. BSC and SDLC software support for X.21 interface is available at speeds of 19,200 or 9,600 bps.

The hardware supports multipoint operation.

The feature consists of a single card, which mounts in a Series/1 processor or I/O expansion unit. It allows the connection of a Series/1 on a switched or nonswitched line to telecommunications networks requiring an X.21 standard interface.

Programming support

Nonswitched support:

- BSC X.21 is supported by:
  - Event Driven Executive
  - Realtime Programming System
- SDLC X.21 is supported (in half-duplex mode) by:
  - Realtime Programming System
  - Event Driven Executive Systems Network Architecture (5719-XX9)
- HDLC is supported by:
  - X.25/HDLC Realtime Programming System Communications Support (5719-HD1)
  - X.25/HDLC Event Driven Executive Communications Support (5719-HD2).

Switched X.21 support:

- BSC is supported by Realtime Programming System and Event Driven Executive
- SDLC is supported (in half-duplex mode) by Realtime Programming System and Event Driven Executive.

Prerequisites

When the V.35 interface is used, Communications Power (feature 2010) is required on the 4955 Model C or D processor or the I/O expansion unit.

Cables

For attachment to a data communications equipment (DCE) arrangement conforming to CCITT recommendation V.35, the BSC V.35/High Speed DDN cable (feature 2060) is available. The cable is 6.1 meters (20 feet) long.

For attachment to a DCE arrangement conforming to CCITT X.21, the X.21 cable (feature 2067) is available.

Local connection cables are a customer responsibility.

Token-Ring Attachment Card

The Series/1 Token-Ring Attachment Card (feature 2200) permits attachment of all Models of the IBM Series/1 4956 Processor to the IBM Token-Ring Network, operating at either 16 or 4M bps. The card provides logical link control functions conforming with the IEEE 802.2 standard, ECMA 89 standards, and is compatible with International Standard ISO - 8802/2. It has a Motorola 68000 processor based design providing an intelligent interface between the Series/1 bus and the Token-Ring. Series/1 EDX software support is provided with the Series/1 EDX Token-Ring Interface Program (5719-EAC), in conjunction with the Outboard Processing Tools PRPQ (5799-CJL), which requires Event Driven Executive Version 6.1 (5719-XS6).

Highlights are:

- Series/1 card for attaching to IBM Token-Ring Network (feature 2200)
- Intelligent Attachment Card
- Separate controller for 802.5 and 802/2 interfaces
- Twenty-foot Token-Ring Cable (feature 2201), separately orderable.

The Token-Ring Attachment Card has two microprocessors: one operates under control of resident microcode and handles the 802.5 ring interface and the link level (802/2) interface. The second microprocessor is a Motorola 68000 which executes the EDX Token-Ring Interface Program (5719-EAC) . The EDX Token-Ring Interface Program, in conjunction with the Outboard Processing Tools PRPQ (5799-CJL), without which the attachment card is non-functional, provides the necessary interface between the hardware and the Series/1 software. The attachment requires one slot in the 4956 Processor or 4959 I/O Expansion Unit.

Series/i communications over the IBM Token-Ring Network operating at either 16 or 4M bps is supported with the following systems:

- 9370
- 3174
- AS/400
- PS/2.

Customer programming of this attachment card is not supported.

Multiline Communications Coprocessor

The IBM Series/1 Multiline Communications Coprocessor is a customer programmable Series/1 communication card with 64K of read-only storage and 1MB of dynamic Random Access Memory (RAM). Each attachment card allows the use of up to two Interface Adapters (IA). The IAs are a two-port EIA-232-D/V.24 adapter (feature 2841) and a one-port CCITT V.35 adapter (feature 2843).

The Multiline Communications Coprocessor offering is composed of the following:

	Feature Code
Series/1 Multiline Communications Coprocessor	2840
EIA-232-D/V.24 Interface Adapter	2841
EIA-232-D/V.24 Shielded Data Set Cable	2842
V.35 Interface Adapter	2843
V.35 Data Set Cable	2844

Highlights are:

- Provides hardware capability to support the SDLC/HDLC, synchronous and asynchronous protocols
- Provides up to four ports of duplex or half duplex communications
- 9600 bps EIA-232-D serial port for use as service port
- EIA-232-D/V.24 and CCITT V.35 Interface Adapters (features 2841 and 2843)
- Operation of up to 64,000 bps on the CCITT V.35 interface with external clocking, and 19,200 bps on the EIA-232-D/V.24 interface
- Provides 1MB of RAM storage
- Uses one Series/1 I/O slot.

The IBM Series/1 Multiline Communications Coprocessor is a standard Series/1 attachment card providing customers the option of selecting electrical interfaces and link speeds. The customer is required to program the link level code. Communications Hardware Interface Control Code (CHICC) is provided in the hardware (ROS) microcode to assist the programmer with interfaces for synchronous, asynchronous, and SDLC/HDLC. There is no communications protocol software provided to support this attachment card.

The IBM Series/1 Multiline Communications Coprocessor can be used on any model of the Series/1 4956. It plugs into the Series/1 I/O channel or (via a channel extender) can plug into the 4959 I/O Expansion Unit or the 4965 Storage and I/O Expansion Unit. Power supply constraints may limit the maximum number of these adapters supported.

The IBM Series/1 Multiline Communications Coprocessor Interface Adapters are small (3.37-inch by 1.90-inch) cards that contain the drivers and receivers used to generate the electrical interfaces. The IAs are mounted with top card connectors to the IBM Series/1 Multiline Communications Coprocessor.

Prerequisites

The following prerequisites are required for use of this product.:

- Event Driven Executive Version 6.1 (5719-XS6)
- Series/1 Outboard Processing Tools PRPQ (5799-CJL) (P82916).

  The Series/1 Outboard Processing Tools PRPQ provides the control program and the C language run-time members required to execute load programs on the IBM Series/1 Multiline Communications Coprocessor. The program also provides an access method interface across the Series/1 channel to support data interchange between the inboard and the outboard control program environments. This access method operates in conjunction with the outboard application access method in EDX. For further information on the Series/1 Outboard Processing Tools, see page 5-18.

Other communications features

- Series/1-System/370 Channel Attachment (feature 1200) provides a high-speed data transfer capability (300,000 bytes per second) between a Series/1 and any of the following IBM processors:
  - System/370 (Models 135 through 168)
  - 3031, 3032, 3033, 3081
  - 4331, 4341.

  The feature requires 32 contiguous device addresses on the System/370 channel and a single device address on the Series/1 channel. IPL of the Series/1 from the host System/370 is supported.

  Communications between the Series/1 and the System/370 is accomplished by the cooperative processing of programs in each processor. The System/370 programs use a subset of the 3272 command set to access the feature. The Series/1 programs use the Series/1 Operate I/O instruction along with IDCB and DCB command codes and formats defined specifically for the feature.
- Local Communication Controller (feature 1400) is intended for high-speed serial data communications between two or more processors. The feature card allows multiple processors to be attached together by way of a ring data link without the need of a primary station. This type of configuration accommodates high-speed, storage-to-storage data transfer between two processors.

  The controller is clocked at 2 million bits per second. A built-in modem provides bit synchronization. The maximum distance allowed between any two active processors is 1524 meters (5000 feet) for twinaxial cables or 610 meters (2000 feet) for coaxial cables. Cable assemblies, bulk cables, and connector kits can be ordered from IBM to provide the link between processors. Up to 16 Series/1 processors can be interconnected on a ring.
- The 4988 Communication Unit (RPQ D02764) is an enclosure and power supply for up to 32 modems (D02763). Each 4988 can accommodate 32 full-duplex lines for 32 modems. The 4988 is a full width unit that mounts in a 4997 or an EIA standard 19-inch rack. The 4988 attaches with the Series/1 Subsystem Controller (RPQ D02761).
- Auto-Call Originate Attachment Card (RPQ D02013) provides 12 input lines and 12 output lines for controlling up to two auto-call modems under direct program control (EIA RS-366 interface). It also provides 16 digital input/process interrupt points and 16 digital output non-isolated points under direct program control.
- Series/1-to-Series/1 Attachment (RPQs D02241 and D02242) permit the direct coupling of two Series/1 processors at distances of up to 21 meters (65 feet). Communication is in cycle-steal mode and operates at instantaneous data rates of up to 55,000 bytes per second. The Series/1s operate in a peer-to-peer relationship, except that the processor with RPQ D02241 installed prevails during data transfer contention.
- Direct BSC Attach (RPQ D02349) provides a half-duplex, single-line interface for connecting one Series/1 to another Series/1 up to 1219.2 meters (4000 feet) away. The interface conforms to EIA RS-422-A interface standards and transmits data at 38,000 bps. This attachment must be installed on both Series/1 processors.
- Asynchronous Direct 8-Line RS-422-A Adapter (RPQ D02350) provides eight RS-422-A interfaces for local attachment of RS-422-A devices such as the 3151, 3163, and 3164 ASCII Display Stations. It is used with the Feature-Programmable 8-Line Communications Control (feature 2095) in place of the Feature-Programmable Multiline 4-Line Communications Adapter (feature 2096). Data rates of up to 19,200 bps are allowed with an aggregate controller throughput of 64K bps (based on a 12-bit character). Attached devices can be placed up to 1219.2 meters (4000 feet) from the Series/1.

Communications support features

- Communications Indicator Panel (feature 2000) is available as an option to the communications features on the data channel of a 4959 or a full-width processor. It mounts under the front cover and provides a means of displaying various states and conditions of lines and also a means of manually controlling certain modem functions. The panel can be used with any of the communications features, one at a time.

Chapter 4. Series/1 input/output and system support units

Series/1 input/output devices are designed to contribute to efficient system performance. Many devices are equipped with cycle-stealing microprocessor controllers that permit device overlapping and reduce processor workload.

Adding one or more 4959 Input/Output Expansion Units or 4965 Storage and Input/Output Expansion Units to your 4956 provides I/O attachment capacity beyond that in the Series/1 processor.

Series/1 I/O units include disk, diskette, magnetic tape, printers, and display stations.

Storage-to-storage communication between Series/1 and System/370 processors is provided by the 4993 Series/1 — System/370 Termination Enclosure and its companion channel attachment feature.

Note: Programming support refers to the latest version and release level that was announced at the time this document was printed. Programming support is available under separate license.

4959 Input/Output Expansion Unit

Physical characteristics

Height	356 millimeters (14 in.)
Width	483 millimeters (19 in.)
Depth	476 millimeters (18.75 in.)
Weight	22.7 kg (50 lb)
Shipping weight	37.5 kg (87 lb)

Environmental conditions

Heat output/hour	500 watts (1705 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

100 volts	7.0 amperes
115 volts	6.1 amperes
200 volts	3.5 amperes
208 volts	3.4 amperes
230 volts	3.2 amperes
Frequency	60±0.5 Hz
kVA	0.7
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

- Series/1 processor
- Channel repower (feature 1565) is required:
  - In processors for the first expansion unit attached
  - In all expansion units, when more than one expansion unit is attached.

Cables

Input/output cables for the processor data channel are used to attach the 4959 to a Series/1 processor.

Standard features

- Fourteen input/output feature locations for attachment of devices to a Series/1
- Designed for mounting in a 4997 Rack Enclosure or an EIA standard 19-inch rack enclosure.

The 4959 provides additional I/O attachment 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 a 4959. Attachment features, data processing I/O attachment features, the Programmable Two-Channel Switch feature, and the sensor I/O unit attachment feature can be installed in any 4959 I/O Expansion Unit.

The Programmable Two-Channel Switch or Two-Channel Switch console is located on the front panel of the 4959 unit, and is a part of the optional feature. The console contains indicator lights and switches for determining the status of the feature and to allow for manual switching. 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 with the Two-Channel Switch feature when switching back to the primary processor, not with the Programmable Two-Channel Switch feature.

Note: The characteristics of the 4959 generally apply to the expansion unit capabilities of the 4965 Storage and I/O Expansion Units.

The Programmable Two-Channel Switch or Two-Channel Switch is supported by the Realtime Programming System only.

Optional features

- Channel Repower (feature 1565) — This feature repowers the data channel along a chain of I/O expansion units. The feature is always installed in the preceding unit and provides channel repower for the subsequent unit. A maximum of five Channel Repower features can be installed in a Series/1 configuration. The limit is three for any processor configuration with the Two-Channel Switch or Programmable Two-Channel Switch.
- Programmable Two-Channel Switch (feature 7777) — This feature electronically switches common I/O devices between two Series/1 processors. The unit also allows direct communication between the two Series/1 processors. At all times, the unit logically connects the common channel features to the I/O interface of one Series/1 processor while listening to the interface of both processors.

4963 Disk Subsystem

Operating characteristics

Rotational speed	3125 RPM
Average latency (nominal)	9.6 milliseconds
Instantaneous data rate	1.03 megabytes per second
Access times	
Cylinder to cylinder	9 milliseconds
Average seek	27 milliseconds
Maximum seek	45 milliseconds
Total usable storage	
Models 64A, 64B	64.5 megabytes
Cylinders	360
Tracks per cylinder	4 (minimum) 11 (maximum)
Sectors per track	64
Bytes per sector	256
Total usable storage	131 kilobytes
Heads	8
Sectors per track	64
Bytes per sector	256

Physical characteristics

Height	356 millimeters (14 in.)
Width	483 millimeters (19 in.)
Depth	584 millimeters (23 in.)
Weight	54.4 kg (120 lb)
Shipping weight	67.9 kg (150 lb)

Environmental conditions

Heat output/hour	242 watts (827 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

100 volts	5.0 amperes
200 volts	2.5 amperes
208 volts	2.5 amperes
230 volts	2.5 amperes
Frequency	60±0.5 Hz
kVA	0.50
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

The 4963 Disk Subsystem Attachment (feature 3590) is required for each 4963 Model 64A.

Highlights include:

- Mid-range disk subsystem with up to 256 megabyte capacity
- Microprocessor control to optimize disk performance
- One to four disks per subsystem — models may be mixed
- Multiple subsystems may be attached
- 27-millisecond average access time
- 10.1-millisecond latency
- 1.03-megabyte-per-second data rate.

This high-performance disk subsystem features multiple microprocessors to off-load the Series/1 processor and optimize disk performance. Each subsystem has one primary drive and may have up to three expansion drives (models may be intermixed). Multiple subsystems may be attached. Each subsystem attaches to the Series/1 through one Disk Subsystem Attachment (feature 3590) installed in a feature location space in a processor 4965 Storage and I/O Expansion Unit.

Automatic retries on soft errors, automatic seek to alternate sector (one alternate sector per track plus use of spare sectors on tracks in same or adjacent cylinder eliminates seeks to alternate track), automatic seek overlap with read or write, and automatic error handling are all under subsystem microprocessor control. The microprocessor executes self-test diagnostics on power up, reset, and during quiescent periods. A three-sector speed matching buffer reduces extra revolutions often encountered on multiple sector read or write operations.

4963	Disk capacity (bytes)	
model	Movable heads	Fixed heads
64A	64,520,192	–
64B	64,520,192	–

A = Primary unit
B = Expansion unit

The 4963 is a full-width unit that mounts in a 4997 Rack Enclosure or an EIA standard 19-inch rack.

4964 Diskette Unit

Operating characteristics

Rotational speed	360 RPM
Average latency (nominal)	83.4 milliseconds
Instantaneous data rate	31.3 kilobytes per second
Access times	
Track to track	5 milliseconds
Average seek	40 milliseconds
Total usable storage by type/sector size	
1/128	246 kilobytes
1/256	284 kilobytes
1/512	303 kilobytes
2/128	493 kilobytes
2/256	568 kilobytes
2/512	606 kilobytes
Tracks per diskette surface	77 (74 data)

Physical characteristics

Height	356 millimeters (14 in.)
Width	216 millimeters (8.5 in.)
Depth	590 millimeters (23.25 in.)
Weight	18.1 kg (40 lb)
Shipping weight	20 kg (44 lb)

Environmental conditions

Heat output/hour	230 watts (785 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

115 volts	2.2 amperes
208 volts	1.2 amperes
230 volts	1.1 amperes
Frequency	60±0.5 Hz
kVA	0.25
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

The 4964 Diskette Unit Attachment (feature 3581) is required.

Rack mounting fixture (feature 4540) is required if mounting in an IBM 4997 Rack Enclosure or an EIA standard 19-inch rack enclosure.

Highlights include:

- Removable storage on two-sided diskette; each side has 74 data tracks
- Average data rate of 31,250 bytes per second
- Track-to-track access time of 40 milliseconds
- Selectable IPL capability.

The 4964 Diskette Unit mounts in half the width of a 19-inch rack enclosure. It is a direct-access storage device that retrieves and records data on a single, removable magnetic diskette and combines the small batch data storage properties with many of the features of magnetic tape. The diskette has the added advantage of providing direct access to a specified group of records filed either sequentially or randomly. Diskette data tracks contain 128-, 256-, or 512-byte sectors. One-or two-sided diskettes can be used. A two-sided diskette provides maximum storage capacity, using the 512-byte sector format. A one-sided diskette recorded in 128-byte sector format can be used to exchange data with other IBM devices.

The 4964 can be designated as either the primary or alternate system IPL device. It attaches to the Series/1 by means of the 4964 Diskette Unit Attachment feature, which can be plugged into either a processor unit or an I/O expansion unit. A microprocessor located in the diskette unit attachment feature controls cycle-steal read/write operations and supports multiple sector transfers. Extensive microdiagnostics along with cyclic redundancy checking are standard.

4965 Storage and I/O Expansion Unit (Model E00)

Disk operating characteristics

Rotational speed	3600 RPM
Average latency (nominal)	8.3 milliseconds
Instantaneous data rate	625 kilobytes per second
Access times	
Cylinder to cylinder	8 milliseconds
Average seek	40 milliseconds
Total usable storage	40 or 72 megabytes
Cylinders	733
Tracks per cylinder	7
Sectors per track	32
Bytes per sector	512

Physical characteristics

Height	346 millimeters (13.75 in.)
Width	480 millimeters (19 in.)
Depth	576 millimeters (22.75 in.)
Weight	55 kg (120 lb)
Shipping weight	72.6 kg (160 lb)

Environmental conditions

Heat output/hour	600 watts (2040 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

115 volts	7.0 amperes
120 volts	6.7 amperes
208 volts	3.9 amperes
230 volts	3.5 amperes
240 volts	3.4 amperes
Frequency	50/60±3.0 Hz
kVA	0.81
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

Channel Repower (feature 1565) is required when attaching a 4965 to a processor or another expansion unit.

Standard features

- One 40 or 72-megabyte fixed-disk drive
- Cache storage (400KB)
- Instantaneous data rate of 625 kilobytes per second
- Average access time less than 40 milliseconds
- Seven I/O feature locations
- Selectable IPL capability.

The 4965 Model E00 is a modular unit with seven I/O feature locations and includes an integrated 40 or 72-megabyte disk with 400KB Cache standard. The unit mounts in a 4997 Rack Enclosure or an EIA standard 19-inch rack enclosure.

The 4965 can be designated as either the primary or alternate system IPL device. A microprocessor located on the integrated attachment card controls cycle-steal read/write operations and supports multiple diskette transfers. Extensive microdiagnostics along with cyclic redundancy checks are standard.

Optional features

- Channel Repower (feature 1565) — Repowers the data channel along a chain of I/O expansion units. The feature is always installed in the preceding unit and provides channel repower for the subsequent unit. Up to five Channel Repower features can be installed in a Series/1 configuration (up to three for any processor configuration with the Two-Channel Switch or Programmable Two-Channel Switch).
- Second Disk Drive (feature 4115) — Provides a second 40-megabyte fixed-disk drive
- Third Disk Drive (feature 4116) — Provides a third 40-megabyte fixed-disk drive
- Second Disk Drive (feature 4172) — Provides a second 72-megabyte fixed-disk drive
- Third Disk Drive (feature 4173) — Provides a third 72-megabyte fixed-disk drive.

4967 High-Performance Disk Subsystem

Operating characteristics

Rotational speed	2964 RPM (nominal)
Average latency (nominal)	10.1 milliseconds
Instantaneous data rate	1.5 megabytes per second
Access times	
Cylinder to cylinder	9 milliseconds
Average seek	25 milliseconds
Total usable storage	
Model 2CA/2CB	200 megabytes
Model 3CA/3CB	358 megabytes
Cylinders	
Model 2CA/2CB	570
Model 3CA/3CB	1022
Tracks per cylinder	14
Sectors per track	50 (1 reserved)
Records per sector	2
Bytes per record	256

Physical characteristics

Height	356 millimeters (14 in.)
Width	483 millimeters (19 in.)
Depth	635 millimeters (25 in.)
Weight	68.1 kg (150 lb)
Shipping weight	90.9 kg (200 lb)

Environmental conditions

Heat output/hour	
Model 2CA/3CA	500 watts (1730 BTU)
Model 2CB/3CB	400 watts (1365 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

Model 2CA/3CA	
110 volts	7.4 amperes
115 volts	7.4 amperes
120 volts	7.4 amperes
208 volts	3.7 amperes
220 volts	3.7 amperes
240 volts	3.7 amperes
Model 2CB/3CB	
110 volts	7.0 amperes
115 volts	7.0 amperes
120 volts	7.0 amperes
208 volts	3.5 amperes
220 volts	3.5 amperes
240 volts	3.5 amperes
Frequency	60±0.5 Hz
kVA	1.25
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

The 4967 high-performance Disk Subsystem Attachment is required for each subsystem in a processor unit or expansion unit (feature 3595 for 2CA and feature 3596 for 3CA).

Highlights include:

- Storage capacity of 200 to 1432 megabytes per subsystem (1 – 4 disk units)
- Cache storage of 384KB per subsystem
- Instantaneous data rate of 1.5 megabytes per second
- Average access time of 25 milliseconds
- Extensive error checking and recovery procedures
- Selectable as IPL device.

The 4967 High Performance Disk Subsystem provides the Series/1 with direct access storage capacities up to 1432 megabytes per subsystem. Multiple subsystems may be attached to a Series/1. The 4967 is a full-width unit designed for mounting in the 4997 Rack Enclosure or EIA standard 19-inch rack.

There are four models of the 4967 disk unit:

- Model 2CA is a primary disk unit that contains 200 megabytes of storage.
- Model 2CB is an expansion unit that contains 200 megabytes of storage.
- Model 3CA is a primary disk unit that contains 358 megabytes of storage.
- Model 3CB is an expansion unit that contains 358 megabytes of storage.

The Model 2CA primary disk unit requires the 4967 Attachment (feature 3595), and can have up to three 2CB expansion units. The Model 3CA primary disk unit requires the 4967 Attachment (feature 3596), and can have up to three 3CB expansion units.

The 384K-byte cache is microprocessor-controlled and has the potential to significantly improve system performance. Selected data sectors, determined by the cache control algorithm to be probable candidates for system read requests, are pre-fetched and stored in cache. Cache functions are transparent to programming.

Performance improvements are application dependent—test cases from a variety of applications thought to be typical have shown improvements in disk throughput ranging from 50% to above 200%. No guarantee of results can be made, however. The microprocessor monitors its own "hit ratio" and adjusts to optimize performance. A least-recently-used algorithm eliminates inactive data from cache as space for new data is required. This allows the 4967 to dynamically adapt to changes in the job stream. Applications that are truly random (test cases found none) or that are heavily write-oriented may experience little or no improvement from the cache function. Cache functions are transparent to programming. In such cases, the standard performance parameters of 25 milliseconds average access time and 10.1 milliseconds latency are seen. During a write operation, data is placed in cache only after being written to the disk.

Further 4967 features include automatic retries on soft error, automatic seek to alternate sector (always on same cylinder; eliminates seek to alternate track), automatic seek overlap with read or write. Error correction code (ECC) mechanism correct the most common form of disk read errors and detect all uncorrectable forms.

4968 Autoload Streaming Magnetic Tape Unit

Operating characteristics

Normal tape speed	635 millimeters (25 in.) per second 1270 millimeters (50 in.) per second 2540 millimeters (100 in.) per second
Normal rewind time	2.6 minutes (2400 foot reel)
Recording mode	IBM/ANSI compatible
Head type	Duel gap
Number of tracks	9

Physical characteristics

Height	222 millimeters (8.75 in.)
Width	483 millimeters (19 in.)
Depth	559 millimeters (22 in.)
Weight	36 kg (80 lb)
Shipping weight	38.6 kg (85 lb)

Environmental conditions

Heat output/hour	180 watts (614 BTU)
Cooling	Forced air
Operating temperature	16 – 32.6°C (60 – 90°F)
Operating humidity	20 – 85%

Power requirements (at full load)

115 volts	1.7 amperes
208 volts	1 ampere
220 volts	0.9 ampere
240 volts	0.8 ampere
Frequency	60±0.5 Hz
kVA	0.2
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Magnetic tape

IBM Multi-system tape.

Prerequisites

The 4968 Autoload Streaming Magnetic Tape Unit attachment (feature 1220) is required for each tape unit.

Highlights include:

- Fast, convenient, save/restore for medium-to-large Series/1 disk products.
- Autoload convenience for standard tape reels.
- Fast, streaming operation of 160KB per second at 100 inches per second (1600 bpi ANSI standard) or 50 inches per second (3200 bpi).
- Reel capacity of 2400-foot reel is up to 80 megabytes at 3200 bpi.
- Start/stop at up to 25 ips (1600 bpi) for limited applications.
- Dual density.

The 4968 Autoload Streaming Magnetic Tape Units are designed for mounting in the 4997 Rack Enclosure Model 2 or EIA standard 19-inch rack. The unit is slide-mounted to facilitate moving the unit into the service position or into position for customer tape path cleaning.

The tape unit attaches to the Series/1 through a tape attachment feature (feature 1220), which can be plugged into either a processor or an I/O expansion unit.

The primary purpose of the 4968 Autoload Streaming Magnetic Tape Unit is to provide fast, convenient, save/restore functions for IBM Series/1 disk products.

The 4968 has the following key parameters of save/restore:

Speed

In streaming mode at 50 or 100 ips, the data rate is 160K bytes per second. The 4968 saves 80 megabytes in approximately 10 minutes; 200 megabytes in approximately 30 minutes. Software is designed to ensure streaming on a quiescent system in a save operation.

Capacity

In the 3200 bpi mode, each 2400 foot tape reel has a capacity of approximately 80 megabytes. A full 200 megabytes can be saved on three reels. At 1600 bpi, tape capacity is approximately 40 megabytes.

Convenience

Autoloading eliminates tape threading by the operator. Autoloading, plus large per reel tape capacity, make operator convenience a key 4968 highlight. The autoload mechanism features self-seating, self-locking tape hub and tape reel upside-down detect. Software support for save/restore operations minimize operator intervention on single or multi-reel operations.

4201 Proprinter

Operating characteristics

Print speeds	
DP quality	200 characters per second
Text quality	100 characters per second
Correspondence quality	40 characters per second
Horizontal spacing	5, 6, 8.5, 10, 12 and 17 characters per inch
Vertical line spacing	1/6, 1/8, N/144 inch (converts N/216 to N/144 where applicable)
Print line length	203 millimeters (8 in.)

Forms specifications

Thickness	0.003 – 0.014 inch
Width	
Continuous	3 – 10 inches
Cut forms	3 – 10 inches
Length (minimum)	3 inches
Number of copies	Original plus 3

Physical characteristics

Height	134 millimeters (5.25 in.)
Width	406 millimeters (16 in.)
Depth	343 millimeters (13.5 in.)
Weight	7.94 kg (17.5 lb)

Environmental conditions

Heat output/hour	60 watts (205 BTU)
Cooling	Convection
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

100 volts	1.8 amperes
120 volts	1.5 amperes
240 volts	0.75 ampere
Frequency	60±0.5 Hz
kVA	0.18
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive.

Print Ribbon

Print cartridge P/N 6328829 or equivalent.

Prerequisites

For the 4956 (Note 1):

- Serial Interface Card (feature 3000)
- Multifunction Attachment (feature 1310), *or*
- Feature Programmable Multiline Controller (features 2095 and 2096).

Cables

For the 4956:

- Communications Adapter cable (feature 2056), *and*
- Communications cable (P/N 5640736).

Notes:

1. Xon/Xoff pacing must be used. For feature 1310, only baud rates up to 4800 bits per second (bps) may be used.

Highlights include:

- Compact, lightweight, tabletop printer
- Bidirectional printing at a maximum of 200 characters per second
- Choice of three print qualities:
  - DP printing at 200 characters per second
  - Text (double-dotted) printing at a maximum of 100 characters per second
  - Correspondence (double-struck) printing at 40 characters per second
- IBM Personal Computer character sets 1 and 2
- Printing at 5, 6, 8.5, 10, 12, and 17 characters per inch
- Single-sheet or fanfold paper may be used
- An original plus three carbons can be made
- 80 characters per line in normal mode
- 137 characters per line in compressed mode.

The 4201 is a compact, tabletop, bidirectional, matrix printer. This serial printer provides data processing (DP) printing, text printing, and correspondence quality printing.

The 4201 Proprinter is a customer-setup unit that allows the user to install or relocate the printer.

A 5KB print buffer (feature 4000) and a Serial Interface Card (feature 3000) are optional features available on the 4201.

For attachment to an IBM 4956, the Serial Interface Card (feature 3000) must be ordered. Also, a Communications Adapter Cable (feature 2056) is used with Communications Cable (P/N 5640736) to attach to the Multifunction Attachment (feature 1310) or to the Feature Programmable Multiline Controller (features 2095 and 2096).

Additional features include:

- 2058 - Printer interface cable
- 3050 - RS232/422 Serial interface cable
- 4003 - 32K Print buffer
- 4927 - Sheetfeed
- 6031 - Serial Attachment Card.

4202 Proprinter XL

Operating characteristics

Print speeds	
DP quality	200 characters per second
Text quality	100 characters per second
Correspondence quality	40 characters per second
Horizontal spacing	5, 6, 8.5, 10, 12 and 17 characters per inch
Vertical line spacing	1/6, 1/8, N/144 inch (converts N/216 to N/144 where applicable)
Print line length	335 millimeters (13.6 in.)

Forms specifications

Thickness	0.003 – 0.014 inch
Width	
Continuous	3 – 15 inches
Cut forms	3 – 16.5 inches
Length (minimum)	3 inches
Number of copies	Original plus 3

Physical characteristics

Height	140 millimeters (5.5 in.)
Width	574 millimeters (22.6 in.)
Depth	368 millimeters (14.5 in.)
Weight	10.9 kg (24 lb)

Environmental conditions

Heat output/hour	60 watts (205 BTU)
Cooling	Convection
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

100 volts	1.8 amperes
120 volts	1.5 amperes
240 volts	0.75 ampere
Frequency	60±0.5 Hz
kVA	0.18
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive.

Print Ribbon

Print cartridge P/N 1040150 or equivalent.

Prerequisites

For the 4956 (Note 1):

- Multifunction Attachment (feature 1310), *or*
- Feature Programmable Multiline Controller (features 2095 and 2096).

Cables

For the 4956:

- Communications Adapter cable (feature 2056), *and*
- Communications cable (P/N 5640736).

Notes:

1. Xon/Xoff pacing must be used. For feature 1310, only baud rates up to 4800 bps may be used.

Highlights include:

- Compact, lightweight, tabletop printer
- Wide-carriage (13.6 inch print line)
- 132 characters per line in normal mode
- 214 characters per line in compressed mode
- 4KB print buffer standard
- 8KB print buffer option
- Bidirectional printing at a maximum of 200 characters per second
- Easy to use operator panel with expanded function
- Increased character set size for downloadable fonts
- "Quiet" mode
- Power-assisted paper loading
- Choice of three print qualities:
  - DP printing at 200 characters per second
  - Text (double-dotted) printing at a maximum of 100 characters per second
  - Correspondence (double-struck) printing at 40 characters per second
- IBM Personal Computer character sets 1 and 2
- Printing at 5, 6, 8.5, 10, 12, and 17 characters per inch
- Single-sheet or fanfold paper may be used
- An original plus three carbons can be made
- Proportional character spacing
- Software-selectable margins.

The 4202 is a wide-carriage bidirectional dot-matrix printer. This serial printer provides data processing (DP) printing, text printing, and correspondence quality printing.

The 4202 Proprinter is a customer-setup unit that allows the user to install or relocate the printer.

An 8KB print buffer (feature 4000) and a Serial Interface Card (feature 3000) are optional features available on the 4202.

For attachment to an IBM 4956, the Serial Interface Card (feature 3000) must be ordered. Also, a Communications Adapter Cable (feature 2056) is used with Communications Cable (P/N 5640736) to attach to the Multifunction Attachment (feature 1310) or to the Feature Programmable Multiline Controller (features 2095 and 2096).

Additional features include:

- 2058 - Printer interface cable
- 3050 - RS232/422 Serial interface cable
- 4003 - 32K Print buffer
- 4927 - Sheetfeed
- 4928 - Sheetfeed
- 6031 - Serial Attachment Card.

4224 Printer

Operating characteristics

Print speeds	
Model 301	200 characters per second
Model 302	400 characters per second
Model 3C2	400 characters per second
Horizontal spacing	10, 12 or 15 characters per inch
Vertical line spacing	6 or 8 lines per inch
Characters per print line	
10 characters per inch	132 characters
12 characters per inch	158 characters
15 characters per inch	198 characters

Forms specifications

Type of forms	Continuous
Thickness	0.003 – 0.025 inch
Width	3 – 15 inches
Length	3 – 14 inches
Number of copies	Original plus 5

Physical characteristics

Height	280 millimeters (11 in.)
Width	710 millimeters (28 in.)
Depth	580 millimeters (23 in.)
Weight	68 kg (149 lb)

Environmental conditions

Heat output/hour	330 watts (1130 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

110 volts	3 amperes
220 volts	1.5 amperes
Frequency	60±0.5 Hz
kVA	0.33
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System (RS-422-A only).

Print Ribbon

Models 301 and 302	
B/W	P/N 6091649
Model 3C2	
B/W	P/N 6115549
4 color	P/N 6115555
8 color	P/N 6115554

Prerequisites (see note)

- Multifunction Attachment (feature 1310), *or*
- Feature Programmable Multiline Controller (features 2095 and 2096).

Cables

- Feature 5770, *or*
- Feature 5790, *or*
- Communications Adapter cable (feature 2056), *and* Communications cable (P/N 5640736).

Note: Xon/Xoff pacing must be used.

Highlights include:

- Printing up to six-part forms
- Vertical spacing at 6 to 8 lines per inch
- Local attachment via RS-232-C or RS-422-A interface.
- Local attachment up to 1219 meters (4000 feet)
- Three models with a maximum speed of up to 400 characters per second
- Printing at 10 characters per inch (132 characters per line), 12 characters per inch (158 characters per line), or 15 characters per inch (198 characters per line)
- Bidirectional printing for optimized throughput
- Prints in Data Processing (DP), Data Processing Text (DPT), or Near Letter Quality (NLQ) modes
- Choice of four-color or eight-color ribbons on Model 3C2.

The 4224 is a tabletop wire-matrix printer that produces characters printed by a pattern of dots, and provides medium-speed output for the Series/1.

The printer meets the needs for a system printer or a work station printer. The 4224 is a customer-setup unit, which allows the user to easily install or relocate the printer.

The 4224 attaches to the Series/1 by either feature 1310 or features 2095 and 2096.

The printer accepts single-part continuous forms or multipart continuous forms.

4234 Printer

Operating characteristics

Print speeds	
Near letter quality	120 Lines per minute
Data processing print	300 lines per minute
Draft print	410 lines per minute
Horizontal spacing	10 or 15 characters per inch
Vertical line spacing	3, 4, 6, or 8 lines per inch
Characters per print line	132 characters at 10 cpi 198 characters at 15 cpi

Forms specifications

Thickness	
Single-part	0 – 0.009 inch
Multipart	0 – 0.02 inch
Width	3.5 – 16 inches
Length	3 – 14 inches
Number of copies	Original plus 5

Physical characteristics

Height	958 millimeters (37.8 in.)
Width	660 millimeters (26 in.)
Depth	765 millimeters (30.3 in.)
Weight	68.1 kg (150 lb)

Environmental conditions

Heat output/hour	700 watts (2387 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

100-110 volts	9.0 amperes
120-127 volts	7.5 amperes
200-220 volts	4.5 amperes
Frequency	50/60±0.5 Hz
kVA	0.9
Phase	1
Branch circuit	15 amperes

Programming support

Event Driven Executive (must be defined as a 5225).

Print Ribbon

P/N 6295158

Prerequisites

Printer attachment—5200 Series (feature 5640) is required.

Cables

Feature 5780, 6.1 meters (20 feet).

The 4234 is a heavy-duty impact-matrix line printer that provides medium-speed output and uses dot-print band technology.

Highlights include:

- A selection of three dot sizes
- selection of three densities of print and print speeds
- 300 lines per minute (nominal)
- Horizontal spacing of 10 and 15 characters per inch
- Vertical spacing of 3, 4, 6, and 8 lines per inch
- Prints up to 6-part forms
- Forms eject and restore for tearing off forms and continuing
- Operator-selectable character sets
- End-of-forms detection
- Variable-width form feed tractors
- Horizontal and vertical vernier-adjustments
- Power-assist when loading forms
- Audible alarm
- Alphameric Status display
- Printer stand
- Low noise level (approximately 57 dB)
- Forms stacker.

The printer meets the needs for a system printer or a work station printer. The 4234 is a customer-setup unit, which allows the user to easily install or relocate the printer.

The 4234 attaches to the Series/1 by means of the IBM Printer Attachment-5200 Series (feature 5640), which can be plugged into either the processor or the I/O expansion unit. Print operations, controlled by a microprocessor located in the attachment feature, are buffered and operate in cycle-steal mode.

The printer accepts single-part continuous forms or multipart continuous forms. Integrated operator controls move and adjust the forms.

5225 Printer

Operating characteristics

Print speeds (based on a 7.4-inch nominal line)	
Model 4 (10 cpi)	560 lines per minute
Model 4 (15 cpi)	420 lines per minute
Horizontal spacing	10 or 15 characters per inch
Vertical line spacing	6 or 8 lines per inch
Characters per print line	
10 characters per inch	132 characters
15 characters per inch	198 characters

Forms specifications

Thickness	
Single-part	0.003 – 0.0075 inch
Multipart	0.0025 – 0.018 inch
Width	3 – 17.7 inches
Length	3 – 12.5 inches
Number of copies	Original plus 3

Physical characteristics

Height	1000 millimeters (39.5 in.)
Width	1110 millimeters (43.75 in.)
Depth	750 millimeters (29.5 in.)
Weight	250 kg (550 lb)

Environmental conditions

Heat output/hour	
Model 4	1000 watts (3416 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

Model 4	
110 volts	8.2 amperes
208 volts	4.3 amperes
240 volts	3.8 amperes
Frequency	60±0.5 Hz
kVA	
Model 1	0.6
Model 2	0.72
Model 3	0.75
Model 4	0.9
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Print Ribbon

Part number 4412372 or equivalent.

Prerequisites

Printer attachment—5200 Series (feature 5640) is required.

Cables

Feature 5780, 6.1 meters (20 feet).

The 5225 printer is a line-impact wire-matrix printer that produces characters printed by a pattern of dots, and provides high-speed output for the Series/1.

The 5225 Line Printer:

- Prints up to four-part forms
- Vertical spacing at 6 or 8 lines per inch
- Local attachment up to 1525 meters (5000 feet)
- Four models with a maximum speed of 280 to 560 lines per minute
- Prints 10 characters per inch (132 characters per line) or 15 characters per inch (198 characters per line)
- Bidirectional printing for optimized throughput.

The printer meets the needs for a system printer or a work station printer. The 5225 is a customer-setup unit, which allows the user to easily install or relocate the printer.

The 5225 attaches to the Series/1 by means of the IBM Printer Attachment-5200 Series (feature 5640), which can be plugged into either the processor or the I/O expansion unit. Print operations, controlled by a microprocessor located in the attachment feature, are buffered and operate in cycle-steal mode.

The printer accepts single-part continuous forms or multipart continuous forms. Integrated operator controls move and adjust the forms.

5262 Printer

Operating characteristics

Print speed	650 lines per minute with 48 character set
Horizontal spacing	10 characters per inch
Vertical line spacing	6 or 8 lines per inch
Characters per print line	132 characters at 10 cpi

Forms specifications

Thickness	
Single-part	0 – 0.009 inch
Multipart	0 – 0.02 inch
Width	3.5 – 16 inches
Length	6 – 14 inches
Number of copies	Original plus 5

Physical characteristics

Height	1000 millimeters (39.5 in.)
Width	965 millimeters (38 in.)
Depth	750 millimeters (29.5 in.)
Weight	246 kg (540 lb)

Environmental conditions

Heat output/hour	1100 watts (3750 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

100 volts	1.2 amperes
110 volts	1.2 amperes
120 volts	1.2 amperes
127 volts	1.2 amperes
Frequency	60±0.5 Hz
kVA	1.2 (maximum)
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Print Ribbon

P/N 7819690 or equivalent.

Prerequisites

Printer attachment—5200 Series (feature 5640) is required.

Cables

Feature 5780, 6.1 meters (20 feet).

The 5262 is a print-band line printer providing high-speed output for the Series/1.

The 5262 line printer provides:

- Printing up to six-part forms
- Vertical spacing at 6 or 8 lines per inch
- Local attachment up to 1525 meters (5000 feet)
- 650 line-per-minute output using a 48-character print belt
- 10 characters per inch (132 characters per line).

The printer meets the needs for a system printer or a work station printer. The 5262 is a customer-setup unit, which allows the user to easily install or relocate the printer.

The 5262 attaches to the Series/1 by means of the IBM Printer attachment-5200 Series (feature 5640), which can be plugged into either the processor or the I/O expansion unit. Print operations, controlled by a microprocessor located in the attachment feature, are buffered and operate in cycle-steal mode.

The printer accepts single-part continuous forms or multipart continuous forms. Integrated operator controls move and adjust the forms.

3151 ASCII Display Station

Display characteristics

Diagonal measurement of Cathode-ray tube	356 millimeters (14 in.)
Character capacity	up to 3300 characters
Format	24/25 rows x 80 or 132 characters

Physical characteristics

Video element

Height	360 millimeters (14.2 in.)
Width	328 millimeters (12.9 in.)
Depth	327 millimeters (12.9 in.)
Weight	8.3 kg (18 lb)

Keyboard
Models 31/42/61

Height	40 millimeters (1.6 in.)
Width	492 millimeters (19.4 in.)
Depth	210 millimeters (8.3 in.)
Weight	2.5 kg (5.5 lb)

Models 11

Height	41 millimeters (1.6 in.)
Width	402 millimeters (15.8 in.)
Depth	190 millimeters (7.5 in.)
Weight	1.9 kg (4.2 lb)

Cartridge

Height	3 millimeters (0.1 in.)
Width	54 millimeters (2.1 in.)
Depth	86 millimeters (3.4 in.)
Weight	0.03 kg (.06 lb)

Environmental conditions

Heat output/hour	88 BTU
Cooling	Convection
Operating temperature	10 – 40.6°C
Operating humidity	8 – 80%

Power requirements (at full load)

127 volts

Frequency	50/60 Hz
kVA	0.1
Phase	1

Programming support

- Event Driven Executive
- Realtime Programming System

Prerequisites

For attachment to a Series/1 processor or an expansion unit, one of the following is required:

- RS-232-C (CCITT V.24/28) interface
- RS-422-A (CCITT V.11) interface in both 50 to 19.2 bps line speed
- Modem with RS-323-C (CCITT V.24/28) interface
- Multi-function attachment Feature 1310, RS-232-C and RS-422-A
- Feature-programmable 4-line Adapter Feature 2096, RS-232-C
- Asynchronous Terminal 8-line Adapter (RPQ D02350), RS-422-A.

Cables

The customer is responsible for preparation of cables. Many IBM systems require unique cables for 3151 attachment and those systems should be referenced for detail information. A 3m (10 ft) modem cable is provided as an IBM accessory for use in attaching the 3151 to certain devices (specifically modems).

A 1.5m (5 ft) I/O cable is provided as an IBM accessory for attaching the 4201 or 4202 Proprinter. The attachment of a mouse to Model 51/61 requires a customer provided cable matcher (pin converting adapter).

Highlights include:

- 14-inch etched monochrome monitor
- Green (Models 110, 310 and 510) or amber (Models 410) screen
- ASCII communications
- RS-232-C for remote attachment
- RS-232-A for local attachment
- Advanced screen and edit functions
- 3101 and various other emulation modes.

The 3151 ASCII Display Station is a stand-alone, high quality, 14-inch, monochrome display station used for displaying up to 3,300 characters, and for entering data into and retrieving data from a host processor. The 3151 provides an asynchronous communication interface with a 7-bit or 8-bit word length, using RS-232-C (CCITT V.24/28) interface expandable to additional RS-422-A (CCITT V.11) interface. It communicates with the 128 7-bit ASCII/ISO character set. The 3151 provides a native mode, 3101 mode and various emulation modes, which allow the 3151 to attach to a variety of host processors. The 3151 native mode is compatible with the native modes of the 3162 with limitations.

The 3151 is designed with three elements and a cartridge for emulation features, and additional functions. The video element is a 14-inch flat screen design. The keyboard is connected to the video element with coiled cable and is detachable. The cartridge is a slim-line design.

The 3151 Model 11X displays 1,920 (80 by 24) and 2,000 (80 by 25) characters. The 3151 Model 31X, 41X, 51X, and 61X display 1,920 (80 by 24), 2,000 (80 by 25), 3,168 (132 by 24) and 3,300 (132 by 25) characters. An alphameric character is represented in a character cell of a 9 x 15 or 9 x 14 dot matrix. The data displayed uses the 128 characters of the 7-bit ASCII/ISO codes and an additional character set containing 24 line-drawing graphics, ten script characters, and ten subscript characters. A line drawing character is represented in a 9 x 15 or 9 x 14 dot matrix to create a contiguous line. Character- (not available on Models 51 and 61) or Echo-transmission mode provides the capability to transmit a character over a communication line upon depression of each key. The block transmission mode, selectable at setup time (not available on Models 51 and 61) allows buffered transmission of data.

The use of ASCII (ISO) codes and the asynchronous communication interface allows the 3151 to attach to a variety of host processors. Various communication options are selectable by the customer on the setup menu such as line speed, parity, interface, word length (7-, 8-bit), operation mode, line control, stop bit and break signal. The 3151 provides XON/XOFF Control.

Keyboard

The 3151 keyboard is a 3163 and 3164 compatible IBM Enhanced keyboard (for Model 31/41), a PS/2 compatible IBM Enhanced keyboard (for Model 51/61 and a 3163 and 3164 compatible space saving keyboard (for Model 11). These keyboards have a low profile with tactile feedback, a coiled cable, and are detachable from the Video. The Model 11 keyboard offers 84 keys including 12 F-keys (Function-keys). The 3151 Model 31X/41X keyboard offers 102 keys including 12 F-keys, shiftable to 36, three Program Access keys, a numeric keypad with a line drawing capability, and recappable keycaps on 31X/41X. The 3151 Model 51/61 keyboard offers 101 keys with PS/2 style layout and nomenclature, and keycaps are recappable.

Input editing capability

Cursor move (up, down, right, left and home), tab (forward, backward, set, and clear), erase (end of line, end of page, and end of field), clear (entire page and entire buffer), insert (character and line) and delete (character and line) are provided. Tab erase, insert and delete may be manipulated by field attribute. All characters can be rendered by character or field attributes. A 12-key numeric keypad and 12 F-keys are provided on the keyboard.

Model-Specific characteristics

Model 11:

- Green phosphor color
- 84-key keyboard
- 12 F-keys
- 80-column display
- Native mode compatible with 3162 ASCII Display Station
- Ten non-IBM emulations included in base model.

Model 31/41:

- Green or amber-gold phosphor colors
- 3163 and 3164 compatible, 102-key keyboard
- Customer recappable keytops. Keycaps are available as option (accessory).
- 12 F-keys shiftable to 36, definable by operator or host
- Three PA (Program Access) keys
- Ten non-IBM emulations included in base model
- RS-422-A communication (option) with speeds up to 38.4K bps
- 3101 Model 23 or Model 881 emulation
- A cartridge for additional attachment capabilities
- 80/132-character column display
- Split screen capability (three horizontal viewports)
- Bidirectional data at auxiliary port, passthrough to/from the 3151 main port.

Model 51/61:

- Green or Amber-gold phosphor colors
- 80/132 character column display
- IBM PS/2 compatible, 101-key keyboard
- Customer recappable keytops
- RS-232-C or RS-422-A main port interface selectable by the user or host application with speeds up to 38.4K bps. DTR pacing for outbound data, RS-232-C.
- The choice of four machine modes by operator or host (IBM 3151 Echo mode, IBM 3151 PC mode, IBM 3151 PC II mode, and 925PC mode)
- Functions in IBM 3151 Echo, IBM 3151 PC, and IBM 3151 PC II modes

The 3151 generates an ISO 646 (ANSI X3.4) data stream. The 3151 Model 31/41 with optional feature 8533 generates an ISO 646 (ANSI X3.4) and ISO 8859/1.2 data stream.

The 3151 communicates with a variety of host processors.

An auxiliary interface is provided for attachment of an input or output device with EIA RS-232-C (CCITT V.24/28). In 3151 native modes, an ASCII printer or a PC printer such as IBM 4201/4202 Proprinter, with EIA RS-232-C (CCITT V.24/28) interface, may be attached to the Auxiliary Port. A print key allows local printing of the screen, while the software commands allow remote printing from a host. For example, the 4201/4202 Proprinter may attach via its serial (RS-232-C) interface to the 3151 for direct printing of text-oriented screens (or graphics and text via host programming).

The passthrough print in 3151 native modes allows printing of the data of the host without interference to the 3151 screen data. In emulation modes, the 3151 provides the same printer support as supported by the emulating product.

Optional features:

- IBM 3151 Cartridge to Emulate IBM and DEC Terminals (feature 8235)
- 3151 Cartridge for Connectivity (feature 8525)
- 3151 Cartridge for Expansion (feature 8535)
- IBM 3151 Cartridge for Multiuser System Attachment (feature 8005)
- 3151 Cartridge to Emulate WYSE WY-50/50+ Terminals — US English (feature 8505)
- 3151 Cartridge to Emulate Data General, TeleVideo, and Zentec Terminals (feature 8545).

3163 ASCII Display Station

Display characteristics

Diagonal measurement of Cathode-ray tube	305 millimeters (12 in.)
Character capacity	1920 characters
Format	24 rows x 80 characters

Physical characteristics

Video element

Height	330 millimeters (13 in.)
Width	310 millimeters (12.2 in.)
Depth	307 millimeters (12.1 in.)
Weight	8.2 kg (18 lb)

Logic element

Height	70 millimeters (2.8 in.)
Width	345 millimeters (13.6 in.)
Depth	315 millimeters (12.4 in.)
Weight	2.2 kg (4.8 lb)

Keyboard

Height	40 millimeters (1.6 in.)
Width	492 millimeters (19.4 in.)
Depth	210 millimeters (8.3 in.)
Weight	2.5 kg (5.5 lb)

Environmental conditions

Heat output/hour	55 watts (188 BTU)
Cooling	Convection
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

120 volts	0.9 amperes (average)
Frequency	50/60±0.5 Hz
kVA	0.18
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

For attachment to a Series/1 processor or an expansion unit, one of the following is required:

- Feature 1310, RS-232-C and RS-422-A interface
- Feature 1610, RS-232-C interface
- Features 2091 and 2092, RS-232-C interface
- Features 2095 and 2096, RS-232-C interface
- Features 2095 and D02350, RS-422-A interface
- Feature 7850, RS-232-C interface (not intended for use with modems).

For attachment to a 4987, one of the following is required:

- Feature 4700, RS-232-C interface
- Feature 4701, RS-232-C interface
- Feature 4709, RS-232-C interface (not intended for use with modems).

Cables

- Power supply, keyboard, and display cables are provided
- a 3-meter (10-foot) display cable is available as an accessory
- a 4-conductor cable (RPQ D02352) is available for attachment of the 3163 (RS-422-A interface) to the 3101 8-line adapter (RPQ D02350).

Highlights include:

- 12-inch monochrome monitor
- Green (Models 11 and 12) or amber (Models 21 and 22) screen
- ASCII communications
- RS-232-C for remote attachment
- RS-422-A for local attachment up to 1219 meters (4000 feet)
- Advanced screen and edit functions
- 3101, Model 881 (23) and six other emulations.

The 3163 ASCII Display Station operates through asynchronous communications interfaces and uses a 7- or 8-bit ASCII code. Line speeds range from 50 to 19,200 bps.

The 3163 is an advanced editing display that provides multiple screen viewports, partitioning and paging, redefinable keyboard with replaceable function key tops, host-loadable character set, block LRC check, advanced editing field attributes, as well as many advanced screen characteristics such as smooth scrolling and double-high, double-wide characters.

The 3163 display attaches to the Series/1 by means of any one of several adapter and attachment cards. Models are selectable to provide RS-422-A interface for local use attachment and RS-232-C interface for remote attachment. The maximum local distance allowed for RS-422-A is 1219 meters (4000 feet) from a Series/1 processor. Series/1 supports Models 11, 12, 21, and 22 for the 3163.

Models	Mode	Interface
11, 21	Character, *or* block	EIA RS-232-C
12, 22	Character, *or* block	EIA RS-232-C, *or* EIA RS-422-A

The 3163 consists of a video element with a tilt and swivel pedestal, a keyboard element, and a logic element, in a compact design. The replaceable element concept permits the user to set up the display station, and perform problem analysis and resolution.

Video element

A high-quality, 12-inch, green or amber phosphor, anti-glare screen is used. The screen format consists of 24 lines of 80 characters each (1920 characters total). The 25th line provides indicators for operation information such as system status and problem analysis results. A stand that snaps onto the base of the video element is provided and allows the display to be tilted and swiveled. A CRT saver function is offered.

Keyboard element

A 102-key, low-profile keyboard with numeric keypad and cursor control keys provides tactile feedback and selectable tilt angle. The keyboard generates the 24 line-drawing characters and the 128 ASCII characters.

Logic element

The video element rests on the logic element. The keyboard and the video element each connect to the logic element by cable. An auxiliary asynchronous interface allows attachment of another ASCII device, such as the 4201 Proprinter. On the 3163, this interface is for both input and output.

3164 ASCII Color Display Station

Display characteristics

Diagonal measurement of Cathode-ray tube	356 millimeters (14 in.)
Character capacity	1920 characters
Format	24 rows x 80 characters

Physical characteristics

Video element	
Height	390 millimeters (15.4 in.)
Width	380 millimeters (15 in.)
Depth	405 millimeters (15.9 in.)
Weight	14 kg (30.9 lb)
Logic element	
Height	70 millimeters (2.8 in.)
Width	345 millimeters (13.6 in.)
Depth	315 millimeters (12.4 in.)
Weight	2.2 kg (4.8 lb)
Keyboard	
Height	40 millimeters (1.6 in.)
Width	492 millimeters (19.4 in.)
Depth	210 millimeters (8.3 in.)
Weight	2.5 kg (5.5 lb)

Environmental conditions

Heat output/hour	100 watts (341 BTU)
Cooling	Convection
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

120 volts	2.3 amperes
Frequency	50/60±0.5 Hz
kVA	0.28
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
- Realtime Programming System.

Prerequisites

For attachment to a Series/1 processor or an expansion unit, one of the following is required:

- Feature 1310, RS-232-C and RS-422-A interface
- Feature 1610, RS-232-C interface
- Features 2091 and 2092, RS-232-C interface
- Features 2095 and 2096, RS-232-C interface
- Features 2095 and D02350, RS-422-A interface
- Feature 7850, RS-232-C interface (not intended for use with modems).

For attachment to a 4987, one of the following is required:

- Feature 4700, RS-232-C interface
- Feature 4701, RS-232-C interface
- Feature 4709, RS-232-C interface (not intended for use with modems).

Cables

- Power supply, keyboard, and display cables are provided
- a 3-meter (10-foot) display cable is available as an accessory
- a 4-conductor cable (RPQ D02352) is available for attachment of the 3164 (RS-422-A interface) to the 3101 8-line adapter (RPQ D02350).

Highlights include:

- 14-inch color monitor
- Eight color foreground/background
- ASCII communications
- RS-232-C for remote attachment
- RS-422-A for local attachment up to 1219 meters (4000 feet)
- Advanced screen and edit functions
- 3101 emulation.

The IBM 3164 is a high-function, ASCII display station of the IBM 316X family which offers such features as menu set-up, definable function keys, split-screen, and character and field attributes. It also has functions such as smooth scroll, windowing, paging, redefinable keys, double-size characters, and is compatible with the IBM 3163.

The 3164 ASCII Display Station is a keyboard display that operates through asynchronous communications interfaces and uses a 7-bit or an 8-bit ASCII code. Line speeds range from 50 to 19,200 bps.

The 3164 attaches to the Series/1 by means of any one of several adapter and attachment cards, that can be plugged into either the processor or input/output expansion unit. Models are selectable to provide RS-422-A interface for local use attachment and RS-232-C interface for remote attachment. The maximum local distance allowed for RS-422-A is 1219 meters (4000 feet) from a Series/1 processor. Series/1 supports a Model 11 and 12 for the 3164.

Model	Mode	Interface
11	Character, *or* block	EIA RS-232-C
12	Character, *or* block	EIA RS-232-C, *or* EIA RS-422-A

The 3164 consists of a video element with a tilt and swivel pedestal, a keyboard element, and a logic element, in a compact design. The replaceable element concept permits the user to set up the display station, and perform problem analysis and resolution.

Video element

A high-quality, 14-inch, color screen is used. Images can be displayed in eight colors (red, green, blue, yellow, magenta, turquoise, black, and white). The screen format consists of 24 lines of 80 characters each (1920 characters total). A 25th line provides indicators for operation information, such as system status and problem analysis results. A stand that snaps onto the base of the video element is provided and allows the display to be tilted and swiveled. A CRT saver function is offered.

Keyboard element

A 102-key, low-profile keyboard with numeric keypad and cursor control keys provides tactile feedback and selectable tilt angle. The keyboard generates the 24 line-drawing characters and the 128 ASCII characters.

Logic element

The video element rests on the logic element. The keyboard and the video element each connect to the logic element by cable. An auxiliary asynchronous interface allows attachment of another ASCII device, such as the 4201 Proprinter. This interface is for both input and output.

4987 Programmable Communications Subsystem

Physical characteristics

Height	356 millimeters (14 in.)
Width	483 millimeters (19 in.)
Depth	610 millimeters (24 in.)
Weight	40.5 kg (110 lb)

Environmental conditions

Heat output/hour	320 watts (1090 BTU)
Cooling	Forced air
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

115 volts	3.2 amperes
208 volts	1.6 amperes
230 volts	1.6 amperes
Frequency	60±0.5 Hz
kVA	0.32
Phase	1
Branch circuit	15 amperes

Programming support

- Realtime Programming System
- Series/1 Programmable Communications Subsystem Preparation Facility
- Series/1 Programmable Communications Subsystem Extended Execution Support.

Prerequisites

The Programmable Communication Subsystem Controller (feature 1300) is required.

Cables

None required.

Highlights include:

- Accommodates multiple line disciplines in a single communication unit
- Accommodates up to 32 lines per subsystem at data rates of 45 to 9600 bps
- Supports point-to-point nonswitched and switched lines or multipoint lines
- Handles communication requirements for standard IBM protocols and nonstandard protocols
- Allows many communication functions to be performed outside the Series/1 processor.

The 4987 is a programmable communication unit that allows the Series/1 to be used in a wide range of applications. It occupies the full width of a 19-inch rack enclosure and attaches to a Series/1 by means of the Programmable Communications Subsystem Controller, which can be installed in a processor or an I/O expansion unit. The controller includes 11KB of storage for user communication-handling programs.

A special communication-oriented instruction set is provided that allows the following function to be done outside the Series/1 processor:

- Protocol handling
- Control character generation and recognition
- Chaining of I/O operations
- Timer functions
- Auto-polling of multipoint hookups
- Error retry functions
- Break signal processing
- Uppercase/lowercase recognition and generation
- Auto-calling.

The 4987 provides line attachment by means of external modems, direct connection, and current interface. It can accommodate asynchronous or synchronous disciplines at speeds to 9600 bps on either switched or nonswitched facilities. It also provides auto-calling and auto-answering capabilities. Features that are program selectable are:

- Synchronous/asynchronous line type
- Switched/non-switched facility
- 5, 6, 7, or 8 bits per character
- 1, 1.5, or 2 stop bits per character
- Internal or external clocking
- Speeds of 45 to 9600 bps
- Least-/most-significant bit character orientation
- Parity of odd, even, or none
- Scanning priority sequence of each line
- Longitudinal redundancy check
- Cyclic redundancy check for standard or user-generated polynomials per line.

The 4987 is a cycle-stealing device and consists of the subsystem unit, up to two controller features, and device attachment features. The subsystem unit contains a power supply, provision for two scanner cards, a backplane, indicator panel, and space for 16 device attachment feature cards. The scanner performs the multiplexing and serializing/deserializing functions for the subsystem. A controller (feature 1300) is required for each scanner.

The 4987 offers a wide variety of programmer and maintenance aids to enhance subsystem reliability, availability, and serviceability. For example, it has program-initiated capability for internal diagnostics, tracing data and/or operations of the 4987, and dumping the contents of the 4987 to the Series/1 for program debug or problem determination.

Device Attachment features

Half-Duplex Digital Communications Equipment Attachment (feature 4730)

Provides for attachment of two independent switched or non-switched, synchronous or asynchronous external data sets. If synchronous, it will use external clocking at speeds up to 9600 bps. If asynchronous, it will use internal clocking at speeds from 45 to 1200 bps or 2400, 4800, or 9600 bps.

Teletypewriter Current Attachment (feature 4734)

Provides two DC current loop attachments for teletypewriters or equivalent devices. Supports 2 or 4-wire half-duplex operation. A programmable local copy option is also supported in 4-wire operation. Can accommodate two teletypewriter current attachment cables and/or 3101 current loop cables.

Synchronous Local Attachment (feature 4740)

Provides two interfaces for synchronous transmission to terminals and other systems without the use of modems. Operates in half-duplex mode only with speeds of 600, 1200, 2400, 4800, and 9600 bps.

Device attachment feature cable information

The modem cable (feature 2130) is a 6 meter (20 foot) EIA RS-232-C and CCITT V.24/V.28 interface cable for use with features 4730, 4731, and 4743.

Modem cable (feature 2130) is a 6 meter (20 foot) modem interface EIA RS-232-C and CCITT V.24/V.28 cable for use with feature 4743.

The EIA extension cable (feature 2100) is a 6 meter (20 foot) EIA interface cable extension that can extend total cable length up to:

- 60.9 meters (200 feet) for asynchronous operation (up to 7200 bits-per-second)
- 12.2 meters (40 feet) for asynchronous operation (9600 bits-per-second)
- 12.2 meters (40 feet) for synchronous operation
- 12.2 meters (40 feet) for feature 4731 (asynchronous or synchronous).

4993 Series/1- System/370 Termination Enclosure specifications

Physical characteristics

Height	133 millimeters (5.25 in.)
Width	483 millimeters (19 in.)
Depth	325 millimeters (12.8 in.)
Weight	11.2 kg (25 lb)

Environmental conditions

Heat output/hour	40 watts (136 BTU)
Cooling	Convection
Operating temperature	10 – 40.6°C (50 – 105°F)
Operating humidity	8 – 80%

Power requirements (at full load)

115 volts	0.5 ampere
200 volts	0.3 ampere
208 volts	0.3 ampere
230 volts	0.3 ampere
Frequency	60±0.5 Hz
kVA	0.04
Phase	1
Branch circuit	15 amperes

Programming support

- Event Driven Executive
  - Series/1-System/370 Channel Attachment
  - Event Driven Executive Communications Facility.
- Realtime Programming System
  - Series/1-System/370 Channel Attachment.

These Series/1 programs have a corresponding program support validated with IBM System/370 control programs OS/VS1, OS/VS2, DOS/VS with BTAM, or DOS/VSE 3.0 with BTAM-ES.

Programming considerations

Proper operation of the feature is dependent upon the cooperative processing of programs in both processors. Applications should be implemented in a manner which guarantees synchronization. Refer to the "Programming Considerations" section in the appropriate Channel Attachment Program Product Description manual for details.

Prerequisites

One Series/1-System/370 Channel Attachment (feature 1200) is required for each 4993 unit.

Limitations

One 4993 per 4997 rack enclosure may be installed (an RPQ must be submitted for more than one unit per rack). The unit must be mounted at the bottom of the rack.

Highlights include:

- Maximum data transfer rate of 300,000 bytes per second, in block multiplexer or selector channel mode
- Optional IPL capability by host System/370
- Up to eight Series/1's per System/370 channel.

The 4993 Model 1 and its attachment feature provide storage-to-storage communication between Series/1 and System/370 (Models 135 through 168, and 3031, 3032, 3033, 308X, 3090, 4331, 4341, 4361, and 4381) processors. Data is transferred under control of both processors. The unit attached to a Series/1 channel using its companion Series/1-System/370 Channel Attachment feature, which can be plugged into either a Series/1 processor or an I/O expansion unit. It is connected to a System/370 selector or block multiplexer (except 2870) channel where it appears as a control unit with 32 device addresses.

The 4993 Model 1 Series/1-System/370 Termination Enclosure provides the physical support, mechanical connection, and electrical termination for the System/370 channel interface cables. It is a full-width module that is designed to be mounted in a standard 19-inch enclosure. The enclosure contains the driver and receiver terminators, power source, power on/off control, enable/disable control, disable indicator lamp, and mechanical assembly. The termination enclosure is a single drop on the System/370 I/O interface.

4997 Rack Enclosure

Physical characteristics

Model 1A and 1B

Height	1000 millimeters (39.4 in.)
Width	613 millimeters (24 in.)
Depth	749 millimeters (29.5 in.)
Weight	57 kg (125 lb)

Model 2A and 2B

Height	1780 millimeters (70 in.)
Width	610 millimeters (24 in.)
Depth	749 millimeters (29.5 in.)
Weight	107 kg (235 lb)

Power requirements

None required.

Programming support

None required.

Prerequisites

None required.

Note: Series/1 units do not require the 4997 rack enclosure. Series/1 units may be mounted in an enclosure meeting RS-310-B (ANSI C83.9-1972) dimensional specifications and using the universal mounting rail hole pattern. Units mounted in non-IBM rack enclosures must conform to IBM safety requirements and must free and clear access for IBM service personnel.

Cables

- Customer Access Panel — Integrated Digital I/O cable (feature 1593) for connection of integrated digital I/O non-isolated feature with the customer access panel feature.
- Customer Access Panel — Customer direct Program Control adapter cable (feature 1594) for connection of customer direct program control adapter feature with the customer access panel feature.
- Teletypewriter Customer Access Panel cable (feature 2059) for the Teletypewriter Adapter feature.

The 4997 Rack Enclosure provides mounting space for IBM Series/1 modular units. It has EIA (RS-310-B) rack-mounting dimensions for housing standard 19-inch (482.6-millimeter) rack units. Two models provide two sizes and a choice of plain or decorative filler covers.

Model 1A is a 1 meter rack with plain covers. Model 1B is a 1 meter rack with decorative covers. Models 1A and 1B have the capacity for mounting two full-width modular units or comparable combinations of full- and half-width modular units.

Model 2A is a 1.8 meter rack with plain covers. Model 2B is a 1.8 meter rack with decorative covers. Models 2A and 2B have the capacity for mounting four full-width modular units or comparable combinations of full- and half-width modular units. A rack mounting fixture is available for mounting two half-width modular units.

When a system requires space for modular units beyond the capacity of a single rack, multiple racks can be bolted together to form a multiple-bay enclosure.

A primary power distribution system, including an instant power-off switch, supplies power to all units in the enclosure. A 20-ampere circuit breaker in the power system provides either four outlets (Models 1A and 1B) or eight outlets (Models 2A and 2B).

Auxiliary features

The following features are ordered with processors or I/O expansion units but pertain to rack mounting options.

- Customer Access Panel (feature 1590) – This feature provides an assembly behind a Series/1 rack for mounting optional, quick-disconnect type connectors for I/O equipment. The assembly can accommodate one timer connector, one teletypewriter connector, and up to four connectors for either the Integrated digital Input/Output Non-isolated feature or the Customer Direct Program Control Adapter feature.
- Rack Mounting Fixture (feature 4540) – This feature provides a mounting assembly for half-width rack units, such as the 4952 Model A Processor. One fixture is required to mount one of two half-width units in a 4997 Rack Enclosure or an EIA standard 19-inch rack enclosure. If only one unit is mounted using the Rack-Mounting Fixture feature, the empty space will be covered with a decorative panel similar to the front covers of Series/1 machines.

Chapter 5. Series/1 programming support

Series/1 hardware is complemented by an extensive set of system and application programs. These programs provide a variety of support that can assist you in developing both simple and sophisticated Series/1 solutions.

The Series/1 offers a choice of two primary operating systems: the Event Driven Executive and Realtime Programming System. Both operating systems are supplemented by functional system programs and programming languages. In addition to operating system based support, independent functional modules are available to allow you to develop your own tailored solution.

Also available are application packages that run in conjunction with an operating system and application packages that provide dedicated system solutions.

This section describes both system and application programs available with the Series/1.

Note: If multiple versions and releases of a Series/1 program are available, this section discusses only the latest version and release level that was announced at the time this document was printed. Operating system environments and programming environments refer to the latest version and release levels, unless otherwise specified. For information concerning the capabilities of prior versions of Series/1 programming, see your IBM representative.

Series/1 Event Driven Executive

Highlights include:

- Multiprogramming, multitasking supervisor
- Device support includes:
  - Direct access
  - Magnetic tape
  - Printers
  - Terminals
  - System/370 Channel Attach
  - Sensor I/O
  - Communications
    - (Including APPC and support for Token-Ring Interface Program and Multiline Communications Coprocessor)
- Flexible operating environment — storage resident, disk or diskette based
- Multiple programming language options, including Series/1 Assembler, EDL, COBOL, FORTRAN, Pascal, PL/I and C
- Online utilities to support production operations and assist program development such as text editors, debugging aids, screen format builders, remote management, and Remote Job Entry facilities
- Online program preparation facility, system generation, and application development
- Session manager that provides an easy-to-use menu of functions with automatic allocation of user work files.

Event Driven Executive (EDX) is the ease-of-use oriented operating system for the Series/1. It is adaptable to a low-entry, diskette-based production system and larger, disk-based development or production systems of moderate complexity.

In keeping with the Series/1 concept of modular offerings, the functions of the Event Driven Executive are available through a number of licensed programs. The Series/1 user may select from these offerings to provide the support for a particular installation.

The Event Driven Executive on the Series/1 can apply to a broad range of applications, such as data entry, remote job entry, distributed processing, and other commercial applications and sensor-based functions such as data acquisition, material and component testing, machine and process control, and shop floor control.

Event Driven Executive - basic system functions

Basic Supervisor and Emulator (5719-XS6)

The IBM Series/1 Event Driven Executive Basic Supervisor and Emulator (5719-XS6) is responsible for managing the overall system operation.

The supervisor supports multiple, independent, time-dependent and event driven applications. The emulator supports a high-level instruction set (EDL) for application development.

- 32 partitions/address spaces supported on the 4956 Model J/K Processors
- 2-megabytes of mapped memory support
- Support for up to 12-megabytes of additional unmapped memory
- Advanced Program-to-Program Communications (APPC). APPC supports LU 6.2 mapped and basic conversations. APPC supports the SDLC feature 2090 up to 19.2 Kbps and the SDLC High Speed feature 2080 in a non-switched environment up to 56 Kbps with a V.35 Interface or up to 48 Kbps with an X.25 Interface.
- SDLC layer of support is included in Event Driven Executive Version 6. SDLC can be shared with Systems Network Architecture (5719-XX9), Version 2.1, Primary Systems Network Architecture (5719-XT4) and Advanced Program-to-Program Communications.
- Shared link support allows APPC to share a common half-duplex link with SNA or Primary SNA.
- Provides support for the Token-Ring Interface Program
- Supports the Outboard Processing Tools to allow communications with the Multiline Communications Coprocessor.

Other highlights are:

- Improved problem determination aids.
- Disk Immediate-Read support.
- System/program Analysis utility.
- Multiple volume memory disk facility.
- BSC Series/1-to-Series/1 transfer utility.
- Application programs can be initiated:
  - From a user terminal through interaction with the supervisor
  - By another program
  - By outside events, such as an IPL or a sensor input interrupt.

- Job streams of applications can be executed in a batch like manner through the job queue processor facility.
- Multiple users can run multiple copies of the same program concurrently.
- Multiple independent applications including the mix of program preparation and production applications can run concurrently.
- Printed output from multiple applications can be spooled by the system and routed to one or more printers.
- Multiple tasks can be started within an application program.
- Selective base partition for common mapping.
- Performance Analysis Tools.
- Terminals can be dynamically assigned to each application as required.
- The relocating loader allows an application program to use any available main storage area at the time of invocation.
- Storage is managed in 32 partitions with cross-partition services provided for information transfer and supervisor services.
- A comprehensive set of production oriented utilities such as data and terminal management facilities, remote system management, RJE to host systems, and hardware device exercisers.

The supervisor supports multiple, independent, time-dependent, and/or event driven applications with minimum interaction. The supervisor overhead can range from 15 kilobytes (KB) of storage for small production systems to over 64KB for a complex interactive communications system. The supervisor can be scattered over many partitions for effective utilization. The average instruction length of EDL application instructions are from 6 to 8 bytes, allowing the generation of very storage-efficient application programs. This low storage overhead makes the Event Driven Executive an excellent base for production systems.

The emulation capability that the supervisor supports refers to the ability of the system to execute programs written in EDL. This high-level, user-oriented, macro instruction language is unique to the structure and functions of the Event Driven Executive, and the instructions are actually translated (or emulated) at execution time. Most system components are written in EDL. This facility which allows for an efficient use of the Series/1, is part of the basis for the design of the operating system.

A set of utilities provides support for production environments such as:

- A queued job stream processing facility that provides batch processing of a series of programs with procedures previously defined and saved on a data set.
- A remote management facility that allows a central site distributed Series/1 management strategy. This utility provides the basis for remote management of distributed Series/1.
- Remote Job Entry facilities to make the Series/1 appear to a host system as a 2780 or 2780 remote work station.
- Device reconfiguration facilities for terminals and other hardware devices.
- Communication trace facilities for BSC, ACCA and EXIO attachments.
- Device message routing facilities.

These utilities are independent load modules capable of running concurrently with other application programs on the system.

This program product is available on either 5.25-inch or 8-inch diskettes.

Minimum hardware requirements

For an operational system, the following are the minimum hardware requirements:

- Series/1 processor with 96KB of storage
- Series/1 disk or diskette unit
- Series/1 display.

For a development system, the following are the minimum hardware requirements:

- Series/1 processor with 128KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Event Driven Executive - program development

Program Preparation Facility (5719-XX7)

The IBM Series/1 Event Driven Executive Program Preparation Facility (5719-XX7) allows a user to compile application programs that use Event Driven Language (EDL) macro instructions. The preparation facility allows:

- Compiling of application programs and Event Driven Executive supervisors
- Accessing supervisor functions from application programs.

The Program Preparation Facility (5719-XX7) can run concurrently with other programs, including other program preparation activities. The user can also reconfigure and compile new supervisors online.

The Event Driven Executive compiler, available with this product, allows the programmer to access all Event Driven Executive supervisor functions. It supports symbolic file addressing and selection of any terminal device for listing output. It provides greater compilation speeds than the Macro Assembler for those programs containing only Event Driven Language macro instructions.

A set of utilities provide productivity aids for Series/1 program development and program maintenance such as:

- Both single-line and full-screen text editors for source data entry and modification
- A linkage editor with overlay support
- Interactive debugging facilities
- A program library update facility
- A screen format build facility for use in designing formatted screen images for Series/1 terminals.

These utilities are independent program load modules capable of running concurrently with other application programs on the system.

A programming development productivity aid called the "Session Manager" is provided as part of this product to assist the application programmer in the efficient use of the system for program development. Using full-screen fill-in-the-blank menus, the session manager allocates temporary work files and provides an easy-to-use interface to all the programming development language compilers, assemblers, text editors, linkage editors and utilities.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Basic Supervisor and Emulator (5719-XS6).

Minimum hardware requirements

- Series/1 processor with 128KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Macro Assembler (5719-ASA)

The IBM Series/1 Event Driven Executive Macro Assembler allows the user to assemble application programs or program modules written in both Series/1 Event Driven Executive Assembler and Event Driven Language. The program supports:

- Converting source code into object modules
- Expansion of Series/1 Assembler macros as well as Event Driven Language macro instructions.

The Macro Assembler can operate concurrently with the execution of other programs. It converts text data sets containing machine instructions and macro instructions into object modules to be processed by the linkage editor.

Through the use of the Macro Library, applications coded in the Event Driven Language can also be processed by the Macro Assembler, including the reconfiguring or customizing of the Event Driven Executive supervisor. User-generated macro instructions for commonly used routines can be incorporated into the macro library.

The Macro Assembler also provides the user with the facility for generating device support modules or specific routines in support of user exits or customized supervisory functions. These routines can be link-edited with user applications generated from COBOL, the Event Driven Language, FORTRAN, Pascal, PL/I and C source programs.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Basic Supervisor and Emulator (5719-XS6).

Minimum hardware requirements

- Series/1 processor with 128KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Macro Library (5719-LMA)

The IBM Series/1 Event Driven Executive Macro Library is used by the Macro Assembler for:

- Building a basic supervisor and emulator
- Assembling application programs written in the Event Driven Language instruction set and/or the Series/1 instruction set.

Macro instructions supplied with the Macro Library can be supplemented by user coded macro instructions placed in the library.

This program product is available on either 5.25-inch or 8-inch diskettes.

Programming environment

- Basic Supervisor and Emulator (5719-XS6)
- Macro Assembler (5719-ASA).

Minimum hardware requirements

- Series/1 processor with 128KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Host Preparation Facility (5799-BNA)

An IBM System/370 Host Program Preparation Facility is available for the Series/1. For the Event Driven Executive user, the host facility provides the following support:

- Translation of Series/1 source programs written in Assembler language into machine language instructions, producing Series/1 object modules
- Printed output-including program listing, symbol dictionaries, cross-references, and diagnostic messages.

All host components execute with the System/370 OS/VS2 (MVS) operating system.

The Host Preparation Facility prepares Series/1 code for execution with the Event Driven Executive.

Macro Library/Host (5740-LM7)

The IBM Series/1 Event Driven Executive Macro Library/Host is a set of libraries and procedures that reside on a System/370. The program includes:

- A macro library, containing Series/1 instructions
- A data set, containing sample Job Control Language (JCL).

The Macro Library/Host, in conjunction with the System/370 Host Program Preparation Facility for Series/1, provides the capability to assemble application programs written in the Event Driven Language and/or the Series/1 instruction set on a host System/370.

Transaction Processing System (5719-TR1)

The Event Driven Executive Transaction Processing System product offers support for developing and managing transaction oriented user application programs. It provides high programmer productivity and use of system functions without the complexity of an operating system interface.

The Transaction Processing System provides support for:

- File management
- Program management
- Storage management
- Error management
- Terminal management
- Multitasking
- Multiple address support
- Security sign-on and access
- Transparent interface to Communication Facility functions.

Using the Communications Facility, the Transaction Processing System supports 3270 passthru and 3270 emulation.

The Transaction Processing System also includes a generalized transaction builder that can develop file maintenance functions such as adding, deleting, and updating records without programming. Formats can be created and edited without the use of a programming language. For more sophisticated processing, exits provide access to user written routines in Assembler, EDL, COBOL, PL/I or C.

The Transaction Processing System has the advantage of allowing a user to develop many interactive applications without the knowledge of the operating system or programming languages.

Transaction Processing System provides native support for the enhanced functions of the 316X and 3151 display stations. This support includes multiple viewports, color support, daisy chain terminals, attached 4201 Proprinter, and large-screen capabilities.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Basic Supervisor and Emulator (5719-XS6).

Programming environment

For certain environments and functions, the following Series/1 Event Driven Executive licensed programs may be required:

- Program Preparation Facility (5719-XX7)
- Macro Library (5719-LMA)
- Macro Assembler (5719-ASA)
- Indexed Access Method (5719-AM4)
- Communications Facility (5719-CF2)
- COBOL Compiler and Resident Library (5719-CB5)
- COBOL Transient Library (5719-CB6)
- PL/I Compiler and Resident Library (5719-PL5)
- PL/I Transient Library (5719-PL6)
- Intelligent Workstation Support Programming (5799-TGC)
- C Compiler PRPQ (5799-TPC)
- C Run-Time Library (5719-EAB).

Minimum hardware requirements

- Series/1 processor with 256KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Event Driven Executive - communications support

Advanced Remote Job Entry (5719-RJ1)

The Series/1 Event Driven Executive Advanced Remote Job Entry (ARJE) program supports both BSC and SNA/SDLC host connections, and allows the Series/1 installation to conform to the protocol required by the host system. The desired line protocol is selected when the Series/1 program is installed. User Remote Job Entry commands are independent of line protocol. The BSC option provides a multileaving RJE (MRJE) work station over a point-to-point (switched or non-switched) connection, appearing to the host as an IBM System/3 with console support. The SDLC option provides an SNA RJE work station over a point-to-point (switched or non-switched) or multipoint connection.

The Series/1 appears to the host as a PU-type 2 with up to four LU type 1's.

The Advanced Remote Job Entry program provides the following support:

MRJE — Multileaving Remote Job Entry (MRJE) support for Binary Synchronous Communications (BSC).

SNA RJE — Multiple Logical Unit Systems Network Architecture (SNA) support for Synchronous Data Link Control (SDLC).

Unattended operation — ARJE allows unattended operation by having ARJE commands on disk/diskette, and support for dynamic punch file allocation and delayed activation.

Full function RJE — In addition to standard RJE capabilities, ARJE has console support with status reporting and journaling, data decompression, and printer form support.

ARJE commands — ARJE commands have been designed for ease of use and are identical for MRJE or SNA RJE operation.

Host Remote Job Entry Subsystems — ARJE supports the following:

BSC	SDLC
OS/VS2 JES2	OS/BS2 JES2
OS/VS2 JES3	OS/BS2 JES3
VM/370 RSCS	DOS/VSE VSE/POWER

This program product is available on either 5.25-inch or 8-inch diskettes.

Programming environment

- Basic Supervisor and Emulator (5719-XS6)
- Systems Network Architecture (5719-XX9) is required for SNA operation.

Minimum hardware requirements

- Series/1 processor with 128KB of storage
- Series/1 disk or diskette unit
- Series/1 display.

Remote Manager (5719-RM1) (5719-RM1)

The IBM Series/1 Event Driven Executive Remote Manager allows Series/1 networks to be managed and operated through the communications and systems management programs available on IBM host processors (System/370, 30XX, and 43XX). Effective network management is made possible with the NetView licensed program and related communications and systems management (C&SM) programs.

The Remote Manager downstream support allows Series/1s that are connected to a connection point Series/1 through the Communications Facility (5719-CF2) to interact with the host network management functions.

The Remote Manager communicates with the following host C&SM programs:

- Network Communications Control Facility (NCCF)
- Network Problem Determination Application (NPDA)
- NetView
- Host Command Facility (HCF)
- Distributed Systems Executive (DSX).

Three major functions are provided by the Remote Manager:

- Alert Processing, the facility to route Series/1 hardware and software error indications to the Network Problem Determination Application (NPDA) or NetView at the host, alerts network operators of real or potential problems with Series/1 network operation.
- Host Operator Facility, allows a host 370 terminal operator to act as a local Series/1 operator. The host operator using the Host Command Facility (HCF) can issue Series/1 commands and invoke system utilities. Series/1 full-screen application programs, which can be accessed by EDX-managed 3101 type (block mode) terminals, can also be accessed by the HCF. Applications that use any other device driver cannot be accessed by the HCF (for example, the Transaction Processing System, 5719-TR1, and the Communications Facility (5719-CF2).

  The host 3270 terminal operator, using the HCF licensed program and the Remote Manager is able to:

  - Display system status, examine error logs, run utilities, start and stop applications in an effort to effect problem determination.
  - Act as the console operator on an unattended Series/1.
  - Start two HCF sessions at any Series/1 concurrently allowing simultaneous testing and debugging.
- Relay allows user and system data sets and programs to flow between a Series/1 and a host using Distributed System Executive. Thus, new or changed data or programs may be sent to a Series/1 in a controlled way. Data or programs may be retrieved from a development or production Series/1. Data that originates at the host, or is destined to be processed at the host, may also be transmitted.

This program product is available on either 5.25-inch or 8-inch diskettes.

Programming environment

- Basic Supervisor and Emulator (5719-XS6)
- Systems Network Architecture (5719-XX9).

Minimum hardware requirements

- Series/1 processor with 256KB of storage
- Series/1 disk unit or diskette unit
- Series/1 display (for installation only)
- SDLC attachment.

Communications Facility (5719-CF2)

The IBM Series/1 Event Driven Executive Communication Facility (Version 2.1) is a licensed program that manages the flow of information throughout a configuration that may include Series/1s, host computers, personal computers, terminals, and printers. The Communication Facility is oriented toward minimal-storage, low-cost Series/1s.

It can be used for communication between Series/1 terminal operators and host programs to which the Series/1 appears as an IBM 3270 Information Display System. It includes aids for the development of application programs, which can communicate with terminal operators or host programs or supply other functions required in an installation. The definition of the configuration is dynamic and can be extended and modified at any time.

Communication with a host may be over a leased or switched BSC line operating in multipoint mode; an SNA connection; or a channel attachment. Communication between Series/1s may be over a leased or switched BSC line operating in point-to-point or multipoint mode, a X.25/HDLC packet-switching network, or over a local Communications Controller. Communication with personal computers must be through the Series/1-to-PC Connect Attachment. I/O devices may be 3270 displays and printers; Series/1 displays and printers, which the Communications Facility manages as though they were 3270 devices; or various devices than can be connected to the Series/1 over BSC lines. The installation can add its own support for other devices.

The Communications Facility's message management functions include:

- *Delivering messages* from a computer, a device, or an application program to another computer, device, or application program.
- *Queueing messages* in processor storage, according to sender-assigned priority, for each destination.
- *Handling undeliverable messages* by placing them on a user-defined disk queue.
- *Handling transactions*-special fixed-format messages to be processed by user application programs.
- *Handling log messages,*.

Application development aids include:

- Event Driven Language (EDL) — Extended instructions that allow use of Communications Facility features.
- A 3270 panel design aid — An interactive utility that guides the programmer through creating a screen image.
- Transactions for use by interactive applications to communicate with Series/1 terminals that are being managed as native EDX terminals, rather than as 3270 terminals.

Aids for operating and controlling the network include:

- An interactive utility program that prompts the operator through the process of defining the network.
- Operator commands to allow for on-line control of the network.
- A diagnostic aid utility.
- Utilities that allow a central operator to send files to a remote site, execute programs at the remote site, allocate and delete data sets in the remote computer, and make a terminal at the central site operate as though it were attached to the remote computer.
- Remote IPL.
- A feature that allows a program access to disk files on remote Series/1s as if they were on the local Series/1.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Basic Supervisor and Emulator (5719-XS6).

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk or diskette unit
- Series/1 display.

Systems Network Architecture (5719-XX9), Version 2

The IBM Series/1 Event Driven Executive Support of Systems Network Architecture executes as a separate program within the Event Driven Executive operating system, and coordinates all user application program requests for SNA/SDLC communications. Basic operation of the Systems Network Architecture (SNA) support involves:

- Establishing communications with the host subsystem, including message recovery/resynchronization assistance
- Transmitting messages to and receiving messages from the host subsystem
- Terminating communications with the host subsystem.
- Support for multiple physical units
- Support for more logical units
- Less storage required per partition, and less overall storage required for large networks
- More efficient use of required storage
- Increased user flexibility
- Transparency of support
- Ability to display SNA network status
- Shares SDLC support in Event Driven Executive Version 6 with APPC and Primary SNA
- Can share a single, half-duplex data link with up to four SNA physical units or with APPC
- 56 Kbps with V.35 Interface on 2080 SDLC Card
- 48 Kbps with X.21 Interface on 2080 SDLC Card.

This program product is available on either 5.25-inch or 8-inch diskettes.

Programming environment

- Basic Supervisor and Emulator (5719-XS6).
- Network Definition Utility (5719-XT5).

Minimum hardware requirements

- Series/1 processor with 128KB of storage
- Series/1 disk or diskette unit
- Series/1 display
- SDLC attachment card.

Primary Systems Network Architecture (5719-XT4)

Primary SNA communications support is provided for all devices. This support provides a PU (physical unit) type 4 and PU type 5 image to the downline PU type 2 controllers. It is not attachable as a PU type 4/5 directly to a host.

Primary SNA supports the following controllers:

- 3174 Control Unit (Models 1R, 2R, 51R, 52R, 81R, and 82R).
- IBM 4680 Store System Controller
- IBM 3651 Store Controller (with IBM 3653 or 3683 point-of-sale terminals attached)
- IBM 3684 Point-of-Sale Control Unit (with 3683 point-of-sale terminals attached).
- IBM 3274 Control Units (models 21C, 31C, 41C, 51C, and 61C), using configuration support C or D
- IBM 4701 Finance Communications Controller (Models 001, 002 and 003)
- IBM 4702 Finance Communications Controller Model 001
- IBM 3624 Consumer Transaction Facility (Models 001, 002, 011, and 012)
- IBM 4730 Personal Banking Machine (Models F01 and F02)

Network configuration for Primary SNA is provided by the corequisite program, Network Definition Utility (5719-XT5).

To address the concern of storage limitations, EDX Primary SNA is designed to allow the customer to specify how much of the code is resident at any one time. The code will be swapped in and out as required for execution purposes. The ability of the customer to fine-tune the use of storage will allow the most storage-efficient use of this program.

This program product is available on either 5.25-inch or 8-inch diskettes.

Programming environment

- Basic Supervisor and Emulator (5719-XS6)
- Network Definition Utility (5719-XT5).

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk or diskette unit
- Series/1 display
- SDLC attachment card.

Network Definition Utility (5719-XT5)

Network Definition Utility (5719-XT5) is used in conjunction with Primary Systems Network Architecture (5719-XT4), Event Driven Executive Systems Network Architecture (5719-XX9), APPC in Event Driven Executive Version 6.1, and Token-Ring Interface Program (5719-EAC). This program provides a user-friendly method of defining the network resource configuration records for primary SNA networks.

Definition of network configuration records is done in full-screen mode. Full-screen mode provides the user with an easy-to-use, interactive method of creating and updating records. By choosing options presented in the menus, the user defines the configuration records for the network and all it's component parts. These same menus can be used to dynamically alter existing network configuration records. Help screens are available to aid the user if questions should arise.

This program product is available on either 5.25-inch or 8-inch diskettes.

Programming environment

- Basic Supervisor and Emulator (5719-XS6)
- Primary Systems Network Architecture (5719-XT4).
- Token-Ring Interface Program (5719-EAC).
- Event Driven Executive Systems Network Architecture (5719-XX9)

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk or diskette unit
- Series/1 display.

Token-Ring Interface Program (5719-EAC)

The Series/1 EDX Token-Ring Interface Program provides an Advanced Program-to-Program Communications (APPC) or a Primary SNA interface to the IBM Token-Ring Network. The IBM Series/1 Event Driven Executive (EDX) Token-Ring Interface Program executes on the IBM Series/1 Token-Ring Attachment Card which provides the IEEE 802.5 and ISO 8802/5, and IEEE 802.2 and ISO 8802.2 interfaces.

The Series/1 EDX Token-Ring Interface Program provides the necessary code for supporting Series/1 EDX applications communicating over the token-ring with the following:

APPC applications with:

- Another Series/1 APPC application executing on Event Driven Executive Version 6.1
- A 9370 APPC application running on ACF/VTAM Version 3.2
- An AS/400 APPC application executing on Operating System/400
- A PS/2 APPC application executing on DOS 4.0
- A PS/2 APPC application executing on Operating System/2 Extended Edition Version 1.1.

Primary SNA applications with:

- A 3174 (using the Series/1 as a passthru to the host or with applications running on the Series/1).
- A PS/2 running Workstation Program Version 1.1 on DOS 4.0 using the Series/1 as a passthru to the host or with applications running on the Series/1.
- A PS/2 running Operating System/2 Extended Edition 1.1 3270 Emulation, using the Series/1 as a passthru to the host, or with applications running on the Series/1.

The Series/1 EDX Token-Ring Interface Program is loaded into the attachment card's resident storage at initial program load, and is executed by its Motorola 68000 microprocessor. The Series/1 EDX Token-Ring Interface Program obtains configuration information from the Network Definition Utility configuration records, which include connection point, device, and link station information. APPC or Primary SNA application programs may be written for execution on the Series/1. The Series/1 EDX Token-Ring Interface Program is not supported with customer-supplied outboard programming (on the Motorola 68000).

Programming environment

- Event Driven Executive Basic Supervisor and Emulator (5719-XS6), Version 6.1
- Outboard Processing Tools PRPQ (5799-CJL) (with PTF 1)
- For native program preparation and assembly, Event Driven Executive Program Preparation Facility (5719-XX7), Version 6.1
- For assembling Series/1 native assembler instructions, Macro Assembler (5719-ASA)
- For assembling EDL instructions using Macro Assembler Version 6.1 (5719-ASA), Macro Library (5719-LMA) or Macro Library/Host (5740-LM7)
- Primary Systems Network Architecture (5719-XT4) (PTF 3) if primary SNA applications are used
- Systems Network Architecture (5719-XX9), Version 2.1 and Primary Systems Network Architecture (5719-XT4), if using the Series/1 as a gateway between a token-ring-connected device and the host
- Network Definition Utility (5719-XT5) (PTF 2), when creating or changing Token-Ring configuration records.

- Systems Network Architecture (5719-XX9), Version 2.1 and EDX Remote Manager (5719-RM1) (5719-RM1) (PTF 2) are required if alerts are to be sent to the host.
- The Series/1 system used to create or change Token-Ring configuration records requires the latest release or version of the IBM Event Driven Executive Network Definition Utility (5719-XT5) (PTF 3) available at Token-Ring Interface Program availability.

Compatibility:

The EDX Token-Ring Interface Program is compatible with the latest released levels of the following:

For Series/1 Event Driven Executive:

- EDX Basic Supervisor and Emulator (5719-XS6), Version 6.1
- EDX Program Preparation Facility (5719-XX7), Version 6.1
- EDX Macro Library Version 6.1 (5719-LMA)
- EDX Macro Library/Host Version 6.1 (5740-LM7)
- Remote Manager (5719-RM1), Version 1.2 (PTF 2)
- Outboard Processing Tools PRPQ Version 1.0 (5799-CJL) (PTF 1)
- EDX Primary Systems Network Architecture (5719-XT4), Version 1.0 (PTF 3)
- EDX Systems Network Architecture (5719-XX9), Version 2.1
- Event Driven Executive Network Definition Utility (5719-XT5) (PTF 2)

For APPC (LU 6.2):

- 9370 — ACF/VTAM Version 3.2.0
- AS/400 — Operating System/400 (5728-SS1)
- Personal System/2 — APPC for the IBM Personal System/2 with DOS 4.0
  - APPC for the IBM Personal System/2 with Operating System/2 Extended Edition Version 1.1

For Primary SNA:

- Personal System/2 — 3270 Workstation Program Version 1.1 with DOS 4.0
- 3270 emulation with Operating System/2 Extended Edition Version 1.1 using the Series/1 as a passthru to the host or with applications running on the Series/1.
- 3174 Model 53R or 3R

Minimum hardware requirements:

- 4956 Processor (any Model)
- Token-Ring Attachment Card (feature 2200).

Outboard Processing Tools Programming RPQ (5799-CJL)

The Series/1 Outboard Processing Tools program supports users' communications requirements by providing customers an environment in which to debug and execute application and data link control programs (particularly CPU-intensive programs) on attachment cards outboard from the Series/1. This relieves the Series/1 of much of the overhead involved in communications processing.

Highlights are:

- Provides multiprogramming and multitasking control of Series/1 coprocessor load module execution (Multiline Communications Coprocessor)
- Provides Series/1-to-coprocessor access method
- Provides an interactive coprocessor debugger
- Provides a configuration and operation utility
- Provides a dumper and formatter
- Supports communication between the Series/1 and the Token-Ring Attachment Card.

The Series/1 Outboard Processing Tools programming RPQ supports the multiprogramming and multitasking control of Series/1 coprocessor load module execution, including the Multiline Communications Coprocessor. This programming RPQ provides the Series/1-to-coprocessor access method that enables load modules to be down-loaded to the coprocessor cards. Programs on the coprocessors communicate between the coprocessor and the Series/1 over the high-speed Series/1 channel. Coprocessor problem determination facilities include an interactive system debugger, and dump and formatter facilities that dump coprocessor memory to the Series/1 disk and format it. Also provided is a configuration and operation facility to aid in configuring the coprocessor tools environment. This programming RPQ supports communication between the Series/1 and either the Multiline Communications Coprocessor and/or the Token-Ring Attachment Card. For more information on Multiline Communications Coprocessor see "Multiline Communications Coprocessor" on page 3-24. For more information on Token-Ring Attachment Card see "Token-Ring Attachment Card" on page 3-23.

Operating system environment

- Basic Supervisor and Emulator (5719-XS6) Version 6.1

Minimum Hardware Requirements:

- Series/1 4956 Processor (all Models)
- Series/1 Multiline Communications Coprocessor (feature 2840) and/or
- Series/1 Token-Ring Card (feature 2200).

X.25/HDLC Communications Support Program (5719-HD2)

The IBM Series/1 Event Driven Executive X.25/HDLC Communications Support program provides a set of functional modules that allow the Series/1 to appear as data terminal equipment (DTE) or data circuit-terminating equipment (DCE), using the X.25 interface.

When used as DTE, the Series/1 can be connected to an X.25 based packet switched network. As DCE, the Series/1 will communicate with packet-mode DTEs whose protocol conforms to the X.25 interface.

This program will manage the X.25 protocols on behalf of the Series/1 users and support many functions designated as essential services by the CCITT Recommendation X.25. It performs the following functions:

- Assembly/disassembly of packets
- Connection/disconnection of virtual circuits
- Flow control and data packets management.

This program will also enable the Series/1 to communicate with other intelligent terminals or processors where high-level data link control (HDLC) is used as the link access protocol. Supported operational modes are Asynchronous Balanced Mode (ABM) and Normal Response Mode (NRM). The Communications Facility for the Series/1 provides a message path interface to the X.25/HDLC Communications Support program.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Basic Supervisor and Emulator (5719-XS6).

Minimum hardware requirements

- Series/1 processor with 128KB of storage
- Series/1 disk or diskette unit
- Series/1 display
- Communications attachment hardware.

Systems Network Architecture RJE Program (5719-SX2)

The IBM Series/1 Event Driven Executive Systems Network Architecture RJE Program is for those users who want to transmit jobs to and from a host System/370 by using a systems network architecture (SNA) protocol (logical unit type 1). The functions include:

- Submitting jobs to the host
- Transmitting remote job entry (RJE) commands to the host
- Stopping transmission to or from the host.

The SNA RJE program transmits and receives jobs under control of a user terminal work station in a manner consistent with the Remote Job Entry programs in the Utilities. The program requires the installation of the Support of Systems Network Architecture as a prerequisite.

Host subsystems supported are: DOS/VSE POWER, OS/VS1 RES, OS/VS2 JES2 or JES3.

This program product is available on either 5.25-inch or 8-inch diskettes.

Programming environment

- Basic Supervisor and Emulator (5719-XS6)
- Systems Network Architecture (5719-XX9).

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk or diskette unit
- Series/1 display
- SDLC attachment card.

Event Driven Executive - device support

Certain device support is provided to the Event Driven Executive user through separate licensed programs.

System/370 Channel Attach Support (5719-CX1)

The IBM Series/1 Event Driven Executive System/370 Channel Attach Program is used in conjunction with the IBM 4993 Model 1 Series/1 — System/370 Termination Enclosure and the IBM Series/1 — System/370 Channel Attachment (feature 1200). The program allows the user to develop an Event Driven Executive application program, written in Series/1 Assembler or Event Driven Language, that will communicate with an application program in a System/370 over a selector or block multiplexer channel.

Communication with the following processors is supported:

- IBM System/370 (Models 135 through 168)
- IBM 3031, 3032, 3033, 3081
- IBM 4331, 4341.

This program has been validated with the following System/370 control programs: DOS/VS, OS/VS1, OS/VS2 (SVS or MVS) and BTAM, or DOS/VSE with BTAM-ES

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Basic Supervisor and Emulator (5719-XS6).

Minimum hardware requirements

- Series/1 processor with 96KB of storage
- Series/1 disk or diskette unit
- Series/1 display
- System/370 channel attachment hardware.

Event Driven Executive - commercial support

These licensed programs aid the Event Driven Executive user in developing and executing commercial applications on Series/1.

Indexed Access Method (5719-AM4)

The IBM Series/1 Event Driven Executive Indexed Access Method (Version 2) provides data management facilities that support indexed file operations for the Event Driven Executive. Such facilities include:

- The use of a predetermined field called a key that allows the user to build, access, and maintain user-defined records in indexed data sets. The program builds an index of keys that provides a fast access to records in a data set. Both primary (unique) and secondary (duplicate) index keys are supported. (The Sort/Merge program is required for this facility.)
- The support of 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 Event Driven Language, Series/1 Assembler, PL/I, COBOL or C. The program is also supported by the Sort/Merge program, which will accept Indexed Access Method data sets as input files.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Basic Supervisor and Emulator (5719-XS6).

Minimum hardware requirements

- Series/1 processor with 96KB of storage
- Series/1 disk or diskette unit
- Series/1 display.

Sort/Merge (5719-SM2)

The IBM Series/1 Event Driven Executive Sort/Merge licensed program 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.
Sort/Merge:

- Accepts fixed-length or variable-length records in unblocked or block formats (Variable-length records are only supported by the Event Driven Executive COBOL compilers and associated libraries)
- Permits user-written exit routines to handle I/O errors and process records during execution
- Permits deviation from the standards EBCDIC or ASCII collating sequence at program execution time
- Allows multiple sorts to be invoked from the same application
- Routes messages to the operator work station or printer.

Sort/Merge can be initiated either as a batch job or from a user routine written in Series/1 Assembler language, COBOL, PL/I or Event Driven Executive.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Basic Supervisor and Emulator (5719-XS6).

Minimum hardware requirements

- Series/1 processor with 96KB of storage
- Series/1 disk or diskette unit
- Series/1 display.

Event Driven Executive - application programming

General Purpose Automation Executive-Distributive GPAX-D (5798-FAS)

General Purpose Automation Executive-Distributive GPAX-D is a Series/1 EDX-based facilities automation application. It supports all other equipment manufacturer (OEM) vendors who meet the facilities automation communications network (FACN) protocol. This is typically on a vendor-supplied IBM Personal Computer (PC) front end to their direct digital control (DDC) or programmable logic control (PLC) equipment. These systems are referred to as remote intelligent sub-systems (RIS).

GPAX-D can support a variety of OEM RISs on the same Series/1. The RISs may be in multiple buildings or sites. Multiple GPAX-D systems can also be connected using bisync communications. Information can be shared with all systems (GPAX-Ds and RISs) in the network. GPAX-D provides for monitoring, control, trend analysis, reporting, graphics, data reduction (highs, lows, averages on hourly, daily, weekly, monthly basis), meter/consumption tracking, and more. It is meant not for high-speed process control, but rather for common facilities automation tasks such as energy management, device optimization, HVAC (heating, ventilation, and air conditioning), lighting schedules, and more.

GPAX-D provides a common user interface for whatever variety of systems attached. The OEM RISs may be used for any suitable purpose while the GPAX-D host is used more in a supervisory mode to move/calculate values taken from multiple sources and to provide the engineer with a powerful tool to view data from all systems at one terminal. GPAX-D is an improved/enhanced version of GPAX (5798-RCZ), originally released in 1981.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Basic Supervisor and Emulator (5719-XS6)

Minimum hardware requirements

- Series/1 processor with 384KB of storage and floating-point
- Series/1 disk unit with 30 megabytes of storage
- Series/1 diskette unit
- Series/1 printer
- Series/1 display with full-screen capability
- Communications attachment.

Series/1 Realtime Programming System

The IBM Series/1 Realtime Programming System provides:

- Multiprogramming, multitasking supervisor
- Device support includes:
  - Direct access
  - Magnetic tape
  - Printers
  - Terminals
  - Programmable Communications Subsystem
  - System/370 Channel Attach
  - Sensor input/output
  - Communications with remote systems.
- Communications support for a variety of line disciplines
- Task, storage, event and queue management options — enabling support of concurrent complex applications
- Multiple programming language options, including Series/1 Assembler, COBOL, FORTRAN, Pascal, and PL/I
- Online program development and utility functions
- Command language facility with an easy-to-use menu interface for requesting services from the system.

The Realtime Programming System provides a full-function operating system for Series/1 users who wish to develop applications and mixes of applications with moderate to high complexity. The Realtime Programming System contains many system management features generally associated with operating systems on larger processors.

To enable users to tailor the software to their particular needs, the Realtime Programming System offers numerous separately packaged, supplemental programs. These include program development tools, languages, commercial, communications, and additional sensor input/output support.

The Realtime Programming System on the Series/1 can apply to a broad range of applications, including commercial use (distributed or stand-alone), communication applications, including network management, and sensor-based functions (such as process control).

Realtime Programming System - basic system functions

Realtime Programming System (5719-PC7)

The basic supervisor and associated services are provided in a program called the IBM Series/1 Realtime Programming System (Version 7.2). This program provides operating system functions to support realtime operations concurrently with the execution of other batch and on-line programs. The Realtime Programming System allow the generation of both multiple-application systems and smaller, single-application systems.

The Realtime Programming System supports a single Series/1 processor or multiple Series/1 processors. Multiple Series/1 processors are connected in a high-speed ring by the Local Communications Controller.

When the system has multiple processors (nodes), all system functions are available for use. Each node can be dedicated to performing unique work, being a backup node, or a combination of both. Each node can have its own I/O devices and communication lines, or it can share certain types of devices that are attached to the other nodes. Except when the Execute I/O (EXIO) interface is used, the Realtime Programming System manages the logical sharing of distributed devices to enable applications to transparently use devices that are attached to other nodes.

Highlights of the operating system include:

- A text editor, which provides the ability to create and modify text modules that can serve as source input to compilers or job streams for batch operations. Both single line and full screen editing is supported.
- Application programs that can use a range of I/O devices from display terminals, disks, diskettes, and printers to communications subsystems and sensor I/O devices.
- Data management, provided for consecutive, random, partitioned, and indexed files. Disk spooling of printed output is supported.
- Duplex volume support, which is available when utilizing at least two disks, provides automatic and transparent data integrity to the application program and the end user.
- Application programs that can access communications support code in the operating system for communicating with asynchronous (start/stop) or binary synchronous devices, or to SNA systems.
- A command language facility, which provides an interactive command- or menu-oriented interface to terminal users for invoking user or system programs. The command language format is similar to that used in VM/CMS on System/370.
- Command language facility batch support, which is part of the command language facility. It enables users to start jobs and have them run to completion even after an event such as a re-IPL after a power failure.
- I/D split support for user applications enables problem-state applications to expand beyond 64KB. The user's instructions can expand to 64KB with the user's data expandable to multiple data spaces (each up to 64KB).
- A standard operating system is supplied initially, reducing the need to perform system generation in development systems.
- Integrated functions, such as communications manager, remote manager, Indexed Access Method, and sort/merge.

A Base Operating System Feature is available for users who do not require these integrated programming functions.

This program product is available on either 5.25-inch or 8-inch diskettes.

Programming environment

- There is no additional programming for a base or uniprocessor system.
- For a multiprocessor system, the uniprocessor feature 2136 must be ordered also.

Minimum hardware requirements

- Series/1 processor with 192KB of storage (256KB of storage for a multiprocessor system)
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Communications Manager: The communications manager functions support line concentration, message routing, terminal control, and distributed processing. One or more Series/1's using the program can be installed to manage the flow of information through the network.

The communications manager supports a variety of terminals and other input/output devices. Support for non-IBM devices can be incorporated by the user through the use of the 4987 Programmable Communications Subsystem.

Remote Manager: The remote manager functions enable Series/1 networks to be managed and operated through the communications and systems management (C&SM) programs available on IBM host processors (System/370, 30XX, and 43XX). Effective network management is made possible with the NetView licensed program and related communications and systems management programs.

The remote manager communicates with the following host C&SM programs:

- NetView
- Host Command Facility (HCF)
- Distributed Systems Executive (DSX).

Indexed Access Method: The Indexed Access Method provides data management facilities that support indexed file operations.

Such facilities include the use of a predetermined field called a key that enables the user to build, access, and maintain user-defined records in indexed data sets. The program builds an index of keys that provides fast access to records in a data set. Both primary (unique) and secondary (duplicate) index keys are supported. (The sort/merge functions are used for this facility.)

The Indexed Access Method can also provide data consistently by backing out file updates as needed in case of an I/O error.

When used with the Multiprocessing Feature, the following additional functions are available:

- Multiple Indexed Access Method in a system, each processing files on its own node
- Indexed Access Method can be paired in a system. In case of a failure, one Indexed Access Method can assume processing for the failing other method.

Applications that use the Indexed Access Method can be programmed in Series/1 Assembler, PL/I, or COBOL. Also, the sort/merge functions accept Indexed Access Method data sets as input files.

Sort/Merge: The sort/merge functions handle the sorting and merging of records from up to eight input data sets into one data set in either ascending or descending order. The user specifies one or more control fields in the record to be sorted. The sort/merge functions:

- Accept fixed-length or variable-length records in blocked or unblocked formats
- Can be initiated either as a batch job, or from a user routine written in Series/1 Assembler language, COBOL, or PL/I
- Permit user-written exit routines to process records and handle I/O errors during sort/merge execution
- Permit deviation from the standard EBCDIC or ASCII collating sequence during program execution
- Allow multiple sorts to be invoked from the same application
- Route messages to the operator work station or printer.

Advanced Program-to-Program Communications: Advanced Program-to-Program Communications (APPC) provides enhanced SNA support for distributed processing. APPC is the name by which the functions provided by an implementation of the LU type 6.2 and PU type 2.1 architectures are known. APPC provides a single, converged solution to the communications requirements of a growing set of current and future IBM products. As a "universal language" for communication among distributed transaction programs, APPC results in improved connectivity.

Primary SNA Support: This support provides a PU Type 4 and PU Type 5 image to the down-line PU Type 2 controllers. It is, however, not attachable as a PU Type 4 or 5 to a host. Primary SNA supports:

- 3274 Control Unit (Models 21C, 31C, 41C, 51C, 61C) with 3287 printers and 3178, 3278, and 3279 terminals
- 4680 Store System Controller
- 4701 Finance Communications Controller (Models 1, 2, 3) with 4710 printers and 4704 displays
- 4702 Finance Communications Controller (Model 1)
- 3624 Consumer Transaction Facility (Models 1, 2, 11, 12)
- 4730 Personal Banking Machine (Models F01 and F02)
- 3651 Store Controller with 3653 and 3683 Point-of-Sale Terminals
- 3684 Point-of-Sale Control Unit with 3683 Point-of-Sale Terminals.

In addition, this support allows session passthru on a logical unit (LU) basis. This enables the Series/1 to pass messages between a logical unit attached downstream and a logical unit attached upline from the Series/1. Some user code is required to activate this support.

Primary SNA, in conjunction with the Remote Manager function, will pass unsolicited alerts to the host from the 3274, 3651, 4701, 4702, 4730, and 4680 controllers.

Realtime Programming System - program development

Program Preparation Subsystem (5719-AS7)

The IBM Series/1 Program Preparation Subsystem (Version 7) provides a group of components that assist in developing and executing user programs. The components are:

- A Macro Assembler, which translates Assembler language source statements to object modules
- An Application Builder, which converts object modules to executable task sets (a process known as link edit in other systems)
- A Macro Preprocessor, which allows the user to develop preprocessed macro programs, thus improving Assembler performance
- A Job Stream Processor, which allows a terminal user to control the execution of one or more programs in an interactive or batch environment
- A set of commands and menus with the Command Language Facility to aid in program preparation tasks
- A system facility, which provides the ability to generate a customized operating system.

This program is used as the basis for program development in conjunction with the Realtime Programming System. In addition to the Assembler provided with this program, it serves as the interface to the licensed programs that provide high-level language capability.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Realtime Programming System (5719-PC7).

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Transaction Processing System (5719-TR6)

The Realtime Programming System Transaction Processing System product offers support for developing and managing transaction oriented user application programs. It provides high programmer productivity and use of system functions without the complexity of an operating system interface.

Transaction Processing System provides support for:

- File management
- Program management
- Storage management
- Error management
- Terminal management
- Multitasking
- Multiple address space support
- Security sign-on and access
- 3270 passthru and 3270 emulation using the Communication Manager
- Switched-line terminal support
- Transparent interface to Communication Manager functions.

Transaction Processing System also includes a generalized transaction builder that can provide functions to develop file maintenance functions such as adding, deleting, and updating records without programming. Formats can be created and edits performed without the use of a programming language. For more sophisticated processing, exits provide access to user-written routines in assembler, COBOL, Pascal, or PL/I. The system is menu-driven and allows access to sequential, direct, and indexed files.

Transaction Processing System has the advantage of allowing a user to develop many interactive applications without the knowledge of the operating system or programming languages.

This program product is available on either 5.25-inch or 8-inch diskettes.

Transaction Processing System provides native support for the enhanced functions of the 316X display stations. This support includes multiple viewports, color support, daisy chain terminals, attached 4201 Printer, and large-screen capabilities.

Operating system environment

- Realtime Programming System (5719-PC7).

Programming environment

For certain environments and functions, the following Series/1 Realtime Programming System licensed programs may be required:

- Program Preparation Subsystem (5719-AS7)
- COBOL Compiler and Resident Library (5719-CB7) and Transient Library (5719-CB8)
- PL/I Compiler and Resident Library (5719-PL2) and Transient Library (5719-PL4)
- Pascal Compiler and Object Library (5799-TEQ)
- Programmable Communications Subsystem Preparation Facility (5719-CS0)
- Programmable Communications Subsystem Extended Execution Support (5719-CS2).

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Host Preparation Facility (5799-BNA)

An IBM System/370 Host Program Preparation Facility is available for the Series/1. For the Realtime Programming System user, the host facility provides the following support:

- Translation of Series/1 source programs written in Assembler language into machine language instructions, producing Series/1 object modules
- Printed output, including program listing, symbol dictionaries, cross-references, and diagnostic messages
- An application builder, which prepares object modules for execution by building load modules or task sets that can execute on the Series/1
- A host application load facility, which can be invoked through TSO to transmit Series/1 object code from the System/370 to the Series/1 for execution across BSC lines.

All host components execute with the System/370 OS/VS2 (MVS) operating system.

Communication of programs to and from the Series/1 on a BSC line can use the Native Application Load Facility (5798-RBR) field-developed program in the Series/1.

The Host Preparation Facility prepares Series/1 code for execution with the Realtime Programming System Version 7.

Series/1 Realtime Programming System - communications support

Programmable Communications Subsystem Execution Support (5719-CS2)

The Programmable Communications Subsystem Execution Support runs under control of the Series/1 Realtime Programming System and provides the user with an interface to the 4987 Programmable Communications Subsystem. The execution support consists of:

- Execution support macros
- A loader utility to load the controller storage image program into controller storage.

The macros provide the user with the execution interface to the 4987 Programmable Communications Subsystem through the Realtime Programming System Execute I/O and Read/Write support in Series/1 Assembler Language.

The loader utility provides a facility to load a user controller storage image program from disk or diskette to controller storage. The user can initiate the load from the system console or an application program.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Realtime Programming System (5719-PC7).

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer
- 4987 Programmable Communications Subsystem and attachments.

Programmable Communications Subsystem Preparation Facility (5719-CS0)

The IBM Series/1 4987 Programmable Communications Subsystem Preparation Facility is used to support the generation of controller storage image programs for the IBM 4987 Programmable Communications Subsystem. The program provides a macro library for use with the Series/1 4987 Program Preparation Subsystem. The library can also be used for assemblies with the Series/1 Base Program Preparation Facilities.

The macro library provides Series/1 users with the capability of defining and customizing the total protocol for their subsystem. It provides communications instructions for implementing user communications applications with two basic macro types:

- Communications macro instructions
- Communications definition macros.

The communications macro instructions are the vehicle used to code the customized communications programs (called function strings) for each line of the subsystem. They are a highly specialized instruction set designed for the coding of function strings in the 4987 Programmable Communications Subsystem.

The communications definition macros are the vehicle used to define the tables and parameters used by the function strings. They are used to define the control characters for each line or line type, the function strings to be used for each line or line type, and all the pointers necessary to set up the controller storage.

The assembled output from these two macro types is linked together into a load module by the standard facilities of the Program Preparation Subsystem and placed onto a disk or diskette. This load module is referred to as the controller storage image program.

This program product is available on either 5.25-inch or 8-inch diskettes.

Programming environment

- Realtime Programming System (5719-PC7)
- Program Preparation Subsystem (5719-AS7).

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

X.25/HDLC Communications Support Program (5719-HD1)

For Series/1 users who require an X.25 interface, the IBM Series/1 Realtime Programming System X.25/HDLC Communications Support Program is available. This program provides a set of functional modules that allow the Series/1 to appear as data terminal equipment (DTE) or data circuit-terminating equipment (DCE).

When used as DTE, the Series/1 can be connected to an X.25 based packet switched network. As DCE, the Series/1 will communicate with packet-mode DTEs whose protocol conforms with the Recommendation X.25.

This program will manage the X.25 protocols on behalf of the Series/1 users and support many functions designated as essential services by the CCITT Recommendation X.25. It performs the following functions:

- Assembly/disassembly of packets
- Connection/disconnection of virtual circuits
- Flow control and data packets management.

The X.25/HDLC Communications Support will also enable the Series/1 to communicate with other intelligent terminals or processors where high-level data link control (HDLC) is used as the link access protocol. Supported operational modes are:

- Asynchronous Balanced Mode (ABM)
- Normal Response Mode (NRM).

The Communications Manager for the Series/1 provides a message path interface to the X.25/HDLC Communications Support program.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Realtime Programming System (5719-PC7).

Minimum hardware requirements

- Series/1 processor with 224KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Attachment feature	X.25 interface[1]	ABM Duplex	NRM (primary/secondary)		Physical interface	Maximum speed (bps)
			Half duplex	Duplex		
2080 with EC 326751	Supported	Supported	Supported	Supported	X.21 V.35	48,000 56,000
2090	Supported[2]	Supported[2]	Supported	Supported[2]	V.24	19,200

[1] Requires selection of appropriate physical interface for each network application

[2] Two required (2090 must be equipped with EC 336758)

Manufacturing Automation Protocol Communications Server (5719-XT2)

Manufacturing Automation Protocol (MAP) is a set of standards based upon the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) Reference Model. These standards enable communication and cooperation among computers and other intelligent devices in a multiple-vendor local area network in manufacturing environments.

The IBM Series/1 Realtime Programming System MAP Communications Server, along with other IBM Series/1 Realtime Programming System functions, allows Series/1s to communicate with other systems in a MAP network.

In addition, a companion program, IBM System/370 MAP Communications Server FTAM (PRPQ 5799-CGB) allows application programs in the host to communicate with MAP processors, numerical controllers, robots, and other industry devices on the plant floor.

Highlights of the licensed program include the following:

- A subset of Manufacturing Automation Protocol at the 2.1 level of function
- Institute of Electrical and Electronics Engineers (IEEE) Standard 802.4 (token bus local area network) and IEEE Standard 802.2 (logical link control) via an external network interface unit
- ISO Internet Connectionless Network Service (CLNS), as an "end system"
- ISO Transport Protocol, Class 4
- ISO Session kernel
- ISO Common Application Service Element (CASE) subset
- A directory server function that can supply directory data to other systems in the network
- MAP Network Management Agent functions
- Reliability, availability, and serviceability aids, such as trace facilities.

Programming environment

- Realtime Programming System (5719-PC7)
- X.25/HDLC Communications Support (5719-HD1)
- Program Preparation Subsystem (5719-AS7) for installation.

Minimum hardware requirements

- Series/1 processor with 1024KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer
- Synchronous Communications Adapter (feature 2080) with cable (feature 2060)
- A network interface unit that meets the MAP specification of the Layer 2 Interim Network Interface Specification. An interface converter (V.35/RS449) and an RS449 secondary cable are also required.

Advanced Remote Job Entry (5719-RJ6)

The IBM Series/1 Realtime Programming System Advanced Remote Job Entry provides an improved RJE facility for users of the Realtime Programming System.

Highlights are:

- Full function RJE console on Series/1
- Logging of console activity to a journal file
- Support for unattended operation
- Status reporting.

The Series/1 serves as a Remote Job Entry work station to a host System/370, 303X, or 4300. The RJE program in the Series/1 can operate concurrently with other applications. Host connection can be either BSC or SNA/SDLC. The BSC connection provides a standard point-to-point multileaving technique (MRJE). The Series/1 can transmit and receive data concurrently. Host connection is supported to OS/VS2 (MVS) using either JES2 or JES3, and to VM/370 RSCS. The Series/1 is viewed by the host as a System/3 with console support. The SNA/SDLC connection uses a logical unit type 1 protocol. The Series/1 is viewed by the host as multiple logical units, allowing intermixing of input and output data streams on a communications line. Host connection is supported to OS/VS2 (MVS) using either JES2 or JES3, and to DOS/VSE/POWER.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Realtime Programming System (5719-PC7).

Minimum hardware requirements

- Series/1 processor with 218KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer
- BSC or SDLC attachment card.

Realtime Programming System - device support

System/370 Channel Attach Support (5719-CA1)

This program is used in conjunction with the IBM 4993 Model 1 Series/1-System/370 Terminal Enclosure and the IBM Series/1-System/370 Channel Attachment (feature 1200). The program allows the Realtime Programming System user to develop application programs written in Series/1 Assembler that will communicate with an application program in a System/370 over a selector or block multiplexer channel.

Communication with the following processors is supported:

- IBM System/370 (Models 135 through 168)
- IBM 3031, 3032, 3033, 3081
- IBM 4331, 4341.

The Series/1 Channel Attach program has been validated with the following System/370 control programs: DOS/VS, OS/VS1, OS/VS2 (SVS or MVS) and BTAM, or DOS/VSE with BTAM-ES

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Realtime Programming System (5719-PC7).

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer
- System/370 channel attachment hardware.

Realtime Programming System - commercial support

Sort/Merge (5719-SM1)

The IBM Series/1 Realtime Programming System Sort/Merge licensed program 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. The licensed program:

- Accepts fixed-length or variable-length records in unblocked or blocked formats
- Can be initiated either as a batch job, or from a user routine written in Series/1 Assembler language, COBOL, or PL/I
- Permits user-written exit routines to handle I/O errors and process records during Sort/Merge execution
- Permits deviation from the standard EBCDIC or ASCII collating sequence at program execution
- Allows multiple sorts to be invoked from the same application
- Routes messages to the operator work station or printer.

This program product is available on either 5.25-inch or 8-inch diskettes.

Operating system environment

Realtime Programming System (5719-PC7), base operating system feature[3]

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

[3] This product is integrated into the uniprocessor feature of Realtime Programming System (5719-PC7).

Realtime Programming System - application programming

Series/1 Data Entry System (S1DES) (5796-ZDE)

The IBM Series/1 Data Entry System (S1DES) developed by Software Consulting Service, Inc., is a heads-down, high-volume key-to-disk data entry system providing enhanced productivity for both the implementer and the end user.

The ease-of-use characteristics are accomplished by a completely menu-driven implementation eliminating the need to write programs to get jobs on-line and operational.

The menu facility also provides for screen formats and their associated editing definitions.

Operator productivity is gained by the extensive use of key assignments to accomplish data entry functions. In addition, notification is made at the time an error occurs, allowing immediate correction and increased throughput.

Use of standard Series/1 operating system functions (Realtime Programming System/Event Driven Executive) allows for enhanced data integrity and error recovery, as well as transportability of data entry files or definitions between the Realtime Programming System and Event Driven Executive operating systems. In addition, files created by S1DES can be directly used by other Series/1 applications.

To extend the data entry environment, an "exit" capability has been provided to allow for the unique requirements of individual customer environments.

System highlights

The IBM Series/1 Data Entry System (S1DES) puts productivity and flexibility in a key-to-disk, heads-down data entry environment by providing these characteristics:

- Menu-driven implementation

  There is little or no need for the user to write programs for jobs, screen definitions, formatting or editing.

- Operator interfaces to enhance throughput
  - The system provides extensive use of key assignments.
  - It includes a Help facility.
  - It notifies the operator at the time an error occurs to eliminate the need for re-keying.
- System compatibility
  - Both Realtime Programming System and Event Driven Executive support the system.
  - Jobs can be transported between operating systems.
  - Files can be used by other Series/1 applications.
  - It permits error recovery through use of standard operating system functions.
  - Operators can use terminals for other functions once they finish data entry.
  - Terminals can be attached locally or remotely.
- Extension of the data entry environment through use of exit facility
  - The system provides the capability to implement additional functions on the Series/1.
  - It allows implementation of exits via COBOL, Assembler, or EDL.
- Ability to implement communications
  - The system allows the user to implement communications with Host systems (4300, 30XX) for update and verification.

Programming environment

- Realtime Programming System (5719-PC7)
- Program Preparation Subsystem (5719-AS7) is required on a development system.

Minimum hardware requirements

- Series/1 processor with 256KB of storage and a system timer
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

Series/1 high-level language support

Series/1 provides a choice of multiple high-level languages for use with the two operating systems. Both the Event Driven Executive and the Realtime Programming System support COBOL, PL/I, Pascal and FORTRAN language options. Event Driven Executive also provides a C language option. The compilers and other programs supporting these programming languages are described in this section.

High-level language support - C

Host C Compiler for Series/1 Event Driven Executive (5740-EAA)

The Host C Compiler for Series/1 Event Driven Executive compiles C source programs and generates Series/1 EDX object code. It also provides the capability to link object modules to create executable load modules that run on the Series/1 Event Driven Executive Version 6.1.

Object modules produced using the Host C Compiler for Series/1 EDX may be transmitted from the host to the Series/1 and link-edited, or link-edited on the host. The transport method used is dependant on whether the Host or the Series/1 is used to do the link editing. The user can write applications that use C run-times, and write Transaction Processing System routines and Indexed Access Method interfaces all in C without having to code in Event Driven Language (EDL) or assembler . Advanced Program-to-Program Communications (APPC) interfaces that conform to the Systems Application Architecture (SAA) Common Programming Interface (CPI) for Communications are supported in C.

The Series/1 EDX C language provides upward compatibility to SAA C level definition as defined in the SAA C Reference Manual (SC26-4353). The Series/1 EDX C programs will require recompilation to run on IBM SAA systems. With the exception of applications using the Indexed Access Method and Transaction Processing System interfaces, a user should be able to port his application to another system that conforms to SAA with minimal changes.

Highlights include:

- Compiler supports C language level that is upward compatible to the SAA C language definition
- The Host resident linker allows the use of overlays for programs greater than 64KB
- Compiler allows linkage between EDL, Assembler, and C programs when the initial entry point of an application is a C program
- Compiler supports passthru of Double Byte Character Set (DBCS) data in character strings and comments.

A System/370 host version of $EDXLINK is provided with the compiler so that customers using NetView Distribution Manager (NetView DM) can transmit complete load modules to the Series/1 EDX system. To be transmitted by NetView DM Release 1, the load modules must be loaded into a NetView DM repository as data sets. Furthermore, Remote Manager and SNA are needed on the Series/1 to accomplish transmission of load modules. An EDX utility, $UPDPGM, is provided to reformat the data sets into compatible EDX load modules for execution on Series/1. Without NetView DM, object modules can be transmitted using Job Entry System (JES) or Remote Spool Control System (RSCS) on the host, and ARJE on the Series/1. An EDX utility, $EABOBJ, is provided to reformat the object modules into a compatible format for $EDXLINK.

Programming environment

- For Compilation:
  - MVS/SP JES2 Version 2 Release 1 (5740-XC6) or MVS/SP JES3 Version 2 Release 1 (5665-291), or
  - VM/SP Release 4 (5664-167) or VM/HPO Release 4.2 (5664-173) system
- For Host Link-Edit and Transmitting Load Modules from System/370 to Series/1:
  - On System/370 using NetView Distribution Manager for MVS/370 and MVS/XA (5685-016) or NetView Distribution Manager for VM (5684-017)
  - Series/1 EDX Basic Supervisor and Emulator Version 6.1 (5719-XS6)
  - Series/1 EDX Remote Manager Version 1.2 (5719-RM1), PTF number 9201
  - Series/1 EDX SNA Version 2.1 (5719-XX9)
- For transmitting object modules from System/370 to Series/1 and Link-Edit on Series/1:
  - On System/370, JES2 or JES3 on MVS or RSCS (Remote Spool Control System) on VM
  - Series/1 EDX Basic Supervisor and Emulator Version 6.1 (5719-XS6)
  - Series/1 EDX ARJE (5719-RJ1) and EDX SNA Version 2.1 (5719-XX9) for SDLC
  - Series/1 EDX $RJE3780 (EDX utility) or ARJE (5719-RJ1) for BSC
  - Series/1 EDX $RJESNA (EDX utility) for SDLC

Additional EDX licensed programs and/or features may be needed depending on functions required.

Minimum Hardware Requirements

- For Compilation/Linking:
  - System/370
- For transmitting load/object modules:
  - System/370
  - Series/1
  - Communications features for the transfer of object code to a Series/1.

Series/1 EDX C Compiler (5799-TPC)

The Series/1 EDX C Compiler runs under the Event Driven Executive Version 6.1 and generates Series/1 object code.

Object modules produced using the Series/1 EDX C Compiler may be link-edited with $EDXLINK on the Series/1. The user can write applications that use C run-times, and write Transaction Processing System routines and Indexed Access Method interfaces all in C without having to code in EDL or Assembler. Advanced Program-to-Program Communications (APPC) interfaces that conform to the Systems Application Architecture (SAA) Common Programming Interface (CPI) for Communications are also supported in C.

Highlights include:

- Supports C language level that is upward compatible to the SAA C language definition
- Supports the SAA CPI for communications to allow C programs to communicate through APPC sessions
- Provides C language interface to existing Series/1 software for Indexed Access Method and Transaction Processing System
- Allows programs to use most of a 64KB address space (8KB required for run-time data area) and allows the use of overlays for programs greater than 64KB
- Allows linkage between EDL, assembler, and C programs when the initial entry point of an application is a C program
- Source programs developed with $FSEDIT
- Supports passthru of Double Byte Character Set (DBCS) data in character strings and comments.

The Series/1 EDX C language provides upward compatibility to SAA C level definition as defined in the SAA C Reference Manual (SC26-4353). The Series/1 EDX C programs will require recompilation to run on IBM SAA systems. With the exception of applications using the Indexed Access Method and Transaction Processing System interfaces, a user should be able to port his application to another system that conforms to SAA with minimal changes.

Programming environment

- Basic Supervisor and Emulator (5719-XS6)
- Event Driven Executive Program Preparation Facility, (5719-XX7)
- Event Driven Executive C Run-Time Library, (5719-EAB)

Additional EDX licensed programs and/or features may be needed depending on functions required.

Minimum Hardware Requirements

For Compilation:

- Processor — IBM 4956, 4955 (Model F only)
  - Storage as required by Event Driven Executive Version 6.1
  - 64KB for the compiler
  - 64KB partition for Run-Time Library
  - 26KB for compiler support routines
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer

For Execution:

- Refer to the hardware requirements for the Series/1 EDX C Run-Time Library (5719-EAB).

Series/1 EDX C Run-Time Library (5719-EAB)

The Series/1 EDX C Run-Time Library provides users of the EDX operating system with the following:

- A reentrant run-time library, allowing multiple applications to run with a single copy of the run-time library. (Minimal storage in the user's partition is used by the library.)
- Standard C run-time support
- Linkage to the Advanced Program-to-Program Communications
- Linkage to the Indexed Access Method
- Linkage to the Transaction Processing System.

Operating System environment

- Basic Supervisor and Emulator (5719-XS6)

Minimum Hardware Requirements

- Processor — IBM 4956, 4954, or 4955
  - Storage as required by Event Driven Executive Version 6.1
  - A default 8KB for the user's stack (program data)
  - An 8KB run-time data buffer area in the user's partition
  - 64KB for the EDX C Run-Time library
  - Partition for user's application (size determined by user)
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer

Additional hardware may be required depending on functions used by the user's applications.

High-level language support - COBOL

COBOL for Event Driven Executive and Realtime Programming System

These COBOL products provide a high-level programming language oriented toward commercial applications:

- **Event Driven Executive COBOL Compiler and Resident Library Version 2 (5719-CB5)**
- **Event Driven Executive COBOL Transient Library Version 2 (5719-CB6)**
- **Realtime Programming System COBOL Compiler and Resident Library Version 2 (5719-CB7)**
- **Realtime Programming System COBOL Transient Library Version 2 (5719-CB8).**

COBOL compilers are available to users of either the Event Driven Executive or Realtime Programming System operating system. Because COBOL for the Series/1 has a high degree of compatibility with COBOL on other IBM systems, the programmer may, within reasonable guidelines, transfer source programs between the Series/1 and other IBM systems, such as the System/370 and the System/34.

The COBOL compilers generate executable object codes and call library subroutines that interact with the operating system. Provided with the COBOL compiler on each Series/1 operating system is a resident library. The COBOL resident library consists of commonly-used subroutines that are combined with a user program through the application builder or linkage editor to form an object program for subsequent execution on Series/1.

The COBOL transient library (separate licensed program) is used in conjunction with the execution of COBOL user programs. Routines in the transient library are loaded only when needed, thus allowing a more efficient utilization of main storage. These routines are reentrant and can also be executed from a shared area in a user partition, or from a shared task set during object program execution.

Program development and productivity aids include: symbolic debug, flow trace, extensive error checking, and error messages at five severity levels.

COBOL for the Series/1 is designed according to the specifications for American National Standard COBOL, X3.23-1974, as understood and interpreted by IBM as of January, 1981, with the exception of the Rerun clause (which is checked for syntactic validity, only). It exceeds the low intermediate level COBOL as defined in FIPS (Federal Information Processing Standard) Pub 21-1. Some of the features above the low intermediate level include support of sort/merge, indexed I/O (packed decimal data), and various extensions of the nucleus features.

These program products are available on either 5.25-inch or 8-inch diskettes.

Programming environment

For compilation:

- Event Driven Executive environment
  - Basic Supervisor and Emulator (5719-XS6)
  - Program Preparation Facility (5719-XX7)
  - Event Driven Executive COBOL Compiler and Resident Library (5719-CB5)
- Realtime Programming System environment
  - Realtime Programming System (5719-PC7)
  - Program Preparation Subsystem (5719-AS7)
  - Realtime Programming System COBOL Compiler and Resident Library (5719-CB7)

For execution:

- Event Driven Executive environment
  - Basic Supervisor and Emulator (5719-XS6)
  - Event Driven Executive COBOL Transient Library (5719-CB6)
- Realtime Programming System environment
  - Realtime Programming System (5719-PC7)
  - Realtime Programming System COBOL Transient Library (5719-CB8)

Minimum hardware requirements

- The minimum hardware requirements are the same as the respective operating system's requirements, with sufficient partition storage available to support a development or execution environment for the user's application, as appropriate.

Host COBOL for the Series/1

Series/1 users who have access to a System/370 may compile their COBOL programs on special compilers that execute on the System/370 under control of OS/VS2 (MVS). Two Host COBOL compilers are available:

- **IBM Host COBOL for the Event Driven Executive Operating System (5799-TEL)**
- **IBM Host COBOL for the Series/1 Realtime Programming System (5799-TEP).**

The level of COBOL supported by both host compilers is equivalent to that available in COBOL Version 2 for the Event Driven Executive and Realtime Programming System. No source modification is required to transfer from host to native compilation.

Host compilation allows the programmer to be more productive by using the larger system for program development.

Highlights include:

- Series/1 object modules produced on System/370
- Interactive compilation capability with access to Structured Programming Facility (SPF) and Time-Sharing Option (TSO) editing
- User options (including source and object listings, cross reference, storage map, statement offset listing, and MAP370 listing).

Programming environment

For compilation:

- System/370 OS/VS2 Multiple Virtual Storage (MVS).

For execution:

- See "COBOL for Event Driven Executive and Realtime Programming System" on page 5-44.

Minimum hardware requirements

For compilation:

- System/370

For execution:

- Series/1
- Communications features for the transfer of object code to the Series/1.

  Note: The mechanism for transferring the object code to the Series/1 and building the user's application program must be provided.

High-level language support - PL/I

Series/1 PL/I

The following programs are available for Series/1 PL/I:

- **Event Driven Executive PL/I Compiler and Resident Library (5719-PL5)**
- **Event Driven Executive PL/I Transient Library (5719-PL6)**
- **Realtime Programming System PL/I Compiler and Resident Library Version 2 (5719-PL2)**
- **Realtime Programming System PL/I Transient Library Version 2 (5719-PL4).**

Series/1 PL/I is a problem-oriented, high-level language that can be used for programming realtime, scientific, problem-solving, and traditional data processing applications as well as advanced applications, such as transaction processing and data base handling. PL/I is aimed at speeding up application development time by making available a wide range of facilities, including error detection and debugging aids. PL/I is available to users of the Realtime Programming System and the Event Driven Executive as separate products for each operating system.

Series/1 PL/I is a subset of American National Standard PL/I (ANSI 3.53 1976), plus additional language functions to support multitasking applications. Functions vary according to the licensed program version selected for the Series/1. However, both operating systems allow:

- Optimized object code
- List-directed and edit-directed stream I/O
- Indexed Access Method support
- Sort/Merge support
- Full screen 4978 and 4979 terminal support
- Communications support.

Series/1 PL/I represents a significant advantage for the Series/1 high-level language user. Entire applications can be written in a high-level language that provides interactive terminal-handling facilities and communications through binary synchronous or start/stop disciplines to other processors and terminals, all using highly-optimized Series/1 code.

Language support is provided through a two-program structure: a compiler, together with a resident library and a transient library.

- The PL/I compiler translates source statements into Series/1 object code.
- The resident library contains frequently used routines that are included in a user program by the application builder or linkage editor.
- The transient library contains less frequently used routines, such as I/O transmission, error handling, and data conversion. These functions are dynamically loaded at execution time, thus permitting storage savings with minimal impact on performance.

This method of dividing the PL/I functions affords the multiple-location Series/1 user with significant economies. The compiler and resident library licensed program can be used at a central source for program development and maintenance, and the object modules, combined with the transient library licensed program, would be used at the outlying locations.

These program products are available on either 5.25-inch or 8-inch diskettes.

Programming environment

For compilation:

- Event Driven Executive environment
  - Basic Supervisor and Emulator (5719-XS6)
  - Program Preparation Facility (5719-XX7)
  - Event Driven Executive PL/I Compiler and Resident Library (5719-PL5)
- Realtime Programming System environment
  - Realtime Programming System (5719-PC7)
  - Program Preparation Subsystem (5719-AS7)
  - Realtime Programming System PL/I Compiler and Resident Library (5719-PL2)

For execution:

- Event Driven Executive environment
  - Basic Supervisor and Emulator (5719-XS6)
  - Event Driven Executive PL/I Transient Library (5719-PL6)
- Realtime Programming System environment
  - Realtime Programming System (5719-PC7)
  - Realtime Programming System PL/I Transient Library (5719-PL4)

Minimum hardware requirements

- The minimum hardware requirements are the same as the respective operating systems requirements with sufficient partition storage available to support a development or execution environment for the user's application, as appropriate.

High-level language support - FORTRAN

FORTRAN IV Compiler and Object Support Library (5719-FO2)

The Event Driven Executive and Realtime Programming System operating systems both support the FORTRAN IV language. This compiler and object support library program is available for either of the operating systems.

Series/1 FORTRAN IV is a high-level, mathematically-oriented language designed to increase application programming productivity. One of the first high-level languages, it has continued to receive wide acceptance because of its easy-to-learn format and computing rules.

Series/1 FORTRAN requires a complementary set of subroutines called Mathematical and Functional Subroutine Library. In addition, an optional Realtime Subroutine Library, which is supported by the Realtime Programming System only, is available in two versions.

Series/1 FORTRAN IV is a subset of American National Standard FORTRAN, X3.9-1966, and includes the American National Standard Basic FORTRAN, X3.10-1966, with the exception of object time formats, adjustable dimensions, complex data type, G-format specifications, and two-level format parenthesis. Series/1 FORTRAN IV also has many language elements not provided by ANS Basic FORTRAN. These extensions adapt FORTRAN to the Series/1 environments and provide greater programming flexibility.

- Multiple program support
- Logical and relational operations
- Bit-level operations
- Direct access I/O
- Additional Read/Write parameters
- Device-independent I/O
- List-directed I/O
- Single and double precision
- Six-character names
- Expanded character set.

The FORTRAN compiler produces object code, maps, and listings. The code emphasizes compact storage and execution speed. The object support library is a group of subroutines designed to be combined, when needed, with the object modules produced by the compiler to form an object program, executable on the Series/1 under control of the Realtime Programming System OR Event Driven Executive supervisor. The library subroutines perform input/output processing, error handling, explicit and implicit service operations and bit manipulation.

FORTRAN-provided diagnostic aids or services assist in program creation and debugging. FORTRAN IV also assists in detecting program data errors and offers several levels of error handling for I/O device errors.

Programming environment

For compilation:

- Event Driven Executive environment
  - Basic Supervisor and Emulator (5719-XS6)
  - Program Preparation Facility (5719-XX7)
  - FORTRAN IV Compiler and Object Support Library (5719-FO2)
- Realtime Programming System environment
  - Realtime Programming System (5719-PC7)
  - Program Preparation Subsystem (5719-AS7)
  - FORTRAN IV Compiler and Object Support Library (5719-FO2)

For execution:

- Event Driven Executive environment
  - Basic Supervisor and Emulator (5719-XS6)
- Realtime Programming System environment
  - Realtime Programming System (5719-PC7)

Minimum hardware requirements

- The minimum hardware requirements are the same as the respective operating systems requirements with sufficient partition storage available to support a development or execution environment for the user's application, as appropriate.

Mathematical and Functional Subroutine Library

The following programs are available:

- **Event Driven Executive Mathematical and Functional Subroutine Library (5719-LM3)**
- **Mathematical and Functional Subroutine Library Version 2 (5719-LM2).**

This set of subroutines is utilized primarily by FORTRAN IV application programs on the Series/1. The library contains subroutines commonly used for mathematical and data conversion functions. Included in the library 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, which 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.
- 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.

Program products 5719-LM3 and 5719-LM2 are available on either 5.25-inch or 8-inch diskettes.

Programming environment

For program preparation:

- Event Driven Executive environment
  - Basic Supervisor and Emulator (5719-XS6)
  - Program preparation Facility (5719-XX7)
  - Event Driven Executive Mathematical and Functional Subroutine Library (5719-LM3),
- Realtime Programming System environment
  - Realtime Programming System (5719-PC7)
  - Program Preparation Subsystem (5719-AS7)
  - Mathematical and Functional Subroutine Library (5719-LM2),

For execution:

- Event Driven Executive Basic Supervisor and Emulator (5719-XS6)

  or
- Realtime Programming System (5719-PC7)

Minimum hardware requirements

- For Event Driven Executive Mathematical and Functional Subroutine Library (5719-LM3), the minimum hardware requirements are the same as the operational system requirements for the Basic Supervisor and Emulator.
- For Mathematical and Functional Subroutine (5719-LM2), the minimum hardware requirements are the same as the requirements for the Realtime Programming System.

FORTRAN IV Realtime Subroutine Library (5719-FO4)

The IBM Series/1 FORTRAN IV Realtime Subroutine Library (Version 2) provides users of the Realtime Programming System who are writing application programs in FORTRAN IV or Series/1 Assembler with additional function suitable to a realtime execution environment. Included are:

- Executive function subroutines that provide the ability to start, stop, or delay the execution of programs
- Process I/O subroutines that access analog and digital points for both input and output
- System service interface subroutines that make system services available to the problem programmer. Examples are attaching/detaching tasks, defining/deleting queues, enqueuing/dequeuing, defining/deleting events and resources, and so on
- Time subroutine that determines the current time of day
- Data subroutine that determines the current calendar date.

Programming environment

For program preparation:

- Realtime Programming System (5719-PC7)
- Program Preparation Subsystem (5719-AS7)
- FORTRAN IV Realtime Subroutine Library (5719-FO4).

For execution:

- Realtime Programming System (5719-PC7).

Minimum hardware requirements

- Series/1 processor with 192KB of storage
- Series/1 disk unit
- Series/1 diskette unit
- Series/1 display
- Series/1 printer.

High-level language support - Pascal

Series/1 Pascal

IBM Series/1 Pascal is a compatible subset of System/370 Pascal/VS (5796-PNQ). Two programs are available for the Series/1:

- **Pascal Compiler and Object Library PRPQ for the Event Driven Executive (5799-TER)**
- **Pascal Compiler and Object Library PRPQ for the Realtime Programming System (5799-TEQ).**

Pascal is high-level programming language capable of supporting a wide variety of applications. Series/1 Pascal I/O support includes sequential and random files, display to user terminals, formatting facilities, and many input/output extensions to Standard Pascal. The Series/1 programs are compatible with the proposed International Standards Organization (ISO) standard as of June 1981, with several extensions.

Each Series/1 PRPQ provides a compiler and object library in a single program. For program development the Pascal compilers interface with the Event Driven Executive session manager and the Realtime Programming System Command Language Facility. Series/1 Pascal includes execution time debugging aids, messages, and tracing. Object code is reentrant. Pascal programs can interface with user programs written in Assembler or Event Driven Language.

Programming Environment

For compilation:

- Event Driven Executive environment
  - Basic Supervisor and Emulator (5719-XS6)
  - Program Preparation Facility (5719-XX7)
  - Pascal Compiler and Object Library PRPQ for EDX (5799-TER).
- Realtime Programming System environment
  - Realtime Programming System (5719-PC7)
  - Program Preparation Subsystem (5719-AS7)
  - Pascal Compiler and Object Library PRPQ for RPS (5799-TEQ).

For execution:

- Event Driven Executive environment
  - Basic Supervisor and Emulator (5719-XS6)
- Realtime Programming System environment
  - Realtime Programming System (5719-PC7).

Minimum hardware requirements

- The minimum hardware requirements are the same as the respective operating systems requirements with sufficient partition storage available to support a development or execution environment for the user's application, as appropriate.
- Floating-point (if application uses real numbers).

Additional system support

Series/1 Intelligent Work Station Version 2 (5799-TNG)

The Series/1 Intelligent Work Station Version 2 provides for the connection of IBM's family of Personal Computers to the IBM Series/1. It supports asynchronous communications between the Personal Computer and the Series/1 in direct-attach and switched-line configurations at speeds of up to 9,600 baud.

Highlights include:

- 3101 Terminal emulation — Allows the Personal Computer to emulate an IBM 3101 Display Terminal in character or block mode.
- Mode switching — Operates in either DOS mode or in terminal emulation mode. It uses a hot key to toggle the computer from one mode to the other. An active DOS program is suspended when the Personal Computer is in terminal emulation mode.
- File transfer — A Series/1 application program can initiate the transfer of files between the Series/1 and a Personal Computer. One may switch to DOS mode and use programs from the IBM Assistant Series, the IBM Accounting Assistant Series, the IBM Business Management Series, or the IBM Personal Decision Series while a file is concurrently being transferred to or from the Series/1. Subroutines for transport data transfer and block checking are provided as part of this program for inclusion in the Series/1 application.
- Direct print — A Series/1 application program may cause printable data to be routed directly to a Personal Computer printer without going through an intermediate file transfer and without operator intervention.
- Outboard formatting — Allows constant data for Series/1 interactive full-screen transactions to be stored on the Personal Computer diskette or disk. This data does not need to be transmitted from the Series/1 each time it is needed.
- Keyboard redefinition — Many of the Personal Computer keys may be redefined to make the keyboard more suitable for an application. This feature allows a single keystroke to generate a string of characters for frequently used commands. Keyboard redefinition is not in effect when switched to DOS mode.
- Color display support — Has four colors in 80 character mode only. The colors are invoked based on the field attributes assigned by the controlling application program.

Series/1 program distribution, licensing, and support

For the IBM Series/1, there are four categories of programming support:

- Licensed program (LP)
- Field-developed program (FDP)
- Installed user program (IUP)
- Programming RPQ (PRPQ).

Licensed Programs

Licensed programs perform an end-use function for the user. Highly specialized task-oriented programs may also be provided as licensed programs.

Licensed programs are distributed through IBM Software Distribution to customers under the terms of the Agreement for IBM Licensed Programs. The majority of Series/1 programs are offered with an option of a continuous monthly charge or a one-time charge with future payments waived. Under either payment option, the licensed program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs. For most Series/1 software offerings, there is a one-time process charge to cover the cost of distribution of basic machine-readable material, including service updates. Customers who have multiple licenses for a program and redistribute within their own enterprise may elect to pay only one process charge.

Depending on the product, Central Services may be included as part of the license fee. These services include the correction of design defects and the distribution of these corrections to users of record. The duration of Central Services varies by program. APARs for products supported by the IBM Support Center are submitted electronically by IBM level 2 personnel. APARs for other products are submitted by mail to the address specified in the product's program directory.

Field-Developed Programs/Installed User Programs

Field-developed programs are licensed programs normally developed by IBM branch office personnel to perform end-use, productivity, or transitional functions for the user. Installed user programs are licensed programs that have been produced by or for an IBM system user and used successfully to perform a variety of user functions. FDPs and IUPs are normally offered with a monthly charge for a fixed number of months with future payments waived at the end of this fixed number of months.

FDPs and IUPs may be announced with or without Central Services.

Programming RPQs

To meet individual customer requirements, IBM offers the following customized programming services:

By means of programming RPQs (Request for Price Quotation), customers may request alterations or additions to available IBM programming. These programming RPQs (PRPQs) will be provided for a charge and may be used in conjunction with Series/1 RPQs to optimize solutions to unique data processing problems.

Correction of design and documentation errors in Series/1 programming RPQs is the responsibility of IBM. This service is available for each programming RPQ for a specified and limited time, at no additional charge. Programming RPQ users may submit APARs to request program error correction. Programming corrections will be distributed to all users of record.

Chapter 6. Series/1 Support Services

Series/1 support continues to underline IBM's commitment to customer service:

- Customer-servicing techniques based on built-in diagnostic aids
- Round-the-clock and across-the-country service and parts availability
- Self-study courses.

As with Series/1 equipment and programming, you select only the particular modules you need for a given installation.

IBM customer engineer support

Maintenance

IBM's serviceability strategies are aimed at minimizing the amount of time and expense incurred to identify and diagnose the failure, repair the defect, verify the correction, and return the system to the customer for use. To support these strategies, IBM customer engineers are provided a number of tools to aid in servicing Series/1.

Integrated maintenance package (IMP)

Maintenance documentation is provided and shipped with each IBM unit.

The integrated maintenance package includes maintenance information manuals, maintenance logic diagrams, theory-diagram manuals, and diagnostic diskettes for each unit that provide detailed information for ease of servicing.

Maintenance Analysis Procedure (MAP) charts for the system and I/O attachments are provided to assist the IBM customer engineer in diagnosing machine failures.

IBM has also developed extensive diagnostic programs for use with Series/1. As an example, the system exercises and tests the IBM I/O devices, their associated I/O attachment features, and the processor functions. The mainline tests are used in conjunction with the MAP charts. They identify failures and direct the customer engineer to the probable failing field-replaceable unit (FRU). Auxiliary tests are provided under computer control to assist the customer engineer in performing timings, adjustments, and calibrations.

All these diagnostics are provided to you with your system. They are shipped (on diskette) with the machine and are, therefore, available for use whenever they are needed.

Special diagnostic tools

Four unique maintenance tools have been developed for use by your customer engineer in servicing your Series/1. These tools are available for the customer engineer's use and are strategically located in branch offices and remote locations, as appropriate, across the country.

Customer Service Maintenance Console: This panel provides all of the functions of the programmer console, and it is packaged in a portable case that can be easily moved from one system to another. If the customer engineer needs the functions of this console for hardware or program problem diagnosis, but a programmer console is not available on the failing system, the IBM customer engineer will use this console to accomplish the problem diagnosis.

Maintenance Program Load Device: The diagnostic programs that are used to isolate machine failures are distributed to the field on diskette. If there is no diskette unit included in the user's configuration and it is necessary to use the diagnostic programs, the customer engineer service representative can provide a portable Maintenance Program Load Device. The unit is be plugged into any available I/O feature location in the system and can be used to load diagnostic programs from diskette.

Signal Tracing and Recording Device: This device is used by the customer engineer to capture intermittent error conditions and to trace I/O channel operations. This tool can be used to record up to 64 words (128 bytes) of information. The customer engineer can install the box and, if appropriate, leave it unattended to trap the intermittent failure. After the failure has occurred, the recorded information can be read out and used to reconstruct the sequence of events that led up to the failure. Using this information, the customer engineer can more effectively define the failure and then replace the appropriate field-replaceable unit or take other necessary remedial action.

Communications Indicator Panel: This panel provides a visual display of various stages, conditions, and interface lines associated with the communications attachments (for example, data set ready, data terminal ready, request to send, clear to send).

Additional maintenance support

In the event that an IBM customer engineer requires diagnostic support in addition to all of the on-site items, a support structure is available to call upon when needed. Support personnel for each machine type are located in IBM branch offices and/or within the geographic region to provide assistance to the on-site customer engineer.

The customer engineer interfaces with RETAIN (a data base containing known problems) by calling the Boca Raton Service Planning and Support Group for assistance. The customer engineer discusses the failure symptoms with a service planning representative who enters the information into RETAIN. Fixes are verbally communicated to the customer engineer.

The Teleprocessing Support Center provides specialized diagnostic phone assistance and computerized testing of teleprocessing devices (non-SDLC). Plant assistance is provided by the IBM Service Planning and Support Groups, including direct interface to IBM engineering groups as required.

Repair parts are stored in strategically located Field Distribution Centers (FDCs) to support the IBM customer engineers who provide warranty and maintenance agreement (MA) service on Series/1. IBM's Parts Inventory Management System (PIMS) maintains a computerized online inventory of all of the parts-stocking locations to ensure that parts are available.

Maintenance agreement: Series/1 elements undergo extensive testing during and after manufacture to ensure that the equipment you receive will serve you properly. To continue this support, IBM recommends the IBM Maintenance Agreement at the conclusion of your 90-day parts and labor warranty. The IBM MA provides maintenance coverage 24 hours a day, seven days a week. Travel by private auto or scheduled public transportation during hours of MA coverage will not result in any additional charge.

Engineering changes: IBM provides engineering changes for Series/1 under the same terms and conditions as is done for other IBM products.

Safety, new production, and quality changes are provided at no charge for parts or labor whether or not a customer has an IBM Maintenance Agreement.

Maintenance reduction changes will also be provided at no additional charge to IBM customers with an MA and will be available to non-MA customers on a charge basis.

On machines with an IBM MA, IBM will order and automatically ship appropriate engineering changes (ECs). The IBM customer engineer will install the changes and update all appropriate documentation and history. There will be no additional charge for this service. On machines without an IBM MA, customers can subscribe to IBM customer engineering memorandums and engineering change announcements, which will notify them of the availability of ECs. Customers can order the ECs as they choose. When the ECs arrive, the customer can notify IBM of their availability and an IBM customer engineer will install the change and update the appropriate documentation. There will be no charge for parts or labor except maintenance reduction ECs.

Other IBM customer engineer support

Physical planning for Series/1 is a customer responsibility. However, IBM customer engineer physical planning assistance can offer significant benefits and should be considered for the first several installations of every Series/1 customer order. This assistance is available for a fee under two offerings:

1. Fixed-price agreement — IBM will provide advice and direction regarding physical planning activities. The customer will receive a *completed* and *personalized* Customer Site Preparation Guide that can be used as a reference for future installations that will normally be done by the customer. The customer will be billed a fixed fee; hence, expenses can be accurately budgeted.
2. Per call — IBM will provide advice, counsel, and clarification of information contained in the *IBM Series/1 Customer Site Preparation Manual*, GA34-0050. The customer will be billed at the hourly rate for the assistance, including travel time and expense.

Teleprocessing systems services

Teleprocessing systems services are available to IBM teleprocessing customers having an IBM processor with an IBM communications adapter and remote IBM terminals serviced under a maintenance agreement.

This work scope includes:

- Problem determination caused by non-IBM modem/data set failure
- Standby diagnostic assistance for data communication lines and non-IBM modems/data sets
- Requests to other vendors by IBM for service on data communication lines and non-IBM modems/data sets
- Installation coordination for data communication lines and non-IBM modems/data sets.

Additional IBM customer services

Special Product Engineering Services

Special Product Engineering Services are offered by IBM to help customers install their IBM Series/1 sensor-based application. The sensor-based subsystem is defined as that portion of the sensor-based system between the customer access area of the sensor-based system and the customer process or equipment, and includes the instrumentation and the interconnections at both ends.

After the customer and the IBM marketing representative have established the application requirements, Special Product Engineering Services will, in conjunction with their offerings, meet with the customer. They will inspect the customer's facilities and review the customer's application plans and functional concepts of the subsystem.

Having established the functional requirements for the subsystem, the customer may then elect to contract with IBM under a fixed-price offering for the type of installation services required. Special Product Engineering Services include:

- Subsystem definition—Definition documentation to meet particular subsystem requirements. Includes description of needed hardware and modifications to the customer's existing equipment as well as installation and checkout instructions.
- Installation guidance service—On-site technical guidance during installation and checkout of the subsystem and, at the customer's option, development of the subsystem installation plan.
- Customized equipment design and procurement—Provide, through subcontractors, special equipment, terminals, and interface panels for use with Series/1.
- Installation management—Define the sensor-based subsystem and, through subcontractors, assume responsibility for the physical installation and checkout of the subsystem.

Sensor-Based System Services

Sensor-Based System Services are offered under a special contract.

Sensor-Based System Services include:

- Instrumentation problem determination—Isolation of the cause of failure to the instrumentation that is attached to this machine to the extent that such isolation can be made at the machine interface.
- Sensor-based diagnostic assistance—Diagnostic assistance or standby on the repair of interconnecting lines and instrumentation that is attached to this machine. Includes running of system tests, interpreting their output and verifying proper signal levels at the machine interface. This service is to be requested of and provided by IBM only when the cause of failure within the interconnecting lines or instrumentation cannot be independently determined.
- Requesting of sensor-based vendor service—Making of arrangements and requests for service directly with vendors, for service of interconnecting lines and instrumentation that is attached to this machine. Customer must previously notify respective vendors that requests for service on the customer's system will be received directly from IBM (not available per call).
- Sensor-based installation coordination—Generation and maintenance of a schedule for installation, system integration, and testing of interconnecting lines and instrumentation that is to be attached to this machine. Includes periodic review of schedule changes with the customer and appropriate notification to affected IBM locations (not available per call).

IBM Support Center

The IBM Support Center (1-800-237-5511) provides defect-oriented support for licensed users, of supported releases of designated IBM licensed programs, experiencing problems. Assistance is provided 24 hours daily, 7 days per week for problem reporting, problem management, status information, problem source identification assistance, identifying known problems, and problem correction assistance. In-depth problem correction support is provided in a call-back mode from 8:30 a.m. to 6 p.m., Eastern time, Monday through Friday (except national holidays). Current and subsequent versions of Event Driven Executive and Realtime Programming System and selected licensed programs supported by Central Service that operate in conjunction with them, are eligible for this service.

The IBM Support Center is designed to meet the customer's responsibility to perform problem determination and problem source identification. The customer should attempt to identify the source of programming problems by following procedures outlined in the Problem Determination Guide. The National Service Division customer engineer is available for problem determination assistance, and the IBM Support Center provides problem source identification assistance.

When contacting the IBM Support Center, customers need the access code that has been assigned to their installation; this code identifies them as an eligible user of the support center. The access code is normally provided by the customer's IBM marketing representative.

A complete listing of Series/1 software components and their support classifications is included in the IBM *Programming Systems General Information Manual* (PSGIM), G229-2228. An explanation of the IBM Support Center and its functions is included in the IBM *Series/1 Software Service Guide*, GC34-0099.

Series/1 education

Customers may enroll in classroom courses or order self-study courses by calling 1-800-IBM-2468. For additional information on Series/1 education, please call the above toll-free number or consult the *Catalog of IBM Education*, (G320-1244).

IBM Series/1 Multiline Communications Coprocessor

S3517, approximately 3.5 days

This classroom course provides information to developers of applications using the IBM Series/1 Multiline Communications Coprocessor. The coprocessor provides a high-level interface to allow programmers to write programs using the SDLC, SYNC, and ASYNC protocols quickly and efficiently within its 1MB RAM storage.

3270 Operation and Design

I0031, approximately 28 hours

This course explains the content and formation of 3270 data streams, remote and local operations, and 3270 configurations and screen design.

ANS '74 COBOL Language Fundamentals

SS126, approximately 25 hours

This course develops the skills needed to code programs using ANS '74 COBOL.

ANS '74 COBOL Programming

SS127, approximately 36 hours

This course covers language specifications common to systems designed according to the ANS COBOL, X3.23 standard.

Using Event Driven Executive and Event Driven Language on the Series/1

32919, approximately 30 hours

This course teaches the student to operate the Series/1 under Event Driven Executive. This is accomplished by writing, debugging, and executing programs; using the Event Driven Executive utilities to allocate, create, and maintain files; generating a tailored supervisor, and using and updating the Session Manager.

SNA Fundamentals

32501, approximately 12 to 16 hours

This course teaches fundamentals of SNA, functions of SNA components, and use of SNA commands.

Index

A

ACC (see asynchronous communications)
additional IBM customer services 6-5
additional I/O feature locations 4-3
additional maintenance support 6-3
address bus 2-9
addressing main storage 2-3
Advanced Remote Job Entry 5-10, 5-35
ANS '74 COBOL Language Fundamentals 6-9
ANS '74 COBOL Programming 6-9
Application programming
  Event Driven Executive 5-23
  Intelligent Work Station 5-52
  Realtime Programming System 5-38
architecture 2-1
asynchronous communications (ACC) 3-21
attachment features 2-2
  General Purpose Interface Bus (GPIB) Adapter 3-13
  GPIB Adapter 3-16
  Integrated Digital Input/Output Non-Isolated 3-13
  Multidrop Work Station Attachment 3-16
  Multifunction Attachment 3-14
  Printer Attachment - 5200 Series 3-15
  Programmable Cycle-Stealing Digital Input/Digital Output Attachment 3-13
  Programmable Subsystem Controller (RPQ D02761) 3-16
  Teletypewriter Adapter 3-13
  Timers 3-13
automatic restart 2-12

B

Basic Supervisor and Emulator (5719-XS6) 5-3
basic supervisor, Realtime Programming System 5-25
basic system functions, Event Driven Executive 5-3
  Basic Supervisor and Emulator (5719-XS6) 5-3
basic system functions, Realtime Programming System 5-25
binary synchronous communications (BSC) 3-20
BSC (see binary synchronous communications
bus
  address 2-9
  data 2-9

C

C Language 5-40
  EDX C Compiler 5-42
  EDX Run-Time Library 5-43
  Host C Compiler for Series/1 Event Driven Executive 5-40
chaining 2-9
checking circuits 2-11
class interrupts 2-8
classroom course 6-8
  IBM Series/1 Multiline Communications Coprocessor 6-8
COBOL 5-44
COBOL for Event Driven Executive and Realtime Programming System 5-44
COBOL for Event Driven Executive and the Realtime Programming System 5-44
command chaining 2-9
commercial support, Event Driven Executive 5-21
  Indexed Access Method 5-21
  Sort/Merge 5-22
commercial support, Realtime Programming System
  Indexed Access Method 5-26
  Sort/Merge 5-37
communications features 3-19
  asynchronous (ACC) features 3-21
  Binary synchronous (BSC) features 3-20
  communications support features 3-25
  feature-programmable multiline communications features 3-21
  Multiline Communications Coprocessor 3-24
  other communications features 3-25
  Synchronous Communications Single-Line Control/High Speed 3-22
  synchronous (SDLC) features 3-20
  Token-Ring Card 3-23
  4988 Communications Unit 3-25
Communications Manager 5-26
communications support features 3-25
communications support, EDX
  Advanced Remote Job Entry 5-10
  Network Definition Utility 5-15
  Outboard Processing Tools Programming RPQ 5-18
  Primary SNA 5-14
  Remote Manager 5-11
  Systems Network Architecture RJE Program 5-19
  Systems Network Architecture Version 2 5-13
  Token-Ring Interface Program 5-16
  X.25/HDLC Communications Support 5-19
communications support, RPS
  Advanced Remote Job Entry 5-35
  Communications Manager 5-26
  MAP Communications Server 5-34
  Programmable Communications Subsystem 5-31
  Programmable Communications Subsystem Preparation Facility 5-32
  Remote Manager 5-26
  X.25/HDLC Communications Support 5-33

communications, programmable subsystem 4-34
condition codes 2-11
configurations, 5200 Series printers 3-15
control lines 2-9
courses (see education)
customer engineer support 6-2
  additional maintenance support 6-3
  maintenance 6-2
  other 6-4
  special diagnostic tools 6-2
  teleprocessing systems services 6-4
cycle-steal operations 2-9

D

data
  bus 2-9
  chaining 2-9
  integrity 2-11
  stacking 2-5
Data channel 2-8
device attachment features 4-35
device support, Event Driven Executive 5-20
  System/370 Channel Attach Support 5-20
device support, RPS 5-36
  System/370 Channel Attach Support 5-36
direct program control operations 2-8
disk units
  overview 1-5
  4963 4-5
  4967 4-11
diskette units
  overview 1-5
  4964 4-7
display stations
  overview 1-6
  3151 4-26
  3163 4-30
  3164 4-32
double-vectored interrupt addressing 2-8
D02013 3-25
D02118 3-13
D02241 3-25
D02242 3-25
D02288 3-13
D02349 3-25
D02350 3-25
D02761 3-16
D02764 3-25
D02856 1-4
D02857 1-4

E

education
  self-study courses 6-9
EDX C Compiler 5-42
EDX C Run-Time Library 5-43
EDX (see Event Driven Executive)
engineering changes 6-3
Event Driven Executive
  Advanced Remote Job Entry 5-10
  application programming 5-23
  Basic Supervisor and Emulator (5719-XS6) 5-3
  basic system functions 5-3
  commercial support 5-21
  description 5-2
  device support 5-20
  General Purpose Automation
    Executive-Distributive 5-23
  Host Preparation Facility 5-8
  Indexed Access Method 5-21
  Macro Assembler 5-7
  Macro Library 5-7
  Macro Library/Host 5-8
  Network Definition Utility 5-15
  Outboard Processing Tools Programming RPQ 5-18
  Primary SNA 5-14
  program development 5-6
  Program Preparation Facility 5-6
  Remote Manager 5-11
  Sort/Merge 5-22
  Systems Network Architecture RJE Program 5-19
  Systems Network Architecture Version 2 5-13
  System/370 Channel Attach Support 5-20
  Token-Ring Interface Program 5-16
  X.25/HDLC Communications Support 5-19
executive overview 1-1
expansion unit, 4959 I/O 4-3
  capabilities 4-3

F

feature locations, I/O 4-3
feature-programmable multiline communications features 3-21
features, by number
  D02013 3-18, 3-25
  D02118 3-13, 3-16
  D02241 3-25
  D02242 3-25
  D02288 3-13
  D02349 3-25
  D02350 3-25
  D02761 3-16
  D02764 3-25
  D02856 1-4, 2-2, 3-9
  D02857 1-4, 2-2, 3-9
  1200 3-25
  1220 4-13
  1250 3-16
  1300 4-34
  1310 3-14
  1400 3-25
  1560 3-13

features, by number *(continued)*
1565 4-3, 4-9
1590 4-39
1610 3-21
2000 3-25
2074 3-20
2075 3-20
2080 3-22
2090 3-20
2091 3-21
2092 3-21
2093 3-20
2094 3-20
2095 3-21
2096 3-21
2200 3-18, 3-23
2201 3-18, 3-23
2840 3-24
2841 3-18, 3-24
2842 3-18, 3-24
2843 3-18, 3-24
2844 3-18, 3-24
3000 4-15, 4-17
3581 4-6
3590 4-5
3595 4-11
3596 4-11
3925 3-3, 3-7
3926 3-5, 3-7
4000 (for Proprinter) 4-15, 4-17
4110 3-7, 3-9
4115 3-7, 3-9, 4-9
4116 3-7, 3-9, 4-9
4172 3-7, 3-9, 4-9
4173 3-7, 3-9, 4-9
4521 3-7, 3-9
4540 4-6, 4-39
4730 4-35
4734 4-35
4740 4-35
5640 3-15
5655 3-3, 3-5, 3-7, 3-9, 3-11
6330 3-5
6331 3-5
6334 3-5, 3-7
7777 4-3
7840 3-13
7850 3-13
feature, attachment (see attachment features)
feature, communications (see communications features)
field-developed programs/installed user programs 5-53
FORTRAN 5-48
FORTRAN IV Compiler and Object Support Library 5-48
FORTRAN IV Realtime Subroutine Library 5-50
Mathematical and Functional Subroutine Library 5-49

G

General Purpose Automation Executive-Distributive 5-23
General Purpose Interface Bus (GPIB) Adapter 3-13
GPIB Adapter 3-16

H

half-duplex mode 3-22
high-level language support 5-39
C Language 5-40
COBOL 5-44
COBOL for Event Driven Executive and Realtime Programming System 5-44
EDX C Compiler 5-42
EDX Run-Time Library 5-43
FORTRAN 5-48
Host C Compiler for Series/1 Event Driven Executive 5-40
Host COBOL for the Series/1 5-45
Mathematical and Functional Subroutine Library 5-49
Pascal 5-51
PL/I 5-46
Realtime Subroutine Library 5-50
Series/1 FORTRAN IV 5-48
Series/1 PL/I 5-46
Host C Compiler for Series/1 Event Driven Executive 5-40
Host COBOL for the Series/1 5-45
Host Preparation Facility 5-8, 5-30

I

Indexed Access Method 5-21, 5-26
Input/Output and System Support Units 4-1
instruction set 2-4
instruction set summary 2-5
Integrated Digital Input/Output Non-Isolated 3-13
integrated maintenance package (IMP) 6-2
integrity of data 2-11
Intelligent Work Station 5-52
interrupt
addressing, double-vectored 2-8
class 2-8
priority 2-8
servicing 2-9
status byte 2-11
structure 2-8
trace class 2-8
I/O expansion unit
4959 4-3

L

licensed programs 5-53

lines, control 2-9
linkage stacking 2-5

M

Macro Assembler 5-7
Macro Library 5-7
Macro Library/Host 5-8
main storage 2-3
maintenance 6-2
maintenance agreement 6-3
MAP Communications Server (Realtime Programming System) 5-34
Mathematical and Functional Subroutine Library 5-49
maximum I/O feature locations 4-3
microdiagnostic routines 2-11
Multidrop Work Station Attachment 3-16
Multifunction Attachment 3-14
Multiline Communications Coprocessor 3-24
  Multiline Communications Coprocessor 3-24
Multiplexer

N

Network Definition Utility 5-15

O

Outboard Processing Tools Programming RPQ 5-18
overview
  architecture 1-3
  communications 1-6
  customer engineers 1-7
  data collection 1-6
  diskette units 1-5
  display stations 1-6
  I/O and system support units 1-5
  printers 1-5
  processors and features 1-3
  programming support 1-6
  racks and enclosures 1-6
  support services 1-7
  system design 2-2
  tape units 1-5

P

parity checking 2-11
Pascal 5-51
PL/I 5-46
power verification 2-12
power/thermal failure 2-12
Primary SNA 5-14
Printer Attachment - 5200 Series 3-15
printers
  overview 1-5
  4201 4-15
  4202 4-17
printers *(continued)*
  4224 4-19
  4234 4-21
  5225 4-23
  5262 4-25
priority interrupts 2-8
processor structure 2-3
processors
  4956 Model B10 3-2
  4956 Model E10 3-4
  4956 Model J00 3-8
  4956 Model K00 3-10
  4956 Models G10 and H10 3-6
  4959 4-2
processors and features 3-1
program development, EDX 5-6
  Host Preparation Facility 5-8
  Macro Assembler 5-7
  Macro Library 5-7
  Macro Library/Host 5-8
  Program Preparation Facility 5-6
program development, Realtime Programming System 5-28
  Host Preparation Facility 5-30
  Program Preparation Subsystem 5-28
program distribution, licensing, and support 5-53
  field-developed programs/installed user programs 5-53
  licensed programs 5-53
  programming RPQs 5-53
program polling 2-8
Program Preparation Facility 5-6
Program Preparation Subsystem 5-28
programmable communications subsystem 4-34
  device attachment features 4-35
Programmable Communications Subsystem Execution Support 5-31
Programmable Communications Subsystem Preparation Facility 5-32
Programmable Cycle-Stealing Digital Input/Digital Output Attachment 3-13
Programmable Subsystem Controller (RPQ D02761) 3-16
programming RPQs 5-53
programming support
  Event Driven Executive 5-2
    basic system functions 5-3
    commercial support 5-21
    device support 5-20
    program development 5-6
  high-level language support 5-39
  Realtime Programming System 5-24
    basic system functions 5-25
    program development 5-28

Q

Query

R

rack enclosure, 4997 4-39
Realtime Programming System
  Advanced Remote Job Entry 5-35
  application programming 5-38
  basic supervisor 5-25
  basic system functions 5-25
  commercial support 5-37
  Communications Manager 5-26
  description 5-24
  device support 5-36
  Host Preparation Facility 5-30
  Indexed Access Method 5-26
  MAP Communications Server 5-34
  program development 5-28
  Program Preparation Subsystem 5-28
  Programmable Communications Subsystem Execution Support 5-31
  Programmable Communications Subsystem Preparation Facility 5-32
  Remote Manager 5-26
  Series/1 Data Entry System (S1DES) 5-38
  Sort/Merge 5-37
  System/370 Channel Attach Support 5-36
  X.25/HDLC Communications Support 5-33
Realtime Subroutine Library 5-50
redundancy checking 2-12
registers 2-4
reliability, availability, and serviceability 2-11
  automatic restart 2-12
  condition codes 2-11
  interrupt status byte 2-11
  microdiagnostic routines 2-11
  parity checking 2-11
  power/thermal failure 2-12
  redundancy checking 2-12
Remote Manager 5-11, 5-26
RPS (see Realtime Programming System)

S

SDLC (see synchronous communications)
self-study courses 6-9
  ANS '74 COBOL Language Fundamentals 6-9
  ANS '74 COBOL Programming 6-9
  3270 Operation and Design 6-9
Sensor-Based System Services 6-5
Series/1 architecture 2-1
  processor structure 2-3
  reliability, availability, and serviceability · 2-11
  system design 2-2
Series/1 Data Entry System (S1DES)
  Realtime Programming System 5-38
Series/1 education (see education)
Series/1 FORTRAN IV 5-48
Series/1 PL/I 5-46
Series/1 support services 6-1
Series/1-System/370 termination enclosure, 4993 4-37
Sort/Merge 5-22, 5-37
special diagnostic tools 6-2
Special Product Engineering Services 6-5
stacking
  data 2-5
  linkage 2-5
storage mapping 2-3
storage protection 2-3
supervisor state 2-4
Synchronous Communications Single-Line Control/High Speed 3-22
synchronous communications (SDLC) 3-20
system design overview 2-2
  attachment features 2-2
  flexibility 2-2
  I/O capacity 2-2
  racks 2-2
  stand-alone enclosure 2-2
  technology 2-2
Systems Network Architecture RJE Program 5-19
Systems Network Architecture Version 2 5-13
  Event Driven Executive Network Definition Utility 5-15
  Event Driven Executive Primary SNA 5-14
  Event Driven Executive SNA Version 2 5-13
System/370 Channel Attach Support 5-20, 5-36
S1DES
  Realtime Programming System 5-38

T

tape units
  overview 1-5
  4968 4-13
teleprocessing systems services 6-4
Teletypewriter Adapter 3-13
terminals (see display stations)
Timers 3-13
Token-Ring
  Token-Ring card 3-23
Token-Ring Attachment Card 3-23
Token-Ring Interface Program 5-16
trace class interrupt 2-8

X

X.25/HDLC Communications Support 5-19, 5-33

Numerics

1200 3-25
1220 4-13

1250 3-16
1300 4-34
1310 3-14
1400 3-25
1560 3-13
1565 4-3, 4-9
1590 4-39
1610 3-21
2000 3-25
2074 3-20
2075 3-20
2080 3-22
2090 3-20
2091 3-21
2092 3-21
2093 3-20
2094 3-20
2095 3-21
2096 3-21
2200 3-18
2201 3-18
2840 3-24
2841 3-18
2842 3-18
2843 3-18
2844 3-18
3000 4-15, 4-17
3151 Display Station 4-26
3163 Display Station 4-30
3164 Display Station 4-32
3270 Operation and Design 6-9
3581 4-6
3590 4-5
3595 4-11
3596 4-11
3600 4-34
3925 3-3, 3-7
3926 3-5, 3-7
4000 (for Proprinter) 4-15, 4-17
4110 3-7, 3-9
4115 3-7, 3-9, 4-9
4116 3-7, 3-9, 4-9
4172 3-7
4173 3-7
4201 Proprinter 4-15
4202 Proprinter XL 4-17
4224 Printer 4-19
4234 Printer (Model 2) 4-21
4521 3-7, 3-9
4540 4-6, 4-39
4730 4-35
4734 4-35
4740 4-35
4956 Model B10 Processor 3-2
4956 Model E10 Processor 3-4
4956 Model J00 Processor 3-8
4956 Model K00 Processor 3-10
4956 Models G10 and H10 Processors 3-6
4959 I/O expansion unit 4-2, 4-3
4963 Disk Subsystem 4-5
4964 Diskette Unit 4-7
4965 Storage and I/O Expansion Unit (Model E00) 4-9
4967 High-Performance Disk Subsystem 4-11
4968 Autoload Streaming Magnetic Tape Unit 4-13
4987 Programmable Communications Subsystem 4-34
4988 Communications Unit 3-25
4993 Series/1-System/370 Termination Enclosure 4-37
4997 Rack Enclosure 4-39
5200 Series, Printer Attachment 3-15
5225 Printer 4-23
5262 Printer 4-25
5640 3-15
5655 3-3, 3-5, 3-7, 3-9, 3-11
5719-AM4 5-21
5719-ASA 5-7
5719-AS7 5-28
5719-CA1 5-36
5719-CB5 5-44
5719-CB6 5-44
5719-CB7 5-44
5719-CB8 5-44
5719-CF2 5-12
5719-CS0 5-32
5719-CS2 5-31
5719-CX1 5-20
5719-EAB 5-43
5719-EAC 5-16
5719-FO2 5-48
5719-FO4 5-50
5719-HD1 5-33
5719-HD2 5-19
5719-LMA 5-7
5719-LM2 5-49
5719-LM3 5-49
5719-PC7 5-25
5719-PL2 5-46
5719-PL4 5-46
5719-PL5 5-46
5719-PL6 5-46
5719-RJ1 5-10
5719-RJ6 5-35
5719-RM1 5-11
5719-SM1 5-37
5719-SM2 5-22
5719-SX2 5-19
5719-TR6 5-29
5719-XS6 5-3
5719-XT4 5-14
5719-XT5 5-15
5719-XX7 5-6
5719-XX9 5-13
5740-EAA 5-40

5740-LM7 5-8
5796-ZDE 5-38
5798-FAS 5-23
5799-BNA 5-8, 5-30
5799-CJL 5-18
5799-TEL 5-45
5799-TEP 5-45
5799-TEQ 5-51
5799-TER 5-51
5799-TNG 5-52
5799-TPC 5-42
5799-XT2 5-34
6330 3-5
6331 3-5
6334 3-5, 3-7
7777 4-3
7840 3-13
7850 3-13

IBM Series/1 Digest

READER'S COMMENT FORM

Order No. G360-0061-12

This manual is part of a library that serves as a reference source for systems analysts, programmers, and operators of IBM systems. You may use this form to communicate your comments about this publication, its organization, or subject matter, with the understanding that IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you. Your comments will be sent to the author's department for whatever review and action, if any, are deemed appropriate.

Note: *Copies of IBM publications are not stocked at the location to which this form is addressed. Please direct any requests for copies of publications, or for assistance in using your IBM system, to your IBM representative or to the IBM branch office serving your locality.*

Note: Staples can cause problems with automated mail sorting equipment.
Please use pressure sensitive or other gummed tape to seal this form.

Thank you for your cooperation. No postage stamp necessary if mailed in the U.S.A. (Elsewhere, an IBM office or representative will be happy to forward your comments or you may mail directly to the address in the Edition Notice on the back of the title page.)

G360-0061-12
Printed in U.S.A.

Reader's Comment Form

—Cut or Fold Along Line—

Fold and tape | Please Do Not Staple | Fold and tape

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 40 ARMONK, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE:

International Business Machines Corporation
Information Development, Department 4S5
1218 (Internal Zip)
P.O. Box 1328
Boca Raton, Florida 33429-9960

Fold and tape | Please Do Not Staple | Fold and tape

IBM®

IBM

International Business Machines Corporation

G360-0061-12
Printed in U.S.A.