Section 11: IBM Personal Computer

Announced August 12, 1981

11:05 IBM Personal Computer Configuration Overview

Introduction

The IBM Personal Computer is a versatile, general-purpose system that supports a wide range of processing environments. It can be used in home, educational, or any size business environment. Four IBM-logo operating systems, several programming languages, and hundreds of application programs (IBM-logo and vendor-logo) are available for this configuration.

An IBM Personal Computer in the home can be a stand-alone system or can use telecommunications to communicate with another computer system. It can execute entertainment, educational, business, word processing, simple and advanced graphics, program development, personal productivity, and remote inquiry application programs. Many of these programs are suitable for a business as well as a home environment.

An IBM Personal Computer in an educational or business environment can be a stand-alone system, cable-connected to other local computer systems, or configured to communicate with remote computer systems via telecommunications. A wide variety of educational, traditional general business (accounts payable, accounts receivable, payroll, inventory control, for example), advanced word processing, and business specific application programs are provided for these environments.

In addition, the hardware and programming provided by the IBM Personal Computer Engineering/Scientific (PC/ES) Series and the graphics hardware and programs available support use of the IBM Personal Computer in business, engineering, and science applications, such as advanced text processing, presentation graphics, computer-aided design, computer-aided engineering, laboratory automation, and numerical analysis.

The IBM Personal Computer can be interconnected via cable with other local IBM personal computers to form a clustered multiuser configuration in which users share a fixed disk and can exchange messages and data. Displaywriters can be included in the cluster via cable attachment to the personal computers.

The IBM Personal Computer can also be included in an IBM PC Network, which is a low-cost local area network that supports the cable interconnection of IBM personal computers. Peer-to-peer communication among the personal computers and resource (file and printer) sharing are supported by the IBM PC Network Program. File transfer, print functions, and message transfer are provided.

The IBM PC Network supports the interconnection of a larger number of IBM personal computers than a clustered configuration and offers additional program-supported functions, including sharing the use of SNA/SDLC communications for access to host processors, sharing the use of 3820 Page Printers, and connection to Series/1 processors.

The IBM Personal Computer can communicate with remote IBM personal computer configurations directly via communications lines or via diskette interchange.

The IBM Personal Computer can also be connected to various local or remote processors (System/370, 30XX, 4300, Series/1, 8100, and System 34/36/38, for example) in order to be used as an intelligent workstation and as a personal computer. Using appropriate programming support, the IBM Personal Computer can emulate several different kinds of workstation. Access to remote information services, such as THE SOURCE (service mark of the Source Telecomputing Corporation, a subsidiary of the Reader's Digest Association, Inc.) and CompuServe™, is also supported and the IBM Personal Computer can be used as a videotex terminal.

Hardware features and programming support enable the IBM Personal Computer to be connected to and communicate with various IBM office systems. Multiple IBM Personal Computers can be cable-attached to a 5520 Administrative System to emulate 5253 Display Stations. The IBM Personal Computer can exchange documents with remote Displaywriter, 6670 Information Distributor, 5520 Administrative System, and Office System 6 configurations as well as with other IBM personal computers.

In addition, document exchange between a cable-connected Displaywriter and IBM Personal Computer configuration is supported and an IBM Personal Computer can communicate with DISOSS/370 in a host processor using Personal Services/PC.

Support of word processing functions for an IBM Personal Computer connected to an 8100 Information System is provided, as is communication between an IBM Personal Computer and a host VM/370 PROFS system. Other programming support (DisplayWrite Series) provides document

processing capabilities for a stand-alone IBM Personal Computer similar to facilities provided for a Displaywriter system. Direct document exchange between IBM personal computers is also supported using Personal Services/PC.

Using the Copier Management Information System (CMIS) program, the IBM Personal Computer can manage up to 20 IBM and/or selected Xerox copiers that are connected to the IBM Personal Computer. This system can be used to control access to the copiers managed by CMIS and to obtain copier usage statistics.

Most application programs that execute under the IBM Personal Computer Disk Operating System in the IBM Personal Computer can also execute in other IBM personal computers that have the required hardware resources.

The IBM Personal Computer configuration is designed for those who require more hardware features, online storage, and/or numbers and types of I/O devices than are available for a PCjr configuration but who do not anticipate the need for fixed disk storage or more than five expansion slots for standard and optional features in their initial configuration. If, however, fixed disk storage and more slots are required at a later time, they can be added to an IBM Personal Computer configuration by installing the 5161 Expansion Unit. A large number optional features are available that permit this configuration to be expanded as processing needs increase.

Physical Components

The IBM-logo personal computer units that can be included in an IBM Personal Computer configuration are the following:

- 5150 System Unit/Keyboard Models 104, 166, and 176 (currently available models)
- 5150 System Unit Models X66 and X76 (these models have no keyboard and are designed to be used only with the IBM 3270 Personal Computer Attachment for the 3278 or 3279)
- 5161 Expansion Unit Model 1 (provides fixed disk storage and additional space for optional features)
- 5151 Monochrome Display Model 1
- 5153 Color Display Model 1
- 5154 Enhanced Color Display Model 1
- 5175 Professional Graphics Display Model 1 (5161 Expansion Unit required)
- 5152 Graphics Printer Model 2
- 5181 Compact Printer Model 1
- 5182 Color Printer Model 1
- 5201 QUIETWRITER® Printer
- 5216 Wheelprinter Model 2
- 5152 Matrix Printer Model 1 (no longer marketed by IBM)
- 7371 and 7372 Color Plotters

The IBM Personal Computer can also be connected to various processors and other I/O devices (both IBM- and vendor-logo).

Minimum Configuration

Every stand-alone IBM Personal Computer configuration must include one 5150 System Unit/Keyboard and one display device. The minimum IBM Personal Computer configuration consists of the following:

- One 5150 System Unit/Keyboard Model 104, which has 64Kb of random access memory and no diskette drive
- One display, which can be any one of the following:
  - 5151 Monochrome Display (Monochrome Display and Printer Adapter or Enhanced Graphics Adapter required)
  - 5153 Color Display (Color/Graphics Monitor Adapter or Enhanced Graphics Adapter required)
  - Customer-supplied direct drive or composite video color or black and white video monitor (Color/Graphics Monitor Adapter required)
  - Customer-supplied color or black and white television set with an RF (radio frequency) modulator (Color/Graphics Monitor Adapter required)

This limited configuration supports stand-alone operations using only the BASIC Interpreter in read only memory of the 5150 System Unit. Input is supplied via the keyboard and output can be shown on the display. The IBM Personal Computer Disk Operating System (DOS) requires one diskette drive and cannot be used in this stand-alone configuration.

The price of a single minimum 5150 hardware configuration, 5150 Model 104 with a TV attached to Color/Graphics Monitor Adapter, is $1634. The price for a single minimum stand-alone 5150 hardware configuration for use with DOS (includes one double-sided diskette drive, the diskette adapter, and a TV attached to the Color/Graphics Monitor Adapter) is $2184. The TV set price is not included in either minimum price.

Configuration Features

The following highlights the features of 5150 configurations, including memory sizes, types and maximum number of attachable I/O devices, and processors/units to which a 5150 configuration can be connected.

- One 5150 System Unit/Keyboard with the Intel 8088 16-bit microprocessor
- Math Co-processor Option available to increase the speed and precision of arithmetic, logarithmic, and trigonometric functions
- Read only memory (ROM) of 40K (40,960) bytes
- BASIC-80 Interpreter in ROM (enhanced version of the widely used Microsoft BASIC – MBASIC – Interpreter)
- Random access memory (RAM) for program use (operating system and application) of 64Kb (65,536 bytes) to 640Kb (655,360 bytes) or of 16Kb (16,384 bytes) to 576Kb (589,824 bytes) for early 5150 models
- One or two IBM 5¼-inch diskette drives installed in the 5150 System Unit of 160/180Kb capacity each for single-sided diskettes or 320/360Kb capacity each for double-sided diskettes (providing 320Kb, 360Kb, 640Kb, or 720Kb maximum of online diskette capacity)
- One or two external 5¼-inch diskette drives (not supplied by IBM)
- One or two fixed disk drives of 10Mb (10,618,880 bytes) capacity each (provided via the 5161 Expansion Unit Model 1) for a maximum capacity of 20Mb (21,237,760 bytes) of online fixed disk storage. Two internal IBM diskette drives, two external diskette drives, and two fixed disk drives can be installed in the same 5150 configuration when the 5161 unit is present. The fixed disks cannot be installed in the 5150 unit.
- Two or four displays, depending on the display adapters installed
- One 5175 Professional Graphics Display via the Professional Graphics Controller to provide advanced graphics application support. A variety of programs (Graphics Development ToolKit, Graphical Kernel System, and Graphical File System, for example) are available to support basic and advanced graphics for IBM displays. In addition, the Graphics Terminal Emulator program allows a 5150 to emulate the Tektronix™ 4010 and 4100 protocols and the Lear Siegler ADM3A terminal using an IBM display and the Graphics Development ToolKit.
- One or two parallel printers via the Monochrome Display and Printer Adapter and the Parallel Printer Adapter and one or two serial printers via the Asynchronous Communications Adapters
- Attachment of one customer-supplied cassette recorder
- Attachment of up to two customer-supplied joysticks or up to four customer-supplied game paddles for video game interaction via the Game Control Adapter
- Programmable speaker for audio and musical applications
- Emulation of terminals, such as the 3278, 3279, and 3101
- Data security via the Keylock Feature
- Connection to the following:
  - System/370, 30XX, 4300, and Series/1 processors using the Asynchronous Communications Adapter, Binary Synchronous Communications (BSC) Adapter, or Synchronous Data Link Control (SDLC) Communications Adapter
  - 5520 Administrative System via cable attachment to the Display Station Emulation Adapter
  - System/34, System/36, or System/38 via the Display Station Emulation Adapter or the Enhanced Display Station Emulation Adapter
  - 8100 Processor using the Asynchronous Communications Adapter, Synchronous Data Link Control Communications Adapter, or 8100 PC Adapter
  - A Series/1 processor with the Series/1 to Personal Computer Channel Attachment and Series/1 to Personal Computer Attachment Cable features. The Personal Computer Channel Extender Card provided with the channel attachment feature is installed in the 5150 configuration (see discussion under "IBM Series/1-Personal Computer Interconnect" in Section 11:10)
  - A 4860 PCjr, another 5150 Personal Computer, a 5155 Portable Personal Computer, a 5160 Personal Computer XT, a 5160 Personal Computer XT/370, a 5170 Personal Computer AT, a 5170 Personal Computer AT/370, 3270 Personal Computer workstations, a 5531 Industrial Computer, a paper tape reader, a communicating typewriter, a laboratory instrument, voice recognition devices, letter-quality printers, mouse devices, or other machines that use the RS-232C interface, via the Asynchronous Communications Adapter
  - A videotex host via the Asynchronous Communications Adapter to use the 5150 as a videotex terminal
  - A remote VM/370 PROFS system using the Asynchronous Communications Adapter or the 3278/79 Emulation Adapter

- DISOSS/370 in a host processor using the Asynchronous Communications Adapter
- A local Displaywriter via cable attachment to the Asynchronous Communications Adapter. The IBM Personal Computer can be a stand-alone system or part of a cluster of IBM personal computers.
- A remote Displaywriter, 6670 Information Distributor, 5520 Administrative System, or Office System 6 via the Binary Synchronous Communications Adapter for document exchange
- 3278 Display Station using the IBM Personal Computer 3278 Attachment Option (which is the IBM Personal Computer portion of the 3270 Personal Computer Attachment for the 3278)
- 3279 Color Display Station using the IBM Personal Computer 3279 Attachment Option (which is the IBM Personal Computer portion of the 3270 Personal Computer Attachment for the 3279)
- 3274 Control Unit, Display/Printer Adapter in a 4321/4331/4361 Processor, Workstation Adapter in a 4361 Processor, or Device Cluster Adapter in a 4701 Finance Communication Controller via the 3278/79 Emulation Adapter
- Up to 63 other local IBM personal computers (IBM PCjrs, IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XTs and XT/370s, IBM Personal Computer ATs and AT/370s, and IBM 5531 Industrial Computers) using the Cluster Adapter and Cluster Cable Kit
- Up to 71 (or up to 255 using non-IBM cabling) other local IBM personal computers (IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XTs and XT/370s, and IBM Personal Computer ATs and AT/370s) via the IBM PC Network Translator Unit, IBM PC Network Adapters, and IBM PC Network Cabling Components to form an IBM PC Network
- IBM Electronic Typewriter 65, 85, or 95 via the Printer Adapter or the Monochrome Display and Printer Adapter
- An IBM SELECTRIC® System/2000 Typewriter with the Printer Option installed via the Printer Adapter or the Monochrome Display and Printer Adapter
- 5218 Printwheel Printer Model A03 or A04 via the 5218 Printer Attachment Cable attached to an Asynchronous Communications Adapter. Up to four IBM personal computers can share one 5218 printer using the 5218 Printer Sharing feature.
- 4975 Printer Model 02R (with the 4975 Printer Attachment feature – RPQ 8V0262) attached to the Asynchronous Communications Adapter. This table-top, serial matrix printer can be used for draft, near-letter-quality, and label printing. The following can be printed on labels: universal product code (UPC) bar code (Versions A and E), 3-of-9 bar code, MSI Plessey bar code, European article numbering (EAN) bar code (Versions 8 and 13), UPC magazine/paperback title and issue coding bar code (2 and 5 digit), optical character recognition (OCR) A font (National Retail Merchants Association – NRMA – subset), and large characters (2, 4, or 8 times standard height). See GA34-0144 for a description of the 4975 Printer.
- 7371 or 7372 Color Plotter (desktop plotters) via a cable connected to the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter. The IBM Personal Computer can be a stand-alone system or connected to a host System/370, 30XX, or 4300 processor.
- 7374 or 7375 Color Plotter when the 5150 configuration is connected to a host System/370, 30XX, or 4300 processor. Attachment of the plotter to the 5150 is via a cable connected to the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter.
- Analog and digital devices and instruments via the Data Acquisition and Control Adapter to control processes, monitor transducers (flow, pressure, temperature, for example), and automate electronic testing
- Up to 48 devices that use the ANSI/IEEE-488 standard via the General Purpose Interface Bus Adapter
- The 3680 Point of Sale System via the Asynchronous Communications Adapter, Binary Synchronous Communications Adapter, or Synchronous Data Link Control Communications Adapter (see *Connecting the IBM Personal Computer and the 3680 Point of Sale System: A Feasibility Study,* GG24-1598)
- Up to 20 IBM and/or selected Xerox copiers using the Terminal Communications Adapter Kit
- Custom attachments using the Prototype Card
- Other host systems using appropriate software

Up to three communications adapters (of more than one type, if desired) can be installed in the same 5150 configuration. The limit for each type is two

for the Asynchronous Communications Adapter, one for the SDLC adapter, and two for the BSC adapter. However, when the SDLC adapter is installed, only one BSC adapter and one asynchronous adapter can be installed as well. Alternatively, two BSC adapters and one asynchronous adapter can be the three installed communications adapters.

The IBM Personal Computer can be connected to the IBM Cabling System for attachment to the following:

- 3274 Control Unit
- Display/Printer Adapter of a 4321/4331/4361 Processor
- Workstation Adapter of a 4361 Processor
- System/36, System/38, or 5294 Remote Control Unit
- Loop Adapter of an 8100 Information System
- 5520 Administrative System
- Device Cluster Adapter of a 4701 Finance Communication Controller

The IBM Cable Data Management System licensed program can be executed in an IBM Personal Computer configuration to aid in the planning, installation, and records maintenance functions associated with the IBM Cabling System. This program is designed to be used by facilities engineers, planners, or managers.

Operating Systems Supporting

The 5150 Personal Computer is supported by the following IBM-logo operating systems:

- IBM Personal Computer Disk Operating System (DOS) – all versions. One diskette drive is required. Fixed disk drives (10Mb capacity) are supported as of Version 2.0.
- IBM Personal Computer/Interactive Executive (PC/IX). One double-sided diskette drive and one fixed disk drive are required.
- CP/M-86™. One diskette drive is required. Fixed disks are not supported.
- UCSD p-System™. Two diskette drives are required. Fixed disks are not supported.

Compatibility

Hardware

The 5150 Personal Computer is compatible with the 4860 PCjr, 5155 Portable Personal Computer, 5160 Personal Computer XT, 5160 Personal Computer XT/370 in PC mode, 5170 Personal Computer AT in real address mode, 5170 Personal Computer AT/370 in PC mode, 3270 Personal Computer workstations, and 5531 Industrial Computer. Since the 8088 microprocessor is used in 4860, 5150, 5155, 5160, 5271, 5371, and 5531 system units, microprocessor instructions for personal computer mode are compatible among these system units. The 80286 microprocessor operating in real address mode in the 5170 is upward-compatible with the 8088 microprocessor.

Diskettes (5¼-inch) are interchangeable without restrictions among 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT and XT/370, 5170 Personal Computer AT and AT/370 (160/180Kb and 320/360Kb capacities only), 3270 Personal Computer workstation, and 5531 Industrial Computer configurations. Cassettes are interchangeable without restrictions between PCjr and 5150 Personal Computer configurations. Cartridges can be used only in a PCjr configuration.

Programming

Programs that operate in an IBM Personal Computer configuration can also operate in an IBM Portable Personal Computer, IBM Personal Computer XT or XT/370 (in PC mode), IBM 3270 Personal Computer workstation, or IBM 5531 Industrial Computer as long as the configuration contains the required memory, features, and I/O devices. The majority can also operate in a PCjr configuration (see discussion in Section 10:05 under "Compatibility" for program compatibility with the PCjr) or an IBM Personal Computer AT or AT/370 (in PC mode).

Customer Responsibilities

The 5150 Personal Computer and its features are customer setup. Detailed setup instructions are included with each unit. The customer is responsible for unpacking the system components, attaching them correctly, and running the supplied diagnostic program. However, setup is available from the IBM National Service Division at the IBM hourly rate and minimum charge.

An individual power source is required for each IBM-logo personal computer unit that can be included in a 5150 configuration (see "Physical Components" earlier in this subsection) except for the 5151 Monochrome Display, which receives power from the 5150 System Unit or 5161 Expansion Unit.

Data Security

The customer is responsible for providing any desired data security functions. Programs or hardware that perform data encryption and decryption can be installed in a 5150 configuration. The Data Encoder program (6024149) that performs encryption and decryption of data is available.

The optional Keylock Feature can be installed on the 5150 System Unit and/or 5161 Expansion Unit to prevent physical and programmed access to the physical and data contents of the 5150 and/or 5161 unit when the keylock is in the locked position. See description of this feature in Section 11:10 under "Keylock Feature."

Security for IBM personal computers is discussed in *Good Security Practices for Personal Computers*, G320-9280, and *Good Security Practices for Control of Offsite Terminals and Software Usage*, G320-9295.

Purchase Location

All 5150 Personal Computer IBM-logo units and features are purchase only. Models 104, 166, and 176 of the 5150 System Unit can be purchased at the following locations:

- IBM NAD and NMD branch offices. Orders for any quantity are accepted by branch office marketing representatives. IBM Credit Corporation Term Lease Financing may be available for IBM Personal Computers purchased from an IBM branch office.
- IBM Product Centers. Major credit cards and the IBM Credit Corporation credit card are accepted. Volume Procurement Amendment (VPA) discounts and educational allowances are not available at IBM Product Centers. However, Product Center Single Delivery Quantity discounts are available.
- Authorized IBM Personal Computer retail dealers

Models X66 and X76 of the 5150 System Unit and certain business-oriented optional features for any 5150 System Unit can be ordered only from an NAD or NMD marketing representative.

Warranty Period

The warranty period for 5150 and 5161 units is three months and the warranty service is Customer Carry-in Repair. The warranty period for all optional features for the 5150 and 5161 units is also three months except for the 256Kb Memory Expansion Option, Cluster Adapter, IBM PC Network Translator Unit, IBM PC Network Adapter, Keylock Feature, Enhanced Graphics Adapter and features, Professional Graphics Controller, Data Acquisition and Control Adapter, General Purpose Interface Bus Adapter, and BIOS Update Kit, for which a one-year warranty period is provided.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
  - Warranty Option. For 5150 and 5161 units, IBM On-Site Repair is available.
  - Annual Maintenance. For 5150 and 5161 units, IBM On-Site Repair and Customer Carry-In Repair are available.
- IBM Hourly Service: Customer Carry-In Repair at an IBM Service/Exchange Center.
- Self-service using the Hardware Maintenance and Service package (a purchased item), which enables the customer to isolate the problem to an under-the-cover field replaceable unit

IBM will also provide service for selected non-IBM products currently sold by IBM for attachment to the IBM Personal Computer. The types of service available are the same as for IBM personal computer products serviced under the IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services.

Service for the following non-IBM units and features that can be installed in a 5150 System Unit is also available:

- Epson FX-100 (type 1575, Model A01)
- IRMA™ (feature 7625)
- AST 3780 BSC RJE (feature 7640)
- AST ComboPlus™ (feature 7800)
- AST MegaPlus II™ (feature 7802)
- AST MegaPak™ (feature 7804)
- AST SixPakPlus™ SPK-064 (feature 7806)
- AST SixPakPlus SPK-192 (feature 7809)
- AST SixPakPlus SPK-384 (feature 7812)

Publications

The following publications are provided with each IBM Personal Computer configuration:

- *Guide to Operations* (6322510). This binder contains setup and starting instructions, keyboard information, instructions for installing each optional feature ordered for the configuration, and testing information. The diagnostics diskette and two diskettes (one for the monochrome display and one for the color display) that contain the system tutorial "Exploring the IBM Personal Computer" are also provided in this binder.
- *BASIC* (6361132). This binder describes the functions provided by the BASIC Interpreter that is included in ROM in a 5150 System Unit.

The following hardware- or software-oriented publications can be purchased:

- *IBM Personal Computer System Technical Reference* (6322507) – $30. This reference describes the system board, Math Co-processor Option, power supply, keyboard, and communications functions and lists 8088 microprocessor and Basic Input/Output System (BIOS) instructions.
- *IBM Personal Computer Options and Adapters Technical Reference* (6322509) – $125. This multivolume reference describes the 5161 Expansion Unit, displays, printers, diskette and disk drives, memory expansion, cables, and connectors. It contains information that is applicable to the IBM Personal Computer, IBM Portable Personal Computer, IBM Personal Computer XT and XT/370, and IBM Personal Computer AT and AT/370.
- *Hardware Maintenance and Service* (6322512) – $295. This binder provides procedures and an advanced diagnostics diskette to isolate a problem to a field replaceable unit.
- *The Directory* (6137591) – $4. This publication describes personally developed software packages that can be ordered by mail or telephone. The categories of programs offered include entertainment, education, productivity, programming, and business. These programs are listed in a table in Section 41:10.
- Educational:
  - Turtle Power Thinker's Guide (6024167) – $11.50
  - Turtle Power Activity Book (6024079) – $13.25
  - Writing Private Tutor Courses for the IBM Personal Computer (6024078) – $14.50

The following form-numbered items that contain hardware and programming information about the 5150 Personal Computer are also available:

- *IBM Personal Computers* (pocket brochure), G520-1036
- *IBM Personal Computers Hardware Facts* (pocket brochure), G520-3916
- *Introduction to Personal Computers for Business – An Executive Overview*, G520-2306
- *The Guide to Personal Computer Offerings from IBM*, G520-0059. This publication highlights hardware features of IBM PCjr, IBM Personal Computer, IBM Portable Personal Computer, IBM Personal Computer XT, and IBM Personal Computer AT configurations and describes the facilities of operating systems, languages, and selected IBM-logo application programs for these configurations. This guide can also be purchased in IBM Product Centers ($3).
- *The Library of IBM Personal Computer Software Offerings*, G520-1107. This publication describes selected IBM-logo programs.
- *Personal Computer Software*, GB30-2037. This publication briefly describes IBM personal computer vendor-logo application programs that are available from IBM. The following is given for each program: feature highlights, description, purpose, application type, operating environment (hardware and software requirements), compatibility (interface to other application programs), and ordering information (including price).
- *Personal Computer Software Pocket Guide*, GB30-2479. This reference card lists the vendor-logo programs available, program part number, program feature code, program charge, and IBM personal computer configurations supported.
- *An IBM Guide to Choosing Business Software*, SB30-3224. This book is designed for non-technical business managers. It describes software features that support all the major areas of accounting, including general ledger, accounts payable, payroll, order entry and invoicing, inventory accounting, and accounts receivable.
- *Engineering and Scientific Programs for IBM Personal Computers Available from non-IBM Sources*, GC34-0588
- *Guide to Learning: Resources for Users of IBM Personal Computers*, G570-2091. This guide provides a brief description of manuals, programs, audiocassettes, and courses that are designed for those who want to learn about and/or teach courses on the IBM PCjr, IBM Personal Computer, or IBM Personal Computer XT. Hardware, operating systems, languages, and application programs are covered.

- Engineering/Scientific Series brochures:
  - *Systems and Software for Integrated Workstations*, G520-5011 (pocket brochure) or G520-5010
  - *Professional Graphics Display and Controller*, G520-5013
  - *Data Acquisition and Control*, G520-5020
  - *General Purpose Interface Bus*, G520-5021
  - *Graphics Terminal Emulator*, G520-5016
  - *Graphical Kernel System*, G520-5015
  - *VDI Specification Sheet*, G520-5018
  - *Graphical File System*, G520-5014
  - *Plotting System*, G520-5017
  - *Professional FORTRAN*, G520-5019

  More detailed information about the above Engineering/Scientific Series hardware and software is contained in *IBM Personal Computer Seminar Proceedings Volume 2, Number 10*, G320-9317.
- *IBM Assistant Series*, G520-5004. This brochure describes the integrated assistant series programs.

The publication *The IBM Personal Computer Catalog*, G570-2064, describes certain 5150 Personal Computer hardware units, printer supplies and accessories, paper forms, diskettes and associated accessories, books, software, 5150 hardware accessories, and furniture that can be ordered from IBM. The items described can be purchased by mail, by telephone (via IBM Direct), at an IBM Product Center, or from an IBM marketing representative, depending on the item. This catalog contains vendor-logo units (such as printers, modems, game paddles, joysticks, and mouses) that can be attached to a 5150 configuration, as well as IBM-logo units.

Additional publications regarding particular features are indicated in the feature descriptions in Section 11:10.

Self-Study Courses

Three self-study courses for first-time users of a personal computer are available. These courses give the new user personal computing concepts, provide practice in using the 5150 Personal Computer and DOS, and provide training in the use of the VisiCalc™ program.

The courses are:

- Personal Computing Concepts. This course introduces data processing concepts, hardware, and software. It is provided on ¾-inch videotape (SR20-8317), ½-inch videotape (SR20-8318), and ½-inch VHS-format videocassette (SR20-8319). Paid-up lease prices are $200 for quantities of 1 to 24, $170 for quantities of 25 to 99, and $160 for quantities of 100 to 249.
- Using the IBM Personal Computer (SR20-8211). This interactive course (provided on a diskette) runs on a 5150 Personal Computer with 64K bytes of memory and two diskette drives. It provides experience using 5150 configuration components and DOS. Paid-up lease prices are $55 for quantities of 1 to 24, $46.75 for quantities of 25 to 99, and $44 for quantities of 100 to 249.
- Using the VisiCalc Program (SR20-8314). This interactive course (provided on a diskette) runs on a 5150 Personal Computer with 64K bytes of memory and two diskette drives. It is a training program that gives step-by-step instructions on how to use the VisiCalc program and also provides eight predesigned application models for immediate use. Paid-up lease prices are $70 for quantities of 1 to 24, $59.50 for quantities of 25 to 99, and $56 for quantities of 100 to 249.

These self-study courses can be ordered by telephone from IBM Direct Education (800/631-5582 for the Continental U.S. and Puerto Rico and 800/526-2484 in Alaska and Hawaii) or by mail from Science Research Associates at the following address:

Science Research Associates
Order Department
155 N Wacker Drive
Chicago, IL 60606

The *Using IBM DisplayWrite 2* computer-based training course can be executed in an IBM Personal Computer under DOS Version 2.1 or 3.0 in 192Kb or 256Kb, respectively. This eight- to twelve-hour self-study interactive course (code 32281) is designed to aid in training operators to use the DisplayWrite 2 Version 1.1 licensed program. The course was designed by Science Research Associates (SRA) and has a one-time charge of $250.00.

11:10 IBM 5150 System Unit

The 5150 System Unit Model 176 for the IBM Personal Computer is shown in Figure 11-1.

Figure 11-1. 5150 System Unit Model 176

Models Available

The models of the 5150 that are available provide different standard features. Otherwise, they are functionally and physically identical. The following 5150 models are available:

- Model 104:
  - System Unit/Keyboard
  - 64Kb random access memory
- Model 166:
  - System Unit/Keyboard
  - 256Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - One Double-Sided Diskette Drive
- Model 176:
  - System Unit/Keyboard
  - 256Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - Two Double-Sided Diskette Drives
- Model X66:
  - System Unit
  - 256Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - One Double-Sided Diskette Drive
- Model X76:
  - System Unit
  - 256Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - Two Double-Sided Diskette Drives

The following 5150 models have been withdrawn from marketing by IBM:

- Model 114:
  - System Unit/Keyboard
  - 64Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - One 5¼-Inch Single-Sided Diskette Drive
- Model 164:
  - System Unit/Keyboard
  - 64Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - One 5¼-Inch Double-Sided Diskette Drive
- Model 174:
  - System Unit/Keyboard
  - 64Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - Two 5¼-Inch Double-Sided Diskette Drives
- Model X14:
  - System Unit
  - 64Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - One 5¼-Inch Single-Sided Diskette Drive
- Model X64:
  - System Unit
  - 64Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - One 5¼-Inch Double-Sided Diskette Drive
- Model X74:
  - System Unit
  - 64Kb random access memory
  - 5¼-Inch Diskette Drive Adapter
  - Two 5¼-Inch Double-Sided Diskette Drives

Models X66 and X76 (and the withdrawn Models X14, X64, and X74) are provided for use only with the IBM 3270 Personal Computer Attachment features.

Each current 5150 model (104, 166, and 176) can be field-upgraded to the maximum 5150 configuration by installing optional features.

Models 813, 824, 1, 14, 64, and 74 of the 5150 have also been withdrawn from marketing. Models 114, 164, and 174 and the single-sided diskette drive (also withdrawn from marketing) may be available at IBM Product Centers and authorized IBM Personal Computer dealers. The optional features and I/O devices for the three currently available 5150 models can be installed in 5150 configurations that include any of the withdrawn 5150 models.

A 5150 System Unit cannot be converted to a 5155 Portable Personal Computer, 5160 System Unit for an IBM Personal Computer XT or XT/370 configuration, or 5170 System Unit for an IBM Personal Computer AT or AT/370 configuration.

Physical Characteristics

Dimensions (approximate)

- Height: 5.5 inches (142 mm)
- Width: 19.5 inches (500 mm)
- Depth: 16 inches (410 mm)

Weight (approximate)

- 21 lb without a diskette drive or adapter (Model 104)
- 25 lb with one diskette drive and diskette drive adapter (Model 166)
- 28 lb with two diskette drives and one diskette drive adapter (Model 176)

Environment

- Air temperature:
  - 60 to 90 degrees F (15.6 to 32.2 C) for system on
  - 50 to 110 degrees F (10 to 43 C) for system off
- Cooling: Air-cooled via a fan inside the 5150 System Unit
- Humidity: 8% to 80% for system on or off
- Noise level:
  - 56 decibels (dB) without printer
  - 66 decibels with printer
- Electrical:
  - 104 to 127 volts AC, 60 Hz
  - 180 to 259 volts AC, 50 Hz (outside U.S.A.)

Standard Features

The following are standard features of all 5150 models unless indicated otherwise. Each feature is discussed under "Standard Feature Descriptions" in this subsection.

- Microprocessor – Intel 8088
- Eight interrupt levels
- Direct memory access (DMA) – three channels
- 40Kb of read only memory (ROM)
- BASIC-80 Interpreter in ROM
- Random access memory (RAM) of 16Kb for the 5150 Model 1, 48Kb for the 5150 Model 813, 256Kb for 5150 Models 166, 176, X66, and X76, and 64Kb for all other 5150 models
- Five system expansion slots for feature cards
- Adapter for a customer-supplied audiocassette recorder
- A programmable speaker and associated adapter

- One 5¼-Inch Diskette Drive Adapter (all models except 1 and 104)
- 5¼-Inch Diskette Drive (all models except 1 and 104) – one single-sided for Models 813, 14, 114 and X14; two single-sided for the Model 824; one double-sided for Models 64, 164, 166, X64, and X66; and two double-sided for Models 74, 174, 176, X74, and X76
- Keyboard adapter and 83-key keyboard (all models except X14, X64, X66, X74, and X76)
- Automatic power-on self-test
- A 63.5-watt power supply with cooling fan

Optional Features

The following are optional features of all 5150 model configurations unless indicated otherwise. Each is discussed under "Optional Feature Descriptions" in this subsection.

- Math Co-processor Option (one maximum)
- 16Kb Memory Module Kit (Models 1 and 813 only)
- 64Kb Memory Module Kit (three maximum on the Model 104, 114, 164, and 174 system board and three maximum on a 64/256Kb Memory Expansion Option card)
- 64/256Kb Memory Expansion Option (two maximum)
- 256Kb Memory Expansion Option (one or two maximum depending on the model)
- Game Control Adapter (one maximum)
- Prototype Card (one maximum)
- 5¼-Inch Diskette Drive Adapter (Models 1 and 104 only – one maximum)
- 5¼-Inch Single-Sided Diskette Drive (two diskette drives maximum per 5150 configuration). This feature has been withdrawn from marketing by NAD and NMD.
- 5¼-Inch Double-Sided Diskette Drive (two diskette drives maximum per 5150 configuration)
- Monochrome Display and Printer Adapter (one maximum)
- Color/Graphics Monitor Adapter (one maximum)
- Printer Adapter (one maximum)
- Enhanced Graphics Adapter (one maximum)
- Graphics Memory Expansion Card (one maximum)
- Graphics Memory Module Kit (one maximum)
- Professional Graphics Controller (one maximum) – 5161 unit required
- Data Acquisition and Control Adapter (four maximum)
- Data Acquisition and Control Adapter Distribution Panel (one maximum)
- General Purpose Interface Bus Adapter (four maximum)
- Asynchronous Communications Adapter (two maximum unless the SDLC adapter is installed, then one maximum)
- Binary Synchronous Communications (BSC) Adapter (two maximum unless the SDLC adapter is installed, then one maximum)
- Synchronous Data Link Control (SDLC) Communications Adapter (one maximum)
- Communications Adapter Cable (one for each BSC and SDLC adapter installed)
- Display Station Emulation Adapter (one maximum)
- Enhanced Display Station Emulation Adapter (one maximum)
- IBM Personal Computer 3278 Attachment Option (one maximum)
- IBM Personal Computer 3279 Attachment Option (one maximum)
- 3278/79 Emulation Adapter (one maximum)
- 8100 PC Adapter (one maximum and mutually exclusive with the SDLC adapter)
- Cluster Adapter (one maximum)
- Cluster Cable Kit (one less than the number of systems in the cluster)
- IBM PC Network Translator Unit (one per network), IBM PC Network Adapters (one maximum per 5150 unit), and IBM PC Network Cabling Components to form an IBM PC Network
- Displaywriter/Personal Computer Attach Convenience Kit (two maximum)
- IBM 65/85/95-PC IPL/Diagnostic Diskette and Diagnostic Tool – MES 8569 (one maximum)
- 5218 Printer Attachment Cable (two maximum)
- 5218 Printer Sharing (one for each group of four IBM personal computers that are to share one 5218)
- Terminal Communications Adapter Kit (one maximum) – to connect copiers
- Keylock Feature (one for the 5150 and one for the 5161)
- BIOS Update Kit (one maximum) – required only for certain early 5150 models

The optional features listed are installed inside the 5150 System Unit or 5161 Expansion Unit except the Communications Adapter Cable, Cluster Cable Kit, MES 8569, 5218 Printer Attachment Cable, 5218 Printer Sharing, Displaywriter/Personal Computer Attach Convenience Kit, 5178 IBM PC Network Translator Unit and Cabling components, Data Acquisition and Control Adapter Distribution Panel, and Keylock Feature.

Physical Components Included

Each 5150 System Unit contains the system board, the programmable speaker, and the power supply and fan. The one or two IBM diskette drives that can be included in a 5150 configuration are also housed in the 5150 System Unit. Certain optional features for a 5150 configuration must be installed only in the 5150 unit or only in the optional 5161 Expansion Unit. Others can be installed in the 5150 or 5161 unit.

Each 5150 system board contains:

- The processor subsystem (includes the Intel 8088 microprocessor and associated functions)
- Read only memory (40Kb)
- Random access memory:
  - 256Kb for 5150 Models 166, 176, X66, and X76
  - 64K to 256Kb for 5150 Models 104, 114, 164, and 174
  - Up to 64Kb for 5150 Models 813, 824, 1, 14, 64, 74, X14, X64, and X74
- The keyboard adapter
- The cassette adapter
- The programmable speaker adapter
- Five system expansion slots that are used to hold feature cards
- Socket for the Math Co-processor Option module

The system board also contains two sets of eight switches that can be read under program control. These switches (called dual inline package –DIP – switches) provide configuration information for the operating system. They must be set to indicate whether the Math Co-processor Option is installed, the amount of memory installed, the types and number of displays installed, the operational mode (40- or 80-character lines) for the color display when power is turned on (when only a color display is installed), and the number of diskette drives attached.

The 5150 is delivered with the DIP switches set for the configuration ordered. If optional features are added to a 5150 configuration thereafter, the customer must set the appropriate switches, if required, as per the instructions in the *Guide to Operations*.

Standard and optional feature cards plug into expansion slots provided in the left rear corner of the system board inside the 5150 or 5161 unit. A feature card that provides for the attachment of an external unit has a connector (frequently a 25-pin D-shell type) attached to one end. When the slot cover for the expansion slot used for a feature card is removed from the rear panel of the 5150 or 5161 unit, the connector on the end of the feature card is exposed so that a cable can be plugged into it to attach the appropriate unit (I/O device or modem, for example).

Standard Feature Descriptions

Microprocessor

The instruction execution function in the 5150 System Unit is the Intel 8088 16-bit microprocessor with a 4.77-megahertz (MHz) clock speed and 410-nanosecond cycle time. The microprocessor is implemented on one logic chip that is about the size of a penny. It can address 1024Kb of memory using a 20-bit address and up to 768 I/O devices.

The Intel 8088 microprocessor uses a 16-bit internal data path and an 8-bit path (external bus) between itself and other components (memory and I/O adapters). The 8088 microprocessor is program-compatible with the Intel 8086 microprocessor, which supports the same instructions but has a 16-bit external bus, and the Intel 80286 microprocessor operating in 8086-compatible real address mode. The 80286 microprocessor is used in the 5170 System Unit.

The 8088 microprocessor responds to requests for service from I/O components via interrupts presented by an interrupt controller rather than polling to determine if a service is required. There are eight prioritized levels of interrupt.

The 8088 microprocessor instruction set is listed in the 5150 *Technical Reference* (6322507). Instructions are variable in length (one to six bytes). The smallest unit of information handled is the bit. Eight bits constitute a byte and two bytes constitute a word.

Add, subtract, multiply, and divide instructions are provided that operate on 8-bit (one-byte) and 16-bit (two-byte) binary numbers. The addition and subtraction of packed decimal numbers of one or two bytes (one to four digits) is also supported. Packed decimal numbers must be converted to binary for multiply and divide operations (unless the Math Co-processor Option is installed).

Add, subtract, multiply, and divide operations can also be performed on unpacked decimal numbers or they can be converted to binary for arithmetic operations. There are no floating-point arithmetic instructions for the 8088. The Math Co-processor Option feature provides such instructions. Floating-point subroutines can be used to perform floating-

point arithmetic when the Math Co-processor Option is not installed.

The character code used is ASCII (American Standard Code for Information Interchange). The standard 128 ASCII characters (codes 0 to 127) and extended ASCII characters (codes 128 to 255) are supported. See the BASIC reference manual that is supplied with the 5150 system for the supported ASCII characters and codes.

Direct Memory Access

The direct memory access (DMA) facility is provided to enable I/O operations to be overlapped with instruction execution. A DMA controller that provides four independent channels is included on the system board. This controller can operate simultaneously with the 8088 microprocessor to handle data transfer from one location to another in random access memory and between random access memory and I/O devices. Up to three DMA transfers can operate at a time. The fourth DMA channel is used to refresh the dynamic random access memory.

Data transfer occurs eight bits at a time to and from I/O and memory adapters. A data rate of up to 1.5Mb/sec can be handled by a DMA channel and up to 64Kb can be transferred in one I/O operation (read or write request). The DMA channels can be used by the diskette drive adapter, fixed disk adapter, SDLC adapter, display adapters, Cluster Adapter, IBM PC Network Adapter, Data Acquisition and Control Adapter, and General Purpose Interface Bus Adapter.

Read Only Memory

The 5150 contains 40Kb of read only memory (ROM). The contents of ROM remain when power to the 5150 System Unit is turned off and writing to this memory cannot be done. ROM is used for the permanent residence of certain programs.

The standard ROM is addressed using the highest 40K addresses in the 1024Kb address space that is accessible to the 8088 microprocessor. An additional 216Kb of address space is reserved for ROM expansion. Note that ROM is also present on certain feature cards to provide device level control for the device attached to the adapter card.

ROM contains the following:

- Power-on self-test program. This program executes a series of diagnostic tests (including a random access memory test) each time power to the 5150 is turned on. The time required for the test is variable and depends on the amount of memory installed. If a failure is found, the appropriate error code is displayed.
- Diskette bootstrap loader to initial program load (IPL) from diskette
- Basic Input/Output System (BIOS). This system provides basic input/output support (device level control) for the major I/O devices that attach to the 5150 (keyboard, display, printer, diskette, and fixed disk), full I/O support for a cassette recorder, and support of the Asynchronous Communications Adapter. BIOS provides an operational interface to the system and relieves the programmer of concern for device hardware characteristics. A graphics character generator and system services, such as time of day and configuration and memory size determination, are also provided by BIOS.

  The programmer should access BIOS via the standard program interrupts (interrupt instruction specifying the BIOS interrupt type) rather than by actual address. There are over 40 defined interrupts that permit the user to IPL, perform I/O operations to supported devices, request timer functions, request installed memory size, print the contents of the display screen, and access ROM BASIC.

  Parameters are passed to and received from BIOS using the registers in the 8088 microprocessor. BIOS uses a small portion of random access memory as a work area. A listing of the BIOS instructions is provided in the 5150 *Technical Reference* (6322507).
- Time-of-day clock support. A programmable interval timer on the system board that provides an interrupt 18.2 times per second is used to support a time-of-day clock. Timer routines in ROM permit a program to set the clock and obtain the current time of day. An indication of whether 24 hours have passed since the last clock read was issued is given with the time of day.
- Dot patterns for 128 characters in graphics mode for displays
- A code indicating this unit is a 5150. This code can be inspected by programming.
- BASIC-80 Interpreter (cassette level enhanced). Highlights of the supported functions are:
  - Full-screen editor for easy program creation and modification
  - 40- or 80-character display lines
  - Up to 16 foreground and 8 background colors supported (requires a color display)
  - Automatic line numbering
  - 40-character variable names (all characters significant)

- Multiple statements per program line
- 250 characters per program line
- Comments on program line
- Up to 17-digit numeric precision
- Error trapping
- Addressable workspace up to 60Kb
- Integer/real/string variables
- Single- and double-precision floating-point numbers
- Support of medium- and high-resolution graphics modes for displays
- Support of sequential cassette files
- Support of the display, keyboard, and printer
- Support of the standard programmable speaker and optional light pen and joysticks

The BASIC Interpreter in ROM of the 5150 is functionally equivalent to the BASIC Interpreter in ROM of other IBM personal computers. The Disk BASIC and Advanced BASIC that are provided with DOS support additional functions.

Once the 5150 has been turned on and the self-test diagnostics have executed successfully, an attempt is made to IPL an operating system from diskette drive A (leftmost drive) or from the first fixed disk (C) drive in the 5161 unit (if present). The BASIC Interpreter is made ready and identified on the screen if an IPL has not occurred.

Random Access Memory

Random access memory (RAM) is read/write program-addressable memory. In the 5150, RAM is dynamic memory (its contents must be refreshed periodically) and its contents are lost when power to the 5150 is removed. This memory is parity-checked for validity. The standard memory in a 5150 model has a 200-ns access time and a 345-ns cycle time (assuming 64K-bit memory modules).

The standard 64Kb in 5150 Models 104, 114, 164, and 174 and the standard 256Kb in 5150 Models 166, 176, X66, and X76 can be expanded to a maximum of 640Kb using the optional 64Kb Memory Module Kit, 64/256Kb Memory Expansion Option, and 256Kb Memory Expansion Option features, as described under "Optional Feature Descriptions" in this subsection. For 5150 Models 813, 824, 1, 14, 64, 74, X14, X64, and X74 (which have a maximum of 64Kb on the system board), maximum memory size is 576Kb using two memory option cards.

A 5150 System Unit that can have a maximum of 256Kb on the system board has a "B" stamped on its rear panel and "64Kb-256Kb" printed on the system board. A 5150 System Unit that can have a maximum of 64Kb on the system board has no identification on its rear panel and "16Kb-64Kb" printed on the system board.

DOS Versions 1.0 and 1.1 require approximately 12Kb of memory for residence during system operation. Thus, for a 64Kb memory configuration, application programs that require up to 52Kb at a time can be used. DOS Versions 2.0 and 2.1 require a minimum of 24Kb of memory for their residence, while DOS Versions 3.0 and 3.1 require 36Kb minimum for residence.

Note that locations in the 1024Kb address space that is accessible to the 8088 microprocessor are preassigned. The first 640Kb address range is allocated to address the 640Kb of random access memory that can be installed in a 5150 configuration. The remaining 384Kb of address space is allocated to address read only memory on the system board and memory on I/O adapters. Thus, the 640Kb to 1024Kb address range is allocated for system functions and cannot be used to address random access memory.

System Expansion Slots

Five full-feature system expansion slots are standard on the system board to contain memory and adapter features. These slots accept full-feature and the smaller special-feature cards. One slot in all 5150 models must be used to hold a display adapter for the required display device. One additional slot is used for the standard 5¼-Inch Diskette Drive Adapter in all 5150 models except 1 and 104.

The following require one system expansion slot each unless otherwise indicated:

- 64/256Kb Memory Expansion Option
- 256Kb Memory Expansion Option
- Game Control Adapter*
- Prototype Card*
- 5¼-Inch Diskette Drive Adapter
- Monochrome Display and Printer Adapter*
- Color/Graphics Monitor Adapter*
- Printer Adapter*
- Enhanced Graphics Adapter
- Data Acquisition and Control Adapter*
- General Purpose Interface Bus Adapter*
- Asynchronous Communications Adapter*
- Binary Synchronous Communications Adapter*
- SDLC Communications Adapter*

- Display Station Emulation Adapter (installation in the 5161 permitted if the 5520/Personal Computer Attachment Program Version 2 or 3 is used)
- Enhanced Display Station Emulation Adapter*
- IBM Personal Computer 3278 Attachment Option
- IBM Personal Computer 3279 Attachment Option
- 3278/79 Emulation Adapter
- 8100 PC Adapter*
- Cluster Adapter*
- IBM PC Network Adapter
- Terminal Communications Adapter*
- 5161 Expansion Unit Model 1 extender card (provided with the 5161 unit)

* This feature can be installed in the 5150 or 5161 Model 1 unit. Others must be installed in the 5150 unit.

The Monochrome Display and Printer Adapter or the Color/Graphics Monitor Adapter can be installed in the 5161 Model 1 only if it is the second display adapter in the configuration. One display adapter must be installed in the 5150 unit for the primary display.

If more than five expansion slots are needed, the 5175 Professional Graphics Display is to be installed, or fixed disk storage is required, the 5161 Expansion Unit Model 1 must be attached to the 5150 System Unit. The 5161 Model 1 provides eight additional expansion slots for a total of 13 slots in the configuration as well as 10Mb of fixed disk storage (see 5161 Model 1 description in Section 11:15 for details).

Cassette Recorder Adapter

This adapter provides for the attachment of one customer-supplied audiocassette recorder via a 5-pin connector at the rear of the 5150 unit via a customer-supplied cable. The earphone output and either the microphone or auxiliary input of the cassette recorder are used. The cassette can be used for loading and saving programs and data. The data transfer rate of the cassette interface varies from 1000 to 2000 bits per second (125 to 250 characters per second, or 150 on average), depending on the data content. The BASIC Interpreter in ROM supports input/output operations using a cassette recorder. DOS does not support the cassette recorder.

Programmable Speaker

A 2¼-inch-diameter, 8-ohm audio speaker is included in the 5150 unit. It attaches to the speaker adapter on the system board. Tones of varying frequency (37 to 32,000 Hz per second) and duration can be generated for musical applications, which can be written using the BASIC provided with DOS.

5¼-Inch Diskette Drive Adapter

One diskette drive adapter is standard in all 5150 models except in 1 and 104, for which the adapter is optional. This adapter requires an expansion slot in the 5150, and only one diskette drive adapter can be installed in a 5150 configuration. One or two IBM-supplied internal 5¼-inch diskette drives can be attached to this adapter. The two drives can be any combination of single-sided and double-sided drives. Two external 5¼-inch diskette drives (not supplied by IBM) can also be attached to this adapter via the adapter connector in the rear of the 5150 unit for a total of four diskette drives. The diskette drive adapter uses direct memory access for record data transfer.

5¼-Inch Single-Sided Diskette Drive

One or two single-sided diskette drives can be present in a 5150 System Unit to provide a maximum online capacity of 320Kb (327,680 bytes) using DOS Version 1.0 or 1.1 or of 360Kb (368,640 bytes) using DOS Version 2.0 or later. The drives attach to the 5¼-Inch Diskette Drive Adapter. The leftmost (A) drive is always used for initial program loading (IPL) at power-on time or when IPL is done via the keyboard. The single-sided diskette drive can read from and write to one side of a soft-sectored, double-density 5¼-inch diskette (but not a double-sided diskette).

DOS Version 1.0 supports reading and writing to only one side of a diskette. All later DOS versions support reading and writing to both sides of a diskette. Note that a single-sided diskette can be read in a double-sided diskette drive.

Single-sided diskette drive characteristics are:

- Rotational speed: 300 rotations per minute (rpm)
- Access time: 8 milliseconds (ms) track to track
- Data transfer rate: 250K bits (32,000 characters) per second
- Head settling time: 15 ms
- Height: 3.4 inches (86 mm)

- Width: 5.87 inches (149 mm)
- Depth: 8 inches (203 mm)
- Weight: 4.4 lb (2 kg)

Single-sided diskette characteristics are:

- Track density: 48 tracks per inch
- Number of tracks: 40
- Number of data surfaces: 1
- Number of bytes per sector: 512 as formatted by DOS (all versions)
- Number of sectors per track:
  - 8 as formatted by DOS Versions 1.0 and 1.1
  - 9 as formatted by DOS Versions 2.0 and later. DOS Versions 1.0 and 1.1 will not read/write a diskette formatted with 9 sectors per track. DOS Versions 2.0 and later will read/write a diskette formatted with 8 or 9 sectors per track.
- Formatted capacity:
  - 160Kb (163,840 bytes) using DOS Versions 1.0 and 1.1
  - 180Kb (184,320 bytes) using DOS Versions 2.0 and later.
    Up to 64 DOS files can be stored on a single-sided diskette. Approximately 92 double-spaced typewritten pages 8½ by 11 inches in size can be stored on a 180Kb diskette or 82 pages on a 160Kb diskette.

Write protection is obtained by placing a write-protect tab across the notch in the upper right-hand corner of the diskette. This tab can be removed later if writing on the diskette is necessary. A diskette without a notch (such as the DOS operating system diskette) is permanently write-protected. A diskette-in-use indicator on the diskette drive is lit (red) whenever the drive is performing an operation.

Customer cleaning of the heads in the diskette drive(s) in a 5150 unit or of diskettes is not recommended.

5¼-Inch Double-Sided Diskette Drive

One or two double-sided diskette drives can be present in a 5150 System Unit to provide an online diskette capacity of 720Kb (737,280 bytes) using DOS Version 2.0 or later or 640Kb (655,360 bytes) maximum using DOS Version 1.1. The two drives attach to the 5¼-Inch Diskette Drive Adapter. The leftmost (A) drive is always used for initial program loading (IPL) at power-on time or when IPL is done via the keyboard.

The double-sided diskette drive can read from and write on both sides of a double-sided, double-density, soft-sectored 5¼-inch diskette or on one side of a single-sided, double-density, soft-sectored 5¼-inch diskette. DOS Versions 1.1 and later support double-sided as well as single-sided diskettes and will read a single-sided or double-sided diskette in a double-sided diskette drive. However, DOS will not read a double-sided diskette in a single-sided diskette drive. A double-sided drive must be used.

Double-sided diskette drive characteristics are:

- Rotational speed: 300 rotations per minute (rpm)
- Access time: 6 milliseconds (ms) track to track
- Data transfer rate: 250K bits (32,000 characters) per second
- Head settling time: 15 ms
- Height: 3.4 inches (86 mm)
- Width: 5.87 inches (149 mm)
- Depth: 8 inches (203 mm)
- Weight: 4.4 lb (2 kg)

Double-sided diskette characteristics are:

- Track density : 48 tracks per inch
- Number of surfaces: 2
- Number of tracks per surface: 40
- Number of bytes per sector: 512 as formatted by DOS (all versions)
- Number of sectors per track:
  - 8 as formatted by DOS Version 1.1
  - 9 as formatted by DOS Version 2.0 and later. DOS Version 1.1 will not read a diskette formatted with 9 sectors per track. DOS Versions 2.0 and later will read/write a diskette formatted with 8 or 9 sectors per track.
- Formatted capacity:
  - 320Kb (327,680 bytes) using DOS Version 1.1
  - 360Kb (368,640 bytes) using DOS Versions 2.0 and later.
    Up to 112 DOS files can be stored on a double-sided diskette. Approximately 184 double-spaced 8½ by 11-inch typewritten pages can be stored on a 360Kb diskette or 164 pages on a 320Kb diskette.

Write protection is obtained by placing a write-protect tab across the notch in the upper right-hand corner of the diskette. This tab can be removed later if writing to the diskette is desired. A diskette without a notch (such as the DOS system diskette) is permanently write protected. A diskette-in-use indicator on the diskette drive lights (red) whenever the drive is performing an operation.

Customer cleaning of the heads in the diskette drive(s) in a 5150 unit or of diskettes is not recommended.

Keyboard

One 83-key keyboard is standard for all 5150 models except X14, X64, X66, X74, and X76. It is the same physical keyboard that is provided for 5160 Personal Computer XT and 5160 Personal Computer XT/370 configurations. The keyboard attaches to a 5-pin connector in the back of the 5150 unit via a 6-foot (1.8-m) coiled cable and can be positioned as desired for typing comfort. Its typing angle can be adjusted to 5 or 15 degrees. Commonly used data and word processing functions are provided.

Approximate dimensions and weight of the keyboard are:

- Height: 2.3 inches (57 mm)
- Width: 19.5 inches (500 mm)
- Depth: 7.8 inches (200 mm)
- Weight: 6.2 lb (2.8 kg)

Highlights of the keyboard, which also apply to the 83-key lightweight keyboard for the 5155 Portable Personal Computer, are as follows:

- 83 keys are provided in three major groups. There are ten programmable function keys on the left, a special 15-key keypad for numeric entry and cursor control on the right, and a standard typewriter layout for alphabetic, numeric, and certain special character keys in the middle of the keyboard. The ten function keys can be programmed to handle any desired functions. The keypad key functions can also be programmed to provide the function specified on each key, if desired.
- The keyboard provides a scan code to the system unit when a key is pressed instead of an ASCII code. A unique scan code is assigned to each key. A BIOS keyboard routine in ROM translates the scan code to the standard or extended ASCII character and presents it to the executing program. This permits the character or function of each key to be defined by programming. The scan codes for the 83-key keyboards for 5150, 5155, 5160, and 5531 System Units, the 84-key keyboard for the 5170, the 62-key keyboard for the 4860, and the 122-key keyboard for the 5271 and 5371 are compatible at the BIOS level. Note that the 4860 keyboard does not generate a scan code for certain key combinations (Alt and F7, Shift and F9, Ctrl and F8, and Ctrl and F9).
- 256 characters are supported, which include 128 standard ASCII and 128 extended ASCII characters. Characters not listed on the keyboard can be entered using the Alt and numeric keypad keys (the decimal code for the character must be entered).
- The ten function keys can be programmed to support up to 40 different functions using keyboard shift keys (shift, Ctrl, and Alt keys). A plastic template, GX20-2413, is available that fits around the program keys and provides space to note the use of each key, program name, program mode, and other details.
- Cursor control keys provide for moving the cursor up, down, right, and left.
- PgUp and PgDn keys and keys to insert and delete characters at the cursor position are provided for word processing.
- The ability to print the current contents of the video display at any time is provided via the PrtSc key.
- All noncontrol keys are typamatic (character or function is repeated as long as the key is held down).
- Tactile feedback provides pressure buildup and release as a key is pressed to indicate the keystroke has registered and the character or command has been sent to the processor. Audio feedback provides a soft click when a key is pressed. These features aid typing when information is entered from notes.
- A 16-character type-ahead buffer is provided to prevent keystrokes from failing to be registered if information or a command is entered before the system unit is ready to receive it.
- A ledge above the top row of keys provides a convenient rest for propping open a book or reference manual between the video display and keyboard.

The keyboard is available in six different language layouts: U.S. English, U.K. English, French, German, Italian, and Spanish. The U.S. English layout (the only layout available in the U.S.A.) is shown in Figure 11-2. The international-layout keyboards are supported by DOS.

Power Supply

The power supply (63.5-watt) in the right rear corner of the 5150 unit provides power (required voltages) to the system unit, its options, and the keyboard. The 5151 Monochrome Display has its own power supply and receives AC power from the power system in the 5150 or 5161 unit.

Overvoltage and overcurrent protection are provided. If any voltage output exceeds 200% of its maximum rated voltage or if any current output exceeds 130% of its nominal value, power to the 5150 is automatically removed. A system shutdown also occurs if adequate power is not being received.

Figure 11-2. U.S. English 83-key keyboard for the IBM Personal Computer

Optional Feature Descriptions

Math Co-processor Option

This option increases the speed and precision of arithmetic, logarithmic, and trigonometric functions. It provides an Intel 8087 coprocessor that performs floating-point arithmetic and provides three to ten times better performance than the 8088 microprocessor executing floating-point subroutines, depending on the operation performed. Multiply and divide operations provide the lower performance improvements while logarithmic, trigonometric, and square root operations provide the higher performance improvements.

The 8087 coprocessor has its own instruction set of approximately 60 instructions, its own set of registers, and can operate in parallel with the 8088 microprocessor. Instruction operation codes are coded to identify them as coprocessor instructions. Instructions are listed in *IBM Personal Computer Seminar Proceedings Volume 1, Number 2*, G320-9307, and in the 5150 *Technical Reference* (6322507).

This optional feature is supported by APL, the Macro Assembler, the FORTRAN Compiler Version 2, and the Pascal Compiler Version 2. The Professional FORTRAN Compiler requires the Math Co-processor Option.

For single-precision floating-point (called short real) format, numbers in the range of plus or minus 8.43×10^{-37} to plus or minus $3.37 \times 10^{+38}$ can be handled with six to seven decimal digits of precision. Numbers in the range of plus or minus 4.19×10^{-307} to plus or minus $1.67 \times 10^{+308}$ can be handled with the double-precision floating-point (called long real) format with 15 to 16 decimal digits of precision.

The Math Co-processor Option also supports binary arithmetic using word (16-bit), short integer (32-bit), and long integer (64-bit) binary to numbers. The number ranges that can be represented are -32,768 +32,767 for word format, plus or minus $2 \times 10^{+9}$ for short integer format, and plus or minus $9 \times 10^{+18}$ for long integer format. In addition, 80-bit (10-byte) packed decimal numbers in the range of plus or minus 99...99 (18 digits) can be handled.

Integer, packed decimal, and floating-point numbers are converted to an 80-bit floating-point number (called a temporary real number) when they are loaded into a register for an arithmetic operation and the result is converted back to the original format when the number is stored in memory. The arithmetic operation is done using 80-bit floating-point numbers.

The Math Co-processor Option kit provides the Intel 8087 coprocessor module and a matched Intel 8088 microprocessor module. The latter replaces the

standard Intel 8088 module. Both modules must be installed on the system board.

64Kb Memory Module Kit

This feature provides 64Kb of parity-checked random access memory via nine small plug-in modules. Each module contains 64K bits. This memory has a 200-ns access time and a 345-ns cycle time. Up to three of the module kits (192Kb) can be installed on a 5150 Model 104, 114, 164, or 174 system board to provide 256Kb on the board. Models 166, 176, X66, and X76 have 256Kb on the system board as a standard feature. Up to three 64Kb module kits can be added to the 64/256Kb Memory Expansion Option feature card.

Note that the 16Kb Memory Expansion Kit can be installed only in a 5150 Model 1 or 813 (which are no longer marketed) to expand the memory on the system board to a maximum of 64Kb in 16Kb increments.

64/256Kb Memory Expansion Option

This option provides 64Kb of parity-checked random access memory on an 11-inch circuit card that plugs into a system expansion slot in the 5150 unit. This option cannot be installed in the 5161 unit. This memory has a 200-ns access time and a 345-ns cycle time.

Up to three 64Kb Memory Module Kits can be plugged into a 64/256Kb Memory Expansion Option card for a total of 256Kb on the card. The system board must have its maximum memory capacity (64Kb or 256Kb) installed before memory can be added via the 64/256Kb Memory Expansion Option. Switches on the option card must be set to indicate the amount of memory on the option card and in the system unit.

One or two 64/256Kb Memory Expansion Option features can be installed in a 5150 unit. For 5150 models with 256Kb on the system board, one memory expansion card contains 256Kb while the other card contains 64Kb or 128Kb to provide a total of 576Kb or 640Kb in the configuration. For models with 64Kb on the system board, each memory expansion card can contain 256Kb to provide a total of 576Kb in the 5150 configuration.

256Kb Memory Expansion Option

This option provides 256Kb of parity-checked random access memory on a 5-inch card. It plugs into an expansion slot only in the 5150 unit (not in the 5161 unit). The system board must have its maximum memory capacity (64Kb or 256Kb) installed. For 5150 models, this feature can be installed instead of the 64/256Kb Memory Expansion Option with three 64Kb Memory Module Kits to add 256Kb of memory at a lower cost.

One or two 256Kb Memory Expansion Options can be installed in 5150 models with 64Kb maximum on the system board to provide up to 576Kb in the configuration. One 256Kb Memory Expansion Option and one 64/256Kb Memory Expansion Option with 64Kb or 128Kb can be installed in 5150 models with 256Kb on the system board to provide up to 576Kb or 640Kb in the configuration.

The access time of the memory on the 256Kb Memory Expansion Option card is 290 ns and the cycle time is 840 ns.

Game Control Adapter

This feature permits up to two joysticks or up to four game paddles to be attached to the 5150 configuration. It can also be used as a general-purpose I/O card with four analog (resistive) inputs plus four digital input points.

A joystick allows the user to move an object shown on the video display in any direction for video game interaction. A game paddle supports simple vertical or horizontal movement of displayed objects. Joysticks and game paddles for the 5150 Personal Computer can be ordered from *The IBM Personal Computer Catalog*, G570-2064. They are supported by BASIC but not by DOS. (The IBM-logo joystick for the IBM PCjr does not attach to the 5150 configuration.)

The Game Control Adapter (one maximum) can be installed in a special- or full-feature slot in the 5150/5161 unit. The adapter provides a 15-pin D-shell connector at the back of the 5150/5161 unit.

Prototype Card

This feature (one maximum) is provided as a base for building and testing custom attachments for the 5150 configuration. The Prototype Card is a full-size circuit board 13.2 inches (335.3 mm) long and 4.2 inches (106.7 mm) high that plugs into a full-feature slot in the 5150 or 5161 unit. Circuitry and module holes are provided for interface with the IBM bus. A bracket is included to secure the card in the 5150/5161, with a cutout provided for an external D-shell connector with 9 to 37 pins. Detailed instructions and component identifications for I/O attachment logic are also included with this feature.

Monochrome Display and Printer Adapter

This adapter provides for attachment to the 5150 configuration of one 5151 Monochrome Display Model 1 and one printer, such as the 5152 Graphics Printer Model 2 (or compatible printer); 5182 Color Printer; 5201 QUIETWRITER® Printer; 5216 Wheelprinter Model 2; IBM SELECTRIC® System/2000 Typewriters; or IBM Electric Typewriter 65, 85, or 95; or a device with TTL (transistor to transistor logic) levels. The printer adapter provides a parallel interface to the attached printer/device (eight bits transferred at a time). See Section 31 for the cables required for printers that attach to this adapter.

One Monochrome Display and Printer Adapter can be installed in a 5150 configuration and requires one full-feature slot in the 5150 or 5161 unit. One other display adapter can be installed together with the Monochrome Display and Printer Adapter: Color/Graphics Monitor Adapter, Enhanced Graphics Adapter, or Professional Graphics Controller.

When the Monochrome Display and Printer Adapter and the Color/Graphics Monitor Adapter are installed in the same 5150 configuration, at least one of the two adapters must be installed in the 5150 unit for the primary display.

This feature provides a 9-pin connector and a 25-pin connector at the rear of the 5150/5161 unit for attachment of a direct-drive display and a printer, respectively. A light pen cannot be attached to this adapter for use with the 5151 or another display.

The monochrome display adapter supports the following:

- Alphameric (text) mode with a 256 character set. All-points-addressable graphics mode is not supported.
- 25 lines of 80 characters
- Resolution of 720 pels horizontal, 350 pels vertical
- White characters on a dark background (normal display)
- Dark characters on a white background (reverse display)
- Blinking characters (on an individual character basis) for normal and reverse display
- White characters on a white background or dark characters on a dark background (for nondisplay of characters on an individual character basis)

The Monochrome Display and Printer Adapter has 8Kb of ROM that contains a character generator and 256 character codes. The adapter also has 4Kb of read/write memory to hold the contents of one display screen of 25 80-character lines. The read/write memory is directly addressable by programming and can be read/written using direct memory access.

Color/Graphics Monitor Adapter

This adapter provides for the attachment of up to three color displays and one light pen to a 5150 configuration. Light pens are supported by BASIC but not by DOS. This adapter provides a 9-pin connector for a display that presents a direct-drive RGB (red, green, blue) signal, a connector (composite signal phone jack) for a display that presents a composite video signal, a four-pin Berg strip for connection of an RF modulator (P-1 connector), and a light-pen (P-2) connector (six-pin Berg strip).

The following can be attached to this adapter:

- 5153 Color Display Model 1, which provides a direct-drive RGB signal, or another RGB direct-drive video monitor (the latter is not provided by IBM) – uses the direct-drive RGB connector (on the end of the adapter card)
- 5154 Enhanced Color Display Model 1, which provides a direct-drive RGB signal – uses the direct-drive RGB connector
- A black and white or color video monitor (not provided by IBM) – uses the composite video connector (on the end of the adapter card)
- A black and white or color television set with an RF modulator (not provided by IBM) – uses the four-pin Berg strip (on the side of the adapter card) or with the appropriate RF

modulator cable plugs into the composite video connector (composite signal phone jack on the end of the adapter card). Only 40-column mode should be used for TV sets to improve character visibility.
- A light pen via the light pen connector (on the side of the adapter card)

Note that if a TV set or non-IBM display is used with the 5150, diskette drive errors may occur unless the display is located at least 12 inches (30 cm) away from the 5150 unit.

One Color/Graphics Monitor Adapter can be installed in a 5150 configuration and requires one full-feature slot in the 5150 or 5161 unit. One other display adapter can be installed together with the Color/Graphics Monitor Adapter: Monochrome Display and Printer Adapter, Enhanced Graphics Adapter, or Professional Graphics Controller.

When the Color/Graphics Monitor Adapter and the Monochrome Display and Printer Adapter are installed in the same 5150 configuration, at least one of them must be installed in the 5150 unit for the primary display.

The Color/Graphics Monitor Adapter supports the following:

- Two modes: alphameric (text) and all-points-addressable (APA) graphics
- 40- and 80-column formats for text mode (40-column for TV sets and low-resolution monitors, 80-column for high-resolution monitors)
- Two submodes for text mode: color (16 colors) and black and white (2 colors)
- Two resolutions supported for color and black and white text modes (320 pels horizontal, 200 pels vertical and 640 pels horizontal, 200 pels vertical)
- Blinking, reverse display, and high intensity for black and white text mode
- 16 foreground and eight background colors in color text mode (with blinking on a per character basis)
- Screen border color selection (1 of 16 colors) for text mode
- Medium-resolution and high-resolution modes for APA graphics mode
- Four colors for medium-resolution graphics mode (320 pels horizontal, 200 pels vertical)
- Black and white for high-resolution graphics mode (640 pels horizontal, 200 pels vertical)
- 256 characters in text mode, 128 characters in medium- or high-resolution graphics mode

The adapter contains 16Kb of dynamic read/write memory to store multiple display screen contents. Four 80-column screen displays or eight 40-column screen displays can be stored at one time. This memory is directly addressable by programming and can be read/written using direct memory access. The adapter also has 8Kb of ROM that contains a character generator.

See Appendix C for modes that are common to the Color/Graphics Monitor Adapter and the Enhanced Graphics Adapter.

Printer Adapter

This adapter provides for attachment to the 5150 configuration of one printer, such as the 5152 Graphics Printer Model 2 (or a compatible printer); 5182 Color Printer; 5201 QUIETWRITER® Printer; 5216 Wheelprinter Model 2; IBM SELECTRIC® System/2000 Typewriters; or IBM Electronic Typewriter 65, 85, or 95; or any device with TTL (transistor to transistor logic) levels. It provides a parallel interface to the printer/device (eight bits transferred at a time).

The Printer Adapter is used (1) to attach a parallel printer when a display adapter other than the Monochrome Display and Printer Adapter is installed or (2) when two parallel printers are to be installed and the Monochrome Display and Printer Adapter is already present.

One Printer Adapter can be installed in a 5150 configuration and requires one slot in the 5150 or 5161 unit (special- or full-feature). The adapter provides a 25-pin connector at the rear of the 5150/5161 unit for attachment of the printer cable. See Section 31 for the cables required for printers that attach to this adapter.

Enhanced Graphics Adapter, Graphics Memory Expansion Card, and Graphics Memory Module Kit

The Enhanced Graphics Adapter provides one 9-pin connector on the end of the card for attaching a display that presents a direct-drive RGB (red, green, blue) signal. Composite video support for attaching analog monitors or TV sets is not provided. One light pen can be attached to this adapter in addition to one display via the P-2 connector (six-pin Berg strip on the side of the card).

This adapter provides for attachment to a 5150 configuration of one of the following: 5154 Enhanced Color Display (which offers a choice of more colors

and a higher resolution than the 5153 Color Display), 5151 Monochrome Display, 5153 Color Display, or another direct-drive display. A light pen cannot be attached to this adapter for use with the 5151 display.

Two modes are supported by the Enhanced Graphics Adapter. Enhanced mode is required for the 5154 display if its 640 × 350 resolution and selection from up 64 colors are to be used. Enhanced display emulation mode supports the 5151, 5153, and 5154 displays and all the modes provided by the Monochrome Display and Printer Adapter and the Color/Graphics Adapter.

The emulation mode also provides an all-points-addressable graphics mode for the 5151 display (which is not provided by the Monochrome Display and Printer Adapter) and certain graphics support for the 5153 display that is not provided by the Color/Graphics Monitor Adapter (16 colors for 40 columns in 320 × 200 resolution and 16 colors for 80 columns in 640 × 200 resolution). The 5154 display emulates the 5153 display when attached to the Enhanced Graphics Adapter operating in enhanced display emulation mode.

See Appendix C for a comparison of the modes supported by the Monochrome Display and Printer Adapter, Color/Graphics Monitor Adapter, and Enhanced Graphics Adapter.

One Enhanced Graphics Adapter can be installed in a 5150 configuration and requires one slot in the 5150 unit. This adapter cannot be installed in the 5161 unit. One Graphics Memory Expansion Card can be installed in a socket on the side of the Enhanced Graphics Adapter, and the modules provided in one Graphics Memory Module Kit can be installed in the sockets provided on the Graphics Memory Expansion Card.

The Enhanced Graphics Adapter contains 64Kb of graphics memory. It supports four colors at a resolution of 640 pels × 350 pels, an 8 × 14 character box for color text, and 256 characters in text mode. A character generator can be loaded into the graphics memory from RAM to allow any set of 256 characters to be used. This facility is not supported by the Monochrome Display and Printer Adapter or the Color/Graphics Monitor Adapter.

The Graphics Memory Expansion Card provides 64Kb of graphics memory for a total of 128Kb on the Enhanced Graphics Adapter to support up to 16 colors at the 640 × 350 resolution and up to 512 text characters. The Graphics Memory Module Kit provides 128Kb of graphics memory for a total of 256Kb on the Enhanced Graphics Adapter with the Graphics Memory Expansion Card to support up to 1024 characters (up to eight 128-character sets), character box sizes up to 8 × 32, and/or other functions, such as smooth scrolling, panning (scanning sequentially through graphics memory), and additional pages (screens) of graphics data.

The Enhanced Graphics Adapter can be installed in a 5150 configuration that has another display adapter installed, which can be the Monochrome Display and Printer Adapter, Color/Graphics Monitor Adapter, or Professional Graphics Controller. When the Monochrome Display and Printer Adapter is installed together with the Enhanced Graphics Adapter, the latter must have a color display attached. Similarly, when the Color/Graphics Monitor Adapter is installed with the Enhanced Graphics Adapter, the latter must have a monochrome display attached.

The Enhanced Graphics Adapter card contains a four-switch module that is accessible when the card is mounted in an expansion slot. This module must be set to indicate the specific display attached to the adapter, which display in the configuration is the primary display if two displays are present, and whether 40- or 80-character mode is to be the power-on default when the primary display is a color display. DIP switches (or the slide switch in the 5170 Personal Computer AT or AT/370) on the system board must also be set as appropriate.

A 5150 Model 813, 824, 1, 14, 64, or 74 with serial number 0300960 or lower without a 5161 unit attached must have the BIOS Update Kit installed in order to install the Enhanced Graphics Adapter.

The Graphics Development ToolKit program can be used by programmers and developers to create graphics programs that remain independent of graphic I/O devices. Such programs have a greater range of portability and compatibility among IBM personal computer configurations and permit users to select from a larger choice of graphics hardware.

See *IBM Enhanced Graphics Adapter Quick Reference Software Guide*, G520-5071, for certain application program support of 5151, 5153, and 5154 displays attached to the Enhanced Graphics Adapter. See *IBM Personal Computer Seminar Proceedings Volume 2, Number 11*, G320-9318, for additional information about this adapter.

Professional Graphics Controller

The Professional Graphics Controller is required to attach the 5175 Professional Graphics Display to a 5150 configuration via the 5161 unit. The 5175 display together with the Professional Graphics Controller offers more colors and a higher resolution than the 5154 Enhanced Color Display and provides high-quality color graphics capabilities for a wide range of specialized applications.

The 5175 display (which has the same dimensions as the 5153 Color Display) can be used by engineers, scientists, technicians, and designers for computer-aided design, computer-aided manufacturing, image processing, and business presentation graphics. The 5175 display permits advanced graphics to be integrated with other work performed by a 5150 Personal Computer.

One Professional Graphics Controller can be installed in a 5150 configuration. It requires two adjacent full-feature slots in the 5161 unit in a 5150 configuration. It cannot be installed in the 5150 unit. This controller can be present in a configuration that has one other display adapter installed (Monochrome Display and Printer Adapter, Color/Graphics Monitor Adapter, or Enhanced Graphics Adapter). Another display must be included in a 5150 configuration that contains a 5175 display in order to execute diagnostics.

The Professional Graphics Controller provides the following:

- Two modes: expanded graphics to support the full facilities of the 5175 display and Color/Graphics Monitor Adapter emulation. Emulation mode enables the 5175 display to be used with application programs that are designed to use the 5153 (or a compatible) display attached to the Color/Graphics Monitor Adapter.
- 16 × 8 character box in emulation mode
- Enhanced text character set in emulation mode
- 640 × 480 resolution for expanded graphics mode, 640 × 400 for emulation mode
- 256 colors from a palette of 4096
- Hardware that has built-in two-dimensional and three-dimensional capability for:
  - Drawing
  - Rotating
  - Translating
  - Scaling
- Moving and drawing with absolute or relative coordinates
- User-redefinable color selection
- Built-in or user-programmable character set
- Variable character size
- Vector and polygon drawing and polygon fill
- Intel 8-MHz 8088 microprocessor for high-performance graphics operations
- 60 frames per second non-interlaced
- Eight-bit planes available for read/write
- 25 MHz video pel rate
- Screen clear/color flood feature
- 320Kb of display storage:
  - 20Kb for display lists and internal variables
  - 300Kb for display data
- 64Kb of graphics microcode that reduces the need to load software routines to support key graphics activities
- Power-on diagnostics. A diagnostics diskette is also provided.

When the Professional Graphics Controller is installed together with the Color/Graphics Monitor Adapter, the Professional Graphics Controller must operate in expanded graphics mode (not Color/Graphics Monitor Adapter emulation mode). When the Professional Graphics Controller is installed together with the Enhanced Graphics Adapter, only one of the two adapters can be emulating the Color/Graphics Monitor Adapter.

For additional information, see the brochure *Professional Graphics Display and Controller*, G520-5013. See *IBM Professional Graphics Controller Quick Reference Card*, G520-5073, for application support of this controller.

Data Acquisition and Control Adapter and Data Acquisition and Control Adapter Distribution Panel

The Data Acquisition and Control Adapter provides analog input and output channels and digital input and output ports to receive data from and send data to instruments and devices for the purpose of data acquisition, control, analysis, and quality control testing in laboratory, pilot plant, or full-scale production lines.

Examples of devices and instruments that can use this adapter are chromatographs, spectrophotometers, pressure gauges, relay controls, thermocouples, gas analyzers, humidity sensors, valve actuators, level gauges, load cells, conductivity cells, and pH meters. Examples of commonly monitored and controlled parameters that can be handled are pressure, flow, temperature, displacement, voltage, light intensity, and rotational speed.

The adapter provides:

- Four analog input channels with a 12-bit resolution and user-selectable unipolar or bipolar

input modes. Throughput to memory is 15,000 conversions per second.
- Two analog output channels with a 12-bit resolution and user-selectable unipolar or bipolar output modes. Throughput from memory is 25,000 conversions per second.
- 16 digital input lines and 16 digital output lines that are TTL (transistor to transistor logic) compatible. An input line presents no more than two TTL loads, while an output line is capable of driving at least ten standard TTL loads. Throughput to/from memory from the input/output lines is 25,000 operations per second.
- Programmed or interrupting mode of operation for analog input and output channels and programmed I/O mode for digital input and output
- 16-bit programmable binary counter that can be used as an event counter, as a programmable rate generator, or for programmable time delay

Optionally, the Data Acquisition and Control Adapter Distribution Panel can be connected to the Data Acquisition and Control Adapter via a shielded flat cable 34 inches long that is permanently connected to the distribution panel. The distribution panel is a printed circuit board with four barrier-type screw terminal strips, which provide a total of 88 terminations. The circuit board is housed in a metal enclosure that is slotted to allow user cabling to enter and exit the panel. This panel can be used to quickly connect, change, or remove the instruments and/or control points being used.

Up to four Data Acquisition and Control Adapters can be installed in a 5150 configuration. When more than one such adapter is installed, all must be installed either in full-feature slots in the 5161 unit or in any available slots in the 5150 unit. A diagnostic program is provided with the adapter to test the hardware, and the Data Acquisition and Control Adapter Program is available to support the operation of up to four of these adapters.

For more information, see the brochure *Data Acquisition and Control*, G520-5020.

General Purpose Interface Bus Adapter

This adapter provides the means to attach devices and/or instruments that use the ANSI/IEEE-488 standard interface, including the 488A-1980 supplement, to a 5150 configuration. This adapter permits engineering and science professionals to access and control over 2000 different instruments that use the IEEE-488 standard.

Up to four General Purpose Interface Bus Adapters can be installed in a 5150 configuration. If multiple adapters use the same interrupt level, they must all be installed in the same unit (5150 or 5161). An adapter can have up to 14 devices or instruments attached with a maximum of 48 devices/instruments in one 5150 configuration.

The 7371, 7372, 7374, and 7375 (Model 1 and 2) Color Plotters can be attached to this adapter. A General Purpose Interface Bus Cable (part number 2720020, feature code 5040) must be purchased for each device that is to be attached to this adapter.

This adapter can use the direct memory access capability and supports a memory access data rate of up to 300Kb per second. A programmed I/O data rate of up to 20Kb per second is also supported. User selection of the direct memory access channel and/or the interrupt level used by this adapter is provided. The adapter can send data as a talker, receive data as a listener, issue commands as a controller, or combine these functions as required.

The General Purpose Interface Bus Adapter Programming Support program supports up to four of these adapters controlling, monitoring, and accessing up to 48 devices.

For more information, see the brochure *General Purpose Interface Bus*, G520-5021.

Asynchronous Communications Adapter

One or two Asynchronous Communications Adapters can be installed in a 5150 configuration. When the SDLC adapter is installed, only one asynchronous adapter can be installed. The asynchronous adapter requires one expansion slot in the 5150 or the 5161 Model 1 (special- or full-feature).

This adapter provides a path to a processor or an I/O device outside the 5150 or 5161 unit. A processor or I/O device can be connected to this adapter directly via cable (for local attachment). A remote processor can be attached to this adapter via a telephone line using a plug-in modem. A customer-supplied cable is required for attachment of an external modem or other device to the asynchronous adapter.

The asynchronous adapter provides one 25-pin D-shell connector to attach a device to the adapter. In addition, a current-loop interface is located in the same connector. A jumper block is provided to manually select the voltage or the current-loop interface. The current-loop interface is used, for example, to attach a 5218 Printwheel Printer to the 5150/5161.

The recommended maximum cable length for attachment of a device to the current-loop interface is 50 feet (15.3 m).

Vendor-logo (Hayes Smartmodem™) external modems and modems that plug into an expansion slot can be purchased from IBM. The internal modems do not require the Asynchronous Communications Adapter.

Two asynchronous adapters in the same 5150 configuration can transmit/receive at the same time. However, because of contention for interrupt levels, concurrent operation of two asynchronous adapters is the only concurrent communications adapter operation possible.

Communication is performed using the EIA (Electronics Industry Association) RS-232C asynchronous interface. This is a serial (bit-by-bit transfer) interface. The adapter is fully programmable. Speed (50 to 9600 bps or 5 to 960 bytes per second), format (5-, 6-, 7-, or 8-bit characters), parity checking, and stop bits (1, 1.5, or 2) are selected as appropriate for the attached processor/device. A prioritized interrupt system controls transmit, receive, error, line status, and data set interrupts.

Line break, signal generation and detection, false-start bit detection, and internal diagnostics are also supported. The EIA-standard I/O signals transmit data, receive data, clear to send, request to send, data set ready, data terminal ready, ring indicator, carrier detect, and received line signal detect are supported. Full double buffering eliminates the need for precise synchronization. The diagnostic capability provides the loop back functions of transmit/receive and input/output signals.

A 5150 configuration can be attached to the following using the Asynchronous Communications Adapter:

- System/370, 30XX, and 4300 processors
- 8100 Processors via the 7426 Terminal Interface Unit
- Series/1 processors
- 4860 PCjrs
- 5150 Personal Computers
- 5155 Portable Personal Computers
- 5160 Personal Computer XTs or XT/370s
- 5170 Personal Computer ATs or AT/370s
- 3270 Personal Computer workstations
- 5531 Industrial Computers
- 5181 Compact Printers
- Displaywriters
- 7371, 7372, 7374, and 7375 (Model 1 and 2) Color Plotters
- 5216 Wheelprinters Model 2
- 5218 Printwheel Printers Models A03 and A04 or other letter-quality serial printers
- 4975 Printers Model 02R
- Paper tape readers
- Communicating typewriters
- Laboratory instruments
- Voice recognition devices and electronic keyboards
- Mouse devices (Microsoft™ Mouse and Mouse Systems PC PC XT Mouse, for example)
- Other devices and processors that use the RS-232C interface

IBM-logo DOS application programs that support the Asynchronous Communications Adapter in a 5150 configuration for communications functions include the following:

- 3101 Emulation Program
- Asynchronous Communications Support Version 2
- Series/1 Intelligent Workstation Support PRPQ
- Personal Communications Manager
- PROFS Personal Computer Connection (PROFS/PC²)
- PC/Videotex
- PC/Colorview
- Personal Services/PC
- Data Edition IBM Personal Decision Series Productivity Product

Using the 3101 Emulation Program, a 5150 with the asynchronous adapter simulates an IBM 3101 Display Terminal Model 20 with some differences. The 5150 is connected to another processor via a duplex modem or direct cabling. The 3101 Emulation Program permits a 5150 to transmit ASCII files to and receive ASCII files from a host processor. The transmission of extended ASCII characters (codes 128 to 255) is not supported. Conversion of ASCII files to and from binary format is also supported.

The 3101 Emulation Program supplies specification files that support 5150 communication with the following:

- Processors (such as System/370, 30XX, and 4300) executing VM/370 or MVS TSO
- 7426 Terminal Interface Unit for communication with 8100 Processors
- Yale IUP for Series/1
- 3101 Pass-through Support
- Dow Jones News Service™
- THE SOURCE
- Another IBM personal computer
- IBM Information Network

The Asynchronous Communications Support Version 2 program permits a 5150 with the asynchronous adapter to be used as an interactive asynchronous (start/stop) TTY ASR 33/35 terminal. The 5150 connects to another processor via a duplex modem or direct cabling. The program supports the exchange of programs and data with the host system with which it is communicating (System/370, 30XX, 4300, Series/1, 8100 via the 7426, or another IBM personal computer with the Asynchronous Communications Support program). ASCII diskette files can be converted to and from binary using the supplied utility. Communication with the Dow Jones News Service or THE SOURCE is also supported by this program.

The Series/1 Intelligent Workstation PRPQ (5799-TGC) provides Series/1 subroutines and an interactive communication program for a 5150 attached to a Series/1 processor as a local or remote workstation via the Asynchronous Communications Adapter. The Series/1 subroutines operate with RPS, EDX, or CPS in the Series/1 processor.

This PRPQ supports 3101 terminal emulation, data transfer to and from the Series/1, printing on a 5150-attached printer by a Series/1 program, 5150 communication with a host processor as a 3270 terminal using binary synchronous or SNA/SDLC communication when the Series/1 has pass-through capability, and concurrent operation in the 5150 system of a DOS application program and a file transfer to/from the Series/1 processor. For additional information, see the brochure *Series/1 Personal Computer Intelligent Workstation Support*, G520-0105.

The Personal Communications Manager program provides terminal emulation for 5150 communication with remote processors and an electronic mail function. When the terminal emulation facility is active, the 5150 has the operating characteristics of an asynchronous (start/stop) Teletype™ ASR 33/35 terminal. The 5150 can communicate with remote processors (System/370, 30XX, and 4300) or access information services, such as Dow Jones News Service™, THE SOURCE, and the CompuServe™ Information Service.

The electronic mail function permits the 5150 to send correspondence to and receive correspondence from multiple locations via a processor that provides message handling services. Messages can be exchanged with up to 400 different user addresses. Messages can be displayed or printed. In addition, DOS-format files can be sent and received. Transmission of messages and files can be done at any time of day or night to any user location that is operating in electronic mail mode.

A 5150 (with an Asynchronous Communications Adapter attached to a duplex modem) that is connected as an ASCII device to a VM/370 host system with Professional Office System (PROFS) installed can use the PROFS Personal Computer Connection (PROFS/PC²) program to transfer PROFS incoming mail and other business information from the host to the 5150 for stand-alone processing. Results can be transferred from the 5150 to PROFS in the host for processing or distribution to other PROFS users. In addition, PROFS documents can be transferred to the 5150 for printing.

When the DisplayWrite 2 or DisplayWrite 3 program is also used with PROFS/PC² in the 5150 systems connected to the PROFS host, revisable form text document content architecture (RFTDCA) format documents can be exchanged between those 5150 systems, using the PROFS library and distribution facilities. The 5150 must use DOS Version 2.0 or later and the Interactive System Productivity Facility/Personal Computer (EZ-VU Runtime Facility) program, as well as PROFS/PC². The VM/370 host must use PROFS Release 2 with PTF 01 applied.

Document exchange between a PROFS host processor and a 5520 is also supported for a 5520 system that is cable-connected to a 5150 system that can communicate with PROFS using PROFS/PC². A 5520 document is transferred to the 5150 and converted to a DOS file. It is then transferred to CMS and then to PROFS. The 5520 documents transferred to PROFS can be stored and/or distributed to other 5520 systems attached to 5150 configurations executing PROFS/PC².

The PC/Videotex program permits a 5150 to be used as a videotex terminal. The 5150 is attached to a videotex host processor (System/370, 30XX, 4300, or Series/1, for example) using the Asynchronous Communications Adapter (with a 1200-bps modem), and asynchronous communications protocols are used. As a videotex terminal, the 5150 can establish communications with a videotex host, receive videotex frames for display on a color monitor or TV, enter data for transmission back to the host, save incoming videotex frames on disk, and view the saved frames.

PC/Videotex (running under DOS Version 2.0 or 2.1) in a 5150 provides videotex-user terminal support for the IBM Series/1 Videotex System (SVS/1) via an implementation of the North Atlantic Presentation Level Protocol Syntax (NAPLPS). It also supports end-user access to videotex host data bases.

Two session-level protocols for videotex communications links are supported. One is the protocol currently implemented by the Norpak Mark IV terminal and the IBM Series/1 Videotex System (SVS/1.1) program. The other is the protocol currently implemented by the Infomart host software (Videotex America). This protocol support enables the 5150 to connect to a variety of videotex networks. Additional information is provided in the brochure *PC/Videotex*, G320-0711.

PC/Colorview allows the user of an IBM Personal Computer to view color ASCII videotex information interactively with a videotex host or to retrieve previously stored videotex information from local files resident on a diskette or fixed disk.

The program uses the standard IBM personal computer character set (graphics are not supported). It provides automatic or manual dial capability for asynchronous communications for tone and pulse telephone systems and main-menu capability for five user-defined selection options of file names or telephone numbers. It has user-definable function key support for each of the five options.

The program provides simultaneous capture of videotex pages and their routing identification numbers as they are viewed. It provides viewing of videotex pages using the routing identification numbers from previously created local files. Selective capture of videotex pages in sequential order without routing information, and viewing of previously captured videotex pages from local files in their sequence of capture is permitted.

Personal Services/PC operating in a 5150 with an Asynchronous Communications Adapter supports communication with DISOSS/370 Version 3 Release 2 or 3 in a host processor. Personal Services/PC supports office systems functions. It can be used to exchange messages, DOS files, and documents (in revisable form text document content architecture or final form text document content architecture format) with a DISOSS/370 host processor. It also supports an electronic file cabinet in the IBM personal computer to allow easy access to items that have been sent or received.

Personal Services/PC also supports direct communication between IBM personal computers (IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XTs, and IBM Personal Computer ATs) that are connected via an asynchronous adapter and that are using Personal Services/PC. The same exchange and electronic file cabinet functions are supported as for a connection with DISOSS/370.

Using an Asynchronous Communications Adapter and a full duplex modem, communication between the 5150 and a System/370, 4300 or 30XX processor executing MVS/TSO or VM/CMS is supported by the Data Edition program, a component of the IBM Personal Decision Series Productivity Products. Data Edition also supports communication with other IBM personal computers executing Data Edition under DOS Version 2.0 or later (5150, 5155, 5160, 5170, 5160 PC XT/370, and 3270-PC configurations) and access to public data base services, such as THE SOURCE and the Dow Jones News Service™.

Data Edition manages an integrated data base for all the IBM Personal Decision Series products and provides report writing functions. It enables users to access data formatted by the IBM Business Management Series, DOS files created by other IBM personal computer software, Data Interchange Format (DIF) files, and public data base files.

Binary Synchronous Communications (BSC) Adapter

One or two BSC adapters can be installed in a 5150 configuration unless the SDLC adapter is present, in which case only one BSC adapter can be installed. The adapter requires a slot in the 5150 or 5161 Model 1 (full-feature). An external modem must be cable-connected between the BSC adapter and a telephone line using the Communications Adapter Cable feature.

The BSC adapter provides an EIA RS-232C interface. The adapter contains a universal synchronous/asynchronous receiver/transmitter, a programmable peripheral interface for an expanded modem interface, and a programmable interval timer. The adapter is programmed by IBM-logo communications software to operate in binary synchronous half-duplex mode.

The BSC adapter operates at up to 9600 bps with switched or nonswitched line support, provides modem control functions, supports program-controlled data transfer, supports electrical wrap and error status reporting, and has prioritized interrupt system controls.

The IBM-logo DOS application programs that support the BSC adapter in a 5150 configuration are the Binary Synchronous 3270 Emulation Program and the DisplayComm Binary Synchronous Communications Program.

The BSC adapter, when used with the Binary Synchronous 3270 Emulation Program, permits the

5150 to emulate 3270 interactive BSC operation and to perform file transfer operations. The adapter provides the ability for a 5150 to be attached via communications lines to a host system that supports 3270 connection (System/370, 30XX, 4300, and Series/1) and to participate in a network using BSC protocol. The network may have either switched or nonswitched lines. When used as a 3270 with the BSC 3270 emulation program, the 5150 operates and appears to the host as one of the following 3270 devices:

- 3271 Model 2/3277 Model 2 – nonswitched line
- 3274 Model 51C/3278 Model 2 – nonswitched line
- 3275 Model 2 – switched or nonswitched line
- 3276 Model 2 – nonswitched line

The BSC 3270 emulation program also supports constant line trace, error logging, and communications statistics accumulation.

The DisplayComm Binary Synchronous Communications (BSC) Program operating under DOS Version 2.1 supports the transmission of revisable form text document content architecture (RFTDCA) files, page image text, or card image text between the 5150 and various IBM office systems over a binary synchronous communications line. Batch data transmission at line speeds up to 4800 bps is supported.

Data exchange between the following is supported by this communications program operating in the 5150:

- A 5150 using the DisplayWrite 2 program and a Displaywriter using the Displaywriter Binary Synchronous Communications Program. RFTDCA-format files can be exchanged.
- A 5150 using the DisplayWrite 2 program and a (1) 5520 Administrative System with communications support, (2) 6670 Information Distributor with binary synchronous communications support, or (3) Office System 6 with binary synchronous support. DisplayWrite 2 documents are converted to/from EBCDIC page image or card image format for these exchanges.
- A 5150 and a 5155 Portable Personal Computer, 5160 Personal Computer XT, 5170 Personal Computer AT, or another 5150 Personal Computer that is also using the DisplayComm Binary Synchronous Communications Program. Any DOS file, including object files, can be exchanged.
- A 5150 and a suitably programmed host processor (System/370, 30XX, or 4300) that supports 2770/3780 or 2780 communication protocols. DOS files in any format can be exchanged. When DisplayWrite 2 is used in the 5150 as well, EBCDIC page image, EBCDIC card image, and RFTDCA files can be exchanged.

Synchronous Data Link Control (SDLC) Communications Adapter

One SDLC Communications Adapter can be installed in a 5150 configuration and only one asynchronous adapter and one BSC adapter can be installed in the 5150 configuration when the SDLC adapter is present. One expansion slot in the 5150 or 5161 unit is required. An external modem must be cable-connected between the SDLC adapter and telephone line using the Communications Adapter Cable feature.

The SDLC adapter provides an EIA RS-232C interface. The adapter contains an SDLC protocol controller, a programmable peripheral interface for an expanded modem interface, and a programmable interval timer. The adapter is programmed by IBM-logo communications software to operate in synchronous half-duplex mode.

The SDLC adapter operates at up to 9600 bps with switched or nonswitched line support (including multipoint), provides modem control functions, supports program-controlled data transfer, supports electrical wrap and error status reporting, and provides prioritized interrupt system controls. The SDLC adapter can use direct memory access for data transfer.

IBM-logo DOS application programs that support the SDLC adapter in a 5160 configuration for communications functions include the following:

- SNA 3270 Emulation and RJE Support Program
- IBM PC Network SNA 3270 Emulation Program
- Remote 5250 Emulation Program
- Batch Communications (program offering)

The SDLC Communications Adapter, when used with the SNA 3270 Emulation and RJE Support Program, permits the 5150 to emulate 3270 interactive SNA operation or 3770 batch SNA (SNA 3770 RJE). The adapter provides the ability for a 5150 attached to a host system (System/370, 30XX, 4300, 8100, or Series/1) via a communications line to participate in a network using SDLC protocol. The 5150 operates and appears to the host as a 3278 Display Station Model 2 attached to a 3274 Model 51C Control Unit or as a 3770. The SDLC

adapter operates at up to 4800 bps with this program.

The IBM 8100 DPPX/SP Personal Computer RJE File Transfer PRPQ (5799-WXT) operating in an 8100 with 8100 DPPX/SP supports program and data file transfer between the 8100 system and a 5150 system in which the SNA 3270 Emulation and RJE Support Program is operating. The 5150 can transfer personal computer programs and data files to the 8100 for storage on disk. Files stored in the 8100 configuration can be shared among all 5150 users attached to the 8100 and among all 8100 users. These files can also be printed by the 8100. Files created or stored at the 8100 can be transferred to the 5150. Conversion of ASCII files to and from EBCDIC is supported. The 5150 configuration can be attached to the 8100 via a leased or dialed communications line.

A 5150 connected to a host processor (System/370, 30XX, or 4300) via the SDLC adapter can communicate with host applications using SNA 3270 communications as supported by the IBM PC Network SNA 3270 Emulation Program operating under DOS Version 2.1 or later. The 5150 can emulate a 3274 Model 51C Control Unit with a 3278 Display Station Model 2 or 3279 Color Display Station Model S2A and/or 3287 Model 1 Printer attached. A subset of 3274 Model 51C Control Unit functions are emulated and certain features of a 3278 Model 2, 3279 Model S2A, and 3287 Model 1 are not supported.

Transfer of files to the 5150 for printing on an attached 5152 Graphics Printer can be initiated from the host processor or by the 5150 user. Transfer of files to the 5150 for storage on diskette or fixed disk and later printing is provided. A 3270 emulation session and a DOS application session can operate concurrently and the user can switch between the two sessions. A keyboard mapping facility enables the 5150 user to define the function of most of the 5150 keyboard keys as desired. A screen-save function allows the user to store a copy of displayed information on diskette or fixed disk.

The Remote 5250 Emulation Program supports a 5150 connected to a System/36 or System/38 via a communications line and the SDLC adapter. This program provides the facilities of the Enhanced 5250 Emulation Program for remote connection of a 5150 to a System/36 or System/38 without the 5294 Remote Control Unit. See discussion of the Enhanced 5250 Emulation Program under "Enhanced Display Station Emulation Adapter" later in this subsection for the facilities provided by the Remote 5250 Emulation Program.

The Batch Communications program offering supports the transmission of files of transactions to supporting host applications, such as IMS and CICS, via a switched network using SNA/SDLC communications. Auto-answer and attended and unattended operation are supported. Automatic session recovery with message synchronization and user exits for security, encryption, and additional user control are provided. This program offering offers low-cost entry for remote collection and distribution functions, particularly when host access need not be permanent and is of short duration.

Communications Adapter Cable

This cable supports the attachment of a modem to the BSC adapter or SDLC adapter card connector at the rear of the 5150/5161. The cable is double-shielded and approximately 10 feet (3 meters) long. A wrap connector is provided to test the cable. This cable is required to connect the BSC adapter or SDLC adapter to an external modem or other data communications equipment.

Display Station Emulation Adapter

One Display Station Emulation Adapter can be installed in a 5150 configuration. It requires one slot in the 5150 System Unit. This adapter can be installed in the 5161 unit instead of in the 5150 unit unless Version 1 of the 5520/Personal Computer Attachment Program is used.

This adapter in a 5150 configuration is supported by the following IBM-logo DOS application programs:

- 5520/Personal Computer Attachment Program (Versions 1, 2, and 3) to permit 5150 systems to communicate with a 5520 Administrative System
- 5250 Emulation Program to permit a 5150 system to communicate with a System/34, System/36, or System/38
- Attachment/36 Edition program executing with the 5250 Emulation Program to permit a 5150 system to communicate with a System/36 executing Attachment/36

This adapter, when used with the 5520/Personal Computer Attachment Program, allows a 5150 Personal Computer to be cable-attached to the 5520 Administrative System (any model) and to emulate the 5253 Display Station. Multiple 5253 displays and 5150 systems can be attached to the same 5520 system. One 5253 station must be included in the 5520 configuration for service use. From five to 35 5150 systems can be cable connected to a 5525

System Unit (depending on the 5525 model) with up to 24 active concurrently.

When the 5150 operates in 5253 Display Station emulation mode, it has access to the word processing, record processing, storage, distribution facilities, and most other functions of the 5520 Administrative System. The 5150 system can also operate as a stand-alone IBM Personal Computer.

Any DOS-format diskette file created during 5150 stand-alone personal computer mode operations can be converted to a 5520 document and stored in the 5520 document library. DOS diskette files created by VisiCalc™ can also be converted to a 5520 document and included in other 5520 documents that are to be printed.

Version 2 of the 5520/Personal Computer Attachment Program permits a 5150 operating in 5253 emulation mode to emulate the 3278 Model 2 Display Station. Version 3 of this program supports all Version 1 and 2 features and the following:

- Transfer of DOS files to and from the 5520 document library without converting them from ASCII to 5520 internal format or from 5520 internal format to ASCII format, as is required by Versions 1 and 2. The 5520 can store DOS files in their 5150 format: binary, RFTDCA (revisable form text document content architecture), or FFTDCA (final form text document content architecture). DOS files in the 5520 document library can be edited, printed, or archived by any 5253 display or 5150.
- Transfer of RFTDCA, FFTDCA, and binary files from one 5150 to any other 5150 or 5253 in the configuration directly (without storing them in the 5520 document library first) and transfer of such files to a 5150 directly from another user in the configuration
- Printing of DOS files in RFTDCA or FFTDCA format on 5520 printers without storing the files in the 5520 document library
- Transfer of files to and from a System/370, 30XX, or 4300 MVS/TSO or VM/CMS host processor connected to the 5520 system. A 5150 DOS file can be transferred to a host processor direct access device, or a host processor data set can be transferred to the 5150. The MVS/TSO 3270-PC File Transfer Program (5665-311) or VM/SP 3270-PC File Transfer Program (5664-281) must be executing in the host processor to handle these file transfer functions. The 5150 uses 5253/3270 display station emulation provided by the 5520/Personal Computer Attachment Program. This transfer permits properly formatted files to be downloaded from the host processor to the 5150 for conversion to 5520 documents, and 5520 documents can be converted to DOS files and uploaded to the host processor for processing.

The 5253 Emulation Installation Convenience Kit Version 1, 2, or 3 can be purchased for the 5150 to provide the items necessary to permit attachment of the 5150 to the 5520 Administrative System and support 5253 emulation (Display Station Emulation Adapter, 5520/Personal Computer Attachment Program Version 1, 2, or 3, respectively, T-connector, and Twinaxial Cable Assembly).

One copy of each of the following publications is provided with the 5520/Personal Computer Attachment Program and additional copies can be ordered:

- 5520/Personal Computer Attachment Program Quick Reference Card Version 1, G570-2022, Version 2, G570-2047, or Version 3, G570-2115
- 5520/Personal Computer Attachment Program User's Guide Version 1, G570-2026, Version 2, G570-2045, or Version 3, G570-2114
- 5520/Personal Computer Attachment Program Keyboard Template Version 1, G570-2025, Version 2, G570-2046, or Version 3, G570-2118
- Display Station Emulation Adapter Installation and Problem Determination Procedures Version 1, G570-2023, Version 2, G570-2044, or Version 3, G570-2112
- 5520/Personal Computer Attachment Program, Learning Guide for Professionals Version 3, G520-2173

A manual (G320-0550) is available that provides detailed instructions for modifying the 5520 Personal Computer Attachment Program Version 3 for use with the 5216 Wheelprinter.

When used with the 5250 Emulation Program, the Display Station Emulation Adapter permits a 5150 Personal Computer to be connected to a System/34, System/36, or System/38 as a locally attached workstation or remotely using the 5251 Display Station Model 12.

When operating in 5250 emulation mode, the 5150 can be used as a 5251 Model 11, 5291, or 5292 Model 1 display; has access to all the functions of the host System/34, System/36, or System/38 that are available to a display station operator; and can also operate in 3270 emulation mode when the host is operating with 3270 emulation support. The 5150

can also operate as a stand-alone IBM Personal Computer.

When the appropriate File Support Utility PRPQ for the IBM Personal Computer is used in the host processor, the Display Station Emulation Adapter with the 5250 Emulation Program permits the 5150 to be attached to a host System/34/36/38 to create virtual diskettes on the host system. The 5150 user can change virtual diskettes on the host without physically handling multiple diskettes, and multiple users can read the same virtual diskette simultaneously. Transfer of data from a host file to a 5150 diskette, conversion of ASCII files to EBCDIC files, and conversion of EBCDIC files to ASCII files are also supported.

The File Support Utility PRPQs (P84057 for System/34, P84059 for System/36, and P84058 for System/38) provide a tool to assist programmers in transferring data between the 5150 and the host system. See the following publications for design objectives: GC21-7994 for the System/34, GC21-7995 for the System/38, and GC21-7999 for the System/36.

The IBM Personal Computer-System/36 Transfer Facility PRPQ P84065 and IBM Personal Computer-System/38 Transfer Facility PRPQ P84066, when used with the 5250 Emulation Program and Display Station Emulation Adapter, support the transfer of data from a System/36 or System/38, respectively, to a 5150 configuration.

An entire file, only selected records, or only selected fields within records can be transferred. The order of the selected fields can be rearranged and the records to be sent to the 5150 can be sorted in ascending or descending sequence. The data sent to the 5150 can be directed to the display, a printer, or a diskette (but not to a fixed disk or the virtual diskettes supported by the File Support Utility PRPQs). For additional information, see the program specifications (GC21-9075 for the System/36 transfer program and GC21-9077 for the System/38 transfer program) and the user's and programmer's guide (SC21-9079 for the System/36 transfer program and SC21-9080 for the System/38 transfer program).

PC Support/36 provides all the functions of the System/36 File Support Utility PRPQ and the System/36 Transfer Facility PRPQ for a 5150 connected to a System/36 plus major enhancements and can be used instead of the two PRPQs for communication between a 5150 and a System/36. PC Support/36 provides programs for the System/36 and the 5150 Personal Computer.

PC Support/36 supports concurrent access to up to eight virtual disks, which can vary in size from 5Kb to 32Mb. It adds a virtual print capability that allows 5150 print output to be directed to a System/36 printer. Data transfer from the 5150 to the System/36 is also supported.

PC Support/36 in the System/36 can be used with the following in the 5150 system:

- 5250 Emulation Program operating with the Display Station Emulation Adapter
- Enhanced 5250 Emulation Program operating with the Enhanced Display Station Emulation Adapter
- Remote 5250 Emulation Program operating with the SDLC Communications Adapter

The 5250 Emulation Convenience Kit provides the items required to connect the 5150 to a System/34, System/36, or System/38 (Display Station Emulation Adapter, 5250 Emulation Program, T-connector, and Twinaxial Cable Assembly).

The following provide information about the 5250 Emulation Program and the Display Station Emulation Adapter:

- 5250 Emulation Program User's Guide (6092654)
- 5250 Emulation Program Quick Reference Card (6092655)
- Display Station Emulation Adapter:
  - Hardware Maintenance Manual (7034652)
  - Installation and Problem Determination Procedures Manual (7033710)

The Attachment/36 Edition program, operating in the 5150 with Data Edition and the 5250 Emulation Program under DOS Version 2.0 or 2.1, supports communication between a 5150 connected to a local System/36 that is executing the Attachment/36 program (5727-BRK). Attachment/36 Edition and Attachment/36 are IBM Personal Decision Series Host Attachment Products. Data Edition is an IBM Personal Decision Series Productivity Product.

The following functions are supported:

- Access to data created both inside and outside the IBM Personal Decision Series environment:
  - Copies data from the System/36 to file types supported by Data Edition in the 5150 Personal Computer
  - Copies data from file types supported by Data Edition in the 5150 Personal Computer to the System/36

  - Uses the standard IBM personal computer DOS text, BASIC, sequential, and direct file types
  - Supports the indexed file type
  - Supports conversion between ASCII and EBCDIC
  - Provides smart field-level copy to allow the user to transfer files containing various numeric data types between the systems
- Utilization of System/36 disk space as 5150 Personal Computer virtual disks:
  - Simulates IBM personal computer fixed disks
  - Shares disks with other IBM personal computers
  - Provides up to two virtual disks at a time, each with a maximum size of 10Mb
  - No limit to the number of virtual disks a user can create
- Archiving of 5150 Personal Computer programs and data at the System/36
- Printing of 5150 Personal Computer data on a System/36 printer and of System/36 output on a 5150 Personal Computer printer
- Ability to save a series of tasks as Data Edition procedures:
  - Executes tasks unattended or with minimum operator intervention
  - Includes tasks from other Personal Decision Series members if desired

See GH30-0774 for the licensed program specifications for Attachment/36 and Attachment/36 Edition.

Enhanced Display Station Emulation Adapter

This adapter permits a 5150 Personal Computer to be connected to a System/34, System/36, or System/38 directly; remotely via the 5251 Display Station Model 12; or remotely via the 5294 Remote Control Unit to emulate a 5250 workstation. This adapter is supported by the Enhanced 5250 Emulation Program.

As a 5250 workstation, the 5150 can emulate a 5291 or 5292 display and a 5256 or 5219 printer. The 5150 system can also operate as a stand-alone IBM Personal Computer. Access to 5150 fixed disk during execution of the Enhanced 5250 Emulation Program is supported.

One or two host sessions and one personal computer session can be active concurrently, and switching between the sessions using the keyboard is supported. Host sessions can be one of the following:

- A single 5291 or 5292 Model 1 display session
- A 5291 or 5292 display session and a 5256/5219 printer emulation session
- Two display sessions involving 5291 and/or 5292 Model 1 displays

The Enhanced 5250 Emulation Program also supports communication with the System/36 and System/38 Transfer Facility PRPQs, System/34, System/36, and System/38 File Support Utility PRPQs, PC Support/36 program, and Attachment/36 program, all of which are also supported by the 5250 Emulation Program (see discussion of these programs under "Display Station Emulation Adapter" earlier in this subsection).

The Enhanced 5250 Emulation Installation Convenience Kit provides all the parts, software, and manuals required to connect a 5150 to a System/34, System/36, or System/38 and perform 5250 emulation.

IBM Personal Computer 3278 Attachment Option

The IBM Personal Computer 3278 Attachment Option for the 5150 Personal Computer and the IBM 3278 Personal Computer Adapter for the 3278 Display Station form the 3270 Personal Computer Attachment for the 3278, which allows a 5150 Personal Computer to be attached to a 3278 Display Station Model 1, 2, 3, 4, or 5 via 5-foot (1.5-meter) cables.

Models X66 and X76 (and withdrawn Models X14, X64, and X74) of the 5150 (which do not have a keyboard), with a display adapter installed and without a display attached, are designed to be used with the IBM Personal Computer 3278 Attachment Option. The display and keyboard of the 3278 are used instead of those for the 5150 (shared between the 5150 and 3278). Alternatively, 5150 Models 114, 164, 174, 166, and 176 (which have a keyboard), with a display adapter installed and without a display attached, can be used with this 3278 attachment option.

A 3278 with an attached 5150 System Unit can be connected (via the 3274/3276 control unit) to any host system that supports 3278 attachment and can alternate between two modes of operation, host compute and personal compute.

For host compute mode, the 3278 operates the same way it did before the 3278 Personal Computer Adapter was installed and also supports data transfer between itself and the 5150 Personal Computer (using the 3274 only). Thus, the 3278 can be used for interaction with the host (via a 3274 or 3276)

while the 5150 Personal Computer executes its own programs. The user switches between the two modes and determines whether the 3278 display and keyboard are associated with the 3278 host processor program or the 5150 Personal Computer program. Most IBM programs for the 5150 that can operate under DOS Version 1.1 and later can be executed in the 5150 in personal compute mode. Data obtained from the host system can also be processed in the 5150.

Sample programs for data transfer between the 3278 and the 5150 Personal Computer are provided with the IBM Personal Computer 3278 Attachment Option. These programs support screen capture (alphameric data shown on the 3278 display is sent to the 5150 for printing or writing to a diskette), transfer of files between VM/SP CMS in the host and the 5150, and transfer of files between MVS TSO in the host and the 5150. Other types of transfer between the host system and the 5150 can be user-written.

The IBM Personal Computer 3278 Attachment Option provides the following:

- An adapter for the 5150 System Unit that connects to the 3278 keyboard and display. It occupies slot 1 in the 5150.
- Additional 5-foot (1.5-meter) cables to connect the 5150 System Unit to the 3278 display and keyboard
- A cable distribution box
- A user's guide containing instructions and 5¼-inch diskettes. Updates to 3274 and 3278 publications also discuss the 3270 Personal Computer Attachment for the 3278.

Included on the supplied diskettes are:

- IBM Personal Computer 3278 Attachment Option Interrupt Handler
- IBM Personal Computer Data Transfer Sample Application Program
- VM/SP CMS File Transfer Sample Application Program (see GC23-0129 for a description of this program)
- TSO File Transfer Sample Application Program (see GC23-0128 for a description of this program)
- IBM 3270 Personal Computer Attachment Customization Program
- IBM Personal Computer 3278 Attachment Option Diagnostic Program

DOS Version 1.1 or later is required to use any of the supplied file transfer programs.

A 5150 System Unit attached to a 3278 can have a desktop 7371 or 7372 Color Plotter or a 7374 or 7375 Color Plotter attached.

The IBM 8100 DPPX/SP 3270 Personal Computer Attachment File Transfer PRPQ (5799-WXT) operating in an 8100 with 8100 DPPX/SP supports program and data file transfer between the 8100 system and a 5150/3278 with the 3270 Personal Computer Attachment for the 3278. The 5150/3278 is connected to a 3274 Control Unit that is attached to an 8100 local loop, remote loop, or communications link.

The 5150 can transfer personal computer programs and data files to the 8100 for storage on disk. Files stored in the 8100 configuration can be shared among all 5150 users attached to the 8100 and among all 8100 users. These files can also be printed by the 8100. Files created or stored at the 8100 can be transferred to the 5150. The 5150 configuration can be attached to the 8100 via a leased or dialed communications line.

One IBM Personal Computer 3278 Attachment Option can be installed in a 5150 System Unit. This option is mutually exclusive with the IBM Personal Computer 3279 Attachment Option. The brochure *IBM 3270 Personal Computer Attachment for the IBM 3278 Display Station*, G520-0097, is available.

IBM Personal Computer 3279 Attachment Option

The IBM Personal Computer 3279 Attachment Option for the 5150 Personal Computer and the IBM 3279 Personal Computer Adapter for the 3279 Color Display Station form the 3270 Personal Computer Attachment for the 3279, which allows a 5150 Personal Computer to be attached to a 3279 Color Display Station (all models except 2C) via 5-foot (1.5-meter) cables.

Models X66 and X76 (and withdrawn Models X14, X64, and X74) of the 5150 (which do not have a keyboard), with the Color/Graphics Monitor Adapter installed and without a display attached, are designed to be used with the IBM Personal Computer 3279 Attachment Option. The display and keyboard of the 3279 are used instead of those for the 5150 (shared between the 5150 and 3279). Alternatively, 5150 Models 114, 164, 166, 174, and 176 (which have a keyboard), with the Color/Graphics Monitor Adapter installed and without a display attached, can be used with this 3279 attachment option.

A 3279 with an attached 5150 System Unit can be connected (via the 3274/3276 control unit) to any host system that supports 3279 attachment and can alternate between two modes of operation, host compute and personal compute.

For host compute mode, the 3279 operates the same way it did before the 3279 Personal Computer Adapter was installed and also supports data transfer between itself and the 5150 (using the 3274 only). Thus, the 3279 can be used for interaction with the host (via a 3274 or 3276) while the 5150 Personal Computer executes its own programs. The user switches between the two modes and determines whether the 3279 display and keyboard are associated with the 3279 host processor program or the 5150 program.

Most IBM programs for the 5150 that can operate under DOS Version 1.1 and later can be executed in the 5150 in personal compute mode. Data obtained from the host system can also be processed in the 5150.

Sample programs for data transfer between the 3279 and the 5150 Personal Computer are provided with the IBM Personal Computer 3279 Attachment Option. These programs support screen capture (alphameric data shown on the 3279 display is sent to the 5150 for printing or writing to a diskette), transfer of files between VM/SP CMS in the host and the 5150, and transfer of files between MVS TSO in the host and the 5150. Other types of transfer between the host system and the 5150 can be user-written.

The IBM Personal Computer 3279 Attachment Option provides the following:

- An adapter for the 5150 System Unit that connects to the 3279 keyboard and display. It occupies slot 1 in the 5150.
- Additional 5-foot (1.5-meter) cables to connect the 5150 System Unit to the 3279 display and keyboard
- A cable distribution box
- A user's guide containing instructions and 5¼-inch diskettes. Updates to 3274 and 3279 publications also discuss the 3270 Personal Computer Attachment for the 3279.

Included on the supplied diskettes are:

- IBM Personal Computer 3279 Attachment Option Interrupt Handler
- IBM Personal Computer Data Transfer Sample Application Program
- VM/SP CMS File Transfer Sample Application Program (see GC23-0129 for a description of this program)
- TSO File Transfer Sample Application Program (see GC23-0128 for a description of this program)
- IBM 3270 Personal Computer Attachment Customization Program
- IBM Personal Computer 3279 Attachment Option Diagnostic Program

DOS Version 1.1 or later is required to use any of the supplied file transfer programs.

A 5150 System Unit attached to a 3279 can have attached a desktop 7371 or 7372 Color Plotter or a 7374 or 7375 Color Plotter.

The IBM 8100 DPPX/SP 3270 Personal Computer Attachment File Transfer PRPQ (5799-WXT) operating in an 8100 with 8100 DPPX/SP supports program and data file transfer between the 8100 system and a 5150/3279 with the 3270 Personal Computer Attachment for the 3279. The 5150/3279 is connected to a 3274 Control Unit that is attached to an 8100 local loop, remote loop, or communications link.

The 5150 can transfer personal computer programs and data files to the 8100 for storage on disk. Files stored in the 8100 configuration can be shared among all 5150 users attached to the 8100 and among all 8100 users. These files can also be printed by the 8100. Files created or stored at the 8100 can be transferred to the 5150. The 5150 configuration can be attached to the 8100 via a leased or dialed communications line.

One IBM Personal Computer 3279 Attachment Option can be installed in a 5150 System Unit. This option is mutually exclusive with the IBM Personal Computer 3278 Attachment Option. The brochure *IBM 3270 Personal Computer Attachment for the IBM 3279 Color Display Station*, G520-0073, is available.

3278/79 Emulation Adapter

This adapter enables the 5150 System Unit to be attached via coaxial cable to one of the following:

- 3274 Control Unit
- 4321, 4331, or 4361 Processor via the Display/Printer Adapter
- 4361 Processor via the Workstation Adapter
- 4701 Finance Communication Controller with the Device Cluster Adapter

One 3278/79 Emulation Adapter can be installed in a 5150 configuration and it requires one slot in the 5150 (not 5161) unit. The 5150 configuration must contain a color display to emulate a 3279 Color Display Station.

When the 3278/79 Emulation Control Program is used, the 5150 Personal Computer can emulate the functions of a 3278 Display Station Model 2 or a 3279 Color Display Station Model 2A or S2A. The 5150 can also support file transfer to and from the host processor (except when attached to a 4701), which must use a 3270/PC File Transfer Program (5665-311 for MVS/TSO or 5664-281 for VM/SP). A host-controlled 3270 session and a local 5150 Personal Computer session can be active concurrently and the 5150 user can interact with either session alternately.

A user's guide, personal computer keyboard aid, and quick reference guide are provided with the 3278/79 Emulation Control Program.

A 5150 with the 3278/79 Emulation Adapter and the 3278/79 emulation program connected as a 3278/79 terminal (via appropriate hardware) to a VM/370 host system with PROFS installed can use the PROFS Personal Computer Connection (PROFS/PC²) program to support the same functions as when the 5150 is connected to a PROFS system via the Asynchronous Communications Adapter. See discussion of PROFS/PC² program functions under "Asynchronous Communications Adapter" earlier in this subsection.

A 5150 with the 3278/79 Emulation Adapter connected to a host processor via a 3274 Control Unit can communicate with DISOSS/370 Version 3 Release 2 or 3 in the host processor using the Personal Services/PC program operating with the 3278/79 Emulation Control Program. See the discussion of Personal Services/PC facilities earlier in this subsection under "Asynchronous Communications Adapter."

The Attachment/370 Edition program operating with the Data Edition program and 3278/79 Emulation Control program under DOS Release 2.1 supports communication between a 5150 connected to a host System/370, 30XX, or 4300 processor that is executing Attachment/MVS (5665-336) under MVS/370 or MVS/XA, or Attachment/VM (5664-290) under VM/SP Release 3 or later. Attachment/370 Edition, Attachment/MVS, and Attachment/VM are IBM Personal Decision Series Host Attachment Products. Data Edition is an IBM Personal Decision Series Productivity Product.

The following functions are supplied:

- Access to data created both inside and outside the IBM Personal Decision Series environment:
  - Copies supported host file types to Data Edition-supported file types in the 5150 Personal Computer
  - Copies 5150 Personal Computer Data Edition-supported file types to supported host file types
  - Supports user-invoked data staging from production files
  - Imports and exports Data Interchange Format (DIF) files
  - Uses standard IBM personal computer DOS direct, text, and BASIC sequential file types
  - Supports smart file copy to allow limited subsetting and field selection, formatting, and file type conversion
  - Supports conversion between ASCII and EBCDIC
- Utilization of host disk space as 5150 Personal Computer virtual disks:
  - Simulates IBM personal computer fixed disks
  - Virtual disks selected and shared, with authorization, by user
  - Provides up to two virtual disks at a time, each with a maximum size of 10Mb
  - Up to eight virtual disks allocated to each user
  - Record-at-a-time access for maximum efficiency and responsiveness
- Archiving 5150 Personal Computer programs and data at the host
- Sending and receiving messages between other IBM Personal Decision Series Attachment/370 Edition users and Host Attachment Product users
- Ability to save series of tasks as Data Edition procedures:
  - Execute tasks unattended or with minimal host operator intervention
  - Include host connection

An addendum to the 5150 *Technical Reference* manual describing the 3278/79 Emulation Adapter (part number 1502336, feature code 2336) is available at a price of $16. An addendum to the *Hardware Maintenance and Service* manual for the 3278/79 Emulation Adapter (part number 1502337, feature code 2337) is also available at a price of $22.

8100 PC Adapter

One 8100 PC Adapter can be installed in a 5150 configuration to connect the 5150 to an available station address on a local or remote RLOOP in an 8100 Information System configuration. Remote attachment requires a 3843 Loop Control Unit.

A 5150 can be attached to a 9.6K-bps or a 38.4K-bps loop. Up to 26 5150 systems can be attached to a local 8100 loop, while up to ten can be attached to a remote 8100 loop. A 5150 can be defined as a single-session or a multiple-session device. The 8100 system must use DPCX Release 4 and DOSF Release 4 (with PTFs UC02659, UC02660, and UC02661 installed), DPPX/SP, or DPCX Release 5 with DSX.

The 8100 PC Adapter requires one slot in the 5150 or 5161 unit. It is mutually exclusive with the SDLC adapter and cannot operate concurrently with an Asynchronous Communications Adapter installed in the same 5150 configuration.

The 8100 PC Adapter feature provides the adapter card, one 5¼-inch diskette with the 8100 PC Adapter programs, the external cable required for attachment to an 8100 loop station connector, the 8100 PC Adapter User's Manual, and the 8100 PC Adapter Keyboard Template.

The supplied diskette contains a configurator program that provides menus for user configuration of the 8100 adapter program. The user can specify the display type (5151 or 5153), specify the type of printer adapter, define the keyboard, and select SNA/SDLC parameters.

The following functions are supported when a 5150 is loop-connected to an 8100 operating with DPCX/DOSF Release 4 (or DPPX/SP):

- 3270 display emulation, which allows the 5150 to act as a 3270 device and access all of the functional capabilities of DPCX and the non-entry/edit DOSF functions (or all of the functional capabilities of DPPX/SP). The user can switch between 5150 personal compute mode and a DPCX/DOSF (or a DPPX/SP) application.

  If the data stream compatibility facility (or reenter function of DPPX/SP) is used, a System/370 host application can be accessed by the 5150 user. In addition, if the DSC-E facility of DPCX (or the DPPX/SP Router) is used, it is possible to switch sessions between an 8100, System/370 host, and 5150 application. Up to two 3270 sessions between the 5150 and DPCX/DOSF (or DPPX/SP) are supported with the ability to swap screen ownership between two 3270 sessions and a normal 5150 session. A 5150 defined as a single-session or a multiple-session device can switch between these sessions. Up to five loop-attached 5150 systems can be defined as multiple-session devices.
- 3287 Printer emulation support, which permits the printer for the 5150 to function as a 3287 Printer. The printer session can operate simultaneously with the other 3270 emulation sessions. A 5150 must be defined as a multiple-session device to use 3287 Printer emulation.
- Bidirectional file transfer between the 5150 and the 8100. The 5150 can transfer personal computer data files to the 8100 for storage on disk. The files can be shared among all 5150 users connected to the 8100 and among all 8100 users. These files can be printed by the 8100. Files created or stored at the 8100 can be transferred to the 5150 and files can be converted from ASCII to EBCDIC format and vice versa.
- System/370 host file transfer, which permits transfers between 5150 systems that are loop attached to an 8100 system and an MVS/TSO host system using data stream compatibility (or the DPPX/SP Router). The System/370 host must have a user-written file transfer application to support this function.
- Screen capture to print the screen image to be captured and sent to the 5150 printer or diskette when there is an interactive session between a 5150 and an 8100 application or a host application.

DPCX/DOSF Release 4 also supports the exchange of documents created by the 5150 using the DisplayWrite 2 program and the 8100 using DOSF text displays. Thus, a 5150 user can edit a document created using a DOSF system and the 8775 with IDTF or using the 3732, and a DOSF user can edit a document created using a 5150 and DisplayWrite 2. A 5150 with DisplayWrite 2 can also exchange documents with DPCX/DOSF-attached users.

DPPX/SP Release 2 supports bidirectional transfer of documents between 8100 loop-attached 5150 systems and DPPX/SP Release 2. Also supported is the exchange of RFTDCA documents between 5150 users and DPPX/SP Release 2 Displaywriter users.

DPCX Release 5 with DSX provides the means for a DSX operator to have central control over the distribution of personal computer files and programs. The DSX operator can transfer personal computer files from loop-attached 5150 systems to the DPCX

File Distribution Library and send files from this library to loop-attached 5150 systems.

This DPCX release also provides an application program interface that permits 8100 application programs to interface with applications executing in the loop-attached 5150 systems. This interface permits data files to be transferred between the 8100 and its loop-attached 5150 systems. In addition, all loop-attached 5150 systems can be defined as multiple-session devices using DPCX Release 5.

Cluster Adapter and Cluster Cable Kit

The Cluster Adapter installed in a 5150 Personal Computer permits it to be included in a cluster of interconnected IBM personal computers, which can include the IBM PCjr, IBM Personal Computer, IBM Portable Personal Computer, IBM Personal Computer XT and XT/370, IBM Personal Computer AT and AT/370, and IBM 5531 Industrial Computer. Each PCjr in the clustered configuration must have the Cluster Attachment feature installed. Each 5150, 5155, 5160, 5170, and 5531 in the clustered configuration must have the Cluster Adapter feature installed.

One Cluster Adapter can be installed in the 5150 or 5161 unit. A 5150 Model 813, 824, 1, 14, 64, or 74 with a serial number lower than 0300961 and without a 5161 unit attached must have the BIOS Update Kit installed together with the Cluster Adapter.

Each cluster adapter contains dual inline package (DIP) switches for setting the station address of this cluster adapter (0 to 63) and whether a remote IPL of the 5150 is to occur at power-on of the 5150 configuration.

Up to 64 IBM personal computers can be interconnected to form a clustered multiuser configuration, which is supported by the IBM Personal Computer Cluster Program described later. The Cluster Cable Kit is used to interconnect the first two IBM personal computers. Each personal computer in the cluster after the first two also requires a Cluster Cable Kit.

A clustered IBM personal computer configuration consists of a main coaxial cable bus up to 3280 feet (1000 meters) in length with cable drops from 3.3 to 16.4 feet (1 to 5 meters) each to the cluster adapters in the clustered IBM personal computers. The cable drop connects to the main coaxial cable via BNC T-connectors and to the Cluster Attachment for the PCjr or Cluster Adapter for other IBM personal computers via BNC connectors provided with the cluster adapter.

The Cluster Cable Kit provides the following:

- Main coaxial cable bus of approximately 32 feet (10 meters)
- Two cable drops approximately 9 feet (3 meters) each for attachment to the main coaxial cable and to the BNC connectors of a cluster adapter
- Two BNC T-connectors for attaching the cable drops to the main coaxial cable
- Two terminating plugs

Baseband signaling and carrier sense multiple access with collision avoidance (CSMA/CA) access protocol are utilized in the clustered configuration. The topology of the interconnection among the IBM personal computers is a bus environment using 75-ohm coaxial cable. The data transmission rate is 375K bits per second.

Installation instructions, including a description of the coaxial cable and connections required to assemble a cluster, are provided with a Cluster Adapter. A diagnostics diskette and a terminating plug that can be used to test operation of the cluster adapter are also provided. Cluster problem determination procedures are included in an update to the *Guide to Operations* for the 5150.

The IBM Personal Computer Cluster Program is provided to support up to 64 IBM personal computers in a clustered configuration. This program permits small work groups in schools and businesses to exchange messages and data files and optionally to share a fixed disk that contains programs. Messages and files can be transferred between any two personal computers in the cluster, and a message can be broadcast from one personal computer to all other personal computers in the cluster.

When fixed disk is to be shared, one personal computer in the cluster must be designated as a disk server. A 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT, 5170 Personal Computer AT, or 5531 Industrial Computer configuration that contains fixed disk can be the disk server. The fixed disk in the disk server configuration is shared by all personal computers in the cluster.

The fixed disk contains one read-only public volume for the cluster, which is accessible to all computers in the cluster and is viewed as an additional diskette drive. The fixed disk also contains one private read/write volume per personal computer in the cluster, which is also viewed as another diskette by

the owning personal computer. The owner controls access to this private volume by other personal computers in the cluster (no access, read-only, write-only, or read/write). The available space on the fixed disk volume is allocated to the disk server computer.

When a disk server personal computer is defined, the download option can be used. This option permits downloading DOS, the cluster program, and an application program from the disk server personal computer to a remote computer in the cluster when the remote computer is powered on. The download option permits application programs to be stored in the public volume and shared by all computers in the cluster. Each user who is to share an application program must be licensed to use that program.

The download option permits a PCjr, without a diskette to be included in a clustered configuration. Thus, a disk server is required if a PCjr 4860 Model 4 without a diskette drive is to be included in a cluster of IBM personal computers.

The IBM Personal Computer Cluster Program operates in each personal computer in a clustered configuration under DOS Version 2.1 or later. A 5150 Personal Computer must have 128Kb of memory and (unless the download option is used) a single- or double-sided diskette drive in addition to the Cluster Adapter. The minimum 5155 Portable Personal Computer configuration with the Cluster Adapter installed can be included in the cluster.

If a 5150 is designated as the disk server computer, it must have 256Kb of memory and one double-sided diskette drive in addition to a 5161 unit with one fixed disk drive. The display for each 5150 in the cluster can be a monochrome or color display.

The cluster program requires a maximum of 29Kb of resident memory in the 5150. The requirement varies depending on the functions used (local or remote IPL and whether background message and file transfer is enabled). When a 5150 is used as the disk server, 136Kb of memory is required for the cluster program. DOS requirements (24Kb or 36Kb minimum) must be added to the cluster program size to determine the memory in the 5150 that is available for application programs.

A user's guide is provided with the IBM Personal Computer Cluster Program. It describes the installation and operation of the cluster program. Menu-driven installation programs are provided. The disk configurator is used to create the public and private volumes. The volume manager is used to load programs in the public volume for sharing if appropriate licensing exists.

The cluster program is provided on one double-sided diskette. It is also available as a five-pack offering that provides five program publications and license agreements and one program diskette. This offering permits use of the cluster program in five IBM personal computers.

The IBM Personal Computer Cluster Program brochure, G520-4217, provides an overview of the cluster program functions. Additional information is provided in *IBM Personal Computer Seminar Proceedings Volume 2, Number 3*, G320-9311.

IBM PC Network

The 5178 IBM PC Network Translator Unit, IBM PC Network Adapters, and IBM PC Network Cabling Components features enable IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XTs and XT/370s, and IBM Personal Computer ATs and AT/370s to be connected to form an IBM PC Network. Up to 72 IBM personal computers (up to 256 using non-IBM cabling) can be included in the network.

The IBM PC Network is a low-cost broadband local area network that is designed for offices, departments, and small businesses. Using the IBM PC Network Program, it supports peer-to-peer communication between the IBM personal computers in the network. Standard 75-ohm coaxial cable (CATV compatible) and standard broadband components are used to provide a reliable low-maintenance network that uses carrier sense multiple access/collision detect (CSMA/CD) protocol to transmit data at 2 million bits per second.

One translator unit, such as the 5178 IBM PC Network Translator Unit, is required for each network and provides fixed-frequency translation for the network. The 5178 unit (6.25 inches long, 10.10 inches deep, and 1.75 inches high) is supplied with a separately packaged 120-volt transformer, which plugs into a standard grounded outlet. The 5178 unit has a connector for attaching up to eight IBM personal computers. The optional IBM PC Network Base Expander feature can be installed in the 5178 unit to permit up to 64 additional IBM personal computers to be attached to the 5178 for a total of 72 in the network. Each IBM personal computer in the network must have one IBM PC Network Adapter installed in a full-feature slot in the system unit (not the 5161 unit).

Each IBM PC Network Adapter has a unique serial number contained in ROM that is used as the network identifier of the personal computer in which

the adapter is installed. In addition, a personal computer in the network can be IPLed remotely by another personal computer in the network (with a server designation) so that it need not have any diskette drives or fixed disks installed (not supported by the IBM PC Network Program).

The network adapter contains an Intel 80188 processor, an Intel 82586 network controller, a fixed-frequency modem, and network microcode that offloads the network control and interface functions from the system (8088 or 80286) microprocessor. The fixed-frequency modem operates at a 50.75-MHz transmit frequency and a 219-MHz receive frequency for transmission on a single-cable broadband network. Direct memory access is used for data transfer.

The network microcode (network basic input/output system – NETBIOS), which resides in the 32Kb of ROM on the IBM PC Network Adapter, is the basis of program control of the network, providing faster network control and eliminating most programmed control of network operations.

The NETBIOS supports the ability to create a session and to interchange information with another user (name) in the network, to send and receive peer-to-peer or broadcast information on the network, to define multiple user names within a node, and to determine network adapter status and control.

The NETBOIS supports up to 32 peer-to-peer sessions active at a time for the personal computer. This allows each personal computer in the network to be logically connected to and transfer files to/from up to 32 other personal computers in the network.

The IBM PC Network Adapter contains power-on self-tests that are executed when the adapter is reset, online tests that execute after an error condition is detected, and a diagnostic statistics function that accumulates error statistics during normal operations.

The IBM PC Network Adapter is provided with a 9-foot (3-meter) cable for attaching the IBM personal computer to the 5178 unit. IBM PC Network Cabling Segments (available in 25-, 50-, 100-, and 200-foot lengths) can be purchased to extend the distance between any personal computer and the 5178 unit to up to 200 feet.

When the optional IBM PC Network Base Expander is installed in the 5178 unit, up to eight Short Distance Kits, Medium Distance Kits, and/or Long Distance Kits in any combination can be attached to the base expander to further extend the distance between the IBM personal computers and the 5178 unit. The IBM PC Network Cabling Segments in combination with the distance kits permit each personal computer (up to 72) in the network to be located up to 1000 feet from the 5178 unit.

If the 5178 translator unit is used with non-IBM cabling, each of up to 256 IBM personal computers with the IBM PC Network Adapter can be located up to 1000 feet from the 5178 unit. When a commercial translator unit and custom cabling are used, each of up to 1000 IBM personal computers with the IBM PC Network Adapter can be located up to 5 kilometers from the translator unit.

If the IBM PC Network Adapter is to be installed in a 5150 Model 813, 824, 1, 14, 64, or 74 that does not have a 5161 unit attached, updating of BIOS in the 5150 unit may be required. If the serial number on the back of the 5150 System Unit is lower than 0300961, the BIOS Update Kit must be purchased and installed in the 5150.

A 5150 in an IBM PC Network is supported by the following IBM-logo programs:

- IBM PC Network Program
- IBM PC Network Program with the Local Area Network PrintManager Program
- IBM PC Network SNA 3270 Emulation Program
- IBM PC Network Program with the IBM Series/1-PC Connect program

The IBM PC Network Program supports message and file transfer between the personal computers in the network. It also allows printers and files contained on diskette or fixed disk in specified personal computers in the network (those designated as servers) to be shared with other personal computers in the network. The ability to restrict directory access to authorized users is provided. Thus, printers and/or data contained on fixed disk can be made available to all users in a network without the necessity of having a printer and/or fixed disk present in each personal computer configuration in the network.

The IBM PC Network Program must operate under DOS Version 3.1 in each IBM personal computer in the network. This program must be configured to support the facilities required by the personal computer in which it will execute. Each personal computer in the network is a node and is assigned a unique name by its user. This name is used to address the node for the purpose of communicating with it (to send a message or send/receive a file, for example).

Each personal computer in the network must also be designated as a redirector, receiver, messenger, or server system. The designation assigned determines the network functions a personal computer can perform as follows:

- Redirector. This designation provides the lowest level of function. The user can execute an application program that issues file and printer requests for shared resources that are part of other personal computer configurations designated as servers. The network control program redirects such I/O requests to the appropriate server personal computer, and the shared resources appear to be part of the redirector personal computer configuration. This permits the redirector personal computer to access data contained in server configurations for use in an executing application program, send and receive data files, and transfer print files to server computers for printing.

  A redirector personal computer can send messages using network commands. In addition, it can use the full-screen interface as the executing application program for message processing (see functions of the editor under the messenger description). A minimum of 128Kb of memory and one double-sided diskette drive are required for a redirector configuration. A printer is optional.
- Receiver. This designation provides the redirector functions (redirection of I/O requests to shared resources in server computers and use of the full-screen interface as an application program). In addition, a receiver personal computer can receive network messages and the user can route them to the display, a printer, or diskette/fixed file concurrently with the execution of an application program. Network comands can be used to send messages. A minimum of 192Kb and one double-sided diskette drive are required for a receiver configuration. A printer is optional.
- Messenger. This designation provides the next to the highest level of function. It provides access to the facilities available to receiver and redirector personal computers, but none of its resources can be shared, as is permitted by the server designation. The user of a messenger personal computer can switch back and forth between an executing application program and the full-screen editor.

  The full-screen editor permits the user to send and receive messages, redirect messages, compare and edit messages, save received messages and recall them for later use, add to the list of personal computers that can receive messages, and send the added computers to other computers. A minimum of 256Kb of memory and one double-sided diskette are required for a messenger configuration. A printer is optional.
- Server. This designation provides the highest level of function. It allows access to all the facilities available to messenger, receiver, and redirector personal computers. The diskettes, fixed disks, directories, and printers of a server computer can be shared by other personal computers in the network. Read-only and read/write access to diskettes and fixed disks in a server configuration are supported as permitted under file sharing control control specifications. Password protection for files and drives is supported.

  A server personal computer receives redirected I/O requests from other personal computers for its shared resources and services these requests. A server computer need not be dedicated to handling directed requests and can execute application programs concurrently with server functions.

  One or more computers in the network can be designated as servers. A minimum of one double-sided diskette drive, one fixed disk, one printer, and 320Kb of memory are required for a server configuration.

  Up to three printers in a server configuration can be shared by other computers and access to each printer can be password-protected. The server personal computer maintains a queue of print jobs (up to 100 print files maximum) and prints files as background jobs. The user of the server can inspect and modify the print queue and remote users can examine the status of their queued jobs.

The IBM PC Network Program, IBM PC Network Installation Program, Exploring the IBM PC Network Program, and IBM PC Network Program Program manual comprise the IBM PC Network Program package. Each program is supplied on a separate diskette. The Exploring the IBM PC Network Program is self-loading and designed to familiarize first-time users with the IBM PC Network using graphics facilities. This program can be executed in a 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT, or 5170 Personal Computer AT, which does not have to be included in a network. One diskette drive, 128Kb memory, and one monochrome or color display are required.

The flyer, *IBM PC Network*, G520-6022, is available. For details about the IBM PC Network see *IBM Personal Computer Seminar Proceedings Volume 2, Number 5*, G320-9313, and/or *IBM PC Network Technical Reference* (6322505).

The Local Area Network PrintManager program, consisting of the LANServe portion and the LANPrint portion, can be used in an IBM PC Network to support formatting of print/text files and printing of the formatted files on one or more 3820 Page Printers included in the network. A 3820 printer must be attached to a 5150 Personal Computer, 5160 Personal Computer XT, or 5170 Personal Computer AT that is designated as a server personal computer and that has a minimum of 512Kb of memory. Attachment of the 3820 printer is via the SDLC Communications Adapter, the Communications Cable Adapter, and a modem.

The LANServe portion of the PrintManager Program operates under DOS Version 3.1 and the IBM PC Network Program in a server personal computer to print files on the 3820 that have been transmitted from other personal computers in the network. The LANPrint portion of the PrintManager program operates under DOS Version 3.1 and the IBM PC Network Program in one or more non-server 5150 Personal Computers, 5160 Personal Computer XTs, and/or 5170 Personal Computer ATs in the network that have a minimum of 384Kb of memory. The supplied LANPrint program can be copied for use in any personal computer in the network that is to use LANServe to print to a 3820 printer.

LANPrint permits the user to specify parameters for formatting a 5152 ASCII print or text file created by an IBM personal computer application program and invoke the print services of the IBM PC Network Program to transmit the file to a server with a 3820 printer attached. The user can specify parameters such as font (one of 54), print orientation (0, 9, 180, or 270 degrees), page size, simplex or duplex print mode, margins, tabs, initial line spacing, and number of copies.

The Local Area Network PrintManager program can also be used in 5150 Personal Computers and 5160 Personal Computer XTs connected in a Corvus OMNINET™ Local Area Network to support the same facilities as for an IBM PC Network. A personal computer that is to use LANServe in this network must have 512Kb memory maximum and operate under DOS Version 2.0 or 3.0 with Corvus OMNINET™ with the appropriate prerequisite programming support. A personal computer that is to use LANPrint in this network must have a minimum of 256Kb and the same programming as is required for using LANServe.

The *IBM 3820 LAN PrintManager* brochure, G544-3184, provides an overview of sharing the 3820 Page Printer using the LAN PrintManager program.

IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XTs, and/or IBM Personal Computer ATs can be connected via an IBM PC Network to communicate with applications executing in System/370, 30XX, and 4300 processors using synchronous data link control communications facilities supported by the IBM PC Network SNA 3270 Emulation Program operating under DOS Version 3.1 in each personal computer in the network.

Each IBM personal computer in the network is designated as a communications server or a communications services user. A communications server must have an SDLC adapter installed and is connected to a host processor via a communications line. This server emulates a subset of the functions of a 3274 Model 51C Control Unit. A communications server provides SDLC communications functions that can be shared by communications services users. A communications services user emulates a 3278 Display Station Model 2 or 3279 Color Display Model S2A and/or 3287 Printer Model 1. Certain functions of the 3278 Model 2, 3279 Model S2A, and 3287 Model 1 are not supported.

A communications server supports concurrent operation of up to 32 SNA sessions communicating with one host processor. More than one IBM personal computer in the network can be designated as a communications server, enabling the communications services user personal computers to communicate with more than one host processor. A communications server that is to support more than 12 concurrent sessions should be dedicated to the server function and 256Kb of memory is required. Otherwise, DOS applications and the server function can operate concurrently in a communications server personal computer and 320Kb of memory is required for concurrent operations. Memory of 256Kb is required for each communications services user personal computer.

The following functions are supported:

- Transfer of files from the host processor to a 5152 Graphics Printer initiated by the host processor or the personal computer operator
- Transfer of files from a host processor to a communications services user personal computer for

storage on diskette or fixed disk and later printing
- Concurrent operation of a 3270 emulation session and a DOS session in the communications services user personal computer
- Ability for the personal computer user to define the function of most keys on the personal computer keyboard, if desired
- Screen-save function that allows the personal computer user to store a copy of displayed information on diskette or fixed disk

IBM Series/1-Personal Computer Interconnect

The IBM Series/1 to Personal Computer Channel Attachment feature and the IBM Series/1-PC Connect program are jointly referred to as IBM Series/1-Personal Computer Interconnect. This facility provides a high-speed data path between a Series/1 processor and a 5150. Data transfer at up to 400 Kb/sec is supported. The 5150 user can access Series/1 resources and communicate with host systems and local area networks.

The Series/1 to Personal Computer Channel Attachment feature (a Series/1 feature) provides an intelligent Series/1 Channel Attachment Controller Card for the Series/1 processor (4954, 4955, 4956, 4959, or 4965) and a Personal Computer Channel Extender Card for the 5150 configuration. The Series/1 to Personal Computer Attachment Cable feature provides a 12-foot cable to connect a Series/1 processor and a 5150 via the two provided cards. A 5150 can be connected to only one Series/1 processor using the Series/1 to Personal Computer Channel Attachment feature.

IBM Series/1-PC Connect Version 1 is a Series/1 licensed program that executes in the 5150 under DOS 3.1 and a network program, such as the IBM PC Network Program or the IBM PC Network SNA 3270 Emulation Program, and uses the NETBOIS interface provided via the IBM PC Network Adapter, which is required in the 5150. The Series/1-PC Connect program is required only in the IBM personal computers in the network that are connected to Series/1 processors and requires Realtime Programming System Version 7.1 in those Series/1 processors.

The Series/1-PC Connect program is designed to allow IBM PC Network users to communicate with other users and programs outside their own local area network.

Separate IBM PC Networks may be attached either to the same Series/1 or to separate interconnected Series/1 processors. The Series/1 interconnection is accomplished with the Series/1 Communications Manager (CM). The Series/1 CM supports several communications protocols, such as bisynchronous, X.25, and the Series/1 Local Communications Controller (LCC). The LCC can operate on the IBM Cabling System.

Series/1-PC Connect provides the connection between a Series/1 and an IBM personal computer attached to a local area network (LAN) to allow multiple personal computer LANs access to Series/1 communications, disks, and printers.

Series/1-PC Connect complements personal computer LAN programs by becoming a communications gateway to the host. The host is any remote Series/1 or System/370 processor that communicates with the Series/1 Communications Manager.

The IBM Series/1-PC Connect Program extends the file/print server functions of the IBM PC Network Program to Series/1 disks and printers and provides:

- 5150 Personal Computer disk emulation services on Series/1 high capacity disks
- 5150 Personal Computer print emulation services on Series/1 printers
- LAN independent services, which permits LAN programs other than the IBM PC Network Program to use Series/1 disks and printers
- Interprogram communications support between personal computer application programs and (1) personal computer application programs running in another IBM PC Network attached to a Series/1, (2) Communication Manager application programs running in any Series/1 in the network, and (3) Realtime Programming System (RPS) application programs running in the gateway-connected Series/1
- IBM PC Network SNA 3270 Emulation Program support through Series/1 communications to System/370 or Series/1 applications. The IBM PC Network SNA 3270 Emulation Program instead of the IBM PC Network Program is required to use this function.
- Remote management services, which allows a network of IBM personal computers to be centrally managed in conjunction with the Series/1 Remote Manager

For additional information, see the following publications:

- *IBM Series/1 Realtime Programming System Version 7 Installation and Configuration Guide for Series/1-PC Connect*, SC34-0611
- *IBM Series/1-Realtime Programming System Version 7 Operations Guide for Series/1-PC Connect*, SX34-0162

Displaywriter/Personal Computer Attach Convenience Kit

This convenience kit permits a Displaywriter system (without any communications features installed in the diskette unit) to be cable-connected to a 5150 configuration via an Asynchronous Communications Adapter. The Compact Printer Connector Adapter (6450102) is also required. The 5150 can be a stand-alone system or part of an IBM personal computer cluster. When the 5150 is not being used as the interface to the cluster for the Displaywriter, it can be used as it would be if the Displaywriter were not attached.

The convenience kit provides the following:

- One 25-foot (7.5-meter) attachment cable to connect the Displaywriter to the 5150
- One 5¼-inch diskette for the 5150 containing the Displaywriter/Personal Computer Attach Program that executes under DOS Version 2.1 or later
- One 8-inch diskette for the Displaywriter with the required attach program. Textpack 4 (5608-TR4) or Textpack 6 (5608-TR-6) is required for the Displaywriter also.
- One installation/operation/diagnostic guide, G544-2280
- Two wrap plugs for diagnostics

When a Displaywriter is attached to a stand-alone 5150, the Displaywriter is used for operational control. The following functions are supported:

- Transfer of documents and files from the Displaywriter to the 5150. Documents are converted to revisable form text document content architecture (RFTDCA) format before transfer to the 5150. Reportpack files are converted to a special interchange format before transfer to the 5150. Chartpack files cannot be sent to the 5150.
- Transfer of documents and files from the 5150 to the Displaywriter. RFTDCA documents are converted to Displaywriter format and Reportpack documents are converted to Displaywriter document format before the transfer. It is recommend that only DOS print files be transferred to the Displaywriter.
- Display of the directories of the 5150 and the Displaywriter
- Deletion of documents and files on 5150 and Displaywriter diskettes
- An optional alternate foreground execution facility, which supports alternating between Displaywriter/Personal Computer Attach program functions (listed above) and Textpack 4 or Textpack 6 functions, such as document creation, revision, pagination, and spelling verification

When the Displaywriter is attached to a 5150 in an IBM personal computer cluster, the functions listed for stand-alone connection are supported. In addition, the Displaywriter shares with its attached 5150 a single cluster address and a private volume on the disk server fixed disk. The Displaywriter can transfer data to and from the shared private volume. Other Displaywriters or IBM personal computers in the same cluster can access the data transferred to the shared private volume if the access control defined for the private volume permits.

The Displaywriter can also send messages to and receive messages from any personal computer in the cluster, broadcast a message to all personal computers in the cluster, and transmit and receive files.

See G320-0553 for information regarding the connection of a Displaywriter to an IBM personal computer.

IBM 65/85/95-PC IPL/Diagnostic Diskette and Diagnostic Tool

When the IBM 65/85/95-PC Attachment Device (MES 8566) is installed (by an IBM service representative) on an IBM Electronic Typewriter 65, 85, or 95 without the Modularity Option, the typewriter can be attached to a 5150 Personal Computer that has the IBM 65/85/95-PC IPL/Diagnostic Diskette and Diagnostic Tool (MES 8569) installed. Attachment is via a 6.5-foot (2-meter) cable to the Printer Adapter or the Monochrome Display and Printer Adapter in the 5150 configuration and permits the typewriter to be used as a letter-quality printer for the 5150 Personal Computer.

This attachment does not permit direct keyboarding from the typewriter to the 5150 Personal Computer. When not used as a printer, the typewriter can be used as an electronic typewriter with all its typewriter features and functions.

When used as a printer for the 5150 Personal Computer, the Model 65, 85, or 95 typewriter operates at 15.5 characters per second. The standard carriage in each model can handle paper as wide as 15.5 inches, while the wide carriage will handle paper up to 19.1 inches in width. A U.S. ASCII or U.S. Correspondence element is supported for the typewriter.

MES 8569 for the 5150 Personal Computer provides the IPL/Diagnostic Diskette and a diagnostic tool. The diskette contains the program that operates

in the 5150 System Unit when printing to the typewriter is desired and a diagnostic program. The printing program operates as an extension of DOS Version 1.0 or later. The diagnostic tool is an adapter plug that aids problem isolation when the diagnostic program is executed.

5218 Printer Attachment Cable and 5218 Printer Sharing

The 5218 Printer Attachment Cable is a 19.7-foot (6-meter) cable that permits a 5218 Printwheel Printer Model A03 or A04 (with specify code 9203) to be attached to a 5150 System Unit via an Asynchronous Communications Adapter configured for current-loop operations. The 5218 printer can be used as a letter-quality printer. Burst speed printing is 40 cps for the 5218 Model A03 and 60 cps for the Model A04.

The 5218 Printer Driver Program, operating under DOS Version 1.1 or later in the 5150, supports printing to the 5218 printer. The Front Sheet Feed, Front Exit Sheet and Envelope Feed, and Tractor Feed features for the 5218 Model A03 or A04 are supported. See *Guide to Operations IBM 5218 Printer Driver Program and Printer Sharing Device*, G570-2063 (part number 6113655), for a description of the 5218 Printer Driver Program. A copy of this publication is provided with the program.

Several word processing, spread sheet, data base, business, and language application programs for the 5150 can be used with the 5218 Printer Driver Program. The Asynchronous Communications Program Version 2 is the only IBM-logo communications program that can operate in the 5150 concurrently with printing to the 5218 printer. The 3278/79 Emulation Control Program can also be used concurrently with the 5218 Printer Driver Program.

A convenience pac consisting of the 5218 Printer Attachment Cable, 5218 Printer Driver Program, and customer setup/operator guide can be ordered.

The 5218 Printer Sharing feature permits up to four 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT, 3270 Personal Computer (3270-PC), 3270 Personal Computer/Graphics, and/or 3270 Personal Computer/Extended Graphics systems in any combination to be attached to one 5218 printer and to share the printer for letter-quality printing applications.

The sharing feature consists of a packaged electronic card and a 6-foot (1.8-m) cable. One end of the packaged card attaches to the 5218 printer via the provided cable. Up to four 5150, 5155, 5160, 5271, and 5371 systems, each with a 5218 Printer Attachment Cable, can be connected to the other end of the card via the 5218 attachment cable. The 5218 Printer Driver Program is required to support this shared 5218 configuration.

Terminal Communications Adapter Kit

One Terminal Communications Adapter can be installed in a 5150 configuration to permit it to manage up to 20 copiers (IBM Series III and Copier II, Kodak 100, and several Xerox models) using the Copier Management Information System (CMIS). Each copier is connected to the specific 6821 Copier Control Device (CCD) that supports its copier type (one of eight different CCDs available from IBM). The units in the CMIS configurations are interconnected via dedicated wiring installed by a contractor or by telephone wiring installed by the telephone company. Either 20 directly wired copiers or 19 directly wired copiers and one copier with a modem can be handled.

Communication between the 5150 configuration and each CCD is handled by the CMIS program executing under DOS Version 1.1 in the 5150. Each CCD accepts information entered by the copier user and data from its attached copier, and transmits it to CMIS in the 5150. User identification data can be accepted from a magnetic strip card or from the CCD keypad. This information can be used to limit access to all or selected copiers to authorized users. The CCD also receives signals from the copier to indicate the number of copies made, number of originals copied, and features used.

The CMIS program processes the information it receives and can generate a usage report for each copier in the CMIS system, a change report that summarizes total cost by copier and account, and an exception report usage profile. CMIS is also used for configuring and changing the system and for system diagnostics.

The following CMIS publications are available:

- CMIS brochure, G552-2000
- Preinstallation Manual, G544-3078
- Physical Planning Manual, G544-3076
- User's Manual, S544-3079

Keylock Feature

The Keylock Feature is a simple mechanical device that can be installed on a 5150 or 5161 unit in approximately 15 minutes using a screwdriver. The keylock unit is 5 inches square, 4 inches high, and weighs less than 2 lb.

The keylock unit is designed to be attached to the right rear corner of the 5160/5161 unit near the power switch. No alteration of the 5150/5161 unit or program support is required for this feature. Two keys are provided with the feature and duplicate keys can be obtained only from the lock manufacturer.

When the keylock is in the locked position, the cover removal screw of the 5150/5161 unit is protected to prevent physical access to the contents of the 5150/5161 unit. This protects against removal of the fixed disk drives in a 5161 unit as well as of the hardware installed in the 5150/5161 unit.

When the keylock is locked, 5150/5161 power-on can be done only by unlocking the keylock. Power-on using the power-on switch on the 5150/5161 unit is not possible. In addition, if the display installed does not receive power from the 5150 unit (5153 or 5154 display, for example), the access port to the 5150 is blocked to prevent the 5150 from being powered on through the access port. Without power on, access to the 5150 configuration via a local program, by another computer via a communications link, or via another personal computer cabled to the 5150 in a clustered configuration or IBM PC Network is not possible.

The cover of the keylock is also designed to permit installation of a cable or chain attachment to secure the 5150/5161 unit to the office furniture.

BIOS Update Kit

The BIOS Update Kit may be required for a 5150 Model 813, 824, 1, 14, 64, or 74 when the optional Enhanced Graphics Adapter, Cluster Adapter, or IBM PC Network Adapter is to be installed. If the serial number on the back of the 5150 System Unit is lower than 6300961 and the 5161 Expansion Unit is not attached, the kit is required to update BIOS in ROM. When the 5161 is included in the 5150 configuration, the appropriate ROM module has already been replaced.

The update kit provides a new BIOS module to replace an existing BIOS module, a module removal tool, and instructions for the module replacement.

Single Unit Prices

Item	Part Number	Feature Code	Single Unit Purchase Price ($)
5150 System Unit/Keyboard			
Model 104	5150104	–	1390
Model 166	5150166	–	1995
Model 176	5150176	–	2295
5150 System Unit			
Model X66	5150X66	–	1725
Model X76	5150X76	–	2150
Asynchronous Communications Adapter	1502074	2074	100
Binary Synchronous Communications Adapter	1502075	2075	240
Binary Synchronous Communications Adapter (also for the 5170 Personal Computer AT)	1501204	1204	240
BIOS Update Kit (certain 5150 Models 813, 824, 824, 1, 14, 64, and 74 only)	1501005	1005	30
Cluster Adapter	1501206	1206	340
Cluster Cable Kit	1501207	1207	110
Color/Graphics Monitor Adapter	1504910	4910	244
Communications Adapter Cable (for use with the BSC or SDLC adapter)	1502067	2067	65
Compact Printer Connector Adapter	6450102	0102	40
Data Acquisition and Control Adapter	6451502	1502	1275
Data Acquisition and Control Adapter Distribution Panel	6451504	1504	245
Display Station Emulation Adapter	6072534	2887	600
Displaywriter/Personal Computer Attach Convenience Kit	6403728	–	495
Enhanced Display Station Emulation Adapter	6403690	2879	595
Enhanced Graphics Adapter	1501200	1200	524
Enhanced 5250 Emulation Installation Convenience Kit	6403692	2880	845
Game Control Adapter	1501300	1300	45
General Purpose Interface Bus Adapter	6451503	1503	395
General Purpose Interface Bus Adapter Cable	2720020	5040	102
Graphics Memory Expansion Card	1501201	1201	199
Graphics Memory Module Kit	1501203	1203	259
IBM Personal Computer 3278 Attachment Option	8051206	5321	850
IBM 3270 Personal Computer Attachment for the 3278 (includes 3278 Personal Computer Adapter for the 3278 and 3278 Attachment Option for the 5150 plus required programming and diagnostic support)	–	5315 or 5316	1700

Item	Part Number	Feature Code	Single Unit Purchase Price ($)
IBM Personal Computer 3279 Attachment Option	–	5322	850
IBM 3270 Personal Computer Attachment for the 3279 (includes 3279 Personal Computer Adapter for the 3279 and 3279 Attachment Option for the 5150 plus required programming and diagnostic support)	–	5325 or 5326	1950
IBM 65/85/95-PC IPL/Diagnostic Diskette and Diagnostic Tool – MES 8569 (includes only the PC attachment)	–	8569	60
IBM 65/85/95-PC Attachment Device for IBM Typewriter (MES 8566)	–	8566	285
Convenience Kit for MES 8566 and MES 8569	–	8570	345
Keylock Feature	2683177	3177	50
Math Co-processor Option	1501002	1002	230
Monochrome Display and Printer Adapter	1504900	4900	250
Printer Adapter	1505200	5200	75
Professional Graphics Controller	6451501	1501	2995
Prototype Card	1501400	1400	35
Synchronous Data Link Control Communications Adapter	1502090	2090	240
Synchronous Data Link Control Communications Adapter (also for the 5170 Personal Computer AT)	1501205	1205	240
Terminal Communications Adapter Kit	–	1614	860
16Kb Memory Expansion Kit (Models 1 and 813)	1501001	1001	30
256Kb Memory Expansion Option	1501209	1209	489
3278/79 Emulation Adapter	1602507	2507	905
5178 PC Network Translator Unit	5178001	–	595
Transformer unit for PC Network	6450238	0238	NC
IBM PC Network:			
Adapter	6450213	0213	695
Base Expander	6450230	0230	59
Distance Kit:			
Short	6450231	0231	39
Medium	6450232	0232	79
Long	6450233	0233	89
Cabling Segments:			
25-foot	6450234	0234	29
50-foot	6450235	0235	39
100-foot	6450236	0236	59
200-foot	6450237	0237	99

Item	Part Number	Feature Code	Single Unit Purchase Price ($)
5218 Printer Attachment Cable	6113647	–	45
5218 Printer Sharing	6113650	4471	625
5218 Convenience Pac	6113651	4470	220
5250 Emulation Convenience Kit	6092656	2886	745
5253 Emulation Installation Convenience Kit			
Version 1	6092541	2890	893
Version 2	6109564	2882	1013
Version 3	6403724	2896	1113
5¼-Inch Diskette Drive Adapter	1503780	3780	125
5¼-Inch Double-Sided Diskette Drive	1503810	3810	425
64Kb Memory Module Kit	1501003	1003	100
64/256Kb Memory Expansion Option	1501013	1013	265
8100 PC Adapter	6113477	–	1275

Discounts Available

The 5150 and most of its hardware features may be eligible for one of the following discounts when purchased from an NAD or NMD branch office:

- Volume Procurement Amendment
- Educational Allowance
- Special Bid

Single Delivery Quantity and Quantity Purchase Plan discounts are available from IBM Product Centers.

A customer who signs a VPA or special bid for an IBM personal computer must establish a Technical Support Location (TSL) and assign a TSL coordinator to be the primary interface to IBM. See *Technical Support Location Customer Guide*, G320-0728, for a discussion of the TSL and TSL coordinator responsibilities. This guide also discusses the responsibilities of a TSL-ECP coordinator, which is needed if an IBM Employee and Collegiate Program (ECP) amendment has been signed.

11:15 IBM 5161 Expansion Unit Model 1

Introduction

The 5161 Expansion Unit with one Fixed Disk Drive is shown in Figure 11-3.

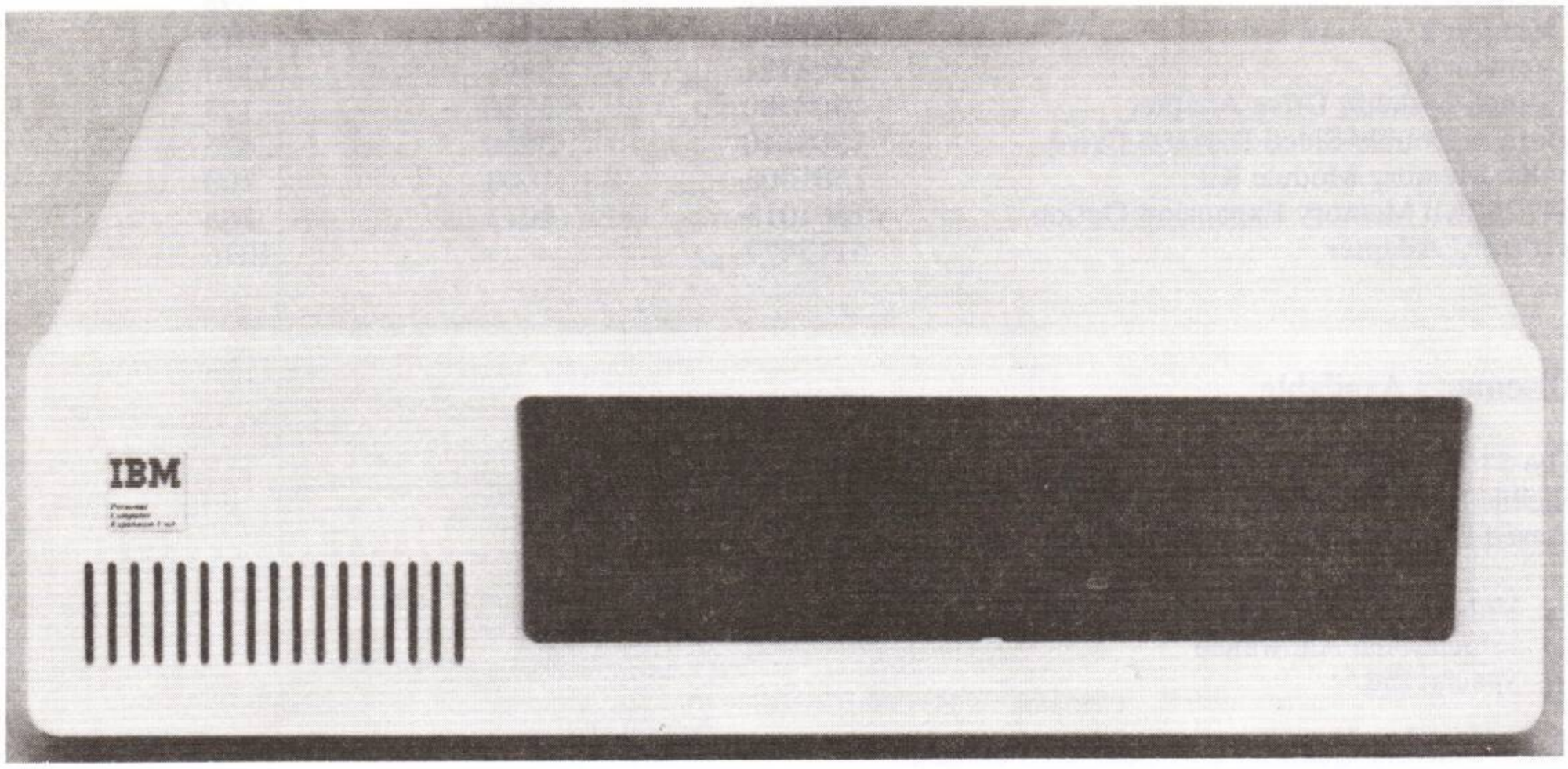

Figure 11-3. 5161 Expansion Unit

The 5161 Expansion Unit Model 1 provides fixed disk storage (10Mb or 20Mb) and additional expansion slots for the 5150 Personal Computer. The expansion slots allow for the installation of optional feature cards to extend the capabilities of the 5150 configuration.

One 5161 Model 1 can be attached to a 5150 System Unit. A ROM kit is provided with the 5161 Model 1. It contains one ROM module that must replace one of the ROM modules in a 5150 System Unit with serial number 6300960 or lower and a tool to use for the replacement.

The 5161 Model 1 can be field-installed and is a customer-setup unit. It can be placed beside the 5150 System Unit or stacked over or under the 5150 unit. When the 5161 is placed beside or on top of the 5150 unit, a printer or display can be placed on top of the 5161 unit. The 5161 unit requires its own power source.

The optional Keylock Feature can be installed on the 5161 unit. See description of this feature in Section 11:10 under "Keylock Feature."

Physical Components

The 5161 Model 1 unit contains the following standard items:

- Eight expansion slots for optional feature cards (provided on an expansion board)
- One Fixed Disk Drive Adapter to attach one or two 10Mb Fixed Disk Drives (uses one slot)
- One 10Mb Fixed Disk Drive
- The receiver card required for connection to the 5150 System Unit (uses one slot in the 5161)
- A 130-watt power supply with cooling fan

A 39-inch (one-meter) signal cable to connect the 5161 and 5150 and an extender card that must be installed in a slot in the 5150 System Unit are also provided with the 5161 Expansion Unit. The extender card has DIP switches that must be set to indicate the amount of memory in the 5150 System

Unit. The 5161 Model 1 has the same dimensions as the 5150 System Unit and weighs approximately 27 lb (12.2 kg) with one fixed disk installed.

Approximate dimensions of the 5161 are:

- Height: 5.5 inches (142 mm)
- Width: 19.5 inches (500 mm)
- Depth: 16 inches (410 mm)

Environmental characteristics are:

- Air temperature:
  - 60 to 90 degrees F (15.6 to 32.2 C) for system on
  - 50 to 110 degrees F (10 to 43 C) for system off
- Humidity:
  - 8% to 80% for system on
  - 20% to 80% for system off
- Electrical:
  - 90 to 137 volts AC, 60 Hz
  - 180 to 259 volts AC, 50 Hz

Feature Descriptions

Expansion Slots

Six of the eight expansion slots in a 5161 are full-feature slots and will accept full-feature or the smaller special-feature cards. The other two slots are special-feature slots. One full-feature slot contains the standard Fixed Disk Drive Adapter and another full-feature slot contains the 5161 receiver card.

The following optional features for 5150 Personal Computer configurations can be installed in the six available slots in the 5161 Model 1 unit:

- Game Control Adapter (special- or full-feature)
- Prototype Card (full-feature)
- Monochrome Display and Printer Adapter (full-feature slot) only if another display adapter is installed in the 5150 unit
- Color/Graphics Monitor Adapter (full-feature) only if another display adapter is installed in the 5150 unit
- Printer Adapter (special- or full-feature)
- Data Acquisition and Control Adapter (full-feature)
- General Purpose Interface Bus Adapter (special- or full-feature)
- Asynchronous Communications Adapter (special- or full-feature)
- Binary Synchronous Communications Adapter (full-feature)
- Synchronous Data Link Control (SDLC) Communications Adapter (full-feature)
- Display Station Emulation Adapter (full-feature) – not if Version 1 of the 5520/Personal Computer Attachment Program is used
- Enhanced Display Station Emulation Adapter (full-feature)
- Professional Graphics Controller (two adjacent full-feature) – must be in the 5161
- 8100 PC Adapter (full-feature)
- Cluster Adapter (full-feature)
- Terminal Communications Adapter (special- or full-feature)

As for a 5150 System Unit, expansion slots are located in the left rear area of the 5161 unit and feature cards plug into these slots. A feature card has a connector at one end into which a cable is plugged for attachment of an external unit (I/O device or modem, for example). All external units connect to the rear of the 5161 unit. One non-standard connector is provided on the back panel of the 5161 for connection of the 5151 Monochrome Display.

Fixed Disk Drive Adapter

This standard adapter provides buffering, error detection, and data transfer between memory in the 5150 and a 10Mb Fixed Disk Drive in the 5161. Up to two 10Mb Fixed Disk Drives can be attached to this adapter and only one Fixed Disk Drive Adapter can be present in a 5161 Model 1. The adapter supports direct memory access transfer, automatic error detection and correction on 11-bit bursts using a 32-bit error checking and correction (ECC) code, automatic retries on disk access errors, and internal diagnostics.

10Mb Fixed Disk Drive

One 10Mb Fixed Disk Drive is standard in the 5161 Model 1 to provide 10,618,880 bytes of fixed disk storage, which is equivalent to about 28 double-sided diskettes at 360Kb each. One fixed disk can store over 5100 double-spaced 8½ × 11 inch typewritten pages. One additional 10Mb Fixed Disk Drive can be installed in a 5161 Model 1 to provide a total of 21,237,760 bytes of fixed disk storage. The first fixed disk drive is addressed as C and the second is addressed as D.

The 10Mb Fixed Disk Drive is permanently sealed and contains two nonremovable 5¼-inch disks. The access mechanism contains one read/write head per disk surface (four heads), and the cylinder concept

of accessing data is used (four tracks per cylinder and 306 cylinders).

The 10Mb Fixed Disk Drive has the following characteristics:

- 345 tracks per inch
- 512 bytes per sector (as formatted by DOS)
- 17 sectors per track
- 306 tracks per surface – 305 data and 1 diagnostic (1224 tracks)
- 4 surfaces
- Rotational speed: 3600 rotations per minute
- Average rotational delay: 8.33 ms
- Access time: 3 ms track-to-track
- Data transfer rate: 5M-bit per second
- Height: 3.25 inches (82.6 mm)
- Width: 5.75 inches (146 mm)
- Depth: 8 inches (203.2 mm)
- Weight: 4.6 lb (2.08 kg)

A disk-in-use indicator on the fixed disk drive is lit (red) whenever the drive is operating.

Fixed disk storage is supported by DOS as of Version 2.0. The minimum file size supported by DOS is 4096 bytes, which provides for a maximum of approximately 2592 files in one 10Mb fixed disk.

Power Supply

The 5161 contains a 130-watt, four-voltage-level power supply in the right rear area of the unit. All power levels are regulated and an automatic shutdown of power to the 5161 occurs if an overvoltage or overcurrent condition is detected. A system shutdown also occurs if adequate power is not being received. The power cable is 6 feet (1.8 m) in length.

A self-test of the 5161 is performed automatically when power to the 5161 is turned on.

Single Unit Prices

Item/Part Number/Feature Code	Single Unit Purchase Price ($)
5161 Expansion Unit Model 1 (5161001)	2585
10Mb Fixed Disk Drive (1602500) (2500)	1195
Keylock Feature (2683177) (3177)	50

Discounts Available

The 5161 and its hardware features may be eligible for one of the following discounts when purchased from an NAD or NMD branch office:

- Volume Procurement Amendment
- Educational Allowance
- Special Bid

Single Delivery Quantity and Quantity Purchase Plan discounts are available from IBM Product Centers.