

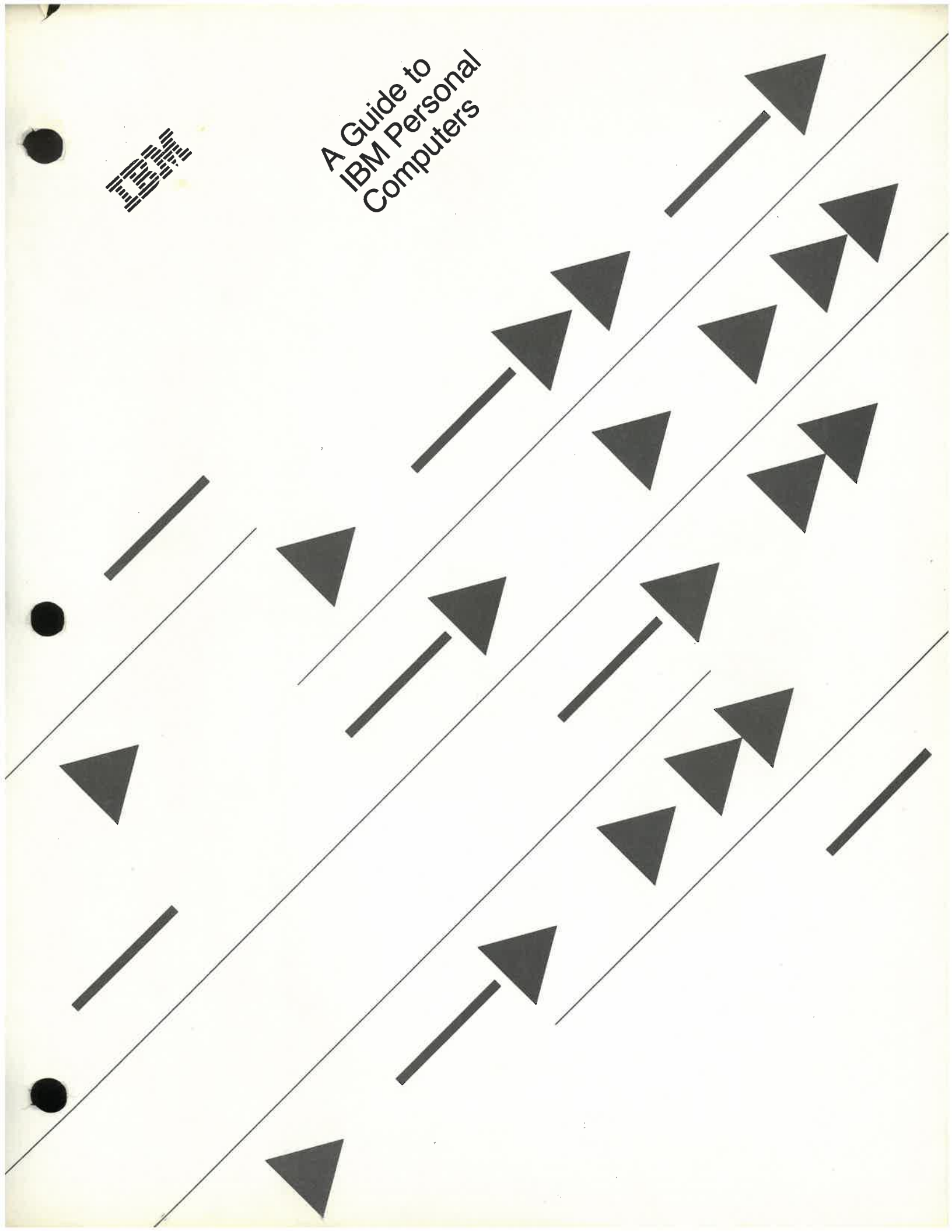


A Guide to IBM Personal Computers





A Guide to IBM Personal Computers



First Edition (April 1985)

This guide reflects IBM personal computer and announcements made as of April 2, 1985 and prices in effect as of April 16, 1985. It will be updated periodically, but at any one time may not reflect the latest versions of options, equipment, or programming support. Some hardware and software described may not yet be available. IBM marketing representatives have availability information.

The information contained herein is furnished for general orientation only. The numerical values given may be rounded or may be approximations. Design decisions must be made on the basis of data obtained from specifications given in other documents. The authoritative sources of information about the components described are, for example, announcement letters and Guide to Operations, Technical Reference, and applicable Systems Reference Library publications.

References in this publication to IBM products, programs, or services do not imply that IBM intends to make these available in all countries in which IBM operates.

Publications are not stocked at the address given below. Requests for copies of IBM publications should be made to your IBM representative or to the IBM branch office serving your locality. representative or to the IBM branch office serving your locality.

A form for readers' comments has been provided at the back of this publication. If the form has been removed, address comments to:
IBM Corporation, Department 824, 1133
Westchester Avenue,
White Plains, New York 10604. IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you.

Preface

This publication is designed for readers who have general knowledge about computers and programming (software). However, it does not assume any knowledge about IBM personal computers and provides a single source of first-level information about the configurations and software announced.

Each available IBM personal computer configuration is described in a separate section. Available and withdrawn models and features are discussed. Other sections describe the IBM-*logo* personal computer displays, printers, and desktop plotters that can be attached to these IBM personal computers and the major functions of the IBM-*logo* operating systems that support IBM personal computers. The IBM-*logo* and vendor-*logo* application programs that are available from IBM are listed by category and in alphabetic sequence. Personally developed software is also listed by category.

Part number (six digits), feature code (four digits), and price (as of the date indicated in the edition notice) are given for all the hardware and software products described. Available IBM service offerings are listed for all hardware units in each section and these offerings are described in Appendix A. Additional sources of information about IBM personal computer hardware and software are also provided. All trademarks are highlighted by the symbol ™ or ® and are listed in Appendix B.

The information presented in this guide is designed to acquaint the reader with IBM personal computer hardware, operating systems, and selected systems-oriented application software. This guide should help in selecting a specific IBM personal computer configuration and operating system, determining the units and features desired, configuring the required hardware, planning for the physical installation of the configuration selected, and obtaining hardware service.

Those who already have an IBM personal computer should also find this guide useful, particularly when additional hardware and its associated software is to be selected.

Contents

Section 1: Introduction	1-1		
Section 10: IBM PCjr	10-1		
10:05 IBM PCjr Configuration Overview	10-2		
Introduction	10-2		
Physical Components	10-2		
Minimum Configuration	10-2		
Configuration Features	10-3		
Operating Systems Supporting	10-4		
Compatibility	10-4		
Customer Responsibilities	10-5		
Data Security	10-5		
Purchase Location	10-5		
Warranty Period	10-5		
IBM Service Offerings	10-5		
Publications	10-5		
10:10 IBM 4860 System Unit	10-7		
Models Available	10-7		
Physical Characteristics	10-8		
Standard Features	10-8		
Optional Features	10-8		
Physical Components Included	10-9		
Standard Feature Descriptions	10-9		
Optional Feature Descriptions	10-17		
Single Unit Prices	10-23		
Discounts Available	10-23		
Section 11: IBM Personal Computer	11-1		
11:05 IBM Personal Computer			
Configuration Overview	11-2		
Introduction	11-2		
Physical Components	11-3		
Minimum Configuration	11-3		
Configuration Features	11-4		
Operating Systems Supporting	11-6		
Compatibility	11-6		
Customer Responsibilities	11-6		
Data Security	11-7		
Purchase Location	11-7		
Warranty Period	11-7		
IBM Service Offerings	11-7		
Publications	11-8		
Self-Study Courses	11-9		
11:10 IBM 5150 System Unit	11-10		
Models Available	11-10		
Physical Characteristics	11-11		
Standard Features	11-11		
Optional Features	11-12		
Physical Components Included	11-13		
Standard Feature Descriptions	11-13		
Optional Feature Descriptions	11-19		
Single Unit Prices	11-47		
Discounts Available	11-49		
11:15 IBM 5161 Expansion Unit			
Model 1	11-50		
Introduction	11-50		
Physical Components	11-50		
Feature Descriptions	11-51		
Power Supply	11-52		
Single Unit Prices	11-52		
Discounts Available	11-52		
Section 12: IBM Portable Personal Computer	12-1		
12:05 IBM Portable Personal Computer			
Configuration Overview	12-2		
Introduction	12-2		
Physical Components	12-3		
Minimum Configuration	12-3		
Configuration Features	12-3		
Operating Systems Supporting	12-5		
Compatibility	12-5		
Customer Responsibilities	12-6		
Data Security	12-6		
Purchase Location	12-6		
Warranty Period	12-6		
IBM Service Offerings	12-6		
Publications	12-7		
Self-Study Courses	12-8		
12:10 IBM 5155 System Unit	12-9		
Models Available	12-9		
Physical Characteristics	12-10		
Standard Features	12-10		
Optional Features	12-10		
Physical Components Included	12-11		
Standard Feature Descriptions	12-11		
Optional Feature Descriptions	12-15		
Single Unit Prices	12-21		
Discounts Available	12-22		
12:15 IBM 5161 Expansion Unit			
Model 1	12-23		
Introduction	12-23		
Section 13: IBM Personal Computer XT	13-1		
13:05 IBM Personal Computer XT			
Configuration Overview	13-2		
Introduction	13-2		
Physical Components	13-3		
Minimum Configuration	13-3		
Configuration Features	13-3		
Operating Systems Supporting	13-6		
Compatibility	13-6		
Customer Responsibilities	13-6		
Data Security	13-6		
Purchase Location	13-7		
Warranty Period	13-7		
IBM Service Offerings	13-7		
Publications	13-7		
Self-Study Courses	13-9		

13:10 IBM 5160 Personal Computer		Remote 327X Emulation Session	14-27
XT System Unit	13-10	Remote 3101 Emulation Session	14-28
Models Available	13-10	Combined Local CMS and	
Physical Characteristics	13-11	Remote 327X Emulation	
Standard Features	13-11	Sessions with VMPCSERV	14-28
Optional Features	13-11	Combined Local CMS and	
Physical Components Included	13-12	Remote 327X Sessions with	
Standard Feature Descriptions	13-13	TSOSERV	14-29
Optional Feature Descriptions	13-21	Performance	14-31
Single Unit Prices	13-45		
Discounts Available	13-46		
13:15 5161 Expansion Unit Models 1		Section 15: IBM 3270 Personal Computer	
and 2	13-47	Workstations	15-1
Introduction	13-47	15:05 IBM 3270 Personal Computer	
Physical Components	13-47	Workstations Overview	15-2
Feature Descriptions	13-47	15:10 IBM 3270 Personal Computer	
Power Supply	13-48	Configuration Overview	15-3
Single Unit Prices	13-48	Introduction	15-3
Discounts Available	13-48	Physical Components	15-4
		Minimum Configuration	15-5
Section 14: IBM Personal Computer XT/370	14-1	Configuration Features	15-5
14:05 IBM Personal Computer XT/370		Operating Systems Supporting	15-7
Configuration Overview	14-2	Compatibility	15-7
Introduction	14-2	Customer Responsibilities	15-8
Physical Components	14-3	Data Security	15-8
Minimum Configuration	14-3	Purchase Location	15-8
Configuration Features	14-3	Warranty Period	15-8
Operating Systems Supporting	14-5	IBM Service Offerings	15-8
Compatibility	14-5	Publications	15-9
Customer Responsibilities	14-5	15:15 IBM 5271 System Unit, IBM	
Data Security	14-5	5272 Color Display, and IBM 3295	
Purchase Location	14-6	Plasma Monitor	15-10
Warranty Period	14-6	Models Available	15-10
IBM Service Offerings	14-6	Physical Characteristics	15-11
Publications	14-6	Optional Features for 5271	
14:10 IBM 5160 Personal Computer		System Units	15-12
XT/370 System Unit	14-8	Physical Components Included	15-12
Models Available	14-8	Feature Descriptions	15-13
Physical Characteristics	14-8	Keyboard	15-18
Standard Features	14-8	5272 Color Display	15-19
Optional Features	14-9	3295 Plasma Monitor	15-19
Physical Components Included	14-10	Single Unit Prices	15-21
Standard Feature Descriptions	14-10	Discounts Available	15-21
Optional Feature Descriptions	14-14	15:20 IBM 5161 Expansion Units	15-22
Single Unit Prices	14-19	5161 Models 1 and 2	15-22
Discounts Available	14-20	Single Unit Prices	15-23
14:15 IBM 5161 Expansion Units	14-21	Discounts Available	15-23
Introduction	14-21	15:25 IBM 3270-PC Control Program	15-24
5161 Expansion Unit Model 2	14-21	Introduction	15-24
5161 Expansion Unit Model 1	14-21	Sessions Supported	15-24
5161 Expansion Unit Model 3	14-22	Screen Management	15-25
Feature Descriptions	14-22	Application Program Interface	15-25
Single Unit Prices	14-23	Copy Functions	15-26
Discounts Available	14-23	Browsing	15-26
14:20 Virtual Machine/Personal		Keystroke Record/Play Function	15-26
Computer (VM/PC)	14-24	Save/Restore Utility	15-26
Introduction	14-24	Printer Support	15-26
Sessions Supported	14-25	Plotter Support	15-27
Local CMS (327X) Session Only	14-26	File Transfer	15-27
		Online Tutorial	15-27

Installation	15-27	Operating Systems Supporting ...	16-5
15:30 IBM 3270 Personal		Compatibility	16-5
Computer/Graphics and IBM 3270		Customer Responsibilities	16-6
Personal Computer/Extended		Data Security	16-6
Graphics Configuration Overviews ..	15-28	Purchase Location	16-6
Introduction	15-28	Warranty Period	16-7
Physical Components	15-30	IBM Service Offerings	16-7
Minimum Configurations	15-30	Publications	16-7
Configuration Features	15-31	Self-Study Courses	16-8
Operating Systems Supporting ..	15-33	16:10 IBM 5170 System Unit	16-9
Compatibility	15-33	Models Available	16-9
Customer Responsibilities	15-34	Physical Characteristics	16-9
Data Security	15-34	Standard Features	16-10
Purchase Location	15-34	Optional Features	16-10
Warranty Period	15-34	Physical Components Included ..	16-11
IBM Service Offerings	15-34	Standard Feature Descriptions ..	16-12
Publications	15-35	Optional Feature Descriptions ..	16-20
15:35 IBM 5371 System Unit	15-36	Single Unit Prices	16-29
Models Available	15-36	Discounts Available	16-30
Physical Characteristics	15-36		
Optional Features for 5371		Section 17: IBM Personal Computer AT/370	17-1
System Units	15-37	17:05 IBM Personal Computer AT/370	
Physical Components Included ..	15-37	Configuration Overview	17-2
Feature Descriptions	15-38	Introduction	17-2
Single Unit Prices	15-42	Physical Components	17-3
Discounts Available	15-42	Minimum Configuration	17-3
15:40 IBM 5279 and 5379 Displays		Configuration Features	17-3
and IBM 5278 and 5378 Display		Operating Systems Supporting ...	17-5
Attachment Units	15-43	Compatibility	17-5
5279 Color Display and 5278		Customer Responsibilities	17-5
Display Attachment Unit	15-43	Data Security	17-6
5379 Displays and 5378 Display		Purchase Location	17-6
Attachment Units	15-44	Warranty Period	17-6
15:45 IBM 5277 Mouse and IBM 5083		IBM Service Offerings	17-6
Tablet Model 2	15-47	Publications	17-6
5277 Mouse	15-47	17:10 IBM 5170 Personal Computer	
5083 Tablet Model 2	15-48	AT/370 System Unit	17-8
15:50 IBM 5161 Expansion Units ...	15-49	Models Available	17-8
15:55 IBM 3270-PC Graphics Control		Physical Characteristics	17-8
Program	15-50	Standard Features	17-8
Introduction	15-50	Optional Features	17-8
Sessions Supported	15-50	Physical Components Included ..	17-9
Screen Management	15-51	Standard Feature Descriptions ..	17-10
Copy Functions	15-52	Optional Feature Descriptions ..	17-13
Browsing	15-52	Single Unit Prices	17-17
Keystroke Record/Play Function	15-52	Discounts Available	17-18
Save/Restore Utility	15-52		
Printer and Plotter Support	15-52	Section 20: IBM 5531 Industrial Computer ..	20-1
File Transfer	15-53	20:05 IBM 5531 Industrial Computer	
Online Tutorial	15-53	Configuration Overview	20-2
Installation	15-54	Introduction	20-2
		Physical Components	20-2
		Minimum Configuration	20-2
		Configuration Features	20-2
		Operating Systems Supporting ...	20-3
		Compatibility	20-3
		Customer Responsibilities	20-4
		Data Security	20-4
		Warranty Period	20-4
Section 16: IBM Personal Computer AT	16-1		
16:05 IBM Personal Computer AT			
Configuration Overview	16-2		
Introduction	16-2		
Physical Components	16-3		
Minimum Configuration	16-3		
Configuration Features	16-3		

IBM Service Offerings	20-4	Hardware Description	31-2
Purchase Location	20-4	Operating Systems Supporting ...	31-3
Publications	20-4	Warranty Period	31-4
20:10 IBM 5531 System Unit	20-6	IBM Service Offerings	31-4
Models Available	20-6	Single Unit Prices	31-4
Physical Characteristics	20-6	Discounts Available	31-4
Standard Features	20-6	31:10 IBM 5181 Compact Printer Model	
Optional Features	20-7	1	31-7
Physical Components Included ..	20-7	Hardware Description	31-7
Standard Feature Descriptions ..	20-8	Operating Systems Supporting ...	31-8
Optional Feature Descriptions ..	20-10	Warranty Period	31-8
Single Unit Prices	20-14	IBM Service Offerings	31-8
Discounts Available	20-14	Single Unit Prices	31-8
20:15 IBM 5532 Industrial Color		Discounts Available	31-8
Display	20-15	31:15 IBM 5182 Color Printer Model 1	31-10
Section 30: Displays	30-1	Hardware Description	31-10
30:05 IBM 5151 Monochrome Display		Operating System Support	31-12
Model 1	30-2	Warranty Period	31-12
Hardware Description	30-2	IBM Service Offerings	31-12
Operating Systems Supporting ...	30-3	Single Unit Prices	31-12
Warranty Period	30-3	Discounts Available	31-12
IBM Service Offerings	30-4	31:20 IBM 3852 Color Printer Model 1	31-16
Single Unit Prices	30-4	Hardware Description	31-16
Discounts Available	30-4	Operating Systems Supporting ..	31-17
30:10 IBM 5153 Color Display Model 1	30-5	Warranty Period	31-17
Hardware Description	30-5	IBM Service Offerings	31-17
Operating Systems Supporting ...	30-6	Single Unit Prices	31-17
Warranty Period	30-7	Discounts Available	31-17
IBM Service Offerings	30-7	31:25 IBM 5201 QUIETWRITER®	
Single Unit Prices	30-7	Printer Model 1	31-18
Discounts Available	30-7	Hardware Description	31-18
30:15 IBM 4863 Color Display Model 1	30-8	Operating System Support	31-19
Hardware Description	30-8	Warranty Period	31-20
Operating Systems Supporting ...	30-9	IBM Service Offerings	31-20
Warranty Period	30-9	Single Unit Prices	31-20
IBM Service Offerings	30-9	Discounts Available	31-20
Single Unit Prices	30-9	31:30 IBM 5216 Wheelprinter Model 2	31-21
Discounts Available	30-9	Hardware Description	31-21
30:20 IBM 5154 Enhanced Color		Operating System Support	31-23
Display Model 1	30-10	Warranty Period	31-23
Hardware Description	30-10	IBM Service Offerings	31-23
Operating Systems Supporting ..	30-11	Single Unit Prices	31-23
Warranty Period	30-11	Discounts Available	31-23
IBM Service Offerings	30-11	Section 32: Color Plotters	32-1
Single Unit Prices	30-12	32:05 IBM 7371 Color Plotter	32-2
Discounts Available	30-12	Hardware Description	32-2
30:25 IBM 5175 Professional Graphics		Operating Systems Supporting ...	32-3
Display Model 1	30-13	Warranty Period	32-3
Hardware Description	30-13	IBM Service Offerings	32-4
Operating Systems Supporting ..	30-14	Single Unit Prices	32-4
Warranty Period	30-14	Discounts Available	32-4
IBM Service Offerings	30-14	32:10 IBM 7372 Color Plotter	32-5
Single Unit Prices	30-14	Hardware Description	32-5
Discounts Available	30-14	Operating Systems Supporting ...	32-6
Section 31: Printers	31-1	Warranty Period	32-7
31:05 IBM 5152 Graphics Printer Model		IBM Service Offerings	32-7
2	31-2	Single Unit Prices	32-7
		Discounts Available	32-7

Section 40: Software	40-1
40:05 IBM Personal Computer Disk	
Operating System	40-2
Introduction	40-2
Configurations Supported	40-3
Components	40-3
Functions Supported	40-4
Languages Supported	40-8
One-Time Charges	40-10
Discounts Available	40-10
40:10 IBM Personal Computer	
Interactive Executive	40-11
Introduction	40-11
Configurations Supported	40-12
Components and Functions	
Supported	40-12
One-Time Charges	40-14
Discounts Available	40-14
40:15 IBM Personal Computer XENIX	
System	40-15
Introduction	40-15
IBM PC XENIX Operating	
System	40-15
IBM PC XENIX Software	
Development System	40-17
IBM PC XENIX Text Formatting	
System	40-18
One-Time Charges	40-18
Discounts Available	40-18
40:20 CP/M-86	40-19
Introduction	40-19
Functions Supported	40-19
Languages Supported	40-20
One-Time Charges	40-20
Discounts Available	40-20
40:25 UCSD p-System	40-21
Introduction	40-21
Functions Supported	40-21
UCSD p-System Runtime Support	
One-Time Charges	40-22
Discounts Available	40-22

Section 41: Application Programs	41-1
41:05 PCjr Cartridges	41-2
Cartridges Available	41-2
One-Time Charges	41-2
Discounts Available	41-2
41:10 Application Programs for IBM	
Personal Computer Configurations ..	41-3
Programs Available	41-3

Appendix A: IBM Service Offering Descriptions	A-1
Types of Service	A-1
IBM Hourly Service	A-1

Appendix B: Trademarks	B-1
-------------------------------------	------------

Appendix C: Modes of Operation for Display	
Adapters and the PCjr Video Subsystem	C-1
Index	X-1

Figures

10-1.	4860 System Unit Model 67	10-7
10-2.	The PCjr 62-key typewriter-style keyboard	10-14
10-3.	Attachable Joystick for the PCjr	10-20
11-1.	5150 System Unit Model 176	11-10
11-2.	U.S. English 83-key keyboard for the IBM Personal Computer	11-19
11-3.	5161 Expansion Unit	11-50
12-1.	5155 System Unit Model 76	12-9
13-1.	5160 System Unit Model 87	13-10
13-2.	U.S. English 83-key keyboard for the IBM Personal Computer XT	13-21
15-1.	3270-PC workstation	15-3
15-2.	5271 System Unit Model 4	15-10
15-3.	Standard keyboard for the 5271 (and 5371) System Unit	15-18
15-4.	3295 Plasma Monitor	15-20
15-5.	3270-PC/G configuration components	15-28
15-6.	3270-PC/GX configuration components	15-29
15-7.	3270 PC/G minimum workstation configuration	15-43
15-8.	5379 display and 5378 Display Attachment Unit	15-45
15-9.	5277 Mouse	15-47
15-10.	5083 Tablet Model 2	15-48
16-1.	5170 System Unit Model 68	16-9
16-2.	U.S. English 84-key keyboard for the IBM Personal Computer AT	16-20
31-1.	Examples of 5152 printing	31-4
31-2.	Character Set 1 for the 5152 Graphics Printer	31-5
31-3.	Character Set 2 for the 5152 Graphics Printer	31-6
31-4.	Character Set for the 5181 Compact Printer	31-9
31-5.	Character Set 1 for the 5182 Color Printer	31-13
31-6.	Character Set 2 for the 5182 Color Printer	31-14
31-7.	All-Characters-Printable Character Set for the 5182 Color Printer	31-15

Section 1: Introduction

IBM personal computers are desktop computers that are suitable for home use, educational environments, and businesses of any size. A variety of compatible configurations are available, enabling a selection to be made on the basis of the functions, performance, and price desired.

Each configuration can be used as a stand-alone system, or connected to a local or remote processor to be used as an intelligent workstation. Configurations use 5¼-inch diskettes for program and data storage and all except the entry-level configuration support fixed disk storage.

A large number of optional features are available from IBM that allow the capabilities of each IBM personal computer configuration to be expanded as processing needs grow or that enable the selected configuration to be adapted to specific needs. In addition, the open-ended design of IBM personal computers permits new features to continue to be made available. This design also permits the attachment of non-IBM features and I/O devices to support facilities not offered by IBM.

Several operating systems, many programming languages, and hundreds of IBM-*logo*, vendor-*logo*, and personally developed application programs are available from IBM. Much additional programming is also available from other vendors. Because of hardware and I/O device compatibility among IBM personal computers, many application programs can be executed in any IBM personal computer configuration that has the hardware (features, random access memory, and I/O devices) required by the program.

The following IBM personal computer configurations are available:

- IBM PCjr
- IBM Personal Computer
- IBM Portable Personal Computer
- IBM Personal Computer XT (extended)
- IBM Personal Computer XT/370
- IBM Personal Computer AT (advanced technology)
- IBM Personal Computer AT/370
- IBM 3270 Personal Computer workstations:
 - 3270 Personal Computer (3270-PC)
 - 3270 Personal Computer/Graphics (3270-PC/G)
 - 3270 Personal Computer/Extended Graphics (3270-PC/GX)
- IBM 5531 Industrial Computer

Utilizing the 4860 System Unit, the IBM PCjr configuration is the entry-level IBM personal computer and is designed primarily for home and educational use.

The IBM Personal Computer configuration utilizes the 5150 System Unit and offers the widest range of hardware features and application programs of all the IBM personal computer configurations. It is suitable for home, educational, and business environments.

The IBM Portable Personal Computer configuration is designed for those who require a portable version of the IBM Personal Computer. It uses a 5155 System Unit, which contains a 9-inch display. Most of the hardware features and software available for the 5150 configuration are also available for this configuration.

The 5160 System Unit, which is an extended version of the 5150 System Unit, is used in the IBM Personal Computer XT configuration. It supports almost all the hardware features and software available for the IBM Personal Computer. The 5160 unit can have fixed disk storage installed and provides more space for optional features than the 5150 System Unit.

The IBM Personal Computer XT/370 (PC XT/370) configuration utilizes a 5160 System Unit with additional hardware that enables the 5160 to execute most System/370 instructions and to emulate a 3277, 3278, or 3279 display. Supported by the Virtual Machine/Personal Computer control program, this configuration is a desktop System/370 workstation that can execute most VM/CMS programs. The PC XT/370 can also operate as a stand-alone IBM Personal Computer XT executing IBM personal computer instructions.

The 5170 System Unit is used for the IBM Personal Computer AT configuration, which offers the most random access memory, most and fastest online diskette and fixed disk storage, and highest internal performance of all the IBM personal computer configurations. It supports most of the hardware features of the IBM Personal Computer and IBM Personal Computer XT and is designed for those who require larger memory and online storage capacity and/or faster execution speed than are provided by those configurations.

This 5170 configuration also supports from one to three users accessing it simultaneously when the

Introduction

IBM Personal Computer XENIX™ Operating System is used. Other IBM personal computers support multiprogramming but are single-user configurations.

The IBM Personal Computer AT/370 (PC AT/370) configuration is based on the IBM Personal Computer AT and offers facilities like those of an IBM Personal Computer XT/370 for those who require more online storage capacity and execution speed for their System/370 workstations. The PC AT/370 can also operate as an IBM Personal Computer AT.

The three 3270 Personal Computer workstations use the 5271 (3270-PC) and 5371 (3270-PC/G and GX) System Units. They provide advanced screen management (up to seven windows displayed simultaneously), basic and advanced graphics support, and a choice of all-points-addressable displays and performance. The 3270-PC, supported by the 3270-PC Control Program, is suited to applications that require simultaneous access to more than one data base. The 3270-PC/G and GX, supported by the 3270-PC Graphics Control Program, provide interactive advanced graphics using vector-to-raster hardware.

The 3270-PC/G and GX workstations can execute graphics applications in a stand-alone environment or interact with a host processor using, for example, Graphical Data Display Manager for host-supported graphics applications. Each 3270 workstation can also operate as an IBM personal computer without a 3270-PC control program.

The 5531 System Unit for the IBM 5531 Industrial Computer configuration consists of an industrialized version of the 5160 unit for the IBM Personal Computer XT. The 5531 is designed to be used in locations with a harsher physical environment than is found in the home or office, such as a plant floor.

The Intel 8088 microprocessor is used in all the IBM personal computer configurations listed except the IBM Personal Computer AT and AT/370. Thus, the same instructions are provided for 4860, 5150, 5155, 5160, 5271, 5371, and 5531 System Units and the instruction execution rate of these units is the same. The Intel 80286 microprocessor is used in IBM Personal Computer AT and AT/370 configurations. The 80286 is upward-compatible with the 8088, has a faster instruction execution rate than the 8088, and provides a protected address mode of operation that permits a multiuser environment to be supported.

Except for PC XT/370 and AT/370 configurations, which can execute System/370 instructions, IBM

personal computers are not program compatible with other IBM processors. However, available software supports communication and data interchange between IBM personal computers and most large, intermediate, and small IBM processors (System/370, 30XX, 4300, Series/1, 8100, System/34/36/38, for example) and IBM office systems (5520 Administrative System, Displaywriter, and Office System 6, for example).

Several IBM-logo displays are available for IBM personal computer configurations. They all support text and graphics modes and provide a range of resolutions and colors, as follows:

- 5151 Monochrome Display, with a screen size of 11.5 inches (diagonal), resolution of 640 × 350 or 720 × 350 pels (depending on the adapter used), and one color
- 5153 Color Display, with a screen size of 13 inches (diagonal), resolutions of 320 × 200 pels and 640 × 200 pels, and up to 16 colors
- 4863 Color Display (for the PCjr only), with a screen size of 13 inches (diagonal), resolution of 320 × 200 pels, up to 16 colors, and a lower resolution than the 5153 display for 80-character lines in text mode
- 5154 Enhanced Color Display, with a screen size of 13 inches (diagonal), resolution of 640 × 350 pels, selection of up to 16 colors from a palette of 64 colors for enhanced mode, and emulation of 5153 Color Display modes
- 5175 Professional Graphics Display, with a screen size of 13 inches (diagonal), resolution of 640 × 480 pels, selection of up to 256 colors from a palette of 4096 colors, and emulation of 5153 Color Display modes

Displays unique to each 3270 Personal Computer workstation are provided for the three 3270 configurations. They provide a range of colors and resolutions and screen sizes of 14 and 19 inches (diagonal).

A variety of tabletop printers are offered, allowing a choice to be made on the basis of the functions, performance, and print quality desired. The following IBM-logo printers are described in this guide:

- 5152 Graphics Printer, a dot-matrix printer with a print speed of 80 characters per second (cps) that can print text and graphics characters in black in a variety of character styles
- 5181 Compact Printer, a thermal printer with a print speed of 50 cps for text or 2400 pels per second for image printing that can print text and all-points-addressable graphics in black
- 5182 Color Printer, a dot-matrix printer with print speeds of 35 cps (for near-letter-quality)

to 200 cps (for draft mode) that can print text and all-points-addressable graphics in black or up to eight colors

- 3852 Color Printer, an ink-jet printer with a print speed of 37 cps for text printing and 3100 pels per second for graphics printing that can print characters, graphics, and graphics images on transparencies, as well as on paper, in black or seven colors
- 5201 QUIETWRITER® Printer, a very quiet, non-impact, letter-quality printer with a print speed of 40 to 60 cps that can print text and graphics in black using four different fonts
- 5216 Wheelprinter Model 2, a letter-quality, impact printwheel printer with a print speed of 25 cps that can print text and graphics in black using a large variety of printwheels

Other IBM-logo printing units can be attached to IBM personal computers, such as the 5218 Printwheel Printer Model A03 or A04 for Displaywriter systems, the 4975 Printer for Series/1 processors, IBM Electronic Typewriter Models 65, 85, and 95, and IBM SELECTRIC® System/2000 Typewriters.

The following IBM-logo desktop color plotters can be attached to IBM personal computers and are described in this guide:

- 7371 Color Plotter, a two-pen plotter that can plot in multiple colors on standard-size (8½ × 11-inch) paper and transparency film
- 7372 Color Plotter, a six-pen plotter that can plot in multiple colors on paper 8½ × 11 or 11 × 17 inches in size, or on transparency film

The IBM 7374 and 7375 Color Plotters can also be attached to IBM personal computers that are attached to a host processor (System/370, 30XX, or 4300).

The following IBM-logo operating systems are available:

- IBM Personal Computer Disk Operating System (DOS)
- IBM Personal Computer Interactive Executive (PC/IX)
- IBM Personal Computer XENIX™ Operating System
- CP/M-86™
- UCSD p-System™

Programs that support business, communications, data base, education, emulation, entertainment graphics, home/personal, professional, program development, and word processing applications are available. IBM-logo and vendor-logo programs that

are available from IBM are listed in this guide by category and in alphabetic sequence. Personally developed software is listed by category. Program descriptions are given only for certain systems-oriented types of application programs. Application program description publications are identified.

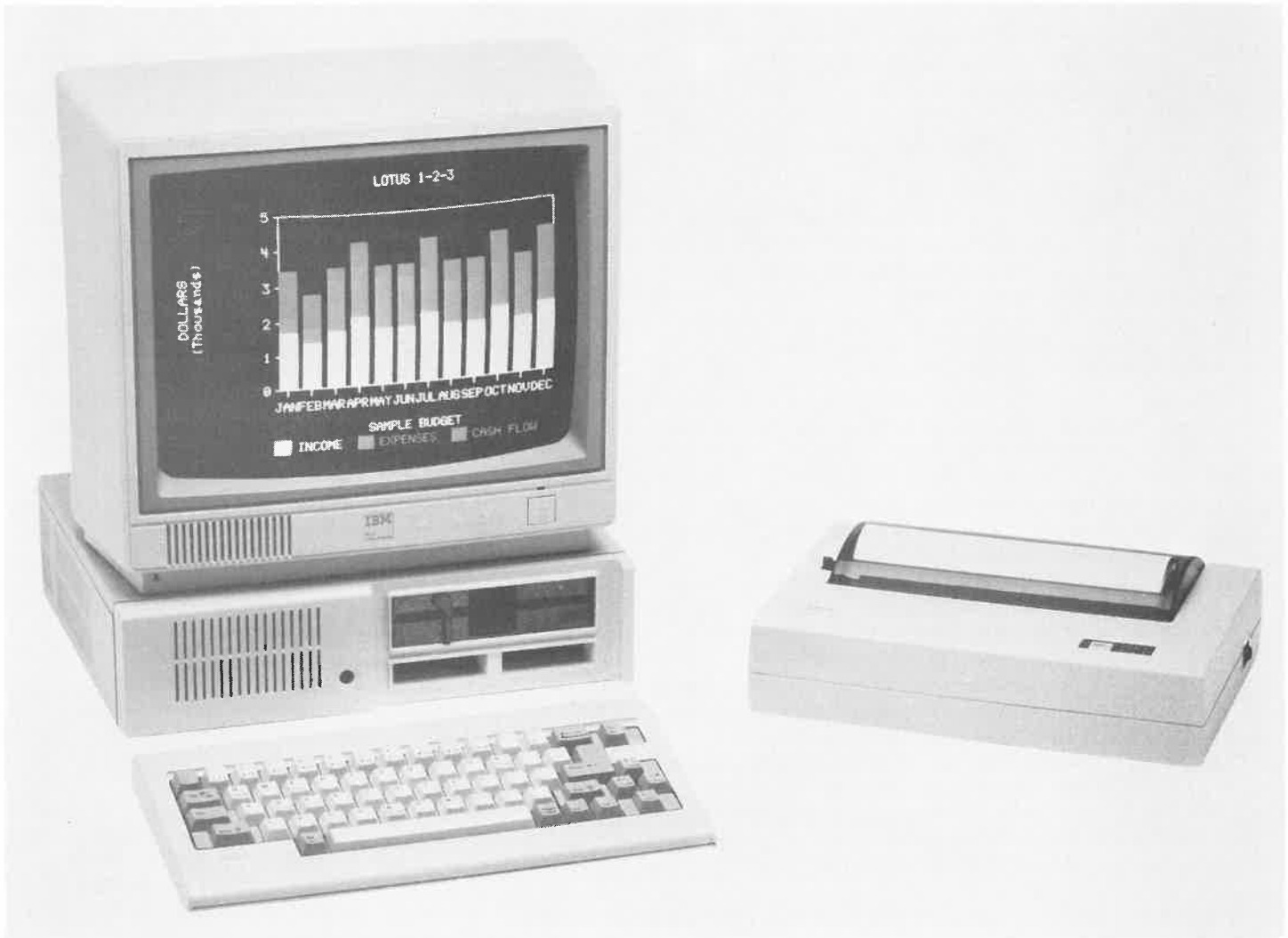
When large quantities of IBM personal computers are to be installed in an organization to be used as intelligent workstations, the implementation of a Workstation Resource Center (WRC) should be considered. A WRC is a focal point within an organization for the evaluation, acquisition, and support of all intelligent workstations. It is designed to provide end-users with a single source of support, including consulting, administrative, technical, and information systems support.

For information about Workstation Resource Centers, see the brochure *The Role of the Workstation Resource Center*, G520-5024, and the manual *Workstation Resource Center Planning and Implementation Guide*, G320-0772.

CONFIGURATIONS

IBM PCjr	Section 10
IBM Personal Computer	Section 11
IBM Portable Personal Computer	Section 12
IBM Personal Computer XT	Section 13
IBM Personal Computer XT/370	Section 14
IBM 3270 Personal Computer Workstations	Section 15
IBM Personal Computer AT	Section 16
IBM Personal Computer AT/370	Section 17
IBM 5531 Industrial Computer	Section 20

Section 10: IBM PCjr



Announced November 1, 1983

10:05 IBM PCjr Configuration Overview

Introduction

The IBM PCjr is the entry-level IBM personal computer. It is a small, low-cost, versatile, general-purpose system that is especially designed for use in the home and educational environments and for personal productivity applications.

Like other IBM personal computer configurations, the PCjr is designed as an expandable system. Standard built-in features permit a basic PCjr configuration to grow by the installation and attachment of many optional features and I/O devices that are available both from IBM and others.

The PCjr also has hardware features that are not implemented for other IBM personal computer configurations, such as a cordless keyboard, program cartridges, an expanded sound subsystem, and a speech attachment.

Hundreds of application programs (both IBM- and vendor-logo) are available for the PCjr. They support entertainment, educational, word processing, business, personal, graphics, program writing, and communications functions.

The majority of the application programs that operate in other IBM personal computer configurations can also operate in a PCjr configuration. This compatibility enables a user to have a PCjr workstation at home that is compatible with the IBM personal computer workstation that is used at work.

The PCjr can be used as a stand-alone system or as an intelligent workstation connected to a local or remote host processor (System/370, 30XX, or 4300, for example). 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 PCjr can be used as a videotex terminal.

The PCjr can be interconnected via cable to other local IBM personal computers to form a clustered multiuser configuration in which users share a fixed disk and exchange messages and data. The PCjr can communicate with a remote IBM personal computer configuration directly using a communications line or via diskette interchange.

The PCjr can be cable-connected to a Displaywriter system for the interchange of documents and files and Displaywriters can be included in an IBM per-

sonal computer cluster via cable attachment to the personal computers.

The combined weight of the PCjr system unit (with a diskette drive), keyboard, transformer, printer attachment, and Connector for TV is approximately 14 lb. A carrying case can be purchased to hold these units and program cartridges and diskettes. The Connector for TV feature permits a television set to be used as the required display for the PCjr system unit.

The PCjr configuration is designed for those who do not require the additional hardware functions, online storage, and I/O devices available for other IBM personal computer configurations.

Physical Components

The IBM-logo personal computer units that can be included in a PCjr configuration are:

- 4860 System Unit/Keyboard Model 4 or 67 with a separate transformer unit
- 4863 Color Display Model 1
- 5153 Color Display Model 1
- 5152 Graphics Printer Model 2
- 5181 Compact Printer Model 1
- 5201 QUIETWRITER® Printer
- 5216 Wheelprinter Model 2
- 5152 Matrix Printer Model 1 (no longer marketed by IBM)

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

Minimum Configuration

Every stand-alone PCjr configuration must include one 4860 System Unit/Keyboard with a transformer unit and one display device. The minimum PCjr configuration consists of the following:

- One 4860 System Unit/Keyboard Model 4, which has 64Kb of memory, two cartridge slots, and no diskette drive
- One display, which can be one of the following:
 - 4863 Color Display Model 1 (cable supplied)
 - 5153 Color Display Model 1 (requires the Adapter Cable for IBM Color Display feature). Higher density video modes sup-

ported by the video subsystem in the 4860 cannot be used unless the 64Kb Memory and Display Expansion feature is also installed.

- User-supplied black and white or color television set (requires Connector for TV feature)
- User-supplied standard composite video monitor and cable (plugs into the standard Composite Video Connector in the 4860 System Unit)

PCjr program cartridges can be purchased for this minimum stand-alone configuration and programs can be written using the BASIC Interpreter in read only memory of the 4860. Cartridges provide arcade-types games that can be played using the keyboard, an advanced BASIC Interpreter for writing and executing programs, a graphics design tool (PCjr Color Paint), and an integrated program (1-2-3™).

A single minimum PCjr hardware configuration that uses a TV for the display (4860 Model 4 with a Connector for TV) costs \$629 without the program cartridges. The single minimum stand-alone PCjr hardware configuration required to execute the IBM Personal Computer Disk Operating System using a TV for the display (4860 Model 67 with a Connector for TV) costs \$1029.

Configuration Features

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

- One 4860 System Unit, containing the Intel 8088 16-bit microprocessor, with a 62-key cordless typewriter-style keyboard and a stand-alone transformer unit. Certain optional features require a feature that provides an additional transformer unit.
- Read only memory (ROM) of 64Kb (65,536) bytes
- BASIC Interpreter in ROM (enhanced version of the widely used Microsoft BASIC – MBASIC – Interpreter)
- Random access memory (RAM) of 64Kb (65,536 bytes) to 512Kb (524,288 bytes). The memory available for program use (operating system and application) is the installed memory size less the memory used for the video display buffer (normally 16Kb).
- Two cartridge slots (for PCjr cartridge programs)
- One IBM 5¼-inch double-sided diskette drive with a capacity of 360Kb (368,640 bytes). A second temporary diskette drive can be simulated in random access memory via programming support provided with the optional 128Kb Memory Expansion Attachment feature.
- Up to three displays
- One printer (serial or parallel)
- One customer-supplied cassette recorder
- One or two joysticks (IBM-logo available)
- One customer-supplied light pen
- Audible alarm (beeper)
- Sound subsystem that uses speakers (those in the 4863 Color Display, customer-supplied TV, or externally attached customer-supplied speakers)
- Speech Attachment feature to record and play speech and sounds
- One internal modem that provides a programmable asynchronous communications (RS-232C) interface for connection to a telephone line via a standard telephone jack
- Serial port (RS-232C interface) for attachment of serial devices (such as a printer or an external modem)
- Carrying case for the 4860 System Unit/Keyboard
- Connection to the following:
 - Another IBM PCjr, an IBM Personal Computer, an IBM Portable Personal Computer, an IBM Personal Computer XT or XT/370, an IBM Personal Computer AT or AT/370, IBM 3270 Personal Computer workstations, an IBM 5531 Industrial Computer, a paper tape reader, a communicating typewriter, a laboratory instrument, voice recognition devices, letter-quality printers, or other machines that use the RS-232C interface, via the standard serial port or the optional internal modem
 - 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) via the Cluster Attachment and Cluster Cable Kit
 - A videotex host via the standard serial port in order to use the PCjr as a videotex terminal
 - A local Displaywriter via cable-attachment to the standard serial port. The PCjr can be a stand-alone system or part of a clustered IBM personal computer configuration.
 - IBM SELECTRIC® System/2000 Type-writers with the Printer Option installed via the Parallel Printer Attachment for letter-quality printing

Operating Systems Supporting

The IBM PCjr is supported by the IBM Personal Computer Disk Operating System (DOS) Version 2.1 and later.

Compatibility

Hardware

The IBM PCjr is generally compatible with other IBM personal computer configurations. Since the Intel 8088 microprocessor is used in 4860, 5150, 5155, 5160, 5271, 5371, and 5531 System Units, microprocessor instructions are fully compatible among 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT, 5160 Personal Computer XT/370 (PC mode), 3270 Personal Computer workstations, and 5531 Industrial Computer configurations. The 8088 is also upward compatible with the 80286 microprocessor in the 5170 Personal Computer AT operating in real address mode and the 5170 Personal Computer AT/370 operating in PC mode.

Diskettes (5¼-inch) are interchangeable without restrictions among IBM PCjr, IBM Personal Computer, IBM Portable Personal Computer, IBM Personal Computer XT and XT/370 (in PC mode), IBM Personal Computer AT and AT/370 (160/180Kb and 320/360Kb capacities only), IBM 3270 Personal Computer workstation, and IBM 5531 Industrial Computer configurations. Audiocassettes are interchangeable without restrictions among IBM PCjr and IBM Personal Computer configurations.

IBM Portable Personal Computer, IBM Personal Computer XT and XT/370, IBM Personal Computer AT and AT/370, IBM 3270 Personal Computer workstation, and IBM 5531 Industrial Computer configurations do not provide an adapter for audiocassettes and program cartridges can be used only with IBM PCjr configurations.

Programming

Most application packages that operate in IBM personal computers with the Intel 8088 microprocessor or 80286 microprocessor in real address mode will also operate in a PCjr as long as the hardware and programming resources required are available in the PCjr configuration.

Applications that require the following cannot operate in the PCjr:

- Two diskette drives unless the 128Kb Memory Expansion Attachment feature is installed to support a temporary diskette drive of the required size
- More than 512Kb of random access memory
- Binary Synchronous Communications Adapter
- Data Acquisition and Control Adapter
- Data Acquisition and Control Adapter Distribution Panel
- Direct memory access facility
- Display Station Emulation Adapter
- Enhanced Display Station Emulation Adapter
- Enhanced Graphics Adapter
- Fixed Disk Drive
- General Purpose Interface Bus Adapter
- IBM PC Network features
- IBM Personal Computer 3278 Attachment Option
- IBM Personal Computer 3279 Attachment Option
- Math Co-processor Option
- Professional Graphics Controller
- Synchronous Data Link Control Communications Adapter
- 3278/79 Emulation Adapter
- 5151 Monochrome Display
- 5154 Enhanced Color Display
- 5175 Professional Graphics Display
- 5218 Printer Attachment and 5218 Printer Sharing
- 7371, 7372, 7374, and 7375 Color Plotters
- 8100 PC Adapter

In addition, programs will not execute correctly in a PCjr if they do any of the following:

- Depend on the timing of a 5150, 5155, 5160, or 5170 System Unit
- Do not interface to the IBM Personal Computer Basic Input/Output System (BIOS) for I/O (that is, if they read and write directly to I/O devices)
- Directly access BIOS locations that differ between the PCjr and other IBM personal computer configurations

Note also that programs that execute from read-only memory run a little faster in the PCjr than in 5150, 5155, and 5160 configurations, while programs that execute from random access memory operate a little slower in the PCjr than in 5150, 5155, and 5160 configurations.

Customer Responsibilities

The PCjr and its features are customer-setup. The customer is responsible for unpacking the system components, unpacking and installing any optional features ordered, executing the power-on self-test program supplied in read only memory, and supplying four AA batteries if cordless keyboard operation is desired. The keyboard can also be attached to the 4860 System Unit via the optional Keyboard Cord feature. Setup from the IBM National Service Division is available 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 PCjr configuration (see "Physical Components" earlier in this subsection).

Data Security

The customer is responsible for providing any desired data security functions.

Purchase Location

- IBM NMD and NAD branch offices. Orders for any quantity are accepted by branch office marketing representatives. IBM Credit Corporation Term Lease Financing may be available for PCjrs 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

Warranty Period

The warranty period for the 4860 unit and its optional features is one year. The warranty service for the 4860 is Customer Carry-In Repair.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Option. For the 4860, IBM On-Site Repair is available.
 - Annual Maintenance. For the 4860, 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 a problem to an under-the-cover field replaceable unit

Publications

The following publications are provided with each PCjr configuration:

- *Guide to Operations* (1502292). This binder contains setup and starting instructions, keyboard information, instructions for installing each optional feature ordered for the configuration, testing information, and the diagnostics diskette. Additional copies can be purchased for \$21.25 each. For 4860 Model 67 configurations, a diskette containing the system tutorial "Exploring the IBM PCjr" is also provided with each 4860 unit.
- *Hands-on BASIC for the IBM PCjr* (1502290). This binder describes the functions provided by the BASIC Interpreter that is included in ROM in a PCjr configuration. Additional copies can be purchased for \$17.50 each.

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

- *BASIC Made Easy for the IBM PCjr* (6024116) – \$13. This is an introductory manual for inexperienced users that provides lessons on using BASIC. It requires the IBM PCjr BASIC program cartridge.
- *IBM PCjr Technical Reference* (1502293) – \$35. This reference describes the design of the hardware features, provides interface information (including logic diagrams), and lists the Basic Input/Output System (BIOS) instructions.
- *IBM PCjr Hardware Maintenance and Service* (1502294) – \$88. This binder provides procedures to isolate a problem to a field replaceable unit.
- *IBM PCjr BASIC Reference Manual* (1504702) – \$11.25. This manual describes the BASIC

10:05 IBM PCjr Configuration Overview

- available on a program cartridge (without the cartridge).
- *The Directory* (6137591) — \$4. This publication describes personally developed software packages that can be ordered by mail or telephone. The categories of program offered include entertainment, education, productivity, programming, and business. These programs are listed in a table in Section 41:10.
- *Logo: Programming with Turtle Graphics* (2229) — \$24
- 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 PCjr hardware and programming information are also available:

- IBM PCjr Brochure, G520-5039 (pocket version, G520-5040)
- *IBM PCjr: A Personal Productivity Tool That Gets Down to Business*, G520-1038
- *IBM PCjr — An Educational Tool in a Class by Itself* (brochure), G520-4229
- *Introduction to Personal Computers for Business — An Executive Overview*, G520-2306
- *IBM Personal Computers Hardware Facts* (pocket brochure), G520-3916
- *IBM Personal Computer Seminar Proceedings Volume 1, Number 3*, G320-9308
- *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.
- *Personal Computer Software Pocket Guide*, GB30-2479. This reference card lists the

vendor-logo programs available, part number, feature code, program charge, and 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.
- *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.

The publication *The IBM Personal Computer Catalog*, G570-2064, describes certain IBM personal computer hardware units, printer supplies and accessories, paper forms, diskette and associated accessories, books, software, 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.

10:10 IBM 4860 System Unit

Models Available

The 4860 System Unit Model 67 for the PCjr is shown in Figure 10-1.



Figure 10-1. 4860 System Unit Model 67

The following 4860 models are available:

- Model 4:
 - System Unit with cordless typewriter-style keyboard and transformer unit
 - 64Kb memory
 - Two cartridge slots
- Model 67 (enhanced):
 - System Unit with cordless typewriter-style keyboard and transformer unit
 - 128Kb memory (includes 64Kb Memory and Display Expansion feature)
 - Two cartridge slots
 - One 5¼-inch double-sided diskette drive and adapter

Models 4 and 67 of the 4860 differ only in the standard features provided. Otherwise, they are

functionally and physically identical. A 4860 Model 4 can be upgraded in the field to contain the same features as are provided in a 4860 Model 67. A 4860 System Unit cannot be upgraded to the 5150, 5155, 5160, or 5170 System Unit that is used in other IBM personal computer configurations.

10:10 IBM 4860 System Unit

Physical Characteristics

Dimensions

- Height: 3.8 inches (97 mm)
- Width: 13.9 inches (354 mm)
- Depth: 11.4 inches (290 mm)

The dimensions of the 4860 System Unit are approximately two-thirds of those of the 5150 and 5160 System Units for other IBM personal computer configurations.

Weight

- 5 lb 8 oz (2.61 kg) without a diskette drive
- 8 lb 4 oz (3.71 kg) with a diskette drive

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
 - 33 to 140 degrees F (1 to 60 C) for storage
 - -40 to 140 degrees F (-40 to 60 C) for shipping
- Cooling: Air-cooled (convection-cooled) – a cooling fan is not used
- Humidity: 8% to 80% for system on or off
- Noise level: 45 decibels (dB)
- Electrical: 110 volts, 60 Hz

Standard Features

The following are standard features of both 4860 models unless indicated otherwise. Each is discussed under "Standard Feature Descriptions" in this subsection.

- Microprocessor – Intel 8088
- Nine interrupt levels
- 64Kb bytes of read only memory (ROM)
- BASIC Version 1.1 Interpreter and Keyboard Adventure Program contained in ROM
- 64K (65,536) bytes of random access memory (RAM) for the Model 4 and 128K (131,072) bytes for the Model 67
- 64Kb Memory and Display Expansion (Model 67 only)
- Two cartridge slots
- Audio subsystem (audible alarm and sound subsystem that uses speakers)
- Video subsystem

- Seventeen I/O connectors to which features and units can be connected
- 62-key cordless typewriter-style keyboard
- One Diskette Drive (5¼-inch double-sided) – Model 67 only
- Transformer unit with attached cords
- Serial port

Optional Features

The following are optional features of both 4860 models unless indicated otherwise. Each is discussed under "Optional Feature Descriptions" in this subsection.

- Diskette Drive – Model 4 only (standard in the Model 67) – one maximum
- 64Kb Memory and Display Expansion – Model 4 only (standard in the Model 67) – one maximum
- 128Kb Memory Expansion Attachment (three maximum)
- Power Expansion Attachment (one maximum)
- Speech Attachment (one maximum)
- Connector for TV (one maximum)
- Adapter Cable for IBM Color Display (one maximum)
- Adapter Cable for Cassette (one maximum)
- Attachable Joystick (two maximum)
- Parallel Printer Attachment (one maximum)
- Internal Modem (one maximum)
- Adapter Cable for Serial Devices (one maximum)
- Keyboard Cord (one maximum)
- Cordless Keyboard Overlays (multiple)
- Carrying Case
- Cluster Attachment (one maximum)
- Cluster Cable Kit (one for each 4860 in the cluster after the first two systems)
- Displaywriter/Personal Computer Attach Convenience Kit

The Parallel Printer Attachment, Cluster Attachment, 128Kb Memory Expansion Attachment, Speech Attachment, and Power Expansion Attachment features are side-attached features that physically connect to the right side of the 4860 System Unit and attach to the I/O Channel Expansion Connector, which has a removable cover over it when no side-attached feature is installed. This cover should be placed over the last installed side-attached feature, if any.

Up to four side-attached features can be connected to the 4860 System Unit. When installed, the Power Expansion Attachment feature must be connected directly to the 4860 System Unit using the supplied screws. The second side-attached feature connects

to the Power Expansion Attachment feature via the screws supplied. The third attaches to the second, and so on.

For the 4860 Model 4, only three optional features (additional 64Kb of memory, the diskette drive, and the internal modem) must be placed inside the system unit. For the 4860 Model 67, only the optional internal modem must be placed inside the system unit. Other optional hardware features for these two models plug into the back of the system unit. The top of the 4860 System Unit is easily removed for feature installation.

Physical Components Included

Each 4860 System Unit contains a system board. This board has the processor subsystem (includes Intel 8088 microprocessor and associated functions, including three programmable timer/counters), read only memory, random access memory, the video subsystem, the audio subsystem (the audible alarm and the sound subsystem), and the games (program cartridge) subsystem. The 5¼-inch diskette drive that can be included in a 4860 configuration is also housed in the 4860 System Unit. It is located above the two cartridge slots in the front of the 4860 System Unit.

Seventeen I/O connectors are also contained in the 4860 System Unit. Standard and optional features and units plug into these connectors.

Standard Feature Descriptions

Microprocessor

The instruction execution function in the 4860 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 1024K bytes 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 with the 80286 microprocessor operating in 8086-compatible real address mode.

The 8088 microprocessor responds to requests for service from I/O components via nine levels of interrupt rather than polling to determine if a service is required. Interrupts are prioritized. The direct memory access facility implemented in other IBM personal computers is not implemented in the PCjr.

The 8088 microprocessor 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.

Add, subtract, multiply, and divide operations can also be performed on unpacked decimal numbers or they can be converted to binary for arithmetic operations. Floating-point arithmetic instructions are not supported by the 8088 microprocessor.

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 PCjr system for the supported ASCII characters and codes.

Read Only Memory

The 4860 System Unit contains 64K bytes of read only memory (ROM) on the system board. An additional 64K bytes of address space is reserved for ROM expansion. The contents of ROM remain when power to the 4860 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 64K addresses in the 1024K-byte address space addressable by the 8088 microprocessor. Note that ROM is also present on certain feature cards to provide device level control for the device attached to the adapter card.

ROM in the 4860 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 4860 is turned on. If an error is found, the appropriate error code is displayed.

10:10 IBM 4860 System Unit

- Diskette bootstrap loader to load a program from diskette
- Basic Input/Output System (BIOS). This system provides basic input and output support (device level control) for the I/O devices that attach to the 4860 and full support for the cassette recorder. BIOS provides an operational interface to the system and relieves the programmer of concern for device hardware characteristics.

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

Parameters are passed to and received from BIOS using registers in the 8088 micro-processor. BIOS uses a small portion of random access memory as a work area. A listing of BIOS instructions is provided in the PCjr *Technical Reference*.

While the BIOS in the 4860 System Unit is not identical to the BIOS in other IBM personal computers, the same BIOS system interrupts are used so that programs that interface with BIOS only via interrupts can be used without modification in PCjr and other IBM personal computer configurations, subject to other compatibility requirements.

- BASIC Version 1.1 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
 - 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/string/real variables
 - Single- and double-precision floating-point numbers
 - Support of medium- and high-resolution graphics modes

- Support of sequential cassette files
- Support of a display, the keyboard, and a printer
- Support of the standard audible alarm and optional light pen and joysticks

The BASIC Interpreter in ROM of the PCjr is functionally equivalent to the BASIC Interpreter in ROM of the 5150 Personal Computer and 5160 Personal Computer XT. The PCjr BASIC program cartridge supports additional functions as do the Disk BASIC and Advanced BASIC that are provided with DOS.

When the 4860 is turned on, after the self-test program executes successfully, a check is made to determine if a diskette is loaded. If so, IPL from the diskette drive is initiated. If a diskette is not present, or does not contain an operating system, a check for a loaded program cartridge is made and execution of the program on the cartridge is initiated if one is present. If neither a diskette nor a cartridge was loaded before power was turned on, the BASIC Interpreter is made ready and identified on the screen.

- Keyboard Adventure Program. While the display screen shows the BASIC Interpreter to be ready for use, the operator can request execution of the Keyboard Adventure Program using the Esc key. Designed for the new user, this program presents the keys, uses, and functions of the keyboard. A description of the Keyboard Adventure Program is contained in the PCjr *Guide to Operations*.
- Dot patterns for 256 characters for use in graphics mode for a display
- User-selectable diagnostics. These are detailed tests that can be executed by the user via Test Menu displays, as described in the PCjr *Guide to Operations*. The storage of diagnostics in ROM enables the diagnostics to be executed without the need for a diskette drive or a cassette recorder to provide an input device for the diagnostics.
- A hexadecimal code identifying this particular system unit as a 4860. This byte can be inspected by programming if this information is required.

Random Access Memory

Random access memory (RAM) is read/write program-addressable memory. In the 4860, RAM is a dynamic memory (its contents must be refreshed periodically) and its contents are lost when power to the 4860 System Unit is turned off. For the 4860 Model 4, 64Kb of memory is standard, while 128Kb is standard for the 4860 Model 67. The standard

memory has a 250-ns access time and a 345-ns cycle time. It is not parity-checked.

The standard 64K bytes in a 4860 Model 4 can be expanded to 128K bytes by installation of the 64Kb Memory and Display Expansion feature, which is standard in the 4860 Model 67. This feature is a prerequisite for installation of the 128Kb Memory Expansion Attachment feature.

For both models, up to three 128Kb Memory Expansion Attachment features can be attached to the right side of the 4860 System Unit to provide a maximum of 512Kb of memory. The 128Kb attachment provides memory with a cycle time of 840 nanoseconds and an access time of 290 nanoseconds that is not parity-checked. (See description of this attachment under "128Kb Memory Expansion Attachment" later in this subsection.)

For 4860 Models 4 and 67, 16Kb of the installed random access memory is normally used as a video display buffer (to refresh the display screen contents) and is not available for program use. The video display buffer size can be varied under program control from its standard size of 16Kb (which supports graphics mode for the display). For the Model 4, the video buffer can vary from 2Kb to 48Kb, while for the Model 67 it can vary from 2Kb to 112Kb. The minimum video buffer size of 2Kb supports black and white text mode for displays.

DOS Version 2.1 requires 24Kb of memory for its residence during system operation. DOS Versions 3.0 and 3.1 require 36Kb of memory. Thus, when DOS 2.1 is used in a 4860 configuration with 64Kb of memory, for example, 24Kb is available for application programs (40Kb is required for DOS and the standard size video display buffer).

Similarly, the BASIC Interpreter in ROM and the BASIC on cartridge require memory during their execution (4Kb for BASIC in ROM, 6Kb for cartridge BASIC without the use of DOS, and 30Kb for cartridge BASIC with the use of DOS Version 2.1). The 16Kb video display buffer requirement must be added to the BASIC requirement to determine the memory available to the BASIC program.

Note that locations in the 1024Kb address space that is accessible to the 8088 are preassigned. Specific address ranges are allocated to address random access memory, read only memory in the 4860 System Unit or on feature cards, and read only memory on program cartridges. The location of the video display buffer is normally the highest 16Kb in random access memory and thus, its addresses vary depending on whether the system has been initial-

ized to use random access memory above the 128Kb address.

64Kb Memory and Display Expansion

This feature (standard in the Model 67 and optional for the Model 4) provides 64Kb of random access memory, support of 80-column text lines for a display, and support of higher-density video modes (as implemented in the 5153 Color Display), as shown below:

Resolution	Number of colors supported with standard density	Number of colors supported with high density
160 × 200	16	16
320 × 200	4	16
640 × 200	2	4

This feature plugs into the 64Kb Memory and Display Expansion Connector slot on the system board. Eight memory modules of 64K bits each provide the additional 64K bytes. Parity checking is not provided. Only one 64Kb Memory and Display Expansion feature can be present in any 4860 System Unit. For a 4860 Model 4, this feature is a prerequisite for installation of the first 128Kb Memory Expansion Attachment feature.

Cartridge Slots

Two cartridge slots are provided in a 4860 System Unit. They are located in the front right portion of the system unit below the area provided for a diskette drive. Several program cartridges are available from IBM. See the discussion of program cartridges in Section 41:05.

A cartridge is 2 by 3 inches (48 by 72 mm) in size. A cyclical redundancy check is used to verify data integrity for cartridges.

A program cartridge for the PCjr can hold a maximum of 128Kb of read-only memory (using 8Kb, 16Kb, or 32Kb ROM modules). However, a maximum of 128Kb of cartridge ROM can be used at one time. Thus, if one loaded cartridge contains 128Kb of ROM, the second cartridge slot cannot be used at the same time.

A program cartridge provides a way to temporarily increase the ROM available in the configuration or to change the functions provided by the standard ROM. Thus, a program cartridge can supply an application program or be used as a replacement for

10:10 IBM 4860 System Unit

the standard 64Kb of ROM inside the 4860 unit (as does the BASIC Interpreter cartridge).

The use of a program cartridge increases the amount of installed RAM that is available for application program use, since the application program itself resides in ROM in the program cartridge rather than in RAM. In addition, since the program in a cartridge does not share memory cycles with the video display buffer, it executes faster than a program located in the first 128Kb of RAM.

Execution of the program contained on a program cartridge is initiated by placing the cartridge in either slot in the 4860 System Unit and then turning power on to the 4860. When 4860 power is already on and a cartridge is inserted in a slot, a system reset occurs automatically and execution of the program on the cartridge begins. System reset occurs whenever a program cartridge is removed from a powered-on 4860 unit. The contents of RAM are lost during a system reset.

Audio Subsystem

The audible alarm and sound subsystem comprise the audio subsystem. The audible alarm can be sounded via programming and produces a short beep. The alarm can be used to alert the user to a changed condition (change in display, error situation, for example).

The sound subsystem will accept input from four sources: a complex sound generator, a timer, cassette audio input, and audio input from the I/O Channel Expansion Connector.

The complex sound generator (not implemented in other IBM personal computers) can be programmed to produce different tones (notes). The range of notes supported is seven octaves. Up to three notes can be sounded simultaneously to produce chords.

In addition, a white noise generator is provided that can be sounded together with the one to three notes to produce special sound effects. Each of the three notes and the white noise can be independently attenuated via programming (theoretical 28 dB maximum attenuation). Musical applications can be programmed using cartridge BASIC.

The output of the sound subsystem is supplied to the Connector for TV Connector (to which a customer-supplied TV can be attached), Direct Drive Video Connector (to which the 4863 Color Display can be attached, for example), and External Audio Connector (to which a customer-supplied external amplifier and two external speakers can be attached, for

example). Thus, the sound generated using a 4860 can be directed to a home stereo system.

Video Subsystem

The video subsystem provides four I/O connectors that permit the following to be attached to a 4860 System Unit:

- One 4863 Color Display Model 1 or one 5153 Color Display Model 1, which provide a direct-drive RGB (red-green-blue) signal, or another RGB video monitor (the latter is not provided by IBM) using the Direct Drive (RGB) Video Connector
- One black and white or color video monitor (not provided by IBM) using the Composite Video Connector
- One black and white or color TV set (not provided by IBM) using the Connector for TV Connector
- One customer-supplied light pen using the Light Pen Connector

The 5151 Monochrome Display cannot be attached to the 4860.

The PCjr video subsystem provides facilities like those supported by the Color/Graphics Monitor Adapter for other IBM personal computers plus three additional modes not supported by that adapter. The video subsystem 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). Color or black and white is supported for either 40- or 80-column format. The 64Kb Memory and Display Expansion feature is required to support 80-column format.
- The character attributes of reverse video, blinking, highlighting, and gray shades for black and white text mode
- Sixteen foreground and 16 background colors in text mode. Blinking on a per-character basis is available for eight background colors.
- Low-, medium-, and high-resolution modes for APA graphics mode
- Sixteen colors for low-resolution graphics mode (160 pels horizontal, 200 pels vertical). Low-resolution mode supports home TV sets, low-resolution displays, and high-resolution displays. This mode is not supported by the Color/Graphics Monitor Adapter for other IBM personal computers.

- Four or 16 colors (or four shades of black and white) for medium-resolution graphics mode (320 pels horizontal, 200 pels vertical). The 64Kb Memory and Display Expansion feature is required to support 16 colors. Medium-resolution mode supports home TV sets, low-resolution displays, and high-resolution displays. Sixteen colors for medium-resolution mode (320 × 200 pels) is not supported by the Color/Graphics Monitor Adapter for other IBM personal computers.
- Two or four colors for high-resolution graphics mode (640 pels horizontal, 200 pels vertical). The 64Kb Memory and Display Expansion feature is required to support four colors. Only high-resolution displays are supported by this mode. Four colors for high-resolution mode (640 × 200 pels) is not supported by the Color/Graphics Monitor Adapter for other IBM personal computers.
- 256 characters in text mode, 128 characters in any graphics mode
- One of 16 colors supported for the screen's border color for all text and graphics modes. For black and white text mode, border colors can be 16 varying shades of gray. Sixteen gray shades are not supported by the Color/Graphics Monitor Adapter.

The default column width assumed for the installed color display at power-on time is 40. The default cannot be set as for other IBM personal computers. Thus, if 80-column width is desired for the display, it must be set by the user via the DOS MODE command or by the application program used.

For text mode, characters are formed from a character generator in ROM, which contains the dot patterns for 256 different characters. A minimum of 2K bytes of memory is required for the video display buffer for text mode (40-column support). A 4Kb display buffer is required for 80-column text mode.

For low-resolution graphics mode, medium-resolution graphics mode with four colors, and high-resolution graphics mode with two colors, 16Kb of memory is required as a display buffer. A 32Kb display buffer is required in memory for medium-resolution graphics mode with 16 colors or high-resolution graphics mode with four colors.

Note that those modes that are implemented in the PCjr video subsystem and in the Color/Graphics Monitor Adapter or Enhanced Graphics Adapter for other IBM personal computers are compatible (see Appendix C).

I/O Connectors

The system board in the 4860 System Unit has 17 I/O connectors into which standard and optional features and units can be plugged. A few connectors are inside the 4860 unit and one is on the right side of the 4860 unit. The rest are located in the back of the 4860 unit and are keyed and labeled to prevent improper attachment of features.

The following are the connectors provided and the IBM-logo optional features and customer-supplied features that can be attached to the 4860 System Unit via these connectors:

- Diskette Drive Adapter Connector for one 5¼-inch Diskette Drive (internal)
- 64Kb Memory and Display Expansion Connector for one 64Kb Memory and Display Expansion feature (internal)
- Internal Modem Connector for one Internal Modem feature (internal)
- Connector for Television Connector for one Connector for TV feature with a customer-supplied TV
- Direct Drive (RGB) Video Connector for the 4863 Color Display and cable or one Adapter Cable for the IBM Color Display feature with one 5153 Color Display (or equivalent customer-supplied direct drive color monitor)
- Composite Video Connector for one customer-supplied composite video monitor with cable
- Cassette Connector for one Adapter Cable for Cassette feature with one customer-supplied audiocassette recorder and cable
- Attachable Joystick Connectors (two) for two Attachable Joystick features or four customer-supplied game paddles (two paddles per connector are supported)
- I/O Channel Expansion Connector for the connection of up to four side-attached features (Cluster Attachment, Parallel Printer Attachment, Speech Attachment, Power Expansion Attachment, and 128Kb Memory Expansion Attachments) – right side of 4860 unit
- Serial Port (RS-232C) Connector for one Adapter Cable for Serial Devices feature to connect one serial device, such as an external modem or a serial printer
- Keyboard Connector for one Keyboard Cord feature to connect the keyboard if cordless operation is not desired
- Light Pen Connector for one customer-supplied light pen. A light pen can be used instead of the keyboard to make selections from a display menu and/or to move the cursor when light pen programming support is provided in an application program.

10:10 IBM 4860 System Unit

- External Audio Connector for a customer-supplied amplifier and one pair of customer-supplied external speakers
- Program Cartridge Connectors (two) for the two program cartridge slots (internal)
- Infra-Red Link Receiver Board Connector (internal)

62-Key Cordless Keyboard

The cordless keyboard is a low-profile, 62-key, typewriter-style, detached keyboard. The PCjr 62-key keyboard is different from the keyboards for other IBM personal computer configurations (which are not detachable) but provides the same functions as the 83-key keyboards for 5150, 5155, and 5160 System Units plus four additional functions.

As shown in Figure 10-2, the keys on the cordless keyboard are arranged in a standard typewriter layout with the addition of one function key and cursor control keys. The function of each key is printed on the keytop. However, the keyboard provides scan codes to the system unit to identify the key pressed instead of ASCII codes. Each key has a unique scan code. A BIOS keyboard routine in ROM translates the scan code into the standard or extended ASCII character printed on the keytops and presents it to the executing program. This approach permits each key to be programmed to represent the desired character or function. Thus, the standard characters and functions listed on the keytops can be changed.

For operator comfort the keyboard has two tilt positions. In the normal position, it has a 5-degree slope; with the keyboard legs extended, it has a 12-degree slope. The bottom of the keyboard has skid resistant feet and the top has a pencil holder. Highlights of the 62-key keyboard are as follows:

- 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, Fn, N, and numeric keys (the decimal code for the character must be entered).
- The F1 through F10 keys can be programmed to support up to 40 different functions using keyboard shift keys (shift, Ctrl, and Alt).
- Cursor control keys provide for moving the cursor up, down, right, and left.
- PgUp and PgDn and keys to insert and delete characters at a 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).



Figure 10-2. The PCjr 62-key typewriter-style keyboard

- Audio feedback provides a soft click when a key is pressed to aid typing when information is entered from notes.
- Phantom-key deletion, not provided for the 83-key keyboards for other IBM personal computers, is supported. When an invalid combination of three or more keys is pressed simultaneously, a code is sent to the 4860 from the keyboard that causes it to take no action (the erroneous keystrokes are ignored).
- A 16-character type-ahead buffer is provided to prevent keystrokes from failing to be registered if information is entered before the system unit is ready to receive it.

The 62-key keyboard has features that are designed to aid first-time computer users and that are not implemented on the 83-key keyboards. The frequently used enter key has a different size and shape from the other keys, and the four cursor keys are separated from the rest of the keys. In addition, certain special keys (Esc, Alt, cursor control, function keys, for example) are highlighted by using different colors on the keytops to indicate key function as an aid in locating these keys.

Functions provided by the 62-key keyboard (using multiple-key combinations) that are not provided by the 83-key keyboards are the following:

- Shift screen contents to the left one to four character positions
- Shift screen contents to the right one to four character positions
- Audio feedback click control. The keyboard click when a key is pressed can be turned on or off. The power-on default is off.
- Execute customer diagnostics contained in ROM

A keyboard difference chart is included in the *PCjr Guide to Operations* manual that is to be referenced when program documentation that refers to the 83-key keyboards is used. The difference chart indicates the PCjr equivalent keys for any key on an 83-key keyboard that is not implemented on the PCjr keyboard.

The cordless keyboard is battery powered and communicates with the 4860 System Unit via an infrared (IR) optical link. Mounted on the keyboard are two infrared emitting diodes that transmit coded information to the 4860 System Unit. The receiver card in the system unit has an infrared sensing device (located to the left of the two cartridge slots) that receives the signal transmitted from the keyboard.

The keyboard is powered by four customer-supplied AA-size batteries during cordless operation. It will function in cordless mode when located within 20

feet of and in front of (in line of sight of) the 4860 unit. The keyboard stays in a standby power-down mode until a key is pressed. Power is then used to transmit the character code to the 4860. After transmission, standby power-down mode, which uses very little power, is reentered if the buffer is empty and no key is pressed. Thus, an on/off switch is not required to provide maximum battery life.

The optional Keyboard Cord feature provides direct connection of the keyboard to the back of the 4860 System Unit to power the keyboard and to send data to the 4860 System Unit. The cord option must be used when multiple PCjr systems are operating in the same immediate area to eliminate cross communication. The cord is flat and 6 feet (1.8 m) in length.

The physical characteristics of the keyboard are:

- Width: 13.45 inches (341.5 mm)
- Depth: 6.61 inches (168 mm)
- Height: 1.12 inches (29 mm)
- Weight: 25 oz (700 grams) without batteries and 28 oz (784 grams) with batteries

Diskette Drive

The Diskette Drive feature is standard in the 4860 Model 67 and optional in the Model 4. It is recommended that the 64Kb Memory and Display Expansion feature also be installed in a 4860 Model 4 when the optional diskette drive is installed. The system tutorial "Exploring the IBM PCjr" is supplied when the Diskette Drive feature is ordered for a 4860 Model 4, as are the required cables.

Note that the 4860 diskette drive (a half-height drive) provides the same function as the double-sided diskette drive for other IBM personal computer configurations. However, the physical implementation of the 4860 diskette drive is different from that of the diskette drive used in other IBM personal computer configurations (including the slimline drive in the IBM Portable Personal Computer). Therefore, the PCjr diskette drive is not physically interchangeable with the 5150/5160 or 5155 diskette drive.

The 4860 diskette drive is a 5¼-inch double-sided diskette drive that reads and writes double-density soft-sectored single- or double-sided diskettes. The capacity of one double-sided diskette is 360Kb (368,640 bytes) as formatted by DOS Version 2.1 or later. Diskettes with a 160Kb or 320Kb capacity (those formatted using DOS Version 1.0 or 1.1) can also be read by DOS Version 2.1 in a PCjr config-

10:10 IBM 4860 System Unit

uration. Up to 112 DOS files can be stored on a double-sided diskette.

One Diskette Drive feature maximum can be present in a 4860 System Unit. The Diskette Drive feature includes a diskette drive adapter, diskette drive, and cables that connect the diskette drive to the Diskette Drive Adapter Connector on the system board.

Note that a second temporary diskette drive can be established in RAM when a 128Kb Memory Expansion Attachment feature is installed (see discussion of this feature later in this subsection).

Diskette drive characteristics are:

- Number of rotations per minute (rpm): 300
- Track to track access time: 6 milliseconds (ms)
- Data transfer rate: 250K bits (32,000 characters) per second
- Head settling time: 21 ms
- Weight: 2.2 lb (1.1 kg)
- Height: 1.75 inches

Characteristics of the double-sided diskette are:

- 512 bytes per sector
- 9 sectors per track
- 48 tracks per inch track density
- 2 surfaces
- 40 tracks per surface

Write protection is provided by placing a 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 necessary. A diskette without a notch (such as the DOS operating system diskette) is permanently write-protected.

The performance of the diskette drive in the PCjr is equivalent to that of the diskette drive in all other IBM personal computer configurations with one exception. That is, the time required after a seek operation is longer for the PCjr diskette drive because of its longer head settling time (21 ms versus 15 ms). DOS as of Version 2.1 is designed to accommodate the diskette drive as appropriate to the IBM personal computer configuration in which it is operating.

Note that the direct memory access facility utilized in other IBM personal computers is not supported by the diskette drive adapter in the PCjr. When a diskette drive I/O operation is in progress, interrupts from the keyboard and asynchronous communications (internal modem and serial port) are not accepted. Thus, keyboard and asynchronous communications operations cannot be overlapped with diskette I/O operations in the PCjr. The application program must ensure that asynchronous operations

do not take place while the diskette drive is operating so that data sent to the PCjr is not lost.

Customer cleaning of the heads in a diskette drive in a 4860 unit or of diskettes is not recommended.

Transformer

The provided transformer is a standard, stepdown, 60-volt/ampere, 33-watt type that is separately housed. The transformer connects to the back of the 4860 unit via its 4-foot (1.2-m) cord and to a power source via its 6-foot (1.8-m) power cord. The transformer weighs 2 lb, 13 oz. Air temperature for system-on should be 60 to 90 degrees F (15.6 to 32.2 C) and humidity should be 8% to 80%. Maximum operating altitude for the transformer is 7000 feet.

The transformer converts household power to lower-level, nonhazardous (18-volt) power and supplies it to a power board that is mounted on the system board in the 4860 unit. A nonresettable fuse is present in the transformer. If an overtemperature or overcurrent condition is detected in the transformer, power is removed. The power board supplies three output voltage levels to the system board. Detection of overcurrent and overvoltage conditions in the power supplied to the system board by the power board is also provided. Overvoltage protection is provided by a fuse.

Use of an external transformer unit rather than a power supply inside the 4860 System Unit eliminates the need for a fan inside the 4860 unit that would add weight.

An additional external transformer is provided with the optional Power Expansion Attachment feature.

Serial Port

The Serial Port Connector provides the ability to attach a serial device (such as a printer or external modem) to the standard serial port in the 4860 System Unit. The 5181 Compact Printer Model 1, 5216 Wheelprinter Model 2, or a mouse (such as the Mouse Systems PCjr Mouse), for example, can be attached to the PCjr via the serial port. The optional Adapter Cable for Serial Devices feature must be used for the connection.

The serial port supports an RS-232C interface compatible with that provided by the Asynchronous Communications Adapter for other IBM personal computers and is fully programmable. Logically, the

serial port is the COM2 device to BIOS, DOS, and BASIC.

The serial port has the following features:

- A programmable baud-rate generator supports transmission speeds of 50 to 4800 bits per second (bps).
- Five-, six-, seven-, or eight-bit characters with 1, 1½, or 2 stop bits are supported.
- Even, odd, or no-parity-bit generation and detection are supported.
- False-start bit detection is provided.
- Full double buffering eliminates the need for precise synchronization.
- Independent receiver clock input is provided.
- Modem control functions provided are clear to send, request to send, data set ready, and data terminal ready. Other signal lines supported are transmit data, receive data, signal ground, shield ground, and carrier detect.
- A fully prioritized interrupt system controls transmit, receive, line status, and data set interrupts.
- Complete status reporting capabilities are provided.
- Line-break generation and detection are supported.
- Break, parity, overrun, and framing error simulation are supported.

IBM-logo application programs that support communications functions using the serial port in the 4860 include the following:

- Personal Communications Manager
- PC/Videotex

For a description of Personal Communications Manager, see discussion under "Internal Modem" later in this subsection.

The PC/Videotex program permits a PCjr (4860 Model 67) to be used as a videotex terminal. The 4860 is attached to a videotex host processor (System/370, 30XX, 4300, or Series/1, for example) using the serial port (with a 1200 bps external modem) and asynchronous communications protocols are used. As a videotex terminal, the 4860 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 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 4860 to connect to a variety of videotex networks.

Optional Feature Descriptions

128Kb Memory Expansion Attachment

Up to three 128Kb Memory Expansion Attachment features can be installed in a 4860 Model 4 or 67 configuration to provide up to 512Kb of random access memory. This memory has an access time of 290 ns and a cycle time of 840 ns and is not parity checked. The Power Expansion Attachment feature is a prerequisite for installation of the second and third 128Kb Memory Expansion Attachments or for installation of the first 128Kb attachment if another side-attached feature is already installed.

The first 128Kb Memory Expansion Attachment connects to the right side of the 4860 System Unit directly, to the Power Expansion Attachment, or to another side-attached feature via the provided screws. The 64Kb Memory and Display Expansion feature and a diskette drive are prerequisites for installation of the first 128Kb Memory Expansion Attachment in the 4860 Model 4.

For each 128Kb memory expansion module attached to the 4860 unit, configuration switches on the back of the module must be set by the user to indicate the presence of additional memory. The memory expansion module is 1.26 inches (32 mm) deep, 11.42 inches (290 mm) wide, and 3.8 inches (96.5 mm) high.

The 128Kb Memory Expansion Attachment feature includes a PCjr Memory Options diskette, a manual titled *Using Your PCjr Memory Options*, and an update to the *PCjr Guide to Operations*. The manual explains how to install the programming required to use the memory above 128Kb.

The Memory Options diskette must be used to create a Memory Expansion diskette, which enables application programs to use more than 128Kb of memory, and/or a Memory Disk diskette, which creates a temporary virtual diskette of user-specified size (60Kb default) in RAM above the 128Kb

address. The installation procedure adds the required programming to one or two diskettes that contain DOS. The Memory Expansion or Memory Disk programming can also be added to any applications program diskette that also contains DOS. The created Memory Expansion or Memory Disk diskette must be used to initialize memory correctly each time the PCjr is to access memory above 128Kb.

The Memory Disk diskette establishes a temporary diskette in RAM to permit the execution of programs that require two diskette drives or that will use a second diskette drive when it is available. DOS commands can be used to copy files to and from the temporary diskette, which is addressed as drive C, and to access the information on the temporary diskette just as if it were a physical diskette. The contents of the temporary diskette are lost when PCjr power is turned off (or power is lost), a system reset is performed (Ctrl-Alt-Del keys are pressed to reinitialize the system), or a cartridge is inserted or removed. Thus, the contents of the temporary diskette must be copied to a physical diskette in drive A if they are to be kept for later use.

Note that the video display buffer is not placed in its usual location during DOS initialization for the use of more than 128Kb of memory. Therefore, any application program that addresses the display buffer using absolute addresses will not execute correctly when the 4860 is initialized to use memory above 128Kb.

Some programs that will not use memory above 128Kb are those that require cartridge BASIC, are self-starting, or do not use DOS Version 2.1. A DOS diskette that does not contain the Memory Options or Memory Expansion programming is required to execute such application programs.

Power Expansion Attachment

The Power Expansion Attachment feature consists of a side-attached power supply module and a stand-alone 56-volt/ampere stepdown transformer unit. The power supply module provides an additional 20 watts of power and attaches to the right side of the 4860 System Unit via four screws. When installed in a 4860 configuration, this feature must be the first side-attached feature installed. The power supply module is 1.26 inches (32 mm) deep, 11.42 inches (290 mm) wide, and 3.8 inches (96.5 mm) high. The transformer attaches to the back of the power supply module via its attached cable and plugs into an electrical outlet via its attached power cord.

This feature provides additional power for a 4860 configuration, permitting any combination of up to three of the following side-attached features to be connected to the side of the 4860 unit after installation of the Power Expansion Attachment:

- 128Kb Memory Expansion Attachment (three maximum)
- Parallel Printer Attachment (one maximum)
- Cluster Attachment (one maximum)
- Speech Attachment (one maximum)

One 128Kb Memory Expansion Attachment, one Parallel Printer Attachment, or one Speech Attachment feature can be attached to any 4860 unit without installation of the Power Expansion Attachment feature. In addition, one Cluster Attachment can be attached to a 4860 Model 4 that does not have a diskette drive, Parallel Printer Attachment, or 128Kb Memory Expansion Attachment installed.

The Power Expansion Attachment feature is required for the following:

- To attach two or three of the other optional side-attached features (128Kb Memory Expansion Attachment, Parallel Printer Attachment, Cluster Attachment, and Speech Attachment)
- To attach the Cluster Attachment to any 4860 Model 67 (which has a standard diskette drive) or to a 4860 Model 4 to which a diskette drive has been added.

Speech Attachment

The Speech Attachment is a side-attached feature that records and retrieves speech and sounds under program control using linear prediction coding (LPC) and continuously variable slope delta (CVSD) modulation techniques.

The attachment contains 196 words, phrases, and sound effects recorded in its ROM. The BIOS required to control the attachment is also in its ROM. A listing of both is contained in the *IBM PCjr Speech Attachment Technical Reference* that is provided with the Speech Attachment feature.

User-supplied speech and sounds can be recorded in RAM, on diskette, or on another storage device using a customer-supplied microphone (miniature phone jack of 3.5 mm with 500-ohm nominal impedance) that connects to the back of the Speech Attachment module.

The vocabulary in ROM of the Speech Attachment, user-recorded speech/sounds on diskette, or prerecorded speech contained on PCjr cartridges can be

played under program control. Audio output is supplied to the sound subsystem and can be directed to the 4863 Color Display, a customer-supplied TV with an RF (radio frequency) modulator, or the External Audio Connector to which a customer-supplied external amplifier and speakers have been connected.

One Speech Attachment feature can be installed in a PCjr configuration. The Power Expansion Attachment feature is not required if the Speech Attachment is the only side-attached feature installed in the PCjr configuration. Otherwise, the Power Expansion Attachment is required. The Speech Attachment module is 1.26 inches (32mm) deep, 11.42 inches (290 mm) wide, and 3.8 inches (96.5 mm) high.

The IBM-Logo Writing to Read licensed program uses the PCjr Speech Attachment feature to provide an instructional system for kindergarten and first-grade students. It is designed to develop reading skills by teaching students to write in a planned learning center. Color graphics as well as sound are used.

Connector for TV

This feature provides an RF modulator that permits the 4860 unit to be connected to a standard home television set made for operation in the U.S. or Canada. It plugs into the Connector for TV Connector in the rear of the 4860 unit and attaches to the VHF terminals of a TV set. The connector operates on channel 3 or 4 of the TV set. The connector provides a switch that allows selection of how the TV will be used — as part of the 4860 PCjr configuration or as a TV set. This feature weighs 12.5 ounces.

If the Connector for TV feature is to be connected to a cable TV and the TV is to be operated as a TV, a customer-supplied 75-ohm-to-300-ohm convertor may be required.

Adapter Cable for IBM Color Display

This feature permits the IBM 5153 Color Display (or equivalent) to be attached to the rear of the 4860 unit via the Direct Drive (RGB) Video Connector. If the higher-density mode of the 5153 display is to be used, the 64Kb Memory and Display Expansion feature must be installed for a 4860 Model 4. This cable is not required for the 4863 Color Display, which is delivered with the required cable.

Adapter Cable for Cassette

This feature permits a customer-supplied player/recorder cassette to be attached to the Cassette Connector in the rear of the 4860 System Unit. The cassette that is to be connected must have all of the following type connectors (or equivalent):

- Belden Style-51 miniature phone-plug (auxiliary)
- Belden Style-51 miniature phone-plug (earphone)
- Belden Style-56 subminiature phone-plug (remote)

The cassette adapter cable has a plug at one end that connects to the 4860 unit and three plugs at the other end that plug into the cassette unit. Cassette I/O support is provided in ROM, which includes error checking using a two-byte cyclic redundancy code (CRC).

Attachable Joystick

One or two joysticks can be connected to the rear of the 4860 unit via the Attachable Joystick Connectors. A joystick has the required cable attached to it. The IBM-Logo PCjr joystick cannot be attached to other IBM personal computers. A joystick, shown in Figure 10-3, is an input device to provide the user with two-dimensional positioning control (up, down, right, left) of the cursor or of an object displayed on the screen. Two momentary contact pushbutton switches and a stick on the unit are used for positioning. Joysticks are supported by many game and personal productivity programs that are available for the PCjr.

Two modes of operation of the stick itself are available. In the spring return mode, the stick will return to the center position when released. The free floating mode allows smooth, force-free operation, with the stick remaining in position when released. Selection of these modes can be made independently for each axis (horizontal and vertical). Two controls are provided for individual adjustment to the electrical center of each axis.



Figure 10-3. Attachable Joystick for the PCjr

Parallel Printer Attachment

This feature permits one 5152 Model 2 Graphics Printer, 5152 Model 1 Matrix Printer (no longer marketed by IBM), 5201 QUIETWRITER® Printer, 5216 Wheelprinter Model 2, IBM SELECTRIC® System/2000 Typewriter, or one of various I/O devices that accept eight parallel bits of data at the standard TTL (transistor to transistor logic) level to be attached to the 4860 unit. Connection of an IBM SELECTRIC® System/2000 Typewriter to this attachment is via the Printer Cable feature that is used for attaching the 5152 printer. For the other printers, see Section 31 for cable requirements.

This side-attached feature is 3 inches high and 9.6 inches long (76 by 244 mm). It connects to the right side of the 4860 System Unit, directly or via another installed side-attached feature using four supplied screws. The Power Expansion Attachment is a prerequisite for the Parallel Printer Attachment only when another side-attached feature is already installed. The printer attachment weighs 12 ounces and provides a 25-pin D-shell connector at its rear edge for attachment of a cable.

Internally, this attachment connects to the I/O Channel Expansion Connector. This printer attachment is program-compatible with the Printer Adapter feature for other IBM personal computer configurations.

When this printer attachment is installed, print output is directed only to this attachment. Thus, if the 5181 Compact Printer Model 1 is to be attached to a 4860 (via the Serial Port Connector), the Parallel Printer Attachment should not be installed.

Internal Modem

This feature plugs into the system board in the 4860 unit. It connects to the Internal Modem Connector in the 4860 unit and provides a programmable asynchronous communications (RS-232C) function. Externally, the Internal Modem connects to a standard telephone line to provide communication with remote processors and access to remote data services. A customer-provided modular telephone jack connected to the telephone system is required.

The Internal Modem cable is provided with this feature. It plugs into the rear of the 4860 unit and into the telephone jack. A telephone is not required for this connection.

The Internal Modem:

- Uses a modular phone jack (USOC RJ11) for direct connection to a telephone line
- Uses duplex communications mode on two-wire switched network channels (normal household telephone installation)
- Supports auto dial using either dual-tone modulated frequency (DTMF) touchtone™ or pulse dialing (rotary dial) by program command
- Supports auto or manual answer and auto or manual originate
- Is programmable using ASCII characters
- Is compatible with Bell 103 Series modems
- Has a data rate of 110 or 300 bits per second
- Provides FCC Part 68 approved direct connection to a telephone line
- Supports error detection and diagnostic facilities
- Supports call progress reporting
- Supports dial tone, ring-back tone, and busy tone detection
- Has fully programmable serial interface characteristics (7- or 8-bit characters; even, odd, or no parity bit generation and detection; one stop bit generation; and data rate generation)
- Supports false-start bit detection
- Has complete status reporting capabilities
- Has line-break detection
- Has internal diagnostic capabilities that include loopback controls for communications link fault isolation and break, parity, overrun, and framing error simulation
- Has fully prioritized interrupt system controls

The Internal Modem connects to an RS-232C interface on the system board that is separate from but identical to the standard serial port RS-232C interface and compatible with the Asynchronous Communications Adapter for other IBM personal computer configurations. When the serial port is to be used for the connection of a serial printer, such as the 5181 Compact Printer, the optional Internal Modem can be used for telecommunications functions. Logically, the Internal Modem is the COM1 device to BIOS, DOS, and BASIC.

The Personal Communications Manager program supports the PCjr Internal Modem and the autocall function. It provides terminal emulation for PCjr communication with remote processors and an electronic mail function.

When the terminal emulation facility is active, the PCjr has the operating characteristics of an asynchronous (start/stop) Teletype™ ASR 33/35 terminal. The PCjr can communicate with remote processors (such as 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 PCjr 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 by the 4860. 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.

Adapter Cable for Serial Devices

This 3-inch (72-mm) cable attaches to the Serial Port Connector in the rear of the 4860 System Unit (which is not a standard 25-pin connector) and to a serial device standard cable connector (RS-232C D-type 25-pin connector). The cable permits a serial device with a data rate up to 4800 bits per second to be attached to the 4860. External modems (such as those with a data rate higher than that of the Internal Modem feature) and serial printers (such as the 5181 Compact Printer Model 1) can be attached to the PCjr using this cable.

Keyboard Cord

The PCjr Keyboard Cord, which is a 6-foot (1.8-m) straight cord, connects the cordless keyboard to the rear of the 4860 unit via the Keyboard Connector. It provides power to the keyboard and transfers serially encoded data to the 4860 unit. When connected to the keyboard, the keyboard cord disengages the battery power and disables the infrared circuit in the keyboard, and when connected to the system unit disables the infrared receiver in the 4860 unit.

Cordless Keyboard Overlays

This feature is available only for the 62-key keyboard that does not have its keytops labeled, which is the keyboard that was originally shipped with PCjr configurations. This keyboard has the standard keyboard layout permanently affixed above each key rather than on the keytops.

The Cordless Keyboard Overlays are provided to customize the earlier keyboard in order to match customized program support for the 62-key keyboard, or to identify the facility associated with each function key supported by an application program.

The overlays are made of blank heavy stock paper and are scored so that they may be easily folded for storage and distribution. The keyboard overlays may be customized by writing on them, by typing on them, or by having them printed commercially. The overlays fit between the keyboard keys and cover the preprinted symbols to customize the keyboard.

Carrying Case

The Carrying Case is made especially for the owner who occasionally wishes to move or store a PCjr safely, securely, and conveniently. The case, which is black with a lightly textured surface, has the capacity for the key elements of a PCjr system. A 3-digit combination lock aids in protecting the PCjr system. The lock combination can be changed easily by the owner. The carrying case will fit under the seats of many airlines.

10:10 IBM 4860 System Unit

The Carrying Case has the capacity for:

- One PCjr 4860 System Unit
- One Parallel Printer Attachment
- One Connector for TV
- One cordless keyboard and optional Keyboard Cord feature
- Transformer unit
- Up to five diskettes
- Up to four program cartridges

The carrying case should not be used as a shipping container. It is intended to provide only hand transportation for, or storage of, a PCjr configuration. The original packing material should be retained for shipping the PCjr system.

The dimensions of the carrying case are:

- Height: 18 inches (45.7 cm)
- Width: 20 inches (50.8 cm)
- Depth: 6.25 inches (15.9 cm)

Cluster Attachment and Cluster Cable Kit

The Cluster Attachment installed in a PCjr 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.

The Cluster Attachment is a side-attached feature that connects to the right side of the 4860 unit. The Power Expansion Attachment feature is not required for installation of the Cluster Attachment in a 4860 Model 4 that does not have a diskette drive, Parallel Printer Attachment, or 128Kb Memory Expansion Attachment installed. If one of these features or the Speech Attachment feature is installed in a 4860 Model 4, the Power Expansion Attachment is a prerequisite for the Cluster Attachment. For a 4860 Model 67, the Power Expansion Attachment feature is always a prerequisite for the Cluster Attachment feature.

For a description of the cluster hardware and the IBM Personal Computer Cluster Program, see Section 11:10 under "Cluster Attachment and Cluster Cable Kit."

Displaywriter/Personal Computer Attachment Convenience Kit

This convenience kit permits a Displaywriter system (without any communications features installed in the diskette unit) to be cable-connected to a 4860 unit via the serial port. The PCjr can be a stand-alone system or part of an IBM personal computer cluster. When the PCjr 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.

For a description of this kit, see "Displaywriter/Personal Computer Attachment Convenience Kit" in Section 11:10.

Single Unit Prices

Item	Part Number	Feature Number	Single Unit Purchase Price (\$)
4860 System Unit/Keyboard			
Model 4	4860004	—	599
Model 67	4860067	—	999
Adapter Cable for Cassette	8600022	0022	30
Adapter Cable for IBM Color Display	8600021	0021	20
Adapter Cable for Serial Devices	8600026	0026	25
Attachable Joystick	8600010	0010	40
Carrying Case	8600023	0023	60
Cluster Attachment	8600027	0027	400
Cluster Cable Kit	1501207	1207	110
Connector for TV	8600020	0020	30
Cordless Keyboard Overlays — quantity of 5	8600013	0013	10
Diskette Drive — Model 4 only	8600005	0005	480
Displaywriter/Personal Computer Attach Convenience Kit	6403728	—	495
Internal Modem	8600008	0008	199
Keyboard Cord	8600012	0012	20
Parallel Printer Attachment	8600009	0009	99
Power Expansion Attachment	8600006	0006	150
Speech Attachment	8600024	0024	300
64Kb Memory and Display Expansion — Model 4 only	8600007	0007	140
128Kb Memory Expansion Attachment	8600031	0031	325

Discounts Available

The 4860 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 (except 4860 Model 4)
- 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.

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 of 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 PCjr's, IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XT's and XT/370's, IBM Personal Computer AT's and AT/370's, 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 XT's and XT/370's, and IBM Personal Computer AT's and AT/370's) 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 - RPO 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

11:05 IBM Personal Computer Configuration Overview

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 mice) 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

11:10 IBM 5150 System Unit

- 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*

11:10 IBM 5150 System Unit

- 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 key-stroke 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 $-32,768$ to $+32,767$ 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

11:10 IBM 5150 System Unit

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

11:10 IBM 5150 System Unit

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 to 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.

11:10 IBM 5150 System Unit

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 PCjr's
- 5150 Personal Computers
- 5155 Portable Personal Computers
- 5160 Personal Computer XT's or XT/370's
- 5170 Personal Computer AT's or AT/370's
- 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.

11:10 IBM 5150 System Unit

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

11:10 IBM 5150 System Unit

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

11:10 IBM 5150 System Unit

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)

11:10 IBM 5150 System Unit

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 (alphanumeric 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 (alphanumeric 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

11:10 IBM 5150 System Unit

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

11:10 IBM 5150 System Unit

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

11:10 IBM 5150 System Unit

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 commands 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 mes-

sages, 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 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 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.

11:10 IBM 5150 System Unit

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 recommended 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

11:10 IBM 5150 System Unit

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

11:10 IBM 5150 System Unit

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.

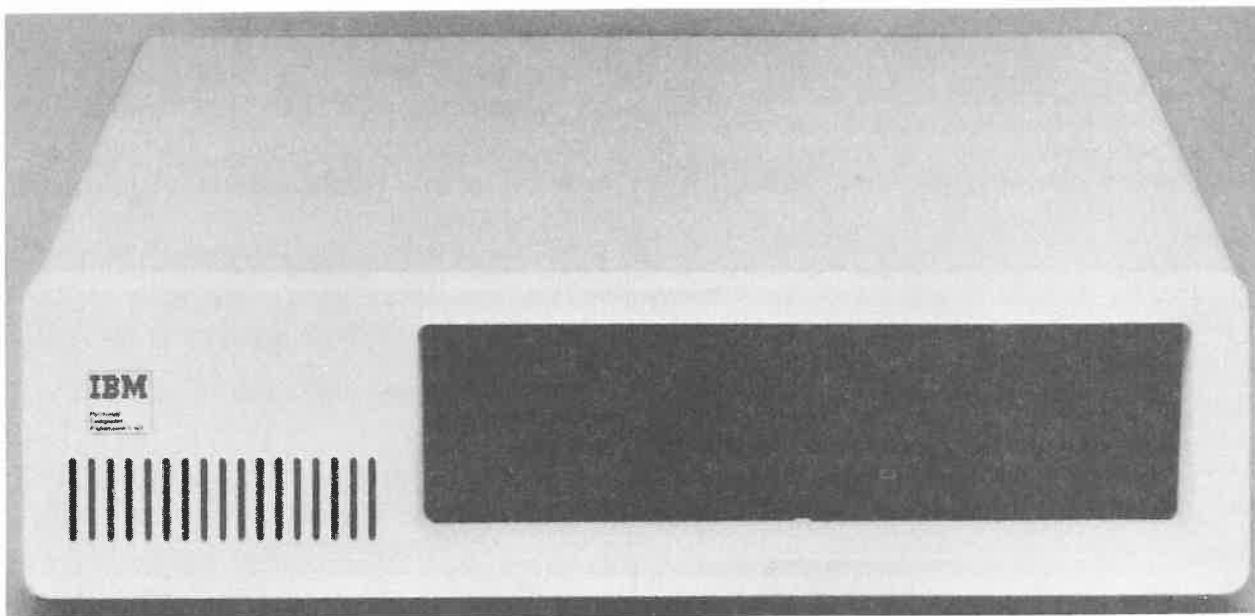


Figure 11-3. 5161 Expansion Unit

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 type-written 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

11:15 IBM 5161 Expansion Unit Model 1

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 shut-down of power to the 5161 occurs if an overvoltage or overcurrent condition is detected. A system shut-down 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

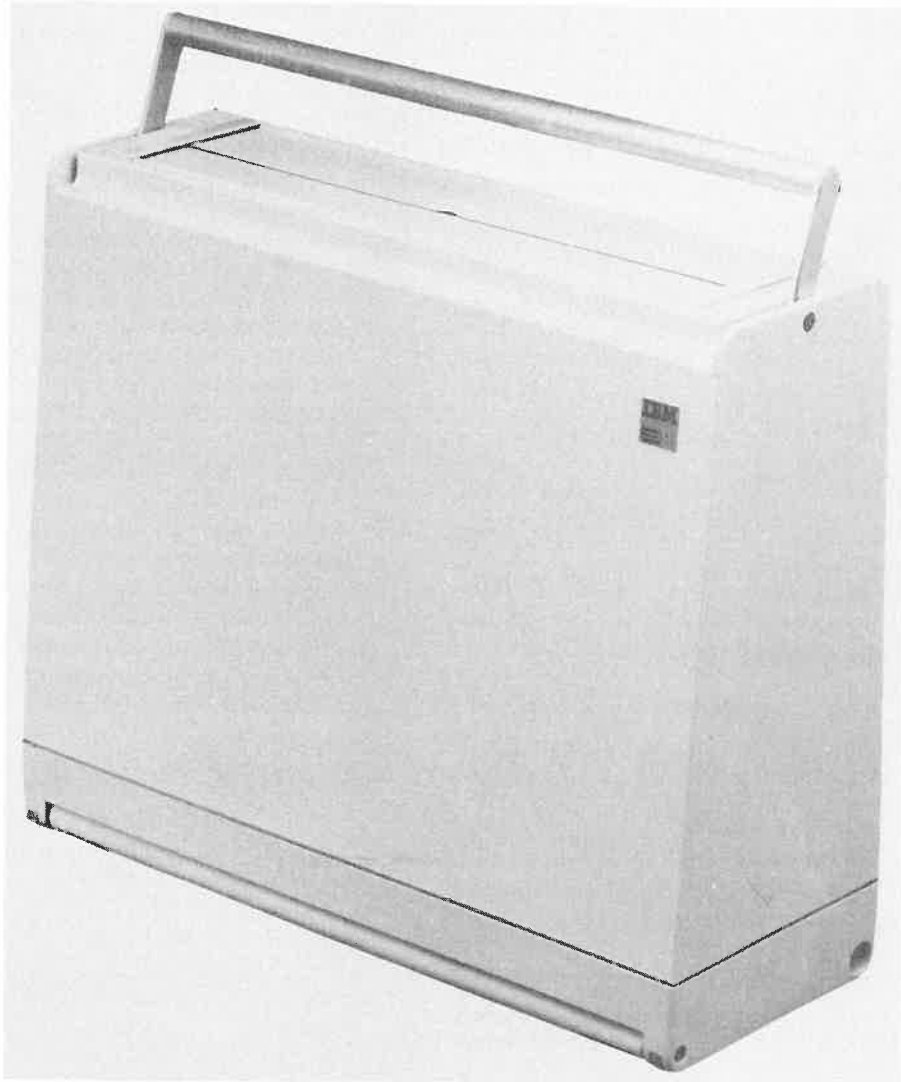
Discounts Available

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.

Section 12: IBM Portable Personal Computer



Announced February 16, 1984

12:05 IBM Portable Personal Computer Configuration Overview

Introduction

The IBM Portable Personal Computer is a versatile, general-purpose system that supports a wide range of processing environments. It offers most of the hardware features and programming support available for the IBM Personal Computer and is designed for those who require a portable version of the IBM Personal Computer.

The IBM Portable Personal Computer system unit is a compact unit with a lightweight casing, carrying handle, and space for diskette storage. It contains a built-in nine-inch amber composite video display that displays 25 lines of 80 characters each and one standard slimline 5¼-inch diskette drive. Room below the standard diskette drive is provided for a second diskette drive and there is a slot above the standard diskette drive to hold four or five diskettes. A lighter-weight version of the 83-key keyboard for the IBM Personal Computer and IBM Personal Computer XT is provided, which attaches to the front of the system unit for carrying purposes.

The IBM Portable Personal Computer system unit with one diskette drive and the keyboard weighs about 30 lb. Also provided as standard is a durable carrying bag that has a shoulder strap as well as handles.

The IBM Portable Personal Computer can be used in home, educational, or any size business environment. Three operating systems, several programming languages, and many IBM- and vendor-logo application programs are available for this configuration.

An IBM Portable 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 Portable 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 Portable 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 Portable Personal Computer can be interconnected via cable with other local IBM personal computers to form a clustered multiuser configuration in which users can 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 Portable 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.

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

The IBM Portable 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. 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.

Hardware features and programming support enable the IBM Portable Personal Computer to be con-

nected to and communicate with various IBM office systems. Multiple IBM Portable Personal Computers can be cable-attached to a 5520 Administrative System to emulate 5253 Display Stations. The IBM Portable 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 Portable Personal Computer configuration is supported and an IBM Portable 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. Other programming support (DisplayWrite Series) provides document processing capabilities for a stand-alone IBM Portable Personal Computer similar to facilities provided for a Displaywriter system. Document exchange between IBM personal computers is also supported using Personal Services/PC.

The majority of application programs that execute in the IBM Personal Computer can also execute in an IBM Portable Personal Computer. Such programs can also execute in other IBM personal computer configurations that have the required hardware resources. This compatibility enables the IBM Portable Personal Computer to be used at home or other nonwork locations to execute most of the same programs that are executed in an IBM personal computer at work.

Fixed disk storage is available for the IBM Portable Personal Computer configuration via the 5161 Expansion Unit Model 1 and many other optional features are also 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 Portable Personal Computer configuration are the following:

- 5155 System Unit/Keyboard Model 68 or 76
- 5161 Expansion Unit Model 1 (provides fixed disk storage and additional space for optional features)
- 5153 Color Display Model 1
- 5152 Graphics Printer Model 2
- 5175 Professional Graphics Display Model 1 (5161 Expansion Unit required)

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

Minimum Configuration

The minimum stand-alone IBM Portable Personal Computer configuration consists of the 5155 System Unit/Keyboard Model 68, which contains a display device, as is required for operation of the system. Since one diskette drive is standard in the 5155 Model 68, the IBM Personal Computer Disk Operating System (DOS) can be used in the minimum stand-alone 5155 configuration. The price of a single minimum 5155 hardware configuration is \$2595.

Configuration Features

The following highlights the features of the 5155 configuration, including memory sizes, types and maximum number of attachable I/O devices, and processors/units to which a 5155 configuration can be connected:

- One 5155 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 256Kb (262,144 bytes) to 640Kb (655,360 bytes)
- One or two IBM 5¼-inch double-sided slimline diskette drives installed in the 5155 System Unit providing 360Kb each for a maximum of 720Kb of online diskette capacity
- 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 slimline diskette drives and two fixed disk drives can be

installed in the same 5155 configuration when the 5161 unit is present. The fixed disk drives cannot be installed in the 5155 unit.

- One or more displays (those that attach to the Color/Graphics Monitor Adapter and the Professional Graphics Controller)
- 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 5155 to emulate the Tektronix™ 4010 and 4100 protocols and the Lear Siegler ADM3A terminal using an IBM display and the Graphics Development ToolKit.
- One parallel printer via the Printer Adapter and one or two serial printers via the Asynchronous Communications Adapters
- 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 installed in the 5161 unit
- 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 or Synchronous Data Link Control (SDLC) Communications Adapter
 - A 4860 PCjr, a 5150 Personal Computer, another 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, or other machines that use the RS-232C interface, using the Asynchronous Communications Adapter
- 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 Portable 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
- 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) via the Cluster Adapter and Cluster Cable Kit
- IBM Electronic Typewriter 65, 85, or 95 via the Printer Adapter
- 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) using the IBM PC Network Translator Unit, IBM PC Network Adapters, and IBM PC Network Cabling Components to form an IBM PC Network
- An IBM SELECTRIC® System/2000 Typewriter with the Printer Option installed via the Printer Adapter
- 5218 Printwheel Printer Model A03 or A04 (for letter-quality printing applications) 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.
- 7371 or 7372 Color Plotter (desktop plotters) via a cable connected to the Asynchronous Communications Adapter or the General Purpose Interface Bus Adapter. The IBM Portable 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 5155 is connected to a host System/370, 30XX, or 4300 processor. Attachment of the plotter to the 5155 is via a cable connected to the Asynchronous Communications Adapter or the 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
- Custom attachments using the Prototype Card

Up to three communications adapters (of more than one type, if desired) can be installed in the same 5155 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 Portable Personal Computer can be connected to the IBM Cabling System for attachment to a 5520 Administrative System.

The IBM Cable Data Management System licensed program can be executed in an IBM Portable 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 5155 Portable Personal Computer is supported by the following IBM-logo operating systems:

- IBM Personal Computer Disk Operating System (DOS) Version 2.1 and later. One diskette drive is required. Fixed disk drives (10Mb capacity) are supported as of Version 2.1.
- 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.

Compatibility

Hardware

The 5155 Portable Personal Computer is compatible with the 4860 PCjr, 5150 Personal Computer, 5160 Personal Computer XT, 5170 Personal Computer AT in real address mode, 5160 Personal Computer XT/370 in PC 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, processor instructions for personal computer mode are compatible among these systems. The 80286 microprocessor in the 5170 operating in real address mode 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. The 5155 Portable Personal Computer does not provide a cassette adapter, as do the PCjr and 5150 Personal Computer configurations, or support program cartridges, as does the PCjr configuration.

Programming

Programs that operate in an IBM Portable Personal Computer configuration can also operate in an IBM Personal Computer, IBM Personal Computer XT, IBM Personal Computer XT/370 (in PC mode), 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 5155 Portable 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 5155 configuration (see "Physical Components" earlier in this subsection).

Data Security

The customer is responsible for providing any desired data security functions. The optional Keylock Feature can be installed in a 5161 Expansion Unit that is attached to a 5155 (see "Keylock Feature" description in Section 11:15). The Data Encoder program (6024149) performs data encryption and decryption.

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 5155 Portable Personal Computer IBM-logo units and features are purchase only and 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 Portable 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 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

Warranty Period

The warranty period for 5155 units is one year. For 5161 units, the warranty period is three months. The warranty service for 5155 and 5161 units is Customer Carry-In Repair.

The warranty period for all optional features for the 5155 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, Professional Graphics Controller, Data Acquisition and Control Adapter, and General Purpose Interface Bus Adapter, for which a one-year warranty period is provided.

However, when a 5155 configuration is purchased with the following features installed, their warranty period is extended from three months to one year to coincide with the one-year warranty of the 5155 system unit:

- Math Co-processor Option
- 64/256Kb Memory Expansion Option
- 64Kb Memory Module Kit
- Printer Adapter
- Game Control Adapter
- Asynchronous Communications Adapter
- Binary Synchronous Communications Adapter
- Synchronous Data Link Control (SDLC) Communications Adapter
- Communications Adapter Cable
- 3278/79 Emulation Adapter
- Display Station Emulation Adapter

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Option. For 5155 and 5161 units, IBM On-Site Repair is available.
 - Annual Maintenance. For 5155 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

Publications

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

- *Guide to Operations*. 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 one diskette that contains the system tutorial "Exploring the IBM Portable Personal Computer" is also provided in this binder.
- *BASIC* (6361132). This binder describes the functions provided by the BASIC Interpreter that is included in ROM in a 5155 System Unit.

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

- *IBM Personal Computer XT/IBM Portable Personal Computer System Technical Reference* (6322508) – \$30. This reference describes the system board, Math Co-processor Option, power supply, keyboard, and communications functions and lists the 8088 instruction set 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* (6936573) – \$111. 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.

The following form-numbered items that contain hardware and programming information about the 5155 Portable Personal Computer are also available:

- *IBM Portable Personal Computer* (pocket brochure), G520-1037
- *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 that operate in a 5155 configuration. 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
- 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
 - *Graphical File System*, G520-5014
 - *VDI System Specification Sheet*, G520-5018
 - *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.

12:05 IBM Portable Personal Computer Configuration Overview

- *IBM Assistant Series*, G520-5004. This brochure describes the integrated assistant series programs.

The publication *The IBM Personal Computer Catalog*, G570-2064, describes certain IBM personal computer hardware units, printer supplies and accessories, paper forms, diskettes and associated accessories, books, software, 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 mice) that can be attached to a 5155 configuration, as well as IBM-logo units.

Additional publications regarding particular features are indicated in the feature descriptions in Section 12:10.

Self-Study Courses

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

12:10 IBM 5155 System Unit

The 5155 System Unit Model 76 for the IBM Portable Personal Computer is shown in Figure 12-1.



Figure 12-1. 5155 System Unit Model 76

Models Available

The models of the 5155 that are available differ only in the number of standard diskette drives provided. Otherwise, they are physically and functionally identical. The following 5155 models are available:

- Model 68:
 - System Unit/Keyboard
 - 256Kb random access memory
 - 5¼-Inch Diskette Drive Adapter
 - One 5¼-Inch Diskette Drive (double-sided)
 - Color/Graphics Monitor Adapter
 - Nine-inch composite video display
- Model 76:
 - System Unit/Keyboard
 - 256Kb random access memory
 - 5¼-Inch Diskette Drive Adapter
 - Two 5¼-Inch Diskette Drives (double-sided)
 - Color/Graphics Monitor Adapter
 - Nine-inch composite video display

A 5155 System Unit cannot be converted to the system unit for any other type of IBM personal computer.

12:10 IBM 5155 System Unit

Physical Characteristics

Dimensions (approximate)

- Height: 8 inches (204 mm)
- Width: 19.5 inches (500 mm)
- Depth: 17 inches (430 mm)

The width and depth of the 5155 unit are about the same as that of the 5150 and 5160 System Units but the 5155 has about 2.5 inches more height.

Weight

- 30 lb (13.6 kg) with one diskette drive and the keyboard (minimum configuration)

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 5155 System Unit
- Humidity: 8% to 80% for system on or off
- Noise level:
 - 49.5 decibels (dB) without a printer
- Electrical:
 - 115 volts (for 100- to 125-volt range) or 230 volts (for 200- to 240-volt range) AC (set via a switch on the back panel)
 - 50 or 60 Hz

Standard Features

The following are standard features of a 5155 Model 68 or 76 configuration. 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
- 256K (262,144) bytes of random access memory (RAM)
- Seven system expansion slots for feature cards
- Color/Graphics Monitor Adapter
- Nine-inch composite video display
- A programmable speaker and associated adapter
- One 5¼-Inch Diskette Drive Adapter

- One (Model 68) or two (Model 76) 5¼-Inch Double-Sided Diskette Drives
- Keyboard adapter and 83-key lightweight keyboard
- Automatic power on self-test
- Universal power supply (115 or 230 volts) with cooling fan (114 watts)
- Lightweight case with carrying handle
- Protective carrying case

Optional Features

The following are optional features for 5155 configurations. Each is discussed under "Optional Feature Descriptions" in this subsection.

- Math Co-processor Option (one maximum)
- 256Kb Memory Expansion Option (one maximum)
- 64Kb Memory Module Kit (three maximum on the 64/256Kb Memory Expansion Option card)
- 64/256Kb Memory Expansion Option (one maximum)
- 5¼-Inch Double-Sided Diskette Drive (one maximum – for the Model 68 only)
- Printer Adapter (one maximum)
- Game Control Adapter (one maximum)
- Prototype Card (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 or SDLC adapter installed)
- Display Station Emulation Adapter (one maximum)
- Enhanced Display Station Emulation Adapter
- 3278/79 Emulation Adapter (one maximum)
- 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 5155 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)

The following features and I/O devices for the 5150 Personal Computer are not available for the 5155 Portable Personal Computer:

- Enhanced Graphics Adapter
- IBM Personal Computer 3278 Attachment Option
- IBM Personal Computer 3279 Attachment Option
- Keylock Feature (can be installed in the 5161 Expansion Unit only)
- Monochrome Display and Printer Adapter
- Terminal Communications Adapter Kit
- 5¼-Inch Single-Sided Diskette Drive
- 8100 PC Adapter
- 5154 Enhanced Color Display

The optional features listed are installed inside the 5155 or 5161 unit except the Communications Adapter Cable, Cluster Cable Kit, MES 8569, Displaywriter/Personal Computer Attach Convenience Kit, 5178 IBM PC Network Translator Unit and Cabling components, Data Acquisition and Control Adapter Distribution Panel, 5218 Printer attachment features, and Keylock Feature.

Physical Components Included

Each 5155 System Unit contains the system board, the programmable speaker, one diskette drive, one nine-inch composite video display, and the power supply and fan. Certain optional features for a 5155 configuration must be installed only in the 5155 unit or only in the 5161 unit. Others can be installed in the 5155 or 5161 unit. Each 5155 system board (which is like that implemented in the 5160 Personal Computer XT) contains:

- The processor subsystem (includes the Intel 8088 microprocessor and associated functions)
- Read only memory (40Kb)
- Random access memory (256Kb)
- The keyboard adapter
- The programmable speaker adapter
- Seven usable system expansion slots that are provided to hold feature cards.
- Socket for the Math Co-processor Option module

The system board also contains one set 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 present on the system board, the type of display installed (whether a 5153 or other color display is present), the operational mode (40- or 80-character lines) for the color display when power is turned on, and the number of diskette drives installed.

The 5155 is delivered with the DIP switches set for the configuration ordered. If optional features are added to a 5155 configuration thereafter, the customer must set the appropriate switches, if required, as per the supplied instructions in the *Guide to Operations*.

Standard and optional feature cards plug into expansion slots provided in the right rear corner of the system board in the 5155 unit or the left rear corner of the 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 5155 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 5155 System Unit, as 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. See description of this microprocessor in Section 11:10 under "Microprocessor."

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

12:10 IBM 5155 System Unit

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 1.5 Mb/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, network adapter, Data Acquisition and Control Adapter, and General Purpose Interface Bus Adapter.

Read Only Memory

The 5155 unit contains 40Kb of read only memory (ROM). The contents of ROM remain when power to the 5155 is turned off and writing to this memory cannot be done. ROM is used for the permanent residence of certain programs.

ROM contains the power-on self-test program, diskette bootstrap loader, Basic Input/Output System (BIOS), time-of-day clock support, dot patterns for 128 characters in graphics mode for displays, BASIC-80 Interpreter, and a code to indicate this unit is a 5155 (which can be inspected by programming). ROM in the 5155 is functionally equivalent to ROM in the IBM Personal Computer XT (see description in Section 13:10 under "Read Only Memory").

Once the 5155 has been turned on and the self-test diagnostics have been executed successfully, an attempt is made to initial program load (IPL) an operating system from diskette drive A (upper 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 5155, RAM is dynamic memory (its contents must be refreshed periodically) and its contents are lost when power to the 5155 is removed. This memory is parity-checked for validity. The standard memory in a 5155 has a 200-ns access time and a 345-ns cycle time.

The 5155 contains 256Kb on the system board as standard. A maximum of 640Kb can be installed 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.

System Expansion Slots

Seven (three full- and four special-feature) system expansion slots are standard on the system board to contain memory and adapter features. The full-feature slots (numbers 1 through 3) will accept full-feature or the smaller special-feature cards. The special-feature slots (numbers 4 through 7) will hold only special-feature cards.

One full-feature slot (number 1) is used for the standard Color/Graphics Monitor Adapter. One additional full-feature slot (number 3) is used for the standard 5¼-Inch Diskette Drive Adapter. Thus, one full-feature (number 2) and four special-feature slots (numbers 4 through 7) are available for optional features.

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

- 256Kb Memory Expansion Option (special- or full-feature)
- 64/256Kb Memory Expansion Option (full-feature)
- Game Control Adapter (special- or full-feature)*
- Prototype Card (full-feature)*
- 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)*
- SDLC Communications Adapter (full-feature)*
- Display Station Emulation Adapter (full-feature)*
- Enhanced Display Station Emulation Adapter (full-feature)*
- 3278/79 Emulation Adapter (full-feature)
- Cluster Adapter (full-feature)*
- IBM PC Network Adapter (full-feature)
- 5161 Expansion Unit Model 1 extender card provided with the 5161 unit (uses full-feature slot 2)

* This a feature can be installed in the 5155 System Unit or 5161 Expansion Unit Model 1. Others must be installed in the 5155.

If more than seven expansion slots or more than three full-feature slots are needed, fixed disk storage

is required, or the 5175 Professional Graphics Display is to be installed, the 5161 Expansion Unit Model 1 must be attached to the 5155 System Unit. The 5161 Model 1 provides eight additional expansion slots for a total of 15 slots in the configuration as well as 10Mb of fixed disk storage (see 5161 Model 1 description in Section 12:15 for details).

Color/Graphics Monitor Adapter

One Color/Graphics Monitor Adapter is standard in the 5155 System Unit and it uses full-feature slot 1. The built-in composite video display is connected to this adapter, which can also have other color displays and one light pen attached. 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 built-in video display is attached to the P-1 connector.

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)
- 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 composite video connector (RF modulator cable must be the type that can plug into the composite signal phono jack). 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 television set or non-IBM display is used with the 5155, diskette drive data errors may occur unless the display is located at least 12 inches (30 cm) away from the 5155 System Unit.

For a description of the characteristics of the Color/Graphics Monitor Adapter see Section 11:10 under “Color/Graphics Monitor Adapter.”

Composite Video Display

The composite video display is contained in the left front portion of the 5155 System Unit. It is signal-connected to the standard Color/Graphics Monitor Adapter (P-1 connector on the side of the card) and power-connected to the power supply in the 5155 unit. The composite display shows amber characters on a dark background. The color signals from the Color/Graphics Monitor Adapter are blanked out.

Highlights of the composite video display areas follows:

- Screen size is 9 inches (228.6 mm) diagonally measured.
- Screen area displays 25 rows of 80 characters each.
- Characters are displayed in an 8 × 8 character box.
- A 256 character set is supported that includes uppercase and lowercase alphabetic characters, numbers, special characters, mathematical symbols, some foreign language characters, and graphics characters.
- Character attributes provide underline, blinking, high intensity, reverse image (displaying the background in amber and the characters in black), and nondisplay.
- Front-mounted brightness and contrast controls are easily adjusted by the operator.
- Screen is medium persistence amber phosphor (LA) with an etched surface to reduce glare. The screen itself is also coated to reduce glare and soften reflections.

If a 5153 Color Display is also attached to the Color/Graphics Monitor Adapter in a 5155 configuration, the same data is displayed on the composite video display and the 5153 when the 5153 is being used. Displaying on the composite video display when using the 5153 can be eliminated by turning the contrast controls all the way to the left.

Programmable Speaker

A 2¼-inch-diameter, 8-ohm audio speaker is included in the 5155 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.

5-1/4 Inch Diskette Drive Adapter

One diskette drive adapter is standard. This adapter uses full-feature slot 3 in the 5155 and only one diskette drive adapter can be installed in a 5155 configuration. One or two IBM-supplied slimline internal 5¼-inch double-sided diskette drives can be attached to this adapter. The diskette drive adapter uses direct memory access for record data transfers.

5-1/4 Inch Double-Sided Diskette Drive

One 5¼-inch double-sided (360Kb) diskette drive is standard in a 5155 Model 68 System Unit and one additional double-sided diskette drive is optional. Two double-sided diskette drives are standard in the 5155 Model 76 System Unit. Two drives provide a maximum online diskette capacity of 720Kb (737,280 bytes) and attach to the 5¼-Inch Diskette Drive Adapter. The top (A) drive is always used for initial program loading (IPL) at power-on time or when IPL is done via the keyboard.

The diskette drive for the 5155 Portable Personal Computer is a slimline drive that is physically different from, and not interchangeable with, the diskette drive used in any other IBM personal computer configuration. However, the 5155 diskette drive is functionally the same as the other IBM personal computer diskette drives.

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.

Double-sided slimline diskette drive characteristics are:

- Number of rotations per minute: 300
- Access time: 6 milliseconds (ms) track to track
- Data transfer rate: 250K bits (32,000 characters) per second
- Head settling time: 21 ms
- Height: 1.6 inches (42 mm)
- Width: 5.8 inches (146 mm)
- Depth: 8 inches (203 mm)
- Weight: 2.4 lb (1.1 kg)

Double-sided diskette characteristics are:

- Track density: 48 tracks per inch
- Number of tracks: 40 per surface
- Number of surfaces: 2
- Number of bytes per sector: 512 as formatted by DOS (all versions)

- Number of sectors per track: 9 as formatted by DOS Version 2.1 or later. DOS Version 2.1 or later will read/write a diskette formatted with 8 or 9 sectors per track.
- Formatted capacity: 360Kb (368,640 bytes) using DOS Version 2.1 or 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.

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 operating.

Customer cleaning of the heads in a diskette drive in a 5155 unit or of diskettes is not recommended.

Keyboard

One 83-key keyboard is standard for the 5155 unit. It is a lighter-weight version of the 83-key keyboard that is provided for 5150 Personal Computer, 5160 Personal Computer XT, and 5160 Personal Computer XT/370 configurations and provides the same functions. The lightweight keyboard weighs 4 lb or about 2.5 lb less than the keyboard for 5150 and 5160 units.

The keyboard attaches to the front of the 5155 System Unit via a 30-inch coiled cable. The keyboard cable can be stored in a compartment in the top left-hand area of the keyboard when the 5155 is not being used. For storage and carrying, the keyboard attaches to the front panel of the 5155 System Unit, covering the display and diskette drive(s) and forming the bottom part of the system unit enclosure/carrying case.

The keyboard can be used attached to or detached from the bottom of the front panel. Figure 12-1 at the beginning of this subsection shows the keyboard detached from the 5155 System Unit for typing. When detached from the 5155 unit, the keyboard can be positioned as desired for typing comfort, subject to the length of the coiled cable, and the typing angle can be adjusted to a 5- or 12-degree angle.

Features of the lightweight keyboard for the 5155 are the same as those of the 83-key keyboard for the 5150 and 5160 units (see highlights discussion and

keyboard layout in Section 11:10 under "Keyboard").

Approximate dimensions of the lightweight keyboard are:

- Height: 1.5 inches
- Width: 18 inches
- Depth: 7.5 inches

The keyboard is available only in the U.S. English layout. However, the *Guide to Operations* for the 5155 provides overlays for the keys that can be pasted on the keytops to customize the layout for U.K. English, French, German, Italian, and Spanish. The international-layout keyboards are supported by DOS.

Power Supply

The power supply (114 watts) in the right area of the 5155 unit provides power (required voltages) to the system unit and its options, the power supply fan, the diskette drive, the composite video display, and the keyboard (five outputs). If adequate power is not being received, a system shutdown occurs. Overvoltage and overcurrent protection are also provided. Power to the 5155 is automatically removed if an overpower condition is detected.

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 has its own instruction set. This feature is the same for the 5155 Portable Personal Computer and the 5150 Personal Computer (see description in Section 11:10 under "Math Co-processor Option").

256Kb Memory Expansion Option

This option provides 256Kb of parity-checked random access memory on a 5-inch card. It plugs into a full-feature or special-feature slot in the 5155 unit. This memory cannot be installed in the 5161 unit.

In the 5155, this feature can be installed instead of the 64/256Kb Memory Expansion Option with three 64Kb Memory Module Kits to add 256K bytes to the 5155 at a lower cost and/or to be able to use a special-feature instead of a full-feature slot for the

additional 256Kb. In addition, this feature and the 64/256Kb Memory Expansion Option are required to provide 576Kb or 640Kb of memory in a 5155 configuration.

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

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 64Kb module kits (192Kb) can be added to the 64/256Kb Memory Expansion Option card.

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 full-feature expansion slot in the 5155 unit. This option cannot be installed in the 5161 Expansion 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. One 64/256Kb Memory Expansion Option card can be installed in a 5155 System Unit to provide up to 512Kb of memory in a configuration without the 256Kb Memory Expansion Option or to provide 576Kb or 640Kb with the 256Kb Memory Expansion Option installed. One 64Kb Memory Module Kit installed on the 64/256Kb Memory Expansion Option card is required for 640Kb.

Game Control Adapter

This feature permits up to two joysticks or up to four game paddles to be attached to the 5155 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 5155 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

12:10 IBM 5155 System Unit

for the IBM PCjr does not attach to the 5155 configuration.)

The Game Control Adapter (one maximum) can be installed in a special- or full-feature slot in the 5155 or in an available slot in the 5161 Model 1. The adapter provides a 15-pin D-shell connector at the back of the 5155/5161 unit.

Prototype Card

This feature (one maximum) is provided as a base for building and testing custom attachments for the 5155 System Unit. The Prototype Card is a full-size circuit board 13.2 inches (335.3 mm) long and 4.2 inches (106.7) high that plugs into slot 2 in the 5155 unit or into a full-feature slot in the 5161 unit. Circuitry and module holes are provided for interface with the IBM bus. A bracket is included to secure the card in the 5155/5161, with a cutout provided for an external D-shell connector with from 9 to 37 pins. Detailed instructions and component identifications for I/O attachment logic are also provided with this adapter.

5-1/4 Inch Double-Sided Diskette Drive

One double-sided slimline diskette drive in addition to the standard diskette drive can be installed in the 5155 Model 68 unit and attached to the diskette drive adapter. The second diskette drive (addressed as B) is located below the standard diskette drive in the 5155 unit and has the same characteristics as the standard diskette drive (described under "Standard Feature Descriptions" in this subsection).

Printer Adapter

This adapter provides for attachment to the 5155 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).

One Printer Adapter can be installed in a 5155 configuration and requires one special- or full-feature slot in the 5155 or 5161 unit. The adapter provides a cable connector at the rear of the 5155/5161 unit for attachment of the printer cable. See Section 31 for the cable required for each type of printer that attaches to this adapter.

Professional Graphics Controller

The Professional Graphics Controller is required to attach the 5175 Professional Graphics Display to a 5155 configuration. The 5175 display together with the Professional Graphics Controller offers more colors and a higher resolution than the 5154 display (which cannot be attached to the 5155) and provides high-quality color graphics capabilities for a wide range of specialized applications.

One Professional Graphics Controller can be installed in a 5155 configuration. It requires two adjacent full-feature slots in the 5161 Expansion Unit in a 5155 configuration. It cannot be installed in the 5155 unit. For a description of this feature, see Section 11:10 under "Professional Graphics 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.

Up to four Data Acquisition and Control Adapters can be installed in a 5155 configuration. When more than one such adapter is installed, all must be installed in the same unit. Since a full-feature slot is required for this adapter, a 5161 is required if more than one Data Acquisition and Control Adapter is to be installed in a 5155 configuration because only one full-feature slot is available in the 5155 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 a description of this adapter, see Section 11:10 under "Data Acquisition and Control Adapter and Data Acquisition and Control Adapter Distribution Panel."

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 5155 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 5155 configuration in special- or full-feature slots. If multiple adapters use the same interrupt level, they must all be installed in the same unit (5155 or 5161). An adapter can have up to 14 devices or instruments attached with a maximum of 48 devices/instruments in one 5155 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 *General Purpose Interface Adapter*, G520-5021.

Asynchronous Communications Adapter

This adapter provides a path to a processor or an I/O device outside the 5155 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 external modems or other devices to this adapter.

The asynchronous adapter provides one 25-pin D-shell connector to attach a device to the adapter. A current-loop interface is also located in the same connector. A jumper block is provided to manually

select the voltage or the current-loop interface. 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.

One or two Asynchronous Communications Adapters can be installed in a 5155 configuration. When the SDLC adapter is installed, only one asynchronous adapter can be installed. The asynchronous adapter requires one special- or full-feature expansion slot in the 5155 or 5161 unit.

IBM-logo DOS application programs that support the Asynchronous Communications Adapter in a 5155 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/Colorview
- Personal Services/PC
- Data Edition IBM Personal Decision Series Productivity Product

For a description of the hardware characteristics of the Asynchronous Communications Adapter, units and processors that can be attached to the adapter, and the facilities of the IBM-logo DOS application programs that support this adapter in the 5155, see Section 11:10 under "Asynchronous Communications Adapter."

Binary Synchronous Communications (BSC) Adapter

One or two BSC adapters can be installed in a 5155 configuration unless the SDLC adapter is present, in which case only one BSC adapter can be installed. One full-feature expansion slot in the 5155 unit (slot 2) or in the 5161 Model 1 unit is required. An external modem must be cable-connected between the BSC adapter and a telephone line using the Communications Adapter Cable.

The IBM-logo DOS application programs that support the BCS adapter in a 5155 configuration are the Binary Synchronous 3270 Emulation Program

12:10 IBM 5155 System Unit

and the DisplayComm Binary Synchronous Communications Program.

For a description of the hardware characteristics of the BSC adapter and the IBM-Logo application programs that support this adapter in the 5155, see Section 11:10 under "Binary Synchronous Communications (BSC) Adapter."

Synchronous Data Link Control (SDLC) Communications Adapter

One SDLC Communications Adapter can be installed in a 5155 configuration and only one asynchronous adapter and one BSC adapter can be installed in the 5155 configuration when the SDLC adapter is present. One full-feature expansion slot in the 5155 unit (slot 2) or in the 5161 unit is required. An external modem must be cable-connected between the SDLC adapter and a telephone line using the Communications Adapter Cable feature.

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)

For a description of the hardware characteristics of the SDLC adapter and its IBM programming support, see Section 11:10 under "Synchronous Data Link Control (SDLC) Communications Adapter."

Communications Adapter Cable

This optional feature supports the attachment of a modem to the BSC adapter or SDLC adapter card connector at the rear of the 5155/5161. 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 a BSC 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 5155 configuration. It requires one full-feature expansion slot in the 5155 or 5161 unit.

This adapter in a 5155 configuration is supported by the following IBM-Logo DOS application programs:

- 5520/Personal Computer Attachment Program Version 3 to permit 5155 systems to communicate with a 5520 Administrative System
- 5250 Emulation Program to permit 5155 systems to communicate with a System/34, System/36, or System/38
- Attachment/36 Edition program executing with the 5250 Emulation Program to permit a 5155 system to communicate with a System/36 executing Attachment/36

For a description of this adapter and its IBM-Logo application programming support for the 5155, see Section 11:10 under "Display Station Emulation Adapter."

Enhanced Display Station Emulation Adapter

This adapter permits a 5155 Portable 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 5155 can emulate a 5291 or 5292 display and a 5256 or 5219 printer. The 5155 system can also operate as a stand-alone IBM Portable Personal Computer. Access to 5155 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 the System/36 and System/38 Transfer Facility PRPQs, the System/34, System/36, and System/38 File Support Utility PRPQs, and the PC Support/36 program, all of which are also supported

by the 5250 Emulation Program (see discussion under "Display Station Emulation Adapter" in Section 11:10 for a description of these programs).

The Enhanced 5250 Emulation Installation Convenience Kit provides all the parts, software, and manuals required to connect the 5155 to a System/34, System/36, or System/38 and perform 5250 emulation.

3278/79 Emulation Adapter

This adapter enables the 5155 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 5155 configuration and requires one full-feature slot in the 5155 (not the 5161) unit. When the 3278/79 Emulation Control Program is used, the 5155 can emulate the functions of a 3278 Display Station Model 2 or 3279 Color Display Station Model 2A or S2A. Communication with PROFS in a VM/370 host processor using PROFS Personal Computer Connection (PROFS/PC²) in the 5155 or with DISOSS/370 using Personal Services/PC in the 5155 is supported. For information about this programming support, see Section 11:10 under "3278/79 Emulation Adapter."

Cluster Adapter and Cluster Cable Kit

The Cluster Adapter installed in a 5155 Portable 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 5155, 5150, 5160, 5170, and 5531 in the clustered configuration must have the Cluster Adapter feature installed. One Cluster Adapter can be installed in a full-feature slot in the 5155 System Unit (slot 2) or the 5161 Expansion Unit.

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. 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.

For a description of the clustered configuration and the IBM Personal Computer Cluster Program, see Section 11:10 under "Cluster Adapter and Cluster Cable Kit."

IBM PC Network

The 5155 Portable Personal Computer can be included in an IBM PC Network, which is a low-cost broadband local area network that allows peer-to-peer communication between IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XTs and XT/370s, and IBM Personal Computer ATs and AT/370s in a shared resource environment. The IBM personal computers in the network are connected using the 5178 IBM PC Network Translator Unit, IBM PC Network Adapter, and IBM PC Network Cabling Component features. One IBM PC Network Adapter can be installed in a 5155 configuration (only in the 5155 unit).

The IBM PC Network Program and IBM PC Network SNA 3270 Emulation program support the 5155 in an IBM PC Network. For a discussion of this network and its programming support for the 5155, see Section 11:10 under "IBM PC Network."

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 5155 System Unit via an Asynchronous Communications Adapter. The Compact Printer Connector Adapter (6450102) is also required.

The 5155 can be a stand-alone system or part of an IBM personal computer cluster. When the 5155 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.

For a description of the facilities provided by this convenience kit and its programming support, see Section 11:10 under "Displaywriter/Personal Computer Attach Convenience Kit."

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 5155 Portable 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 and permits the typewriter to be used as a letter-quality printer for the 5155 Portable Personal Computer.

For a further description of this connection, see Section 11:10 under "IBM 65/85/95-PC IPL/Diagnostic Diskette and Diagnostic Tool."

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 5155 configuration via an Asynchronous Communications Adapter configured for current-loop operations. The 5218 printer can be used as a letter-quality printer. The 5218 Printer Sharing feature permits up to four IBM personal computers to be attached to one 5218 Printer to share the printer for letter-quality printing applications. The 5218 Printer Driver Program supports these features.

A convenience pac consisting of the 5218 Printer Attachment Cable, 5218 Printer Driver Program, and customer setup/operator guide can be ordered. See "5218 Printer Attachment Cable and 5218 Printer Sharing" in Section 11:10 for a description of these features.

Single Unit Prices

Item	Part Number	Feature Code	Single Unit Purchase Price (\$)
5155 System Unit/Keyboard			
Model 68	5155068	—	2595
Model 76	5155076	—	2895
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
Cluster Adapter	1501206	1206	340
Cluster Cable Kit	1501207	1207	110
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 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
IBM 65/85/95-PC IPL/Diagnostic Diskette and Diagnostic Tool — MES 8569 (includes only the PC feature)	—	8569	345
IBM 65/85/95-PC Attachment Device for IBM Typewriter (MES 8566)	—	8566	285
Convenience Kit for MES 8566 and MES 8569	—	8570	345
Math Co-processor Option	1501002	1002	230
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
256Kb Memory Expansion Option	1501209	1209	489
3278/79 Emulation Adapter	1602507	2507	905

12:10 IBM 5155 System Unit

Item	Part Number	Feature Code	Single Unit Purchase Price (\$)
5178 PC Network Translator Unit	5178001	—	595
Transformer unit for IBM 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
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 3	6403724	2896	1113
5¼-Inch Double-Sided Diskette Drive	6450300	0300	425
64Kb Memory Module Kit	1501003	1003	100
64/256Kb Memory Expansion Option	1501013	1013	265

Discounts Available

The 5155 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.

12:15 IBM 5161 Expansion Unit Model 1

Introduction

The 5161 Expansion Unit Model 1 provides fixed disk storage (10Mb or 20Mb) and additional expansion slots for the 5155 Portable Personal Computer. The expansion slots allow for the installation of optional feature cards to extend the capabilities of the 5155 configuration.

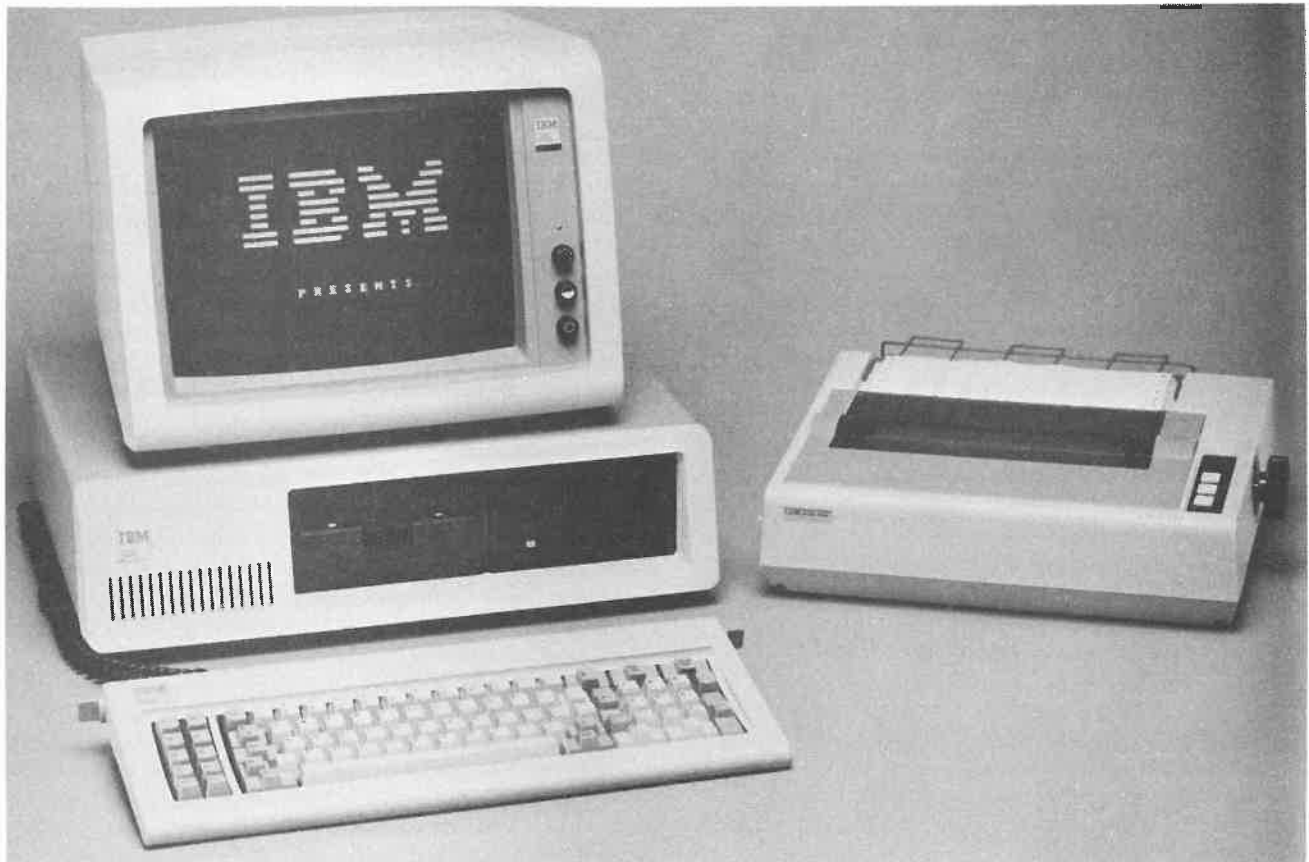
One 5161 Model 1 can be attached to a 5155 System Unit. The 5161 Model 1 can be field-installed and is a customer-setup unit. It can be placed beside the 5155 System Unit or stacked over the 5155 unit. When the 5161 is placed beside or on top of the 5155 unit, a printer or display can be placed on top of the 5161 unit.

The following optional features for the 5155 Portable Personal Computer can be installed in the 5161 Model 1 unit:

- Game Control Adapter (special- or full-feature)
- Printer Adapter (special- or full-feature)
- Prototype Card (full-feature)
- Professional Graphics Controller (two adjacent full-feature) – must be installed in the 5161 unit
- 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)
- Enhanced Display Station Emulation Adapter (full-feature)
- Cluster Adapter (full-feature)

In addition, the Keylock Feature can be installed in a 5161 Model 1 to provide data security (see description in Section 11:10 under “Keylock Feature”). See Section 11:15 for a description of the 5161 Model 1 unit and prices.

Section 13: IBM Personal Computer XT



Announced March 8, 1983

13:05 IBM Personal Computer XT Configuration Overview

Introduction

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

An IBM Personal Computer XT 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 XT 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 XT 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 XT can be interconnected via cable with other local IBM personal computers to form a clustered multiuser configuration. 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 XT can also be included in an IBM PC Network, which is a low-cost local area network that supports the cable intercon-

nection 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 interconnection to Series/1 processors.

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

The IBM Personal Computer XT can be connected to various local and remote processors (System/370, 30XX, 4300, Series/1, 8100, System/34/36/38, for example) to be used as an intelligent workstation and as a personal computer. Using appropriate programming support, the IBM Personal Computer XT 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 XT can be used as a videotex terminal.

Hardware features and programming support enable the IBM Personal Computer XT to be connected to and communicate with various IBM office systems. Multiple IBM Personal Computer XTs can be cable-attached to a 5520 Administrative System to emulate 5253 Display Stations. The IBM Personal Computer XT 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 XT configuration is supported and an IBM Personal Computer XT can communicate with DISOSS/370 in a host processor using Personal Services/PC.

Support of word processing functions for an IBM Personal Computer XT connected to an 8100 Information System is provided, as is communication

between an IBM Personal Computer XT and a host VM/370 PROFS system. Other programming support (DisplayWrite Series) provides document processing capabilities for a stand-alone IBM Personal Computer XT similar to facilities provided for a Displaywriter system. Direct document exchange between IBM personal computers is also supported using Personal Services/PC.

The majority of application programs that execute under the IBM Personal Computer Disk Operating System in an IBM Personal Computer XT configuration can also execute in other IBM personal computers that have the required hardware resources.

The IBM Personal Computer XT configuration provides more standard (8) and total (16) expansion slots for standard and optional features than does the IBM Personal Computer (with 5 standard and 13 total slots) and the ability to install fixed disk storage in the system unit. A model of the IBM Personal Computer XT system unit that has 10Mb of fixed disk storage as a standard feature can be selected by those who require the larger online capacity and faster speed of fixed disk storage (as opposed to diskette storage) in their initial configuration. For an IBM Personal Computer, fixed disk storage is provided only by the 5161 Expansion Unit.

Many optional features enable an IBM Personal Computer XT configuration to be expanded as processing needs expand. This configuration should be selected if conversion to an IBM Personal Computer XT/370 configuration could be desirable in the future. An IBM Personal Computer XT/370 Option Kit can be installed in an IBM Personal Computer XT System Unit to convert it to an IBM Personal Computer XT/370 System Unit.

Physical Components

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

- 5160 System Unit/Keyboard Model 68, 78, 87, or 86
- 5161 Expansion Unit Model 1 or 2 (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
- 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 XT 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 XT configuration must include one 5160 System Unit/Keyboard and one display device. The minimum IBM Personal Computer XT configuration consists of the following:

- One 5160 System Unit/Keyboard Model 68, which has 256Kb of random access memory and one 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)

The price of a single minimum IBM Personal Computer XT hardware configuration, 5160 Model 68 with a TV attached to the Color/Graphics Monitor Adapter, is \$2514. This configuration supports operation of the IBM Personal Computer Disk Operating System (DOS).

Configuration Features

The following highlights the features of IBM Personal Computer XT configurations, including memory sizes, types and maximum number of attachable I/O devices, and the processors/units to which a 5160 configuration can be connected:

- One 5160 Model 68, 78, 87, or 86 System Unit/Keyboard with the Intel 8088 16-bit microprocessor

13:05 IBM Personal Computer XT Configuration Overview

- 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 128Kb (131,072 bytes) to 640Kb (655,360 bytes)
- One or two IBM 5¼-inch diskette drives installed in the 5160 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 for a maximum capacity of 20Mb (21,237,760 bytes) of online fixed disk storage. Two IBM internal diskette drives, two external diskette drives, and two fixed disk drives can be installed in the same 5160 configuration when the 5161 unit is present. When the 5161 is not present, a 5160 unit can have two double-sided diskette drives or one double-sided diskette drive and one 10Mb Fixed Disk Drive installed.
- Up to 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 5160 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 Printer Adapter and one or two serial printers via Asynchronous Communications Adapters
- 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
- Field upgrade to an IBM Personal Computer XT/370 using an IBM Personal Computer XT/370 Option Kit
- Data security provided by 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 5160 configuration (see discussion under “IBM Series/1-Personal Computer Interconnect” in Section 13:10).
 - Another 5160 Personal Computer XT, a 4860 PCjr, a 5150 Personal Computer, a 5160 Portable Personal Computer, a 5160 Personal Computer XT/370, 5170 Personal Computer AT or AT/370, a 3270 Personal Computer workstation, 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 5160 as a videotex terminal
 - A remote VM/370 PROFS system via the Asynchronous Communications Adapter or using 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 XT 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
 - 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 PCjr's, IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XT's and XT/370s, IBM Personal Computer AT's and AT/370s, and IBM 5531 Industrial Computers) via 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 XT's and XT/370s, and IBM Personal Computer AT's and AT/370s) using 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 attached to an Asynchronous Communications Adapter via the 5218 Printer Attachment Cable. Up to four IBM personal computer systems 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 an Asynchronous Communications Adapter or the General Purpose Interface Bus Adapter. The IBM Personal Computer XT can be a stand-alone system or connected to a host System/370, 30XX, or 4300 processor.
 - 7374 or 7375 Color Plotter when the IBM Personal Computer XT is connected to a host System/370, 30XX, or 4300 processor. Attachment of the plotter to the 5160 is via a cable connected to the Asynchronous Communications Adapter or the 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)
 - Custom attachments using the Prototype Card
 - Other host processors using appropriate software
- Up to three communications adapters (of more than one type, if desired) can be installed in the same 5160 Personal Computer XT configuration. The limit for each type is two for the Asynchronous Communications Adapter, one for the SDLC adapter, and two for the BSC adapter. 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 XT 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

13:05 IBM Personal Computer XT Configuration Overview

- 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 XT 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 5160 Personal Computer XT is supported by the following IBM-logo operating systems:

- IBM Personal Computer Disk Operating System (DOS) Versions 2.0 and later. One diskette drive is required. DOS Version 1.1 can execute in a 5160 configuration but does not support 10Mb fixed disk drives, which are supported by DOS 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.

Compatibility

Hardware

The 5160 Personal Computer XT is compatible with the 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 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 are fully compatible among these system units for personal computer mode operations. The 80286 microprocessor in the 5170 operating in real address mode is upward compatible with the 8088 microprocessor.

Diskettes (5¼-inch) are interchangeable without restriction among 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT and XT/370, 5170 Personal Computer AT and AT/370 (160/180 Kb and 320/360 Kb capacities only), 3270 Personal Computer workstation, and 5531 Industrial Computer configurations. The 5160 Personal Computer XT does not have a cassette recorder adapter (as do the

PCjr and 5150 Personal Computer) and does not support program cartridges (as does the PCjr).

Programming

Programs that operate in a 5160 Personal Computer XT configuration can also operate in a 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT/370 (in PC mode), 3270 Personal Computer workstation, or 5531 Industrial Computer if the configuration contains the required memory, features, and I/O devices. The majority of programs that operate in a 5160 Personal Computer XT can also operate in a PCjr configuration (see discussion in Section 10:05 under "Compatibility" for details about compatibility with the PCjr) or an IBM Personal Computer AT or AT/370 (in PC mode).

Customer Responsibilities

The 5160 Personal Computer XT 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 5160 configuration (see "Physical Components" earlier in this subsection) except for the 5151 Monochrome Display, which receives power from the 5160 System Unit or 5161 Expansion Unit.

Data Security

The customer is responsible for providing any desired data security functions. Programs and hardware that perform data encryption and decryption can be installed in a 5160 configuration. The Data Encoder program (6024149) that performs encryption and decryption of data is available from IBM.

The optional Keylock Feature can be installed on the 5160 System Unit and/or 5161 Expansion Unit to prevent physical and programmed access to the physical and data contents of the 5160 and/or 5161 unit when the keylock is in the locked position. See description of this feature in Section 13:10 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 5160 Personal Computer XT IBM-logo units and features are purchase only and 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 Computer XTs purchased from an IBM branch office.
- IBM Product Centers. Major credit cards and the IBM Credit Corporation credit card are accepted. Volume Procurement Amendment 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

Warranty Period

The warranty period for 5160 and 5161 units is three months and the warranty service is Customer Carry-In Repair.

The warranty period for all optional features of the 5160 and 5161 Model 2 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, and General Purpose Interface Bus Adapter, for which a one-year warranty period is provided.

IBM Service Offerings

The following IBM service options are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Option. For 5160 and 5161 units, IBM On-Site Repair is available.
 - Annual Maintenance. For 5160 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 XT. The types of service 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 5160 System Unit is also available:

- Epson FX-100 (machine 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 XT configuration:

- *Guide to Operations* (6322511). 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 monochrome displays and one for color displays) containing the system tutorial "Exploring the IBM Personal Computer XT" 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 5160 System Unit.

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

- *IBM Personal Computer XT/IBM Portable Personal Computer System Technical Reference* (6322508) – \$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.

13:05 IBM Personal Computer XT Configuration Overview

- *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* (6322513) – \$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 5160 Personal Computer XT configuration are available:

- *IBM Personal Computer XT, Expanding Your IBM PC Options*, G520-6019 (pocket flyer)
- *IBM Personal Computer XT* (brochure), G520-0094
- *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 com-

puter 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
 - *Graphical File System*, G520-5014
 - *VDI System Specification Sheet*, G520-5018
 - *Plotting System*, G520-5017
 - *Professional FORTRAN*, G520-5019

More detailed information about the 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 IBM Personal

Computer XT hardware units, printer supplies and accessories, paper forms, diskettes and associated accessories, books, software, hardware accessories, and furniture that can be ordered from IBM. The items listed can be purchased by mail, by telephone (via IBM Direct), at an IBM Product Center, or from an IBM NAD or NMD marketing representative, depending on the item. This catalog contains vendor-logo units (such as printers, modems, game paddles, joysticks, and mice) that can be attached to a 5160 configuration, as well as IBM-logo units.

Additional publications regarding particular features are indicated in the feature descriptions in Section 13:10.

Self-Study Courses

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

13:10 IBM 5160 Personal Computer XT System Unit

The 5160 System Unit Model 87 for the IBM Personal Computer XT is shown in Figure 13-1.

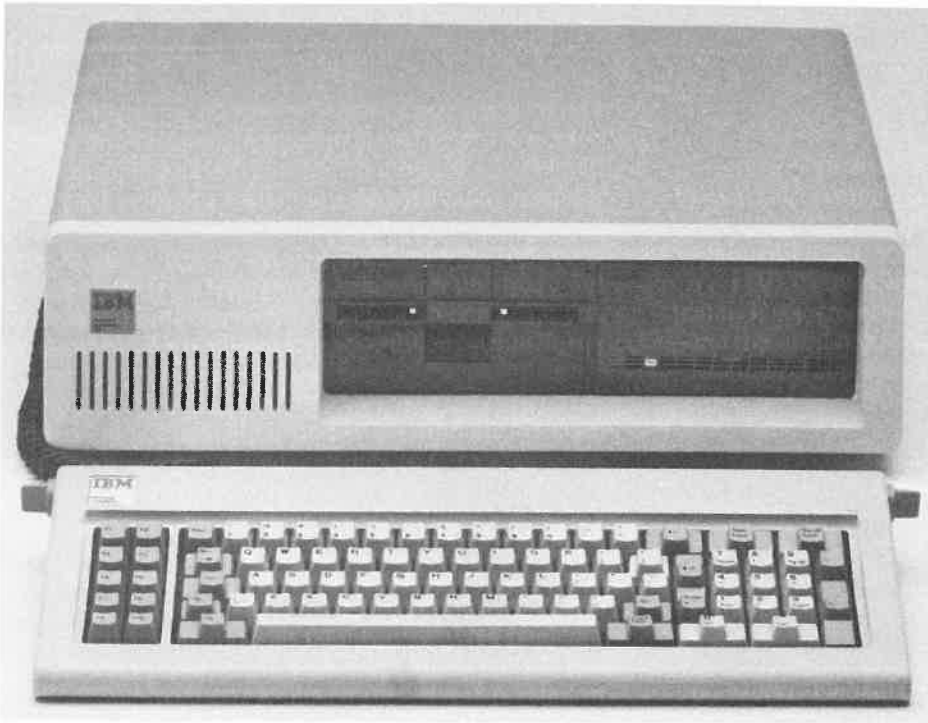


Figure 13-1. 5160 System Unit Model 87

Models Available

The models of the 5160 that are available for an IBM Personal Computer XT configuration differ only in the standard features provided. Otherwise they are functionally and physically identical. The following 5160 models are provided for an IBM Personal Computer XT configuration:

- Model 68:
 - System Unit/Keyboard
 - 256Kb random access memory
 - 5¼-Inch Diskette Drive Adapter
 - One 5¼-Inch Double-Sided Diskette Drive
- Model 78:
 - System Unit/Keyboard
 - 256Kb random access memory
 - 5¼-Inch Diskette Drive Adapter
 - Two 5¼-Inch Double-Sided Diskette Drives
- Model 87:
 - System Unit/Keyboard
 - 128Kb random access memory
 - 5¼-Inch Diskette Drive Adapter
 - One 5¼-Inch Double-Sided Diskette Drive
 - Fixed Disk Drive Adapter
 - One 10Mb Fixed Disk Drive
 - One Asynchronous Communications Adapter
- Model 86:
 - System Unit/Keyboard
 - 256Kb random access memory
 - 5¼-Inch Diskette Drive Adapter
 - One 5¼-Inch Double-Sided Diskette Drive
 - Fixed Disk Drive Adapter
 - One 10Mb Fixed Disk Drive
 - One Asynchronous Communications Adapter

Any model of the 5160 System Unit with 256Kb of memory can be upgraded to the 5160 System Unit for an IBM Personal Computer XT/370 configura-

tion by installing an IBM Personal Computer XT/370 Option Kit. The 5160 cannot be upgraded to the 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)

- Model 68: 28 lb (12.7 kg)
- Models 78, 86, and 87: 32 lb (14.5 kg)

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 5160 System Unit
- Humidity:
 - 8% to 80% for system on
 - 20% to 80% for system off
- Noise level:
 - 56 decibels (dB) without printer
 - 66 decibels with printer
- Electrical:
 - 90 to 137 volts AC, 60 Hz
 - 180 to 259 volts AC, 50 Hz (outside U.S.A.)

Standard Features

The following are standard features of 5160 models as indicated. 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
- 128K (131,072) bytes for the Model 87 and 256K (262,144) bytes for Models 68, 78, and 86 of random access memory (RAM)
- Eight system expansion slots to hold feature cards

- A programmable speaker and associated adapter
- One 5¼-Inch Diskette Drive Adapter
- One 5¼-Inch Double-Sided Diskette Drive for Models 68, 87, and 86 and two 5¼-Inch Double-Sided Diskette Drives for the Model 78
- One Fixed Disk Drive Adapter (Models 87 and 86)
- One 10Mb Fixed Disk Drive (Models 87 and 86)
- One Asynchronous Communications Adapter (Models 87 and 86)
- Keyboard adapter and 83-key keyboard
- Automatic power-on self-test
- A 130-watt power supply with cooling fan

Optional Features

The following are optional features of 5160 model configurations as indicated. Each is discussed under "Optional Feature Descriptions" in this subsection.

- Math Co-processor Option (one maximum)
- 64Kb Memory Module Kit (two maximum on the Model 87 system board and three maximum on a 64/256Kb Memory Expansion Option – six maximum added to a Model 87 configuration and four maximum added to a Model 68, 78, or 86 configuration)
- 64/256Kb Memory Expansion Option (two maximum)
- 256Kb Memory Expansion Option (one maximum)
- Game Control Adapter (one maximum)
- Prototype Card (one maximum)
- 5¼-Inch Single-Sided Diskette Drive (one maximum). This feature has been withdrawn from marketing by NAD and NMD.
- 5¼-Inch Double-Sided Diskette Drive (one maximum) – Models 68, 87, and 86
- 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)
- Data Acquisition and Control Adapter (four maximum)
- Data Acquisition and Control Adapter Distribution Panel (one maximum)
- General Purpose Interface Bus Adapter (four maximum)
- Binary Synchronous Communications (BSC) Adapter (two maximum unless the SDLC Com-

munications 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)
- Asynchronous Communications Adapter (two maximum in a configuration if the SDLC adapter is not installed otherwise one maximum in a configuration)
- Display Station Emulation Adapter (one maximum)
- Enhanced Display Station Emulation Adapter (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 5160 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 a 5218 printer)
- Keylock Feature (one for the 5160 and one for the 5161)
- IBM Personal Computer XT/370 Option Kit with the 3277 emulation card or IBM Personal Computer XT/370 Option Kit without the 3277 emulation card (one kit maximum)

All optional features are installed inside the 5160 or 5161 unit except the Communications Adapter Cable, Cluster Cable Kit, Displaywriter/Personal Computer Attach Convenience Kit, MES 8569, 5218 Printer Attachment Cable, 5218 Printer Sharing, 5178 IBM PC Network Translator Unit and Cabling components, Data Acquisition and Control Adapter Distribution Panel, and Keylock Feature.

Physical Components Included

Each 5160 System Unit contains the system board, the programmable speaker, and the power supply and fan. The standard diskette drive in all 5160 models, the two standard diskette drives in a Model 78, and the standard fixed disk drive in Models 87 and 86 are also housed in the 5160 unit. Certain optional features for a 5160 configuration can be installed only in the 5160 System Unit. Others can be installed in the 5160 or 5161 unit.

Each 5160 system board contains:

- The processor subsystem (includes the Intel 8088 microprocessor and associated functions)
- Read only memory (40Kb)
- Random access memory (128Kb to 256Kb for the Model 87 and 256Kb for Models 68, 78, and 86)
- The keyboard adapter
- The programmable speaker adapter
- Eight system expansion slots that are used to hold feature cards
- Socket for the Math Co-processor Option module

The system board also contains one set of eight switches that can be read under program control. These switches (called dual inline package – DIP – switches) provide configuration information to the operating system. They must be set to indicate whether the Math Co-processor Option is installed, the amount of memory installed on the system board, 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 5160 is delivered with the DIP switches set for the configuration ordered. If optional features are added to a 5160 configuration thereafter, the customer must set the appropriate switches, if required, as per the supplied instructions in the 5160 *Guide to Operations*.

Standard and optional feature cards plug into expansion slots provided in the left rear corner of the system board in the 5160 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 5160 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 5160 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 with 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 5160 *Technical Reference* (6322508). 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 microprocessor. 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 5160 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 in random access memory to another 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 1.5 Mb/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 5160 contains 40Kb of read only memory (ROM) on the system board. The contents of ROM remain when power to the 5160 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 5160 is turned on. The time required for the test varies, depending on the amount of memory

13:10 IBM 5160 Personal Computer XT System Unit

- 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 and output support (device level control) for the major I/O devices that attach to the 5160 (keyboard, display, printer, diskette, and fixed disk) and for cassettes and 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 defined program interrupts (interrupt instruction specifying the BIOS interrupt type) rather than by actual addresses. There are over 40 defined interrupts that permit the programmer 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 BIOS instructions is contained in the 5160 *Technical Reference* (6322508).

- 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 request 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 5160. This code can be inspected by programming.
- BASIC-80 Interpreter (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 5160 System Unit 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 5160 has been turned on and the self-test diagnostics have executed successfully, an attempt is made to IPL an operating system from the standard (A) diskette drive and then from the first fixed disk (C) drive in the configuration, if any. The BASIC Interpreter is made ready and identified on the screen if an IPL from diskette or fixed disk has not occurred.

Random Access Memory

Random access memory (RAM) is read/write program-addressable memory. In the 5160, RAM is dynamic memory (its contents must be refreshed periodically) and its contents are lost when power to the 5160 is removed. This memory is parity-checked for validity. The standard memory has a 200-ns access time and a 345-ns cycle time.

The standard memory in each 5160 model (128Kb for the Model 87 and 256Kb for Models 68, 78, and 86) 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.

DOS Versions 2.0 and 2.1 require a minimum of 24Kb of memory for residence during system operation. Thus, for a 5160 configuration with 128Kb of memory, application programs that require up to 104Kb at a time can be used. 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 5160 configuration. The remaining 384Kb of address space is allocated to address read only memory on the system board and the 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

Six full-feature (numbered 1 through 6) and two special-feature (numbered 7 and 8) system expansion slots are standard on the system board to contain memory and adapter features. The full-feature slots will accept full-feature or the smaller special-feature cards. Special-feature slot 7 will accept only a special-feature card. Special-feature slot 8 can be used only for the Asynchronous Communications Adapter. A small jumper (J-13) is provided with this adapter that must be used only when the asynchronous adapter is installed in slot 8 of a 5160 unit.

One full-feature slot is used for the standard 5¼-Inch Diskette Drive Adapter and another full-feature slot must be used for a display adapter in all 5160 models. One additional full-feature slot is used for the standard Fixed Disk Drive Adapter in all 5160 models and slot 8 is used for the standard Asynchronous Communications Adapter in all 5160 models in a 5160 Model 87 or 86.

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

- 64/256Kb Memory Expansion Option (full-feature)
- 256Kb Memory Expansion Option (special- or full-feature)
- Fixed Disk Drive Adapter (full-feature)
- Game Control Adapter (special- or full-feature)*
- Prototype Card (full-feature)*
- Monochrome Display and Printer Adapter (full-feature)*
- Color/Graphics Monitor Adapter (full-feature)*
- Printer Adapter (special- or full-feature)*
- Enhanced Graphics Adapter (full-feature)
- Professional Graphics Controller (two adjacent full-feature)*
- Data Acquisition and Control Adapter (full-feature)*
- General Purpose Interface Bus Adapter (special- or full-feature)*
- Binary Synchronous Communications Adapter (full-feature)*
- SDLC Communications Adapter (full-feature)*
- Asynchronous Communications Adapter (special- or full-feature)*
- 3278/79 Emulation Adapter (full-feature)
- Display Station Emulation Adapter (full-feature)*
- Enhanced Display Station Emulation Adapter*
- 8100 PC Adapter (full-feature)*
- Cluster Adapter (full-feature)*
- IBM PC Network Adapter (full-feature)
- IBM Personal Computer XT/370 Option Kit with 3277 emulation card (slots 2, 3, and 4 only)
- IBM Personal Computer XT/370 Option Kit without 3277 emulation card (slots 3 and 4 only)
- 5161 Expansion Unit extender card (provided with the 5161 unit) – full-feature

* This feature can be installed in the 5160 or 5161 unit. Others must be installed in the 5160 unit.

The Monochrome Display and Printer Adapter or the Color/Graphics Monitor Adapter can be installed in the 5161 unit only if it is the second display adapter in the configuration. One display adapter must be installed in the 5160 unit for the primary display.

If more than eight expansion slots are needed, the 5161 Expansion Unit can be attached to the 5160 System Unit. The 5161 provides 8 additional expansion slots for a total of 16 slots in the configuration as well as 10Mb of fixed disk storage (see description of 5161 Model 1 and 2 units in Section 13:15 for details).

Programmable Speaker

A 2¼-inch-diameter, 8-ohm audio speaker is included in the 5160 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 the 5160 System Unit (all models). This adapter uses a full-feature expansion slot and is the only diskette drive adapter that can be installed in a 5160 configuration. One or two IBM-supplied internal 5¼-inch diskette drives can be attached to this adapter. 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 5160 unit for a total of four

13:10 IBM 5160 Personal Computer XT System Unit

diskette drives. The diskette drive adapter uses direct memory access for record data transfer.

5¼-Inch Double-Sided Diskette Drive

One double-sided diskette drive (leftmost drive addressed as A) is standard in the 5160 System Unit. It provides a capacity of 360Kb using DOS Version 2.0 or later. 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.

Double-sided diskette drive characteristics are:

- Number of rotations per minute: 300
- 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 tracks: 40 per surface
- Number of surfaces: 2
- 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 or later. DOS Version 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:
 - 320Kb (327,680 bytes) using DOS Version 1.1
 - 360Kb (368,640 bytes) using DOS Version 2.0 or 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 operating 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 a diskette drive in a 5160 unit or of diskettes is not recommended.

Fixed Disk Drive Adapter

This adapter is standard in 5160 Models 87 and 86 and optional for the 5160 Model 68 unit. It provides buffering, error detection, and data transfer between memory in the 5160 and a 10Mb Fixed Disk Drive. 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 5160 configuration (located in the 5160 or 5161 unit). The adapter supports direct memory access data transfer, automatic error detection and correction on 11-bit bursts using a 32-bit error checking and correction (ECC) code, automatic retries on disk errors, and internal diagnostics.

10Mb Fixed Disk Drive

One 10Mb Fixed Disk Drive (rightmost drive) is standard in a 5160 Model 87 and 86 System Unit and optional for the 5160 Model 68 unit 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 8½ × 11-inch double-spaced typewritten pages.

One additional 10Mb Fixed Disk Drive can be installed in a 5160 Model 68, 87, or 86 configuration via the 5161 Model 2 to provide 21,237,760 bytes of fixed disk storage. Note that the 10Mb Fixed Disk Drive and Fixed Disk Drive Adapter must be moved from the 5160 unit to the 5161 Model 2 unit when the second 10Mb Fixed Disk Drive is installed. For a 5160 Model 78, the 5161 Model 1 (which contains a Fixed Disk Drive Adapter) can be installed to provide 10Mb or 20Mb of fixed disk storage.

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
- 3600 rotations per minute
- 8.33 ms average rotational delay
- 3 ms track-to-track access
- 5M-bit per second data transfer rate
- 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 fixed disk file size supported by DOS is 4096 bytes, which provides for a maximum of approximately 2592 files on one fixed disk. The first fixed disk drive is addressed as C and the second is addressed as D.

Asynchronous Communications Adapter

One Asynchronous Communications Adapter is standard in a 5160 Model 87 or 86 System Unit in slot 8 and one additional asynchronous adapter can be installed. One or two asynchronous adapters are optional for a 5160 Model 68 or 78 configuration. Only one asynchronous adapter can be present in any 5160 model configuration when the SDLC adapter is installed.

This adapter provides a path to a processor or an I/O device outside the 5160 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 5160/5161. 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 5160 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 5160 configuration can be attached to the following using an 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

13:10 IBM 5160 Personal Computer XT System Unit

- 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 the 5160 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 5160 simulates a 3101 Display Terminal Model 20 with some differences. The 3101 Emulation Program permits a 5160 to transmit ASCII files to and receive ASCII files from a host processor. The transfer of extended ASCII characters (codes 128 to 255) is not supported. Conversion of ASCII files to and from binary format is also supported. The 5160 connects to another processor via a duplex modem or direct cabling.

The 3101 Emulation Program supplies specification files that support 5160 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 5160 to be used as an asynchronous (start/stop) TTY ASR 33/35 terminal. The 5160 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 files 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 5160 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 5160-attached printer by a Series/1 program, 5160 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 5160 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 5160 communication with remote processors and an electronic mail function. When the terminal emulation facility is active, the 5160 has the operating characteristics of an asynchronous (start/stop) Teletype™ ASR 33/35 terminal. The 5160 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 5160 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 5160 (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 5160 for stand-alone proc-

essing. Results can be transferred from the 5160 to PROFS in the host for processing or distribution to other PROFS users. In addition, PROFS documents can be transferred to the 5160 for printing.

When the DisplayWrite 2 or DisplayWrite 3 program is also used with PROFS/PC² in the 5160 systems connected to the PROFS host, revisable form text document content architecture (RFTDCA) format documents can be exchanged between these 5160 systems, using the PROFS library and distribution facilities. The 5160 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 5160 system that can communicate with PROFS using PROFS/PC². A 5520 document is transferred to the 5160 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 5160 configurations executing PROFS/PC².

The PC/Videotex program permits a 5160 to be used as a videotex terminal. The 5160 is attached to a videotex host processor (such as a System/370, 30XX, 4300, or Series/1 processor) using the Asynchronous Communications Adapter (with a 1200-bps modem) and asynchronous communications protocols are used. As a videotex terminal, the 5160 can establish communication 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 5160 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 5160 to connect to a variety of videotex networks. Addi-

tional information is provided in the brochure *PC/Videotex*, G320-0711.

PC/Colorview allows the user of an IBM Personal Computer XT 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 of 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 5160 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 5160 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

13:10 IBM 5160 Personal Computer XT System Unit

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 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.

Keyboard

One 83-key keyboard is standard for the 5160 System Unit. It is the same physical keyboard that is provided for 5150 Personal Computer and 5160 Personal Computer XT/370 configurations. The keyboard attaches to a 5-pin connector in the back of the 5160 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 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 be programmed to provide the function specified on each key, if desired.
- The keyboard provides scan codes to the system unit instead of ASCII codes. A unique scan code is assigned to each key. A BIOS keyboard routine in ROM translates the scan code to a standard or extended ASCII code and presents it to the executing program. This approach permits the character or function of each key to be defined via programming. The scan codes for the 83-key keyboards for the 5150, 5155, 5160, and 5531, the 84-key keyboard for the 5170,

the 122-key keyboard for the 5271 and 5371, and the 62-key keyboard for the 4860 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 is entered using the numeric keypad keys.
- 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 function keys and provides space to note the use of each key, program name, program mode, and other information.
- 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 keyboard layout (the only layout available in the U.S.A.) is shown in Figure 13-2. The international-layout keyboards are supported by DOS.



Figure 13-2. U.S. English 83-key keyboard for the IBM Personal Computer XT

Power Supply

The power supply (130-watt) in the right rear area of the 5160 unit provides power (required voltages) to the system unit, its options, and the keyboard (four outputs). The 5151 Monochrome Display has its own power supply and receives AC power from the power system in the 5160 or 5161 unit. If adequate power is not being received, a system shut-down occurs. Overvoltage and overcurrent protection are also provided via two fuses. Power to the 5160 is automatically removed if an overpower condition is detected.

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 micro-processor 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.

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.

The 8087 coprocessor has its own instruction set of about 60 instructions, its own set of registers, and can operate in parallel with the 8088 micro-processor. 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 *5160 Technical Reference (6322508)*.

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 numbers. The number ranges that can be represented are $-32,768$ to $+32,767$ 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

13:10 IBM 5160 Personal Computer XT System Unit

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 two of the module kits (128Kb) can be installed on the 5160 Model 87 system board to provide 256Kb on the board. Up to three 64Kb module kits can be added to the 64/256Kb Memory Expansion Option card.

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 full-feature system expansion slot in the 5160 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 in a 5160 Model 87 must have 256Kb of memory 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 Options can be installed in a 5160 to provide up to 384Kb in addition to the 256Kb of memory on the system board. For two memory expansion cards, one memory expansion card contains 256Kb while the other card contains 64Kb or 128Kb. Alternatively, one 256Kb Memory Expansion Option and one

64/256Kb Memory Expansion Option with 128Kb can be installed to provide 384Kb.

256Kb Memory Expansion Option

This option provides 256Kb of parity-checked random access memory on a 5-inch card. It plugs into a full-feature slot or special-feature slot 7 in the 5160 System Unit. This memory cannot be installed in slot 8 in the 5160 unit or in any slot in the 5161 unit. The 5160 Model 87 must have 256Kb installed on the system board as a prerequisite.

For the 5160, this feature can be installed instead of the 64/256Kb Memory Expansion Option with three 64Kb Memory Module Kits to add 256Kb to the 5160 at a lower cost and/or to be able to use a special-feature instead of a full-feature slot for the additional 256Kb. One 256Kb Memory Expansion Option and one 64/256Kb Memory Expansion Option with 64Kb or 128Kb can be installed to provide 576Kb or 640Kb of memory in the 5160 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 5160 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 5160 Personal Computer XT can be purchased from *The IBM Personal Computer Catalog*, G570-2064. They are supported by BASIC but not by DOS. (The IBM-logo joysticks that are available for the IBM PCjr do not attach to the 5160 configuration.)

The Game Control Adapter (one maximum) can be installed in a special- or full-feature slot in the 5160 or 5161 unit. The adapter provides a 15-pin D-shell connector at the back of the 5160/5161 unit.

Prototype Card

This feature (one maximum) is provided as a base for building and testing custom attachments for the 5160 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 5160 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 5160/5161, with a cutout provided for an external D-shell connector with from 9 to 37 pins. Detailed instructions and component identifications for I/O attachment logic are also included with this feature.

5¼-Inch Single-Sided Diskette Drive

One single-sided diskette drive can be present in a 5160 System Unit to provide a capacity of 180Kb (184,320 bytes) using DOS Version 2.0 or later. The drive attaches to the standard 5¼-Inch Diskette Drive Adapter. The single-sided diskette drive can read from and write to one side of a single-sided double-density soft-sectored 5¼-inch diskette (but not to a double-sided diskette). A single-sided diskette can be read/written in a single- or double-sided diskette drive.

Single-sided diskette drive characteristics are:

- Number of rotations per minute: 300
- Access time: 8 ms track to track
- Data transfer rate: 250K bits (32,000 characters) per second
- Head settling time: 15 ms
- Height: 3.38 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 Version 2.0 or 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 lights (red) whenever the drive is performing an operation.

Customer cleaning of the heads in a diskette drive in a 5160 unit or of diskettes is not recommended.

5¼-Inch Double-Sided Diskette Drive

One double-sided diskette drive in addition to the standard double-sided diskette drive can be installed in a 5160 System Unit Model 68, 87, or 86 to provide an online diskette capacity of 720Kb (737,280 bytes) using DOS Version 2.0 or later. The two drives attach to the 5¼-Inch Diskette Drive Adapter.

The second double-sided diskette drive has the same characteristics as the standard double-sided diskette drive (described under "Standard Feature Descriptions" earlier in this subsection).

Diskette drives must be installed in the 5160 System Unit. Thus, when a second double-sided diskette drive is installed in a 5160 Model 87 or 86 configuration, the 10Mb Fixed Disk Drive and Fixed Disk Drive Adapter in the 5160 System Unit must be moved to the 5161 Expansion Unit Model 2. The 5161 must be purchased if not already installed. The second diskette drive replaces the fixed disk drive in the 5160 System Unit.

Monochrome Display and Printer Adapter

This adapter provides for attachment to the 5160 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 Electronic Typewriter 65, 85, or 95; or a device with TTL (tran-

13:10 IBM 5160 Personal Computer XT System Unit

sistor 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 5160 configuration and requires one full-feature slot in the 5160 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 5160 configuration, at least one of the two adapters must be installed in the 5160 unit for the primary display.

This feature provides a 9-pin connector and a 25-pin connector at the rear of the 5160/5161 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:

- Alphanumeric (text) mode with a 256 character set. 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 character (on an individual character basis) for normal or 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 contains 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 5160 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 phono 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, 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 phono 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 5160, diskette drive data errors may occur unless the display is located at least 12 inches (30 cm) away from the 5160 unit.

One Color/Graphics Monitor Adapter can be installed in a 5160 configuration and requires one full-feature slot in the 5160 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 5160 configuration, at least one of them must be installed in the 5160 unit for the primary display

The Color/Graphics Monitor Adapter supports the following:

- Two modes: alphanumeric (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
- Screen border color selection (1 of 16 colors) for text mode
- 16 foreground and eight background colors in color text mode and blinking on a per-character basis
- 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 5160 configuration of 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 Electronic Typewriter Model 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 5160 configuration and requires one special- or full-feature slot in 5160 or 5161 unit. The adapter provides a 25-pin connector at the rear of the 5160/5161 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 a 9-pin connector on the end of the card for 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 5160 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 to 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 Monitor 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). A 5154 display emulates a 5153 display when attached to the Enhanced Graphics Adapter operating in enhanced display emulation mode.

13:10 IBM 5160 Personal Computer XT System Unit

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 5160 configuration and requires one full-feature slot in the 5160 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 \times 350 pels, an 8 \times 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 \times 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 \times 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 5160 configuration that has another display adapter installed, which can be the Monochrome Display and Printer Adapter, the Color/Graphics Monitor Adapter, or the 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. DIP switches (or the slide switch on the 5170 Personal Computer AT or AT/370) on the system board must also be set as appropriate.

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 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 5160 configuration. 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 5160 Personal Computer XT.

One Professional Graphics Controller can be installed in a 5160 configuration. It requires two adjacent full-feature slots in the 5160 or 5161 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).

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 and 640 × 400 for emulation mode
- 256 colors from a palette of 4096 for expanded graphics mode
- 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

13:10 IBM 5160 Personal Computer XT System Unit

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 5160 configuration. When more than one such adapter is installed, all must be installed either in full-feature slots in the 5160 unit or in the 5161 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 5160 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 5160 configuration in special- or full-feature slots. If multiple adapters use the same interrupt level, they must all be installed in the same unit (5160 or 5161). An adapter can have up to 14 devices or instruments attached with a maximum of 48 devices/instruments in one 5160 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.

Binary Synchronous Communications (BSC) Adapter

One or two BSC adapters can be installed in a 5160 configuration unless the SDLC adapter is present, in which case only one BSC adapter can be installed. The adapter requires a full-feature slot in the 5160 or 5161. 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 5160 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 5160 to emulate 3270 interactive BSC operation and to perform file transfer operations. The adapter provides the ability for a 5160 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 5160 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 that supports this adapter 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 5160 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 5160:

- A 5160 using the DisplayWrite 2 program and a Displaywriter using the Displaywriter Binary Synchronous Communications Program. RFTDCA format files can be exchanged.
- A 5160 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 5160 and a 5150 Personal Computer, a 5155 Portable Personal Computer, a 5170 Personal Computer AT, or another 5160 Personal Computer XT that is also using the DisplayComm BCS program. Any DOS files, including object files, can be exchanged.
- A 5160 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 5160 as well, EBCDIC page image, EBCDIC card image, and RFTDCA files can be exchanged also.

Synchronous Data Link Control (SDLC) Communications Adapter

One SDLC Communications Adapter can be installed in a 5160 configuration and only one asynchronous adapter and one BSC adapter can be present in the 5160 configuration when the SDLC adapter is installed. One full-feature slot in the 5160 or 5161 unit is required. An external modem must be cable-connected between the SDLC adapter and a 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 5160 to emulate 3270 interactive SNA operation or 3770 batch SNA (SNA 3770 RJE). The adapter provides the ability for a 5160 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 5160 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 line speed supported is up to 4800 bps.

The IBM 8100 DPPX/SP Personal Computer RJE File Transfer PRPQ (5799-WXT) operating in an 8100 with DPPX/SP supports program and data file transfer between the 8100 system and a 5160 in which the SNA 3270 Emulation and RJE Support Program is operating. The 5160 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 5160 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 5160. Conversion of ASCII files to and from EBCDIC is supported. The 5160 configuration can be attached to the 8100 via a leased or dialed communications line.

A 5160 connected to a host processor (System/370, 30XX, or 4300) via the SDLC adapter can commu-

13:10 IBM 5160 Personal Computer XT System Unit

nicate 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 5160 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 5160 for printing on an attached 5152 Graphics Printer can be initiated from the host processor or by the 5160 user. Transfer of files to the 5160 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 5160 user to define the function of most of the 5160 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 5160 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 5160 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

The Communications Adapter Cable feature supports the attachment of a modem to the BSC adapter or SDLC adapter card connector at the rear of the 5160/5161. 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 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 5160 configuration. It requires one full-feature slot in the 5160 or 5161 unit.

This adapter in a 5160 configuration is supported by the following IBM-*logo* DOS application programs:

- 5520/Personal Computer Attachment Program (Versions 2 and 3) to permit 5160 systems to communicate with a 5520 Administrative System
- 5250 Emulation Program to permit a 5160 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 5160 system to communicate with a System/36 executing Attachment/36

This adapter, when used with the 5520/Personal Computer Attachment Program Version 2 or 3, allows a 5160 to be cable-attached to the 5520 Administrative System (any model) and to emulate the 5253 Display Station. Multiple 5253 displays and 5160 units can be cable-attached to the same 5520 system. One 5253 display must be included in the 5520 system configuration for service use. From five to 35 5160 systems can be attached to a 5525 System Unit (depending on the 5525 model) with up to 24 active concurrently.

When the 5160 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 5160 can also operate as a stand-alone IBM Personal Computer XT.

Any DOS-format diskette file created during 5160 stand-alone personal computer 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 docu-

ment and included in other 5520 documents that are to be printed.

A 5160 operating in 5253 emulation mode can emulate the 3278 Model 2 Display Station as of Version 2 of the 5520/Personal Computer Attachment Program. Version 3 supports all Version 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 Version 2. The 5520 can store DOS files in their 5160 format: binary, RFTDCA (reversible 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 5160.
- Transfer of RFTDCA, FFTDCA, and binary files from one 5160 to any other 5160 or 5253 in the configuration directly (without storing them in the 5520 document library first) and transfer of such files to a 5160 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 5160 DOS file can be transferred to a host processor direct access device, or a host processor data set can be transferred to the 5160. 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 5160 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 5160 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 2 or 3 can be purchased to provide the items necessary to permit attachment of the 5160 to the 5520 Administrative System and support 5253 emulation (Display Station Emulation Adapter, 5520/Personal Computer Attachment Program Version 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 2, G570-2047, or Version 3, G570-2115
- 5520/Personal Computer Attachment Program User's Guide Version 2, G570-2045, or Version 3, G570-2114
- 5520/Personal Computer Attachment Program Keyboard Template Version 2, G570-2046, or Version 3, G570-2118
- Display Station Emulation Adapter Installation and Problem Determination Procedures 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 5160 Personal Computer XT 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 5160 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 5160 can also operate as a stand-alone IBM Personal Computer XT.

When the appropriate File Support Utility PRPQ for the IBM Personal Computer XT is used in the host processor, the Display Station Emulation Adapter with the 5250 Emulation Program permits the 5160 to be attached to a host System/34/36/38 to create virtual diskettes on the host system. The 5160 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 5160 diskette, conversion of ASCII diskette 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

13:10 IBM 5160 Personal Computer XT System Unit

transferring data between the 5160 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 5160 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 5160 can be sorted in ascending or descending sequence. The data sent to the 5160 can be directed to the display, a printer, or a diskette (but not to a fixed disk or the virtual disks 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 and SC21-9080 for the System/38).

PC Support/36 provides all the functions of the System/36 File Support Utility PRPQ and the System/36 Transfer Facility PRPQ for a 5160 connected to a System/36 plus major enhancements. It can be used instead of the two PRPQs for communication between a 5160 and a System/36.

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 5160 print output to be directed to a System/36 printer. Data transfer from the 5160 to the System/36 is also supported.

PC Support/36 in the System/36 can be used with the following in the 5160 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 5160 to a System/34, System/36, or System/38 and support 5250 emulation (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 5160 with Data Edition and the 5250 Emulation Program under DOS Version 2.0 or 2.1, supports communication between a 5160 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 5160 Personal Computer XT
 - Copies data from file types supported by Data Edition in the 5160 Personal Computer XT 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 5160 Personal Computer XT 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 5160 Personal Computer XT programs and data at the System/36

- Printing of 5160 Personal Computer XT data on a System/36 printer and of System/36 output on a 5160 Personal Computer XT 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 5160 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 5160 can emulate a 5291 or 5292 display and a 5256 or 5219 printer. The 5160 system can also operate as a stand-alone IBM Personal Computer XT. Access to 5160 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 the 5160 to a System/34, System/36, or System/38 and perform 5250 emulation.

3278/79 Emulation Adapter

This adapter enables the 5160 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 5160 configuration and it requires one full-feature slot in the 5160 (not 5161) unit. The 5160 configuration must contain a color display for emulation of a 3279 Color Display Station.

The 3278/79 Emulation Adapter can also be installed in a 5160 with the IBM Personal Computer XT/370 Option Kit (feature 1509, which does not include the 3277 emulation card). See discussion under "IBM Personal Computer XT/370 Option Kits" later in this subsection.

When the 3278/79 Emulation Control Program is used, the 5160 can emulate the functions of a 3278 Display Station Model 2 or a 3279 Color Display Station Model 2A or S2A. The 5160 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 5160 Personal Computer XT session can be active concurrently and the 5160 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 Program.

A 5160 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 5160 is connected to a PROFS system via the Asynchronous Communications Adapter. See discussion of PROFS/PC² functions under "Asynchronous Communications Adapter" earlier in this subsection.

A 5160 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

13:10 IBM 5160 Personal Computer XT System Unit

3278/79 Emulation Control Program. See the discussion of Personal Services/PC facilities 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 5160 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 5160 Personal Computer XT
 - Copies 5160 Personal Computer XT 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 5160 Personal Computer XT virtual disks:
 - Simulates IBM personal computer fixed 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 5160 Personal Computer XT 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 5160 *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 5160 configuration to connect the 5160 to an available station address on a local or remote RLOOP in an 8100 Information System configuration. Remote attachment of the 5160 requires a 3843 Loop Control Unit.

A 5160 can be attached to a 9.6K-bps or a 38.4K-bps loop. Up to 26 5160 systems can be attached to a local 8100 loop, while up to 10 can be attached to a remote 8100 loop. A 5160 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 full-feature slot in the 5160 or 5161 unit. It is mutually exclusive with the SDLC adapter and cannot operate concurrently with an Asynchronous Communications Adapter installed in the same 5160 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 5160 is loop-connected to an 8100 operating with DPCX/DOSF Release 4 (or DPPX/SP):

- 3270 display emulation, which allows the 5160 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 5160 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 5160 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 5160 application. Up to two 3270 sessions between the 5160 and DPCX/DOSF or (DPPX/SP) are supported with the ability to swap screen ownership between two 3270 sessions and a normal 5160 session. A 5160 defined as a single-session or a multiple-session device can switch between these sessions. Up to five loop-attached 5160 systems can be defined as multiple-session devices.

- 3287 Printer emulation support, which permits the printer for the 5160 to function as a 3287 Printer. The printer session can operate simultaneously with the other 3270 emulation sessions. A 5160 must be defined as a multiple-session device to use 3287 Printer emulation.
- Bidirectional file transfer between the 5160 and the 8100. The 5160 can transfer personal computer data files to the 8100 for storage on disk. The files can be shared among all 5160 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 5160 and files can be converted from ASCII to EBCDIC format and vice versa.
- System/370 host file transfer, which permits transfers between 5160 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 5160 printer or diskette when there is an interactive session between a 5160 and an 8100 application or a host application.

DPCX/DOSF Release 4 also supports the exchange of documents created by the 5160 using the DisplayWrite 2 program and the 8100 using DOSF text displays. Thus, a 5160 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 5160 and DisplayWrite 2. A 5160 with DisplayWrite 2 can also exchange documents with DPCX/DOSF-attached Displaywriter users.

DPPX/SP Release 2 supports bidirectional transfer of documents between 8100 loop-attached 5160 systems and DPPX/SP Release 2. Also supported is the exchange of RFTDCA documents between 5160 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 5160 systems to the DPCX File Distribution Library and send files from this library to loop-attached 5160 systems.

This DPCX release also provides an application program interface that permits 8100 application programs to interface with applications executing in the loop-attached 5160 systems. This interface permits data files to be transferred between the 8100 and its loop-attached 5160 systems. In addition, all loop-attached 5160 systems can be defined as multiple-session devices using DPCX Release 5.

Cluster Adapter and Cluster Cable Kit

The Cluster Adapter installed in a 5160 Personal Computer XT 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 5160, 5150, 5155, 5170, and 5531 system in the clustered configuration must have the Cluster Adapter feature installed.

One Cluster Adapter can be installed in a full-feature slot in the 5160 or the 5161 unit. Each Cluster Adapter contains dual inline (DIP) switches for setting the station address of the cluster adapter (0 to 63) and whether a remote IPL of the 5160 is to occur at power-on of the 5160 configuration.

Up to 64 IBM personal computers can be interconnected to form a clustered multiuser configuration,

13:10 IBM 5160 Personal Computer XT System Unit

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 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 the 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 *5160 Guide to Operations* manual.

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 other personal computers in the cluster.

The fixed disk contains one read-only public volume for the cluster, which is accessible to all personal 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 personal 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 4860 Model 4 without a diskette drive to be included in a clustered configuration. Thus, a disk server is required if such a PCjr 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. The minimum configuration 5160 with the Cluster Adapter installed can be included in the cluster. If a 5160 is designated as the disk server computer, it must have 256Kb of memory and one fixed disk. The display for each 5160 in the cluster can be a monochrome or color display.

The cluster program requires a maximum of 29Kb of resident memory in the 5160. The requirement varies depending on the functions used (local or remote IPL and whether background message and file transfer is enabled). When a 5160 is used as the disk server, 136Kb of memory is required for the cluster program. DOS requirements (24Kb or 36Kb) must be added to the cluster program size to

determine the memory 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 drive. 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 overview information. 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 among 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). Optionally, a second IBM PC Network Adapter can be installed in a 5170 system unit (not supported by the IBM PC Network Program).

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 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 NETBIOS 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

13:10 IBM 5160 Personal Computer XT System Unit

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.

A 5160 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 commands 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 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 redirected 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 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

graphic 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 of 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 Adapter Cable, 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

13:10 IBM 5160 Personal Computer XT System Unit

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 5160. Data transfer at up to 400 Kb/sec is supported. The 5160 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 5160 configuration. The Series/1 to Personal Computer Attachment Cable feature provides a 12-foot cable to connect a Series/1 processor and a 5160 via the two provided cards. A 5160 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 5160 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 5160. 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:

- 5160 Personal Computer XT disk emulation services on Series/1 high capacity disks
- 5160 Personal Computer XT 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 5160 configuration via an Asynchronous Communications Adapter. The Compact Printer Connector Adapter (6450102) is also required. The 5160 can be a stand-alone system or part of an IBM personal computer cluster. When the 5160 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 5160
- One 5¼-inch diskette for the 5160 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-TR6) 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 5160, the Displaywriter is used for operational control. The following functions are supported:

- Transfer of documents and files from the Displaywriter to the 5160. Documents are converted to revisable form text document content architecture (RFTDCA) format before transfer to the 5160. Reportpack files are converted to a special interchange format before transfer to the 5160. Chartpack files cannot be sent to the 5160.
- Transfer of documents and files from the 5160 to the Displaywriter. RFTDCA documents are converted to Displaywriter format and Reportpack documents are converted to Displaywriter document format before the

13:10 IBM 5160 Personal Computer XT System Unit

transfer. It is recommended that only DOS print files be transferred to the Displaywriter.

- Display of the directories of the 5160 and the Displaywriter
- Deletion of documents and files on 5160 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 5160 in an IBM personal computer cluster, the functions listed for stand-alone connection are supported. In addition, the Displaywriter shares with its attached 5160 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 5160 Personal Computer XT 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 Monochrome Display and Printer Adapter in the 5160 configuration and permits the typewriter to be used as a letter-quality printer for the 5160 Personal Computer XT.

This attachment does not permit direct keyboarding from the typewriter to the 5160. 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 5160, 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 can handle paper up to 19.1 inches in width. A U.S. ASCII or U.S. Correspondence type element is supported for the typewriter.

MES 8569 for the 5160 provides the IPL/Diagnostic Diskette and a diagnostic tool. The diskette contains the program that operates in the 5160 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 5160 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 5160, 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 5160 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 5160 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.

Keylock Feature

The Keylock Feature is a simple mechanical device that can be installed on a 5160 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 5160/5161 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 5160/5161 unit is protected to prevent physical access to the contents of the 5160/5161 unit. This protects against removal of the fixed disk drives in a 5160/5161 unit as well as of the hardware installed in the 5160/5161 unit.

When the keylock is locked, 5160/5161 power-on can be done only by unlocking the keylock. Power-on using the power-on switch on the 5160/5161 unit is not possible. In addition, if the display installed does not receive power from the 5160 unit (5153 or 5154 display, for example), the access port to the 5160 is blocked to prevent the 5160 from being powered on through the access port. Without power on, access to the 5160 configuration via a local program, by another computer via a communications link, or via another personal computer cabled to the 5160 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 5160/5161 unit to the office furniture.

IBM Personal Computer XT/370 Option Kits

Two IBM Personal Computer XT/370 Option Kits are available. One of these features can be purchased to upgrade an IBM Personal Computer XT to an IBM Personal Computer XT/370. The 5160 unit must have 256Kb of memory on the system board and two or three available full-feature expansion slots. The Virtual Machine/Personal Computer (VM/PC) program, which operates under DOS Version 2.0 or later, supports the IBM Personal Computer XT/370 configuration.

The IBM Personal Computer XT/370 Option Kit with feature code 3891 contains a 3277 emulation card while the kit with feature code 1509 does not and is designed to be installed with the 3278/79 Emulation Adapter. Otherwise, the two kits are functionally identical.

The option kit with feature code 3891 provides the following:

- A set of three cards (PC/370-P, PC/370-M, and PC/3277EM) and three card support brackets. These cards must be installed in slots 4, 3, and 2, respectively, on the 5160 system board. These cards cannot be installed in the 5161 Expansion Unit.
- A logo kit to change the nameplate on the 5160 System Unit to "IBM Personal Computer XT/370"
- A cable to connect two of the three provided cards (PC/370-P and PC/370-M)
- Installation instructions
- The *Guide to Operations* for the IBM Personal Computer XT/370

If the IBM Personal Computer XT/370 configuration is to be attached to a control unit or processor adapter, a customer-supplied coaxial cable (of up to 2000 feet) is required. The configuration can then emulate a 3277 Model 2 display.

The option kit with feature code 1509 provides the following:

- A set of two cards (PC/370-P and PC/370-M) and two card support brackets. These cards must be installed in slots 4 and 3, respectively, on the 5160 system board. These cards cannot be installed in the 5161 Expansion Unit.

13:10 IBM 5160 Personal Computer XT System Unit

- A logo kit to change the nameplate on the 5160 System Unit to "IBM Personal Computer XT/370"
- A cable to connect the two provided cards
- Installation instructions
- The *Guide to Operations* for the IBM Personal Computer XT/370

The 3278/79 Emulation Adapter can be installed in an IBM Personal Computer XT/370 configuration that contains the above option kit (feature code 1509) to permit emulation of a 3278 Display Station Model 2 or 3279 Color Display Station Model 2A or S2A. The 5160 must be connected to one of the following via a customer-supplied coaxial cable:

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

Connection to one of the above via the IBM Cabling System is also supported.

When an IBM Personal Computer XT/370 Option Kit is installed in a 5160 System Unit, the configuration becomes an IBM Personal Computer XT/370 configuration and operates as such. See Section 14 for a description of the IBM Personal Computer XT/370 hardware and its programming support.

Single Unit Prices

Item	Part Number	Feature Code	Single Unit Purchase Price (\$)
5160 System Unit/Keyboard			
Model 68	5160068	—	2270
Model 78	5160078	—	2570
Model 87	5160087	—	3775
Model 86	5160086	—	3895
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
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
Fixed Disk Drive Adapter	1602501	2501	495
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 XT/370 Option Kit (with 3277 emulation card)	1503891	3891	3790
IBM Personal Computer XT/370 Option Kit (without 3277 emulation card)	6523710	1509	3095
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

13:10 IBM 5160 Personal Computer XT System Unit

Item	Part Number	Feature Code	Single Unit Purchase Price (\$)
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
10Mb Fixed Disk Drive	1602500	2500	1195
256Kb Memory Expansion Option	1501209	1209	489
3278/79 Emulation Adapter	1602507	2507	905
5178 PC Network Translator Unit	5178001	—	595
Transformer unit for IBM 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
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 2	6109564	2882	1013
Version 3	6403724	2896	1113
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 5160 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.

13:15 5161 Expansion Unit Models 1 and 2

Introduction

The 5161 Expansion Unit provides fixed disk storage and additional expansion slots for the 5160 Personal Computer XT. The expansion slots allow for the installation of optional feature cards to extend the capabilities of the 5160 configuration. For a photo of the 5161 unit, see Figure 11-3 in Section 11:15.

One 5161 Model 1 can be attached to a 5160 System Unit Model 68 or 78. One 5161 Model 2 can be attached to a 5160 System Unit Model 87 or 86. The 5161 can be field-installed and is a customer-setup unit. It can be placed beside the 5160 System Unit or stacked over or under the 5160 unit. If the 5161 is placed beside or on top of the 5160 unit, a display or printer can be placed on 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 13:10 under "Keylock Feature."

Physical Components

The 5161 Model 2 unit contains the following standard items:

- Eight expansion slots for optional feature cards (provided on an expansion board)
- One 10Mb Fixed Disk Drive
- The receiver card required for connection to the 5160 System Unit (uses one slot in the 5161)
- A 130-watt power supply with cooling fan (same as in the 5160)

The 5161 Model 1 unit has the same features as the 5161 Model 2 plus one Fixed Disk Drive Adapter.

A 39-inch (one-meter) signal cable to connect the 5161 and 5160 and an extender card that must be installed in a full-feature slot in the 5160 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 5160. The 5161 unit has the same dimensions as a 5160 System Unit and weighs approximately 27 lb (12.2 kg) with one fixed disk installed.

Approximate dimensions of the 5161 unit 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 the 5161 unit 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 5161 receiver card. Another full-feature slot is required for the Fixed Disk Drive Adapter, which together with the 10Mb Fixed Disk Drive must be moved to the 5161 Model 2 unit from the 5160 unit when the 5161 is included in a 5160 Model 87 or 86 configuration. The 10Mb Fixed Disk Drive in the 5160 Model 87 or 86 unit must also be moved to the 5161 unit.

The following optional features for 5160 Personal Computer XT configurations can be installed in the six available slots in the 5161 unit:

- Game Control Adapter (special- or full-feature)
- Prototype Card (full-feature)
- Monochrome Display and Printer Adapter (full-feature) only if another display adapter is installed in the 5160 unit
- Color/Graphics Monitor Adapter (full-feature) only if another display adapter is installed in the 5160 unit
- Printer Adapter (special- or full-feature)
- Professional Graphics Controller (two adjacent full-feature)

13:15 5161 Expansion Unit Models 1 and 2

- Data Acquisition and Control Adapter (full-feature)
- General Purpose Interface Bus Adapter (special- or full-feature)
- Binary Synchronous Communications Adapter (full-feature)
- Synchronous Data Link Control (SDLC) Communications Adapter (full-feature)
- Asynchronous Communications Adapter (if the SDLC adapter is not installed) – special- or full-feature
- Display Station Emulation Adapter (full-feature)
- Enhanced Display Station Emulation Adapter (full-feature)
- 8100 PC Adapter (full-feature)
- Cluster Adapter (full-feature)

10Mb Fixed Disk Drive

One 10Mb Fixed Disk Drive is standard in the 5161 Model 1 or 2 unit to provide 10,618,880 bytes of fixed disk storage. This disk drive attaches to the Fixed Disk Drive Adapter. One additional 10Mb Fixed Disk Drive can be installed in a 5161 Model 1 or 2 to provide 20Mb (21,237,760 bytes) of fixed disk storage. The two 10Mb Fixed Disk Drives, have the same characteristics (as described under "10Mb Fixed Disk Drive" in Section 13:10). The first fixed disk drive is addressed as C and the second is addressed as D.

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 shut-down of power to the 5161 occurs if an overvoltage or overcurrent condition is detected. A system shut-down 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
5161 Expansion Unit Model 2 (5161002)	2090
10Mb Fixed Disk Drive (1602500) (2500)	1195
Fixed Disk Drive Adapter (1602501) (2501)	495
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.

Section 14: IBM Personal Computer XT/370



Announced October 18, 1983

14:05 IBM Personal Computer XT/370 Configuration Overview

Introduction

The IBM Personal Computer XT/370 (PC XT/370) is an extended version of the IBM Personal Computer XT that can execute most System/370 instructions as well as the IBM Personal Computer XT (Intel 8088) instruction set. It is a desktop System/370 intelligent workstation that can be connected to and interact with a variety of host processors. As a System/370 workstation, the PC XT/370 configuration provides compatibility with System/370 architecture host processors, and PC XT/370 programming support provides a terminal environment familiar to VM/CMS users.

The PC XT/370 can operate in Personal Computer (PC) mode or in Virtual Machine/Personal Computer (VM/PC) mode (one mode at a time). When PC mode is in effect, the PC XT/370 operates as an IBM Personal Computer XT and the operating systems and most application programs that are available for the IBM Personal Computer XT can be executed. When it is operating in VM/PC mode, the PC XT/370 is supported by the Virtual Machine/Personal Computer (VM/PC) licensed program operating under the IBM Personal Computer Disk Operating System (DOS). VM/PC is functionally similar to Virtual Machine/System Product (VM/SP).

VM/PC supports three major facilities: local VM/CMS operation, remote 3277 or 3278/3279 emulation, and remote 3101 emulation. All three facilities (called sessions) can be in effect concurrently and the operator determines which is the currently active session (the one with which operator interaction can occur using the keyboard).

Local VM/CMS operation permits the PC XT/370 to operate in stand-alone mode (without communication with a host processor) as a CMS virtual machine to execute most VM/CMS programs. This facility can be used for program development and program execution.

Remote 3278/3279 emulation permits the PC XT/370 to emulate a remote 3278 Display Station Model 2 or 3279 Color Display Station Model 2A or S2A for communication as a nonintelligent terminal with a host processor to which a 3278 or 3279 can be attached, respectively. Remote 3277 emulation permits the PC XT/370 to emulate a remote 3277 Display Station Model 2 for communication as a nonintelligent terminal with any host processor to which a 3277 can be attached.

The remote 327X emulation facility, for example, permits a user to log on to a VM/370 system using the PC XT/370 as the virtual operator's console and to execute programs in a virtual machine supported by the host VM/370 system.

Access to VM/370 host processor resources for use in a PC XT/370 local CMS virtual machine is also supported using remote 327X emulation when the Remote Server Program (VMPCSERV) that is part of VM/PC executes in the VM/370 host processor virtual machine. The exchange of programs and data between the PC XT/370 local CMS virtual machine and a VM/370 host processor executing VMPCSERV is supported.

The TSO Host Server program offering (TSOSERV) provides facilities similar to those provided by VMPCSERV for communication with a remote host MVS/370 or MVS/XA processor via an SNA or BSC network using ACF/VTAM. When TSOSERV is used in the host processor, VM/PC remote 327X emulation support permits a user to access MVS host processor resources for use in the PC XT/370 local CMS virtual machine, to exchange data files between the PC XT/370 and the MVS host processor, and to issue certain TSO commands from the PC XT/370 CMS virtual machine for execution in the MVS host processor.

Using the 3101 Emulation Program as an application program with VM/PC, the PC XT/370 can emulate a remote 3101 Display Terminal Model 20 for communication with a host processor to which a 3101 can be attached. All the facilities supported by the 3101 Emulation Program are available to the PC XT/370 user. VM/PC functions are discussed in Section 14:20.

The PC XT/370 configuration is designed for data processing, engineering/scientific, and business professionals. It permits them to interact with a host processor to develop programs (using VM/CMS and/or MVS/TSO, for example), interactively develop and/or execute VM/CMS programs in the PC XT/370, and develop and/or execute IBM personal computer programs at their own workstation. Access to a host processor to download and upload programs and data is also supported.

The PC XT/370 configuration can particularly benefit VM/370 and/or combined VM/370-MVS installations with a heavy CMS workload or a backlog of work at the host processor. It permits

applications to be offloaded from the host processor to PC XT/370 workstations, thereby lessening host processor hardware resource constraints and moving the offloaded applications closer to the end-user. Improved productivity for the end-user can result from consistent response times, user control of the computing resources, and increased availability of computer resources. In addition, since data can be kept in the PC XT/370, better security can be maintained for sensitive data.

The PC XT/370 can be installed without connection to a host processor to operate as a desktop System/370 VM/CMS processor. The PC XT/370 configuration is compact and suitable for home as well as office environments.

Physical Components

The following IBM-logo personal computer units can be included in a PC XT/370 configuration supported by VM/PC as of Release 1.1:

- 5160 System Unit/Keyboard Model 589, 568, or 588 (Models 568 and 588 have been withdrawn from marketing)
- 5161 Expansion Unit Models 1, 2, and 3
- 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
- 5152 Matrix Printer Model 1 (no longer marketed by IBM)

The PC XT/370 can also be connected to various processors and other I/O devices for operation under DOS without VM/PC or under another operating system.

Minimum Configuration

Every PC XT/370 configuration that is to use the VM/PC program must contain a system unit/keyboard, one display device, one diskette drive, and one fixed disk drive. The minimum PC XT/370 configuration for operation with the VM/PC program consists of the following:

- One 5160 System Unit/Keyboard Model 589 (which contains a diskette drive, a fixed disk drive, and the 3278/79 Emulation Adapter)

- 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)
 - 5154 Enhanced Color Display (Color/Graphics Monitor Adapter or Enhanced Graphics Adapter required)
 - 5175 Professional Graphics Display (Professional Graphics Controller required)
 - Customer-supplied direct-drive or composite video color or black and white video monitor (Color/Graphics Monitor Adapter required)

The price of a single minimum PC XT/370 (5160 Model 589) hardware configuration for use with VM/PC, assuming a 5151 Monochrome Display attached to the Monochrome Display and Printer Adapter, is \$8,420. Adding the price of the Disk Operating System Version 2.1 and VM/PC Release 1.1 to the hardware cost gives a single minimum PC XT/370 workstation cost of \$9,635.

If a PC XT/370 configuration without 327X emulation is desired, a 5160 Personal Computer XT (5160 Model 86) with the IBM Personal Computer XT/370 Option Kit that does not include 327X emulation (the one with feature code 1509) should be ordered.

Configuration Features

The following highlights the features of PC XT/370 configurations, including memory sizes, types and number of attachable I/O devices, and the processors/units to which a PC XT/370 can be connected. Items identified by an asterisk (*) are not supported by the VM/PC program and can be used only during PC mode of operation.

- One 5160 System Unit/Keyboard Model 589 with the Intel 8088 microprocessor and additional cards that permit System/370 instructions to be executed, provide additional random access memory, and provide 3277 or 3278/3279 emulation
- 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 of 480K bytes for VM/PC mode operations and of 640K bytes for PC mode operations

14:05 IBM Personal Computer XT/370 Configuration Overview

- Math Co-processor Option to increase the speed and precision of arithmetic, logarithmic, and trigonometric functions*
- One or two IBM 5¼-inch double-sided diskette drives installed in the 5160 unit providing 360Kb (368,640 bytes) each for a maximum of 720Kb (737,280 bytes) 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 for a maximum capacity of 20Mb (21,237,760 bytes) of online fixed disk storage. Two internal diskette drives, two external diskette drives, and two fixed disk drives can be installed in a PC XT/370 configuration when the 5161 Expansion Unit is present.
- Up to two or four displays, depending on the display adapters installed
- One or two parallel printers via the printer adapters and one or two serial printers via the Asynchronous Communications Adapters
- One 5175 Professional Graphics Display via the Professional Graphics Controller to provide advanced graphics application support in PC mode. 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 PC XT/370 to emulate the Tektronix™ 4010 and 4100 protocols and the Lear Siegler ADM3A terminal using an IBM display and the Graphics Development ToolKit.*
- Connection to a 3274 Control Unit, 4321/4331/4361 Display/Printer Adapter, 4361 Workstation Adapter, or 4701 Device Cluster Adapter via coaxial cable for communication with a local or remote host processor using VM/PC and remote 3278 or 3279 emulation
- Connection to a 3274 Control Unit via a coaxial cable for communication with a local or remote host processor using VM/PC and remote 3277 emulation
- Asynchronous Communications Adapter for connection to:
 - A remote host processor (System/370, 30XX, 4300, 8100, Series/1, for example) to perform 3101 emulation for VM/PC mode or PC mode operations
 - 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT, another 5160 Personal Computer XT/370, 5170 Personal Computer AT or AT/370, 3270 Personal Computer workstation, or 5531 Industrial Computer*
 - 7371 or 7372 Color Plotter (desktop plotters) via cable connection to the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter. The PC XT/370 can be a stand-alone system or connected to a host System/370, 30XX, or 4300 processor.*
 - 7374 or 7375 Color Plotter when the PC XT/370 is connected to a host System/370, 30XX, or 4300 processor. Attachment of the plotter to the 5160 is via a cable connected to the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter.*
 - A paper tape reader, a communicating typewriter, a laboratory instrument, a letter-quality printer, or other machines that use the RS-232C interface*
- Binary Synchronous Communications Adapter for connection to a System/370, 30XX, 4300, or Series/1 processor*
- Synchronous Data Link Control (SDLC) Communications Adapter for connection to a System/370, 30XX, 4300, 8100, or Series/1 processor*
- Display Station Emulation Adapter (for cable attachment of the PC XT/370 to a 5520 Administrative System)*
- Data security via the Keylock Feature
- Programmable speaker*
- Connection to the following*:
 - 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) via 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) using the IBM PC Network Translator Unit, IBM PC Network Adapters, and IBM PC Network Cabling Components to form an IBM PC Network
 - 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
 - Custom attachments via the Prototype Card

Up to three communications adapters (of more than one type, if desired) can be installed in the same PC XT/370 configuration. The limit for each type is two for the asynchronous adapter, two for the BSC adapter, and one for the SDLC adapter. When the SDLC adapter is installed, only one asynchronous adapter and one BSC adapter can be installed as well. Alternatively, two BSC adapters and one asynchronous adapter can be the three installed communications adapters.

If desired, the PC XT/370 can be connected to the IBM Cabling System for attachment to the 3274 Control Unit, 4321/4331/4361 Display/Printer Adapter, 4701 Device Cluster Adapter, or 5520 Administrative System.

Operating Systems Supporting

When operating in VM/PC mode, the PC XT/370 is supported by Virtual Machine/Personal Computer (VM/PC), which is a licensed program that operates under DOS Version 2.0 or later (or equivalent).

When operating in PC mode, the PC XT/370 is supported by the IBM Personal Computer Disk Operating System (DOS) Version 2.0 or later (or equivalent), IBM Personal Computer Interactive Executive (PC/IX), and CP/M-86™. For PC mode, application programs that execute in the IBM Personal Computer XT under DOS Version 2.0 or later can execute in a PC XT/370 configuration that has the required hardware resources.

Compatibility

Hardware

The 5160 Personal Computer XT/370 operating in PC mode is compatible with the 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT, 5170 Personal Computer AT and AT/370, 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 are fully compatible among these units for personal computer mode operations. The 80286 microprocessor in the 5170 operating in real address mode is upward-compatible with the 8088 microprocessor.

The 5160 PC XT/370 operating in VM/PC mode is compatible only with the 5170 Personal Computer AT/370 configuration operating in VM/PC mode.

Diskettes are interchangeable without restriction among 4860 PCjr, 5150 Personal Computer, 5160 Personal Computer XT and XT/370, 5155 Portable Personal Computer, 5170 Personal Computer AT and AT/370 (160/180Kb and 320/360Kb capacities only), 3270 Personal Computer workstation, and 5531 Industrial Computer configurations. The 5160 Personal Computer XT/370 does not provide a cassette adapter (as do the PCjr and 5150 Personal Computer) or support program cartridges (as does the PCjr).

Programming

Programs that execute in a PC XT/370 operating in PC mode can also operate in an IBM Personal Computer, IBM Portable Personal Computer, or IBM Personal Computer XT as long as the configuration contains the required memory, features, and I/O devices. For compatibility with PCjr configurations, see discussion in Section 10:05 under "Compatibility." Most programs can also operate in an IBM Personal Computer AT or AT/370.

Customer Responsibilities

The 5160 Personal Computer XT/370 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 PC XT/370 configuration (see "Physical Components" earlier in this subsection) except for the 5151 Monochrome Display, which receives power from the 5160 System Unit or 5161 Expansion Unit.

Data Security

The customer is responsible for providing any desired data security functions. Programs and hardware that perform data encryption and decryption can be installed in a PC XT/370 configuration. The Data Encoder program (6024149) that performs data encryption and decryption is available from IBM.

The optional Keylock Feature can be installed in the 5160 System Unit and/or 5161 Expansion Unit to prevent physical and programmed access to the

physical and data contents of the 5160 and/or 5161 unit when the keylock is in the locked position. See description of this feature in Section 14:10 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 5160 Personal Computer XT/370 IBM-logo units and features are purchase only. A PC XT/370 configuration can be purchased from NAD and NMD marketing representatives. IBM Credit Corporation Term Lease Financing may be available for PC XT/370 configurations.

Warranty Period

The warranty period for 5160 and 5161 units and their optional features for the PC XT/370 configuration is three months except for the 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, and General Purpose Interface Bus Adapter, for which a one-year warranty period is provided. The warranty service for 5160 and 5161 units is Customer Carry-In Repair.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Centers:
 - Warranty Option. For 5160 and 5161 units, IBM On-Site Repair is available.
 - Annual Maintenance. For 5160 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

Publications

The following publications are provided with each PC XT/370 configuration:

- *Guide to Operations* for the Personal Computer XT (6322511). This binder contains setup and starting instructions, keyboard information, instructions for installing each optional feature ordered for the configuration, testing information, and a diagnostics diskette.
- *Guide to Operations* for the Personal Computer XT/370. This binder provides additional operating information, problem determination procedures, and a diagnostics diskette.
- *BASIC* (6361132). This binder describes the functions provided by the BASIC Interpreter that is included in ROM in a PC XT/370 configuration.

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

- *IBM Personal Computer XT/IBM Portable Personal Computer System Technical Reference* (6322508) – \$30. This reference describes the system board, Math Co-processor Option, power supply, keyboard, and communications functions and lists the 8088 instruction set and Basic Input/Output System (BIOS) instructions, which are common to IBM Personal Computer XT and XT/370 configurations.
- *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 AT, and IBM Personal Computer XT/370 and AT/370.
- *Technical Reference for the IBM Personal Computer XT/370* (6936732) – \$28. This reference describes the hardware that is added to an IBM Personal Computer XT to enable it to execute System/370 instructions and to emulate a 3277 display.
- *3278/79 Emulation Adapter Technical Addendum* (632236) – \$16
- *Hardware Maintenance and Service* for the IBM Personal Computer XT (6322513 – \$295) and that for the IBM Personal Computer XT/370 (6936731 – \$60). These manuals provide procedures and advanced diagnostics diskettes to isolate a problem to a field replaceable unit.
- *Hardware Maintenance and Service for the 3278/79 Emulation Adapter* (6322980) – \$22

- *VM/PC Primer Version 1.0* (6024174) or *Version 1.1* (6024176) – \$18. This primer supplements the *VM/PC User's Guide*, SC24-5254, and is designed to introduce the user to VM/PC facilities.

The following form-numbered items that contain hardware and programming information about the PC XT/370 are available:

- *IBM Personal Computer XT/370 Facts Folder*, G520-1095
- *IBM Personal Computer 370 Workstations Executive Brochure*, G520-5038
- *IBM PC/370 Workstations Presentation Guide*, G320-0757
- *VM/PC User's Guide*, SC24-5254. One copy is provided with the VM/PC licensed program. Additional copies can be purchased for \$22 each.
- *VM/PC System/370 Language Supplement*, SC26-4120 – \$6
- *TSO Host Server for the IBM PC XT/370 and PC AT/370*:
 - *User's Guide*, SC28-1390
 - *Program Description/Operations Manual*, SC28-1391
 - *Availability Notice*, SC28-1392

See "Publications" in Section 13:05 for publications that describe application programs that operate under DOS in an IBM Personal Computer XT and that may also execute in a PC XT/370 operating in PC mode.

14:10 IBM 5160 Personal Computer XT/370 System Unit

Models Available

The 5160 models for a PC XT/370 configuration differ only in the standard features provided. Otherwise, they are functionally and physically identical. The following 5160 model is currently available for a PC XT/370 configuration:

- Model 589:
 - System Unit/Keyboard
 - 480Kb random access memory for VM/PC mode
 - 640Kb random access memory for PC mode
 - 5¼-Inch Diskette Drive Adapter
 - One 5¼-Inch Double-Sided Diskette Drive
 - Fixed Disk Drive Adapter
 - One 10Mb Fixed Disk Drive
 - 3278/79 Emulation Adapter
 - Asynchronous Communications Adapter

The following two 5160 models for a PC XT/370 configuration have been withdrawn from marketing but can be upgraded with optional features discussed in this section:

- Model 568:
 - System Unit/Keyboard
 - 480Kb random access memory for VM/PC mode
 - 640Kb random access memory for PC mode
 - 5¼-Inch Diskette Drive Adapter
 - One 5¼-Inch Double-Sided Diskette Drive
 - 3277 Model 2 Device Emulation Card
- Model 588:
 - System Unit/Keyboard
 - 480Kb random access memory for VM/PC mode
 - 640Kb random access memory for PC mode
 - 5¼-Inch Diskette Drive Adapter
 - One 5¼-Inch Double-Sided Diskette Drive
 - Fixed Disk Drive Adapter
 - One 10Mb Fixed Disk Drive
 - 3277 Model 2 Device Emulation Card

Installed 5160 Models 568 and 588 can be configured to support 3278/79 instead of 3277 emulation by removing the 3277 Model 2 Device Emulation Card and replacing it with the 3278/79 Emulation Adapter. Version 1.1 of VM/PC must be installed to support 3278/3279 emulation for VM/PC mode operations.

The 5160 System Unit for the IBM PC XT/370 configuration is shown on page 14-1.

Physical Characteristics

Dimensions (approximate)

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

Weight (approximate)

- Model: 589 34 lb (15.4 kg)
- Model: 588 34 lb (15.4 kg)
- Model: 568 29 lb (13.2 kg)

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 5160 System Unit
- Humidity:
 - 8% to 80% for system on
 - 20% to 80% for system off
- Noise level:
 - 59 decibels (dB) without printer
 - 66 decibels with printer
- Electrical:
 - 90 to 137 volts AC, 60 Hz
 - 180 to 259 volts AC, 50 Hz

Standard Features

The following are standard features of 5160 Models 589, 568, and 588. Each feature is discussed under "Standard Feature Descriptions" in this subsection.

- Microprocessor – Intel 8088
- Eight interrupt levels
- Direct memory access (DMA) – three channels
- 40K bytes of read only memory (ROM)
- BASIC-80 Interpreter in ROM
- IBM Personal Computer XT/370 processor card (PC/370-P card)
- IBM Personal Computer XT/370 512Kb memory card (PC/370-M card)
- 3278/79 Emulation Adapter (Model 589 only)

- 3277 Model 2 Device Emulation Card (PC/3277EM card) – Models 568 and 588 only
- 256K (262,144) bytes of random access memory (RAM) on the system board
- Eight system expansion slots to hold feature cards
- A programmable speaker and associated adapter
- 5¼-Inch Diskette Drive Adapter
- One 5¼-Inch Double-Sided Diskette Drive
- One Fixed Disk Drive Adapter (Models 588 and 589 only)
- One 10Mb Fixed Disk Drive (Models 588 and 589 only)
- One Expansion Unit Adapter (Model 568 only)
- Asynchronous Communications Adapter (Model 589 only)
- Keyboard adapter and 83-key keyboard
- Automatic power-on self-test
- A 130-watt power supply with cooling fan

Optional Features

The following are optional features of 5160 Model 589, 568, and 588 configurations that are supported by VM/PC for VM/PC mode operations:

- One display:
 - 5151 Monochrome Display Model 1 attached via the Enhanced Graphics Adapter or the Monochrome Display and Printer Adapter
 - 5153 Color Display Model 1 attached via the Enhanced Graphics Adapter or the Color/Graphics Monitor Adapter
 - 5154 Enhanced Color Display attached via the Enhanced Graphics Adapter or Color/Graphics Monitor Adapter
 - 5175 Professional Graphics Display attached via the Professional Graphics Controller
- VM/PC Release 1.1 is required to support the Enhanced Graphics Adapter or 5175 display.
- One 5152 Graphics Printer Model 2 attached via the Monochrome Display and Printer Adapter or via the Printer Adapter. Attachment of a printer is optional.
- One additional 5¼-Inch Double-Sided Diskette Drive (two diskette drives)
- One additional 10Mb Fixed Disk Drive (two fixed disk drives)
- Asynchronous Communications Adapter (one maximum) – standard in the 5160 Model 589 only
- Keylock Feature (one for the 5160 and one for the 5161) – no programming support required

The following are optional features that can be used only during PC mode operations (they are not supported by VM/PC):

- Math Co-processor Option (one maximum)
- Prototype Card (one maximum)
- Game Control Adapter (one maximum)
- Data Acquisition and Control Adapter (four maximum)
- General Purpose Interface Bus Adapter (four maximum)
- Cluster Adapter (one maximum) and Cluster Cable Kit
- IBM PC Network Adapter (one maximum)
- Binary Synchronous Communications (BSC) Adapter (two maximum unless the SDLC Communications Adapter is installed, then one maximum)
- Synchronous Data Link Control (SDLC) Communications Adapter (one maximum)
- Display Station Emulation Adapter (one maximum)
- A second Asynchronous Communications Adapter if the SDLC adapter is not installed

Each optional feature listed above for IBM PC XT/370 configurations is discussed under “Optional Feature Descriptions” in this subsection.

The following optional features or connections that are available for the 5160 Personal Computer XT should operate in the PC XT/370 in PC mode but have not been tested by IBM to assure viability:

- 8100 PC Adapter for connection of the PC XT/370 to an 8100 Processor loop
- IBM 65/85/95-PC IPL/Diagnostic Diskette and Diagnostic Tool (MES 8569) to support connection of the PC XT/370 to an IBM Electronic Typewriter 65, 85, or 95 via the Printer Adapter or Monochrome Display and Printer Adapter
- 5218 Printer Attachment Cable for connection of the PC XT/370 to a 5218 Printwheel Printer Model A03 or A04 via the Asynchronous Communications Adapter for letter-quality printing
- Displaywriter/Personal Computer Attach Convenience Kit for connection of the PC XT/370 to a Displaywriter via cable attachment to the Asynchronous Communications Adapter for document exchange using the DisplayWrite 2 or DisplayWrite 3 program in the PC XT/370
- Connection to a remote VM/370 PROFS system using the Asynchronous Communications Adapter with the PROFS Personal Computer Connection (PROFS/PC²) program operating in the PC XT/370
- Connection to a videotex host via the Asynchronous Communications Adapter to use the PC

14:10 IBM 5160 Personal Computer XT/370 System Unit

XT/370 as a videotex terminal operating with the PC/Videotex program

- Connection to a remote Displaywriter, 6670 Information Distributor, 5520 Administrative System, or Office System 6 via the Binary Synchronous Communications Adapter for document interchange using the DisplayComm Binary Synchronous Communications program in the PC XT/370

The facilities for the 5160 Personal Computer XT listed above are designed to be used only during PC mode operation of a PC XT/370. For a description of these features and connections, see the descriptions in the 5160 Personal Computer XT section (13:10).

Physical Components Included

Each 5160 Model 589, 568, or 588 System Unit contains the system board, the programmable speaker, and the power supply and fan. The standard diskette drive in all models and the standard fixed disk drive in a 5160 Model 588 or 589 are also housed in the 5160 System Unit. Certain optional features for a 5160 configuration must be installed only in the 5160 System Unit or, because of 5160 slot unavailability, can be installed only in the optional 5161 Expansion Unit. Others can be installed in the 5160 or 5161 unit.

Each 5160 Model 589, 568, or 588 system board contains:

- The Intel 8088 microprocessor and associated functions
- Read only memory (40K bytes)
- Random access memory (256K bytes)
- The keyboard adapter
- The programmable speaker adapter
- Eight system expansion slots that are used to hold feature cards. Six slots in Models 568 and 588 and seven slots in the Model 589 are used by standard and required feature cards.
- Socket for the Math Co-processor Option module

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

The 5160 is delivered with the DIP switches set for the configuration ordered. If optional features are added to a 5160 configuration thereafter, the customer must set the appropriate switches, if required, as per the supplied instructions in the *Guide to Operations*.

Most optional features tested for the PC XT/370 are installed inside the 5160 or 5161 unit. Feature cards plug into expansion slots provided in the left rear corner of the system board in the 5160 or 5161. 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 is removed from the rear panel of the 5160 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

8088 Microprocessor and Direct Memory Access

The instruction execution function for PC mode operations is the Intel 8088 16-bit microprocessor with a 4.77-megahertz (MHz) clock speed and 410-ns cycle time. The 8088 also executes DOS and a portion of the VM/PC program during VM/PC mode operations. It can address 1024K bytes of memory using a 20-bit address and up to 768 I/O devices. The direct memory access (DMA) facility is provided to enable I/O operations to be overlapped with instruction execution.

The Intel 8088 microprocessor and DMA in the PC XT/370 and the IBM Personal Computer XT are the same (see description in Section 13:10 under "Microprocessor").

Read Only Memory

The PC XT/370 contains 40K bytes of read only memory (ROM) on the system board. The contents of ROM remain when power to the 5160 System Unit is turned off and writing to this memory cannot be done. ROM is used for the permanent residence of certain programs. It is addressed using the highest 40K addresses in the 1024K-byte address space accessible to the 8088 microprocessor. ROM is also present on certain feature cards to provide device level control for the device attached to the adapter card.

ROM contains the power-on self-test program, diskette bootstrap loader, Basic Input/Output System (BIOS), time-of-day clock, BASIC Interpreter, and a code to indicate this unit is a 5160. These facilities are the same in PC XT/370 and PC XT configurations (see description in Section 13:10 under "Read Only Memory").

Once the 5160 unit has been turned on and the self-test diagnostics have been executed successfully, an attempt is made to initial program load (IPL) an operating system from diskette drive A (leftmost drive) or from the first fixed disk (C) drive. The BASIC Interpreter is made ready and identified on the screen if an IPL has not occurred.

Random Access Memory on the System Board

Random access memory (RAM) is read/write program-addressable memory. The 256Kb on the system board is dynamic memory (its contents must be refreshed periodically) and its contents are lost when power to the 5160 is removed. This memory is parity-checked for validity and has a 200-ns access time and a 345-ns cycle time. Additional memory for the PC XT/370 is provided on the 512Kb Memory Card. All memory available for the PC XT/370 is standard.

Processor (PC/370-P) Card

The PC/370-P card is standard in 5160 Models 589, 568, and 588. It executes System/370 instructions during VM/PC mode operations. Specifically, the CP and CMS portions of VM/PC and the executing CMS application program are executed by the PC/370-P card. Communication between the PC/370-P card and the 8088 microprocessor is done via interrupts.

The PC/370-P card contains three microprocessors, a page table, and associated circuitry. The first microprocessor (Motorola 68000) executes most of the commonly used fixed-point System/370 instructions. It performs all instruction fetches, instruction decoding, and effective address calculations. The general registers and program status word are kept in this microprocessor.

A second microprocessor (Intel 8087 coprocessor) executes System/370 floating-point instructions. The floating-point registers are kept in this microprocessor.

A third microprocessor (Motorola 68000) emulates the remaining non-floating-point System/370 instructions that are implemented in the PC

XT/370, interprets the Diagnose instruction, manipulates the page table, handles exception conditions, and performs hardware housekeeping as required.

The PC XT/370 executes 147 System/370 instructions. The instructions supported are those in the following groups as defined in the *System/370 Principles of Operation*, GA22-7000 (also see PC XT/370 *Technical Reference*):

- Commercial instruction set*
- Translation*
- Conditional swapping
- CPU timer and clock comparator
- Floating point
- Extended precision floating point
- MOVE INVERSE instruction
- PSW key handling

* Certain deviations are implemented (see *Technical Reference* for the PC XT/370)

The System/370 time-of-day clock is supported using the PC XT/370 timer and is kept accurate to the nearest 65 ms. An interval timer is not supported.

The page table is used to perform virtual-to-real address translation when dynamic address translation is enabled for VM/PC mode operations. It consists of three static random access memory devices arranged in a 1024 × 12 bit array. Each entry represents one 4096-byte virtual page and contains the associated real page number and status bits (reference, change, page fault, parity, and invalid real memory address). A virtual storage size of 4 megabytes is supported by this page table. A page size of 4K bytes and a segment size of 64K or 1024K bytes are supported.

The processor (PC/370-P) card is connected to the memory (PC/370-M) card by a one-inch (25.4-mm) cable.

512Kb Memory (PC/370-M) Card

This card is standard in 5160 Models 589, 568, and 588. It contains 512Kb of parity-checked random access memory that can be accessed by the PC/370-P card or the PC XT/370 logic. Concurrent requests for memory access are handled on a priority basis with the PC XT/370 logic receiving the higher priority.

This 512Kb memory is viewed in PC mode as a contiguous memory area that begins at the end of the 256Kb contained on the system board. In PC mode, the PC XT/370 has 640Kb of usable memory

(256Kb on the system board and 384Kb on the 512Kb Memory Card). The memory on the 512Kb Memory Card operates marginally slower than the 256Kb of memory on the system board.

For VM/PC mode, the 512Kb memory is viewed by the PC/370-P card as two separate areas that are not contiguously addressable. The first 480Kb area is addressed as 0 to 480Kb and is used as the System/370 real memory area. The 32Kb area above the first 480Kb is addressed as 0 to 32Kb and is used as control storage for a microprocessor on the PC/370-P card.

The VM/PC Release 1.0 program requires 64K bytes of memory for its residence, which leaves 416K bytes available for CMS (requires 80Kb) and the application program (up to 336Kb). VM/PC Release 1.1 requires 69Kb for residence, leaving 411Kb for CMS and the application program.

3278/79 Emulation Adapter

The 3278/79 Emulation Adapter is standard in a 5160 Model 589. Optionally, it can be installed in a 5160 Model 568 or 588 to replace the 3277 Model 2 Device Emulation Card.

This adapter permits a PC XT/370 to be attached via customer-supplied coaxial cable to one of the following:

- 3274 Control Unit Category A terminal port (maximum cable length of 4920 feet, or 1500 meters)
- 4321, 4332, or 4361 Processor via the Display/Printer Adapter
- 4361 Processor via the Workstation Adapter
- 4701 Finance Communication Controller with the Device Cluster Adapter

This adapter permits a PC XT/370 to emulate a 3278 Model 2 Display Station or 3279 Color Display Station Model 2A or S2A using a 5151, 5153, 5154, or 5175 display. Color support is not emulated and the default four colors are used for a color display. Graphics mode is not supported.

Connection of a PC XT/370 to a local or remote host processor permits the PC XT/370 to log on to the host processor and to interact with host processor programming as a 3278 or 3279 display without change to host processor programming. In addition, the remote support facilities provided by VMPSERV and TSOSERV can be used.

3277 Model 2 Device Emulation (PC/3277EM) Card

The PC/3277EM card is standard in 5160 Models 568 and 588. It is used to attach the PC XT/370 via a customer-supplied coaxial cable to a local or remote 3274 Control Unit that has a type B adapter. The maximum length of the cable is 2000 feet (610 meters). The PC/3277EM card permits the PC XT/370 to emulate a 3277 Model 2 using a 5151, 5153, 5154, or 5175 display. Since there is no color support for 3277 emulation mode, the default four colors are used for a color display. Graphics mode is not supported.

Attachment to a 3274 is required if PC XT/370 communication with a local or remote host processor via 3277 emulation is desired. Connection to a 3274 permits the PC XT/370 to log on to any host processor to which a 3277 display can be attached and to interact with host processor programming as a 3277 display. No change to host processor programming is required. Connection to a 3274 is required to utilize the remote support facilities provided by the VMPCSERV or TSOSERV program.

System Expansion Slots

Six full-feature (numbered 1 through 6) and two special-feature (numbered 7 and 8) system expansion slots are standard on the 5160 system board to contain feature cards. The full-feature slots will accept full-feature or the smaller special-feature cards. Special-feature slot 7 will accept only a special-feature card. Special-feature slot 8 can be used only for installation of the Asynchronous Communications Adapter. The slots are used for standard and required features as follows:

- Required display adapter – slot 1
- Standard PC/370-P Card (in slot 4)
- Standard PC/370-M Card (in slot 3)
- Standard 3278/79 Emulation Adapter (in slot 2 of the Model 589 only)
- Standard PC/3277EM Card (in slot 2 of Models 568 and 588 only)
- Standard 5¼-Inch Diskette Drive adapter (in slot 6)
- Standard Fixed Disk Drive Adapter for Models 588 and 589 or standard Expansion Unit Adapter for the Model 568 (in slot 5)
- Standard Asynchronous Communications Adapter (in slot 8 of the Model 589 only)

The PC/370-P Card, PC/370-M Card, and PC/3277EM Card or 3278/79 Emulation Adapter must be present in the 5160 unit. They cannot be

moved to a 5161 unit. One display adapter must also be present in the 5160 unit for the primary display.

Slots 7 and 8 in Models 568 and 588 and slot 7 in the Model 589 are available for optional features. Optional features can also be installed in the 5161 unit if it is included in the configuration. The following optional features for the PC XT/370 require one system expansion slot unless indicated otherwise:

- A second display adapter (Monochrome Display and Printer Adapter, Color/Graphics Monitor Adapter, Enhanced Graphics Adapter, or Professional Graphics Controller, depending on the primary adapter). Two adjacent full-feature slots are required for the Professional Graphics Controller.
 - Prototype Card (full-feature)
 - Game Control Adapter (special- or full-feature)*
 - Data Acquisition and Control Adapter (full-feature)
 - General Purpose Interface Bus Adapter (special- or full-feature)*
 - Cluster Adapter (full-feature)
 - PC Network Adapter (full-feature)—5160 unit only
 - Asynchronous Communications Adapter (special- or full-feature)*
 - Printer Adapter (special- or full-feature)*
 - Binary Synchronous Communications Adapter (full-feature)
 - Synchronous Data Link Control Communications Adapter (full-feature)
 - Display Station Emulation Adapter (full-feature)
- * This feature can be installed in the 5161 Expansion Unit or the 5160 System Unit. Others must be installed in the 5161 unit because no full-feature slots are available in the 5160. The 5161 provides six full-feature and two special-feature slots.

Programmable Speaker

A 2¼-inch-diameter, 8-ohm audio speaker is included in the 5160 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 the 5160 Model 589, 568, or 588 System Unit. This adapter requires an expansion slot in the 5160 and is the

only diskette drive adapter that can be installed in a PC XT/370 configuration. One or two IBM internal 5¼-inch double-sided diskette drives can be attached to this adapter. 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 5160 unit for a total of four diskette drives. The diskette drive adapter uses direct memory access for record data transfer.

5¼-Inch Double-Sided Diskette Drive

One double-sided diskette drive is standard in the 5160 Model 589, 568, or 588 System Unit (leftmost drive). It provides a capacity of 360Kb using DOS Version 2.0 or later. 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.

The characteristics of the double-sided diskette drive and double-sided diskettes for PC XT/370 and IBM Personal Computer XT configurations are the same (see description in Section 13:10 under "5¼-Inch Double-Sided Diskette Drive").

Fixed Disk Drive Adapter

This adapter is standard in 5160 Models 589 and 588. It provides buffering, error detection, and data transfer between memory in the 5160 and a 10Mb Fixed Disk Drive. 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 PC XT/370 configuration (located in the 5160 or 5161 unit). The adapter supports direct memory access data transfer, automatic error detection and correction on 11-bit bursts using a 32-bit error checking and correction (ECC) code, automatic retries on disk errors, and internal diagnostics.

10Mb Fixed Disk Drive

One 10Mb Fixed Disk Drive is standard in the 5160 Model 589 or 588 System Unit (rightmost drive) to provide 10,618,880 bytes of fixed disk storage, which is equivalent to about 28 double-sided diskettes at 360Kb each. One additional 10Mb Fixed Disk Drive can be installed in a 5160 Model 589 or 588 configuration via the 5161 Model 2 to provide 21,237,760 bytes of disk storage.

Note that the 10Mb Fixed Disk Drive and Fixed Disk Drive Adapter must be moved from the 5160 Model 589 or 588 unit to the 5161 Model 2 unit when a second 10Mb Fixed Disk Drive is installed in

14:10 IBM 5160 Personal Computer XT/370 System Unit

a Model 589 or 588 PC XT/370 configuration. For a 5160 Model 568 configuration, fixed disk storage is obtained by installing a 5161 Model 1 (for 10Mb) or Model 3 (for 20Mb), which contain a Fixed Disk Drive Adapter. See 5161 description in Section 14:15.

The characteristics of the 10Mb Fixed Disk Drive for PC XT/370 and IBM Personal Computer XT configurations are the same (see description in Section 13:10 under "10Mb Fixed Disk Drive").

Asynchronous Communications Adapter

For a 5160 Model 589 configuration, one asynchronous adapter is standard and one is optional. One or two Asynchronous Communications Adapters are optional for a 5160 Model 568 or 588 configuration. An asynchronous adapter can be installed in a special-feature slot in the 5160 Model 589, 568, or 588 or in a special- or full-feature slot in a 5161 Expansion Unit. The asynchronous adapter (or its equivalent) is the only feature that can be installed in slot 8 of a 5160 Model 568 or 588.

This adapter provides a path to a processor or an I/O device outside the 5160 or 5161 unit. A processor or I/O device can be connected to this adapter directly via cable (for local attachment) or via a telephone line using a plug-in modem (for remote attachment).

The Asynchronous Communications Adapter is required to support a remote 3101 emulation session in a PC XT/370 configuration during operation under the VM/PC program or for 3101 emulation under DOS during PC mode operations. Also required is the 3101 Emulation Program. A customer-supplied cable is required for attachment of external modems or other devices to the asynchronous adapter.

One 25-pin D shell connector on the adapter is provided 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 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.

The 3101 Emulation Program supports the Asynchronous Communications Adapter and can operate together with VM/PC in a PC XT/370 configuration operating in VM/PC mode. The 3101 Emulation Program can also execute under DOS in a PC XT/370 configuration operating in PC mode as can the Data Edition IBM Personal Decision Series Productivity Product. For a discussion of asynchronous adapter hardware and these two programs, see "Asynchronous Communications Adapter" in Section 13:10.

Keyboard

One 83-key keyboard is standard for the 5160 Model 589, 568, or 588. This is the same keyboard as is provided for 5150 Personal Computers and 5160 Personal Computer XTs. The keyboard attaches to a 5-pin connector in the back of the 5160 unit via a 6-foot (1.8-meter) coiled cable and can be positioned as desired for typing comfort. For a description of the 83-key keyboard, see Section 13:10 under "Keyboard."

Power Supply

The power supply (130-watt) in the right rear of the 5160 System Unit provides the power (required voltages) to the system unit, its options, and the keyboard (four inputs). The 5151 Monochrome Display has its own power supply and receives AC power from the power system in the unit to which it is attached (5160 or 5161). If adequate power is not being received by the 5160, a system shutdown occurs automatically. Overvoltage and overcurrent protection are also provided via fuses. Power to the 5160 is automatically removed if an overpower condition is detected.

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 has its own instruction set. The Math Co-processor Option feature for the IBM Personal Computer XT/370 is the same as for the IBM Personal Computer XT (see description in Section 13:10 under "Math Co-processor Option").

5¼-Inch Double-Sided Diskette Drive

One double-sided diskette drive in addition to the standard double-sided diskette drive can be installed in a 5160 Model 589, 568, or 588 System Unit to provide a maximum online diskette capacity of 720Kb (737,280 bytes) using DOS Version 2.0 or later. The two drives attach to the 5¼-Inch Diskette Drive Adapter.

The second double-sided diskette drive has the same characteristics as the standard double-sided diskette drive (described under "5¼-Inch Double-Sided Diskette Drive" in Section 13:10).

Diskette drives must be installed in the 5160 System Unit. Thus, when a second double-sided diskette drive is installed in a 5160 Model 589 or 588 configuration, the 10Mb Fixed Disk Drive and Fixed Disk Drive Adapter in the 5160 Model 589 or 588 unit must be moved to the 5161 Expansion Unit Model 2. The 5161 must be purchased if not already installed. The second diskette drive replaces the fixed disk drive in the 5160 Model 589 or 588 unit.

Monochrome Display and Printer Adapter

This adapter provides for attachment to the PC XT/370 of one 5151 Monochrome Display Model 1 and one 5152 Graphics Printer Model 2 (or compatible printer), 5182 Color Printer, 5201 QUIETWRITER® Printer, 5216 Wheelprinter Model 2, IBM SELECTRIC® System/2000 Typewriters, 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 cable required for each type of printer that attaches to this adapter.

One Monochrome Display and Printer Adapter can be installed in a PC XT/370 configuration and requires one full-feature slot in the 5160 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 only one display adapter is installed in a PC XT/370 configuration, it must be installed in the 5160 unit for the primary display.

This feature provides a 9-pin connector and a 25-pin connector for attachment of a display and a printer, respectively, at the rear of the 5160/5161 unit. A light pen cannot be attached to this adapter for use with the 5151 or another display.

The Monochrome Display and Printer Adapter is the same for PC XT/370 and IBM Personal Computer XT configurations (see Section 13:10 under "Monochrome Display and Printer Adapter" for additional information).

Color/Graphics Monitor Adapter

This adapter provides for attachment to the PC XT/370 of up to three color displays and one light pen. 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 (such as a 5153 Color Display or 5154 Enhanced Color Display), 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).

One Color/Graphics Monitor Adapter can be installed in a PC XT/370 configuration and requires one full-feature slot in the 5160 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 only one display adapter is installed in the PC XT/370 configuration, it must be installed in the 5160 unit for the primary display.

This adapter is the same for PC XT/370 and IBM Personal Computer XT configurations (see its characteristics in Section 13:10 under "Color/Graphics Monitor Adapter").

Printer Adapter

This adapter provides for attachment to the PC XT/370 of one 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 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 the Color/Graphics Monitor Adapter, Enhanced Graphics Adapter, or Professional Graphics Controller is installed instead of the Monochrome Display and Printer Adapter 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 PC XT/370 configuration. It can use one of the two available special-feature expansion slots in the 5160 Model 568 or 588, slot 7 in the Model 589 unit, or a slot in the 5161 unit. The adapter provides a cable connector at the rear of the 5160/5161 unit for attachment of the printer cable. See Section 31 for the cable required for each type of printer that attaches to this adapter.

Game Control Adapter

This feature permits up to two joysticks or up to four game paddles to be attached to the PC XT/370 configuration. It can also be used as a general-purpose I/O card with four analog (resistive) inputs plus four digital input points.

The Game Control Adapter (one maximum) can be installed in a special- or full-feature slot in the 5160 or 5161 unit. The adapter provides a 15-pin D-shell connector at the back of the 5160/5161 unit.

Prototype Card

This feature (one maximum) is provided as a base for building and testing custom attachments for the PC XT/370 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 5161 unit in a PC XT/370 configuration. Circuitry and module holes are provided for interface with the IBM bus. A bracket is included to secure the card in the 5161, with a cutout provided for an external D-shell connector with from 9 to 37 pins. Detailed instructions and component identifications for I/O attachment logic are also included with this feature.

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

The Enhanced Graphics Adapter provides one 9-pin connector at the back 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 PC XT/370 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 via the P-2 connector (six-pin Berg strip on the side of the card).

One Enhanced Graphics Adapter can be installed in a PC XT/370 configuration and requires one full-feature slot in the 5160 System Unit. This adapter cannot be installed in the 5161 unit. One other display adapter can also be installed in the PC XT/370 configuration. 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.

For a description of these features, see Section 13:10 under "Enhanced Graphics Adapter, Graphics Memory Expansion Card, and Graphics Memory Module Kit."

Professional Graphics Controller

The Professional Graphics Controller is required to attach the 5175 Professional Graphics Display to a PC XT/370 configuration. 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.

One Professional Graphics Controller can be installed in a PC XT/370 configuration. It requires two adjacent full-feature slots in the 5161 unit. This controller can be present in a configuration that has one other display adapter installed. For a description of this controller, see Section 13:10 under "Professional Graphics 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.

Up to four Data Acquisition and Control Adapters can be installed in a PC XT/370 configuration. All must be installed in full-feature slots in the 5161 unit in a PC XT/370. 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 a description of this adapter, see Section 13:10 under "Data Acquisition and Control Adapter and Data Acquisition and Control Adapter Distribution Panel."

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 PC XT/370 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 PC XT/370 configuration in special- or full-feature slots. If multiple adapters use the same interrupt level, they must all be installed in the same unit (5160 or 5161). An adapter can have up to 14 devices or instruments attached with a maximum of 48 devices/instruments in one PC XT/370 configuration.

The 7371, 7372, 7374, and 7375 (Models 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 features 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 *General Purpose Interface Bus*, G520-5021.

Binary Synchronous Communications (BSC) Adapter

One or two BSC adapters can be installed in a PC XT/370 configuration unless the SDLC adapter is present, in which case only one BSC adapter can be installed. One full-feature slot in the 5161 unit is required in a PC XT/370 configuration. An external modem must be cable-connected between the BSC adapter and a telephone line using the Communications Adapter Cable feature.

The IBM-Logo DOS programs that support the BSC adapter in a PC XT/370 configuration operating in PC mode are the Binary Synchronous 3270 Emulation Program and the DisplayComm Binary Synchronous Communications Program. See Section 13:10 under "Binary Synchronous Communications Adapter" for a description of these programs and the BSC adapter hardware.

Synchronous Data Link Control (SDLC) Communications Adapter

One SDLC Communications Adapter can be installed in a PC XT/370 configuration. It must be installed in a full-feature slot in the 5161 unit, and only one BSC adapter and one asynchronous adapter can be installed in the PC XT/370 configuration when the SDLC adapter is present. An external modem must be cable-connected between the SDLC adapter and a telephone line using the Communications Adapter Cable feature.

See Section 13:10 under "Synchronous Data Link Control (SDLC) Communications Adapter" for a description of this adapter and its programming support for PC mode.

Communications Adapter Cable

This feature allows the BSC adapter or SDLC adapter card to be connected to a modem via its connector at the rear of the 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 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 PC XT/370 configuration. It requires one full-feature slot in the 5161 Expansion Unit.

This adapter, when used with the 5520/Personal Computer Attachment Program Version 3, allows a PC XT/370 to be cable-attached to the 5520 Administrative System (any model) and to emulate the 5253 Display Station. Multiple 5253 displays and PC XT/370s can be attached to the same 5520 system. One 5253 display must be included in the 5520 system configuration for service use. From 5 to 35 PC XT/370 systems can be attached to a 5525 System Unit (depending on the 5525 model) with up to 24 active concurrently.

For a PC XT/370 configuration, 5253 emulation can be performed for PC mode operations (it is not supported by the VM/PC program). For a description of 5253 emulation, see Section 13:10 under "Display Station Emulation Adapter."

Cluster Adapter and Cluster Cable Kit

The Cluster Adapter installed in a PC XT/370 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, 5160, 5155, 5170, and 5531 system in the clustered configuration must have the Cluster Adapter feature installed.

One Cluster Adapter can be installed in a PC XT/370 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. 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. For a description of a cluster and its programming support, see Section 13:10 under "Cluster Adapter and Cluster Cable Kit."

IBM PC Network

The PC XT/370 can be included in an IBM PC Network, which is a low-cost broadband local area network that allows peer-to-peer communication among IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XTs and XT/370s, and IBM Personal Computer ATs and AT/370s in a shared resource environment. The IBM personal computers in the network are connected using the 5178 IBM PC Network Translator Unit, IBM PC Network Adapter, and IBM PC Network Cabling Component features. Programming support for the PC XT/370 is provided by the IBM PC Network Program. For a discussion of this network and program, see Section 13:10 under "IBM PC Network."

Keylock Feature

The Keylock Feature is a simple mechanical device that can be installed on a 5160 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 5160/5161 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 5160/5161 unit is protected to prevent physical access to the contents of the 5160/5161 unit. This protects against removal of the fixed disk drives in a 5161 unit as well as of the hardware installed in the 5160/5161 unit.

When the keylock is locked, 5160/5161 power-on can be done only by unlocking the keylock. Power-on using the power-on switch on the 5160/5161 unit is not possible. In addition, if the display installed does not receive power from the 5160 unit (5153 or 5154 display, for example), the access port to the 5160 is blocked to prevent the 5160 from being powered on through the access port. Without power on, access to the 5160 configuration via a local program, by another computer via a communications link, or via another personal computer cabled to the 5160 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 5160/5161 unit to the office furniture.

Single Unit Prices

Item	Part Number	Feature Code	Single Unit Purchase Price or License Fee (\$)
5160 System Unit/Keyboard			
Model 589	5160589	—	7895
Asynchronous Communications Adapter	1502074	2074	100
Binary Synchronous Communications Adapter	1502075	2075	240
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
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
Enhanced Graphics Adapter	1501200	1200	524
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
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
3278/79 Emulation Adapter (for Models 568 and 588)	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

14:10 IBM 5160 Personal Computer XT/370 System Unit

Item	Part Number	Feature Code	Single Unit Purchase Price or License Fee (\$)
5253 Emulation Installation Convenience Kit			
Version 3	6403724	2896	1113
5¼-Inch Double-Sided Diskette Drive	1503810	3810	425
VM/PC Version 1.1	6024175	4175	1150
DOS Version 2.1	6024120	4120	65

Discounts Available

The PC XT/370 and most of its hardware features may be eligible for one of the following discounts:

- Volume Procurement Amendment
- Educational Allowance
- Special Bid

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.

14:15 IBM 5161 Expansion Units

Introduction

The 5161 Model 1 or 3 Expansion Unit can be attached to a 5160 Model 568 System Unit, while the 5161 Model 2 can be attached to the 5160 Model 588 or 589 System Unit. The 5161 provides fixed disk storage (10Mb or 20Mb) and additional expansion slots for the PC XT/370 configuration. The expansion slots allow for the installation of optional feature cards to extend the capabilities of the PC XT/370 configuration.

One 5161 unit can be attached to a 5160 Model 589, 568, or 588 System Unit. The 5161 can be field-installed and is a customer-setup unit. It can be placed beside the 5160 System Unit or stacked over or under the 5160 unit. When the 5161 is placed beside or on top of the 5160 unit, a printer or display can be placed on top of the 5161 unit.

The dimensions of the 5161 unit (all models) are the same as those of a 5160 System Unit:

- 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

The optional Keylock Feature can be installed on any 5161 unit. See description of this feature in Section 14:10 under "Keylock Feature."

The 5161 Expansion Unit with one fixed disk drive, shown in Figure 11-3 in Section 11:15, weighs approximately 27 lb (12.2 kg).

5161 Expansion Unit Model 2

The 5161 Model 2 Expansion Unit can be attached to the 5161 Model 589 or 588 to provide an additional 10Mb of fixed disk storage. The 5161 Model 2 unit contains the following standard items:

- Eight expansion slots (six full-feature and two special-feature) for optional feature cards
- One 10Mb Fixed Disk Drive
- The receiver card required for connection to the 5160 Model 589 or 588 System Unit (uses one full-feature slot)
- A 130-watt power supply with cooling fan

A one-meter (39-inch) cable and an extender card that must be installed in a full-feature slot in the 5160 Model 589 or 588 unit are also provided with the 5161 Model 2 unit. The Fixed Disk Drive Adapter and 10Mb Fixed Disk Drive in the Model 589 or 588 System Unit must be moved to the 5161 Model 2 unit. The supplied attachment card replaces the Fixed Disk Drive Adapter that is removed from the 5160 Model 589 or 588.

5161 Expansion Unit Model 1

The 5161 Model 1 Expansion Unit can be attached to the 5160 Model 568 System Unit when only 10Mb of fixed disk storage is required. If an additional 10Mb of fixed disk storage is required later, it can be added to the 5161 Model 1.

The 5161 Model 1 unit contains the following standard items:

- Eight expansion slots (six full-feature and two special-feature) 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 full-feature slot)
- One 10Mb Fixed Disk Drive
- The receiver card required for connection to the 5160 Model 568 System Unit (uses one full-feature slot)
- A 130-watt power supply with cooling fan

A 39-inch (one-meter) signal cable is provided to attach the 5161 unit to the 5160 Model 568 unit, which contains the Expansion Unit Adapter that is also required for connection of the 5160 and 5161 units.

5161 Expansion Unit Model 3

The 5161 Model 3 Expansion Unit can be attached to the 5161 Model 568 System Unit when 20Mb of fixed disk storage is required. The 5161 Model 3 contains the following standard items:

- Eight expansion slots (six full-feature and two special-feature) for optional feature cards
- One Fixed Disk Drive Adapter to which the two 10Mb Fixed Disk Drives are attached (uses one full-feature slot)
- Two 10Mb Fixed Disk Drives
- The receiver card required for connection to the 5160 Model 568 System Unit (uses one full-feature slot)
- A 130-watt power supply with cooling fan

A 39-inch (one-meter) signal cable is provided to attach the 5161 unit to the 5160 Model 568 unit, which contains the Expansion Unit Adapter that is also required for connection of the 5160 and 5161 units. The 5161 Model 3 weighs approximately 32 lb (14.5 kg).

Feature Descriptions

Expansion Slots

Six of the eight expansion slots in any 5161 model 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 (number 5) contains the 5161 receiver card and another full-feature slot (number 6) is required for the Fixed Disk Adapter.

The following optional features for PC XT/370 configurations can be installed in the available slots in the 5161 unit:

- Monochrome Display and Printer Adapter (if the Color/Graphics Monitor Adapter or Enhanced Graphics Adapter is installed in the 5160) – full-feature
- Color/Graphics Monitor Adapter (if the Monochrome Display and Printer Adapter or Enhanced Graphics Adapter is installed in the 5160) – full-feature
- Printer Adapter (special- or full-feature)
- Game Control Adapter (special- or full-feature)
- Prototype Card (full-feature)
- Professional Graphics Controller (if another display adapter is installed in the 5160 unit) – two adjacent full-feature
- Data Acquisition and Control Adapter (full-feature)

- General Purpose Interface Bus Adapter (special- or full-feature)
- Cluster Adapter (full-feature)
- Binary Synchronous Communications Adapter (full-feature)
- Synchronous Data Link Control (SDLC) Communications Adapter (full-feature)
- Display Station Emulation Adapter (full-feature)
- Asynchronous Communications Adapter (special- or full-feature)

As for a 5160 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 adapter is standard in 5161 Models 1 and 3 and must be moved to the 5161 Model 2 from the 5160 Model 589 or 588 unit when the 5161 Model 2 is installed. It provides buffering, error detection, and data transfer between memory in the 5160 and a 10Mb Fixed Disk Drive. 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 PC XT/370 configuration. The adapter supports direct memory access data transfer, automatic error detection and correction on 11-bit bursts using a 32-bit error checking and correction (ECC) code, automatic retries on disk errors, and internal diagnostics.

10Mb Fixed Disk Drive

The 10Mb Fixed Disk Drive provides 10,618,880 bytes of disk storage. This disk drive attaches to the Fixed Disk Drive Adapter. The 5161 (any model) can contain a maximum of two 10Mb Fixed Disk Drives, which have the same characteristics (see description under "10Mb Fixed Disk Drive" in Section 13:10).

Power Supply

The 5161 contains a 130-watt, four-voltage-level power supply in the right area of the unit. All power levels are regulated and an automatic shutdown of power to the 5161 occurs if an overvoltage or over-current condition is detected. A system shutdown also occurs if adequate power is not being received. The power cable is six 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
Model 2 (5161002)	2090
Model 3 (5161003)	4145
10Mb Fixed Disk Drive for 5161	
Model 1 or 2 (1602500) (2500)	1195
Fixed Disk Drive Adapter	
(1602501) (2501)	495
Keylock Feature (2683177) (3177)	50

Discounts Available

The 5161 and its hardware features may be eligible for one of the following discounts:

- Volume Procurement Amendment
- Educational Allowance
- Special Bid

14:20 Virtual Machine/Personal Computer (VM/PC)

Introduction

VM/PC runs as an application program under the control of DOS and uses DOS I/O support. VM/PC supports the PC XT/370 and PC AT/370 configurations operating in VM/PC mode. VM/PC provides an interactive environment for the PC XT/370 or AT/370 user and has the characteristics of VM/System Product (VM/SP).

VM/PC allows the PC XT/370 or AT/370 to operate as a single-user CMS virtual machine to execute most CMS programs and to interact with a local or remote VM/370 host processor. Programs and data can be interchanged between the PC XT/370 or AT/370 user and the host processor.

The PC XT/370 or AT/370 can be used for program development under CMS to create application programs that will be executed in the PC XT/370 or AT/370 or the host processor and/or for executing existing CMS applications that are offloaded from the host VM/370 processor to the PC XT/370 or AT/370. VM/PC supports the conversion of VM/PC-format files to and from DOS format.

VM/PC also supports remote 327X and remote 3101 emulation. The 327X emulation facility permits the PC XT/370 to emulate a 3277, 3278, or 3279 display to interact with applications, such as VM/CMS, MVS/TSO, IMS, and CICS, in a host processor that supports 3277, 3278, or 3279 attachment. The PC AT/370 can emulate a 3278 or 3279 display. The 327X emulation facility and the VMPCSERV program provided with VM/PC support access to VM/370 host processor facilities for use by the PC XT/370 or AT/370 and the exchange of programs and data between the PC XT/370 or AT/370 and a VM/370 host processor.

The TSO Host Server Program (TSOSERV) can be licensed for use in an MVS host processor to support PC XT/370 or AT/370 access to MVS host processor facilities via 327X emulation. Support of 327X emulation permits the PC XT/370 or AT/370 to emulate a 327X display when attached to an MVS/TSO processor running the TSOSERV program. Data can be exchanged between the PC XT/370 or AT/370 and the MVS host processor.

Use of remote 3101 emulation requires operation of the 3101 Emulation Program together with VM/PC. The 3101 Emulation Program permits the PC XT/370 or AT/370 to access host processors that

support 3101 attachment and is the only DOS application program that can execute with VM/PC.

For a PC XT/370 configuration, VM/PC requires one display (5151 Monochrome Display, 5153 Color Display, 5154 Enhanced Color Display, 5175 Professional Graphics Display, or another monitor that displays 25 lines of 80 characters each), one double-sided diskette drive (360Kb capacity), and one fixed disk drive (10Mb capacity).

For a PC XT/370 configuration, VM/PC also supports a second double-sided diskette drive, a second fixed disk drive (10Mb), one printer (5152 Graphics Printer, 5182 Color Printer, 5181 Compact Printer, or a compatible printer), the Asynchronous Communications Adapter (requires the 3101 Emulation Program), and remote 3277/78/79 emulation. Emulation of a 327X display or a 3101 requires connection of the PC XT/370 to a local or remote processor.

For a PC AT/370 configuration, VM/PC requires one display (5151 Monochrome Display, 5153 Color Display, 5154 Enhanced Color Display, 5175 Professional Graphics Display, or another monitor that displays 25 lines of 80 characters each), with the 5170 Model 599 System Unit. VM/PC also supports a second double-sided diskette drive, a second fixed disk drive (20Mb), one 5152 Graphics Printer or 5182 Color Printer (or compatible printer), the serial port in one Serial/Parallel Adapter (requires the 3101 Emulation Program), and remote 3278/3279 emulation. Emulation of a 3278/79 display or a 3101 requires connection of the PC AT/370 to a local or remote processor.

The VM/PC licensed program is provided on several diskettes together with the *IBM Virtual Machine/Personal Computer User's Guide*, SC24-5254. Included on the distribution diskettes are the utilities needed for VM/PC installation and configuration and the Remote Server Program (VMPCSERV). The latter must be installed in the host VM/370 system if VM/370 host processor resources, such as programs and data, are to be used in the PC XT/370 or PC AT/370 configuration. The contents of the provided diskettes are loaded to a fixed disk in the PC XT/370 or AT/370 configuration during VM/PC installation.

TSOSERV (program number 5798-DTL) must be purchased separately for installation in a host MVS processor if host processor MVS resources are to be used in the PC XT/370 or AT/370 configuration

and the CMS local session is to be used in conjunction with MVS/TSO.

The *VM/PC User's Guide*, SC24-5254, provides installation, configuring, operational, and problem determination information about VM/PC. It assumes the reader is familiar with VM/370 and CMS.

VM/PC Releases 1.0 and 1.1 have been made available. VM/PC Release 1.0 executes under DOS Version 2.0 or 2.1 and has the characteristics of VM/SP Release 2. It supports only 3277 emulation (not 3278 or 3279) and the PC XT/370 configuration (not the PC AT/370).

VM/PC Release 1.1, a replacement for Release 1.0, operates under DOS Version 2.1, 3.0, or 3.1 and has the characteristics of VM/SP Release 3. VM/PC Release 1.1 includes the REXX Macro/Executive processor and XEDIT enhancements. It supports 3277, 3278, and 3279 emulation for the PC XT/370 and 3278 and 3279 emulation for the PC AT/370.

TSOSERV operates with VM/PC Release 1.0 and 1.1. For support of 3278/79 emulation or the PC AT/370 configuration using TOSERV, Release 1.1 of VM/PC is required.

DOS Version 2.1 is recommended for use with VM/PC Release 1.1 operating in a PC XT/370 configuration. DOS Version 3.0 or later is required for use with VM/PC Release 1.1 operating in a PC AT/370 configuration.

The following VM/PC discussion applies to support provided for a PC XT/370 or PC AT/370 by VM/PC Release 1.1.

Sessions Supported

VM/PC supports the execution of local and remote sessions. Different functions can be performed depending on the session in effect. One local session (CMS) and two types of remote session (327X emulation and 3101 emulation) are supported. Up to three unique sessions can be in effect concurrently and, using the keyboard, the user determines which is the currently active session (the one that can be interacted with via the keyboard). Line 25 of the display indicates the currently active session and when a nonactive session has a change of status.

The environments supported by VM/PC (number and types of operating sessions) are:

- One local CMS session. The PC XT/370 or AT/370 operates as a stand-alone single-user CMS virtual machine to execute CMS programs. There is no communication with another processor. This session is also called a local 327X session, since the PC XT/370 display and keyboard are used to emulate a 3277 Model 2, 3278 Model 2, or 3279 Model 2A or S2A display and keyboard. The PC AT/370 emulates a 3278 or 3279 only. The PC XT/370 or PC AT/370 may or may not be connected to a host processor.
- One remote 327X emulation session. The PC XT/370, connected to a host processor, emulates a 3277 Model 2, 3278 Model 2, or 3279 Model 2A or S2A display and communicates as a nonintelligent terminal with a local or remote host processor that supports 3277, 3278, or 3279 attachment. The PC AT/370 emulates a 3278 or 3279 only. The PC XT/370 or PC AT/370 user logs on to and communicates with the host processor using the procedures defined for the host processor programming. This type of session, for example, permits a user to log on to a host VM/370 processor using the PC XT/370 or AT/370 as the virtual operator's console, or to an MVS/TSO host processor using the PC XT/370 or AT/370 as a TSO terminal.
- One remote 3101 emulation session. The PC XT/370 or AT/370, connected to any host processor that supports 3101 attachment via the Asynchronous Communications Adapter and a telephone line, emulates a 3101 terminal using the 3101 Emulation Program and communicates with the local or remote host processor. This function permits a PC XT/370 or AT/370 that is or is not connected to a host processor via a 327X emulation card to communicate under VM/PC control with a host processor to perform functions supported by the 3101 Emulation Program. It also permits a PC XT/370 or AT/370 that is installed in the home to communicate with a remote host processor.
- Local CMS session and remote 327X emulation session with VMPCSERV. This environment combines the local CMS session and the remote 327X session and is used to support access to local or remote VM/370 host processor programs, data, and printers for use in the PC XT/370 or AT/370 local CMS session. The host processor must be executing VM/370 and (1) VM/SP (any release) with or without VM/SP High Performance Option or (2) Basic Systems Extensions (BSE) Release 2. VMPCSERV executes in a virtual machine sup-

14:20 Virtual Machine/Personal Computer (VM/PC)

ported by the host processor as the remote 327X session. This environment supports the interchange of data and programs between the PC XT/370 or AT/370 and the VM/370 host processor.

- Local CMS session and remote 327X emulation session with TSOSERV. This environment combines the local CMS session and remote 327X session for use with the TSOSERV program executing in an MVS/370 or MVS/XA host processor with TSO (with or without the TSO/E program product) and with ACF/VTAM Version 1 Release 2 for MVS/370 or ACF/VTAM Version 2 for MVS/XA. This environment supports PC XT/370 or AT/370 communication with a local or remote MVS host processor via an SNA or BSC network. The PC XT/370 or AT/370 user can access certain MVS data sets and printers for use by the PC XT/370 or AT/370 and the user can issue certain TSO commands from the local CMS session.
- Concurrent unique sessions:
 - Local CMS and one remote emulation (327X or 3101). For example, a local CMS session handling file editing in the PC XT/370 or AT/370 and a remote 327X session handling program compilation in the host VM/370 processor could operate concurrently. Switching between the two sessions is supported.
 - Local CMS, one remote 327X emulation, and one remote 3101 emulation. Switching between the three sessions is supported.

At VM/PC installation time, use of the 370 Processor Control session can be specified. The 370 Processor Control session provides a general purpose full-screen debugging facility that is similar to the debugging facilities available on the operator console of System/370 architecture processors. It permits stopping, starting, and instruction stepping of the processor; stopping execution on a real address equal comparison; resetting the processor; external interrupt generation; and display and modification of virtual and real memory, the page table, and 370 registers.

The 370 Processor Control session can operate concurrently with any of the environments listed previously. It can be entered and left from any other type of session. The 370 Processor Control program requires 32K bytes of memory for its execution.

When a PC XT/370 or AT/370 system with VM/PC installed is powered on, it enters PC mode. When the VMPC command is entered by the user (or if the automatic program execution feature of DOS is used to initiate VM/PC execution), VM/PC

is invoked and VM/PC mode is entered. VM/PC displays a session selection menu that indicates the session types actually available to this PC XT/370 or AT/370 hardware configuration. The session selected by the operator is then activated.

The session selection menu is used first to initiate each session that is to operate concurrently. Thereafter, it must be invoked by the user (via a keyboard key) to invoke a different session each time the currently active session is to be changed.

Local CMS (327X) Session Only

When the local 327X session is selected from the session selection menu, the user can log on to the PC XT/370 or AT/370 as a CMS user. VM/PC establishes a single-user CMS virtual machine for the user. CMS programs can then be executed in the PC XT/370 or AT/370 virtual machine and VM/PC reads and writes CMS-format files on PC XT/370 or AT/370 diskettes and fixed disks. Printing of spool printer files to a printer attached to the PC XT/370 or AT/370 is supported and the IMPORT/EXPORT facility permits conversion between CMS-format and DOS-format files.

The PC XT/370 or AT/370 user controls operation of the local CMS session using VM/PC commands that are identical or similar in format and function to the CP, CMS, XEDIT, and EXEC2 commands supported by VM/SP Release 2 (for VM/PC Release 1.0 – supports PC XT/370 only) or VM/SP Release 3 (for VM/PC Release 1.1 – supports PC XT/370 or AT/370). Modification of some VM/370 commands for use with VM/PC was made, some CMS commands were deleted, and commands and options have been added as required to support the PC XT/370 and AT/370 configurations. In addition, tape I/O, virtual readers and punches, and the CMS/DOS environment are not supported by VM/PC. The *VM/PC User's Guide*, SC24-5254, compares the VM/PC and VM/SP products.

VM/CMS programs and user programs developed for operation under VM/SP on a System/370 architecture processor can operate in a local CMS session in a PC XT/370 or AT/370 configuration under VM/PC control without alteration if they observe all of the following:

- Use no more than one virtual address space. For example, PROFS and SQL cannot execute in a local CMS session.
- Operate in a virtual machine with up to 4Mb of virtual storage for a PC XT/370 or 8Mb for a PC AT/370

- Support the 327X display being emulated
- Do not rely on protection exception
- Do not depend on CMS/DOS emulation (which is not supported by VM/PC)
- Do not exceed the fixed disk capacity of the PC XT/370 or AT/370 configuration
- Do not require more than 416Kb for a PC XT/370 or 411Kb for a PC AT/370 of real memory. The VM/PC control program requires 64Kb of real memory for Release 1.0 and 69Kb for Release 1.1. If the 370 Processor Control program is also used (which requires 32Kb of memory), 384Kb for Release 1.0 or 379Kb for Release 1.1 is available for the execution of application programs.
- Use only those VM/370 commands supported by VM/PC
- Do not rely on internal VM/SP and/or VM/SP High Performance Option structure and formats
- Do not rely on OS LOADLIB emulation
- Do not rely on time-dependent operations

The VM/PC program and DOS require a portion of fixed disk storage for residence – 2.3Mb for VM/PC Release 1.1 (1.5Mb for Release 1.0) and .5Mb for DOS Version 3.0 (.1Mb for Version 2.1). The remaining fixed disk storage in a PC XT/370 or AT/370 configuration can be allocated for the 3101 Emulation Program (if 3101 emulation is to be used), paging (4Mb or 8Mb maximum), printer spooling, user minidisks, System/370 licensed programs and data, IBM personal computer programs and data, and user application programs and data.

CMS files can be stored on PC XT/370 or AT/370 diskettes as well as on fixed disk storage. Minidisks of up to 354Kb can be defined on a double-sided diskette, while a minidisk up to 10Mb (PC XT/370) or 20Mb (PC AT/370) can be defined on a fixed disk. PC XT/370 or AT/370 minidisks have 512-byte records.

Debugging facilities in addition to the 370 Processor Control session are available to the CMS user. These include the standard CMS and CP debugging functions, a dump facility that writes the entire contents of real memory (768Kb) to three diskettes, and a facility to debug the remote server VMPCSERV. Other debugging aids are available to the person designated as the technical coordinator. Comprehensive information regarding problem solving is contained in the *VM/PC User's Guide*.

VM/PC supports only one user operating the PC XT/370 or AT/370 at a time. However, up to 20 users can share the use of one PC XT/370 or AT/370 configuration. Users are installation-defined in the VM/PC configurator. Each user can have up to 26 links and/or minidisks, subject to the

availability of system resources. User IDs and passwords for security protection are defined as for a VM/370 configuration.

A VM/PC configuration file is provided with the VM/PC program that defines a default VM/PC configuration. This configuration file can be altered in part or in total using the supplied VM/PC configurator program, which executes under DOS. Options that can be modified include the following:

- User IDs and optional passwords (additions, deletions, and modifications can be made)
- Minidisk allocation and optional read/write passwords for sharing the minidisks
- Use of the 370 Processor Control session
- Virtual machine size (maximum 4Mb for a PC XT/370 or 8Mb for a PC AT/370)
- Password required to access the VM/PC configurator program
- System configuration specifications (for example, page file size, location and number of spool files, and I/O device addresses)

Remote 327X Emulation Session

For a remote 327X emulation session, the PC XT/370 operates as a 3277, 3278, or 3279 display, while the PC AT/370 operates as a 3278 or 3279 display. The PC XT/370 or AT/370 communicates with a local or remote host processor. If the host processor is executing VM/370, for example, the user can log on to VM/370 and execute programs in a virtual machine supported by the host processor (the remote 327X session). The PC XT/370 or AT/370 is used as the virtual operator's console just as if it were a nonintelligent terminal. The user can access any VM/370 host processor resources for which authorization exists.

If a local CMS session is initiated later to operate concurrently with the remote 327X session, none of the VM/370 host processor resources can be processed by the PC XT/370 or AT/370 in the local CMS session, since VMPCSERV is not active in the remote 327X session.

Similarly, the user can communicate with an MVS/TSO host processor and initiate a TSO session in the host processor as the remote 327X emulation session with which the PC XT/370 or AT/370 interacts.

Remote 3101 Emulation Session

When a remote 3101 emulation session is initiated, the user can communicate with a remote processor over a telephone line using the PC XT/370 or AT/370 to emulate a 3101 terminal. The functions available to the user are those supported by the 3101 Emulation Program, which operates under VM/PC control. For the functions provided by the 3101 Emulation Program, see description under "Asynchronous Communications Adapter" in Section 13:10.

Note that executable programs (or any binary format files) cannot be transferred to or from the PC XT/370 or AT/370 using the 3101 Emulation Program. Thus, executable programs cannot be transferred using 3101 emulation. For a PC XT/370 or AT/370 configuration that is not connected to a 3274 Control Unit, executable CMS programs that are to be used in the PC XT/370 or AT/370 must be obtained another way. Note that source programs can be transferred to the PC XT/370 or AT/370 using the 3101 Emulation Program.

While a remote 3101 session can operate concurrently with other sessions in a PC XT/370 or AT/370 configuration, a file transfer operation in a remote 3101 session should not be initiated while a remote 327X session involving file transfer using the VMPCSERV program is active, since loss of data can occur.

In addition, when a 3101 session is the active session and a switch is made to another session, program execution in the 3101 session is stopped until the 3101 session again becomes the active session. This approach is not used for other session types. Thus, sessions that are to operate concurrently with a 3101 session should be started first, and once an activity, such as file transfer, is begun in the 3101 session, the active session should not be switched until the 3101 activity completes.

Combined Local CMS and Remote 327X Emulation Sessions with VMPCSERV

For this environment, the user initiates a remote 327X session and then invokes VMPCSERV to execute in a VM/370 host processor virtual machine as the remote 327X session. VMPCSERV establishes communication with VM/PC and remains active in the remote 327X session virtual machine until terminated by the user.

A local CMS session is also established. The local CMS session has access to VM/370 host processor

resources as supported by VMPCSERV. VMPCSERV accepts requests from the local CMS session that are then processed in the VM/370 host processor. VMPCSERV makes host processor resources available to the local CMS session just as if they were local resources.

VMPCSERV supports the following:

- Remote minidisks. The PC XT/370 or AT/370 user can link and access any CMS-format disk of the host VM/370 processor (remote minidisks) from a local CMS session. The remote minidisks appear to be local minidisks to the local CMS session. VMPCSERV receives requests for remote minidisk link/access from the local CMS session and executes them in the host processor. This support permits access to remote files for use in a local CMS session, as described next.
- Remote files. When the PC XT/370 or AT/370 user has linked to and accessed a remote minidisk, any files on that remote minidisk can be accessed from the local CMS session. This permits a program that executes in the local CMS session to read and write VM/370 host processor files (remote files) during its execution. Read and write requests to remote files and data for write requests are passed from the local CMS session to VMPCSERV in the remote 327X session for execution by the host processor. For read requests, VMPCSERV returns the requested data to the local CMS session.

Remote file support provides for the downloading and uploading of CMS files and, therefore, permits programs and data to be exchanged between the PC XT/370 or AT/370 and the VM/370 system. The COPYFILE command can be issued by the PC XT/370 or AT/370 user to (1) copy a host processor minidisk file to a PC XT/370 or AT/370 minidisk file (download the file) or copy it to another host processor minidisk file and (2) copy a PC XT/370 or AT/370 minidisk file to a host processor minidisk file (upload the file) or copy it to another PC XT/370 or AT/370 minidisk file.

The download facility can be used to transfer customer application programs and data and certain IBM licensed programs from the VM/370 system to the PC XT/370 or AT/370 for use in a local CMS session in the PC XT/370 or AT/370. The PC XT/370 or AT/370 must be licensed to use any transferred IBM licensed program via the IBM Personal Computer XT/370 or AT/370 License Option

Amendment. This amendment offers a lower monthly charge than that for the host processor license. A one-time charge is also available. An IBM Personal Computer XT/370 or AT/370 License Option Amendment can exist only for programs for which a host processor license exists.

The following IBM programs can execute under VM/PC and can be licensed to execute in a PC XT/370 or AT/370 via the IBM Personal Computer License Option Amendment:

- OS/VS COBOL Compiler and Library (5740-CB1)
- OS/VS COBOL Library (5740-LM1)
- COBOL Interactive Debug (5734-CB4)
- VS FORTRAN Compiler and Library (5748-FO3)
- VS FORTRAN Library (5748-LM3)
- VS FORTRAN Interactive Debug (5668-903)
- IBM BASIC/VM Processor and Library (5668-996)
- PL/I Optimizing Compiler and Libraries (5734-PL3)
- PL/I Transient Library (5734-LM5)
- PL/I Resident Library (5734-LM4)
- Pascal/VS (5796-PNQ)
- Assembler H (5668-962)
- Document Composition Facility (Script/VS) - (5748-XX9)
- Interactive Instructional Authoring System (IIAS) (5668-011)
- Interactive Instructional Presentation System (IIPS) (5668-012)
- Display Management System/CMS (DMS/CMS) (5748-XXB)
- VM/Interactive Productivity Facility (FLIST and BROWSE functions supported) - (5748-MS1)
- Interactive System Productivity Facility (ISPF) (5668-960)
- ISPF/PDF (5664-172)
- CMS Sort for VM/CMS and CMS Sort Extensions (5798-BDW)
- The Information Facility (TIF) - (5798-DLK)
- High Accuracy Arithmetic (ACRITH) Subroutine Library Release 2 - (5664-185)
- STAIRS/CMS (5664-189)
- System/370 Automatically Programmed Tool-Intermediate Contouring (APT-IC) - (5740-M52)
- System/370 Automatically Programmed Tool-Advanced Contouring (APT-AC) - (5740-M53)
- Dynamic Simulation Language/VS (DSL/VS) - (5798-PXJ). Graphics functions that use GDDM are not supported.

- Elementary Math Library Programming RPQ (P81005) - (5799-BTB)
- MPSX/370 (including MIP/370) - (5740-XM3)

The *System/370 Language Supplement*, SC26-4120, provides information about downloading licensed programs to a PC XT/370 configuration. The *Pascal/VS Programmer's Guide*, SH20-6162, provides downloading information for Pascal/VS.

The upload facility can be used to transfer data processed using either VM/PC or DOS, or programs developed using VM/PC and CMS, from the PC XT/370 or AT/370 to the VM/370 host processor.

- Remote printers. The PC XT/370 or AT/370 can access printers attached to the VM/370 host processor from a local CMS session to support remote spooling. The PC XT/370 or AT/370 user can transfer printer spool files to the VM/370 host processor for printing on a host processor printer or for transmission via the Remote Spooling Communication Subsystem (RSCS) in the host processor to another printer in the VM/370 network.

Modification of VMPCSERV to support installation-dependent requirements, such as control of access to host processor files, maintenance of a history of which users are accessing host processor files, and accounting record generation, can be done (as described in the *VM/PC User's Guide*).

Combined Local CMS and Remote 327X Sessions with TSOSERV

The TSO Host Server program (TSOSERV), 5798-DTL, is required to support this environment. The user initiates a remote 327X session, logs on to TSO, and invokes TSOSERV to execute in the TSO session in the MVS host processor. TSOSERV establishes communication with VM/PC and remains active in the remote 327X TSO session until terminated by the user.

A local CMS session is also initiated. This session has access to MVS host processor resources as supported by TSOSERV. The TSOSERV program accepts requests from the local CMS session that are then processed by the MVS host processor. TSOSERV makes MVS host processor resources available to the local CMS session just as if they were local resources.

14:20 Virtual Machine/Personal Computer (VM/PC)

The TSOSERV program (which is distributed on a tape) provides the following:

- A TSO command processor, which executes in the TSO session in the MVS host processor. It receives requests from the PC XT/370 or AT/370 (interfacing with TSO/VTAM for communications support) and invokes the requested functions. The TSO command processor accepts the same VM/PC commands as does VMPCSERV and performs the same functions with a few minor differences (see the TSOSERV User's Guide, SC28-1390).
- Two CMS commands that execute in the PC XT/370 or AT/370. The DSNMAP command provides for the mapping of CMS filenames to MVS data set names. The TSO command allows the user to issue certain TSO commands from the local CMS session for execution in the MVS host processor.
- A TSO utility (PDSMAC) that converts an MVS partitioned data set to the CMS MACLIB (sequential) format. This utility enables CMS compilers executing in the local CMS session to use MVS macro libraries that have been converted. This utility executes in the host processor. It can be initiated to execute in a remote 327X session or it can be invoked from a local CMS session using the TSO command.

TSOSERV supports the following:

- Remote data sets. MVS host processor sequential and members of partitioned data sets with any record format except undefined (remote data sets) can be accessed from a local CMS session using VM/PC commands, and a program executing in a local CMS session can read and write MVS sequential and partitioned data sets just as if they were CMS files on local minidisks. Read and write requests to remote data sets and the data for write requests are passed from the local CMS session to TSOSERV in the remote TSO session for execution by the host processor. For read requests, TSOSERV returns the requested data to the local CMS session.

Thus, MVS sequential and partitioned data sets at the host processor containing data can be read by the PC XT/370 or AT/370 local CMS session and written as CMS files on PC XT/370 or AT/370 diskettes or fixed disk. CMS data files on PC XT/370 diskettes and fixed disks can be read and sent to the MVS host processor to be written as MVS sequential or partitioned data sets.

Note that MVS executable load modules and VM/CMS executable load modules do not have the same format and an MVS load module transferred to the PC XT/370 or AT/370 from an MVS host processor cannot be executed under VM/PC. Therefore, MVS load modules may not be downloaded for execution in the PC XT/370 or AT/370 and CMS module files may not be uploaded to MVS for execution in the MVS host processor. However, object modules can be downloaded or uploaded and link edited by the system in which they are to be executed. In addition, CMS module files can be uploaded to the MVS host processor.

Therefore, programs that are to be downloaded to the PC XT/370 or AT/370 under the licensing provided by the IBM Personal Computer XT/370 or AT/370 License Option Amendment must be downloaded from a VM/370 system using VMPCSERV. They cannot be downloaded from an MVS system using TSOSERV. Once an executable program has been downloaded to one PC XT/370 or AT/370 from a VM/370 system, it can be uploaded from another PC XT/370 or AT/370 to an MVS system using TSOSERV and then downloaded to other PC XT/370 or AT/370 configurations connected to that MVS host processor that are to use the program.

- Remote printers. The PC XT/370 or AT/370 can have access to printers attached to the MVS host processor from a local CMS session to support remote spooling. The PC XT/370 or AT/370 user can transfer printer output to the MVS host processor using VM/PC commands for printing by the host processor. Alternatively, the printer output can be tagged for transmission to other printers in the network for printing.
- TSO command execution. The user can issue a subset of the TSO commands from the local CMS session that are sent to the MVS host processor for execution. LOGON and LOGOFF commands, TSO commands that are interactive (prompt the user for information), full-screen TSO commands (such as EDIT, TEST, or ISPF), and CLISTs cannot be issued using the TSO command.

Performance

When operating under VM/PC as a CMS virtual machine, the PC XT/370 executes instructions at one-third to one-half the speed of a 4331 Model Group 1 doing commercial work and at one to two times the speed of the 4331 Model Group 1 performing scientific calculations. The trivial XEDIT commands are performed with less than one second response time.

When operating under VM/PC as a CMS virtual machine, the PC AT/370 executes instructions at 40% to 60% of the speed of a 4331 Model Group 1 processing commercial work and at 125% to 250% of the speed of a 4331 Model Group 1 performing scientific calculations. Trivial commands, such as XEDIT subcommands, are performed with sub-second response times.

The PC/370-P2 Card in the PC AT/370 can execute System/370 instructions about 25% faster than the PC/370-P Card in the PC XT/370 and the 80286 microprocessor in the PC AT/370 is 25% faster than the 8088 microprocessor in the PC XT/370. Thus, the average instruction execution rate of the PC AT/370 is approximately 1.25 times that of the PC XT/370 for VM/PC mode operations, and processor bound jobs will run somewhat faster in a PC AT/370 than in a PC XT/370.

In addition, the PC AT/370 transfers diskette and fixed disk data 16 bits at a time rather than 8 bits at a time, and the access time and data transfer rate of the 20Mb fixed disk drive are faster than that of the 10Mb fixed disk drive. Hence, I/O-bound jobs execute significantly faster on a PC AT/370 than on a PC XT/370.

Typical compile speed in lines per minute (lpm) is shown below for the PC XT/370 and PC AT/370 configurations executing selected language translators.

Language	PC XT/370 (lpm)	PC AT/370 (lpm)	Percent Difference
Assembler H	330	557	69
IBM BASIC	100	216	116
OS/VS COBOL	150	205	37
VS FORTRAN	75	125	67
Pascal/VS	300	594	98
PL/I Optimizing Compiler	110	179	65

The response times that will be experienced by a user of a PC XT/370 or AT/370 configuration in a given environment depend on the types of activities

involved in the commands to be executed. High paging and/or other high I/O activity, location of the minidisks to be accessed (local PC XT/370 or AT/370 or remote host processor), use of the remote services provided by VMPCSERV or TSOSERV, and other activity on the 3274 Control Unit or adapter to which the PC XT/370 or AT/370 is attached are major factors that affect response time.

For remote 327X sessions, a PC XT/370 or AT/370 user may experience response times that are different from those provided by a large VM/370 host processor. However, for stand-alone local CMS sessions, response times will be consistent. In addition, while execution in a local CMS session in the PC XT/370 or AT/370 may take longer than in a remote 327X session in a large host processor, turnaround time may be less using the PC XT/370 or AT/370 because of delays encountered accessing a fully loaded host processor.

Section 15: IBM 3270 Personal Computer Workstations

3270 Personal Computer (3270-PC) – announced October 18, 1983

3270 Personal Computer/Graphics (3270-PC/G) – announced June 25, 1984

3270 Personal Computer/Extended Graphics (3270-PC/GX) – announced June 25, 1984

15:10 IBM 3270 Personal Computer Configuration Overview

Introduction

The 3270 Personal Computer (3270-PC), shown in Figure 15-1, is a programmable workstation that combines the host-interactive functions of the 3270 system with the computing power and versatility of an IBM personal computer. Graphics like that provided by a 3279 Color Display Station is supported for host sessions while all-points-addressable graphics is supported for a local session.

The 3270-PC attaches to the 3274 Control Unit or 3276 Control Unit Display Station and can interact with a System/370, 30XX, 4300, or 8100 processor. It can be included in the IBM Information Network.

The 3270-PC is supported by the 3270-PC Control Program operating under the IBM Personal Computer Disk Operating System (DOS) Version 2.0 or later. The 3270-PC Control Program Version 1 supports up to seven sessions operating concurrently in the 3270-PC. Up to four host-interactive (3270-type) sessions, one or two local notepad sessions, and one IBM Personal Computer DOS Version 2.0 or 2.1 session can be operating at the same time. Version 2 of the 3270-PC Control Program permits multiple DOS Version 2.1 or 3.0 sessions to operate concurrently with four host-interactive and two notepad sessions.

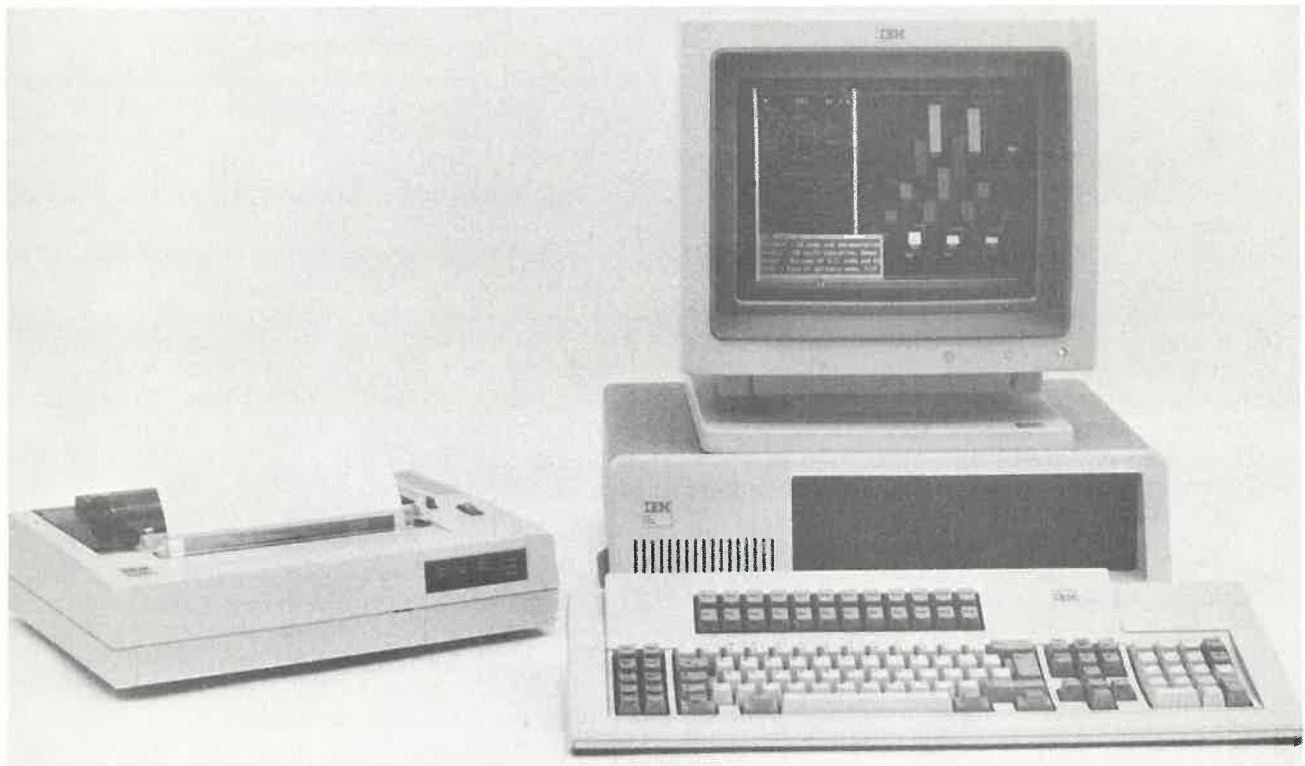


Figure 15-1. 3270-PC workstation

15:10 IBM 3270 Personal Computer Configuration Overview

The operator can interact with one session at a time and can easily switch from one session to another using the keyboard. When the Programmed Symbols feature is installed in a 3270-PC, output from current 3279 graphics applications executing in a System/370, 30XX, or 4300 host processor can be displayed at the 3270-PC workstation.

The 3270-PC Control Program supports advanced screen management functions. It permits each operating session or part of a session to be displayed using a technique called windowing. The operator can control the display (window size) for each session and each window location on the screen.

Session data can be copied or transferred from one session to any other session (except to the DOS session in Version 1 of the 3270-PC Control Program) or printed on a printer attached to the 3274/3276 control unit or 3270-PC. Color hard copy, including foils and flipcharts, can be created using the supported printers. In addition, files can be transferred between one host-interactive session in the 3270-PC and a host MVS/TSO, CICS/VS, or VM/SP processor using a 3270-PC File Transfer Program executing in the host processor.

The 3270-PC permits a user to access data contained in up to four data bases and/or systems, to view this data on the screen, and to manipulate the displayed data. These facilities make the 3270-PC especially suitable for use with insurance, utility, marketing, industrial, and financial applications, for example, or for any application that requires access to multiple data files.

The business professional, data processing professional, executive, or clerical worker will find the 3270-PC workstation to be a productivity tool. Professionals in engineering/scientific, government, and educational environments and personnel in any environment with a need for information from several sources will also find the 3270-PC workstation very useful.

The 3270-PC can also be used as a stand-alone IBM personal computer that operates under DOS control with or without the 3270-PC Control Program. Many DOS application programs that execute in other IBM personal computer configurations can execute in the 3270-PC when the required hardware resources are present. Thus, the 3270-PC can be the workstation selected for use in combined host-interactive and IBM personal computer environments.

The 3270-PC can also be included in text processing environments with other IBM personal computers that use DisplayWrite 2 and/or DisplayWrite 3 and

in office systems environments supported by the Personal Services/PC and Personal Services/370 programs, which support interaction with DISOSS/370 operating under MVS/XA, MVS/370, or VSE.

Physical Components

The 5271 System Unit is used in 3270-PC configurations and two 5271 model groups are available. Models 2, 4, and 6 of the 5271 are designed for use with a 5151 Monochrome Display or 5272 Color Display. Models 24 and 26 are designed for use with the 3295 Plasma Monitor.

The 3295 is a large-capacity monitor that is similar to the 3290 Information Panel Display Station and that displays up to 9920 alphameric characters. The 3295 display is designed primarily for environments that require concurrent viewing of more than 2048 characters using windows larger than 2048 characters or that require multiple windows of 2048 characters each, where the primary applications are host-related.

A 3270-PC workstation without the 3295 Plasma Monitor consists of the following required and optional IBM-logo hardware and programming components as supported by the 3270-PC Control Program:

- 5271 System Unit Model 2, 4, or 6 with a keyboard
- 5151 Monochrome Display or 5272 Color Display
- 3270-PC Control Program (any release)
- IBM Personal Computer Disk Operating System (DOS) Version 2.0 or later
- 5161 Expansion Unit Model 1 or 2 to provide fixed disk storage and space for additional features (optional)
- 5152 Model 2 Graphics Printer (optional)
- 5182 Color Printer Model 1 (optional)
- 3852 Color Printer Model 1 (optional)
- 5218 Printwheel Printer (optional)
- 5201 QUIETWRITER® Printer (optional)
- 5216 Wheelprinter Model 2 (optional)

A 3270-PC workstation with the 3295 Plasma Monitor consists of the following required and optional IBM-logo hardware and programming components as supported by the 3270-PC Control Program:

- 5271 System Unit Model 24 or 26 with a keyboard
- 3295 Plasma Monitor

- 3270-PC Control Program Version 1 Release 2.2
- IBM Personal Computer Disk Operating System (DOS) Version 2.0 or later
- 5161 Expansion Unit Model 1 or 2 to provide fixed disk storage and space for additional features (optional)
- 5152 Model 2 Graphics Printer (optional)
- 5182 Color Printer Model 1 (optional)
- 5218 Printwheel Printer (optional)
- 5201 QUIETWRITER® Printer (optional) – supported for printing from the DOS session only
- 5216 Wheelprinter Model 2 (optional) – supported for printing from the DOS session only
- 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 (DOS operating system, 3270-PC Control Program, and DOS application programs) of 256K to 640K bytes
- One or two IBM 5¼-inch double-sided diskette drives installed in the 5271 unit with a capacity of 360K bytes each
- One or two fixed disk drives of 10Mb (10,618,880 bytes) capacity each. The 5161 Expansion Unit is required for two fixed disk drives. A maximum of two diskette drives or one diskette drive and one fixed disk drive can be installed in one 5271 System Unit. When the 5161 Expansion Unit is installed, a maximum of two diskette drives and two fixed disk drives is permitted in a 3270-PC configuration.

Minimum Configuration

The minimum 3270-PC hardware configuration consists of a 5271 System Unit Model 2 with a keyboard and a 5151 Monochrome Display. The price for a single 3270-PC minimum hardware configuration is \$4,020. Adding the price of DOS Version 2.1 and the 3270-PC Control Program to the minimum hardware price gives a minimum single workstation cost of \$4385.

Configuration Features

The 5271 System Unit is based on the 5160 System Unit for the IBM Personal Computer XT. Thus, it has many hardware features and several I/O devices that are identical to those for other IBM personal computer configurations. Certain adapter features (3270 System Adapter, 5151/5272 Display Adapter, Printer/Memory Adapter, and Keyboard/Timer Adapter) and I/O devices (5272 Color Display, 3295 Plasma Monitor, and the keyboard) are not available for 4860, 5150, 5155, 5160, and 5170 IBM personal computer configurations.

The following highlights the features of 3270-PC configurations, including memory sizes, types and maximum number of attachable I/O devices, and the processors/units to which a 3270-PC can be connected:

- One 5271 System Unit with a keyboard
- Intel 8088 16-bit microprocessor in the 5271 System Unit
- Eight interrupt levels
- Direct memory access (DMA) – three channels
- Math Co-processor Option available to increase the speed and precision of arithmetic, logarithmic, and trigonometric functions
- One display (5151 Monochrome Display, 5272 Color Display, or 3295 Plasma Monitor)
- One parallel printer via the Printer Adapter and one or two serial printers via the Asynchronous Communications Adapters
- 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
- Data security via the Keylock Feature
- Connection to the following:
 - 3274 Control Unit or 3276 Control Unit Display Station via the standard 3270 System Adapter for connection to a local or remote System/370, 30XX, or 4300 processor to use the 3270-PC as a host-interactive 3270 terminal supported by the 3270-PC Control Program
 - 3274 Control Unit via the 3270 System Adapter for connection to a local or remote 8100 Processor for host-interactive operations supported by the 3270-PC Control Program
 - 4321, 4331, or 4361 Processor via the Display/Printer Adapter or to a 4361 Processor via the Workstation Adapter attached to the 3270 System Adapter to use the 3270-PC as a host-interactive 3270 terminal supported by the 3270-PC Control Program
 - System/370, 30XX, 4300, and Series/1 processors via the Asynchronous Communications Adapter, Binary Synchronous Communications Adapter, or Synchronous Data Link Control Communications Adapter

15:10 IBM 3270 Personal Computer Configuration Overview

- 8100 Processor using the Asynchronous Communications Adapter or Synchronous Data Link Control Communications Adapter
- 5520 Administrative System via the Display Station Emulation Adapter
- 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT or XT/370, 5170 Personal Computer AT or AT/370, other 3270 Personal Computer workstations, 5531 Industrial Computer, communicating typewriter, laboratory instrument, voice recognition device, letter-quality printer, or other machine that uses the RS-232C interface via the Asynchronous Communications Adapter
- A remote VM/370 PROFS system via the Asynchronous Communications Adapter
- A local Displaywriter via cable attachment to the Asynchronous Communications Adapter
- 5218 Printwheel Printer Model A03 or A04 (for letter-quality printing applications) via the 5218 Printer Attachment Cable attached to an Asynchronous Communications Adapter. Up to four IBM personal computer systems can share one 5218 printer using the 5218 Printer Sharing feature.
- 5201 QUIETWRITER® Printer via the Printer Adapter or to the 5216 Wheelprinter Model 2 via the Printer Adapter or the Asynchronous Communications Adapter for letter-quality printing applications
- 7371, 7372, 7374, or 7375 Color Plotter via cable connection to the Asynchronous Communications Adapter

In order for the 3270-PC to be used as a host-interactive terminal, the 3270-PC Control Program must be customized during installation to operate in one of two host-interactive modes:

- Distributed function terminal (DFT). For this mode, the 3270-PC attaches to System/370 and 30XX processors via certain models of the 3274 Control Unit with Configuration Support T or D. One physical type A 3274 port and up to four logical addresses are used for the 3270-PC. DFT mode is not supported for 4300 Processors.

The 3270-PC with a 5271 Model 12, 14, or 16 emulates a 3178, 3278 (except Models 1 and 2A), or 3279 (except Model 2C) display. A 3270-PC with a 5271 Model 24 or 26 (and a 3295 Plasma Monitor) emulates a 3178, 3179, 3180, 3278 (except Models 1 and 2A), 3279 (except Model 2C), or 3290 display. The 3270-PC supports from one to four host-

interactive sessions operating concurrently. DFT mode supports base (four-color) data stream or extended (eight-color) data stream operations. The Programmed Symbols feature can be used by one of the operating host-interactive sessions to support graphics output to the 3270-PC display.

Note that Category B display stations (such as the 3277) cannot be attached to a 3274 that is customized for DFT mode operations.

- Control unit terminal (CUT). For this mode, the 3270-PC attaches to System/370, 30XX, and 4300 processors via the 3276 Control Unit Display Station (except Model 1) or any model of the 3274 Control Unit with any type Configuration Support via a type A terminal adapter; 4321, 4331, and 4361 Processors via the Display/Printer Adapter; or 4361 Processors via the Workstation Adapter.

The 3270-PC emulates a 3178, 3278 Model 2, or 3279 Model S2A and supports only one host-interactive session operating at a time. CUT mode supports only base (four-color) data stream operations. The Programmed Symbols feature cannot be used in CUT mode.

The 3270-PC is data stream compatible (implicit partition only) with any model 3178, 3278 (except Models 1 and 2), or 3279 (except Model 2C) in alphameric application environments. Thus, no programming changes are required to use the 3270-PC for current alphameric applications if the hardware features used on the current 3270 display are available on the 3270-PC.

The 3270-PC does not support the following 3270 hardware and facilities:

- 3270 diagnostic reset dump
- 3274 Entry Assist feature
- APL/TEXT character set
- Base color (four-color) copy to the 3274- or 3276-attached printer
- Binary Synchronous Copy command
- Explicit partitions
- Graphics escape
- Katakana
- Keyboard clicker
- Keyboard types
- Magnetic Reader Control and accessories
- Monocase switch
- Numeric lock
- Port 0 customization function of the 3274 Control Unit
- RPQs

- Security keylock
- Selector light pen
- Video output

The following capabilities are available only for CUT mode:

- Category B terminals attached to the same 3274 Control Unit as a 3270-PC
- Encryption/decryption
- Port 0 operation permitted only with the alternate IML of the 3274

Up to 32 5271 System Units (all models) can be attached to a 3274 Control Unit via coaxial cable, depending on the application and 3274 model used. Up to seven 5271 System Units (Models 2, 4, and 6 only) can be attached to the 3276 Control Unit Display Station. The 5271 is attached to the 3274/3276 using the same type of coaxial cable as is used to attach 3270 units to the 3274/3276. The cable attaches to the standard 3270 System Adapter in the 5271 System Unit.

All host processor attachment environments are supported for all 5271 models:

- SNA local channel
- Non-SNA local channel
- Synchronous data link control (SDLC) remote
- Binary synchronous control (BSC) remote

The 3270-PC can be connected to the IBM Cabling System for attachment to the following:

- 3274 Control Unit or 3276 Control Unit Display Station
- Display/Printer Adapter of a 4321, 4331, or 4361 Processor
- Workstation Adapter of a 4361 Processor
- 5520 Administrative System

The 3270-PC operating in CUT mode can be installed to replace an existing 3178, 3278 Model 2, or 3279 Model S2A display that is attached to a 3274 or 3276 control unit or as an additional terminal to interact with a processor without change to the 3274/3276 control unit or host processor programming. Up to four sessions (one host-interactive, two notepad, and one DOS) and all the 3270-PC Control Program functions are supported for this mode.

Alternatively, the 3270-PC operating in DFT mode can be installed as a full-function 3270-PC that supports multiple sessions (four host-interactive, two notepad, and one DOS for Version 1 or multiple DOS for Version 2 of the 3270-PC Control Program). All the 3270-PC Control Program func-

tions are also supported for this mode. Customization of the 3274 Control Unit is necessary unless it is already customized for multiple sessions (for use with the 3290 Information Panel Display Station, for example). Host processor programming need not be changed.

The 3270-PC executing the 3270-PC Control Program under DOS can also be used as an IBM personal computer when not being used for any host-interactive session. Three sessions (one DOS and two notepad) for Version 1 or multiple sessions (multiple DOS and two notepad) for Version 2 and all the functions of the 3270-PC Control Program (described in Section 15:25) except file transfer to and from a host processor are supported. Most DOS application programs that are available from IBM can also be executed under DOS in a 3270-PC without use of the 3270-PC Control Program.

Operating Systems Supporting

The 3270-PC operating as a 3270 workstation is supported by the IBM Personal Computer Disk Operating System (DOS) Version 2.0 and later with the 3270-PC Control Program Version 1 or 2. Operating as an IBM personal computer, the 3270-PC is supported by DOS Version 2.0 and later.

Compatibility

Hardware

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

Diskettes (5¼-inch) are interchangeable without restriction between 3270 Personal Computer workstations, 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), and 5531 Industrial Computers. A

15:10 IBM 3270 Personal Computer Configuration Overview

cassette adapter is not provided and cartridges are not supported by the 3270-PC.

Programming

Programs that operate in other IBM personal computers under DOS Version 2.0 or later and that observe DOS and Basic Input/Output System (BIOS) protocols can also operate in a DOS session under the 3270-PC Control Program in the 3270-PC that has the required hardware resources, subject to the restrictions listed below. These programs can also execute under DOS Version 2.0 or later without the 3270-PC Control Program.

Applications executing in the DOS session under the 3270-PC Control Program must not:

- Use interrupt vectors X"50" through X"57"
- Reprogram the 8259 Interrupt Controller
- Access memory addresses above the interrupt level 12 pointer in BIOS, except to reference the IBM personal computer display refresh buffer
- Disable interrupts, fail to issue an end-of-interrupt or IRET on a hardware interrupt level, or mask selected interrupt levels for more than 100 ms
- Issue instructions to an IBM personal computer display adapter 6845 CRT Controller (they will be ineffectual)
- Use the print spooling capability of DOS

Customer Responsibilities

The 3270-PC and its features are customer setup. Detailed setup instructions are included with each system. However, setup is available from the IBM National Service Division at the IBM hourly rate and minimum charge. The customer must contact an IBM customer service coordinator for attachment of the 5271 System Unit communication cable to an onsite serviced 3274 or 3276 control unit where a customer access area is not permitted.

The 3270-PC Control Program and 3274 Control Unit must be customized by the installation. The 3270-PC installation planning and 3274 customizing guides (GA23-0179 and GA23-0065, respectively) provide the necessary customizing information. The customer must perform the Customer Problem Analysis and Resolution (CPAR) procedure and testing of any IBM personal computer optional features that are not part of the IBM-verified set (listed in Section 15:15 under "Optional Features for 5271 System Units").

A power source is required for the 5271 System Unit, the 5272 Color Display, the 3295 Plasma Monitor, the 5161 Expansion Unit, and any printers included in the configuration. The 5151 Monochrome Display receives power from the 5271 unit.

Data Security

The customer is responsible for providing any desired security functions. The Keylock Feature can be installed on a 5271 System Unit and/or 5161 Expansion Unit in a 3270-PC configuration (see discussion in Section 15:15 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 3270-PC units and features are purchase only. The 5271, 5272, and 3295 can be purchased from NAD and NMD marketing representatives. IBM Credit Corporation Term Lease Financing may be available for the 3270-PC.

Warranty Period

The warranty period for 5271, 5272, and 5161 units is three months. For the 3295, the warranty period is one year. The warranty period for features of the 5271 unit is three months. The warranty service for the 5271 and 3295 is IBM On-Site Repair. For the 5272, the warranty service is IBM On-Site Exchange. For the 5161, the warranty service is Customer Carry-In Repair.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Service:
 - Warranty Option. For the 5161, IBM On-Site Repair is available. A warranty option is not available for 5271, 5272, and 3295 units.
 - Annual Maintenance. IBM On-Site Repair and Customer Carry-In Repair are available for the 5271 and 5161 units. For the 3295, IBM On-Site Repair is available. For the 5272 unit, IBM On-Site Exchange, Cus-

tomer On-Site Exchange, Customer Carry-In Exchange, and Customer Carry-In Repair are available.

- IBM Hourly Service: Customer Carry-in Repair at an IBM Service/Exchange Center
- Self-service using the *Maintenance Information* package, which enables the customer to isolate the problem to an under-the-cover field replaceable unit

Publications

The following publications are provided with each 3270-PC hardware configuration:

- *Guide to Operations*, SA23-0141. This publication provides hardware setup, operational, and customer problem analysis and recovery procedures.
- *Maintenance Information*, SY27-2567. This publication presents hardware problem recovery procedures, a parts catalog, and maintenance information.
- *BASIC* (6361132). This binder describes the functions provided by the BASIC Interpreter that is included in ROM in a 5271 unit.

The publications *3270-PC Control Program User's Guide and Reference* (contains the diskettes with the 3270-PC Control Program), SC23-0103, and *3270-PC Online Tutorial*, SA23-0163, and a summary card, SX23-0231, are provided with the 3270-PC Control Program.

The following publications describing the 3270-PC and the 3274 are available:

- *3270-PC for End-Users* brochure, G520-1041
- *3270-PC Facts Folder*, G520-1090
- *3270-PC Graphics Workstations* brochure, G520-4220
- *3270-PC Introduction and Preinstallation Planning*, GA23-0179
- *3270-PC Hardware Reference*, GA23-0233
- *3270-PC Control Program Programming Guide*, SA23-0221
- *3270-PC Control Program: Reference*, GA23-0232
- *IBM 3274 Control Unit Description and Programmer's Guide*, GA23-0061
- *IBM 3274 Control Unit Customizing Guide Configuration D*, GA23-0065
- *IBM 3274 Control Unit Planning, Setup, and Customizing Guide*, GA27-2827
- *IBM 3274 Control Unit Planning and Site Preparation Guide*, GA23-0064
- *An Introduction to the IBM 3270 Information Display System*, GA27-2739

- *IBM 3270 Information Display System User's Guide*, GA23-0058
- *IBM 3270 Information Display System Installation Manual – Physical Planning*, GA27-2787
- *CICS/VS 3270-PC File Transfer Program Specifications*, G320-0369
- *TSO 3270-PC File Transfer Program Specifications*, GC23-0128
- *VM 3270-PC File Transfer Program Specifications*, GC23-0129

The following publications provide information about the DOS operating system and IBM-logo and vendor-logo application programs that are available from IBM:

- *The Guide to Personal Computer Offerings from IBM*, G520-0059
- *The Library of IBM Personal Computer Software Offerings*, G520-1107
- *Personal Computer Software*, GB30-2037, and *Personal Computer Software Pocket Guide*, GB30-2479
- *The Directory* (6137591)

15:15 IBM 5271 System Unit, IBM 5272 Color Display, and IBM 3295 Plasma Monitor

The 5271 System Unit Model 4 for the 3270-PC is shown in Figure 15-2.

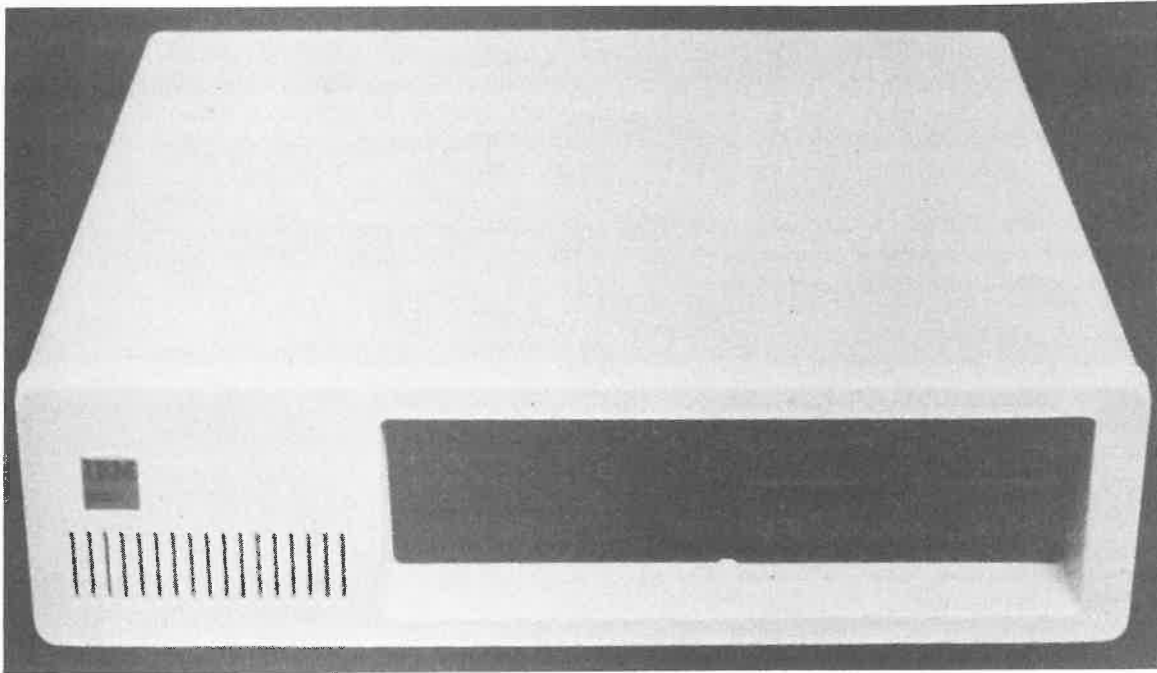


Figure 15-2. 5271 System Unit Model 4

Models Available

Five models of the 5271 System Unit are provided for a 3270-PC configuration. These models provide standard configurations to select from on the basis of user need. These models differ only in the standard features provided and/or the display supported. Otherwise, they are physically and functionally identical.

The 5271 Model 2 provides:

- 256Kb of random access memory, which is expandable to 640Kb
- One keyboard
- Eight system expansion slots (numbers 1 to 6 are full-feature, while numbers 7 and 8 are special-feature)
- 3270 System Adapter in slot 1
- One 5151/5272 Display Adapter in slot 3
- 3270-PC Keyboard/Timer Adapter in slot 8
- Diskette Drive Adapter in slot 6
- One 5¼-Inch Double-Sided Diskette Drive

The 5271 Model 2 configuration provides an entry-level workstation and is appropriate for a clerical or industry information worker.

The 5271 Model 4 provides:

- 384Kb of random access memory, which is expandable to 640Kb
- One keyboard
- Eight system expansion slots (numbers 1 to 6 are full-feature, while numbers 7 and 8 are special-feature)
- 3270 System Adapter in slot 1
- One 5151/5272 Display Adapter in slot 3
- 3270-PC Keyboard/Timer Adapter in slot 8
- Diskette Drive Adapter in slot 6
- Two 5¼-Inch Double-Sided Diskette Drives
- Printer/Memory Adapter in slot 7

The 5271 Model 4 configuration can also be used by clerical or industry information workers and as a

workstation with entry-level functions for the business professional.

The 5271 Model 6 provides:

- 384Kb of random access memory, which is expandable to 640Kb
- One keyboard
- Eight system expansion slots (numbers 1 to 6 are full-feature, while numbers 7 and 8 are special-feature)
- 3270 System Adapter in slot 1
- 5151/5272 Display Adapter in slot 3
- 3270-PC Keyboard/Timer Adapter in slot 8
- Diskette Drive Adapter in slot 6
- One 5¼-Inch Double-Sided Diskette Drive
- Printer/Memory Adapter in slot 7
- Fixed Disk Drive Adapter in slot 5
- One 10Mb Fixed Disk Drive

The 5271 Model 6 configuration is designed to support the full function of the 3270-PC workstation and is the suggested standard configuration for an executive, business professional, or DP professional.

The 5271 Model 24 provides:

- 384Kb of random access memory, which is expandable to 640Kb
- One keyboard
- Eight system expansion slots (numbers 1 to 6 are full-feature, while numbers 7 and 8 are special-feature)
- 3270 System Adapter in slot 1
- One 3295 Display Adapter in slot 3
- 3270-PC Keyboard/Timer Adapter in slot 8
- Diskette Drive Adapter in slot 6
- Two 5¼-Inch Double-Sided Diskette Drives
- Printer/Memory Adapter in slot 7

The 5271 Model 26 provides:

- 384Kb of random access memory, which is expandable to 640Kb
- One keyboard
- Eight system expansion slots (numbers 1 to 6 are full-feature, while numbers 7 and 8 are special-feature)
- 3270 System Adapter in slot 1
- 3295 Display Adapter in slot 3
- 3270-PC Keyboard/Timer Adapter in slot 8
- Diskette Drive Adapter in slot 6
- One 5¼-Inch Double-Sided Diskette Drive
- Printer/Memory Adapter in slot 7
- Fixed Disk Drive Adapter in slot 5
- One 10Mb Fixed Disk Drive

Models 2, 4, and 6 of the 5271 can be field-upgraded with optional features to the maximum configuration possible. In addition, Models 2, 4, and 6 of the 5271 can be field-upgraded to 5271 Models 24 and 26.

The following are also standard features of all 5271 System Unit models:

- Microprocessor – Intel 8088
- Eight interrupt levels
- Direct memory access (DMA) – three channels
- 40K bytes of read-only memory (ROM)
- BASIC-80 Interpreter in ROM
- A programmable speaker and associated adapter
- Automatic power-on self-test
- A 130-watt power supply with cooling fan

Physical Characteristics

Dimensions

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

Weight

- Model 2: 27.9 lb (12.7 kg)
- Models 4 and 24: 31.5 lb (14.3 kg)
- Models 6 and 26: 33 lb (15 kg)

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 in the 5271 System Unit
- Humidity: 8% to 80%
- Noise level:
 - 51 decibels (dB) without printer
 - 66 decibels with printer
- Electrical: 120 volts, 50 or 60 Hz

Optional Features for 5271 System Units

The following optional features are available for 5271 System Unit Models 2, 4, and 6 as indicated:

- Math Co-processor Option (all models) – one maximum**
- Game Control Adapter (all models) – one maximum**
- Printer/Memory Adapter (Model 2 only) – one maximum
- 256Kb Memory Expansion Option (all models) – one maximum
- 64/256Kb Memory Expansion Option (all models) – one or two for the Model 2 and one for Models 4 and 6*
- 64Kb Memory Module Kit (all models)*
- 10Mb Fixed Disk Drive (Model 2 only) – one maximum
- Fixed Disk Drive Adapter (Model 2 only) – one maximum
- 5¼-Inch Double-Sided Diskette Drive (Model 2 or 6) – one maximum
- Programmed Symbols Adapter (all models) – one maximum
- All-Points-Addressable Adapter (all models) – one maximum
- Asynchronous Communications Adapter (all models) – two maximum**
- Binary Synchronous Communications Adapter (all models) – two maximum**
- Synchronous Data Link Control Communications Adapter (all models) – one maximum**
- Communications Adapter Cable (all models) – one for each BSC or SDLC adapter installed**
- Display Station Emulation Adapter (all models) – one maximum**
- 5218 Printer Attachment Cable (all models) – two maximum
- 5218 Printer Sharing (all models) – two maximum
- Keylock Feature (all models) – one maximum

* For 5271 models shipped without the Printer/Memory Adapter

** Not supported by the 3270-PC Control Program for host-interactive sessions. Can be used in a DOS session or when the 3270-PC Control Program is not executing in the 3270-PC.

The following optional features are available for 5271 Models 24 and 26:

- 256Kb Memory Expansion Option (both models) – one maximum
- 5¼-Inch Double-Sided Diskette Drive (Model 26 only) – one maximum
- Asynchronous Communications Adapter (both models) – two maximum
- Keylock Feature (both models) – one maximum

The following IBM personal computer features cannot be used with the 3270-PC configuration:

- 83-key or 84-key keyboard for other IBM personal computers
- Monochrome Display and Printer Adapter
- Color/Graphics Monitor Adapter

Other IBM personal computer features may be usable in a 3270-PC configuration but need to be tested by the user to assure correct operation. IBM does not accept any responsibility for them.

Physical Components Included

Each 5271 System Unit contains the system board, the programmable speaker, and the power supply and fan. The standard diskette drive in all models, the standard fixed disk drive in 5271 Models 6 and 26, and the second standard diskette drive in 5271 Models 4 and 24 are also contained in the 5271 unit.

Each 5271 system board contains:

- The processor subsystem (includes the Intel 8088 microprocessor and associated functions)
- Read only memory (40K bytes)
- Random access memory (256K bytes)
- The programmable speaker adapter
- Eight system expansion slots that are used to hold feature cards
- Socket for the Math Co-processor Option module

The system board also contains one set of eight switches that can be read under program control. These switches (called dual inline package – DIP – switches) provide configuration information to the operating system. In a 3270-PC configuration, they must be set to indicate whether the Math Co-processor Option is installed, the type of display attached, the amount of memory on the system board, and the number of diskettes attached.

Standard and optional features are installed inside the 5271 System Unit or the 5161 Expansion Unit except the Communications Adapter Cable, 5218

Printer Attachment Cable, and Keylock Feature. Feature cards plug into expansion slots provided in the left rear corner of the 5271 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 5271 System 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).

Feature Descriptions

Microprocessor and Direct Memory Access

The instruction execution function in the 5271 System Unit is the Intel 8088 16-bit microprocessor with a 4.77-megahertz (MHz) clock speed and 410-nanosecond cycle time. The 8088 microprocessor in the 5271 System Unit and direct memory access are the same as in the IBM Personal Computer XT (see descriptions in Section 13:10 under "Microprocessor" and "Direct Memory Access").

Math Co-processor Option

This optional feature for 5271 Models 2, 4, and 6 increases the speed and precision of arithmetic, logarithmic, and trigonometric functions. It provides an Intel 8087 co-processor that has its own instruction set. This option is the same as that for the IBM Personal Computer XT (see description in Section 13:10 under "Math Co-processor Option").

Read Only Memory

Each 5271 contains 40K bytes of read only memory (ROM) on the system board. The contents of ROM remain when power to the 5271 System Unit is turned off and writing to this memory cannot be done. ROM is used for the permanent residence of certain programs. ROM in the 3270-PC is the same as that in the IBM Personal Computer XT (see description in Section 13:10 under "Read Only Memory").

Once the 5271 has been turned on and the self-test diagnostics have executed successfully, an attempt is made to initial program load (IPL) and operating system from diskette drive A (leftmost drive) or from the first fixed disk (C) drive, 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 5271, RAM is dynamic memory (its contents must be refreshed periodically) and its contents are lost when power to the 5271 is removed. This memory is parity-checked for validity and has a 200-ns access time and a 345-ns cycle time.

The standard memory in any 5271 model can be expanded to a maximum of 640K bytes using the Printer/Memory Adapter and 256Kb Memory Expansion Option or the 64Kb Memory Module Kit and 64/256Kb Memory Expansion Option features.

Printer/Memory Adapter and 256Kb Memory Expansion Option

The Printer/Memory Adapter is standard in 5271 Models 4, 6, 24, and 26 and optional for the 5271 Model 2. It provides the functions of a printer adapter and 128Kb of parity-checked random access memory on a card that can be placed in a special- or full-feature slot. The 256Kb Memory Expansion Option can be added to the Printer/Memory Adapter to provide 384Kb on the card and 640Kb in the 5271 unit. One Printer/Memory Adapter and 256Kb Memory Expansion Option are permitted in a 5271 unit and cannot be installed in the 5161 unit.

The Printer/Memory Adapter permits memory above 256Kb to be located in a special-feature slot instead of requiring one or two full-feature slots, as is required when one or two 64/256Kb Memory Expansion Options are used.

The printer adapter portion of the Printer/Memory Adapter provides for the attachment of one parallel printer to the 3270-PC configuration, such as the 5152 Graphics Printer Model 2, 5182 Color Printer, 3852 Color Printer, 5201 QUIETWRITER® Printer, or 5216 Wheelprinter Model 2, or one device with TTL (transistor to transistor logic) levels. See Section 31 for the cable required for each type of printer that attaches to this adapter.

64/256Kb Memory Expansion Option and 64Kb Memory Module Kit

These features can be used in 5271 units that do not have the Printer/Memory Adapter installed (those shipped before availability of the Printer/Memory Adapter). The 64/256Kb Memory Expansion Option provides 64Kb on a circuit card that plugs into a full-feature expansion slot in the 5271 System Unit. Up to three 64Kb Memory Module Kits can be plugged into a memory expansion circuit card for a total of 256Kb on the card. The 64Kb Memory Module Kit provides 64Kb of parity-checked random access memory via nine small plug-in modules. Each module contains 64K bits.

Up to 512Kb of memory can be installed in a 5271 System Unit using one 64/256Kb Memory Expansion Option card. If up to 640Kb of memory is desired, one additional memory expansion card (with a 64Kb Memory Module Kit for 640Kb) must be installed in the 5271 unit.

System Expansion Slots

Six full-feature (numbered 1 to 6) and two special-feature (numbered 7 and 8) expansion slots are standard on the system board in all 5271 models to contain memory and adapter features. The full-feature slots will accept full-feature or the smaller special-feature cards. The special-feature slots will accept only the special-feature cards.

Slot assignments for standard features of 5271 models are shown below (a blank indicates an available slot):

Slot	Feature	5271 Model		
		2	4/24	6/26
1	3270 System Adapter (Available)	X	X	X
3	5151/5272 Display Adapter (Available)	X	X	X
5	Fixed Disk Drive Adapter			X
6	Diskette Drive Adapter	X	X	X
7	Printer/Memory Adapter		X	X
8	Keyboard/Timer Adapter	X	X	X

The following optional features require one system expansion slot:

- 64/256Kb Memory Expansion Option (full-feature) – all models without the Printer/Memory Adapter
- Printer/Memory Adapter (special- or full-feature) – Model 2 only
- Programmed Symbols Adapter (full-feature slot adjacent to the Display Adapter) – slot 2 or 4 in any model
- All-Points-Addressable Adapter (full-feature slot adjacent to the Display Adapter) – slot 2 or 4 in any model
- Fixed Disk Drive Adapter (full-feature) – Model 2 only*
- Game Control Adapter (special- or full-feature) – all models except 24 and 26*
- Asynchronous Communications Adapter (special- or full-feature) – all models*
- Binary Synchronous Communications Adapter (full-feature) – all models except 24 and 26*
- Synchronous Data Link Control Communications Adapter (full-feature) – all models except 24 and 26*
- Display Station Emulation Adapter (full-feature) – all models except 24 and 26*

* This feature can be installed in the 5271 System Unit or the 5161 Expansion Unit. Others must be installed in the 5271 unit.

If more than eight expansion slots are needed, the 5161 Expansion Unit Model 1 for 5271 Models 2, 4, and 24 or 5161 Model 2 for 5271 Models 6 and 26 can be included in the 3270-PC configuration to provide additional slots (as well as fixed disk storage) for a total of 16 (see Section 15:20 "IBM 5161 Expansion Units").

Programmable Speaker

A 2¼-inch-diameter, 8-ohm audio speaker is included in each 5271 System 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 each 5271 System Unit. This adapter is installed in slot 6 and is the only diskette adapter that can be installed in a 3270-PC configuration. One or two internal 5¼-inch diskette drives can be attached to this adapter.

5¼-Inch Double-Sided Diskette Drive

One double-sided 5¼-inch diskette drive is standard in each 5271 model. It provides a capacity of 360Kb using DOS Version 2.0 or later. The double-sided 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.

One additional double-sided diskette drive is optional for 5271 Models 2, 6, and 26 and standard in Models 4 and 24 to provide a total of 720Kb of diskette storage. If a second diskette drive is to be installed in a 5271 Model 6 or 26, the 5161 Expansion Unit must be installed and the standard fixed disk drive must be moved from the 5271 to the 5161 unit.

Double-sided diskette drive and double-sided diskette characteristics for the 3270-PC are the same as those for the IBM Personal Computer XT (see description under "5¼-Inch Double-Sided Diskette Drive" in Section 13:10).

Fixed Disk Drive Adapter

This adapter is standard in 5271 Models 6 and 26 and optional for the 5271 Model 2. It provides buffering, error detection, and data transfer between memory in the 5271 and a 10Mb Fixed Disk Drive. One 10Mb Fixed Disk Drive can be attached to this adapter when it is installed in the 5271 unit, and only one Fixed Disk Drive Adapter can be installed in a 5271 configuration. When this adapter is present in the 5161 unit, two 10Mb Fixed Disk Drives can be attached to it.

This 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 errors, and internal diagnostics.

10Mb Fixed Disk Drive

One 10Mb Fixed Disk Drive is standard in 5271 Model 6 and 26 units and one is optional for the 5271 Model 2 unit. A second fixed disk drive can be included in a Model 2, 6, or 26 configuration by installing the 5161 Expansion Unit Model 2. For 5271 Models 4 and 24, fixed disk storage (one or two drives) is provided via the 5161 Expansion Unit Model 1.

The fixed disk drive provides 10,618,880 bytes of fixed disk storage, which is equivalent to about 28

double-sided diskettes at 360Kb each. The characteristics of the 10Mb Fixed Disk Drive for the 3270-PC are the same as those for the IBM Personal Computer XT (see description in Section 13:10 under "10Mb Fixed Disk Drive").

Game Control Adapter

This optional feature for 5271 Models 2, 4, and 6 permits up to two joysticks or up to four game paddles to be attached to the 3270-PC configuration. It can also be used as a general-purpose I/O card with four analog (resistive) inputs plus four digital input points.

The Game Control Adapter (one maximum) can be installed in a special- or full-feature slot in the 5271 or 5161 unit. The adapter provides a 15-pin D-shell connector at the rear of the 5271/5161 unit.

Programmed Symbols (PS) Adapter

This optional adapter for 5271 Models 2, 4, and 6 requires a full-feature slot adjacent to the 5151/5272 Display Adapter. It provides storage in the 3270-PC for up to six symbol sets that can be loaded from the host processor or defined by the user. This feature can be used with the host presentation graphics of GDDM, including the Image View Facility (IVF). It is supported for one active DFT mode host-interactive session only.

All Points Addressable (APA) Adapter

This optional adapter for 5271 Models 2, 4, and 6 requires a full-feature slot adjacent to the 5151/5272 Display Adapter. It provides facilities like those provided by the Color/Graphics Monitor Adapter for other IBM personal computers. It permits existing DOS application programs that support the 5153 Color Display to be executed in the DOS session in a 3270-PC using the 5272 Color Display. New application programs that use the higher resolution of the 3270-PC APA adapter can also be written and executed in the 3270-PC.

The APA adapter supports:

- Four-color graphics – 360 × 350 pels for 3270-PC resolution or 320 × 200 pels for 5153 medium-resolution mode
- Two-color graphics – 720 × 350 pels for 3270-PC resolution or 640 × 200 pels for 5153 high-resolution mode

Note that programs written to execute using the Color/Graphics Monitor Adapter may execute in a 3270-PC with an APA adapter but because of the higher resolution of the 5272 display, the data may appear differently than on a 5153 display. For example, a circle will appear elliptical on the 5272 display. Techniques to use the full screen capability of the 5272 display are given in the *3270-PC Control Program User's Guide and Reference*, SC23-0103.

Asynchronous Communications Adapter

One or two Asynchronous Communications Adapters are optional for all 5271 models. The adapter requires one special- or full-feature slot in the 5271 or 5161 unit. This adapter provides a path to a processor or I/O device outside the 5271 System Unit. A processor or I/O device can be connected to this adapter directly via cable (for local attachment) or via a telephone line using a plug-in modem (for remote attachment).

IBM-Logo DOS application programs that support communications using the asynchronous adapter and that can be executed in a DOS session in the 3270-PC include the following:

- 3101 Emulation Program
- Asynchronous Communications Support Version 2
- PROFS Personal Computer Connection (PROFS/PC²)
- Data Edition IBM Personal Decision Series Productivity Product

For a description of the asynchronous adapter hardware and the functions supported by the communications programs that support the asynchronous adapter in the 3270-PC, see Section 13:10 under "Asynchronous Communications Adapter."

Binary Synchronous Communications (BSC) Adapter

One or two BSC adapters can be installed in a 5271 Model 2, 4, or 6 3270-PC configuration. Only one BSC adapter can be installed if the SDLC adapter is present in the 3270-PC configuration. This adapter requires one full-feature slot in the 5271 or 5161 unit. An external modem must be cable-connected between the BSC adapter and a telephone line using the Communications Adapter Cable feature.

The optional 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-supplied 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 BSC adapter, when used with the Binary Synchronous 3270 Emulation Program, permits the 3270-PC to emulate 3270 interactive BSC operation and to perform file transfer operations. The adapter provides the ability to attach a 3270-PC to a communications line connected to a host processor 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 3270-PC 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.

Synchronous Data Link Control (SDLC) Communications Adapter

One SDLC adapter can be installed in a 5271 Model 2, 4, or 6 3270-PC configuration. One full-feature slot in the 5271 or 5161 unit is required. An external modem must be cable-connected between the SDLC adapter and a telephone line using the Communications Adapter Cable feature.

The optional 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-supplied 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.

The SDLC adapter, when used with the SNA 3270 Emulation and RJE Support Program, permits the 3270-PC to emulate 3270 interactive SNA operation or 3770 batch SNA (SNA 3770 RJE). The adapter provides the ability for a 3270-PC attached to a host processor (System/370, 30XX, 4300, or 8100) via communications lines to participate in a network using SDLC protocol. The 3270-PC operates and appears to the host as a 3278 Display Station Model 2 attached to a 3274 Model 51C Control Unit or a 3770. The line speed supported is up to 4800 bps.

The IBM 8100 DPPX/SP Personal Computer RJE File Transfer PRPQ (5799-WXT) operating in an 8100 with DPPX/SP supports program and data file transfer between the 8100 system and a 3270-PC in which the SNA 3270 Emulation and RJE Support Program is operating. The 3270-PC 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 the 3270-PC 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 3270-PC. Conversion of ASCII files to and from EBCDIC is supported. The 3270-PC configuration can be attached to the 8100 via a leased or dialed communications line.

Communications Adapter Cable

This optional feature supports the attachment of a modem to the BSC adapter or SDLC adapter card connector at the rear of the 5271 or 5161 unit. The cable is double-shielded and approximately 10 feet (3 meters) long. A wrap connector is provided to test the cable. The cable is required to connect the BSC 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 3270-PC configuration. It requires one full-feature slot in the 5271 Model 2, 4, or 6 or the 5161 unit. This adapter, when used with the 5520/Personal Computer Attachment Program Version 3, allows multiple 3270-PCs to be attached to the 5520 Administrative System (any model) and to emulate the 5253 Display Station. Multiple 5253

displays and 3270-PCs can be attached to the same 5520 system. One 5253 display must be included in the 5520 system configuration for service use. From five to 35 3270-PCs can be attached to a 5525 System Unit (depending on the 5525 model) with up to 24 active concurrently.

The 5253 Emulation Installation Convenience Kit Version 3 can be purchased to provide the items necessary to permit attachment of the 3270-PC to the 5520 Administrative System and perform 5253 emulation.

When the 3270-PC 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. For additional information about the functions of the 5520/Personal Computer Attachment Program, see Section 13:10 under "Display Station Emulation Adapter."

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 3270-PC configuration Model 2, 4, or 6 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 2.0 or later in a DOS session in the 5271, supports printing to the 5218 printer. The Front Sheet Feed, Front Exit Sheet and Envelope Feed, and Tractor Feed features 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 can be used 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 3270-PC, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT, 3270 Personal Computer/Graphics, and/or 3270 Personal Computer/Extended Graphics systems (in any combination) to be attached to one 5218 printer

15:15 IBM 5271 System Unit, IBM 5272 Color Display, and IBM 3295 Plasma Monitor

and to share the printer for letter-quality printing applications.

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

Keylock Feature

The Keylock Feature is a simple mechanical device that can be installed on a 5271 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 5271/5161 unit near the power switch. No alteration of the 5271/5161 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 5271/5161 unit is protected to prevent physical access to the contents of the 5271/5161 unit. This protects against removal of the fixed disk drives in a 5271/5161 unit as well as of the hardware installed in the 5271/5161 unit.

When the keylock is locked, 5271/5161 power-on can be done only by unlocking the keylock. Power-on using the power-on switch on the 5271/5161 unit is not possible. In addition, if the display installed does not receive power from the 5271 unit (5272 display, for example), the access port to the 5271 is blocked to prevent the 5271 from being powered on through the access port. Without power on, access to the 3270-PC configuration via a local program or by another computer via a communications link is not possible.

The cover of the keylock is also designed to permit installation of a cable or chain attachment to secure the 5271/5161 unit to the office furniture.

Keyboard

The standard keyboard for the 5271, shown in Figure 15-3, is the same keyboard that is provided for the 3290, 3179, and 3180 display stations and is also used with the 3270-PC/G and GX workstations. The APL layout keyboard for the 3270-PC/G and 3270-PC/GX workstations is not available for the 3270-PC workstation.

The standard 122-key keyboard for 3270-PC and 3270-PC/G and GX workstations is different from the keyboard for any other IBM personal computer configuration. Its keys are divided into five groups:

- Left control keys that include advanced function workstation control keys (similar to keys on 3278 and 3279 keyboards) and 3270 mode and personal computer mode control keys
- Standard typewriter layout keys for alphabetic, numeric, and special characters

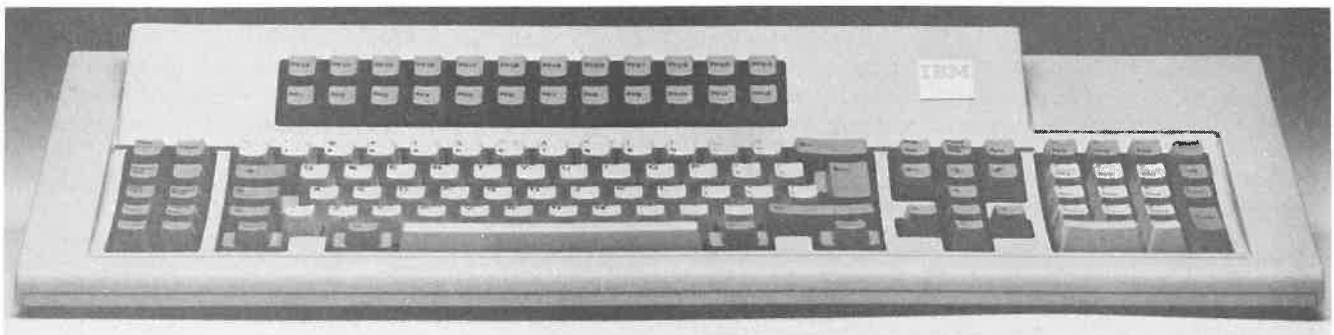


Figure 15-3. Standard keyboard for the 5271 (and 5371) System Unit

- Right control keys that provide cursor movement and control for 3270 mode operations (similar to keys on 3278 and 3279 keyboards)
- Numeric keypad keys that provide a numeric keypad for 3270 mode operations and cursor movement and control for personal computer mode operations (as found on the 83-key keyboard for other IBM personal computers)
- Function keys (24)

Keys for 3270 host-interactive operation are color-coded black, while those unique to IBM personal computer operations are printed in blue. Tactile and audible feedback are provided. The keyboard attaches to the 5271 System Unit (keyboard adapter) via a 6-foot (1.8-m) coiled cable and has an adjustable slope of 3.5, 12, or 17 degrees.

The 5271 keyboard has the following dimensions and weight:

- Height: 2.5 inches (64 mm) – lowest position
- Width: 22 inches (559 mm)
- Depth: 9 inches (229 mm)
- Weight: 9.4 lb (4.3 kg)

5272 Color Display

The 5272 is a high-resolution color display, shown in Figure 15-1, that is available only for the 3270-PC personal computer configuration. It has a 14-inch (356-mm) cathode ray tube and attaches to the 5271 System Unit via a 4.6-foot (1.4-meter) cable. For host-interactive and notepad sessions, it displays 24 lines of 80 characters each. A twenty-fifth line is available as an operator information area. For a DOS session, 25 lines of 80 characters each are displayed. The screen is antiglare and brightness controls are provided.

The 5272 display supports eight colors and has a resolution of 720 pels horizontal and 320 pels vertical. The character box is 9 × 14 pels and the character size is 7 × 14 pels. Reverse image, blinking, underscore, and nondisplay are supported.

The 5272 Line Cord (6 feet, or 1.8 meters), and 5272 Color Display Stand are standard features for the 5272 Color Display. The 5272 requires its own power source. Power requirements are 100 to 127 volts and 50 to 60 Hz. The display stand provides a base for the 5272 display and allows -4 to +15 degrees of tilt and -50 to +50 degrees of swivel (50 degrees of turn to the right or left). The display stand is designed to support the 5272 display when it is or is not placed on top of the 5271 unit.

The dimensions and weight of the 5272 display are:

- Height: 15.2 inches (386 mm) at a 0 degree tilt
- Width: 15 inches (380 mm)
- Depth: 16.5 inches (418 mm)
- Weight: 33 lb (15 kg) with pedestal

3295 Plasma Monitor

The 3295 Plasma Monitor is a large-capacity (up to 9920 characters) monochrome display that utilizes plasma panel technology to produce a large, distortion-free viewing area. This technology provides uniform image clarity at every point of the viewing area while requiring less surface space than CRT monitors of equivalent screen size. The 3295 monitor is supported by the standard 3295 Display Adapter in 5271 Models 24 and 26. This adapter supports Programmed Symbols and provides compatibility with the Color/Graphics Monitor Adapter for all-points-addressable four-color mode.

Highlights of the 3295 Plasma Monitor are:

- Plasma panel size of 13.44 × 10.75 inches (17 inch diagonal screen) with continuous tilt
- Orange characters displayed on a black background (brightness controls provided)
- Resolution of 960 × 768 pels
- Two character sets supported:
 - Small character set that uses a 6 × 12 pel character box (5 × 8 character size) to display 9920 characters in 62 lines of 160 characters each
 - Alternate character set that uses a 9 × 16 pel character box (7 × 9 character size) to display 4876 characters in 46 lines of 106 characters each
- Concurrent display of up to four 2048-character windows for four host-interactive sessions using the small character set. For a DOS session, window size is 2000 characters.
- Display of windows larger than 2048 characters for host-interactive sessions (to emulate a 3290 or 3270 Model 3, 4, or 5 with reduced need for scrolling)
- Display of a window up to 9920 characters for a local notepad session
- Compatibility with the Color/Graphics Monitor Adapter for 640 × 200 pels all-points-addressable color mode only. Black and three shades of orange are used as the colors.
- Support of the 3270 Programmed Symbols feature for graphics output to the display. Six Programmed Symbols 192-character buffers are available for host-interactive sessions when no DOS session is active. Five buffers are available when a DOS session is active.

15:15 IBM 5271 System Unit, IBM 5272 Color Display, and IBM 3295 Plasma Monitor

- Dimensions of:
 - 22.8 inches (580 mm) width
 - 19.5 inches (496 mm) height
 - 7.8 inches (200 mm) depth
- Weight of 48 lb (21.8 kg)
- Six-foot (1.8-m) power cable and 4.6-foot (1.4-m) signal cable provided
- Power requirements: 100 to 127 volts, 50 to 60 Hz

The 3295 Plasma Monitor is shown in Figure 15-4.



Figure 15-4. 3295 Plasma Monitor

Single Unit Prices

Item	Part Number	Feature Code	Single Unit Purchase Price or License Fee (\$)
5271 System Unit and keyboard			
Model 2	5271002	—	3745
Model 4	5271004	—	4485
Model 6	5271006	—	5710
Model 24	5271024	—	5825
Model 26	5271026	—	7050
5272 Color Display	5272001	—	995
3295 Plasma Monitor	3295001	—	3695
3295 Extended Signal Cable (provides additional 5 meters of cable)	2720066	3001	95
All Points Addressable (APA) Adapter	1501208	4910	550
Asynchronous Communications Adapter	1502074	2074	100
Binary Synchronous Communications Adapter	1502075	2075	240
Communications Adapter Cable	1502067	2067	65
Display Station Emulation Adapter	6072534	2887	600
Fixed Disk Drive Adapter	1602501	2501	495
Game Control Adapter	1501300	1300	45
Keylock Feature	2683177	3177	50
Math Co-processor Option	1501002	1002	230
Printer/Memory Adapter	2683115	4505	440
Programmed Symbols (PS) Adapter	1503142	5790	800
RS-232C Cable	2719931	5030	51
Synchronous Data Link Control Communications Adapter	1502090	2090	240
10Mb Fixed Disk Drive	1602500	2500	1195
256Kb Memory Expansion Option	2683117	4500	490
5218 Printer Attachment Cable	6113647	—	45
5218 Printer Sharing	6113650	4471	625
5218 Convenience Pac	6113651	4470	220
5253 Emulation Installation Convenience Kit Version 3	6403724	2896	1113
5¼-Inch Double-Sided Diskette Drive	1503810	3810	425
64Kb Memory Module Kit	1501003	1003	100
64/256Kb Memory Expansion Option	1501013	1013	265
3270-PC Control Program			
Version 1 Release 2	1837434	1505	300
Version 1 Release 2.2	6423236	3010	300
Version 2	6423236	3005	300
DOS Version 2.1	6024120	4120	65

Discounts Available

The 3270-PC and all its optional hardware features may be eligible for one of the following discounts:

- Volume Procurement Amendment
- Educational Allowance
- Special Bid

A customer who signs a VPA or special bid for an IBM personal computer must establish a Technical

Support Location 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.

15:20 IBM 5161 Expansion Units

5161 Models 1 and 2

The 5161 Model 1 Expansion Unit can be attached to a 5271 Model 2, 4, or 24 System Unit, while the 5161 Model 2 can be attached to the 5271 Model 6 or 26 System Unit. The 5161 provides fixed disk storage (10Mb or 20Mb) and additional expansion slots for the 3270-PC configuration. The expansion slots allow for the installation of optional feature cards to extend the capabilities of the 3270-PC configuration.

One 5161 unit can be attached to a 5271 System Unit and requires its own power source. The 5161 can be field-installed and is a customer-setup unit. It can be placed beside the 5271 System Unit or stacked over or under the 5271 unit. When the 5161 is placed beside or on top of the 5271 unit, a printer or display can be placed on top of the 5161 unit. The Keylock Feature can be installed on the 5161 for data security (see discussion in Section 15:15 under "Keylock Feature").

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

The 5161 Model 1 contains the following standard items:

- Eight expansion slots (six full-feature and two special-feature) 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 full-feature slot)
- One 10Mb Fixed Disk Drive

- The receiver card required for connection to the 5271 System Unit (uses one full-feature slot)
- A 130-watt power supply with cooling fan

A 39-inch (one-meter) signal cable to attach the 5161 unit to the 5271 unit, and an extender card that must be installed in a full-feature slot in the 5271 are also provided with the 5161 unit. Switches on this card must be set to indicate the amount of memory in the 5271 System Unit. The 5161 Model 1 without the second fixed disk drive installed weighs approximately 27 lb (12.2 kg).

For a photo of the 5161 unit, see Figure 11-3 in Section 11:15.

The 5161 Expansion Unit Model 2 contains the following standard items:

- Eight expansion slots (six full-feature and two special-feature) for optional feature cards
- One 10Mb Fixed Disk Drive
- The receiver card required for connection to the 5271 System Unit (uses one full-feature slot)
- A 130-watt power supply with cooling fan

A 39-inch (one-meter) signal cable and an extender card that must be installed in a full-feature slot in the 5271 unit are also provided with the 5161 Model 2 unit. The Fixed Disk Drive Adapter and 10Mb Fixed Disk Drive in the 5271 Model 6 or 26 System Unit must be moved to the 5161 Model 2 unit. The supplied extender card replaces the Fixed Disk Drive Adapter that is removed from the 5271 Model 6 or 26. Switches on this card must be set to indicate the amount of memory in the 5271 System Unit.

The 5161 Model 2 weighs approximately 27 lb (12.2 kg) without the second fixed disk drive installed.

Six of the eight expansion slots in the 5161 models 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 (number 5) contains the 5161 receiver card and another full-feature slot (number 6) is required for the Fixed Disk Drive Adapter.

The following optional features for 3270-PC configurations can be installed in the available slots in the 5161 unit:

- Game Control 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)
- Asynchronous Communications Adapter (special- or full-feature)
- Printer Adapter (special- or full-feature)

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 additional 10Mb Fixed Drive can be installed in a 5161 Model 1 or 2. See description of the fixed disk drive in Section 13:10 under "10Mb Fixed Disk Drive."

Single Unit Prices

Item/Part Number/Feature Code	Single Unit Purchase Price (\$)
5161 Expansion Unit	
Model 1 (5161001)	2585
Model 2 (5161002)	2090
10Mb Fixed Disk Drive for 5161 Model 1 or 2 (1602500) (2500)	1195
Fixed Disk Drive Adapter (1602501) (2501)	495
Keylock Feature (2683177) (3177)	50

Discounts Available

The 5161 and its 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

15:25 IBM 3270-PC Control Program

Introduction

The 3270-PC Control Program supports use of the 3270-PC as a 3270 Information Display System workstation without reprogramming the host applications with which the 3270-PC is to interact. The 3270-PC Control Program operates under DOS Version 2.0 or later in the 3270-PC to provide the user with the ability to activate multiple concurrent sessions, manage displayed data for the active sessions, and manipulate and interact with the data displayed.

Printing functions, help and online tutorials, and file transfer to and from a host processor using a 3270-PC File Transfer Program executing in the host processor are also supported.

Note that the 3270-PC Control Program cannot be used with 3270-PC/G or 3270-PC/GX workstations and that the 3270-PC Graphics Control Program for the 3270-PC/G and GX workstations does not support the 3270-PC workstation.

Sessions Supported

Version 1 Releases 1 and 2.2 of the 3270-PC Control Program support the concurrent operation of one to seven sessions in a 3270-PC: four host-interactive (3270), two local notepad, and one DOS Version 2.0 or 2.1. Version 2 of the 3270-PC Control Program supports the concurrent operation of up to four host-interactive sessions, two local notepad, and multiple DOS Version 2.0 or 3.0 sessions. The user activates one or more sessions, determines the information displayed on the screen for each operating session, and interacts with one session at a time.

For a host-interactive session, the user logs onto and interacts with an application in the host processor (System/370, 30XX, 4300, or 8100 processor) just as if the 3270-PC were a 3270 display. The 5271 emulates the functions of the keyboard for a 3278 or 3279 display. No reprogramming of host applications is required.

A 3270-PC operating in distributed function terminal (DFT) mode can support the concurrent operation of four host-interactive sessions, one of which can display Programmed Symbols graphics. Each host-interactive session operates as a separate 3270 display and is referred to as a logical terminal. Thus, for DFT mode the 3270-PC Control Program

permits up to four logical terminals to operate concurrently in one 3270-PC using one 3274/3276 port and the 3270-PC operates much like the 3290 Information Panel Display Station.

One host-interactive session is supported for a 3270-PC operating in control unit terminal (CUT) mode and graphics is not supported for this mode.

For DFT and CUT modes, the 3270-PC Control Program supports one or two local notepad sessions operating with other sessions. A notepad session can be used to copy or save data from other operating sessions, to transfer data to any other operating session, to save personal notes on diskette or fixed disk in the 3270-PC configuration, and to provide a scratchpad area.

For DFT and CUT modes, Version 1 of the 3270-PC Control Program supports the operation of one DOS session in which an application program that operates under DOS Version 2.0 or later executes. Version 2 of the 3270-PC Control Program supports the operation of multiple DOS Version 2.1 or 3.0 sessions. Multiple DOS sessions can be used to allow simultaneous communication between host-interactive and DOS sessions using the facilities provided by the application program interface (API) discussed later. The application program operating in any DOS session must observe DOS and BIOS protocols and conventions and use only those hardware features that are available in the 3270-PC configuration.

The TopView program, which supports the operation of multiple DOS application programs and windows, can execute in the DOS session under DOS Version 2.0 or later. TopView is discussed in Section 40:05 under "Multiprogramming Using the TopView Program."

The 3270-PC can also be used as a stand-alone personal computer. It can operate using DOS and the 3270-PC Control Program or only DOS. When DOS and the 3270-PC Control Program are used, one or more DOS sessions and two notepad sessions are supported. In addition, except for file transfer support (which requires a host-interactive session), all the other functions supported by the 3270-PC Control Program (such as the session-to-session copy facility, keystroke record/play function, and save/restore utility) can be used. When only DOS is used, the 3270-PC operates like other IBM personal computers.

Screen Management

The advanced screen management provided by the 3270-PC Control Program permits the user to simultaneously display data for a maximum of seven operating sessions on the screen of the 5151, 5272, or 3295 display. The traditional approach of displaying data for only one operating session at a time and switching from one session to another to display data using the keyboard is also supported.

The 3270-PC Control Program represents each active session by a presentation space contained in 5271 random access memory. A presentation space is a logical representation of display screen data for an active session. For a host-interactive or local notepad session, the presentation space can be up to 3440 EBCDIC characters for a 5271 Model 2, 4, or 6 or up to 9920 EBCDIC characters for a 5271 Model 24 or 26. For a DOS session, a presentation space is up to 2000 ASCII characters.

The user can view all or a portion of the presentation space for each active session on the display screen via a window. The window size can vary from one character minimum to the maximum size of the display screen or the actual size of the presentation space for the session, whichever is smaller.

For 5151 and 5272 displays, the maximum display screen size for a host-interactive or notepad session is 1920 characters, while for a DOS session it is 2000 characters. If a window larger than 1920 characters is required for a host-interactive session, scrolling can be used on a 5151 or 5272 to view the entire presentation space. For the 3295 display, the maximum display size for a host-interactive or notepad session is 9920 characters and for a DOS session is 2000 characters.

While viewing the presentation space for a session, the user can move the window to any location within the presentation space or move the window to any location on the screen. The user can also alter the size of each window. Combinations of session windows, with each combination containing any number of windows up to seven, can be defined in screen profiles. Up to ten screen profiles can be installation-defined, and any one of them can be used to control the display contents at any time using the ChgSc key. Screen profiles can be modified (windows can be added or deleted or changed in size, for example).

The user can interact with only one operating session at a time using the keyboard. Switching among the sessions is accomplished using the keyboard (Jump key). The window for the session with which the operator is currently interacting is called

the active window. It has a double border and contains the cursor. The active window can be expanded to the full screen size or to the presentation space size, whichever is smaller, using the Enlarge Window key.

When the 5272 Color Display is present in the 3270-PC configuration, the user can define the foreground and background colors for the host-interactive session windows (not using extended data stream attributes), define the background color for the 5272 screen, and select base color (3279 four-color) mode.

The screen management provided supports two modes of operation: application and screen management. Application mode is used for interaction between the user and the application (one session at a time) via the keyboard. This mode permits the user to invoke basic screen management functions, which provide for manipulating windows for the active sessions. Screen management mode is used for communication between the user and the 3270-PC and is used to invoke advanced screen management functions. This mode cannot be used to enter data into a window.

Advanced screen management functions include setup specifications (color and window definitions for screen profiles, for example), copying a block of data from one session to another, browsing, the keystroke record/play function, the save/restore facility, printing to a local or remote printer, and file transfer to/from the host processor.

Application Program Interface

This interface is supported as of Version 1 Release 2.2 of the 3270-PC Control Program. It permits direct communication between DOS application programs and host-interactive sessions, copy of data between a DOS session and a host-interactive session, and initiation of a program in a host-interactive session by a DOS application program.

This interface permits a program executing in any DOS session to send keystroke codes to any of the four host-interactive sessions, the local notepad sessions, or to the screen management function. The keystroke codes sent are treated as if they had been entered by the operator using the keyboard. Thus, DOS application programs can be written to automate and simplify operations such as screen copying, autokey playback, and application logon.

The 3270-PC High Level Language Application Program Interface program offering can operate in a DOS 2.0 or 2.1 session under Version 1 Release 2.2

15:25 IBM 3270-PC Control Program

of the 3270-PC Control Program to use the application program interface.

This program offering provides an interactive interface between a DOS application program and a host-based application; support of BASIC, COBOL, and Pascal high-level languages; documented interfaces that allow users of other high-level languages to write language interface modules to provide access to services of the program offering; common ASCII interfaces that allow users to access data in a host-interactive or notepad session; and tools to allow the DOS application program to wait for a host-response and check the keyboard status.

The facilities supported provide a high-level language application program interface that can be used to develop programs for execution in the DOS session. These programs can enter data into active host sessions, notepad sessions, and the workstation control facility and also receive data from active host-interactive and notepad sessions. These facilities can be used to automate workstation control functions for improved ease of use and to facilitate the exchange of data between active sessions.

The brochure *3270-PC High Level Language Application Program Interface*, G320-9224, is available.

Copy Functions

The following copy operations are supported as of Version 2 of the 3270-PC Control Program:

- From one area to another area within the same window for host-interactive, notepad, and DOS sessions
- From one window to another window in the same or a different screen profile for host-interactive, notepad, and DOS sessions

Browsing

The browsing function permits the user to view the presentation space data for a session by moving the data contained within the presentation space vertically or horizontally within the window. Data can be inspected but not changed until application mode is reentered.

Keystroke Record/Play Function

The keystroke record/play function is designed to reduce the amount of repetitive keying required at the workstation. It can be used, for example, to save logon/logoff information, short letters or notes that are directed to different people, or frequently entered long commands. Manual entry of variable data is supported.

Once recording is initiated using the keyboard (AUTO and RECORD keys), each entered keystroke is saved in a 2000-byte area in memory until recording is terminated. When recording is stopped, the saved data can be written to a diskette or fixed disk using the Save/Restore Utility and is identified by the name indicated when recording was initiated. To retrieve the recording, the AUTO and PLAY keys are used and the recording name is specified. Recordings can also be erased.

Save/Restore Utility

The Save/Restore Utility is provided to save keystroke recordings, screen profiles, or the presentation space from notepad sessions on diskette or fixed disk, and to retrieve saved data when requested by the user. The Save/Restore Utility operates in a DOS session.

Printer Support

The 3270-PC Control Program supports printing to a 5152 Graphics Printer, 5182 Color Printer, 3852 Color Printer, 5218 Printwheel Printer, 5201 QUIETWRITER® Printer, or 5216 Wheelprinter Model 2 attached to the 3270-PC; a printer attached to the 3274/3276 control unit; and a printer attached to the Display/Printer Adapter of a 4321, 4331, or 4361 Processor.

A copy of the current screen contents (using the PrtSc key), the contents of the window for an operating host-interactive, notepad, or DOS session, or the entire presentation space for the operating DOS session can be printed on the 3270-PC printer (only to a 5152 or 5182 printer for a 5271 Model 24 or 26). A copy of the entire presentation space for a host-interactive session can be printed on the printer attached to a 3274/3276 control unit or a Display/Printer Adapter.

Support of 5152, 5182, 3852, 5201, 5216, and 5218 printers by the 3270-PC Control Program enables application programs that can execute in a DOS session to use these printers. Support of the 5201, 5216, and 5218 printers enables the 3270-PC to be

used as a word processing workstation, using DisplayWrite 2 or DisplayWrite 3, for example.

Plotter Support

The 737X Color Plotters can be attached to a 3270-PC via the Asynchronous Communications Adapters using the RS-232C Cable (part number 2719931, feature code 5030). Direct output to these plotters from a host-interactive session in the 3270-PC is not supported. However, GDDM Graphics Data Format (GDF) support can be used in the host processor to create a picture interchange format (PIF) file that is sent to a host-interactive session in the 3270-PC and placed in a file. A plotter program operating in a DOS session can transfer the PIF file to a 737X plotter attached to the 3270-PC.

File Transfer

The 3270-PC Control Program supports the transfer of files to and from a host System/370, 30XX, or 4300 processor operating under MVS/TSO, CICS/VS, or VM/SP Release 2.1 with a 3270-PC File Transfer Program (5665-311 for MVS/TSO, 5798-DQH for CICS/VS, or 5664-281 for VM/SP). All three file transfer programs can be used when the 3270-PC is attached to a 3274 Control Unit. The MVS/TSO and VM/SP transfer programs are supported for attachment of the 3270-PC to a 3276.

The files transferred can have ASCII, binary, or EBCDIC data format. The file transfer is done to or from a host-interactive session in the 3270-PC, which can operate concurrently with up to three other host-interactive sessions (in DFT mode) that are not performing file transfer. The file transfer commands are issued from the DOS session.

The file transfer facility permits programs, data, and procedures to be obtained from the host processor for use in a DOS session. Similarly, data processed in a DOS session in the 3270-PC can be sent to the host processor for printing or distribution.

The 3270-PC File Transfer Express program offering permits the transfer of any type of file between a 3270-PC and a host processor supported by the standard DPCX/DOSF or DPPX/SP2 in an 8100 processor or by an appropriately coded System/370/30XX/4300 program provided by the user. This program offering runs in a DOS 2.0 session under the 3270-PC Control Program Version 1 Release 2.

Online Tutorial

An online tutorial (HELPER) that operates under DOS 2.0 or later is provided on a diskette as part of the 3270-PC Control Program. It can be executed in the 3270-PC or in another IBM personal computer that has a double-sided diskette drive. When used in the 3270-PC, the tutorial executes in the DOS session and thus can be active during host-interactive sessions.

The tutorial is interactive and is designed for the novice and for the experienced user. Since the tutorial is modular, only the desired portions need be utilized. The *3270-PC Online Tutorial*, SA23-0163, is provided for use with the tutorial.

Other aids to learning to use the 3270-PC workstation include help panels that can be displayed by pressing the Help key and prompts and messages that are displayed when commands or information is typed in. Line 25 of the display provides operating and status information.

Installation

The 3270-PC Control Program to be used in a given 3270-PC hardware configuration must be customized to support the mode to be used by the 3270-PC and the characteristics of the 3274 Control Unit to which the 3270-PC is attached. A menu-driven customization program that executes under DOS 2.0 or later in the 3270-PC is provided with the 3270-PC Control Program. The customization procedure uses the two diskettes on which the 3270-PC Control Program is provided and produces a customized system diskette for use in the 3270-PC.

When the customized system diskette is in diskette drive A (the leftmost drive) or if the 3270-PC Control Program is on fixed disk when the 3270-PC is powered on, an automatic IPL of DOS and the 3270-PC Control Program occurs. The resident memory requirements for the customized 3270-PC Control Program vary, depending on the number of operating sessions, the mode (DFT or CUT) in effect, and other facilities used. See the preinstallation planning guide, GA23-0179, for estimating resident memory requirements.

15:30 IBM 3270 Personal Computer/Graphics and IBM 3270 Personal Computer/Extended Graphics Configuration Overviews

Introduction

The 3270 Personal Computer/Graphics (3270-PC/G) and 3270 Personal Computer/Extended Graphics (3270-PC/GX) are programmable workstations that combine the host-interactive functions of the 3270 system, interactive graphics support, and the computing power and versatility of an IBM personal computer.

These workstations attach to the 3274 Control Unit and can interact with local or remote System/370, 30XX, and 4300 processors. The 3270-PC/G configuration components are shown in Figure 15-5 while the configuration components for the 3270-PC/GX are shown in Figure 15-6.

These workstations are supported by the 3270-PC Graphics Control Program operating under DOS Version 2.1. The 3270-PC Graphics Control Program supports up to seven sessions operating concurrently in the 3270-PC/G or GX. Up to four host-interactive (3270-type) sessions (all with interactive graphics if desired), one or two local notepad sessions, and one DOS 2.1 session (with graphics if desired) can be operating at the same time.

The operator can interact with one session at a time and can easily switch from one session to another using the keyboard. The operator can interact with a graphics session using a keyboard, a mouse, or a tablet, and hard-copy color output to printers and plotters is supported.

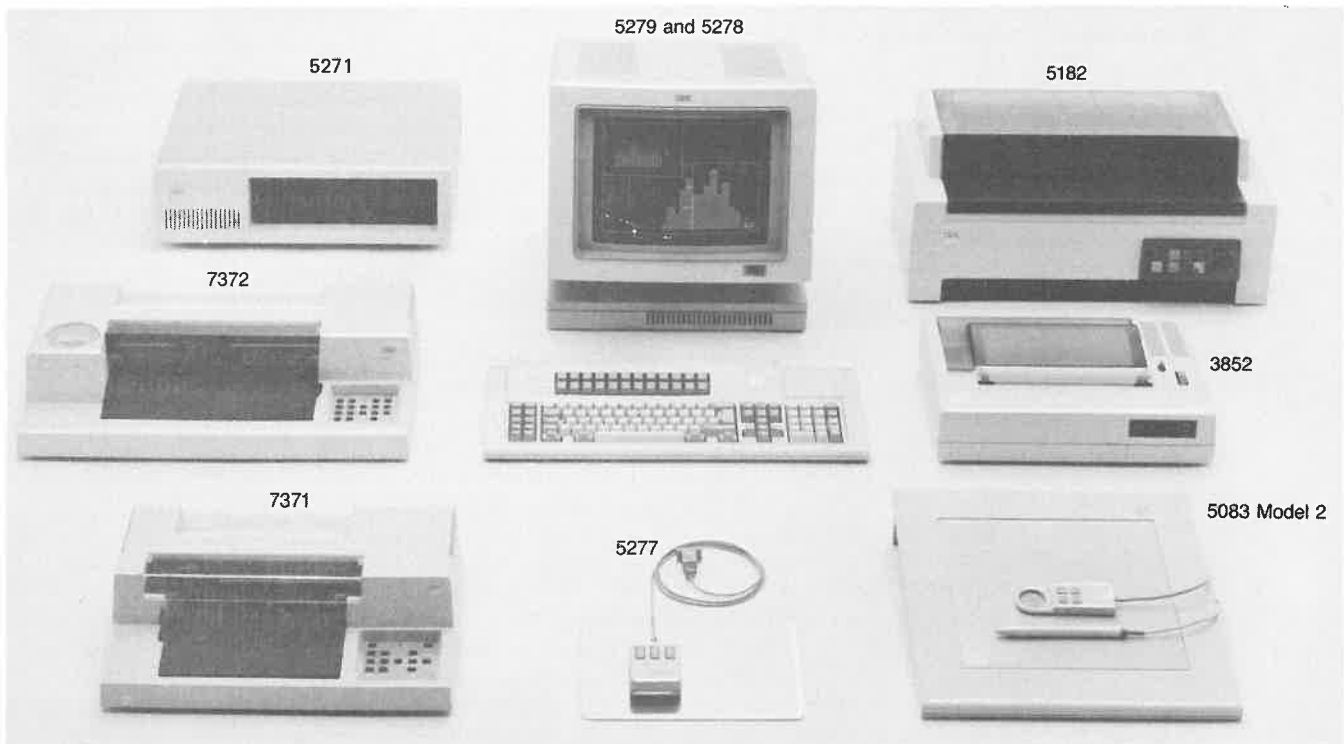


Figure 15-5. 3270-PC/G configuration components

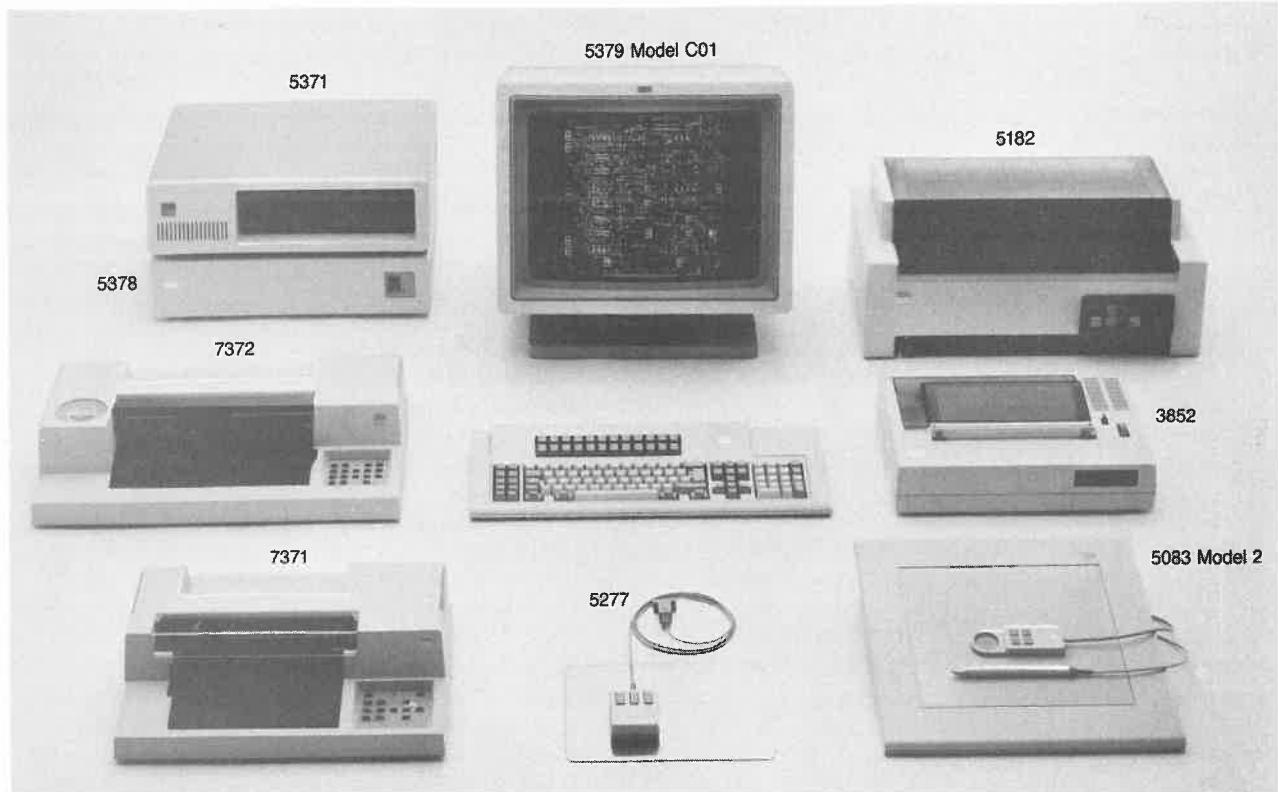


Figure 15-6. 3270-PC/GX configuration components

The 3270-PC Graphics Control Program supports advanced screen management functions like those supported by the 3270-PC Control Program for the 3270-PC. It permits each operating session or part of a session to be displayed using a technique called windowing. The operator can control the display (window size) for each session and each window location on the screen. Session data can be copied or transferred from one session to any other session (except to the DOS session) or printed on a printer attached to the 3274 Control Unit or 3270-PC/G or GX workstation. In addition, files can be transferred between one host-interactive (3270-type) session and a host MVS/TSO, CICS/VS, or VM/SP processor.

The 3270-PC Color Graphics Applications program executes under the 3270-PC Graphics Control Program and DOS to provide graphics editing and picture plotting (see description in Section 15:55 under "Printer and Plotter Support").

The 3270-PC/G and GX contain special graphics hardware (not included in the 3270-PC) that is used

to create pictures on the workstation display. While the 3270-PC uses Programmed Symbols for picture definition, the 3270-PC/G and GX workstations use vectors and the graphics hardware in these workstations performs vector-to-raster conversion to display a picture.

Vector format offers functional and performance advantages over Programmed Symbols picture definition. First, since vector data is maintained in the workstation and can be accessed by the user, interactive graphics is possible using a 3270-PC/G or GX workstation. In addition, much more complex pictures can be displayed than are possible using Programmed Symbols. Second, because vector-to-raster conversion is done in the workstation, vector processing usually done in the host processor (by the Graphical Data Display Manager, for example) is done in the workstation, reducing the graphics processing load on the host processor.

The 3270-PC/G and GX workstations are designed for business professionals, engineering and scientific or technical professionals, and data processing pro-

professionals who require interactive graphics and non-graphics computing in a single workstation. Interactive graphics can be used to develop bar charts, line charts, pie charts, engineering drawings, maps, artwork for manuals, mathematical formulas and notation, flow diagrams, flowcharts, PERT charts, and Gantt charts, for example.

The 3270-PC/G or GX can be used as a stand-alone IBM personal computer that operates under DOS control with or without the 3270-PC Graphics Control Program. Many DOS application programs that execute in other IBM personal computer configurations can execute in the 3270-PC/G or GX when the required hardware resources are present.

The 3270-PG/G or GX can also be included in text processing environments with other IBM personal computers that use DisplayWrite 3.

Thus, the 3270-PC/G and GX are multifunction workstations that can be used for executing host processor data base, high-quality host processor and local graphics, and IBM personal computer applications.

Physical Components

The 3270-PC/G workstation consists of the following IBM-logo required and optional hardware and programming components (as supported by the 3270-PC Graphics Control Program):

- 5371 System Unit Model 12, 14, or 16
- 5279 Color Display
- 5278 Display Attachment Unit (provides vector-to-raster conversion and interactive graphics support)
- One keyboard (standard or APL)
- 3270-PC Graphics Control Program
- IBM Personal Computer Disk Operating System (DOS) Version 2.1
- One of the following printers (optional):
 - 5152 Graphics Printer Model 2
 - 5182 Color Printer Model 1
 - 3852 Color Printer Model 1
- 5083 Tablet Model 2 or 5277 Mouse Model 1 (optional – one attached to the 5371 at a time)
- 5161 Expansion Unit Model 1 (optional for a 5371 Model 12 or 14) or Model 2 (optional for a 5371 Model 16)
- 7371, 7372, 7374, and 7375 Color Plotters (optional)

The 3270-PC/GX workstation consists of the following IBM-logo required and optional hardware and programming components (as supported by the 3270-PC Graphics Control Program):

- 5371 System Unit Model 12, 14, or 16
- 5379 Monochrome Display Model M01 or 5379 Color Display Model C01
- 5378 Monochrome Display Attachment Unit Model M01 for the 5379 Monochrome Display or 5378 Color Display Attachment Unit Model C01 for the 5379 Color Display (provides high-speed vector-to-raster conversion and interactive graphics support)
- One keyboard (standard or APL)
- 3270-PC Graphics Control Program
- IBM Personal Computer Disk Operating System (DOS) Version 2.1
- 5151 Monochrome Display (optional to provide a dual-screen configuration)
- One of the following printers (optional):
 - 5152 Graphics Printer Model 2
 - 5182 Color Printer Model 1
 - 3852 Color Printer Model 1
- 5083 Tablet Model 2 or 5277 Mouse Model 1 (optional – one attached to the 5371 at a time)
- 5161 Expansion Unit Model 1 (optional for a 5371 Model 12 or 14) or Model 2 (optional for a 5371 Model 16)
- 7371, 7372, 7374, and 7375 Color Plotters (optional)

The 5201 QUIETWRITER® Printer, 5216 Wheelprinter Model 2, and 5218 Printwheel Printer Model A03 or A04 can also be attached to the 3270-PC/G or GX workstation for use by a DOS application program.

Minimum Configurations

The minimum 3270-PC/G hardware configuration consists of a 5371 System Unit Model 12 with a standard or APL keyboard, a 5279 Color Display, and a 5278 Display Attachment Unit. The price for a single 3270-PC/G minimum hardware configuration is \$9045. Adding the price of DOS Version 2.1 and the 3270-PC Graphics Control Program to the minimum hardware price gives a single minimum workstation cost of \$9560.

The minimum 3270-PC/GX hardware configuration consists of a 5371 System Unit Model 12 with a standard or APL keyboard, a 5379 Monochrome Display, and a 5378 Monochrome Display Attachment Unit. The price for a single 3270-PC/GX minimum hardware configuration is \$14,945. Adding the price of DOS Version 2.1 and the 3270-PC Graphics Control Program to the minimum hardware price gives a minimum single workstation cost of \$15,460.

Configuration Features

The 5371 System Unit is based on the 5160 System Unit for the IBM Personal Computer XT. Thus, it has many hardware features and some I/O devices that are identical to those for other IBM personal computer configurations. Certain adapter features (3270 System Adapter, Display Unit Adapter, Keyboard/Tablet/Mouse Adapter, and Printer/Memory Adapter) and I/O devices (5279 and 5379 displays, 5278 and 5378 Display Attachment Units, 5277 Mouse, and 5083 Tablet Model 2) are unique to 3270-PC/G and GX personal computer configurations.

The following highlights the features of 3270-PC/G and GX configurations, including memory sizes, types and maximum number of attachable I/O devices, and the processors/units to which a 3270-PC/G and GX can be connected:

- One 5371 System Unit Model 12, 14, or 16
- One standard or APL keyboard
- One display attachment unit (5278 for the 3270-PC/G or 5378 for the 3270-PC/GX)
- Intel 8088 16-bit microprocessor in the 5371 System Unit
- Math Co-processor Option available to increase the speed and precision of arithmetic, logarithmic, and trigonometric functions
- Eight interrupt levels
- Direct memory access (DMA) – three channels
- 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 (DOS operating system, 3270-PC Graphics Control Program, and DOS application programs) of 384K to 576K bytes for the 3270-PC/GX and from 384K to 640K bytes for the 3270-PC/G
- One or two IBM 5¼-inch double-sided diskette drives installed in the 5371 unit with a capacity of 360K bytes each
- One or two fixed disk drives of 10Mb (10,618,880 bytes) capacity each. A maximum of two diskette drives or one diskette drive and one fixed disk drive can be installed in one 5371 System Unit. When the 5161 Expansion Unit Model 1 or 2 is installed, a maximum of two diskette drives and two fixed disk drives is permitted in a configuration.
- One display for the 3270-PC/G (5279 Color Display)
- One or two displays for the 3270-PC/GX (one 5379 Monochrome Display or 5379 Color Display and one 5151 Monochrome Display)
- One parallel printer via the Printer Adapter and one or two serial printers via the Asynchronous Communications Adapters (plus one additional parallel printer for a 3270-PC/GX with a Monochrome Display and Printer Adapter installed)
- Programmable speaker for audio and musical applications
- Data security for fixed disk storage in the 5161 unit via the Keylock Feature
- Connection to the following:
 - 3274 Control Unit via the standard 3270 System Adapter for connection to a local or remote System/370, 30XX, or 4300 processor to use as a host-interactive terminal supported by the 3270-PC Graphics Control Program
 - System/370, 30XX, 4300, and Series/1 processors via the Asynchronous Communications Adapter
 - 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT or XT/370, 5170 Personal Computer AT or AT/370, other 3270 Personal Computer workstations, 5531 Industrial Computer, communicating typewriter, laboratory instrument, voice recognition device, letter-quality printer, or other machine that uses the RS-232C interface via the Asynchronous Communications Adapter
 - A remote VM/370 PROFS system via the Asynchronous Communications Adapter
 - A local Displaywriter via cable-attachment to the Asynchronous Communications Adapter
 - 5218 Printwheel Printer Model A03 or A04 (for letter-quality printing applications) via the 5218 Printer Attachment Cable attached to an Asynchronous Communications Adapter. Up to four IBM personal computer systems can share one 5218 printer using the 5218 Printer Sharing feature.
 - 5201 QUIETWRITER® Printer via the Printer Adapter or to the 5216 Printwheel Printer Model 2 via the Printer Adapter or the Asynchronous Communications Adapter for letter-quality printing
 - 7371, 7372, 7274, and 7375 Color Plotters via cable connection to the IEEE-488 Adapter and Cable

In order for the 3270-PC/G or GX workstation to be used as a host-interactive terminal, the 3270-PC Graphics Control Program must be customized during installation to operate in one of two host-interactive modes:

- Distributed function terminal (DFT). For this mode, the 3270-PC/G or GX attaches to

System/370, 30XX, and 4300 processors via certain models of the 3274 Control Unit with Configuration Support T or D. One physical type A 3274 port and up to four logical addresses are used for the 3270-PC/G or GX.

The 3270-PC/G or GX emulates a 3178, 3179, 3180, 3278 (except Models 1 and 2A), or 3279 (except Model 2C) and supports from one to four host-interactive, one local notepad, and one DOS session operating concurrently. DFT mode supports base (four-color) data stream or extended (eight-color) data stream operations. DFT mode is required to use the interactive graphics functions provided by the 3270-PC/G and GX workstations and supported by the 3270-PC Graphics Control Program.

Note that Category B display stations (such as the 3277) cannot be attached to a 3274 that is customized for DFT mode operations.

- Control unit terminal (CUT). For this mode, the 3270-PC attaches to System/370, 30XX, and 4300 processors via any model of the 3274 Control Unit with any type Configuration Support via a type A terminal adapter.

The 3270-PC/G or GX emulates a 3178, 3179, 3180, 3278 Model 2, or 3279 Model S2A and supports only one session (host-interactive) operating at a time. CUT mode supports only base (four-color) data stream operations and no graphics functions are supported.

The 3270-PC/G and GX are data stream compatible (implicit partition only) with the 3270 displays they emulate for alphanumeric application environments. Thus, no programming changes are required to use the 3270-PC/G or GX for most current alphanumeric applications if the hardware features used on the current 3270 display are available on the 3270-PC/G or GX. In addition, most existing 3270 graphics application programs that use Programmed Symbols can be executed in a 3270-PC/G or GX workstation without change. See *Introducing the IBM 3270 Personal Computer/G and GX Workstations*, GA33-3141, for specific compatibility constraints.

The 3270-PC/G and GX do not support, or provide limited support of, the following 3270 hardware facilities:

- 3278 Model 5 (emulated by means of horizontal scrolling)
- 3270 diagnostic reset dump
- 3274 Entry Assist feature
- Base color (four-color) copy to the 3274-attached printer

- Binary Synchronous Copy command
- Multiple partitions per session (only one partition is supported)
- Graphics escape support only as required for APL
- Katakana
- Separate keyboard clicker with mode option
- Standard typewriter keyboard layout only as available with the APL option
- Magnetic Reader Control and accessories
- Monocase switch
- Numeric lock
- Port 0 customization function of the 3274 Control Unit
- Programmed Symbols (two sets with single plane only are supported)
- RPQs
- Security keylock
- Selector light pen
- Video output

The following capabilities are available only for CUT mode:

- Category B terminals attached to the same 3274 Control Unit as a 3270-PC/G or GX
- Encryption/decryption
- Response time monitor
- Port 0 operation permitted only with the alternate IML (ALT IML) of the 3274

Up to 32 5371 System Units can be attached to a 3274 Control Unit via coaxial cable, depending on the application and 3274 model used. The 5371 is attached to the 3274 using the same type of coaxial cable as is used to attach 3270 units to the 3274. The cable attaches to the standard 3270 System Adapter in the 5371 System Unit. The 5371 can be attached to a 3274 Control Unit that also has 3278, 3279, and 3290 displays and 3270-PC workstations attached.

All host processor attachment environments are supported:

- SNA local channel (via 3274 Models 1A, 1D, 31A, 31D, 41A, and 41D)
- Non-SNA local channel (same models as for SNA local channel)
- Synchronous data link control (SDLC) remote (via 3274 Models 1C, 31C, 41C, 51C, and 61C)
- Binary synchronous control (BSC) remote (same models as for SDLC remote)

If desired, the 3270-PC/G or GX can be connected to the IBM Cabling System for attachment to the 3274 Control Unit.

15:30 IBM 3270 Personal Computer/Graphics and IBM 3270 Personal Computer/Extended Graphics Overviews

The 3270-PC/G or GX operating in DFT mode can be installed as a full-function workstation that supports up to seven sessions (four host-interactive, two notepad, and one DOS) and interactive graphics. All the 3270-PC Graphics Control Program functions are also supported for this mode. GDDM Release 4 must be installed in the host processor to support interactive graphics applications using an attached 3270-PC/G or GX workstation. Customization of the 3274 Control Unit is necessary unless it is already customized for multiple sessions (for use with the 3290 Information Panel Display Station, for example).

Host processor interactive graphics applications that execute under GDDM Release 3 can execute unchanged with the 3270-PC/G or GX workstations using GDDM Release 4 in the host processor. Improved performance, reduced host processor utilization, and reduced host processor controller utilization will be experienced when compared with 3279 display performance, since certain graphics support is offloaded to the 3270-PC/G or GX workstation and the data stream transmitted to the workstation will be shorter for the majority of pictures.

The 3270-PC/G or GX operating in CUT mode can be installed to replace an existing 3178, 3278 Model 2, or 3279 Model S2A display that is attached to a 3274 Control Unit or as an additional terminal to interact with a host processor for alphameric applications without change to the 3274 Control Unit or host processor programming. Only one session (host-interactive) is supported for this mode.

The 3270-PC/G or GX executing the 3270-PC Graphics Control Program under DOS can also be used as an IBM personal computer when not being used for any host-interactive session. Three sessions (one DOS and two notepad) and all the functions of the 3270-PC Graphics Control Program (described in Section 15:55) except file transfer to and from a host processor are supported.

Operating Systems Supporting

The 3270-PC/G and GX operating as 3270 workstations are supported by the IBM Personal Computer Disk Operating System (DOS) Version 2.1 with the 3270-PC Graphics Control Program. The 3270-PC/G and GX workstations are designed to operate as workstations in the same host processor environments as the 3270 Information Display System. A host processor executing VSE/Advanced Functions, MVS/370, MVS/XA, or VM/SP supports the 3270-PC/G and GX workstations. Graphical Data Display Manager (GDDM) Release 4

provides host processor support for host-interactive sessions operating in a 3270-PC/G or GX.

A 3270-PC/G or GX operating as an IBM personal computer is supported by DOS Version 2.1.

Compatibility

Hardware

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

Diskettes (5¼-inch) are interchangeable without restriction among 3270-PC/G and GX, 3270 Personal Computer, 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), and 5531 Industrial Computer configurations. A cassette adapter is not provided by the 3270-PC/G or GX and cartridges are not supported.

Programming

Programs that operate in other IBM personal computers under DOS Version 2.1 and that observe DOS and Basic Input/Output System (BIOS) protocols can also operate in a DOS session under the 3270-PC Graphics Control Program in a 3270-PC/G or GX that has the required hardware resources, subject to the restrictions listed below. These programs can also execute under DOS Version 2.1 without the 3270-PC Graphics Control Program.

Applications executing in the DOS session under the 3270-PC Graphics Control Program must not:

- Use interrupt vectors X"50" through X"57"
- Reprogram the 8259 Interrupt Controller

- Access memory addresses above the interrupt level 12 pointer in BIOS, except to reference the IBM personal computer display refresh buffer
- Disable interrupts, fail to issue an end-of-interrupt or IRET on a hardware interrupt level, or mask selected interrupt levels for more than 100 ms
- Issue instructions to an IBM personal computer display adapter 6845 CRT Controller (they will be ineffectual)
- Use the print spooling capability of DOS
- Depend on receiving control within a fixed amount of time after an interrupt (if the DOS application is to be executed at the same time as graphics processing in the workstation)

Customer Responsibilities

The 3270-PC/G and GX and their features are customer setup. Detailed setup instructions are included with each system. However, setup is available from the IBM National Service Division at the IBM hourly rate and minimum charge. The customer must contact an IBM customer service coordinator for attachment of the 5371 System Unit communication cable to an onsite serviced 3274 control unit where a customer access area is not permitted.

The 3270-PC Graphics Control Program and 3274 Control Unit must be customized by the installation. The *Graphics Control Program User's Guide*, SC33-0180, and 3274 customizing guides, GA27-2827 and GA23-0065, provide the necessary customizing information. The customer must perform the Customer Problem Analysis and Resolution (CPAR) procedure and testing of any IBM personal computer optional features that are not part of the IBM-verified set (listed in Section 15:35 under "Optional Features for 5371 System Units").

A power source is required for the 5371 System Unit, 5272 Color Display, 5279 Color Display, 5378 Display Attachment Unit, any installed printer, 5161 Expansion Unit, and each 737X Color Plotter installed. The 5278 Display Attachment Unit receives power from the 5279 display and the 5379 display receives power from the 5378 Display Attachment Unit. Note that printers and plotters must be placed at least one foot (305 mm) away from the display to avoid interference. Also, in a 3270-PC/GX configuration with two displays, the 5379 and 5151 displays can interfere with each other if placed too close together.

Data Security

The customer is responsible for providing any desired security functions. The Keylock Feature can be installed on a 5161 Expansion Unit included in a 3270-PC/G or GX configuration (see discussion in Section 15:15 under "Keylock Feature").

Purchase Location

All 3270-PC/G and GX units and features are purchase only and can be purchased from marketing representatives in NAD and NMD branch offices. IBM Credit Corporation Term Lease Financing may be available for the 3270-PC/G and GX workstations.

Warranty Period

The warranty period for 5371, 5278, 5279, 5378, 5379, 5277, 5083, and 5161 units is three months. The warranty period for features of the 5371 unit is also three months. Warranty service for the 5371, 5378, and 5379 is IBM On-Site Repair. For the 5277, 5278, 5279, and 5083, the warranty service is IBM On-Site Exchange. For the 5161, the warranty service is Customer Carry-In Repair.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Service:
 - Warranty Option. For the 5161, the warranty option is IBM On-Site Repair. No warranty option is available for other 3270-PC/G and GX units.
 - Annual Maintenance. IBM On-Site Repair and Customer Carry-In Repair are available for the 5371, 5378, and 5161 units. For 5278 and 5279 units, IBM On-Site Exchange, Customer On-Site Exchange, Customer Carry-In Exchange and Customer Carry-In Repair are available. For 5379 displays, IBM On-Site Repair is available. For 5277 and 5083 units, IBM On-Site Exchange, Customer On-Site Exchange, and Customer Carry-In Exchange are available.
 - IBM Hourly Service: Customer Carry-In Repair at an IBM Service/Exchange Center
 - Self-service using the *Maintenance Information* package, which enables the customer to isolate the problem to an under-the-cover field replaceable unit

Publications

The following publications are provided with each 3270-PC/G or GX hardware configuration:

- *Guide to Operations*. This publication provides hardware setup, operational, and customer problem analysis and recovery procedures.
- *Maintenance Information*. This publication presents hardware problem recovery procedures, a parts catalog, and maintenance information.
- *BASIC* (6361132). This binder describes the functions provided by the BASIC Interpreter that is included in ROM in a 3270-PC/G or GX system unit.

The publication *3270-PC/G and GX Graphics Control Program User's Guide* (contains the diskettes with the 3270-PC Graphics Control Program), SC33-0180, and an online tutorial are provided with the 3270-PC Graphics Control Program. *The 3270-PC/G or 3270-PC/GX Graphics Control Program Workstation Programmer's Guide and Reference*, SC33-0181, can be ordered.

The following publications describing the 3270-PC/G and GX and the 3274 are available:

- *3270-PC Graphics Workstations brochure*, G520-4220
- *3270-PC/G Facts Folder*, G520-4236
- *3270-PC/GX Facts Folder*, G520-4237
- *Introducing the IBM 3270 Personal Computer/G and GX Workstations*, GA33-3141
- *3270-PC Graphics Editor*, G520-5057
- *3270-PC Picture Plotting*, G520-5058
- *3270-PC/G: Guide to Operations for Workstations that Use the IBM 5279 Color Display*, SA33-3140
- *3270-PC/GX Guide to Operations for Workstations that Use the IBM 5379 Color Display*, SA33-3139
- *3270-PC/GX Maintenance Information for Workstations that Use the IBM 5279 Color Display*, SY33-0112
- *3270-PC/G Maintenance Information for Workstations that Use the IBM 5379 Color Display*, SY33-0111
- *3270-PC/G or GX Graphics Control Program: Pascal Programmer's Reference*, SC33-0210
- *IBM 3274 Control Unit Description and Programmer's Guide*, GA23-0061
- *IBM 3274 Control Unit Customizing Guide: Configuration D*, GA23-0065
- *IBM 3274 Control Unit Planning, Setup, and Customizing Guide*, GA27-2827
- *IBM 3274 Control Unit Planning and Site Preparation Guide*, GA23-0064

- *An Introduction to the IBM 3270 Information Display System*, GA27-2739
- *IBM 3270 Information Display System User's Guide*, GA23-0058
- *IBM 3270 Information Display System Installation Manual – Physical Planning*, GA27-2787
- *IBM 3270 Information Display System: Data Stream Programmer's Reference*, GA23-0059
- *Graphical Data Display Manager: General Information*, GC33-0100

The following publications provide information about the DOS operating system and IBM- and vendor-logo application programs:

- *The Guide to Personal Computer Offerings from IBM*, G520-0059
- *The Library of IBM Personal Computer Software Offerings*, G520-1107
- *Personal Computer Software*, GB30-2037, and *Personal Computer Software Pocket Guide*, GB30-2479
- *The Directory* (6137591)

15:35 IBM 5371 System Unit

Models Available

Models 12, 14, and 16 of the 5371 System Unit are provided for a 3270-PC/G and GX configuration. These models provide three standard configurations to select from on the basis of user need. The models differ only in the standard features provided and otherwise are physically and functionally identical.

The 5371 Model 12 provides:

- 384Kb of random access memory, which is expandable to 640Kb for a 3270-PC/G or to 576Kb for a 3270-PC/GX
- Eight system expansion slots (numbers 1 to 6 are full-feature, while numbers 7 and 8 are special-feature)
- 3270 System Adapter in slot 2
- One 64/256Kb Memory Expansion Option in slot 3
- One Display Unit Adapter in slot 1
- Adapter for one keyboard and one 5083 Tablet or one 5277 Mouse in slot 4
- Printer Adapter in slot 7
- Diskette Drive Adapter in slot 6
- One 5¼-Inch Double-Sided Diskette Drive

The 5371 Model 14 provides:

- 512Kb of random access memory, which is expandable to 640Kb for a 3270-PC/G or to 576Kb for a 3270-PC/GX
- Eight system expansion slots (numbers 1 to 6 are full-feature, while numbers 7 and 8 are special-feature)
- 3270 System Adapter in slot 2
- One 64/256Kb Memory Expansion Option in slot 3
- One Display Unit Adapter in slot 1
- Adapter for one keyboard and one 5083 Tablet or one 5277 Mouse in slot 4
- Printer Adapter in slot 7
- Diskette Drive Adapter in slot 6
- Two 5¼-Inch Double-Sided Diskette Drives

The 5371 Model 16 provides:

- 576Kb of random access memory, which is expandable to 640Kb only for a 3270-PC/G
- Eight system expansion slots (numbers 1 to 6 are full-feature, while numbers 7 and 8 are special-feature)
- 3270 System Adapter in slot 2
- One 64/256Kb Memory Expansion Option in slot 3

- One Display Unit Adapter in slot 1
- Adapter for one keyboard and one 5083 Tablet or one 5277 Mouse in slot 4
- Printer/Memory Adapter in slot 7
- Diskette Drive Adapter in slot 6
- One 5¼-Inch Double-Sided Diskette Drive
- Fixed Disk Drive Adapter in slot 5
- One 10Mb Fixed Disk Drive

Each 5371 model can be field-upgraded with optional features to the maximum 3270-PC/G or GX configuration. Note that the 5271 System Unit for the 3270-PC workstation cannot be converted to a 5371 System Unit.

The following are also standard features of all 5371 System Unit models:

- Microprocessor – Intel 8088
- Eight interrupt levels
- Direct memory access (DMA) – three channels
- 40K bytes of read-only memory (ROM)
- BASIC-80 Interpreter in ROM
- A programmable speaker and associated adapter
- Automatic power-on self-test
- A 130-watt power supply with cooling fan

Physical Characteristics

Dimensions

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

Weight

- Model 12: 27.9 lb (12.7 kg)
- Model 14: 31.5 lb (14.3 kg)
- Model 16: 33 lb (15 kg)

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 in the 5371 System Unit

- Humidity:
 - 50% to 80% system on
 - 20% to 80% system off
- Noise level:
 - 51 decibels (dB) without printer
 - 66 decibels with printer
- Electrical: 100 to 127 volts, 50 or 60 Hz

Optional Features for 5371 System Units

The following optional features are available for 5371 System Unit models as indicated:

- Math Co-processor Option (all models) – one maximum*
- Standard keyboard or APL keyboard (all models) – one maximum (a keyboard is required and must be ordered as a separate feature)
- 64/256Kb Memory Expansion Option – one maximum for Models 12 and 14 only
- 64Kb Memory Module Kit (all models)
- 5¼-Inch Double-Sided Diskette Drive (Model 12 or 16) – one maximum
- Fixed Disk Drive Adapter (Model 12 only) – one maximum
- 10Mb Fixed Disk Drive (Model 12 only) – one maximum
- Monochrome Display and Printer Adapter (all models for the 3270-PC/GX workstation only) – one maximum
- IEEE-488 Adapter and Cable (all models) – one maximum
- Asynchronous Communications Adapter (all models) – two maximum*
- 5218 Printer Attachment Cable (all models) – two maximum*
- 5218 Printer Sharing (all models) – two maximum*

* This feature is not supported by the 3270-PC Graphics Control Program for host-interactive sessions. It can be used in a DOS session or when DOS is executing without the 3270-PC Graphics Control Program.

The following optional features can be installed in the 5161 Expansion Unit Model 1 or 2 when it is included in a 3270-PC/G or GX configuration:

- 10Mb Fixed Disk Drive (one to provide 20Mb of fixed disk storage in the 5161 unit)
- IEEE-488 Adapter and Cable (one maximum)
- Monochrome Display and Printer Adapter (one maximum)
- Asynchronous Communications Adapter (two maximum)

Other IBM personal computer features may be usable in a 3270-PC/G or GX configuration but need to be tested by the user to assure correct operation. IBM does not accept any responsibility for them.

Physical Components Included

Each 5371 System Unit contains the system board, the programmable speaker, and the power supply and fan. The standard diskette drive in all models, the second standard diskette in the 5371 Model 14, and the standard fixed disk drive in the 5371 Model 16 are also housed in the 5371 unit.

Each 5371 system board contains:

- The processor subsystem (includes the Intel 8088 microprocessor and associated functions)
- Read only memory (40K bytes)
- Random access memory (256K bytes)
- The programmable speaker adapter
- Eight system expansion slots that are used to hold feature cards
- Socket for the Math Co-processor Option module

The system board also contains one set of eight switches that can be read under program control. These switches (called dual inline package – DIP – switches) provide configuration information to the operating system. In a 3270-PC/G or GX configuration, they must be set to indicate whether the Math Co-processor Option is installed, the type of display attached, the amount of memory on the system board, and the number of diskettes attached.

Standard and optional features except the IEEE-488 cable, 5218 Printer features, and (for the 5161) Keylock Feature, are installed inside the 5371 System Unit or 5161 Expansion Unit. Feature cards plug into expansion slots provided in the left rear corner of the 5371 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 5371 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).

Feature Descriptions

Microprocessor and Direct Memory Access

The instruction execution function in the 5371 System Unit is the Intel 8088 16-bit microprocessor with a 4.77-megahertz (MHz) clock speed and 410-nanosecond cycle time. The 8088 microprocessor and direct memory access in the 5371 System Unit are the same as in the IBM Personal Computer XT (see descriptions in Section 13:10 under "Microprocessor" and "Direct Memory Access").

Math Co-processor Option

This optional feature increases the speed and precision of arithmetic, logarithmic, and trigonometric functions. It provides an Intel 8087 co-processor that has its own instruction set. This option is the same as that for the IBM Personal Computer XT (see description in Section 13: under "Math Co-processor Option").

Read Only Memory

Each 5371 contains 40K bytes of read only memory (ROM) on the system board. The contents of ROM remain when power to the 5371 System Unit is turned off and writing to this memory cannot be done. ROM is used for the permanent residence of certain programs. ROM in the 5371 System Unit is the same as that in the IBM Personal Computer XT (see description in Section 13:10 under "Read only Memory").

Once the 5371 has been turned on and the self-test diagnostics have executed successfully, an attempt is made to initial program load (IPL) an operating system from diskette drive A (leftmost drive) or from the first fixed disk (C) drive, 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 5371, RAM is dynamic memory (its contents must be refreshed periodically) and its contents are lost when power to the 5371 is removed. This memory is parity-checked for validity and has a 200-ns access time and a 345-ns cycle time.

The standard memory in any 5371 model in a 3270-PC/G workstation can be expanded in 64K-byte increments to a maximum of 640K bytes using the 64Kb Memory Module Kit and 64/256Kb Memory Expansion Option features. For a 3270-PC/GX workstation, the standard memory in 5371 Models 12 and 14 can be expanded to a maximum of 576K bytes in 64K-byte increments. The maximum memory for a 3270-PC/GX is reduced from 640Kb because the 5378 Display Attachment Unit contains 64K bytes that is accessible by the 5371 System Unit (64K bytes of the 640Kb random access memory address space is used).

64Kb Memory Module Kit

This feature is optional for all 5371 models. It provides 64Kb of parity-checked random access memory via nine small plug-in modules. Each module contains 64K bits. Up to three 64Kb module kits can be added to a 64/256Kb Memory Expansion Option feature card.

64/256Kb Memory Expansion Option

This feature is standard in all 5371 models. It provides 64Kb on a circuit card that plugs into a full-feature expansion slot in the 5371 System Unit. Up to three 64Kb Memory Module Kits can be plugged into a memory expansion circuit card for a total of 256Kb on the card. This memory has a 200-ns access time and a 345-ns cycle time.

Up to 512Kb of memory can be installed in a 5371 Model 12 System Unit using the standard 64/256Kb Memory Expansion Option card. If up to 640Kb of memory is desired for a 5371 Model 12 or 14, one additional memory expansion card (with a 64Kb Memory Module for 640Kb) must be installed in the 5371 Model 12 or 14 unit in slot 5.

For the 5371 Model 16, 256Kb is present on the system board, 128Kb is present on the Printer/Memory Adapter card, and 192Kb is present on the 64/256Kb Memory Expansion Option card for a total of 576Kb. No memory can be added to a 5371 Model 16 that is included in a 3270-PC/GX workstation configuration. For a 3270-PC/G workstation with a 5371 Model 16, one 64Kb Memory Module Kit can be added to the 64/256Kb Memory Expansion Option card to provide 640Kb in the configuration.

System Expansion Slots

Six full-feature (numbered 1 to 6) and two special-feature (numbered 7 and 8) expansion slots are standard on the system board in all 5371 models to contain memory and adapter features. The full-feature slots will accept full-feature or the smaller special-feature cards. The special-feature slots will accept only the special-feature cards.

Standard and optional features must be installed in specific slots in the 5371 and 5161 units. Slot assignments for standard features of 5371 models are shown below (a blank indicates an available slot):

Slot	Feature	5371 Model		
		12	14	16
1	Display Unit Adapter	X	X	X
2	3270 System Adapter	X	X	X
3	64/256Kb Memory Expansion Option	X	X	X
		128Kb	256Kb	192Kb
4	Keyboard/Tablet/Mouse Adapter	X	X	X
5	Fixed Disk Drive Adapter			X
6	Diskette Drive Adapter	X	X	X
7	Printer Adapter	X	X	
7	Printer/Memory Adapter			X
				128K
8	(Available)			

The following optional features require one system expansion slot:

- 64/256Kb Memory Expansion Option. Can be installed in full-feature slot 5 in a 5371 Model 12 or 14 without a 5161 Expansion Unit installed or in slot 5 of a 5371 Model 16 with a 5161 unit installed. If the 5161 Expansion Unit is installed, the 3270 System Adapter can be moved to slot 2 in the 5161 unit and the memory expansion card can be installed in slot 2 of the 5371. This memory expansion feature cannot be installed in the 5161 Expansion Unit.
- Fixed Disk Drive Adapter. Can be installed in full-feature slot 5 in the 5371 Model 12 unit.
- IEEE-488 Adapter and Cable. Can be installed in a special- or full-feature slot in any 5371 model (slot 5 or 8 if available) or in slot 6 of the 5161 Expansion Unit.
- Monochrome Display and Printer Adapter. For a 3270-PC/GX configuration, this feature can

be installed in slot 5 in 5371 Models 12 and 14 or in slot 1 of the 5161 unit.

- Asynchronous Communications Adapter. This feature can be installed in slot 8 in all 5371 models or in any available slot in the 5161 unit.

Note that the availability of slots in any 5371 model limits the features that can be installed in the configuration unless there is a 5161 Expansion Unit in the configuration. When the 5161 unit is included in a 5371 configuration, the extender card provided with the 5161 unit must be installed in slot 5 of the 5371 unit.

Programmable Speaker

A 2¼-inch-diameter, 8-ohm audio speaker is included in each 5371 System 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 each 5371 System Unit. This adapter is installed in slot 6 and is the only diskette adapter that can be installed in a 5371 unit. One or two internal 5¼-inch diskette drives can be attached to this adapter.

5¼-Inch Double-Sided Diskette Drive

One double-sided 5¼-inch diskette drive is standard in each 5371 model. It provides a capacity of 360Kb using DOS Version 2.1. The double-sided 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.

One additional double-sided diskette drive is optional for 5371 Models 12 and 16 and standard in the Model 14 to provide a total of 720Kb of diskette storage. If a second diskette drive is to be installed in a 5371 Model 16, its Fixed Disk Drive Adapter and fixed disk drive must be moved to a 5161 Model 2 unit.

Double-sided diskette drive and double-sided diskette characteristics for the 3270-PC/G and GX are the same as those for other IBM personal computers (see description under "5¼-Inch Double-Sided Diskette Drive" in Section 13:10).

Fixed Disk Drive Adapter

This adapter is standard in the 5371 Model 16 and optional for the 5371 Model 12. It provides buffering, error detection, and data transfer between memory in the 5371 and a 10Mb Fixed Disk Drive. One 10Mb Fixed Disk Drive can be attached to this adapter when it is present in a 5371 unit. One or two 10Mb Fixed Disk Drives can be attached when this adapter is in a 5161 unit. Only one Fixed Disk Drive Adapter can be installed in a 3270-PC/G or GX configuration.

For a 5371 Model 12 with one diskette drive, the Fixed Disk Adapter and one 10Mb Fixed Disk Drive can be installed in the 5371 System Unit if full-feature slot 5 is available. Otherwise, fixed disk storage is obtained by installing the 5161 Expansion Unit Model 1, which contains a Fixed Disk Drive Adapter and one 10Mb Fixed Disk Drive. A second 10Mb fixed disk drive can be installed in the 5161.

For a 5371 Model 14, the 5161 Model 1 unit is required to provide fixed disk storage (10Mb or 20Mb). For a 5371 Model 16, the 5161 Model 2 must be installed if 20Mb of fixed storage is required.

The Fixed Disk Drive 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 errors, and internal diagnostics.

10Mb Fixed Disk Drive

One 10Mb Fixed Disk Drive is standard in the 5371 Model 16 unit and one is optional for a 5371 Model 12 unit with only one diskette drive installed. The fixed disk drive provides 10,618,880 bytes of fixed disk storage, which is equivalent to about 28 double-sided diskettes at 360Kb each. One additional 10Mb Fixed Disk Drive can be installed in a 5161 Model 1 or 2 unit to provide 20Mb of fixed disk storage.

The characteristics of the 10Mb Fixed Disk Drive for the 3270-PC/G and GX are the same as those for other IBM personal computers (see description in Section 13:10 under "10Mb Fixed Disk Drive").

Printer Adapter

This adapter provides for the attachment of one parallel printer to the 3270-PC/G or GX configuration, such as the 5152 Graphics Printer, 5182 Color Printer, or 3852 Color Printer (which are supported by the 3270-PC Graphics Control Program); the 5201 QUIETWRITER® Printer; or the 5216 Wheelprinter Model 2. Any device with TTL (transistor to transistor logic) levels can be attached instead of the preceding printers. See Section 31 for the cable required for each type of printer that attaches to this adapter.

This adapter is standard in 5371 Models 12 and 14 and is functionally included in the standard Printer/Memory Adapter for the 5371 Model 16. One Printer Adapter or Printer/Memory Adapter can be present in a 3270-PC/G or GX configuration.

Monochrome Display and Printer Adapter

One Monochrome Display and Printer Adapter is optional for a 3270-PC/GX configuration to provide a dual-display workstation. It can be installed in an available full-feature slot in the 5371 or 5161 unit. This adapter provides for the attachment of one 5151 Monochrome Display and one parallel printer (same as attach to the Printer Adapter) or one device with TTL levels. For a description of this adapter, see Section 13:10 under "Monochrome Display and Printer Adapter."

IEEE-488 Adapter and Cable

One IEEE-488 Adapter and Cable feature is optional for all 5371 models and the adapter card requires one special- or full-feature slot in the 5371 or 5161 unit. The adapter can have attached up to 13 I/O devices (IBM- and vendor-logo) that use the IEEE-488 interface. Only one device attached to this adapter can be operating at a time.

This adapter permits 7371 Model A and A4 (2-pen), 7372 Model B and A3 (6-pen), 7374 Model D and A1 (8-pen), and 7375 Model E and A0 (8-pen) Color Plotters to be attached to 3270-PC/G and GX workstations. The 737X plotters are supported by the 3270-PC Graphics Control Program and by GDDM Release 4 for host-interactive applications. Any other I/O device type attached to this adapter requires user-supplied I/O support.

The IEEE-488 cable is 6 feet (1.8 meters) long and has a special IEEE-488 connector at one end that plugs into the 5371 unit via the IEEE-488 adapter

card connector. This cable is provided to attach the first device to the IEEE-488 adapter card. Additional devices can be connected using one General Purpose Interface Bus Adapter (IEEE-488) Cable (part number 2720020, feature code 5040) for each device. The total cable length for all devices attached to the IEEE-488 adapter should not exceed 65 feet (20 meters).

Asynchronous Communications Adapter

One or two Asynchronous Communications Adapters are optional for all 5371 models. The adapter requires one special- or full-feature slot in the 5371 or 5161 unit. It provides a path to a processor or I/O device outside the 5371 or 5161 unit. A processor or I/O device can be connected to this adapter directly via cable (for local attachment) or via a telephone line using a plug-in modem (for remote attachment).

The IBM-logo DOS application programs that support communications using the asynchronous adapter and that can be used in a DOS session in a 3270-PC/G or GX include the following:

- 3101 Emulation Program
- Asynchronous Communications Support Version 2
- PROFS Personal Computer Connection (PROFS/PC²)

For a description of the Asynchronous Communications Adapter hardware and the functions supported by the communications programs that support the asynchronous adapter in the 3270-PC/G or GX, see Section 13:10 under "Asynchronous Communications Adapter."

5218 Printer Attachment Cable and 5218 Printer Sharing

These features permit a 5218 Printwheel Printer Model A03 or A04 to be attached to the 3270-PC/G or GX for use in letter quality printing applications, as supported by DOS, and permit the 5218 printer to be shared by up to four IBM personal computer systems (see description in Section 15:15 under "5218 Printer Attachment Cable and 5218 Printer Sharing").

Keyboard

One keyboard, standard or APL layout, is required for a 3270-PC/G or GX configuration. The standard layout keyboard for the 5371 is the same as the 122-key keyboard for 3290, 3179, and 3180 display stations and for the 3270-PC workstation. This keyboard is different from the keyboards for other IBM personal computer configurations. It attaches to the Keyboard/Tablet/Mouse Adapter in the 5371 System Unit. For a description of this keyboard, see Section 15:15 under "Keyboard."

The APL layout keyboard has APL symbols marked in orange on the keytops. It can be used with host processor APL graphics products, such as ADRS-II/BG.

An overlay indicating the functions assigned to the program function keys by the 3270-PC Graphics Control Program is supplied with the standard or APL keyboard.

15:35 IBM 5371 System Unit

Single Unit Prices

Item	Part Number	Feature Code	Single Unit Purchase Price or License Fee (\$)
5371 System Unit			
Model 12	5371012	—	4090
Model 14	5371014	—	4590
Model 16	5371016	—	6080
Standard keyboard (including overlay)	6110344	5730	295
APL keyboard (including overlay)	1351768	5731	295
5083 Tablet Model 2	5083002	—	650
Cursor	6248428	1511	250
Stylus	6248427	6351	100
5277 Mouse	5277001	—	340
5278 Display Attachment Unit Model 1	5278001	—	3060
5279 Color Display Model 1	5279001	—	1600
5378 Display Attachment Unit Model C01	5278C01	—	8310
5378 Display Attachment Unit Model M01	5378M01	—	7810
5379 Color Display Model C01	5379C01	—	3600
5379 Monochrome Display Model M01	5379M01	—	2750
5379 Stand with tilt and swivel	1887676	7676	NC
5379 Stand with tilt, swivel, and height adjustment	1887675	7675	200
Asynchronous Communications Adapter	1502074	2074	100
Fixed Disk Drive Adapter	1602501	2501	495
General Purpose Interface Bus Adapter (IEEE-488) Cable	2720020	5040	102
IEEE-488 Adapter and Cable	6450600 and 6450601	3907	545
Math Co-processor Option	1501002	1002	230
Monochrome Display and Printer Adapter	1504900	4900	250
RS-232C Cable	2719931	5030	51
10Mb Fixed Disk Drive	1602500	2500	1195
5218 Printer Attachment Cable	6113647	—	45
5218 Printer Sharing	6113650	4471	625
5218 Convenience Pac	6113651	4470	220
5¼-Inch Double-Sided Diskette Drive	1503810	3810	425
64Kb Memory Module Kit	1501003	1003	100
64/256Kb Memory Expansion Option	1501013	1013	265
3270-PC Graphics Control Program	1887697	1507	450
DOS Version 2.1	6024120	4120	65

Discounts Available

The 3270-PC/G and GX and all their optional hardware features may be eligible for one of the following discounts:

- Volume Procurement Amendment
- Educational Allowance
- Special Bid

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 *Tech-*

nical Support Location Customer Guide, G320-0728, for a discussion of the TSL and TSL coordinator responsibilities.

15:40 IBM 5279 and 5379 Displays and IBM 5278 and 5378 Display Attachment Units

5279 Color Display and 5278 Display Attachment Unit

The 5279 Color Display and 5278 Display Attachment Unit are standard units in a 3270-PC/G workstation configuration (shown in the minimum workstation configuration in Figure 15-7). The 5279 is an all-points-addressable, medium-resolution, color display that is designed for general graphics work, such as the creation of simple pictures, pie charts, bar charts, histograms, foils, and layout diagrams. A standard tilt and swivel stand or the optional tilt and swivel stand with height adjustment can be selected to hold the 5279 display, which can be mounted on the 5278 unit, as shown in Figure 15-7.

The 5278 Display Attachment Unit provides alphanumeric and graphics processing functions, buffer storage for the 5279 display, and emulation of the Color/Graphics Monitor Adapter for other IBM personal computers. The 5278 contains hardware to assist in drawing lines and filling areas to draw a graphics picture.

The 5278 unit connects to the 5371 System Unit via the IBM-supplied 3-foot (one-meter) signal cable and to the 5279 via the IBM-supplied 26.7-inch (680-mm) signal cable. The 5278 receives power from the 5279 unit, which has a 6-foot (1.8-m) power cord and requires its own power source.

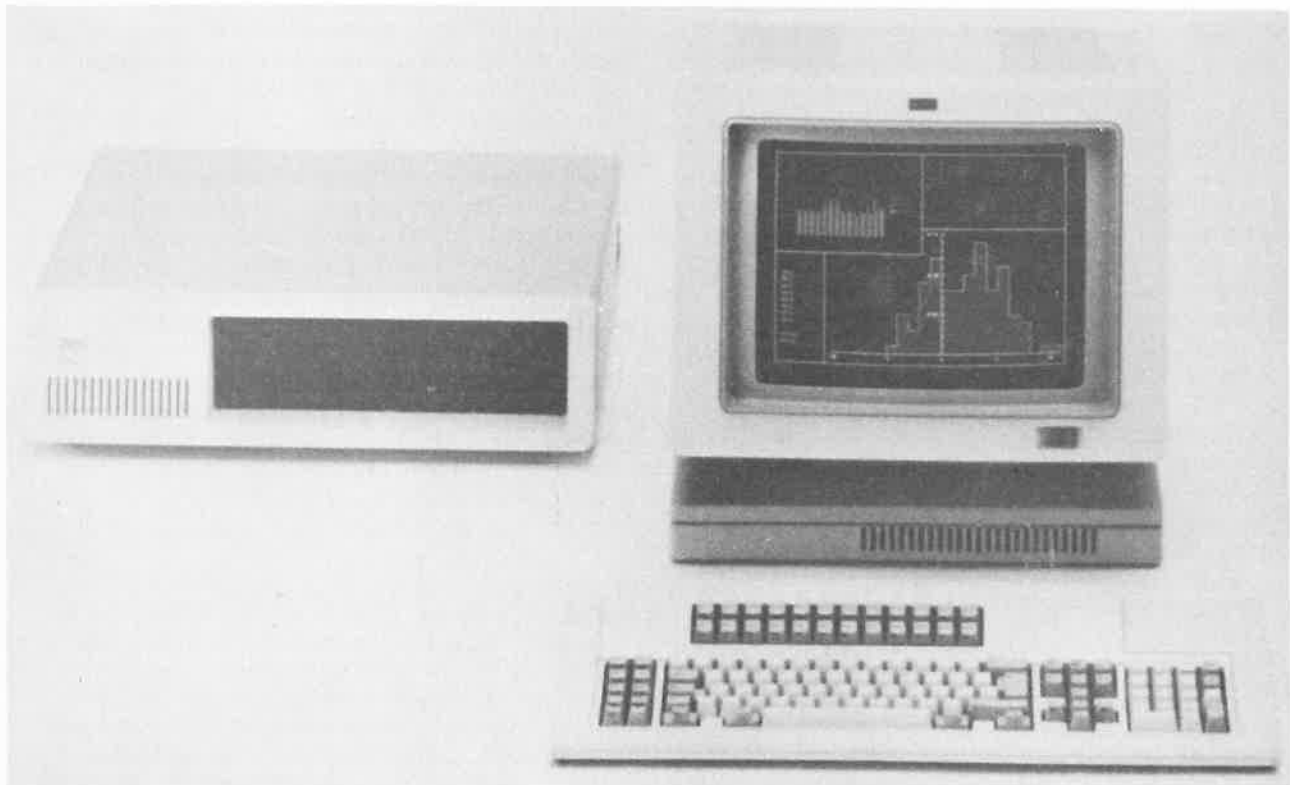


Figure 15-7. 3270 PC/G minimum workstation configuration

15:40 IBM 5279 and 5379 Displays and IBM 5278 and 5378 Display Attachment Units

The 5278 provides the following:

- Vector-to-raster conversion
- Picture moving, scaling, scrolling, and clipping
- Two-dimensional transforms
- Correlation of cursor position with picture elements for interactivity
- Area color fill (filling an area of the picture with a special color or shading pattern)
- Arc and fillet generation
- Font definition
- 3270 character buffer emulation with a capacity of either 2560 or 3920 characters
- Emulation of the Color/Graphics Monitor Adapter for other IBM personal computers for programs that execute in the DOS session

The 5278 unit has the following dimensions and weight:

- Width: 16.2 inches (411 mm)
- Depth: 15 inches (380 mm)
- Height: 1.5 inches (37 mm)
- Weight: 18 lb (8.2 kg)

The 5279 display has the following characteristics:

- Screen size is 14 inches (diagonal measurement) with a viewing area of 9.4 inches (240 mm) by 7.1 inches (181 mm).
- Screen viewing area displays 32 rows of 80 characters (2560 characters) or 49 rows of 80 characters (3920 characters) as selected during customization of the 3270-PC Graphics Control Program.
- Screen resolution is 720 pels horizontal and 512 pels vertical (76 pels per inch).
- Display refresh time is 42 times per second noninterlaced.
- Characters are displayed using 9 × 10 pels (or 8 × 10 pels in a DOS session) in a 9 × 16 box.
- Graphics and alphanumeric information is displayed in up to eight colors and the Color/Graphics Monitor Adapter is emulated.
- Screen has an antiglare coating and high brightness to minimize reflections.
- Brightness controls are provided.
- Voltage is 100 to 127 volts, 50 or 60 Hz.
- Dimensions are:
 - Width: 16.2 inches (411 mm)
 - Depth: 15.7 inches (400 mm)
 - Height: 12.4 inches (315 mm) without stand, or 14.1 inches (359 mm) with standard stand, or 14.7 inches (372.5 mm) to 20.5 inches (522.5 mm) with adjustable stand

- Weight is 40 lb (18.2 kg) or 55 lb (25 kg) with lift/tilt/swivel stand.
- Tilt is -5 to +20 degrees.
- Swivel is plus or minus 40 degrees.

Environmental requirements for the 5279 and 5278 are:

- 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

5379 Displays and 5378 Display Attachment Units

A 5379 display and 5378 Display Attachment Unit are standard units in a 3270-PC/GX workstation configuration (shown in the minimum workstation configuration in Figure 15-8). The 5379 Monochrome Display Model M01 or 5379 Color Display Model C01 can be selected for the 3270-PC/GX configuration. The 5379 units are all-points-addressable, high-resolution displays that provide higher resolution and higher performance than the 5279 Color Display. The 5379 Color Display is designed for precision graphics work where color offers an advantage, such as map drawing, electronic design, and complex business graphics. The 5379 Monochrome Display is designed for high-precision graphics work and text applications, such as engineering drawings and page composition.

The 5379 display is mounted in an enclosure that contains a convenient lockable tilt and swivel mechanism that enables the display to be positioned to suit the user's needs. Figure 15-8 shows a 5379 display and its associated 5378 Display Attachment Unit with the 5371 System Unit placed on top of it.

The 5378 units support 5379 displays and provide higher performance than the 5278 Display Attachment Unit because of the inclusion of a graphics processor (Motorola 68000 microprocessor) in the 5378 unit. The microprocessor performs vector, character, and image processing. The 5378 also contains 128K bytes of memory for vector lists, standard and user-defined characters, character buffers, and system functions. This memory is shared by the 68000 and 8088 microprocessors.

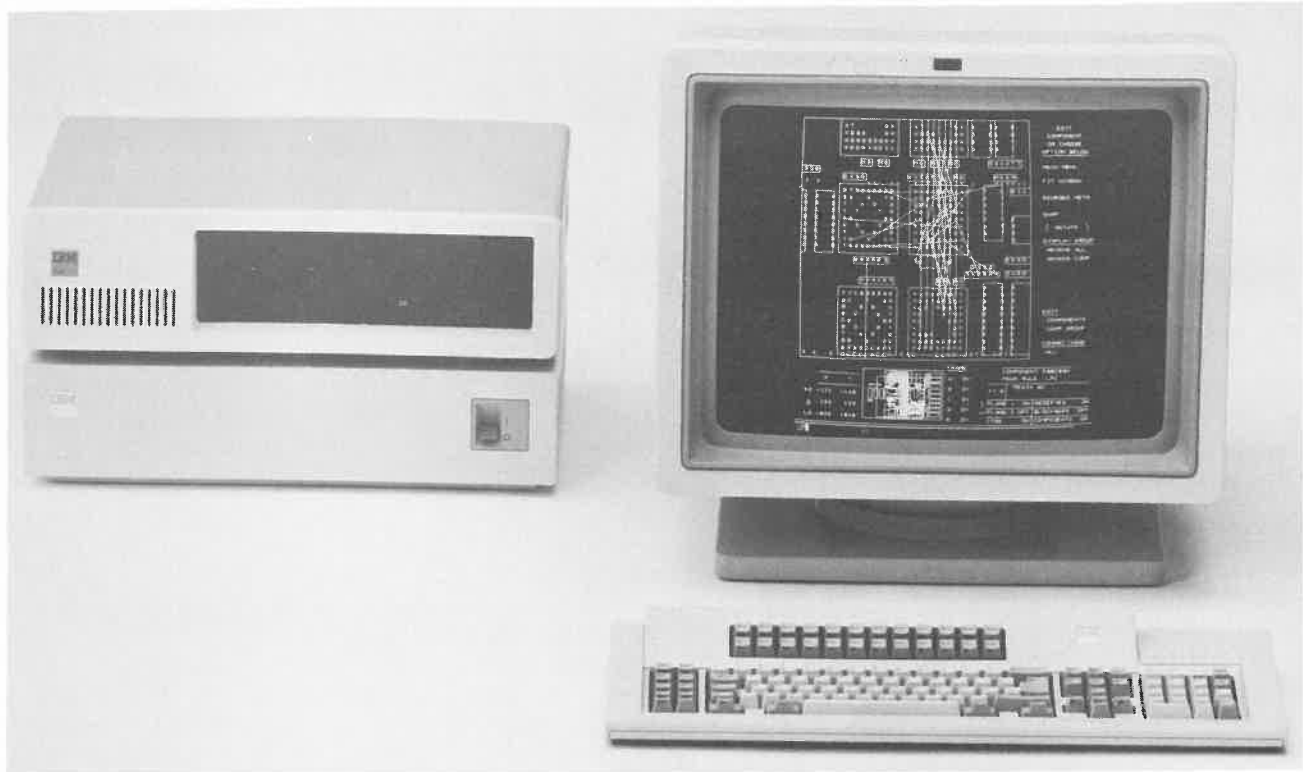


Figure 15-8. 5379 display and 5378 Display Attachment Unit

The specific graphics functions supported by the 5378 include:

- High-speed vector-to-raster conversion
- Two- and three-dimensional transforms
- Moving, scaling, clipping, and rotating picture elements
- Correlation of cursor position with picture elements for interactivity
- Area and pattern fill
- Arcs and fillets

The character handling functions supported by the 5378 include:

- Programmable character generation to permit user creation of vector or image definitions for any character
- 3270 extended data stream character buffer emulation with a capacity for 4000 characters
- Emulation of the Color/Graphics Monitor Adapter for programs that execute in the DOS local session

The 5378 units have the following physical characteristics:

- Width: 19.5 inches (495 mm)
- Depth: 16 inches (406 mm)
- Height: 4.7 inches (130 mm)
- Weight: 31 lb (14 kg)

The 5378 unit connects to the 5371 System Unit via an IBM-supplied 3.3-foot (1-meter) signal cable and to the 5379 display via IBM-supplied 6.6-foot (2-meter) cables. The 5378 has a 6-foot (1.8-meter) power cable and requires its own power source. The 5378 unit can be stacked over or under the 5371 or 5161 unit.

15:40 IBM 5279 and 5379 Displays and IBM 5278 and 5378 Display Attachment Units

The 5379 Monochrome Display and 5379 Color Display have the following characteristics:

- Screen size is 19 inches (diagonal measurement) with a viewing area of 11 inches (280 mm) by 11 inches (280 mm).
- Screen viewing area can display 50 rows of 80 characters (4000 characters) for the alphameric layer.
- Screen resolution is 1024 pels vertical and 1024 pels horizontal for the graphics layer (93 pels per inch). This is equal to the resolution of the 5080 Graphics System display. A resolution of 960 horizontal pels and 1000 vertical pels is supported by the 3270-PC Graphics Control Program in a viewing area 10.3 by 11 inches (261 by 279 mm).
- Display refresh time is 52 frames per second non-interlaced.
- Characters are displayed using a 12 × 20 character box.
- For the 5379 Color Display, up to 16 colors for the graphics layer and up to 8 colors for the alphameric layer are supported.
- For the 5379 Monochrome Display, up to four intensities for the graphics layer and up to two intensities for the alphameric layer are supported.
- Brightness control for the color and monochrome displays and degauss control for the color display are provided.
- Voltage is 100 to 127 volts, 50 or 60 Hz.
- Screen has an antiglare coating and high brightness to minimize reflections and images are distortion-free.
- Dimensions for both displays are:
 - Width: 19.7 inches (500 mm)
 - Depth: 19.2 inches (488 mm) for the color display and 20.7 inches (525 mm) for the monochrome display
 - Height: 18.1 inches (460 mm)
- Weight is 77 lb (35 kg).
- Tilt is -5 to +15 degrees.
- Swivel is plus or minus 120 degrees.

Environmental characteristics for 5379 and 5378 units are:

- 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: 100 to 127 volts, 50 or 60 Hz

15:45 IBM 5277 Mouse and IBM 5083 Tablet Model 2

One 5277 Mouse or one 5083 Tablet Model 2 can be attached to the 5371 unit in a 3270-PC/G or GX configuration at a time. The 5083 or 5277 attaches to the 5371 (via the Keyboard/Tablet/Mouse Adapter) via a 5-foot (1.5-meter) signal cable and provides an alternative to the keyboard for controlling the cross hair graphics cursor on the display screen.

5277 Mouse

The 5277 Mouse, shown in Figure 15-9, is an easy-to-use device for controlling the position of the graphics cursor on the display screen. The graphics cursor is controlled by moving the mouse on a thin pad printed with horizontal and vertical lines. As

the mouse moves, it optically scans a pattern printed on the pad and sends movement coordinates to the 5371 via the cable attaching the mouse to the 5371 unit. Thus, the mouse supplies changes in position, and programming determines the response of the graphics cursor to the movement of the mouse.

The mouse has three keys that initiate an action when pressed. Two of these keys can be assigned specific functions by application programming (like the function keys on the keyboard), such as function selection and function initiation. The mouse is 2.6 × 3.9 inches (66 × 99 mm) in size, 1 inch (25 mm) high, and weighs 6 oz (168 gm).

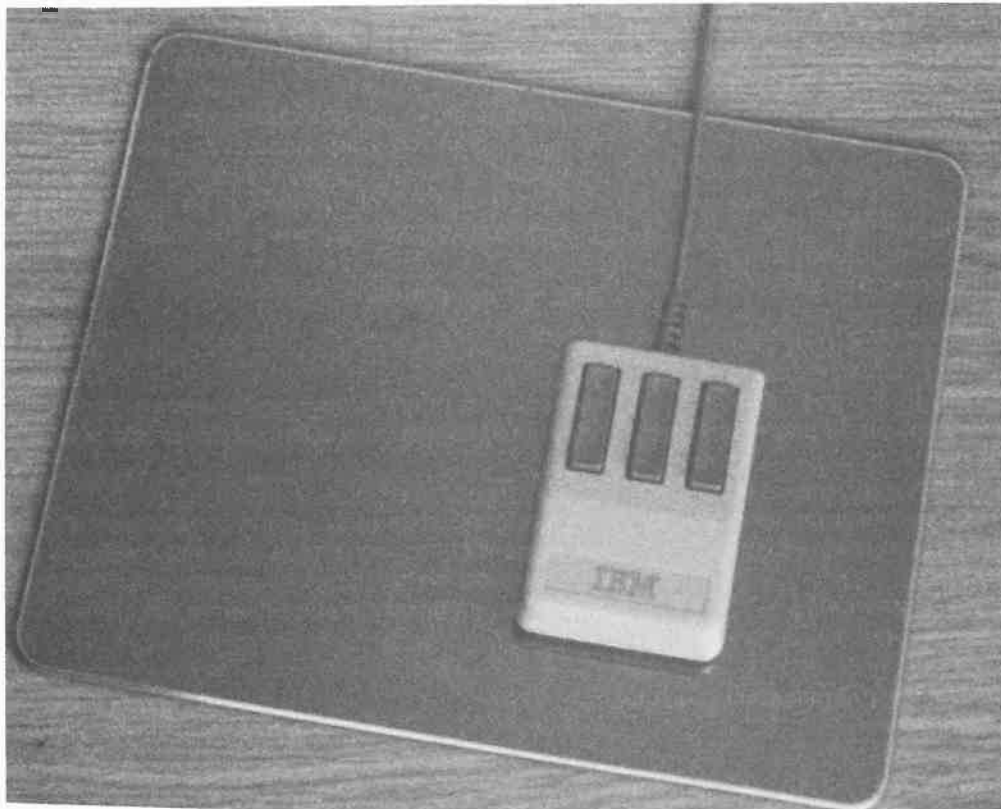


Figure 15-9. 5277 Mouse

5083 Tablet Model 2

The 5083 Tablet Model 2, shown in Figure 15-10, provides higher-precision cursor positioning than the mouse. The tablet is 15.8 × 17 inches (400 × 431.8 mm) in size with an .8-inch (20.3-mm) height, has an active area of 11.5 × 11.5 inches (292 by 292 mm), and weighs 6.5 lb (2.9 kg). It connects to the 5371 unit via a 6.6-foot (2-meter) signal cable.

The tablet provides a resolution of 200 lines per inch and offers a choice of two user-controlled inputs: the four-button cursor or the stylus. Both can be ordered but only one can be used at a time. The stylus or cursor is used to supply exact positions (x-y coordinates) on the tablet.

The tablet cursor is a convenient, hand-held, mouse-shaped unit with four buttons that can be assigned functions by application programs and a fine cross-

hair that permits the cursor unit to be positioned over a precise point on the tablet. The cross hair cursor can be used to copy a drawing that is lying on the tablet onto the display screen. The tablet cursor can be used for general control of the graphics cursor on the display and for addressing specific areas of the screen.

The stylus feature provides a pen-like device for user interaction with the screen. The tactile feedback from pressing the stylus tip on the tablet assures the user that a selection has been made. The stylus permits the user to select an option from the paper menu lying on the tablet, copy an original drawing lying on the tablet onto the screen, and draw on the tablet to produce a picture on the screen. The stylus is particularly useful for entering fine line drawings or signatures, for example.

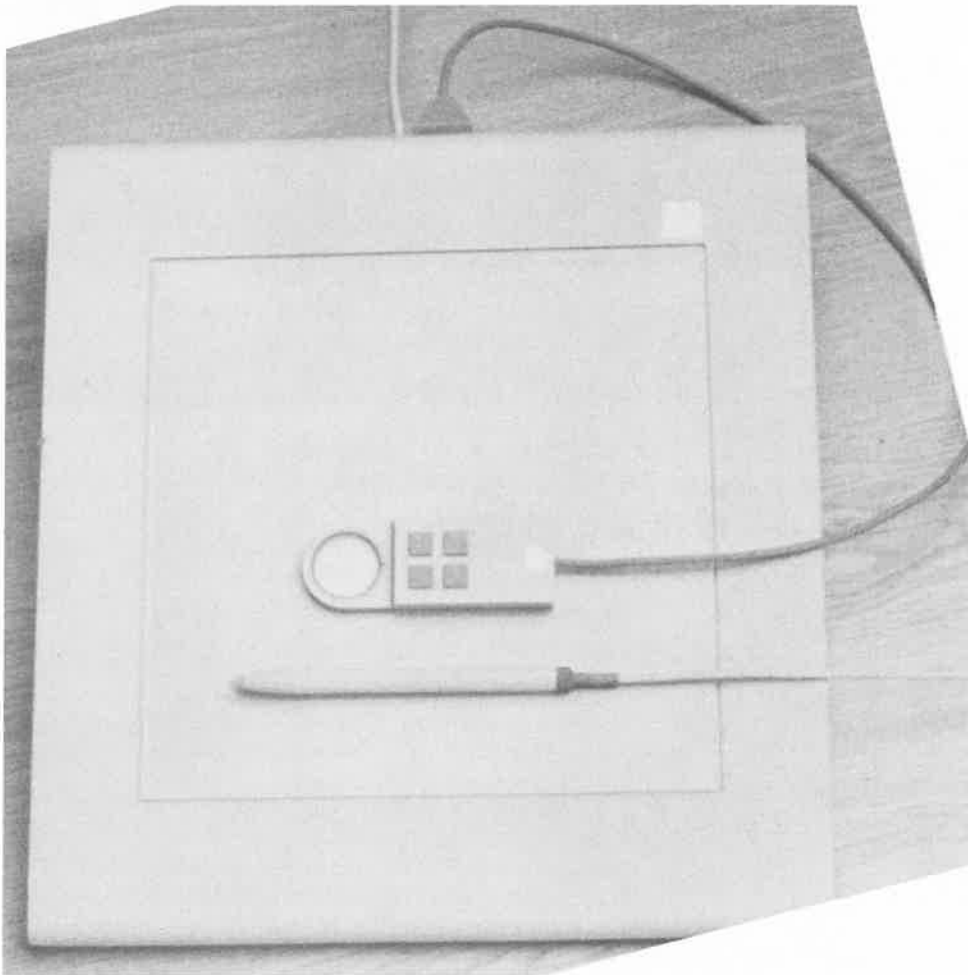


Figure 15-10. 5083 Tablet Model 2

15:50 IBM 5161 Expansion Units

The 5161 Expansion Unit Model 1 can be included in a 3270-PC/G or GX configuration that contains a 5371 Model 12 or 14 System Unit to provide fixed disk storage and additional expansion slots. The 5161 Model 2 can be included in a configuration with a 5371 Model 16.

One 5161 unit can be attached to a 5371 unit and requires its own power source. It can be field-installed and is a customer-setup unit. It can be placed beside or stacked over or under the 5371 unit. When the 5161 is placed beside or on top of the 5371 unit, a printer, display, or the 5378 unit can be placed on top of the 5161 unit.

The following features can be installed in the slots in a 5161 unit that is included in a 3270-PC/G or GX configuration:

- IEEE-488 Adapter and Cable in slot 6
- Monochrome Display and Printer Adapter in slot 1 (3270-PC/GX only)
- Asynchronous Communications Adapter (any available slot)
- 3270 System Adapter in slot 2 (moved from slot 2 in the 5371 unit)
- 10Mb Fixed Disk Drive

See description of 5161 Models 1 and 2 in Section 15:20.

15:55 IBM 3270-PC Graphics Control Program

Introduction

The 3270-PC Graphics Control Program supports use of the 3270-PC/G and GX as 3270 Information Display System workstations without reprogramming the host applications with which the 3270-PC/G or GX is to interact. The 3270-PC Graphics Control Program operates under DOS Version 2.1 in the 3270-PC/G or GX to provide the user with the ability to activate multiple concurrent sessions, manage displayed alphanumeric and graphics data for the active sessions, and manipulate and interact with the data displayed.

Printing functions, help and online tutorials, and file transfer to and from a host processor using a 3270-PC File Transfer Program executing in the host processor are also supported.

The 3270-PC Graphics Control Program provides for the 3270-PC/G and GX facilities like those of the 3270-PC Control Program that supports the 3270-PC workstation. It also supports the following:

- Expanded graphics presentations and user interaction with graphic displays. The graphics functions supported include vector drawing, area fill, coordinate transformations, clipping, correlation, and circle/arc operations. Interactive graphics is supported for the local DOS session as well as for up to four active host-interactive sessions.
- User input via the 5277 Mouse and the 5083 Tablet Model 2
- Interaction with GDDM Release 4 operating in a host processor, which can send vector-formatted pictures for the 3270-PC/G and GX. GDDM-plotted pictures can also be sent to the 3270-PC/G or GX for transcription to an attached 737X plotter using a host-interactive session.
- A spool function to create spool files that are to be printed using the provided print spool utility in addition to support of direct printing
- Storage of graphics objects in files and retrieval for transmission to a printer or plotter. Graphics objects cannot be copied from one session to another.
- A Graphics Procedure Interface (GPI) that DOS programmers can use to access the graphics functions of the 3270-PC Graphics Control Program in a DOS session and to develop new graphics applications

- Support for host processor-based APL applications using the optional APL keyboard

Note that the 3270-PC Control Program cannot be used with 3270-PC/G or 3270-PC/GX workstations and that the 3270-PC Graphics Control Program does not support the 3270-PC workstation.

The 3270-PC Graphics Control Program is designed to be used with the following host processor program releases:

- MVS/SP Release 1.3.2 (TSO, BTAM)
- DOS/VSE AF Release 1.3
- VM/SP Release 3.0
- ACF/VTAM Version 2 Release 1
- IMS Release 1.3
- OS/VS/CICS Release 1.6.1
- DOS/CICS Release 1.6.0
- GDDM Release 4
- 3274 microcode Release 61

The 3270-PC Graphics Control Program does not support prior releases of this programming. Other systems may be used but need to be tested by the user to insure viability.

Sessions Supported

The 3270-PC Graphics Control Program supports the concurrent operation of one to seven sessions in a 3270-PC/G or GX: four host-interactive (3270), two local notepad, and one DOS Version 2.1. The user activates one or more sessions, determines the information displayed on the screen for each operating session, and interacts with one session at a time.

For a host-interactive session, the user logs onto and interacts with an application in the host processor (System/370, 30XX, or 4300 processor) just as if the 3270-PC/G or GX were a 3270 display. The 5371 emulates the functions of the keyboard for the supported 3270 displays. No reprogramming of host applications is required.

A 3270-PC/G or GX operating in distributed function terminal (DFT) mode can support the concurrent operation of four host-interactive sessions, two local notepad sessions, and one local DOS session. For DFT mode, each host-interactive session operates as a separate 3270 display and is referred to as a logical terminal. Thus, the 3270-PC Graphics Control Program permits up to four logical terminals

to operate concurrently in one 3270-PC/G or GX using one 3274 port. For DFT mode, the 3270-PC operates much like the 3290 Information Panel Display Station.

Each of the four host-interactive sessions supported for DFT mode can be alphameric only, alphameric and graphics combined, or dual-screen alphameric and graphics combined. For dual-screen support, a 3270-PC/GX configuration with a 5379 and a 5151 display are required and the graphics information is displayed on the 5379 display while the alphameric information is displayed on the 5151 display.

One or two local notepad sessions can operate with other sessions in DFT mode. Only alphameric data is supported for notepad sessions. A notepad session can be used to copy or save data from other operating sessions, to transfer data to any other operating session except the DOS session, to save personal notes on diskette or fixed disk in the 3270-PC/G or GX configuration, and to provide a scratchpad area.

One DOS session in which an application program that operates under DOS Version 2.1 executes can operate with other sessions in DFT mode. The application program must observe DOS 2.1 and BIOS protocols and conventions and use only those hardware features that are available in the 3270-PC/G or GX configuration.

A DOS application program that uses the Color/Graphics Monitor Adapter in text or graphics (APA) mode can be executed with emulation of the Color/Graphics Monitor Adapter handled by the 3270-PC Graphics Control Program. A DOS application program can also use the Graphics Procedure Interface (GPI), which provides access to the graphics functions of the 3270-PC Graphics Control Program, if support of the GPI option is selected during control program customization.

A 3270-PC/G or GX operating in control unit terminal (CUT) mode can support one host-interactive session and only alphameric data is supported (no graphics). Local notepad and local DOS sessions are not supported for CUT mode.

The 3270-PC/G or GX can also be used as a stand-alone personal computer. It can operate using DOS 2.1 and the 3270-PC Graphics Control Program or only DOS. When DOS 2.1 and the 3270-PC Graphics Control Program are used, one DOS session and two notepad sessions are supported. In addition, except for file transfer support (which requires a host-interactive session), all the other functions supported by the 3270-PC Graphics Control Program (such as the session-to-session

copy facility, keystroke record/play function, save/restore utility, and printer/plotter support) can be used. When only DOS is used, the 3270-PC/G or GX operates like other IBM personal computers.

Screen Management

The advanced screen management provided by the 3270-PC Graphics Control Program permits the user to simultaneously display data for each operating session (up to the maximum of seven) on the display screen. The traditional approach of displaying data for only one operating session at a time and switching from one session to another to display data using the keyboard is also supported.

The 3270-PC Graphics Control Program represents each active session by a presentation space contained in random access memory. A presentation space is a logical representation of display screen data for an active session. For a host-interactive or local notepad session, the presentation space can be up to 4000 EBCDIC characters, while for a DOS session a presentation space is up to 2000 ASCII characters. The user can view all or a portion of the presentation space for each active session on the display screen via a window. The window size can vary from one character minimum to the maximum size of the display screen or the actual size of the presentation space for the session, whichever is smaller.

The maximum display screen size for a single-screen host-interactive or notepad session is 1920 characters, while for a DOS session it is 2000 characters. If a window larger than 1920 characters is required for a single-screen host-interactive session, scrolling can be used to view the entire presentation space. For dual-screen sessions involving a 5379 and 5151, the presentation space and window sizes are preset to the full area size of both displays.

While viewing the presentation space for a session, the user can move the window to any location within the presentation space or move the window to any location on the screen. The user can also alter the size of each window. Combinations of session windows, with each configuration containing any number of windows up to seven, can be defined in screen profiles. Up to ten screen profiles can be installation-defined, and any one of them can be used to control the display contents at any time using the ChgSc key. Screen profiles can be modified (windows can be added or deleted or changed in size, for example).

The user can interact with only one operating session at a time using the keyboard. Switching

among the sessions is accomplished using the keyboard (Jump key). The window for the session with which the operator is currently interacting is called the active window. It has a double border and contains the cursor. The active window can be expanded to the full-screen size or to the presentation space size, whichever is smaller, using the Enlarge Window key.

For a color display, the user can define the foreground and background colors for the host-interactive session windows (not using extended data stream attributes or graphics in the data stream), define the background color for the screen, and select base color (3279 four-color) mode.

The screen management provided supports two modes of operation: application and screen management. Application mode is used for interaction between the user and the application (one session at a time) via the keyboard. This mode permits the user to invoke basic screen management functions, which provide for manipulating windows for the active sessions. Screen management mode is used for communication between the user and the 3270-PC/G or GX and is used to invoke advanced screen management functions. This mode cannot be used to enter data into a window.

Advanced screen management functions include setup specifications (color and window definitions for screen profiles, for example), copying a block of data from one session to another, browsing, the keystroke record/play function, the save/restore facility, printing to a local or remote printer, and file transfer to/from the host processor.

Copy Functions

The following copy operations are supported:

- From one area to another area within the same window for host-interactive and notepad sessions
- From one window to another window in the same or a different screen profile for host-interactive and notepad sessions. Information can be copied from a DOS session window but not into a DOS session window.

Browsing

The browsing function permits the user to view the presentation space data for a session by moving the data contained within the presentation space vertically or horizontally within the window. Data can be inspected but not changed until application mode is reentered.

Keystroke Record/Play Function

The keystroke record/play function is designed to reduce the amount of repetitive keying required at the workstation. It can be used, for example, to save logon/logoff information, short letters or notes that are directed to different people, or frequently entered long commands. Manual entry of variable data is supported.

Once recording is initiated using the keyboard (AUTO and RECORD keys), each entered keystroke is saved in a 2000-byte area in memory until recording is terminated. When recording is stopped, the saved data can be written to a diskette or fixed disk using the Save/Restore Utility and is identified by the name indicated when recording was initiated. To retrieve the recording, the AUTO and PLAY keys are used and the recording name is specified. Recordings can also be erased.

Save/Restore Utility

The Save/Restore Utility is provided to save keystroke recordings, screen profiles, or the presentation space from notepad sessions on diskette or fixed disk, and to retrieve saved data when requested by the user. The Save/Restore Utility operates in the DOS session.

Printer and Plotter Support

The 3270-PC Graphics Control Program supports printing to a printer attached to the 3270-PC/G or GX workstation and to a printer attached to the 3274 Control Unit (3287 and 3268 printers). Direct printing and creation of a spool file for later printing by a spool print utility are supported.

For a DOS session, the presentation space can be printed directly on a 5152, 5182, or 3852 printer attached to the 3270-PC/G or GX using the Print key on the workstation keyboard. Executing DOS application programs can print on DOS-supported printers attached to the workstation (including to 5152, 5182, 3852, 5201, 5216, and 5218 printers)

as usual. DOS-supported printer spooling cannot be used in a DOS session.

The entire alphameric content of the presentation space for a host-interactive session can be printed directly on a printer attached to the 3274 Control Unit, using the Print key.

A spool print facility is also supported. Print files are created on diskette or disk using the Print key while in workstation control mode. The print file is written in picture interchange format (PIF). A spool print utility operating in the DOS session is then used to print the PIF file on a 5152, 5182, or 3852 printer attached to the workstation. PIF files created using GDDM Release 4 and sent to the workstation can also be printed on the workstation printer using the print utility (and/or displayed on the screen).

PIF print files can be created by any type operating session (host-interactive, notepad, or DOS application that is using the graphics procedure interface). In addition, the current alphameric content of the display screen can be written to a PIF print file. A PIF file can be sent to the host processor for processing or processed by an application program in the DOS session, in addition to being printed using the spool print utility.

The 3270-PC Graphics Control Program also supports output to workstation-attached plotters. GDDM can create pictures for 737X plotters and send them to a 3270-PC/G or GX via a host-interactive session to be plotted directly to a 737X plotter attached to the workstation via the IEEE-488 adapter. A DOS session can pass data to a 737X plotter directly using the graphics procedure interface.

Alternatively, GDDM Graphics Data Format (GDF) support can be used in the host processor to create a GDF file that is converted to a PIF file and sent to the 3270-PC/G or GX and placed in a file. A plotter program operating in the DOS session can transmit the file data to a 737X that is attached to the Asynchronous Communications Adapter in the 5371 configuration.

The 3270-PC Color Graphics Applications licensed program (3270-PC/GGXA) operates in a DOS session with DOS Version 2.1 under control of the 3270-PC Graphics Control Program in a 3270-PC/G or GX workstation. It contains the 3270-PC Graphics Editor and the 3270-PC Picture Plotting components, which are interactive and designed for ease of use. This program will use the Math Co-processor Option if this feature is installed.

The 3270-PC Graphics Editor enables a user to create, modify, file, and retrieve pictures, such as flowcharts, foils, diagrams, and free-form sketches. It also provides the ability to display, edit, and file pictures generated by other programs that produce PIF files, such as GDDM Release 4. The 3270-PC Picture Plotting component enables the user to plot output from the 3270-PC Graphics Editor or other PIF files on a 737X plotter attached to the IEEE-488 adapter. PIF files can be sent to or received from GDDM Release 4 in a host processor.

The 3270-PC/GGXA program provides a ready-to-use application program that can be used to take advantage of the facilities provided by the 3270-PC/G and GX workstations to support a variety of graphics application, including, for example, foil creation.

File Transfer

The 3270-PC Graphics Control Program supports the transfer of files to and from a host System/370, 30XX, or 4300 processor operating under MVS/TSO, CICS/VS, or VM/SP Release 2.1 with a 3270-PC File Transfer Program (5665-311 for MVS/TSO, 5798-DHQ for CICS/VS, or 5664-281 for VM/SP). The files transferred can have ASCII, binary, or EBCDIC data format. The file transfer is done to or from a host-interactive session, in the 3270-PC/G or GX, which can operate concurrently with up to three other host-interactive sessions (in DFT mode) that are not performing file transfer. The file transfer commands are issued from the DOS session.

The file transfer facility permits programs, data, and procedures to be obtained from the host processor for use in a DOS session. Similarly, data processed in a DOS session in the 3270-PC/G or GX can be sent to the host processor for printing or distribution.

Online Tutorial

An online tutorial (HELPER) that operates under DOS 2.1 is provided on a diskette as part of the 3270-PC Graphics Control Program. It can be executed in the 3270-PC/G or GX or in another IBM personal computer that has a double-sided diskette drive. When used in the 3270-PC/G or GX, the tutorial executes in the DOS session and thus can be active during host-interactive sessions.

The tutorial is interactive and is designed for the novice and for the experienced user. Since the tutorial is modular, only the desired portions need be utilized.

15:55 IBM 3270-PC Graphics Control Program

Other aids to learning to use the 3270-PC/G or GX workstation include help panels that can be displayed by pressing the Help key and prompts and messages that are displayed when commands or information is typed in. Line 25 of the display provides operating and status information.

Installation

The 3270-PC Graphics Control Program to be used in a given 3270-PC/G or GX hardware configuration must be customized to support the control program functions to be used by the workstation and the characteristics of the 3274 Control Unit to which the workstation is attached. A menu-driven customization program that executes under DOS 2.1 control in the 3270-PC/G or GX (or in another IBM personal computer) is provided with the 3270-PC Graphics Control Program. The customization procedure uses the two diskettes on which the 3270-PC Graphics Control Program is provided and produces a customized system diskette for use in the 3270-PC/G or GX.

When the customized system diskette is in diskette drive A (the leftmost drive) or if the 3270-PC/G or GX Graphics Control Program is on fixed disk when the 3270-PC/G or GX is powered on, an automatic IPL of DOS and the 3270-PC Graphics Control Program occurs. The resident memory requirements for the customized 3270-PC Graphics Control Program vary, depending on the number of operating sessions, the mode (DFT or CUT) of operation, and other facilities used. See the introduction manual, GA33-3141, for estimating resident memory requirements.

Section 16: IBM Personal Computer AT



Announced August 14, 1984

16:05 IBM Personal Computer AT Configuration Overview

Introduction

The IBM Personal Computer AT (advanced technology) is a versatile, general-purpose system that supports a wide range of computing requirements. It offers faster processing speed, higher capacity and faster diskette and fixed disk drives, and more and faster random access memory than other IBM personal computers.

The IBM Personal Computer AT can execute most application programs under the IBM Personal Computer Disk Operating System Version 3.0 two to three times faster than, provide over twice the amount of online direct access storage as, and provide over 4.5 times the amount of random access memory as other IBM personal computers. It can also support multiple users accessing the system simultaneously.

The IBM Personal Computer AT can be used in home, education, or any business environment that can benefit from its high performance, large online direct access storage, large memory size, and/or multiuser capability.

An IBM Personal Computer AT 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 AT 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 available graphics hardware and programs support use of the IBM Personal Computer AT in business, engineering, and scientific applications, such as advanced text processing, presentation graphics,

computer-aided design, computer-aided engineering, laboratory automation, and numerical analysis.

The IBM Personal Computer AT can be interconnected via cable with other local IBM personal computers to form a clustered multiuser configuration. 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 AT 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 AT can communicate with remote IBM personal computer configurations directly via communications lines or via diskette interchange.

The IBM Personal Computer AT can be connected to various local and remote processors (System/370, 30XX, 4300, Series/1, 8100, System/34/36/38, for example) to be used as an intelligent workstation as well as a personal computer. 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 AT can be used as a videotex terminal.

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

urations as well as with other IBM personal computers.

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

Support of word processing functions for an IBM Personal Computer AT connected to an 8100 Information System is provided, as is communication between an IBM Personal Computer AT and a host VM/370 PROFS system. Other programming support (DisplayWrite Series) provides document processing capabilities for a stand-alone IBM Personal Computer AT similar to facilities provided for a Displaywriter system. Direct document exchange between IBM personal computers is also supported using Personal Services/PC.

The IBM Personal Computer AT is upward-compatible with other IBM personal computers. Thus, most application programs that execute under the Disk Operating System in another IBM personal computer configuration can also execute in an IBM Personal Computer AT.

The IBM Personal Computer AT/370 Option Kit can be installed in an IBM Personal Computer AT System Unit to convert it to an IBM Personal Computer AT/370 System Unit.

Physical Components

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

- 5170 System Unit/Keyboard Model 68 or 99
- 5151 Monochrome Display Model 1
- 5153 Color Display Model 1
- 5154 Enhanced Color Display Model 1
- 5175 Professional Graphics Display Model 1
- 5152 Graphics Printer Model 2
- 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 AT 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 AT configuration must include one 5170 System Unit/Keyboard and one display device. The minimum IBM Personal Computer AT configuration consists of the following:

- One 5170 System Unit/Keyboard Model 68, which has 256Kb of random access memory and one high-capacity 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)
 - 5154 Enhanced 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)

The price of a single minimum stand-alone IBM Personal Computer AT hardware configuration (5170 Model 68), assuming a 5151 Monochrome Display attached via the Monochrome Display and Printer Adapter, is \$4520. This configuration supports operation of the Disk Operating System (DOS).

Configuration Features

The following highlights the features of IBM Personal Computer AT configurations, including memory sizes, types and maximum number of attachable I/O devices, and the processors/units to which a 5170 can be connected:

- One 5170 Model 68 or 99 System Unit/Keyboard with the Intel 80286 16/24-bit microprocessor
- Two modes of operation – real address and protected virtual address
- Math Co-processor Option available to increase the speed and precision of arithmetic, logarithmic, and trigonometric functions for both modes
- Read only memory (ROM) of 64K (65,536) bytes

16:05 IBM Personal Computer AT Configuration Overview

- BASIC-80 Interpreter Version 3 in ROM (enhanced version of the widely used Microsoft BASIC – MBASIC – interpreter)
- Complementary Metal Oxide Semiconductor (CMOS) battery-backed random access memory to contain a realtime clock and configuration information
- Random access memory (RAM) for program use (operating system and application) of 256Kb (262,144 bytes) to 3Mb (3,145,728 bytes)
- One or two diskette drives. One or two 5¼-inch High Capacity Diskette Drives (1.2Mb each) or one High Capacity Diskette Drive and one 5¼ Double-Sided Diskette Drive (320/360Kb capacity) can be installed in a 5170 unit.
- One or two fixed disk drives of 20Mb (21,237,760 bytes) capacity each for a maximum capacity of 40Kb (42,475,520 bytes) of online fixed disk storage. A maximum of two diskette drives and one fixed disk drive or one diskette drive and two fixed disk drives can be installed in a 5170 unit.
- Up to 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 5170 to emulate the Tektronix™ 4010 and 4100 protocols and the Lear Siegler ADM3A terminal using an IBM d'splay and the Graphics Development ToolKit.
- One to five printers. One or two parallel printers and one or two serial printers can be connected via the Serial/Parallel Adapters. One parallel printer can be connected via the Monochrome Display and Printer Adapter.
- 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 the 3101 terminal
- Data security via the standard Keylock feature
- Field-upgrade to the IBM Personal Computer AT/370 via the IBM Personal Computer AT/370 Option Kit
- Connection to the following:
 - System/370, 30XX, 4300, and Series/1 processors using the Serial/Parallel Adapter (serial port), 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 Serial/Parallel Adapter (serial port), 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 5170 configuration.
 - A 4860 PCjr, a 5150 Personal Computer, a 5155 Portable Personal Computer, a 5160 Personal Computer XT or XT/370, another 5170 Personal Computer AT, a 5170 Personal Computer AT/370, a 3270 Personal Computer workstation, 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 a serial port of a Serial/Parallel Adapter
 - A videotex host via the serial port of a Serial/Parallel Adapter to use the 5170 as a videotex terminal
 - A remote VM/370 PROFS system via the serial port of a Serial/Parallel Adapter
 - DISOSS/370 in a host processor using the serial port of a Serial/Parallel Adapter
 - A local Displaywriter via cable attachment to the serial port of a Serial/Parallel Adapter. The IBM Personal Computer AT 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
 - 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) via 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) using 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 parallel port of a Serial/Parallel Adapter or via the Monochrome Display and Printer Adapter
- An IBM SELECTRIC® System/2000 Typewriter with the Printer Option installed via the parallel port of a Serial/Parallel Adapter or via the Monochrome Display and Printer Adapter
- 7371 or 7372 Color Plotter (desktop plotters) via a cable connected to the serial port of a Serial/Parallel Adapter or to the General Purpose Interface Bus Adapter. The IBM Personal Computer AT can be a stand-alone system or connected to a host System/370, 30XX, or 4300 processor.
- 7374 or 7375 Color Plotter when the IBM Personal Computer AT is connected to a host System/370, 30XX, or 4300 processor. Attachment of the plotter to the 5170 is via a cable connected to the serial port of a Serial/Parallel Adapter or to the 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
- Custom attachments using the Prototype Adapter
- Other host processors using appropriate software

Up to four communications adapters (of more than one type, if desired) can be installed in the same 5170 Personal Computer AT configuration. The limit for each type is two for the Serial/Parallel Adapter, one for the SDLC adapter, and two for the BSC adapter. When the SDLC adapter is installed, only one BSC adapter can be installed as well.

The IBM Personal Computer AT 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 the 4361 Processor

- System/36, System/38, or 5294 Remote Control Unit
- Loop Adapter of an 8100 Information System
- 5520 Administrative System

The IBM Cable Data Management System licensed program can be executed in a 5150, 5155, or 5160 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 IBM Personal Computer AT is supported by the following IBM-logo operating systems:

- IBM Personal Computer Disk Operating System (DOS) as of Version 3.0 (5170 operating in real address mode). One diskette drive is required. DOS Version 3.0 is required to support high-capacity (1.2 Mb) diskettes and the 20Mb fixed disk drive. Earlier DOS versions can be executed using the 5170 if necessary but will support only 160/180Kb and 320/360Kb diskettes and no fixed disk.
- IBM Personal Computer Interactive Executive (PC/IX) Version 1.1 (5170 operating in real address mode). One double-sided diskette drive and one fixed disk are required.
- IBM Personal Computer XENIX™ System (5170 operating in protected address mode). One high capacity diskette drive and one fixed disk drive are required.

Compatibility

Hardware

The 80286 microprocessor operating in real address mode in the 5170 is upward-compatible with the 8088 microprocessor. Thus, the 5170 Personal Computer AT is upward compatible with the 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT, 5160 Personal Computer XT/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. The 5170 Personal Computer AT is also compatible with the 5170 Personal Computer AT/370 operating in PC mode.

Diskettes (5¼-inch) with a 160/180Kb or 320/360Kb capacity used in 4860 PCjr, 5150 Per-

16:05 IBM Personal Computer AT Configuration Overview

sonal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT and XT/370, 5170 Personal Computer AT and AT/370, 3270 Personal Computer workstation, and 5531 Industrial Computer configurations can be read/written in a 5170 Personal Computer AT configuration using the High Capacity Diskette Drive or the Double-Sided Diskette Drive.

High capacity (1.2Mb) diskettes used in 5170 Personal Computer AT configurations can be read/written in a High Capacity Diskette Drive in a 5170 Personal Computer AT/370 but not in the diskette drives for other IBM personal computers. For additional diskette compatibility information, see "High Capacity Diskette Drive" in Section 16:10.

The 5170 Personal Computer AT does not provide a cassette adapter (as do the PCjr and 5150 Personal Computer) or support program cartridges (as does the PCjr).

Programming

Most programs that operate in a 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT or XT/370 (in PC mode), 3270 Personal Computer workstation, or 5531 Industrial Computer and that are not time-dependent can also operate in a 5170 Personal Computer AT configuration that contains the required random access memory, features, and I/O devices. Such programs use the standard interface (interrupts and function codes) to DOS and to the Basic Input/Output System (BIOS) in read only memory in IBM personal computers.

Programs that operate in a 5170 Personal Computer should also operate in a 5170 Personal Computer XT/370 operating in PC mode.

The publications *IBM Personal Computer Seminar Proceedings Volume 2, Number 4*, G320-9312, and *5170 Technical Reference* (1502243) contain details about the differences between a 5170 Personal Computer AT and other IBM personal computers that affect program compatibility.

Customer Responsibilities

The 5170 Personal Computer AT 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 5170 configuration (see "Physical Components" earlier in this subsection) except for the 5151 Monochrome Display, which receives power from the 5170 System Unit.

Data Security

The customer is responsible for providing any desired data security functions. The standard Keylock feature in the 5170 System Unit provides protection when the keylock is in the locked position. See description of this feature in Section 16:10 under "Keylock." The Data Encoder program (6024149) that performs encryption and decryption of data is available from IBM.

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 5170 Personal Computer AT IBM-logo units and features are purchase only and 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 Computer ATs 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

Warranty Period

The warranty period for the 5170 unit is one year and the warranty service is Customer Carry-In Repair. The warranty period for the following optional features for the 5170 is also one year: BSC adapter, Double-Sided Diskette Drive, High Capacity Diskette Drive, IBM Personal Computer AT/370 Option Kit, Math Co-processor Option, Serial/Parallel Adapter and its cables, SDLC adapter, all memory options, and the 20Mb Fixed Disk Drive. For the Prototype Adapter, the warranty period is one year or until modified, whichever is earlier, and for the Floor Standing Enclosure the warranty period is three months.

The warranty period for optional features for the 5170 that are also available for other IBM personal computer configurations is three months or one year, depending on the feature (see "Warranty Period" in Section 13:05 for features with a one-year warranty).

During the warranty period for the 5170 unit, warranty periods that are less than one year for optional features included in the original 5170 configuration will be extended to coincide with the expiration of the 5170 warranty.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Option. For the 5170, IBM On-Site Repair is available.
 - Annual Maintenance. For the 5170, 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

Publications

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

- *Installation and Setup* (1502491). This manual contains setup information, instructions for installing optional features, and instructions for executing the Setup program, which the customer must use to specify certain configuration

information before using the 5170 system the first time or after certain configuration changes are made

- *Guide to Operations* (1502241). This binder provides information about operating, testing, and moving the 5170 configuration. The diagnostics diskette and one diskette containing the system tutorial "Exploring the IBM Personal Computer AT" are included in this binder. The tutorial can be used with a monochrome or color display in the minimum 5170 configuration.
- *BASIC* (6361132). This binder describes the functions provided by the BASIC Interpreter Version 3 that is included in ROM in a 5170 System Unit.

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

- *IBM Personal Computer AT Technical Reference* (1502243) – \$30. This reference discusses the system board, Math Co-processor Option, power supply, keyboard, communications functions, and 5170 compatibility with other IBM personal computers. It also lists 80286 and 80287 instruction sets and Basic Input/Output System (BIOS) instructions.
- *IBM Personal Computer Options and Adapters Technical Reference* (6322509) – \$125. This multivolume reference describes displays, printers, diskette and disk drives, memory expansion, adapters, 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* (1502242) – \$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.

The following form-numbered items that contain hardware and programming information about the 5170 Personal Computer AT configuration are available:

- *IBM Personal Computer AT* (brochure), G520-5007
- *IBM Personal Computer AT* (flyer), G520-5008
- *IBM Personal Computer Seminar Proceedings, Volume 2, Number 4*, G320-9312

16:05 IBM Personal Computer AT Configuration Overview

- *IBM Personal Computers Hardware Facts*, G520-3916
- *IBM PC XENIX System* (brochure), G520-5022
- *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 selected operating systems, languages, and IBM-*logo* application programs. 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
- 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
 - *Graphical File System*, G520-5014
 - *VDI System Specification Sheet*, G520-5018
 - *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.

Additional publications regarding particular features are indicated in the feature descriptions in Section 16:10.

Self-Study Courses

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

16:10 IBM 5170 System Unit

The 5170 System Unit Model 68 for the IBM Personal Computer AT is shown in Figure 16-1.

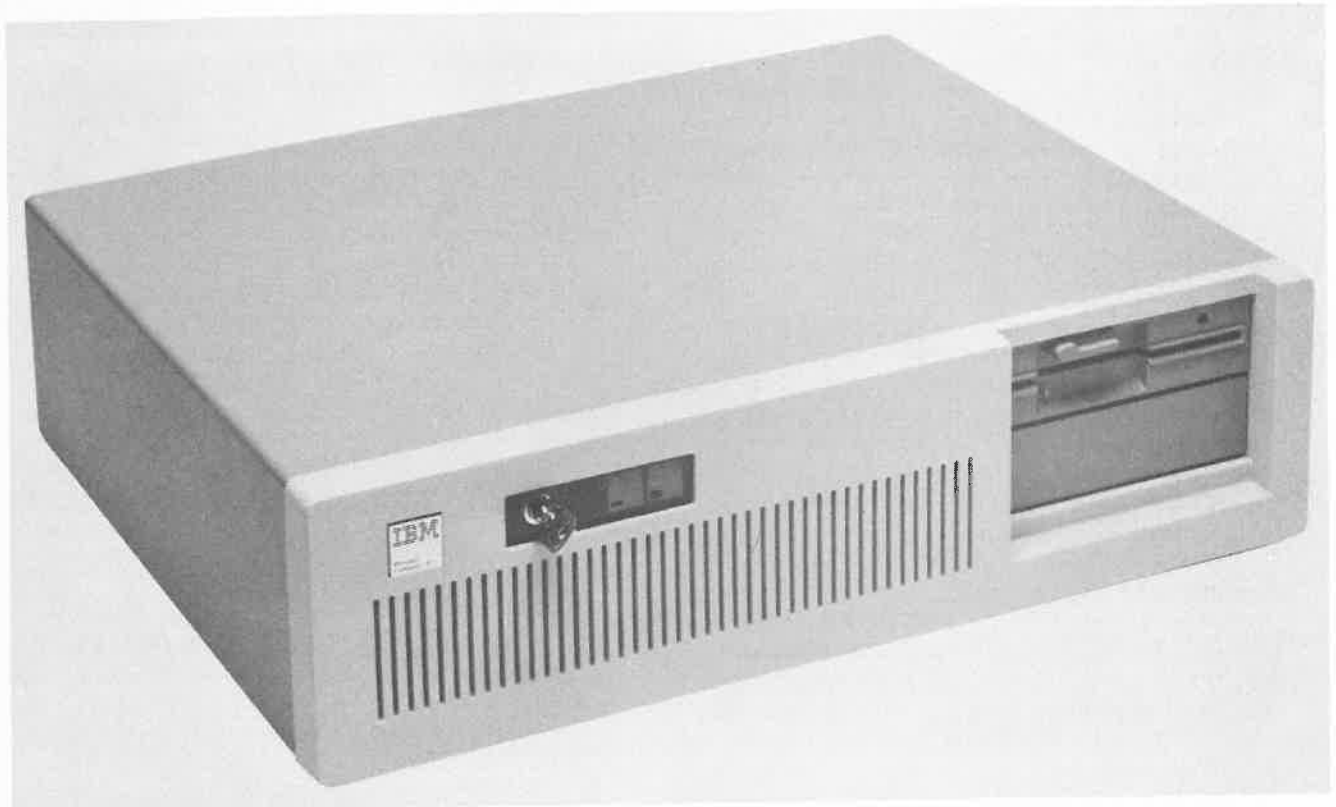


Figure 16-1. 5170 System Unit Model 99

Models Available

The two models of the 5170 that are available for an IBM Personal Computer AT configuration differ only in the standard features provided. Otherwise they are functionally and physically identical. The following 5170 models are provided:

- Model 68:
 - System Unit/Keyboard
 - 256Kb random access memory
 - Fixed Disk and Diskette Drive Adapter
 - One 5¼-Inch High Capacity Diskette Drive
- Model 99:
 - System Unit/Keyboard
 - 512Kb random access memory
 - Fixed Disk and Diskette Drive Adapter
 - One 5¼-Inch High Capacity Diskette Drive
 - One 20Mb Fixed Disk Drive
 - One Serial/Parallel Adapter

A 5170 System Unit Model 68 or 99 with the appropriate optional features installed can be upgraded to the 5170 System Unit for the IBM Personal Computer AT/370 configuration by installing the IBM Personal Computer AT/370 Option Kit.

Physical Characteristics

Dimensions (approximate)

- Height: 6.38 inches (162 mm)
- Width: 21.25 inches (540 mm)
- Depth: 17.28 inches (439 mm)

Weight

- Model 68: 37 lb (16.8 kg)
- Model 99: 42 lb (19.01 kg)

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 variable-speed, temperature-controlled fan inside the 5170 System Unit that significantly reduces acoustical noise in most environments
- Noise level: 42 decibels (dB) without printer
- Humidity:
 - 8% to 80% for system on
 - 20% to 80% for system off
- Electrical:
 - 90 to 137 volts AC, 50 to 60 Hz
 - 180 to 259 volts AC, 50 to 60 Hz

Standard Features

The following are standard features of 5170 Models 68 and 99. Each feature is discussed under "Standard Feature Descriptions" in this subsection.

- Microprocessor – Intel 80286
- Sixteen interrupt levels
- Direct memory access (DMA) – seven channels
- 64K bytes of read only memory (ROM)
- BASIC-80 Interpreter Version 3 in ROM
- Complementary Metal Oxide Semiconductor (CMOS) memory (64 bytes)
- Realtime clock in CMOS
- 256K (262,144) bytes of random access memory (RAM) for the Model 68 and 512K (524,288) bytes for the Model 99
- Eight system expansion slots to hold feature cards
- Programmable speaker
- One Fixed Disk and Diskette Drive Adapter
- One High Capacity Diskette Drive
- One 20Mb Fixed Disk Drive (Model 99 only)
- One Serial/Parallel Adapter (Model 99 only)
- Keylock feature
- Keyboard adapter and enhanced 84-key keyboard
- Automatic power-on self-test
- A 192-watt, worldwide, switchable power supply with cooling fan and green power-on indicator

Optional Features

The following are optional features of 5170 Models 68 and 99. Each is discussed under "Optional Feature Descriptions" in this subsection.

- Math Co-processor Option (one maximum)
- 256Kb Memory Module Kit (one maximum) – Model 68 only
- 128Kb Memory Expansion Option (one maximum) to expand random access memory to 640Kb maximum
- 512Kb Memory Expansion Option (five maximum and mutually exclusive with the 128Kb Memory Expansion Option) to expand random access memory to 3Mb maximum
- Game Control Adapter (one maximum)
- Prototype Adapter (five maximum)
- High Capacity Diskette Drive (1.2Mb) – one maximum
- Double-Sided Diskette Drive (320Kb or 360Kb capacity) – one maximum
- 20Mb Fixed Disk Drive (two maximum for the Model 68, one maximum for the Model 99)
- Monochrome Display and Printer Adapter (one maximum)
- Color/Graphics Monitor 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)
- Data Acquisition and Control Adapter (four maximum)
- Data Acquisition and Control Adapter Distribution Panel (one maximum)
- General Purpose Interface Bus Adapter (four maximum)
- Serial/Parallel Adapter (one maximum for the Model 99 and two maximum for the Model 68)
- Serial Adapter Cable (one for each Serial/Parallel Adapter)
- Serial Adapter Connector (one for each Serial/Parallel Adapter)
- Binary Synchronous Communications (BSC) Adapter (two maximum unless the SDLC Communications 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)
- Display Station Emulation Adapter (one maximum)
- Enhanced Display Station Emulation Adapter (one maximum)

- 8100 PC Adapter (one maximum and mutually exclusive with the SDLC adapter)
- Cluster Adapter (one maximum)
- Cluster Cable Kit (one for each IBM Personal Computer AT in the cluster after the first two systems)
- IBM PC Network Translator Unit, (one maximum per network), IBM PC Network Adapters (two maximum per 5170), 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)
- IBM Personal Computer AT/370 Option Kit and 3278/79 Emulation Adapter (one maximum each). The 3278/79 Emulation Adapter can be installed only with the option kit.
- Floor Standing Enclosure

The following features (with their feature codes indicated) and units for 5150, 5155, and 5160 System Units cannot be used in a 5170 configuration:

- Asynchronous Communications Adapter (2074)
- Binary Synchronous Communications Adapter (2075)
- Fixed Disk Drive Adapter (2501)
- Printer Adapter (5200)
- Prototype Card (1400)
- SDLC Communications Adapter (2090)
- 10Mb Fixed Disk Drive (2500)
- 5¼-Inch Diskette Drive Adapter (3780)
- 5¼-Inch Single-Sided Diskette Drive (3800)
- 5¼-Inch Double-Sided Diskette Drive (3810)
- 5161 Expansion Unit Model 1, 2, or 3
- 5181 Compact Printer
- 64Kb Memory Module Kit (1003)
- 64/256Kb Memory Expansion Option (1013)
- 83-key keyboard (1100)

All optional features are installed inside the 5170 System Unit except the Communications Adapter Cable, Cluster Cable Kit, Displaywriter/Personal Computer Attach Convenience Kit, MES 8569, 5178 IBM PC Network Translator Unit and Cabling components, Data Acquisition and Control Adapter Distribution Panel, Serial Adapter Cable, Serial Adapter Connector, and Floor Standing Enclosure.

Physical Components Included

Each 5170 Model 68 or 99 System Unit contains the system board, which uses very large scale integration (VLSI) technology, the programmable speaker, a battery, and the power supply and fan. Any diskette and fixed disk drives in the configuration are also housed in the 5170 System Unit.

Each 5170 Model 68 or 99 system board contains:

- Intel 80286 microprocessor
- System support functions:
 - Direct memory access (seven channels)
 - 16-level interrupt
 - System clock
 - Three programmable timers
- Read only memory (64K bytes)
- Random access memory (256Kb or 512Kb for the Model 68 and 512Kb for the Model 99)
- Complementary Metal Oxide Semiconductor (CMOS) memory (64 bytes)
- Realtime clock in CMOS
- Battery connector
- Keyboard controller
- Programmable speaker connector
- Eight system expansion slots that are used to hold feature cards
- Socket for the Math Co-processor Option module

The system board also contains one slide switch (to the right of the expansion slots) that must be set to indicate the display adapter(s) installed. The switch should be moved towards the front of the system unit when only the Color/Graphics Monitor Adapter is installed. For any other display adapter or a combination of display adapters, the slide switch should be moved towards the back of the system unit.

The 5170 system board does not contain DIP (dual inline package) switches that must be set by the user to provide hardware configuration data, such as are implemented on the system board for most other IBM personal computers. Instead, the Setup program is used to supply configuring information, which is maintained on CMOS random access memory, as discussed under "Complementary Metal Oxide Semiconductor RAM (CMOS)" later in this subsection.

Standard and optional feature cards plug into expansion slots provided in the left rear corner of the system board in the 5170 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

16:10 IBM 5170 System Unit

from the rear panel of the 5170 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).

A decorative rear panel is provided for every 5170 unit to improve the appearance of the unit when viewed from the rear.

Standard Feature Descriptions

Microprocessor

The instruction execution function in the 5170 System Unit is the Intel 80286 16/24-bit microprocessor with a 6-megahertz (MHz) clock speed and 167-nanosecond cycle time. It can execute instructions 25 percent faster than the 8088 microprocessor and address up to 1024 I/O devices.

The Intel 80286 microprocessor uses a 16-bit internal data path (as do the Intel 8088 and 8086 microprocessors) and a 16-bit path (external bus) between itself and other components (memory and I/O adapters), as does the 8086 microprocessor.

The 80286 microprocessor is more advanced than the 8088 or 8086 microprocessor (as well as faster) in that it supports two modes of operation: real address mode and protected virtual address mode. For real address mode, the 80286 uses 20 bits to address a maximum of 1024K (1,048,576) bytes of real memory, just like the 8088 in other IBM personal computers or the 8086 microprocessor.

For protected virtual address mode, the 80286 uses a 24-bit address to address up to 16M (16,777,216) bytes of real memory and supports multitasking. Multiple virtual memories of up to 1 gigabyte (1,073,741,842 bytes) each are supported using 32-bit pointers. Intertask communication, synchronization, and memory sharing, as well as task scheduling and task switching, are provided.

Four levels of memory protection are implemented for protected virtual address mode. They provide isolation of the system software from user applications, isolation of each user from all other users, checking of data types, and control of the use of privileged instructions.

Thus, the protected virtual address mode supports a virtual memory environment, a facility implemented in large and intermediate IBM processors (System/370, 30XX, and 4300).

The 80286 microprocessor is specifically designed to support a multitasking environment. Four independent units are implemented for instruction execution — instruction unit, execution unit, address unit, and bus unit — and they operate to minimize bus requirements and maximize microprocessor performance.

For both modes of microprocessor operation, the first 1024K bytes of address space is preassigned. The first 640Kb address range is allocated to address the first 640Kb of random access memory that can be installed in a 5170 configuration. The next 384Kb of address space is allocated to address read only memory on the system board and the read/write 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.

The 80286 microprocessor responds to requests for service from I/O components via interrupts presented by two interrupt controllers rather than polling to determine if a service is required. There are 16 prioritized levels of interrupt.

The 80286 microprocessor has a larger instruction set for real address mode than that implemented for the 8088 microprocessor and additional instructions are included to support protected virtual address mode. The instruction set is listed in the *5170 Technical Reference* (1502243). For real address mode, the following instructions are implemented in the 80286 but not the 8088:

- Integer Immediate Multiply
- Shift/Rotate by Immediate Count
- Push Immediate
- Push All and Pop All
- Input/Output Strings (I/O data transfer at microprocessor speed without DMA overhead)
- Enter and Leave (allocate/release stack bytes for a routine)
- Bound (verification that a value is within a set of limits)

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 80286 microprocessor. The Math Co-processor Option feature provides such instructions. Floating-point subroutines can be used to performed 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 5170 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. Two DMA controllers that provide four independent channels each are included on the system board. These controllers can operate simultaneously with the 80286 microprocessor to handle data transfer from one location in random access memory to another or between random access memory and I/O devices. Up to seven data transfers can operate at a time. One DMA channel is used to coordinate the activity of the two DMA controllers.

One DMA controller is used like the DMA controller in IBM personal computers with the 8088 microprocessor. It has four channels (0 through 3) and is used for 8-bit data transfers to/from 8-bit I/O adapters, 8-bit memory adapters, and 16-bit memory adapters. It can transfer up to 64Kb in one read/write operation. This DMA controller is used for I/O operations involving the 8-bit I/O adapters that can use DMA in a 5170 (those that are common to the 5170 and IBM personal computer configurations with the 8088 microprocessor).

The other DMA controller has channels 4 through 7 and provides data transfers at twice the speed of the first DMA controller. Channels 5 through 7 are used for 16-bit data transfers for 16-bit I/O and 16-bit memory adapters (Fixed Disk and Diskette Drive Adapter, Prototype Adapter, 128Kb Memory Expansion Option, and 512Kb Memory Expansion Option). It can transfer up to 128Kb in one read/write operation. Both DMA controllers in the 5170 have the addressing capability to access a random access memory of up to 16Mb in size.

Read Only Memory

The 5170 contains 64K bytes of read only memory (ROM) on the system board. The contents of ROM remain when power to the 5170 System Unit is turned off and writing to this memory cannot be done. ROM is used for the permanent residence of certain programs. It has an access time of 150 ns and a cycle time of 230 ns.

The standard ROM is addressed using the highest 64K addresses in the 1024Kb address space that is accessible to the 80286 microprocessor operating in real address mode. An additional 64Kb 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 5170 is turned on. The time required for the test varies, depending 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
- Setup program that the user executes to supply date and time and certain configuration information
- Basic Input/Output System (BIOS). This system provides basic input and output support (device level control) for the major I/O devices that attach to the 5170 (keyboard, display, printer, diskette, and fixed disk) and for cassettes and the serial port of the Serial/Parallel 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 defined program interrupts (interrupt instruction specifying the BIOS interrupt type) rather than by actual addresses. There are over 40 defined interrupts that permit the programmer 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 80286 microprocessor. BIOS uses a small portion of random access memory as a work area. A listing of BIOS instructions is con-

tained in the 5170 *Technical Reference* (1502243).

BOIS in the 5170 is not physically identical to BIOS in other IBM personal computers but maintains compatibility by using the same BIOS and DOS interrupt calls.

- Realtime clock support. Timer routines in ROM permit a program to obtain the current time of day.
- Dot patterns for 128 characters in graphics mode for displays
- A code to indicate this unit is a 5170. This code can be inspected by programming.
- BASIC-80 Interpreter Version 3 (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 the display, keyboard, and printer
 - Support of sequential cassette files
 - Support of the standard programmable speaker and optional light pen and joysticks

The BASIC interpreter in ROM of the 5170 System Unit 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 5170 has been turned on and the self-test diagnostics have been executed successfully, the system attempts to initial program load (IPL) an operating system from the first (A) diskette drive and then from the first fixed disk (C) drive (if present). The BASIC Interpreter is made ready and identified on the screen if an IPL has not occurred.

Complementary Metal Oxide Semiconductor (CMOS) RAM

The system board contains 64 bytes of CMOS random access memory that is backed up by a battery so that its contents remain when 5170 System Unit power is turned off. The battery is a 6-volt, long-life lithium battery that must be attached to the battery connector at the back of the system board when the 5170 system is installed.

The realtime clock is implemented in the first 14 bytes of this CMOS RAM, and system configuration information is maintained in the balance of CMOS memory. A Setup program is included in read only memory that is used to place the user-supplied required configuration information in CMOS.

During execution of the power-on self-tests, a determination is made as to whether the Setup program must be executed. If so, a run Setup program message is displayed on the screen. The Setup program must be used when the 5170 system is first installed, a new battery for the realtime clock is installed, or certain options are added or removed. The 5170 *Guide to Operations* explains how to use this program.

The following information must be supplied to the Setup program:

- Time and date
- Number and type of diskette drives installed
- Number and type of fixed disks installed
- RAM size, including whether the 128Kb Memory Expansion Option or one or more 512Kb Memory Expansion Options are installed
- Default line length (40 or 80 characters) if a color display is set as the primary display

The configuration information supplied is checked against the actual hardware installed to verify its accuracy. Other configuration information maintained on CMOS is whether the Math Co-processor Option is installed.

Realtime Clock

The realtime clock is implemented in the first 14 bytes of CMOS RAM. It is set during 5170 system installation using the Setup program and need not be modified thereafter unless a date or time change is required or the battery is replaced. The clock can be set to operate using Standard Time or Daylight Saving Time and 12- or 24-hour cycles, with a default of Standard Time and a 24-hour cycle.

Random Access Memory

Random access memory (RAM) is read/write program-addressable memory. In the 5170, RAM is dynamic memory (its contents must be refreshed periodically by a refresh controller) and its contents are lost when power to the 5170 is removed. This memory is parity-checked for validity. It has a 150-ns access time, a 275-ns cycle time, and a 16-bit data path. It is implemented in 128K-bit modules, each of which contains two 64K-bit memory chips.

The standard memory in the 5170 Model 68 (256Kb) can be expanded to 512Kb using the optional 256Kb Memory Module Kit. The 128Kb Memory Expansion Option can be installed in a 5170 Model 68 with 512Kb or in a 5170 Model 99 to provide 640Kb of memory. Alternatively, one to five 512Kb Memory Expansion Options can be installed to provide up to 3072Kb (3Mb) of memory, as described under "Optional Feature Descriptions" in this subsection.

System Expansion Slots

Eight system expansion slots (numbered 1 through 8) are standard on the system board to contain memory and adapter features. Slots 1 and 7 consist of one 62-pin socket each and support 8-bit transfer operations. These two slots are functionally equivalent to the full-feature slots in 5150, 5155, and 5160 System Units.

The other six slots each consist of one 62-pin connector and one 36-pin connector and support 16-bit transfer operations. Some 5170 features must be installed in the two-connector slots (128Kb Memory Expansion Option, 512Kb Memory Expansion Option, Prototype Adapter, and Fixed Disk and Diskette Drive Adapter, which support 16-bit data transfers). These features cannot be used in other IBM personal computers, except the IBM Personal Computer AT/370. Some features can be installed in any available slot and others must be installed in slot 1 or 7 in a 5170.

In 5170 Models 68 and 99, the standard Fixed Disk and Diskette Drive Adapter is installed in slot 8, while in the 5170 Model 99, the standard Serial/Parallel Adapter is installed in slot 7.

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

- 128Kb Memory Expansion Option (any slot 2 through 6)
- 512Kb Memory Expansion Option (any slot 2 through 6)
- Game Control Adapter (any slot)
- Prototype Adapter (any slot 2 through 6)
- Monochrome Display and Printer Adapter (any slot)
- Color/Graphics Monitor Adapter (slot 1 or 7)
- Enhanced Graphics Adapter (any slot)
- Professional Graphics Controller (any two adjacent slots)
- Data Acquisition and Control Adapter (any slot)
- General Purpose Interface Bus Adapter (any slot)
- Serial/Parallel Adapter (any slot)
- Binary Synchronous Communications Adapter (any slot)
- SDLC Communications Adapter (any slot)
- Display Station Emulation Adapter (any slot)
- Enhanced Display Station Emulation Adapter (any slot)
- 8100 PC Adapter (any slot)
- Cluster Adapter (any slot)
- IBM PC Network Adapter (any slot)
- IBM Personal Computer AT/370 Option Kit (slots 5 and 6 only) and 3278/79 Emulation Adapter (slot 4 only)

Programmable Speaker

A 2¼-inch diameter, 8-ohm audio speaker is included in the 5170 unit. It attaches to the speaker connector 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.

Fixed Disk and Diskette Drive Adapter

One Fixed Disk and Diskette Drive Adapter is standard in the 5170 Model 68 or 99 System Unit. This adapter is present in slot 8 and is the only Fixed Disk and Diskette Drive Adapter that can be installed in a 5170 configuration.

Up to three diskette drives and fixed disk drives can be attached to this adapter: two diskette drives and one fixed disk drive or one diskette drive and two fixed disk drives. The two diskette drives in a 5170 configuration can be two High Capacity Diskette Drives or one High Capacity Diskette Drive and one Double-Sided Diskette Drive.

The Fixed Disk and Diskette Drive Adapter supports direct memory access for diskette data transfer operations and permits concurrent data transfer operations on one diskette drive and one fixed disk drive.

16:10 IBM 5170 System Unit

A data transfer rate up to 2Mb/sec is supported. For fixed disks, the adapter supports automatic error detection and correction on up to five bits in a data field, using an ECC code, and internal diagnostics. DMA is not used for fixed disk data transfer. The I/O String Move instruction is used instead.

High Capacity Diskette Drive

One High Capacity Diskette Drive is standard in the 5170 Model 68 or 99 System Unit. This diskette drive is a half-height, 5¼-inch, double-sided diskette drive with a capacity of 1.2Mb (1,228,800 bytes) using the high capacity diskette. It is the topmost drive in the right side of the 5170 System Unit and is addressed as drive A.

The High Capacity Diskette Drive uses a different 5¼ diskette from that used in other IBM personal computer configurations (except the IBM Personal Computer AT/370) to achieve a 1.2Mb capacity. This diskette is the IBM 5.25 Diskette HC, double-sided, high capacity, 96-track-per-inch, soft-sectored diskette (part number 6109660 in the IBM System Supplies catalog). This high capacity diskette contains twice the number of tracks as the regular diskette and should not be used in a 5¼-inch single-sided or double-sided diskette drive in any other IBM personal computer configuration or in the optional Double-Sided Diskette Drive in the 5170.

The High Capacity Diskette Drive can also read from and write on both sides of a double-sided, double-density, soft-sectored 320/360Kb capacity 5¼-inch diskette created using DOS Version 1.1 or later or on one side of a single-sided, double-density, soft-sectored 160/180Kb capacity 5¼-inch diskette created using DOS Version 1.0 or later.

However, a single- or double-sided (160/180Kb or 320/360Kb) diskette that has been written on by a High Capacity Diskette Drive in a 5170 may not be readable by a single- or double-sided diskette drive in another IBM personal computer or in the Double-Sided Diskette Drive in the 5170. This diskette may be readable only by a High Capacity Diskette Drive. Therefore, the High Capacity Diskette Drive in the 5170 should be used only to read any single- or double-sided diskette that is also to be read/written using a 5¼-inch single- or double-sided diskette drive in another IBM personal computer (or the Double-Sided Diskette Drive in a 5170).

Single- and double-sided (160/180Kb or 320/360Kb) diskettes that are to be read and written by both the 5170 and another IBM personal computer should be read and written in the 5170

only by the optional Double-Sided Diskette Drive to preserve portability.

High Capacity Diskette Drive characteristics are:

- Number of rotations per minute: 360
- Average access time for high capacity diskettes: 91 ms
- Track-to-track access time: 3 milliseconds (ms)
- Data transfer rate: 500K bits (64,000 characters) per second for high capacity diskettes, 300K bits for 160/180Kb and 320/360Kb capacity diskettes
- Head settling time: 18 ms
- Height: 1.7 inches (42.9 mm)
- Width: 6.1 inches (153.3 mm)
- Depth: 8 inches (203.2 mm)
- Weight: 3.5 lb (1.6 kg)

High capacity diskette characteristics are:

- Track density: 96 tracks per inch
- Number of tracks: 80 per surface
- Number of surfaces: 2
- Number of bytes per sector: 512
- Number of sectors per track: 15
- Formatted capacity: 1.2Mb (can store approximately 600 8½ × 11-inch pages of double-spaced typed information)

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 operating system diskette) is permanently write-protected. A diskette-in-use indicator on the diskette drive is lit (red) whenever the drive is operating.

Customer cleaning of the heads in the diskette drives in a 5170 unit or of diskettes is not recommended.

20Mb Fixed Disk Drive

One 20Mb Fixed Disk Drive is standard in the 5170 Model 99 System Unit to provide 21,411,840 bytes of fixed disk storage, which is equivalent to about 17 high capacity (1.2Mb) diskettes or 56 double-sided diskettes at 360Kb each (or nearly 10,000 8½ × 11-inch double-spaced typed pages). The fixed disk drive is located in the middle of the 5170 unit to the left of the standard High Capacity Diskette Drive (behind the ventilation grille) and is addressed as drive C. It attaches to the standard Fixed Disk and Diskette Drive Adapter.

The 20Mb 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). A dedicated landing zone for the read/write heads is provided to protect the disk drive and its contents during shipping, moving, or storage of the 5170 unit. The read/write heads can be placed in this zone via programming (a procedure is provided on the diagnostics diskette).

The 20Mb Fixed Disk Drive has the following characteristics:

- 750 tracks per inch
- 512 bytes per sector
- 17 sectors per track
- 615 tracks per surface (2460 tracks)
- 4 surfaces
- 3573 rotations per minute
- 85 ms maximum access time
- 40 ms average access time
- 8.4 ms average rotational delay
- 2 ms track-to-track access
- 5M-bit per second data transfer rate
- Height: 3.25 inches (82.6 mm)
- Width: 6.1 inches (154.3 mm)
- Depth: 8 inches (203.2 mm)
- Weight: 6.4 lb (2.9 kg)

A disk-in-use indicator on the left of the 5170 from panel lights (red) whenever a fixed disk drive is operating.

Serial/Parallel Adapter

One Serial/Parallel Adapter is standard in a 5170 Model 99 System Unit. It occupies slot 7. This adapter provides one serial port and one parallel port. The serial port provides asynchronous (RS-232C) communications like the Asynchronous Communications Adapter for other IBM personal computers and can be addressed as communications port 1 or 2 (as defined by a jumper).

The parallel port provides an 8-bit parallel interface like that provided by the Printer Adapter for other IBM personal computers (which is not available for the 5170) and the printer adapter portion of the Monochrome Display and Printer Adapter (which is optional for the 5170). The parallel port can be addressed as 1 or 2 (as defined by a jumper).

Note that the current-loop interface that is provided via the Asynchronous Communications Adapter for other IBM personal computers is not provided by the serial port of the Serial/Parallel Adapter. Thus, the 5218 Print WheelPrinter cannot be attached to a 5170 configuration.

The serial port provides a path to a processor or an I/O device outside the 5170 unit. A processor or I/O device can be connected to this port 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 external modems or other devices to the serial port.

The Serial/Parallel Adapter provides a nine-pin D-shell connector that is defined as an RS-232C port. The optional Serial Adapter Connector (10 inches long) or Serial Adapter Cable (10 feet, or 3 meters long) can be connected to the serial port. The other end of each of these features has a 25-pin D-shell connector that provides all the signals of the standard Electronics Industry Association (EIA) RS-232C interface. The Serial Adapter Connector is designed primarily to be used to connect a non-communication type serial device that has its own cable.

Vendor-logo (Hayes Smartmodem™) external modems and modems that plug into an expansion slot can be purchased from IBM. The internal modem does not connect to the serial port in the 5170 (asynchronous communications function is included within the modem card).

When two Serial Parallel Adapters are installed in a 5170 unit, the two serial ports can operate concurrently. No other concurrent communications adapter operation is possible.

The parallel port is provided for the attachment of parallel printers, such as the 5152 Graphics Printer Model 2 (or compatible printers); 5182 Color Printer; 5201 QUIETWRITER® Printer; 5216 Wheelprinter Model 2; IBM SELECTRIC® System/2000 Typewriters; or IBM Electronic Typewriter 65, 85, or 95; or a device with TTL (transistor to transistor logic) levels. See Section 31 for the cable required for each type of printer that attaches to this adapter.

The serial port provides bit-by-bit transfer and 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,

16:10 IBM 5170 System Unit

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 5170 Model 68 or 99 configuration can be attached to the following using the serial port of a Serial/Parallel Adapter:

- System/370, 30XX, and 4300 processors
- 8100 Processors via the 7426 Terminal Interface Unit
- Series/1 processors
- 4860 PCjr's
- 5150 Personal Computers
- 5155 Portable Personal Computers
- 5160 Personal Computer XT's or XT/370's
- 5170 Personal Computer AT's or AT/370's
- 3270 Personal Computer workstations
- 5531 Industrial Computers
- Displaywriters
- 7371, 7372, 7374, and 7375 (Model 1 and 2) Color Plotters
- 5216 Wheelprinters Model 2
- Paper tape readers
- Communicating typewriters
- Laboratory instruments
- Voice recognition devices and electronic keyboards
- Mouse devices
- Other devices and processors that use the RS-232C interface

IBM-logo DOS application programs that support the serial port in the 5170 for communications functions include the following:

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

For a description of these programs, see Section 13:10 under "Asynchronous Communications Adapter."

Keylock

The standard keylock is provided for data security. It is present on the left front side of 5170 System Unit to the left of the power-on indicator. It is locked with a tubular key. When the keylock is in the locked position, the following actions are prevented:

- Removal of the system unit cover. This prevents removal of the fixed disk (and protects its data) and any feature card in the 5170 unit.
- Initialization of the system. If the keylock is locked when power is off, a user without the key can turn the power on (the power-on diagnostics will execute) but an automatic IPL will not occur and cannot be done by the user.
- Entering of any commands/data via the keyboard. All keystrokes are ignored. This feature allows a 5170 system to run unattended without the possibility of someone disturbing system operation (and inadvertently or deliberately destroying fixed disk and/or diskette files).

Keyboard

One 84-key keyboard is standard for a 5170 unit. It is the same physical keyboard that is provided for 5170 Personal Computer Computer AT/370 configurations but different from the keyboard for other IBM personal computer configurations. This 84-key keyboard cannot be attached to 5150, 5155, 5160, or 5531 System Units because of its bidirectional interface.

The keyboard attaches to a 5-pin connector in the back of the 5170 System Unit via a 10-foot (3-meter) 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: 1.5 inches (38 mm)
- Width: 18.4 inches (467.5 mm)
- Depth: 8.3 inches (210 mm)
- Weight: 6 lb (2.7 kg)

Highlights of the 84-key keyboard are as follows (same facilities as are provided for the 83-key keyboard for other IBM personal computers except for one additional key):

- 84 keys are provided in three major groups. There are ten programmable function keys on the left, a special 18-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 be programmed to provide the function specified on each key, if desired.

- The keyboard provides scan codes to the system unit instead of ASCII codes. A unique scan code is assigned to each key. A BIOS keyboard routine in ROM translates the scan code to a standard or extended ASCII code and presents it to the executing program. This approach permits the character or function of each key to be defined via programming. The scan codes for the 84-key keyboard for the 5170, 83-key keyboards for the 5150, 5160, 5155, and 5531, and the 62-key keyboard for the 4860 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 is entered using the numeric keypad keys.
- 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 function keys and provides space to note the use of each key, program name, program mode, and other information.
- 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 key-stroke 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 ref-

erence manual between the video display and keyboards.

The following are differences between the 84-key and 83-key keyboards:

- The three major groups of keys are divided by metal strips on the 84-key keyboard, as is done only for the function key group for the 83-key keyboard.
- The size of the enter key has been considerably enlarged and is now J-shaped (resembling the Return key on a typewriter). It is labeled as the Enter key.
- The width of the two shift keys, the insert (Ins) key, and the tab keys has been expanded.
- The backspace key is narrower and has been moved a little to the right. The Del key is also smaller.
- The space bar has extra space at each end to separate it from the Alt and Caps Lock keys to its left and right, respectively.
- The Prtsc and Esc keys are now located in the numeric/cursor control keypad on the right.
- The plus sign key is shorter.
- A new key (eighty-fourth) — SysReg — is included in the numeric/cursor control keypad to be used with multitasking operating systems.
- The tilde/grave key that was on the right above the shift key on the 83-key keyboard has been moved to the left above the tab key on the 84-key keyboard (where the Esc key is on the 83-key keyboard).
- The status of the Caps Lock, Num Lock, and Scroll Lock keys is indicated by three green LED indicators located above the number/cursor control keypad on the right of the keyboard.
- The backslash key has been moved from the left side of the keyboard (next to the shift key) to the left of the backspace key.

The 84-key keyboard is available in six different language layouts: U.S. English, U.K. English, French, German, Italian, and Spanish. The U.S. English keyboard layout (the only layout available in the U.S.A) is shown in Figure 16-2. The international-layout keyboards are supported by DOS.



Figure 16-2. U.S. English 84-key keyboard for the IBM Personal Computer AT

Power Supply

The power supply (192 watts) in the right rear area of the 5170 unit provides power (required voltages) to the system board, adapters, diskette and fixed disk drives, and the keyboard. The 5151 Monochrome Display has its own power supply and receives AC power from the power system in the 5170. If adequate power is not being received, a system shutdown occurs. Overvoltage and overcurrent protection are also provided via two fuses. Power to the 5170 is automatically removed if an overpower condition is detected.

Two input voltage supplies are provided: 110 AC and 220/240 AC for either 50 or 60 Hz. The desired voltage is selected using a switch above the power-cord plug at the rear of the power supply. A green indicator on the front panel of the 5170 unit (to the right of the keylock) is lit while power to the 5170 is on.

Optional Feature Descriptions

Math Co-processor Option

This option increases the speed and precision of arithmetic, logarithmic, and trigonometric functions. It provides an Intel 80287 coprocessor that performs floating-point arithmetic significantly faster than the floating-point subroutines that are executed by the 80286 microprocessor.

The 80287 coprocessor has its own instruction set, its own set of registers, and can operate in parallel with the 80286 microprocessor. Instruction operation codes are coded to identify them as coprocessor instructions. The 80287 instructions are listed in the *5170 Technical Reference* (1502243).

This option provides higher performance than, and is compatible with, the Math Co-processor Option for IBM personal computers that contain the 8088 microprocessor, which uses the 8087 coprocessor. A 5170 with this option installed fully conforms to the proposed IEEE 754 Floating-Point Standard.

Like the 80286 microprocessor, the 80287 coprocessor uses two operating modes: real address and protected virtual address. The default mode at power-on is real address, which is compatible with the mode of operation of the 8087 coprocessor. Protected virtual address mode can be set using an instruction.

This optional feature is supported by APL, the Macro Assembler Version 2.0, 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 numbers. The number ranges that can be represented are -32,768 to +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 80287 coprocessor module, which must be installed on the system board.

256Kb Memory Module Kit

This feature provides 256Kb of parity-checked random access memory via 18 small plug-in modules. Each module contains 128K bits. This memory has a 150-ns access time, a 275-ns cycle time, and a 16-bit data path. One 256Kb module kit can be installed on the 5170 Model 68 system board to provide 512Kb on the board. This kit cannot be installed in a 5170 Model 99 unit.

128Kb Memory Expansion Option

This option provides 128Kb of parity-checked random access memory on a circuit card that plugs into a two-connector expansion slot in the 5170 System Unit to provide 640Kb of memory in the configuration. This memory has a 150-ns access time, a 275-ns cycle time, and a 16-bit data path.

One 128Kb Memory Expansion Option can be installed in a 5170 Model 68 or 99. The system board in a 5170 Model 68 must have 512Kb of memory installed (using the 256Kb Memory Module Kit) before this feature can be added.

If more than 640Kb of memory is desired (up to 3Mb maximum), 512Kb Memory Expansion Option features must be installed instead of this feature.

512Kb Memory Expansion Option

This option provides 512Kb of parity-checked random access memory on a card. The memory has a 150-ns access time, a 275-ns cycle time, and a 16-bit data path. It requires a two-connector slot in the 5170 System Unit Model 68 or 99. The 5170 Model 68 must have 512Kb installed on the system board as a prerequisite (using the 256Kb Memory Module Kit).

Up to five 512Kb Memory Expansion Options can be installed in a 5170 Model 68 or 99 to provide up to 3Mb of memory in .5Mb increments. Each 512Kb option card has two sets of DIP (dual inline package) switches that must be set by the user to indicate the memory configuration (as described in the instructions supplied with the option). The 512Kb Memory Expansion Option cannot be installed with the 128Kb Memory Expansion Option.

Memory above 1024Kb is supported by DOS as of Version 3.0 for virtual diskettes and by the IBM Personal Computer XENIX™ Operating System.

Game Control Adapter

This feature permits up to two joysticks or up to four game paddles to be attached to the 5170 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.

16:10 IBM 5170 System Unit

Joysticks and game paddles for the 5170 Personal Computer AT can be ordered from *The IBM Personal Computer Catalog*, G570-2064. They are not supported by BASIC but not by DOS. (The IBM-logo joysticks that are available for the IBM PCjr do not attach to the 5170 configuration.)

The Game Control Adapter (one maximum) can be installed in any slot in the 5170 unit. The adapter provides a 15-pin D-shell connector at the back of the 5170 unit.

Prototype Adapter

This feature is provided as a base for building and testing custom attachments for the 5170 configuration. The Prototype Adapter is 13.22 inches (333.25 mm) long and 4.8 inches (121.9 mm) high. It plugs into any two-connector slot in the 5170 unit and has a 16-bit data path. Two card edge tabs, one 2 by 31 positions and one 2 by 18 positions, provide all system control signals and voltages. No components are shipped with this card.

The adapter contains a voltage bus (+5 Vdc) and a ground bus (0 Vdc). Each bus borders the adapter with the ground bus on the component side and the voltage bus on the pin side. A system interface (wiring only) is also provided with a space for a jumper to specify whether the device has an 8- or 16-bit data bus. This adapter also accommodates a D-shell connector containing 9 to 37 positions. Additional information is provided in *Options and Adapters Technical Reference Volume 2* (6322509).

A recommended system interface logic diagram is available along with a list of recommended components to be used to interface custom logic to the 5170. Up to five Prototype Adapters can be installed in a 5170 unit. Note that this adapter cannot be installed in other IBM personal computer configurations, for which the Prototype Card is available.

Double-Sided Diskette Drive

One Double-Sided Diskette Drive can be installed in a 5170 System Unit in addition to the standard High Capacity Diskette Drive. It attaches to the Fixed Disk and Diskette Drive Adapter. The Double-Sided Diskette Drive in the 5170 can be used to read and write 5¼-inch diskettes that are to be used in IBM personal computer configurations that do not have a High Capacity Diskette Drive.

This diskette drive can read and write single- (160/180Kb capacity) and double-sided (320/360Kb capacity) double-density, soft sectored

5¼-inch diskettes. This drive is required in the 5170 to maintain diskette portability only if writing is to be done to single- and/or double-sided diskettes that are also used in other IBM personal computer configurations. Such diskettes can be read only using the High Capacity Diskette Drive (see description of this drive earlier in this subsection).

The Double-Sided Diskette Drive is a half-height drive that is installed below the standard High Capacity Diskette Drive in the 5170 and is addressed as drive B. It is mutually exclusive with the second High Capacity Diskette Drive and second 20Mb Fixed Disk Drive.

Double-Sided Diskette Drive characteristics are:

- Number of rotations per minute: 300
- Average access time: 91 ms
- Track-to-track access time: 6 ms
- Data transfer rate: 250K bits (32,000 characters) per second
- Head settling time: 15 ms
- Height: 1.7 inches (42.9 mm)
- Width: 6.1 inches (154.3 mm)
- Depth: 8 inches (203.2 mm)
- Weight: 3.5 lb (1.6 kg)

Double-sided diskette characteristics are:

- Track density: 48 tracks per inch
- Number of tracks: 40
- Number of data surfaces: 2
- Number of bytes per sector: 512
- Number of sectors per track:
 - 8 as formatted by DOS Version 1.1
 - 9 as formatted by DOS Versions 2.0 and later
- Formatted capacity:
 - 320Kb (327,680 bytes) using DOS Version 1.1
 - 360Kb (368,640 bytes) using DOS Version 2.0 or later

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 drive is lit (red) whenever the drive is operating. A large asterisk below the in-use indicator identifies the diskette drive as a Double-Sided Disk Drive. The High Capacity Diskette Drive has no special marking.

Customer cleaning of the heads in a diskette drive in a 5170 unit or of diskettes is not recommended.

High Capacity Diskette Drive

One High Capacity Diskette Drive in addition to the standard High Capacity Diskette Drive can be installed in a 5170 Model 68 or 99 to provide an online diskette capacity of 2.4Mb. The two drives attach to the Fixed Disk and Diskette Drive Adapter.

The second High Capacity Diskette Drive has the same characteristics as the standard High Capacity Diskette Drive (see description earlier in this subsection).

The second High Capacity Diskette Drive is installed below the standard High Capacity Diskette Drive in the 5170 and addressed as drive B. It is mutually exclusive with the Double-Sided Diskette Drive and second 20Mb Fixed Disk Drive.

20Mb Fixed Disk Drive

One or two 20Mb Fixed Disk Drives can be installed in a 5170 Model 68 and one additional 20Mb Fixed Disk Drive can be installed in a 5170 Model 99 to provide a maximum of 40Mb of fixed disk storage in a 5170 configuration. Only one 20Mb Fixed Disk Drive can be installed in either 5170 model if two diskette drives are installed.

The first 20Mb Fixed Disk Drive in a 5170 configuration is always located in the middle of the 5170 unit to the left of the standard diskette drive. The second 20Mb Fixed Disk Drive is installed below the standard diskette drive and is addressed as drive D. The two fixed disk drives have the same characteristics (as discussed under "20Mb Fixed Disk Drive" earlier in this subsection).

Monochrome Display and Printer Adapter

This adapter provides for attachment to the 5170 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 Electronic 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) as does the parallel port of the Serial/Parallel Adapter. See Section 31 for the cable required for each type of printer that attaches to this adapter.

One Monochrome Display and Printer Adapter can be installed in a 5170 configuration and can use any available slot. This feature provides a 9-pin connector and a 25-pin connector at the rear of the 5170 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.

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. See description of this adapter in Section 13:10 under "Monochrome Display and Printer Adapter."

Color/Graphics Monitor Adapter

This adapter provides for the attachment of up to three color displays and one light pen to a 5170 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 phono 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 5153 Color Display or 5154 Enhanced Color Display, a black and white or color video monitor, and a black and white or color television set can be attached to this adapter.

One Color/Graphics Monitor Adapter can be installed in a 5170 Model 68 or 99 configuration and must be installed in slot 1 or 7 in the 5170 unit. Another display adapter can be installed together with the Color/Graphics Monitor Adapter: Monochrome Display and Printer Adapter, Enhanced Graphics Adapter, or Professional Graphics Controller.

See Section 13:10 under "Color/Graphics Monitor Adapter" for a description of this adapter.

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

The Enhanced Graphics Adapter provides a 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 the adapter in addition

16:10 IBM 5170 System Unit

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 5170 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.

One Enhanced Graphics Adapter can be installed in any available slot in the 5170 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.

For a description of these features, see Section 13:10 under "Enhanced Graphics Adapter, Graphics Memory Expansion Card, and Graphics Memory Module Kit."

Professional Graphics Controller

The Professional Graphics Controller is required to attach the 5175 Professional Graphics Display to a 5170 configuration. 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 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 5170 Personal Computer AT.

One Professional Graphics Controller can be installed in a 5170 configuration. It requires any two adjacent slots in the 5170 unit. This controller can be present in a 5170 configuration that has one other display adapter installed (Monochrome Display and Printer Adapter, Color/Graphics Monitor Adapter, or Enhanced Graphics Adapter).

For a description of this feature, see Section 13:10 under "Professional Graphics 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.

Up to four Data Acquisition and Control Adapters can be installed in a 5170 configuration in any available slots. 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 "Data Acquisition and Control Adapter and Data Acquisition and Control Adapter Distribution Panel" in Section 13:10.

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 5170 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 5170 configuration in any available slots. An adapter can have up to 14 devices or instruments attached with a maximum of 48 devices/instruments in one 5170 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.

Binary Synchronous Communications (BSC) Adapter

One or two BSC adapters can be installed in a 5170 configuration unless the SDLC adapter is present, in which case only one BSC adapter can be installed. Any available slot(s) in the 5170 unit can be used. An external modem must be cable-connected between the BSC adapter and a telephone line using the Communications Adapter Cable feature.

The BSC adapter for the 5170 is functionally compatible with the BSC adapter for other IBM personal computers (part number 1502075, feature code 2075), which cannot be installed in the 5170 unit. The BSC adapter for the 5170, however, can be installed in other IBM personal computers.

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 5170 configuration are the Binary Synchronous 3270 Emulation Program and the DisplayComm Binary Synchronous Communications Program. See Section 13:10 under "Binary Synchronous Communications (BSC) Adapter" for a description of these programs.

Synchronous Data Link Control (SDLC) Communications Adapter

One SDLC Communications Adapter can be installed in a 5170 configuration and only one BSC adapter can be present in the 5170 configuration when the SDLC adapter is installed. Any available slot in the 5170 can be used. An external modem must be cable-connected between the SDLC adapter and a telephone line using the Communications Adapter Cable feature.

The SDLC adapter for the 5170 is functionally compatible with the SDLC adapter for other IBM personal computers (part number 1502090, feature code 2090), which cannot be installed in the 5170 unit. The SDLC adapter for the 5170, however, can be installed in other IBM personal computers.

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.

The SDLC Communications Adapter, when used with the SNA 3270 Emulation and RJE Support Program, permits the 5170 to emulate 3270 interactive SNA operation or 3770 batch SNA (SNA 3770 RJE). The adapter provides the ability for a 5170 attached to a host system (System/370, 30XX, 4300, 8100, or Series/1) via communications lines to participate in a network using SDLC protocol. The 5170 operates and appears to the host as a 3278 Display Station Model 2 attached to a 3274 Model 51C or as a 3770. The adapter operates at up to 4800 bps with this program.

The Remote 5250 Emulation Program supports a 5170 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 5170 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"

16:10 IBM 5170 System Unit

later in this subsection for the facilities provided by the Remote 5250 Emulation Program.

Communications Adapter Cable

The Communications Adapter Cable feature supports the attachment of a modem to the BSC adapter or SDLC adapter card connector at the rear of the 5170. 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 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 5170 configuration. Any available slot in the 5170 System Unit can be used.

This adapter in a 5170 configuration is supported by the 5520/Personal Computer Attachment Program Version 3 to permit 5170 systems to communicate with a 5520 Administrative System. For a discussion of this adapter and its 5520 programming support, see Section 13:10 under "Display Station Emulation Adapter."

Enhanced Display Station Emulation Adapter

This adapter permits a 5170 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 5170 can emulate a 5291 or 5292 display and a 5256 or 5219 printer. The 5170 can also operate as a 5170 Personal Computer AT. Access to the 5170 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 the System/36 and System/38 Transfer Facility PRPQs, the System/34, System/36, and System/38 File Support Utility PRPQs, the PC Support/36 program, and the Attachment/36 program, all of which are supported by the 5250 Emulation Program (see discussion of these programs under "Display Station Emulation Adapter" in Section 13:10).

The Enhanced 5250 Emulation Installation Convenience Kit provides all the parts, software, and manuals required to connect the 5170 to a System/34, System/36, or System/38 and perform 5250 emulation.

8100 PC Adapter

One 8100 PC Adapter can be installed in a 5170 Model 68 or 99 configuration (any available slot) to connect the 5170 to an available station address on a local or remote RLOOP in an 8100 Information System configuration. Remote attachment of the 5170 requires a 3843 Loop Control Unit.

For a description of the 8100 PC Adapter and its programming support, see Section 13:10 under "8100 PC Adapter." DPCX/DOSF Release 5 is required to support the 5170.

Cluster Adapter and Cluster Cable Kit

The Cluster Adapter installed in a 5170 Personal Computer AT 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 5170, 5150, 5155, 5160, and 5531 system in the clustered configuration must have the Cluster Adapter feature installed. One Cluster Adapter can be installed in a 5170 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. 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.

For a description of the clustered configuration and its programming support, see Section 13:10 under "Cluster Adapter and Cluster Cable Kit."

IBM PC Network

The 5170 Personal Computer AT can be included in an IBM PC Network, which is a low-cost broadband local area network that allows peer-to-peer communication among IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XTs and XT/370s, and IBM Personal Computer ATs and AT/370s in a shared resource environment. The IBM personal computers in the network are connected using the 5178 IBM PC Network Translator Unit, IBM PC Network Adapter, and IBM PC Network Cabling Component features. Two IBM PC Network Adapters can be installed in a 5170 unit.

A 5170 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

For a discussion of this network, and its programming support see Section 13:10 under "IBM PC Network."

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 5170 System Unit via the serial port of a Serial/Parallel Adapter in the 5170. The Compact Printer Connector Adapter must be installed in the 5170 also. The 5170 can be a stand-alone system or part of an IBM computer cluster. When the 5170 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.

See Section 13:10 under "Displaywriter/Personal Computer Attach Convenience Kit" for the components of this kit and its programming support.

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 5170 Personal Computer AT 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 parallel port of the Serial/Parallel Adapter or to the Monochrome Display and Printer Adapter in the 5170) and permits the typewriter to be used as a letter-quality printer for the 5170 Personal Computer AT.

This attachment does not permit direct keyboarding from the typewriter to the 5170. 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 5170, 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 can handle paper up to 19.1 inches in width. A U.S. ASCII or U.S. Correspondence type element is supported for the typewriter.

MES 8569 for the 5170 provides the IPL/Diagnostic Diskette and a diagnostic tool. The diskette contains the program that operates in the 5170 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 diagnostics tool is an adapter plug that aids problem isolation when the diagnostic program is executed.

IBM Personal Computer AT/370 Option Kit

The IBM Personal Computer AT/370 Option Kit can be purchased to upgrade an IBM Personal Computer AT to an IBM Personal Computer AT/370. The 5170 System Unit must have 512Kb of memory installed on the system board and two available slots. The Virtual Machine/Personal Computer (VM/PC) Release 1.1 program operating under DOS Version 3.0 or later supports the IBM Personal Computer AT/370 configuration.

16:10 IBM 5170 System Unit

The option kit provides the following:

- A set of two cards (PC/370-P2 and PC/370-M2) and two card support brackets. These cards require two-connector slots and should be installed in slots 6 and 5, respectively, on the 5170 system board.
- A logo kit to change the nameplate on the 5170 System Unit to "IBM Personal Computer AT/370"
- A cable to connect the two provided cards
- Installation instructions
- The *Guide to Operations* for the IBM Personal Computer AT/370

Optionally, the 3278/79 Emulation Adapter can be installed in a 5170 unit (slot 4) with the option kit to permit emulation of a 3278 Display Station Model 2 or 3279 Color Display Station Model 2A or S2A. Note that the 3278/79 Emulation Adapter cannot be installed in a 5170 unit unless the IBM Personal Computer AT/370 Option Kit is installed as well.

When the 3278/3279 Emulation Adapter is present, the 5170 can be connected to one of the following via a customer-supplied coaxial cable:

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

Connection to one of the above via the IBM Cabling System is also supported.

An addendum to the 5170 *Technical Reference* manual describing the 3278/79 Emulation Adapter (part number 632236) is available at a price of \$16. An addendum to the *Hardware Maintenance and Service* manual for the 3278/79 Emulation Adapter (part number 6322980) is also available at a price of \$22.

When the IBM Personal Computer AT/370 Option Kit is installed in a 5170 Model 68 or 99 System Unit, the configuration becomes an IBM Personal Computer AT/370 configuration and operates as such. See Section 17 for a description of the IBM Personal Computer AT/370 hardware and Section 14:20 for its programming support (VM/PC).

Floor Standing Enclosure

The Floor Standing Enclosure provides a floor stand that the 5170 System Unit can be placed in vertically to reduce the area occupied by the unit and to place the 5170 to the left, to the right, or below the workspace containing the keyboard, display, and other units.

The cover of the 5170 unit must be removed and two guide rails must be attached to it before the 5170 unit is placed in the floor stand. The 5170 stands on its left side so that the power-on switch at the back right side of the unit is accessible at the top of the floor stand.

Before placing the 5170 System Unit in the floor stand, all options that reside in the 5170 unit must be installed and all cable connections to the 5170 unit must be removed. Because of the length of the signal cable for the Monochrome Display, the Monochrome Display and Printer Adapter (when installed) should be put in slot 7 on the system board when the 5170 is to be placed in the floor stand. In addition, if the 5170 contains a fixed disk, the heads should be placed in the landing zone to prevent data loss using the "Prepare System for Moving" procedure contained on the diagnostics diskette. The fixed disk contents should be loaded to diskette (backed up) as well.

The floor stand has the following physical characteristics:

- Height: 24 inches (610 mm)
- Length: 16.4 inches (416 mm)
- Width:
 - Unit: 7.8 inches (197 mm)
 - Base: 12.7 inches (322 mm)
- Weight: 13 lb (5.9 kg)

Single Unit Prices

Item	Part Number	Feature Code	Single Unit Purchase Price (\$)
5170 System Unit/Keyboard			
Model 68	5170068	—	3995
Model 99	5170099	—	5795
Binary Synchronous Communications Adapter	1501204	1204	240
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
Double-Sided Diskette Drive	6450207	0207	425
Enhanced Display Station Emulation Adapter	6403690	2879	680
Enhanced Graphics Adapter	1501200	1200	524
Enhanced 5250 Emulation Installation Convenience Kit	6403692	2880	995
Floor Standing Enclosure	6450218	0218	165
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	1510201	1201	199
Graphics Memory Module Kit	1501203	1203	259
High Capacity Diskette Drive	6450206	0206	650
IBM Personal Computer AT/370 Option Kit	—	6115	3095
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
Math Co-processor Option	6450211	0211	375
Monochrome Display and Printer Adapter	1504900	4900	250
Professional Graphics Controller	6451501	1501	2995
Prototype Adapter	6450220	0220	35
Serial Adapter Cable	6450217	0217	65
Serial Adapter Connector	6450242	0242	35
Serial/Parallel Adapter	6450215	0215	150
Synchronous Data Link Control (SDLC) Communications Adapter	1501205	1205	240
128Kb Memory Expansion Option	6450209	0209	350
20Mb Fixed Disk Drive	6450205	0205	1595
256Kb Memory Module Kit	6450202	0202	495
3278/79 Emulation Adapter (requires IBM Personal Computer AT/370 Option Kit)	1602507	2507	905

16:10 IBM 5170 System Unit

Item	Part Number	Feature Code	Single Unit Purchase Price (\$)
512Kb Memory Expansion Option	6450203	0203	1125
5178 PC Network Translator Unit	5178001	—	595
Transformer unit for IBM 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
5253 Emulation Installation Convenience Kit Version 3	6403724	2896	1113
8100 PC Adapter	6113477	—	1275

Discounts Available

The 5170 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.

Section 17: IBM Personal Computer AT/370



Announced October 25, 1984

17:05 IBM Personal Computer AT/370 Configuration Overview

Introduction

The IBM Personal Computer AT/370 (PC AT/370) is an extended version of the IBM Personal Computer AT that can execute most System/370 instructions as well as the IBM Personal Computer AT (Intel 80826) instruction set. It is a desktop System/370 intelligent workstation that can be connected to and interact with a variety of host processors. As a System/370 workstation, the PC AT/370 configuration provides compatibility with System/370 architecture host processors, and PC AT/370 programming support provides a terminal environment familiar to VM/CMS users.

The PC AT/370 can operate in Personal Computer (PC) mode or in Virtual Machine/Personal Computer (VM/PC) mode (one mode at a time). When PC mode is in effect, the PC AT/370 operates as an IBM Personal Computer AT and the operating systems and most application programs that are available for the IBM Personal Computer AT can be executed. When it is operating in VM/PC mode, the PC AT/370 is supported by the Virtual Machine/Personal Computer (VM/PC) licensed program operating under the IBM Personal Computer Disk Operating System (DOS). VM/PC is functionally similar to Virtual Machine/System Product (VM/SP).

VM/PC supports three major facilities for a PC AT/370: local VM/CMS operation, remote 3278 or 3279 emulation, and remote 3101 emulation. All three facilities (called sessions) can be in effect concurrently and the operator determines which is the currently active session (the one with which operator interaction can occur using the keyboard).

Local VM/CMS operation permits the PC AT/370 to operate in stand-alone mode (without communication with a host processor) as a CMS virtual machine to execute most VM/CMS programs. This facility can be used for program development and program execution.

Remote 3278/3279 emulation permits the PC AT/370 to emulate a remote 3278 Display Station Model 2 or 3279 Color Display Station Model 2A or S2A for communication as a nonintelligent terminal with a host processor to which a 3278 or 3279 can be attached, respectively.

The remote 327X emulation facility, for example, permits a user to log on to a VM/370 system using the PC AT/370 as the virtual operator's console and

to execute programs in a virtual machine supported by the host VM/370 system.

Access to VM/370 host processor resources for use in a PC AT/370 local CMS virtual machine is also supported using remote 327X emulation when the Remote Server Program (VMPCSERV) that is part of VM/PC executes in the VM/370 host processor virtual machine. The exchange of programs and data between the PC AT/370 local CMS virtual machine and a VM/370 host processor executing VMPCSERV is supported.

The TSO Host Server program offering (TSOSERV) provides facilities similar to those provided by VMPCSERV for communication with a remote host MVS/370 or MVS/XA processor via an SNA or BSC network using ACF/VTAM. When TSOSERV is used in the host processor, VM/PC remote 327X emulation support permits a user to access MVS host processor resources for use in the PC AT/370 local CMS virtual machine, to exchange data files between the PC AT/370 and the MVS host processor, and to issue certain TSO commands from the PC AT/370 CMS virtual machine for execution in the MVS host processor.

Using the 3101 Emulation Program as an application program with VM/PC, the PC AT/370 can emulate a remote 3101 Display Terminal Model 20 for communication with a host processor to which a 3101 can be attached. All the facilities supported by the 3101 Emulation Program are available to the PC AT/370 user. VM/PC functions are discussed in Section 14:20.

The PC AT/370 configuration is designed for data processing, engineering/scientific, and business professionals. It permits them to interact with a host processor to develop programs (using VM/CMS and/or MVS/TSO, for example), interactively develop and/or execute VM/CMS programs in the PC AT/370, and develop and/or execute IBM personal computer programs at their own workstation. Access to a host processor to download and upload programs and data is also supported.

The PC AT/370 configuration can particularly benefit VM/370 and/or combined VM/370-MVS installations with a heavy CMS workload or a backlog of work at the host processor. It permits applications to be offloaded from the host processor to PC AT/370 workstations, thereby lessening host processor hardware resource constraints and moving the offloaded applications closer to the end-user.

Improved productivity for the end-user can result from consistent response times, user control of the computing resources, and increased availability of computer resources. In addition, since data can be kept in the PC AT/370, better security can be maintained for sensitive data.

The PC AT/370 can be installed without connection to a host processor to operate as a desktop System/370 VM/CMS processor. The PC AT/370 configuration is compact and suitable for home as well as office environments.

Physical Components

The following IBM-logo personal computer units can be included in a PC AT/370 configuration supported by VM/PC as of Release 1.1:

- 5170 System Unit/Keyboard Model 599
- 5151 Monochrome Display Model 1
- 5153 Color Display Model 1
- 5154 Enhanced Color Display Model 1
- 5175 Professional Graphics Display Model 1
- 5152 Graphics Printer Model 2
- 5182 Color Printer Model 1

The PC AT/370 can also be connected to various processors and other I/O devices for operation under DOS without VM/PC or under another operating system.

Minimum Configuration

Every PC AT/370 configuration that is to use the VM/PC program must contain a system unit/keyboard, one display device, one diskette drive, and one fixed disk drive.

The minimum PC AT/370 configuration for operation with the VM/PC program consists of the following:

- One 5170 System Unit/Keyboard Model 599 (which contains a diskette drive, a fixed disk drive, and the 3278/79 Emulation Adapter)
- 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)
 - 5154 Enhanced Color Display (Color/Graphics Monitor Adapter or Enhanced Graphics Adapter required)

- 5175 Professional Graphics Display (Professional Graphics Controller required)
- Customer-supplied direct-drive or composite video color or black and white video monitor (Color/Graphics Monitor Adapter required)

The price of a single minimum PC AT/370 Model 599 hardware configuration for use with VM/PC, assuming a 5151 Monochrome Display attached to the Monochrome Display and Printer Adapter, is \$10,320. Adding the price of the Disk Operating System Version 3.0 and VM/PC Release 1.1 to the hardware cost gives a single minimum PC AT/370 workstation cost of \$11,535.

If a PC AT/370 configuration without 327X emulation is desired, a 5170 Personal Computer AT (5170 Model 99) with the IBM Personal Computer AT/370 Option Kit, which does not include the 3278/79 Emulation Adapter, should be ordered.

Configuration Features

The following highlights the features of PC AT/370 configurations, including memory sizes, types and number of attachable I/O devices, and the processors/units to which a PC AT/370 can be connected. Items identified by an asterisk (*) are not supported by the VM/PC program and can be used only during PC mode of operation.

- One 5170 System Unit/Keyboard Model 599 with the Intel 80286 microprocessor and additional cards that permit System/370 instructions to be executed, provide additional random access memory, and provide 3278/3279 emulation
- Math Co-processor Option to increase the speed and precision of arithmetic, logarithmic, and trigonometric functions*
- Read only memory (ROM) of 64K (65,536) bytes
- BASIC-80 Interpreter Version 3 in ROM (enhanced version of the widely used Microsoft BASIC – MBASIC – interpreter)*
- Complementary Metal Oxide Semiconductor (CMOS) battery-backed random access memory to contain a realtime clock and configuration information
- Random access memory (RAM) for program use of 480K bytes for VM/PC mode operations and of 640K bytes for PC mode operations
- One or two diskette drives. One or two 5¼-inch High Capacity Diskette Drives (1.2Mb each) or one High Capacity Diskette Drive and one 5¼-Double-Sided Diskette Drive (320/360 Kb) can be installed in a 5170 unit.

17:05 IBM Personal Computer AT/370 Configuration Overview

- One or two fixed disk drives of 20Mb (21,237,760 bytes) capacity each for a maximum capacity of 40Mb (42,475,520 bytes) of online fixed disk storage. A maximum of two diskette drives and one fixed disk drive or one diskette drive and two fixed disk drives can be installed in a 5170 unit.
- Up to two or four displays, depending on the display adapter installed
- One to five printers. One or two parallel printers and one or two serial printers can be connected via the Serial/Parallel Adapters. One parallel printer can be connected via the Monochrome Display and Printer Adapter.
- One 5175 Professional Graphics Display via the Professional Graphics Controller to provide advanced graphics application support in PC mode. 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 PC AT/370 to emulate the Tektronix™ 4010 and 4100 protocols and the Lear Siegler ADM3A terminal using an IBM display and the Graphics Development ToolKit.*
- Programmable speaker*
- Connection to a 3274 Control Unit, 4321/4331/4361 Display/Printer Adapter, 4361 Workstation Adapter, or Device Cluster Adapter in a 4701 Finance Communication Controller via coaxial cable for communication with a local or remote host processor using VM/PC and remote 3278 or 3279 emulation
- Data security via the standard Keylock feature
- Connection to the following via the serial port of a Serial/Parallel Adapter:
 - A remote host processor (System/370, 30XX, 4300, 8100, Series/1, for example) to perform 3101 emulation for VM/PC mode or PC mode operations
 - 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT or XT/370, 5170 Personal Computer AT, another 5170 Personal Computer AT/370, 3270 Personal Computer workstation, or 5531 Industrial Computer*
 - 7371 or 7372 Color Plotter (desktop plotters) via cable connection to the serial port of a Serial/Parallel Adapter or to the General Purpose Interface Bus Adapter. The PC AT/370 can be a stand-alone system or connected to a host System/370, 30XX, or 4300 processor.*
 - 7374 or 7375 Color Plotter when the PC AT/370 is connected to a host System/370, 30XX, or 4300 processor. Attachment of the plotter to the 5170 is via a cable connected to the serial port of a Serial/Parallel Adapter or to the General Purpose Interface Bus Adapter.*
- A paper tape reader, a communicating typewriter, a laboratory instrument, a letter-quality printer, or other machines that use the RS-232C interface*
- Binary Synchronous Communications Adapter for connection to a System/370, 30XX, 4300, or Series/1 processor*
- Synchronous Data Link Control (SDLC) Communications Adapter for connection to a System/370, 30XX, 4300, 8100, or Series/1 processor*
- Connection to the following:
 - 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) via 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) using the IBM PC Network Translator Unit, IBM PC Network Adapters, and IBM PC Network Cabling Components to form an IBM PC Network*
 - 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*
 - Custom attachments via the Prototype Adapter*

Up to three communications adapters (of more than one type, if desired) can be installed in the same PC AT/370 configuration. The limit for each type is two for the Serial/Parallel Adapter, two for the BSC adapter, and one for the SDLC adapter. When the SDLC adapter is installed, only one BSC adapter can be installed as well.

If desired, the PC AT/370 can be connected to the IBM Cabling System for attachment to the 3274 Control Unit, 4321/4331/4361 Display/Printer Adapter, 4701 Device Cluster Adapter, or 5520 Administrative System.

Operating Systems Supporting

When operating in VM/PC mode, the PC AT/370 is supported by Virtual Machine/Personal Computer (VM/PC) Version 1.1, which is a licensed program that must operate under DOS Version 3.0 or later (or equivalent) in a PC AT/370 configuration.

When operating in PC mode, the PC AT/370 is supported by the IBM Personal Computer Disk Operating System (DOS) Version 3.0 or later (or equivalent), IBM Personal Computer Interactive Executive (PC/IX), and IBM Personal Computer XENIX™ System. For PC mode, application programs that execute in the IBM Personal Computer AT under DOS Version 3.0 or later can execute in a PC AT/370 configuration that has the required hardware resources.

Compatibility

Hardware

The 80286 microprocessor operating in real address mode in the 5170 is upward compatible with the 8088 microprocessor. Thus, the 5170 Personal Computer AT/370 operating in real address mode of PC mode is upward-compatible with the 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT and XT/370, 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. The PC AT/3270 is also compatible with the 5170 Personal Computer AT for PC mode operations.

The 5170 PC AT/370 operating in VM/PC mode is upward compatible with the 5160 Personal Computer XT/370 configuration.

Diskettes (5¼-inch) with a 160/180Kb or 320/360Kb capacity used in 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT and XT/370, 5170 Personal Computer AT and AT/370, 3270 Personal Computer workstation, and 5531 Industrial Computer configurations can be read/written in a 5170 Personal Computer AT/370 configuration using the High Capacity Diskette Drive or Double-Sided Diskette Drive.

High capacity (1.2Mb) diskettes used in 5170 Personal Computer AT configurations can be read/written in a High Capacity Diskette Drive in a 5170 Personal Computer AT/370. For additional

diskette compatibility information, see "High Capacity Diskette Drive" in Section 16:10.

The 5170 Personal Computer AT/370 does not provide a cassette adapter (as do the PCjr and 5150 Personal Computer) or support program cartridges (as does the PCjr).

Programming

Most programs that operate in a 4860 PCjr, 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT or XT/370 (in PC mode), 3270 Personal Computer workstation, or 5531 Industrial Computer and that are not time-dependent can also operate in real address mode in a 5170 Personal Computer AT/370 configuration that contains the required random access memory, features, and I/O devices. Such programs use the standard interface (interrupts and function codes) to DOS and to the Basic Input/Output System (BIOS) in read only memory in IBM personal computers.

The publications *IBM Personal Computer Seminar Proceedings Volume 2, Number 4, G320-9312*, and *Technical Reference* for the IBM Personal Computer AT (1502243) contain details about the differences between a 5170 Personal Computer AT or AT/370 and other IBM personal computers that affect program compatibility.

Customer Responsibilities

The 5170 Personal Computer AT/370 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 PC AT/370 configuration (see "Physical Components" earlier in this subsection) except for the 5151 Monochrome Display, which receives power from the 5170 System Unit.

Data Security

The customer is responsible for providing any desired data security functions. The standard Keylock feature in the 5170 system unit provides protection when the keylock is in the locked position. See description of this feature in Section 17:10 under "Keylock." The Data Encoder program (6024149) that performs data encryption and decryption is available from IBM.

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 5170 Personal Computer AT/370 IBM-logo units and features are purchase only. A PC AT/370 configuration can be purchased from NAD and NMD marketing representatives. IBM Credit Corporation Term Lease Financing may be available for PC AT/370 configurations.

Warranty Period

The warranty period is one year for the 5170 unit and the following optional features: BSC adapter, Double-Sided Diskette Drive, High Capacity Diskette Drive, Math Co-processor Option, Serial/Parallel Adapter and its cables, SDLC adapter, all memory options, and the 20Mb Fixed Disk Drive. For the Prototype Adapter the warranty period one year or until modified, whichever is earlier.

The warranty period for optional features for the 5170 that are available for other IBM personal computer configurations is one year or three months depending on the feature (see "Warranty Period" in Section 13:05 for features with a one-year warranty).

During the warranty period for the 5170, warranty periods that are less than a year for optional features included in the original 5170 configuration will be extended to coincide with the expiration of the 5170 warranty.

The warranty service for the 5170 unit is Customer Carry-In Repair.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Centers:
 - Warranty Option. For the 5170, IBM On-Site Repair is available.
 - Annual Maintenance. For the 5170, 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

Publications

The following publications are provided with each PC AT/370 configuration:

- *Installation and Setup* for the IBM Personal Computer AT (1502491). This manual contains setup information, instructions for installing optional features, and instructions for executing the Setup program, which the customer must use to specify certain configuration information before using the 5170 system the first time or after certain configuration changes are made.
- *Guide to Operations* for the Personal Computer AT (1502241). This binder contains information about operating, testing, and moving a 5170 configuration. A diagnostics diskette and one diskette containing the system tutorial "Exploring the IBM Personal Computer AT" are also provided in this binder. The tutorial can be used with a monochrome or color display in the minimum PC AT/370 configuration.
- *Guide to Operations* for the Personal Computer AT/370. This binder provides additional setup information, additional problem determination procedures, and a diagnostics diskette that are needed for a PC AT/370 configuration.
- A 3278/79 Emulation Adapter setup instructions and problem determination procedures insert for the *Guide to Operations* for the Personal Computer AT/370 and a diagnostics diskette.
- *BASIC* (6361132). This binder describes the functions provided by the BASIC Interpreter Version 3 that is included in ROM in a PC AT/370 configuration.

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

- *IBM Personal Computer AT Technical Reference* (1502243) – \$30. This reference describes the system board, Math Co-processor Option, power supply, keyboard, and communications functions and lists the 80286 instruction set and Basic Input/Output System (BIOS) instructions that are common to IBM Personal Computer AT and AT/370 configurations.
- *IBM Personal Computer Options and Adapters Technical Reference* (6322509) – \$125. This multivolume reference describes the displays, printers, diskette and disk drives, memory expansion, adapters, cables, and connectors. It contains information that is applicable to the IBM Personal Computer, IBM Portable Personal Computer, IBM Personal Computer XT and AT, and IBM Personal Computer XT/370 and AT/370.
- *Technical Reference for the IBM Personal Computer AT/370* (6322527) – \$28. This reference describes the hardware that is added to an IBM Personal Computer AT to enable it to execute System/370 instructions.
- *3278/3279 Emulation Adapter Technical Addendum* (6322336) – \$16
- *Hardware Maintenance and Service for the IBM Personal Computer AT* (1502242 – \$295) and that for the *IBM Personal Computer AT/370* (6322529 – \$60). These manuals provide procedures and advanced diagnostics diskettes to isolate a problem to a field replaceable unit.
- *Hardware Maintenance and Service for the 3278/3279 Emulation Adapter* (6322980) – \$22
- *VM/PC Version 1.1 Primer* (6024176) – \$18. This primer supplements the *VM/PC User's Guide*, SC24-5254, and is designed to introduce the user to VM/PC facilities.
- *TSO Host Server for the IBM PC XT/370 and PC AT/370:*
 - *User's Guide*, SC28-1390
 - *Program Description/Operations Manual*, SC28-1391
 - *Availability Notice*, SC28-1392

See "Publications" in Section 16:05 for publications that describe application programs that operate under DOS in an IBM Personal Computer AT and that may also execute in a PC AT/370 operating in PC mode.

The following form-numbered items that contain hardware and programming information about the PC AT/370 are available:

- *IBM Personal Computer AT/370 Facts Folder*, G520-5087
- *IBM Personal Computer 370 Workstations Executive Brochure*, G520-5038
- *IBM PC/370 Workstation Presentation Guide*, G320-0757
- *VM/PC User's Guide*, SC24-5254. One copy is provided with the VM/PC licensed program. Additional copies can be purchased for \$22 each.
- *VM/PC System/370 Language Supplement*, SC26-4120 – \$6

17:10 IBM 5170 Personal Computer AT/370 System Unit

Models Available

The following 5170 model is available for a PC AT/370 configuration:

- Model 599:
 - System Unit/Keyboard
 - 480Kb random access memory for VM/PC mode
 - 640Kb random access memory for PC mode
 - Fixed Disk and Diskette Drive Adapter
 - One 5¼-Inch High Capacity Diskette Drive
 - One 20Mb Fixed Disk Drive
 - 3278/79 Emulation Adapter
 - Serial/Parallel Adapter

The 5170 System Unit for the PC AT/370 configuration is shown on page 17-1.

Physical Characteristics

Dimensions (approximate)

- Height: 6.38 inches (162 mm)
- Width: 21.25 inches (540 mm)
- Depth: 17.28 inches (439 mm)

Weight (approximate)

- 42 lb (19.01 kg)

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 variable-speed, temperature-controlled fan inside the 5170 System Unit that significantly reduces acoustical noise in most environments
- Noise level: 42 decibels (dB) without printer
- Humidity:
 - 8% to 80% for system on
 - 20% to 80% for system off
- Electrical:
 - 100 to 125 volts AC, 50 to 60 Hz
 - 200 to 240 volts AC, 50 to 60 Hz

Standard Features

The following are standard features of the 5170 Model 599. Each feature is discussed under "Standard Feature Descriptions" in this subsection.

- Microprocessor – Intel 80286
- 16 interrupt levels
- Direct memory access (DMA) – seven channels
- 64K bytes of read only memory (ROM)
- BASIC-80 Interpreter Version 3 in ROM
- Complementary Metal Oxide Semiconductor (CMOS) memory (64 bytes)
- Realtime clock in CMOS
- IBM Personal Computer AT/370 Processor Card (PC/370-P2 card)
- IBM Personal Computer AT/370 512Kb Memory Card (PC/370-M2 card)
- 3278/79 Emulation Adapter
- 512K (524,288) bytes of random access memory (RAM) on the system board
- Eight system expansion slots to hold feature cards
- Programmable speaker
- Fixed Disk and Diskette Drive Adapter
- One High Capacity Diskette Drive
- One 20Mb Fixed Disk Drive
- One Serial/Parallel Adapter
- Keylock feature
- Keyboard adapter and enhanced 84-key keyboard
- Automatic power-on self-test
- A 192-watt, worldwide, switchable power supply with cooling fan and green power-on indicator

Optional Features

The following are optional features of the 5170 Model 599 that are supported for by VM/PC as of Release 1.1 for VM/PC mode operations:

- One display:
 - 5151 Monochrome Display attached via the Enhanced Graphics Adapter or the Monochrome Display and Printer Adapter
 - 5153 Color Display attached via the Enhanced Graphics Adapter or the Color/Graphics Monitor Adapter
 - 5154 Enhanced Color Display attached via the Enhanced Graphics Adapter or Color/Graphics Monitor Adapter

- 5175 Professional Graphics Display attached via the Professional Graphics Controller
- One 5152 Graphics Printer Model 2 attached via the parallel port of a Serial/Parallel Adapter or via the Monochrome Display and Printer Adapter. Attachment of a printer is optional.
- One additional 5¼-inch diskette drive (two diskette drives with one fixed disk) or one additional 20Mb Fixed Disk Drive (two fixed disk drives with one diskette drive)

The following are optional features that can be used only during PC mode operations (they are not supported by VM/PC):

- Math Co-processor Option (one maximum)
- Prototype Adapter (one maximum)
- Game Control Adapter (one maximum)
- Data Acquisition and Control Adapter (two maximum)
- Data Acquisition and Control Adapter Distribution Panel (one maximum)
- General Purpose Interface Bus Adapter (two maximum)
- Cluster Adapter (one maximum) and Cluster Cable Kits
- IBM PC Network Adapter (two maximum)
- Binary Synchronous Communications (BSC) Adapter (two maximum unless the SDLC Communications 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)
- A second Serial/Parallel Adapter
- Serial Adapter Cable (one per Serial/Parallel Adapter)
- Serial Adapter Connector (one per Serial/Parallel Adapter)

Each optional feature listed above for IBM PC AT/370 configurations is discussed under "Optional Feature Descriptions" in this subsection.

All optional features are installed inside the 5170 unit except the Cluster Cable Kit, Communications Adapter Cable, Data Acquisition and Control Adapter Distribution Panel, Serial Adapter Cable, and Serial Adapter Connector.

Physical Components Included

Each 5170 Model 599 System Unit contains the system board, which uses very large scale integration (VLSI), the programmable speaker, a battery, and the power supply and fan. Diskette and fixed disk drives are also housed in the 5170 System Unit.

Each 5170 Model 599 system board contains:

- Intel 80286 microprocessor
- System support functions
 - Direct memory access (seven channels)
 - 16 level interrupt
 - System clock
 - Three programmable timers
- Read only memory (64K bytes)
- Random access memory (512K bytes)
- Complementary Metal Oxide Semiconductor (CMOS) memory (64 bytes)
- Realtime clock in CMOS
- Battery connector
- Keyboard controller
- Programmable speaker controller
- Eight system expansion slots that are used to hold feature cards
- Socket for the Math Co-processor Option module

The system board also contains one slide switch (to the right of the expansion slots) that must be set to indicate the display adapters installed. This switch should be moved towards the front of the system unit when only the Color/Graphics Monitor Adapter is installed. For any other display adapter or a combination of display adapters, the slide switch should be moved towards the back of the system unit.

The 5170 system board does not contain DIP (dual inline package) switches that must be set by the user to provide hardware configuration data, as are implemented on the system board for other IBM personal computers. Instead, a Setup program is used to supply configuring information, which is maintained in CMOS random access memory, as discussed under "Complementary Metal Oxide Semiconductor (CMOS) RAM" later in this subsection.

Standard and optional feature cards plug into expansion slots provided in the left rear corner of the system board in the 5170 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 is removed from the rear panel of the 5170 unit, the connector on the end of the feature card is exposed so that a cable can be

17:10 IBM 5170 Personal Computer AT/370 System Unit

plugged into it to attach the appropriate unit (I/O device or modem, for example).

A decorated rear panel is provided for every 5170 unit to improve the appearance of the unit when viewed from the back.

Standard Feature Descriptions

80286 Microprocessor

The instruction execution function for PC mode operations is the Intel 80286 16/24-bit microprocessor with a 6-megahertz (MHz) clock speed and 167-ns cycle time. The 80286 also executes DOS and a portion of the VM/PC program during VM/PC mode operations.

The Intel 80286 microprocessor in the PC AT/370 and that in the IBM Personal Computer AT are the same (see description in Section 16:10 under "Microprocessor").

Direct Memory Access

The direct memory access (DMA) facility is provided to enable I/O operations to be overlapped with instruction execution. For a description of this hardware, see Section 16:10 under "Direct Memory Access."

Read Only Memory

The PC AT/370 contains 64K bytes of read only memory (ROM) on the system board. The contents of ROM remain when power to the 5170 System Unit is turned off and writing to this memory cannot be done. ROM is used for the permanent residence of certain programs. ROM in the PC AT/370 and the 5170 Personal Computer AT are the same (see description in Section 16:10 under "Read Only Memory").

Once the 5170 unit has been turned on and the self-test diagnostics have been executed successfully, the system attempts to initial program load (IPL) an operating system from the standard (A) diskette drive and then from the standard (C) fixed disk drive. The BASIC Interpreter is made ready and identified on the screen if an IPL from diskette or fixed disk has not occurred.

Complementary Metal Oxide Semiconductor (CMOS) RAM

The system board contains 64 bytes of CMOS random access memory that is backed up by a battery so that its contents remain when 5170 System Unit power is turned off. This memory contains the realtime clock and system configuration information. It is like the CMOS RAM in the 5170 Personal Computer AT (see description in Section 16:10 under "Complementary Metal Oxide Semiconductor (CMOS) RAM").

Random Access Memory on the System Board

Random access memory (RAM) is read/write program-addressable memory. The 512Kb on the system board is dynamic memory (its contents must be refreshed periodically) and its contents are lost when power to the 5170 is removed. This memory is parity-checked for validity and has a 150-ns access time, a 275-ns cycle time, and a 16-bit data path. Additional memory for the PC AT/370 is provided on the 512Kb Memory Card. All memory that can be used during VM/PC or PC mode operations is standard.

Processor (PC/370-P2) Card

The PC/370-P2 card is standard in 5170 Model 599. It executes System/370 instructions during VM/PC mode operations. Specifically, the CP and CMS portions of VM/PC and the executing CMS application program are executed by the PC/370-P2 card. Communication between the PC/370-P2 card and the 80286 microprocessor is done via interrupts.

This card has a 16-bit bus instead of the 8-bit bus in the PC/370-P card for the PC XT/370, and a higher clocking frequency. The PC/370-P2 card can execute System/370 instructions 25% faster than the PC/370-P card. For additional performance information, see Section 14:20 under "Performance."

The PC/370-P2 card contains three microprocessors, a page table, and associated circuitry. The first microprocessor executes most of the commonly used fixed-point System/370 instructions. It performs all instruction fetches, instruction decoding, and effective address calculations. The general registers and program status word are kept in this microprocessor.

A second microprocessor executes System/370 floating-point instructions. The floating-point registers are kept in this microprocessor.

A third microprocessor emulates the remaining non-floating-point System/370 instructions that are implemented in the PC AT/370, interprets the Diagnose instruction, manipulates the page table, handles exception conditions, and performs hardware house-keeping as required.

The PC AT/370 executes 147 System/370 instructions. The instructions supported are those in the following groups as defined in the *System/370 Principles of Operation*, GA22-7000 (also see PC AT/370 *Technical Reference*):

- Commercial instruction set*
- Translation*
- Conditional swapping
- CPU timer and clock comparator
- Floating point
- Extended precision floating point
- MOVE INVERSE instruction
- PSW key handling

* Certain deviations are implemented (see *Technical Reference* for the PC AT/370)

The System/370 time-of-day clock is supported using the PC AT/370 realtime clock. An interval timer is not supported.

The page table is used to perform virtual-to-real address translation when dynamic address translation is enabled for VM/PC mode operations. It consists of two static random access memory devices arranged in a 2048 × 12 bit array. Each entry represents one 4096-byte virtual page and contains the associated real page number and status bits (reference, change, page fault, parity, and invalid real memory address). A virtual storage size of 8 megabytes is supported by this page table. A page size of 4K bytes and a segment size of 64K or 1024K bytes are supported.

The Processor (PC/370-P2) Card is connected to the 512Kb Memory (PC/370-M2) Card by a one-inch (25.4-mm) cable.

512Kb Memory (PC/370-M2) Card

This card is standard in 5170 Model 599. It contains 512Kb of parity-checked random access memory that can be accessed by the PC/370-P2 card or by the PC AT/370 logic. Concurrent requests for memory access are handled on a priority basis with the PC AT/370 logic receiving the higher priority.

This 512Kb memory is viewed in PC mode as a contiguous memory area that begins at the end of the 512Kb contained on the system board. In PC mode,

the PC AT/370 has 640Kb of usable memory (512Kb on the system board and 128Kb on the 512Kb Memory Card).

For VM/PC mode, the 512Kb memory is viewed by the PC/370-P2 card as two separate areas that are not contiguously addressable. The first 480Kb area is addressed as 0 to 480Kb and is used as the System/370 real memory area. The 32Kb area above the first 480Kb is addressed as 0 to 32Kb and is used as control storage for a microprocessor on the PC/370-P2 card.

The VM/PC Release 1.1 program requires 69K bytes of memory for its residence, which leaves 411K bytes available for CMS (requires 80Kb) and the application program (up to 331Kb).

3278/79 Emulation Adapter

The 3278/79 Emulation Adapter is standard in a 5170 Model 599. It permits a PC AT/370 to be attached via customer-supplied coaxial cable to one of the following:

- 3274 Control Unit Category A terminal port (maximum cable length of 4920 feet or 1500 meters)
- 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

This adapter permits a PC AT/370 to emulate a 3278 Model 2 Display Station or 3279 Color Display Station Model 2A or S2A using a 5151, 5153, 5154, or 5175 display. Color support is not emulated and the default four colors are used for a color display. Graphics mode is not supported.

Connection of a PC AT/370 to a local or remote host processor permits the PC AT/370 to log on to the host processor and to interact with host processor programming as a 3278 or 3279 display without change to host processor programming. In addition, the remote support facilities provided by VMPCSERV and TSOSERV can be used.

System Expansion Slots

Eight system expansion slots (numbered 1 through 8) are standard on the system board to contain memory and adapter features. Slots 1 and 7 consist of one 62-pin socket each. These slots are equivalent to the full-feature slots in 5150, 5155, and 5160 System Units and support 8-bit data transfers. The other slots each consist of one 62-pin connector and one 32-pin connector and support 16-bit transfers.

Six slots are used for standard and required features as follows:

- Required display adapter (Monochrome Display and Printer Adapter, Color/Graphics Monitor Adapter, Enhanced Graphics Adapter or Professional Graphics Controller) – slot 1 (or 1 and 2 for the Professional Graphics Controller) recommended
- Standard PC/370-P2 card (slot 6)
- Standard PC/370-M2 card (slot 5)
- Standard 3278/79 Emulation Adapter (slot 4)
- Standard Serial/Parallel Adapter (slot 7)
- Standard Fixed Disk and Diskette Drive Adapter (in slot 8)

Slots 2 and 3 in 5170 Model 599 are available for optional features. The following optional features for the PC AT/370 configuration require one slot (any available) unless indicated otherwise:

- A second display adapter (Monochrome Display and Printer Adapter, Color/Graphics Monitor Adapter, Enhanced Graphics Adapter, or Professional Graphics Controller, depending on the primary adapter). Two adjacent slots are required for the Professional Graphics Controller.
- A second Serial/Parallel Adapter
- Prototype Adapter
- Game Control Adapter
- Data Acquisition and Control Adapter
- General Purpose Interface Bus Adapter
- Cluster Adapter
- PC Network Adapter
- Binary Synchronous Communications Adapter
- Synchronous Data Link Control Communications Adapter

Programmable Speaker

A 2¼-inch-diameter, 8-ohm audio speaker is included in the 5170 unit. It attaches to the speaker connector 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.

Fixed Disk and Diskette Drive Adapter

One Fixed Disk and Diskette Drive Adapter is standard in the 5170 Model 599 System Unit. This adapter is present in slot 8 and is the only Fixed Disk and Diskette Drive Adapter that can be installed in a PC AT/370 configuration.

Up to three diskette drives and fixed disk drives can be attached to this adapter: two diskette drives and one fixed disk drive or one diskette drive and two fixed disk drives. The two diskette drives in a PC AT/370 configuration can be two High Capacity Diskette Drives or one High Capacity Diskette Drive and one Double-Sided Diskette Drive.

The Fixed Disk and Diskette Drive Adapter supports direct memory access for diskette data transfer operations and permits concurrent data transfer operations on one diskette drive and one fixed disk drive. For fixed disks, the adapter supports automatic error detection and correction on up to five bits in a data field, using an ECC code, and internal diagnostics. DMA is not used for fixed disk data transfer. The I/O String Move instruction is used instead.

High Capacity Diskette Drive

One High Capacity Diskette Drive is standard in the 5170 Model 599 System Unit. This diskette drive is a half-height, 5¼-inch, double-sided diskette drive with a capacity of 1.2Mb. It is the topmost drive in the right side of the 5170 System Unit and is addressed as drive A.

For a description of this drive, see Section 16:10 under "High Capacity Diskette Drive."

20Mb Fixed Disk Drive

One 20Mb Fixed Disk Drive is standard in the 5170 Model 599 to provide 21,237,760 bytes of fixed disk storage, which is equivalent to about 17 high capacity (1.2Mb) diskettes or 56 double-sided diskettes at 360Kb each. The fixed disk drive is located in the middle of the 5170 unit (behind the ventilation grille) to the left of the standard High Capacity Diskette Drive and is addressed as drive C. It attaches to the Fixed Disk and Diskette Drive Adapter.

The characteristics of the 20Mb Fixed Disk Drive for PC AT/370 and 5170 Personal Computer AT configurations are the same (see description in Section 16:10 under "20Mb Fixed Disk Drive").

Serial/Parallel Adapter

For a 5170 Model 599, one Serial/Parallel Adapter is standard and one is optional. One available slot is required for an optional Serial/Parallel Adapter. See section 16:10 under "Serial/Parallel Adapter" for a description of this adapter.

Keylock

The standard keylock is provided for data security. It is present on the left front side of 5170 System Unit to the left of the power-on indicator. It is locked with a tubular key. When the keylock is in the locked position, the following actions are prevented:

- Removal of the system unit cover. This prevents removal of the fixed disk (and protects its data) and any feature card in the 5170 unit.
- Initialization of the system. If the keylock is locked when power is off, a user without the key can turn the power on (the power-on diagnostics will execute) but an automatic IPL will not occur and cannot be done by the user.
- Entering of any commands/data via the keyboard. All keystrokes are ignored. This feature allows a 5170 system to run unattended without the possibility of someone disturbing system operation (and inadvertently or deliberately destroying fixed disk and/or diskette files).

Keyboard

One 84-key keyboard is standard for the 5170 Model 599. This is the same keyboard as is provided for the 5170 Personal Computer AT and cannot be attached to other IBM personal computer configurations. The keyboard attaches to a 5-pin connector in the back of the 5170 unit via a 10-foot (3-meter) coiled cable and can be positioned as desired for typing comfort. For a description of the 84-key keyboard, see Section 16:10 under "Keyboard."

Power Supply

The power supply (192-watt) in the right rear of the 5170 System Unit provides the power (required voltages) to the system unit, adapters, diskette and fixed disk drives, and the keyboard. The 5151 Monochrome Display has its own power supply and receives AC power from the power system in the 5170 unit. If adequate power is not being received by the 5170, a system shutdown occurs automatically. Overvoltage and overcurrent protection are also provided via fuses. Power to the 5170 is auto-

matically removed if an overpower condition is detected.

Two input voltage supplies are provided: 110 AC and 220/240 AC for either 50 or 60 Hz. The desired voltage is selected using a switch above the power-cord plug at the rear of the power supply. A green indicator on the front panel of the 5170 unit (to the right of the keylock) is lit while power to the 5170 is on.

Optional Feature Descriptions

Math Co-processor Option

This option increases the speed and precision of arithmetic, logarithmic, and trigonometric functions. It provides an Intel 80287 coprocessor that performs floating-point arithmetic significantly faster than the floating-point subroutines that are executed by the 80286 microprocessor.

The characteristics of the Math Co-processor Option for the PC AT/370 and the 5170 Personal Computer AT are the same (see description in Section 16:10 under "Math Co-processor Option").

Game Control Adapter

This feature (one maximum for a 5170 Model 599) permits up to two joysticks or up to four game paddles to be attached to the PC AT/370 configuration. It can also be used as a general-purpose I/O card with four analog (resistive) inputs plus four digital input points.

Double-Sided Diskette Drive

One Double-Sided Diskette Drive can be installed in a 5170 Model 599 System Unit in addition to the standard High Capacity Diskette Drive. It attaches to the Fixed Disk and Diskette Drive Adapter. The Double-Sided Diskette Drive in the 5170 can be used to read and write 5¼-inch diskettes that are to be used in other IBM personal computer configurations.

The Double-Sided Diskette Drive in the PC AT/370 has the same characteristics as the Double-Sided Diskette Drive in the 5170 Personal Computer AT (described under "Double-Sided Diskette Drive" in Section 16:10).

20Mb Fixed Disk Drive

One additional 20Mb Fixed Disk Drive can be installed in a 5170 Model 599 to provide a maximum of 40Mb of fixed disk storage in a PC AT/370 configuration. Only one 20Mb Fixed Disk Drive can be installed in the 5170 Model 599 if two diskette drives are installed.

The second 20Mb Fixed Disk Drive is installed below the standard diskette drive and is addressed as drive D. The two fixed disk drives have the same characteristics (as discussed under "20Mb Fixed Disk Drive" in Section 16:10).

Monochrome Display and Printer Adapter

This adapter provides for attachment to the PC AT/370 of one 5151 Monochrome Display Model 1 and one 5152 Graphics Printer Model 2 (or compatible printer), 5182 Color Printer, 5201 QUIETWRITER® Printer, 5216 Wheelprinter Model 2, or IBM SELECTRIC® System/2000 Typewriter, 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 cable required for each type of printer that attaches to this adapter.

One Monochrome Display and Printer Adapter can be installed in a PC AT/370 configuration and slot 1 in the 5170 System Unit is recommended if this is the only display adapter installed. 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.

See Section 13:10 under "Monochrome Display and Printer Adapter" for additional information.

Color/Graphics Monitor Adapter

This adapter provides for attachment to the PC AT/370 of up to three color displays and one light pen. Light pens are supported by BASIC but not by DOS. The 5153 Color Display or 5154 Enhanced Color Display, a black and white or color video monitor, and a black and white or color television set can be attached to this adapter.

One Color/Graphics Monitor Adapter can be installed in a PC AT/370 configuration and slot 1 in the 5170 System Unit is recommended. Another display adapter can be installed together with the

Color/Graphics Monitor Adapter: Monochrome Display and Printer Adapter, Enhanced Graphics Adapter, or Professional Graphics Controller.

See Section 13:10 under "Color/Graphics Monitor Adapter") for a description of this adapter.

Prototype Adapter

This feature (two maximum) is provided as a base for building and testing custom attachments for the PC AT/370 configuration. See description of this feature in Section 16:10 under "Prototype 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 PC AT/370 configuration of one of the following: 5154 Enhanced Color Display, 5151 Monochrome Display, 5153 Color Display, or another direct-drive display.

One Enhanced Graphics Adapter can be installed in a PC AT/370 configuration, and slot 1 is recommended if this is the only display adapter installed. 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.

For a description of this adapter and its features, see Section 13:10 under "Enhanced Graphics Adapter, Graphics Memory Expansion Card, and Graphics Memory Module Kit."

Professional Graphics Controller

The Professional Graphics Controller is required to attach the 5175 Professional Graphics Display to a PC AT/370 configuration. 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.

One Professional Graphics Controller can be installed in a PC AT/370 configuration. It requires two adjacent slots in the 5170 unit. This controller can be present in a configuration that has one other display adapter installed. For a description of this controller, see Section 13:10 under "Professional Graphics 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.

One or two Data Acquisition and Control Adapters can be installed in a PC AT/370 configuration. 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 these adapters. For a description of this adapter, see Section 13:10 under "Data Acquisition and Control Adapter and Data Acquisition and Control Adapter Distribution Panel."

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 PC AT/370 configuration. This adapter permits engineering and science professionals to access and control over 2000 different instruments that use the IEEE-488 standard.

One or two General Purpose Interface Bus Adapters can be installed in a PC AT/370 configuration. An adapter can have up to 14 devices or instruments attached with a maximum of 28 devices/instruments in one PC AT/370 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 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 features 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 *General Purpose Interface Bus*, G520-5021.

Binary Synchronous Communications (BSC) Adapter

One or two BSC adapters can be installed in a PC AT/370 configuration unless the SDLC adapter is present, in which case only one BSC adapter can be installed. An external modem must be cable-connected between the BSC adapter and a telephone line using the Communications Adapter Cable feature.

The BSC adapter for the PC AT/370 is the same as that for the 5170 Personal Computer AT and is functionally compatible with the BSC adapter for other IBM personal computers (part number 1502075, feature code 2075), which cannot be installed in a 5170 unit. The BSC adapter for the 5170, however, can be installed in other IBM personal computers.

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-ologo 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, aids program-controlled data transfer, supports electrical wrap and error

17:10 IBM 5170 Personal Computer AT/370 System Unit

status reporting, and has prioritized interrupt system controls.

The IBM-logo DOS programs that support the BSC adapter in a PC AT/370 configuration operating in PC mode are the Binary Synchronous 3270 Emulation Program and the DisplayComm Binary Synchronous Communications Program. See Section 13:10 under "Binary Synchronous Communications (BSC) Adapter" for a description of these programs and the BSC adapter hardware.

Synchronous Data Link Control (SDLC) Communications Adapter

One SDLC Communications Adapter can be installed in a PC AT/370 configuration. Only one BSC adapter can be installed in the PC AT/370 configuration when the SDLC adapter is present. An external modem must be cable-connected between the SDLC adapter and a telephone line using the Communications Adapter Cable feature.

The SDLC adapter for the PC AT/370 is the same as that for the 5170 Personal Computer AT and is functionally compatible with the SDLC adapter for other IBM personal computers (part number 1502090, feature code 2090), which cannot be installed in a 5170 unit. The SDLC adapter for the 5170, however, can be installed in other IBM personal computers.

For a PC AT/370 configuration, the SDLC adapter can be used for PC mode operations (it is not supported by the VM/PC program). See Section 13:10 under "Synchronous Data Link Control (SDLC) Communications Adapter" for a description of this adapter and its programming support.

Communications Adapter Cable

This feature allows the BSC adapter or SDLC adapter card to be connected to a modem via its connector at the rear of the 5170 unit. 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 or SDLC adapter to an external modem or other data communications equipment.

Cluster Adapter and Cluster Cable Kit

The Cluster Adapter installed in a PC AT/370 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 5170, 5150, 5155, 5160, and 5531 system in the clustered configuration must have the Cluster Adapter feature installed.

One Cluster Adapter can be installed in a PC AT/370 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. 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. For a description of a cluster and its programming support, see Section 13:10 under "Cluster Adapter and Cluster Cable Kit."

IBM PC Network

The PC AT/370 can be included in an IBM PC Network, which is a low-cost broadband local area network that allows peer-to-peer communication among IBM Personal Computers, IBM Portable Personal Computers, IBM Personal Computer XTs and XT/370s, and IBM Personal Computer ATs and AT/370s in a shared resource environment. The personal computers in the network are connected using the 5178 IBM PC Network Translator Unit, IBM PC Network Adapter, and IBM PC Network Cabling Component features. Two IBM PC Network Adapters can be installed in a 5170 unit.

Programming support of the PC AT/370 in a network is provided by the IBM PC Network Program. For a discussion of this network and the IBM PC Network Program, see Section 13:10 under "IBM PC Network."

Single Unit Prices

Item	Part Number	Feature Code	Single Unit Purchase Price or License Fee (\$)
5170 System Unit/Keyboard Model 599	5170599	—	9795
Binary Synchronous Communications Adapter	1501204	1204	240
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
Data Acquisition and Control Adapter	6451502	1502	1275
Data Acquisition and Control Adapter Distribution Panel	6451504	1504	245
Double-Sided Diskette Drive	6450207	0207	425
Enhanced Graphics Adapter	1501200	1200	524
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
High Capacity Diskette Drive	6450206	0206	650
Math Co-processor Option	6450211	0211	375
Monochrome Display and Printer Adapter	1504900	4900	250
Professional Graphics Controller	6451501	1501	2995
Prototype Adapter	6450220	0220	35
Serial Adapter Cable	6450217	0217	65
Serial Adapter Connector	6450242	0242	35
Serial/Parallel Adapter	6450215	0215	150
Synchronous Data Link Control (SDLC) Communications Adapter	1501205	1205	240
20Mb Fixed Disk Drive	6450205	0205	1595
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
VM/PC Version 1.1	6024175	4175	1150
DOS Version 3.0	6024180	4180	65

17:10 IBM 5170 Personal Computer AT/370 System Unit

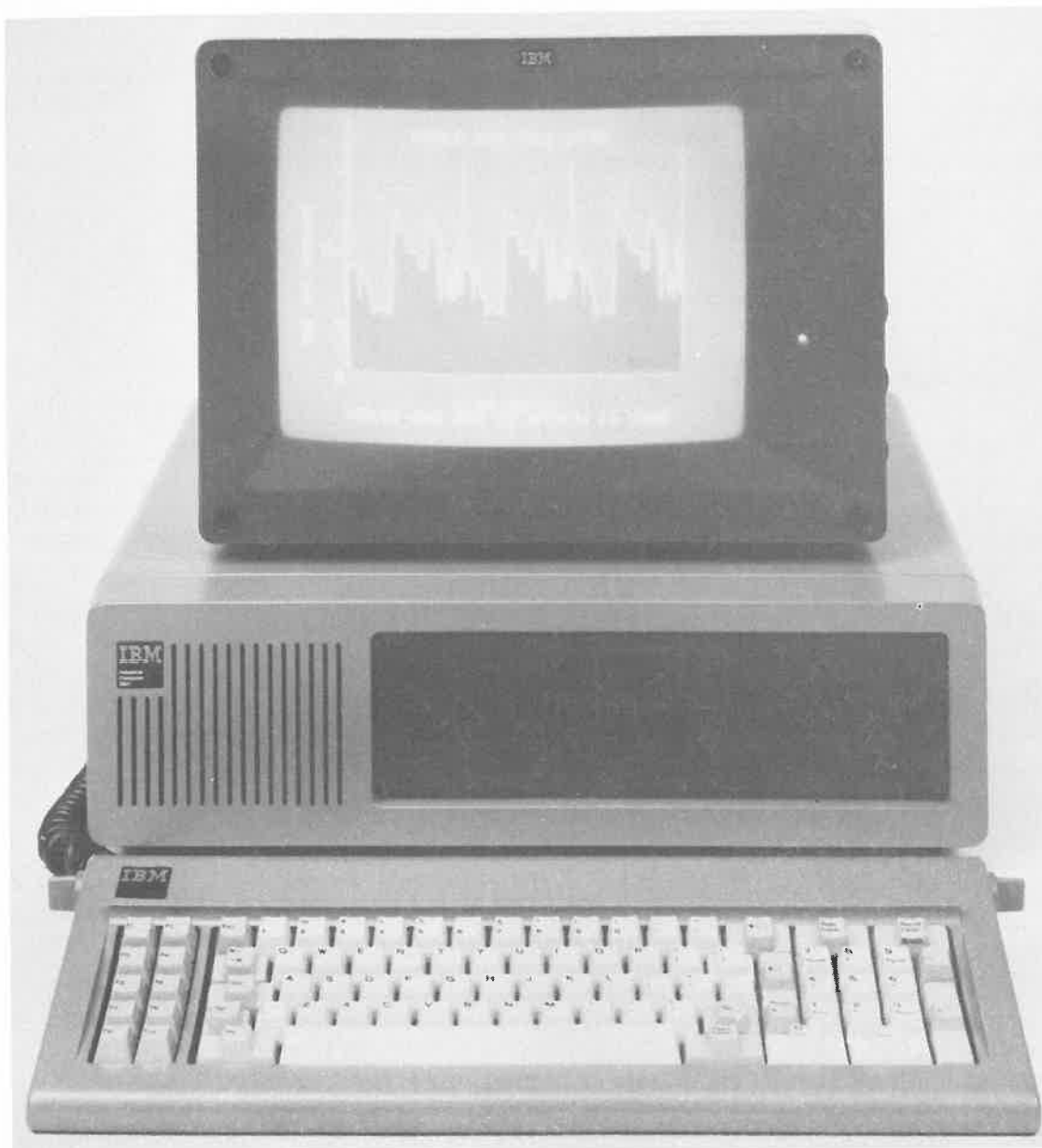
Discounts Available

The PC AT/370 and most of its hardware features may be eligible for one of the following discounts:

- Volume Procurement Amendment
- Educational Allowance
- Special Bid

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.

Section 20: IBM 5531 Industrial Computer



Announced May 1, 1984

20:05 IBM 5531 Industrial Computer Configuration Overview

Introduction

The IBM 5531 Industrial Computer is an industrialized version of the IBM Personal Computer XT. It is a desktop system that is designed to be installed in areas where a system more resistant to harsh physical conditions is required, such as a plant floor. The IBM 5531 Industrial Computer is designed to meet industrial environmental conditions, including operation in extended temperatures and operation subject to extended vibration and shock, extended voltage transients, and extended particulates contaminants.

Application programs that execute under the IBM Personal Computer Disk Operating System in an IBM Personal Computer XT configuration can also execute in an IBM 5531 Industrial Computer that has the required hardware resources.

The IBM 5531 Industrial Computer is a versatile, general-purpose system that supports a wide variety of application programs, as does the IBM Personal Computer XT. It can be connected to various local and remote processors (System/370, 30XX, 4300, Series/1, 8100, System/34/36/38, for example) to be used as an intelligent workstation as well as a personal computer.

The IBM 5531 Industrial Computer can be interconnected via cable with local IBM personal computers to form a clustered multiuser configuration. 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.

Communication with remote IBM personal computer configurations is possible via communications lines or via diskette interchange.

The IBM Personal Computer XT/370 Option Kit can be installed in an IBM 5531 Industrial Computer System Unit to convert it to an IBM Personal Computer XT/370 System Unit.

Physical Components

The IBM-logo personal computer units that can be included in an IBM 5531 Industrial Computer configuration are the following:

- 5531 System Unit/Keyboard Model 1 or 21
- 5532 Industrial Color Display Model 1

The 5531 and 5532 units are the only IBM-logo personal computer units that have been tested for operation in an industrial environment. Other IBM-logo personal computer units are not designed for the industrial environment in which the 5531 will operate. However, the IBM 5531 Industrial Computer can be connected to various local and remote IBM processors and to local non-IBM devices that can operate in the same industrial environment as the 5531 System Unit.

Minimum Configuration

Every stand-alone IBM 5531 Industrial Computer configuration must include one 5531 System Unit/Keyboard and one display device. The minimum IBM Industrial Computer configuration consists of one 5531 System Unit/Keyboard Model 1 (which has 128Kb of random access memory, one diskette drive, and one fixed disk drive) and one display, which can be the 5532 Industrial Color Display or a customer-supplied 5532-compatible display.

The price of a single minimum stand-alone IBM 5531 Industrial Computer hardware configuration, 5531 System Unit Model 1 with the 5532 Industrial Color Display, is \$6795. This configuration supports operation of the Disk Operating System.

Configuration Features

The following highlights the features of 5531 configurations, including memory sizes, types and maximum number of attachable I/O devices, and the processors/units to which a 5531 can be connected:

- One 5531 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 128Kb (131,072 bytes) to 640Kb (655,360 bytes) in 64Kb increments
- Realtime clock (backed up by a battery)

- One IBM 5¼-inch double-sided diskette drive installed in the 5531 unit with a capacity of 360Kb (368,640 bytes)
- One fixed disk drive of 10Mb (10,618,880 bytes) capacity installed in the 5531 unit
- Keylock feature to protect against unauthorized access to the diskette drive
- One color (5532 or compatible) display
- One parallel printer via the parallel interface port of the Combination Adapter and one or two serial printers via asynchronous communications attachments
- Programmable speaker for audio and musical applications
- Field-upgrade to an IBM Personal Computer XT/370 using the IBM Personal Computer XT/370 Option Kit (with the 3277 emulation card)
- Connection to the following:
 - System/370, 30XX, 4300, and Series/1 processors via the asynchronous communications port of the Combination Adapter, Asynchronous Communications Adapter, Binary Synchronous Communications (BSC) Adapter, or Synchronous Data Link Control (SDLC) Communications Adapter
 - 5520 Administrative System, System/34, System/36, or System/38 using the Display Station Emulation Adapter
 - 8100 Processor using the Asynchronous Communications Adapter or SDLC Communications Adapter
 - Another 5531 Industrial Computer, a 4860 PCjr, a 5150 Personal Computer, a 5155 Portable Personal Computer, a 5160 Personal Computer XT or XT/370, a 5170 Personal Computer AT or AT/370, 3270 Personal Computer workstations, a paper tape reader, a communicating typewriter, a laboratory instrument, voice recognition devices, letter-quality printers, or other machines that use the RS-232C interface, via the asynchronous communications port of the Combination Adapter or the Asynchronous Communications Adapter
 - A remote VM/370 PROFS system using the Asynchronous Communications Adapter or the 3278/79 Emulation Adapter
 - 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 IBM personal computers (IBM PCjrs, IBM Personal Computers, IBM Personal Computer XTs and XT/370s, IBM Portable Personal Computers, IBM Personal Computer AT and AT/370s, and IBM 5531

Industrial Computers via the Cluster Adapter and Cluster Cable Kit)

- Other host processors using appropriate software

Multiple communications adapters, of more than one type, if desired, can be installed in the same 5531 configuration. The limit for each type is one for the Asynchronous Communications Adapter, one for the SDLC adapter, and two for the BSC adapter. When the SDLC adapter is installed, only one BSC adapter and no asynchronous adapter can be installed.

Operating Systems Supporting

The 5531 Industrial Computer is supported by the IBM Personal Computer Disk Operating System (DOS) as of Version 2.0.

Compatibility

Hardware

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

Diskettes (5¼-inch) are interchangeable without restriction among 5531 Industrial Computer, 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), and 3270 Personal Computer workstation configurations. The 5531 Industrial Computer does not provide a cassette adapter (as do the PCjr and 5150 Personal Computer) or support cartridges (as does the PCjr).

Programming

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

Customer Responsibilities

The 5531 Industrial 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 the 5531 and 5532 units. Periodic checking and changing of the filters in 5531 and 5532 units is also required.

Data Security

The customer is responsible for providing any desired data security functions. The Keylock Option Kit can be installed to restrict access to the diskette drive (as described in Section 20:10 under "Keylock Option Kit"). The Data Encoder program (6024149) that performs encryption and decryption of data is available from IBM.

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.

Warranty Period

The warranty period for 5531 and 5532 units is three months. The warranty service for the 5531 is Customer Carry-In Repair and for the 5532 is Customer Carry-In Exchange. The warranty period for all optional features of the 5531 is also three months except for the 256Kb Memory Expansion Option and Cluster Adapter for which a twelve-month 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 the 5531 unit, IBM On-Site Repair is available.
 - Annual Maintenance. For the 5531, IBM On-Site Repair and Customer Carry-In Repair are available. For the 5532, IBM On-Site Exchange, Customer On-Site Exchange, Customer Carry-In Exchange, and Customer Carry-In Repair are available.
- IBM Hourly Service: Customer Carry-In Repair at an IBM Service/Exchange Center
- Self-service using the *Maintenance Information* publication (a purchased item), which enables the customer to isolate the problem to an under-the-cover field replaceable unit

Purchase Location

All 5531 Industrial Computer units and features are purchase only and can be purchased from IBM NAD and NMD branch offices.

Publications

The following publication is provided with each 5531 Industrial Computer configuration:

- *Operator's Guide*. This publication contains setup and starting instructions, keyboard information, instructions for installing optional features ordered for the configuration, and testing information. Three diskettes are provided with this publication: Exploring the IBM 5531 Industrial Computer (which contains a system tutorial), Industrial Computer Utilities, and Industrial Computer Diagnostics. The utilities diskette contains two programs that handle the realtime clock and the thermal sensor in the 5531 unit. These utilities should be copied to the DOS diskette or the fixed disk containing DOS.

The following publications can be purchased:

- *BASIC* (6361132). This binder describes the functions provided by the BASIC Interpreter that is included in ROM in a 5531 System Unit.
- *Technical Reference* (6003) – \$53. This three-volume reference describes the design of the hardware features, provides interface informa-

tion, (including logic diagrams), and lists Basic Input/Output System (BIOS) instructions.

- *Maintenance Information* (6004) – \$155. This manual provides procedures and an advanced diagnostics diskette to isolate a problem to a field replaceable unit.

The following form-numbered items contain hardware or programming information for the 5531 Industrial Computer:

- *IBM 5531 Industrial Computer Facts Folder*, G520-4235
- *The Guide to Personal Computer Offerings from IBM*, G520-0059. This publication describes the facilities of the DOS operating system, DOS languages, and selected IBM-logo DOS application programs. 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 personal computer configurations supported.

20:10 IBM 5531 System Unit

Models Available

Two 5531 models are provided for an IBM 5531 Industrial Computer configuration. They differ only in the amount of standard memory provided and otherwise are functionally and physically identical.

- Model 1:
 - System Unit/Keyboard
 - 128Kb memory
 - 5¼-Inch Diskette Drive Adapter
 - One 5¼-Inch Double-Sided Diskette Drive
 - Fixed Disk Drive Adapter
 - One 10Mb Fixed Disk Drive
 - Color/Graphics Monitor Adapter
 - Combination Adapter
- Model 21:
 - System Unit/Keyboard
 - 256Kb memory
 - 5¼-Inch Diskette Drive Adapter
 - One 5¼-Inch Double-Sided Diskette Drive
 - Fixed Disk Drive Adapter
 - One 10Mb Fixed Disk Drive
 - Color/Graphics Monitor Adapter
 - Combination Adapter

The 5531 System Unit, shown on page 20-1, is functionally like a 5160 System Unit but has been physically modified and tested in an industrial environment. For example, the 5531 unit has heavier covers than the 5160 unit, an intake air filter, a cooling fan with a filter, multiple air circulation fans, and a cover over the drives for protection in an industrial environment.

A 5531 System Unit can be upgraded to the system unit for an IBM Personal Computer XT/370 configuration by installing an IBM Personal Computer XT/370 Option Kit.

Physical Characteristics

Dimensions (approximate)

- Height: 6 inches (152 mm)
- Width: 19.5 inches (496 mm)
- Depth: 17.9 inches (455 mm)

Weight

- Approximately 39 lb (17.7 kg)

Environment

- Air temperature:
 - 39.2 to 115 degrees F (4 to 46.1 C) for system on
 - 39.2 to 125 degrees F (4 to 51.7 C) for system off
- Cooling: Air-cooled via a fan with a filter inside the 5531 System Unit
- Humidity: 8% to 80% noncondensing
- Particulates contaminants filtering:
 - Suspended particulates: 500 micrograms per cubic meter
 - Benzene soluble organics: 30 micrograms per cubic meter
 - Settleable particulates: 1500 micrograms per square centimeter for 30 days
- Shock: .5g at 10 ms duration
- Vibration:
 - 5 to 17 Hz at .005 inches double amplitude displacement
 - 17 to 200 Hz at .07g peak
 - 200 to 500 Hz at .036g peak
- Electrical:
 - 130-watt power supply
 - AC operating voltages: 104 minimum to 127 maximum, 57 Hz to 63 Hz
 - Power surges of plus or minus 2500 volts maximum as outlined in FCC Docket 19528 – Part 68

Standard Features

The following are standard features of 5531 models. 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
- 128K (131,072) bytes (Model 1) or 256K (262,144) bytes (Model 21) of random access memory (RAM)
- Eight system expansion slots to hold feature cards with a retainer bar to secure the cards
- A programmable speaker and associated adapter
- Color/Graphics Monitor Adapter
- One 5¼-Inch Diskette Drive Adapter
- One 5¼-Inch Double-Sided Diskette Drive
- One Fixed Disk Drive Adapter
- One 10Mb Fixed Disk Drive

- One Combination Adapter providing an asynchronous communications port, parallel interface port, battery-backed clock, and thermal sensor
- Keyboard adapter and 83-key keyboard
- Automatic power-on self-test
- A 130-watt power supply with cooling fan

The standard diskette drive and fixed disk drive are contained in the 5531 unit. They are protected from environmental contaminants by a drive cover door that must be lowered to access the diskette drive. Optionally, the door can have a keylock to restrict access to the diskette drive to those who have the keylock key.

Optional Features

The following are optional features of the 5531 System Unit. Each is discussed under "Optional Feature Descriptions" in this subsection.

- Math Co-processor Option (one maximum)
- 64Kb Memory Module Kit (two maximum on the Model 1 system board and three maximum on a 64/256Kb Memory Expansion Option)
- 64/256Kb Memory Expansion Option (two maximum)
- 256Kb Memory Expansion Option (one maximum)
- Combination Adapter Cable (one maximum)
- Keylock Option Kit (one maximum)
- Binary Synchronous Communications (BSC) Adapter (two maximum unless the SDLC Communications 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)
- Asynchronous Communications Adapter (one if the SDLC adapter is not installed)
- Display Station Emulation Adapter (one maximum)
- 3278/79 Emulation Adapter (one maximum)
- Cluster Adapter (one maximum)
- Cluster Cable Kit (one for each IBM 5531 Industrial Computer in the cluster after the first two systems)
- IBM Personal Computer XT/370 Option Kit (one maximum)

All optional features are installed inside the 5531 System Unit except the Combination Adapter Cable, Communications Adapter Cable, Keylock Option Kit, and Cluster Cable Kit.

Physical Components Included

Each 5531 System Unit contains the system board, the programmable speaker, and the power supply and fan. The standard diskette drive and standard fixed disk drive are also housed in the 5531 unit.

Each 5531 system board contains:

- The processor subsystem (includes the Intel 8088 microprocessor and associated functions)
- Read only memory (40Kb)
- Random access memory (128Kb to 256Kb)
- The keyboard adapter
- The programmable speaker adapter
- Eight system expansion slots that are used to hold feature cards
- Socket for the Math Co-processor Option module

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

The 5531 is delivered with the DIP switches set for the configuration ordered. If optional features are added to a 5531 configuration thereafter, the customer must set the appropriate switches, if required, as per the supplied instructions in the *Operator's Guide*.

Standard and optional feature cards plug into expansion slots provided in the left rear corner of the system board. 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 5531 System 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 and Direct Memory Access

The instruction execution function in the 5531 System Unit is the Intel 8088 16-bit microprocessor with a 4.77-megahertz (MHz) clock speed and 410-nanosecond cycle time. Direct memory access (DMA) is implemented. The 8088 microprocessor and DMA are the same in the 5531 as in the 5160 Personal Computer XT (see descriptions in Section 13:10 under "Microprocessor" and "Direct Memory Access").

Read Only Memory

The 5531 contains 40Kb of read only memory (ROM) on the system board. The contents of ROM remain when power to the 5531 System Unit is turned off and writing to this memory cannot be done. ROM is used for the permanent residence of certain programs.

ROM contains the power-on self-test program, diskette bootstrap loader, Basic Input/Output System (BIOS), time-of day clock, dot patterns for 128 characters in graphics mode for displays, BASIC-80 Interpreter, and a code to identify the specific system unit (5160 code is present for the 5531).

Once the 5531 has been turned on and the self-test diagnostics have been executed successfully, an attempt is made to initial program load (IPL) an operating system from the diskette drive and then from the fixed disk drive. The BASIC Interpreter is made ready and identified on the screen if an IPL from diskette or fixed disk has not occurred.

ROM in the 5531 Industrial Computer is functionally like that in the 5160 Personal Computer XT (see description in Section 13:10 under "Read only Memory").

Random Access Memory

Random access memory (RAM) is read/write program-addressable memory. It is dynamic memory (its contents must be refreshed periodically) and its contents are lost when power to the 5531 is removed. This memory is parity checked for validity and has a 200-ns access time and a 345-ns cycle time.

The standard 128Kb in the 5531 Model 1 and 256Kb in the 5531 Model 21 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 discussed under "Optional Feature Descriptions" in this subsection.

DOS Versions 2.0 and 2.1 require a minimum of 24Kb of memory for residence during system operation. Thus, for a 5531 configuration with 128Kb of memory, application programs that require up to 104Kb at a time can be used. DOS Versions 3.0 and 3.1 require at least 36Kb for residence.

System Expansion Slots

Six full-feature and two special-feature system expansion slots are standard to contain memory and adapter features. The full-feature slots will accept full-feature or the smaller special-feature cards. Special-feature slot 7 will accept only special-feature cards. Only the Asynchronous Communications Adapter can be installed in special-feature slot 8.

Three full-feature slots are used for the standard Color/Graphics Monitor Adapter, 5¼-Inch Diskette Drive Adapter, and Fixed Disk Drive Adapter. One special-feature slot is used for the Combination Adapter.

The following optional features for the 5531 require one system expansion slot each unless indicated otherwise:

- 64/256Kb Memory Expansion Option (full-feature)
- 256Kb Memory Expansion Option (special- or full-feature)
- Binary Synchronous Communications Adapter (full-feature)
- SDLC Communications Adapter (full-feature)
- Asynchronous Communications Adapter (special- or full-feature)
- 3278/79 Emulation Adapter (full-feature)
- Display Station Emulation Adapter (full-feature)
- Cluster Adapter (full-feature)
- IBM PC XT/370 Option Kit with 3277 emulation (slots 2, 3, and 4 required)

Programmable Speaker

A 2¼-inch-diameter, 8-ohm audio speaker is included in the 5531 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 the 5531 System Unit. This adapter uses a full-feature expansion slot in the 5531 and is the only diskette drive adapter that can be installed in a 5531 configuration. One IBM-supplied internal 5¼-inch diskette drive is attached to this adapter. The diskette drive adapter uses direct memory access for record data transfers.

5¼-Inch Double-Sided Diskette Drive

One double-sided diskette drive is standard in the 5531 System Unit (leftmost drive addressed as A). It provides a capacity of 360Kb using DOS Version 2.0 or later. 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. See Section 13:10 under "5¼-Inch Double-Sided Diskette Drive" for diskette drive and diskette characteristics.

Fixed Disk Drive Adapter

This standard adapter provides buffering, error detection, and data transfer between memory in the 5531 and a 10Mb Fixed Disk Drive. One 10Mb Fixed Disk Drive is attached to this adapter in a 5531 configuration and only one Fixed Disk Drive Adapter can be present in a 5531 configuration. The adapter supports direct memory access data transfer, automatic error detection and correction on 11-bit bursts using a 32-bit error checking and correction (ECC) code, automatic retries on disk errors, and internal diagnostics.

10Mb Fixed Disk Drive

One 10Mb Fixed Disk Drive is standard in the 5531 System Unit (rightmost drive addressed as C) to provide 10,618,880 bytes of fixed disk storage, which is equivalent to about 28 double-sided diskettes at 360Kb each. 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).

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
- 4 surfaces
- 3600 rotations per minute
- 8.33 ms average rotational delay
- 3 ms track-to-track access
- 5M-bit per second data transfer rate
- 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.

Combination Adapter

The Combination Adapter is a 4 × 7 inch card that provides the following:

- Asynchronous communications port
- Parallel interface port
- Battery-backed clock
- Thermal sensor

This adapter provides an asynchronous communications port connector and a parallel interface port connector at the rear of the 5531 System Unit to which appropriate cables can be attached. One Combination Adapter can be present in a 5531 unit.

The asynchronous communications port is functionally equivalent to the optional Asynchronous Communications Adapter feature (see description later in this subsection under "Asynchronous Communications Adapter").

The parallel interface port is functionally equivalent to the Printer Adapter feature that is available for other IBM personal computers. It provides a parallel interface to which a printer or a device with TTL (transistor to transistor logic) levels can be attached. Eight bits are transferred at a time.

The battery-backed clock is a realtime, 24-hour clock with a four-year calendar (excluding leap year) that is backed up by a battery for continuous operation. The realtime clock is supported by the realtime clock utility contained on the Industrial Computer Utilities diskette.

The realtime clock can be set after the date and time have been entered to DOS. The clock can be set to the current DOS date and time (as would be done at installation time, for example). Alternatively, the realtime clock can be left unchanged and its date and time values can be given to DOS (as would be done normally after 5531 installation).

20:10 IBM 5531 System Unit

The thermal sensor in the 5531 unit indicates when the internal temperature of the 5531 is exceeding design limits. The status of this sensor can be tested by programming.

The thermal sensor is supported by the thermal warning program, which is contained on the Industrial Computer Utilities diskette. This program can be loaded after DOS IPL or any time thereafter to monitor the thermal sensor. When the thermal sensor indicates the internal operating temperature of the 5531 unit exceeds its design limits, a thermal warning message that contains the time the overtemperature condition was detected is displayed on line 25 of the display.

If program execution is stopped by the operator, the system unit continues to run for 10 minutes with a sounding of the audible alarm every 10 seconds. If the temperature in the 5531 returns to normal within the 10-minute interval, the audible alarm stops sounding, the thermal timer is reset, and the thermal normal message is displayed. Otherwise, the system unit should be stopped and allowed to cool.

Color/Graphics Monitor Adapter

This adapter provides for the attachment of up to three color displays and one light pen. Light pens are supported by BASIC but not by DOS. This adapter provides a 9-pin connector for a display that can present 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).

Only one Color/Graphics Monitor Adapter can be present in a 5531 unit. In a 5531 configuration, a 5532 Industrial Color Display or other compatible displays suitable to an industrial environment can be attached to this adapter.

For a description of this adapter, see Section 13:10 under "Color/Graphics Monitor Adapter."

Keyboard

One 83-key keyboard is standard for the 5531. It is an industrialized version of the 83-key U.S. English-layout keyboard that is provided for 5150 Personal Computer and 5160 Personal Computer XT configurations. The keyboard attaches to a 5-pin connector in the back of the 5531 System 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 industrialized keyboard are:

- Height: 2.2 inches (57 mm)
- Width: 19.6 inches (500 mm)
- Depth: 7.9 inches (200 mm)
- Weight: 4.7 lb (2.13 kg)

For keyboard highlights and a photo of the keyboard layout, see Section 13:10 under "Keyboard."

Power Supply

The power supply (130 watts) in the right rear area of the 5531 System Unit provides power (required voltages) to the system unit, its options, and the keyboard (four inputs). If adequate power is not being received, a system shutdown occurs. Overvoltage and overcurrent protection are also provided. Power to the 5531 is automatically removed if an overpower condition is detected.

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 has its own instruction set. This feature is the same as that for the 5160 Personal Computer XT (see description in Section 13:10 under "Math Co-processor Option").

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. Up to two of the module kits (128Kb) can be installed on the 5531 Model 1 system board to provide 256Kb on the board. Up to three 64Kb module kits can be added to a 64/256Kb Memory Expansion Option feature card.

64/256Kb Memory Expansion Option

This option provides 64Kb on an 11-inch circuit card that plugs into a full-feature system expansion slot in the 5531 System 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 5531 Model 1 system board must have 256Kb of memory installed before memory can be added via the memory expansion option.

One or two 64/256Kb Memory Expansion Options can be installed in a 5531 unit to provide up to 384Kb in addition to the 256Kb memory on the system board. One memory expansion card contains 256Kb (four 64Kb modules) and the other card contains 64Kb or 128Kb. Alternatively, one 64/256Kb option card with 64Kb or 128Kb and one 256Kb Memory Expansion Option can be installed in the same 5531 unit to provide 576Kb or 640Kb in the configuration.

256Kb Memory Expansion Option

This option provides 256Kb of parity checked random access memory on a 5-inch card. It plugs into a special- or full feature expansion slot in the 5531 unit. The 5531 Model 1 system board must have 256Kb of memory installed as a prerequisite.

For the 5531, this feature can be installed instead of the 64/256Kb Memory Expansion Option with three 64Kb Memory Module Kits to add 256Kb at a lower cost and/or to be able to use a special-feature instead of a full-feature slot for an additional 256Kb.

One 64/256Kb option card with 64Kb or 128Kb and one 256Kb Memory Expansion Option can be installed in the same 5531 unit to provide 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.

Keylock Option Kit

The Keylock Option Kit provides a keylock on the drive cover door for the diskette and fixed disk drives to prevent access to the diskette drive except by those with the keylock key.

Combination Adapter Cable

The Combination Adapter Cable is available to attach an external modem or other device to the asynchronous communications port. This cable is double-shielded and approximately 10 feet (3 meters) long. A wrap connector is provided to test the cable. This feature must be ordered with the 5531 System Unit. It cannot be installed in the field.

Asynchronous Communications Adapter

One Asynchronous Communications Adapter can be installed in a 5531 unit and requires one special- or full-feature slot. An asynchronous adapter cannot be installed in a 5531 configuration if the SDLC adapter is installed.

This adapter provides a path to a processor or an I/O device outside the 5531 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 external modems or other devices to the asynchronous adapter. The 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.

Vendor-logo (Hayes Smartmodem TM) 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 (or asynchronous communications port of the Combination Adapter).

A 5531 configuration can be attached to the following using the Asynchronous Communications Adapter (or the asynchronous communications port of the Combination 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 and XT/370s
- 5170 Personal Computer ATs and AT/370s
- 3270 Personal Computer workstations
- 5531 Industrial Computers

20:10 IBM 5531 System Unit

- Other devices and processors that use the RS-232C interface

IBM-logo DOS application programs that support communications functions using the Asynchronous Communications Adapter or asynchronous communications port in the 5531 Industrial Computer include the following:

- 3101 Emulation Program
- Asynchronous Communications Support Version 2
- Personal Communications Manager
- PROFS Personal Computer Connection (PROFS/PC²)

For a description of the asynchronous adapter hardware and the programs that support the asynchronous adapter in a 5531 configuration, see Section 13:10 under "Asynchronous Communications Adapter."

Binary Synchronous Communications (BSC) Adapter

One or two BSC adapters can be installed in a 5531 configuration unless the SDLC adapter is present, in which case only one BSC adapter can be installed. The adapter requires a full-feature slot in the 5531 System Unit. An external modem must be cable-connected between the BSC adapter and a telephone line using the Communications Adapter Cable feature.

The IBM-logo application programs that support the BSC adapter in a 5531 Personal Computer configuration are the Binary Synchronous 3270 Emulation Program and the DisplayComm Binary Synchronous Communications Program. For a description of BSC adapter hardware and its programming support, see Section 13:10 under "Binary Synchronous Communications (BSC) Adapter."

Synchronous Data Link Control (SDLC) Communications Adapter

One SDLC Communications Adapter can be installed in a 5531 configuration and only one BSC adapter can be present in the 5531 configuration when the SDLC adapter is installed. One full-feature slot in the 5531 System Unit is required. An external modem must be cable-connected between the SDLC adapter and a telephone line using the Communications Adapter Cable feature.

The SDLC adapter in a 5531 is supported by the SNA 3270 Emulation and RJE Support Program.

For a description of the SDLC adapter and its programming support for the 5531, see Section 13:10 under "Synchronous Data Link Control (SDLC) Communications Adapter."

Communications Adapter Cable

This cable supports the attachment of a modem to the BSC adapter or SDLC adapter card connector at the back of the 5531 unit. 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 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 5531 unit and it requires one full-feature slot. This adapter in a 5531 is supported by the 5520/Personal Computer Attachment Program Version 2 or 3 to permit 5531 systems to communicate with a 5520 Administrative System and by the 5250 Emulation Program to permit a 5531 system to communicate with a System/34, System/36, or System/38.

The 5253 Emulation Installation Convenience Kit Version 2 or 3 can be purchased to provide the items necessary to permit attachment of the 5531 to the 5520 Administrative System (Display Station Emulation Adapter, 5520/Personal Computer Attachment Program Version 2 or 3, respectively, T-connector, and Twinaxial Cable Assembly).

The 5250 Emulation Convenience Kit provides the items required to connect the 5531 to a System/34, System/36, or System/38 (Display Station Emulation Adapter, 5250 Emulation Program, T-connector, and Twinaxial Cable Assembly).

For a description of the Display Station Emulation Adapter, the 5520/Personal Computer Attachment Program, and the 5250 Emulation Program, see Section 13:10 under "Display Station Emulation Adapter."

3278/79 Emulation Adapter

One 3278/79 Emulation Adapter can be installed in a 5531 configuration and it requires one full-feature slot in the 5531 unit. This adapter enables the 5531 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

When the 3278/79 Emulation Control Program is used, the 5531 Industrial Computer can emulate the functions of a 3278 Display Station Model 2 or a 3279 Color Display Station Model 2A or S2A. See Section 13:10 under "3278/79 Emulation Adapter" for a further discussion of the emulation program.

Cluster Adapter and Cluster Cable Kit

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

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. 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.

Operation of the cluster adapter and the IBM Personal Computer Cluster Program is the same as in the 5160 Personal Computer XT (see description in Section 13:10 under "Cluster Adapter and Cluster Cable Kit").

IBM Personal Computer XT/370 Option Kit

This feature (code 3891), which provides 3277 emulation, can be purchased to upgrade an IBM 5531 Industrial Computer to an IBM Personal Computer XT/370. The 5531 Industrial Computer must have 256Kb of memory installed on the system board and three available full-feature expansion slots. The Virtual Machine/Personal Computer (VM/PC) program, which operates under DOS Version 2.0 or later, supports the IBM Personal Computer XT/370 configuration.

The option kit provides the following:

- A set of three cards (PC/370-P, PC/370-M, and PC/3277EM) and three card support brackets. These cards must be installed in slots 4, 3, and 2, respectively, on the 5531 system board.
- A logo kit to change the nameplate on the 5531 System Unit to "IBM Personal Computer XT/370"
- A cable to connect two of the three provided cards (PC/370-P and PC/370-M)
- Installation instructions
- The *Guide to Operations* for the IBM Personal Computer XT/370

If the IBM Personal Computer XT/370 configuration is to be attached to a 3274 Control Unit, a customer-supplied coaxial cable (of up to 2000 feet) is required.

When the IBM Personal Computer XT/370 Option Kit is installed in a 5531 System Unit, the configuration becomes an IBM Personal Computer XT/370 configuration that can be used in an industrialized environment. See Section 14 for a description of the IBM Personal Computer XT/370 hardware that is provided by the IBM Personal Computer XT/370 Option Kit and the VM/PC programming support.

20:10 IBM 5531 System Unit

Single Unit Prices

Item	Part Number	Feature Code	Single Unit Purchase Price (\$)
5531 System Unit/Keyboard			
Model 1	5531001	—	5945
Model 21	5531021	—	6065
5532 Industrial Color Display	5532001	0001	850
Asynchronous Communications Adapter	1502074	2074	100
Binary Synchronous Communications Adapter	1502075	2075	240
Cluster Adapter	1501206	1206	340
Cluster Cable Kit	1501207	1207	110
Combination Adapter Cable	6421646	6001	75
Communications Adapter Cable (for use with the BSC or SDLC adapter)	1502067	2067	65
Display Station Emulation Adapter	6072534	2887	600
IBM Personal Computer XT/370 Option Kit (with 3277 emulation card)	1503891	3891	3790
Keylock Option Kit	6421587	6002	10
Math Co-processor Option	1501002	1002	230
Synchronous Data Link Control Communications Adapter	1502090	2090	240
256Kb Memory Expansion Option	1501209	1209	489
3278/79 Emulation Adapter	1602507	2507	905
5250 Emulation Convenience Kit	6092656	2886	745
5253 Emulation Installation Convenience Kit			
Version 2	6109564	2882	1013
Version 3	6403724	2896	1113
64Kb Memory Module Kit	1501003	1003	100
64/256Kb Memory Expansion Option	1501013	1013	265

Discounts Available

The 5531 System Unit and all its optional features may be eligible for one of the following discounts:

- Industrial Computer Volume Procurement Amendment
- Educational Allowance
- Special Bid

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.

20:15 IBM 5532 Industrial Color Display

The 5532 Industrial Color Display, shown on page 20-1, is an industrialized version of the 5153 Color Display that is available for other IBM personal computers. The 5532 has the following protection features:

- Heavier covers and more air circulation fans than the 5153 Color Display
- Intake air and cooling fan filters that should be inspected and replaced periodically
- A membrane under the keyboard keys to prevent dirt and moisture from entering the keyboard mechanism
- An impact-resistant cover over the screen. An optional clear screen cover accessory is also available.

The 5532 is a medium- to high-resolution direct drive RGB (red, green, blue) monitor that displays text and all-points-addressable graphics in color. One 5532 display can be attached to a 5531 unit via the Color/Graphics Monitor Adapter.

Highlights of the 5532 Color Display are:

- Three modes of operation are supported:
 - Text mode supports 256 characters, up to 25 lines with either 40 or 80 characters per line, and up to 16 foreground (character) colors on any one of 8 background colors. An 8 × 8 character box is used. Resolution of 320 pels horizontal, 200 pels vertical or 640 pels horizontal, 200 pels vertical is supported.
 - Medium-resolution (320 pels horizontal, 200 pels vertical) color graphics mode supports the use of two sets of four colors at a time. Each set provides three colors (green, red, and brown in one and cyan, magenta, and white in the other) that can be used against the fourth background color (any of the 16 colors supported). Text can be printed in graphics mode also. An 8 × 8 character box is used.
 - High-resolution (640 pels horizontal, 200 pels vertical) graphics mode supports the use of two colors (black and white) and an 8 × 8 character box.

- The 16 colors provided are:
 - Red
 - Light red
 - Magenta
 - Light magenta
 - Yellow
 - Green
 - Light green
 - Blue
 - Light blue
 - Brown
 - Cyan
 - Light cyan
 - Dark gray
 - Light gray
 - Black
 - White
- The character attributes of reverse video, blinking, and highlighting are available in black and white graphics mode. Blinking on a per-character basis is available in color graphics mode.

Physical characteristics of the 5532 Color Display are:

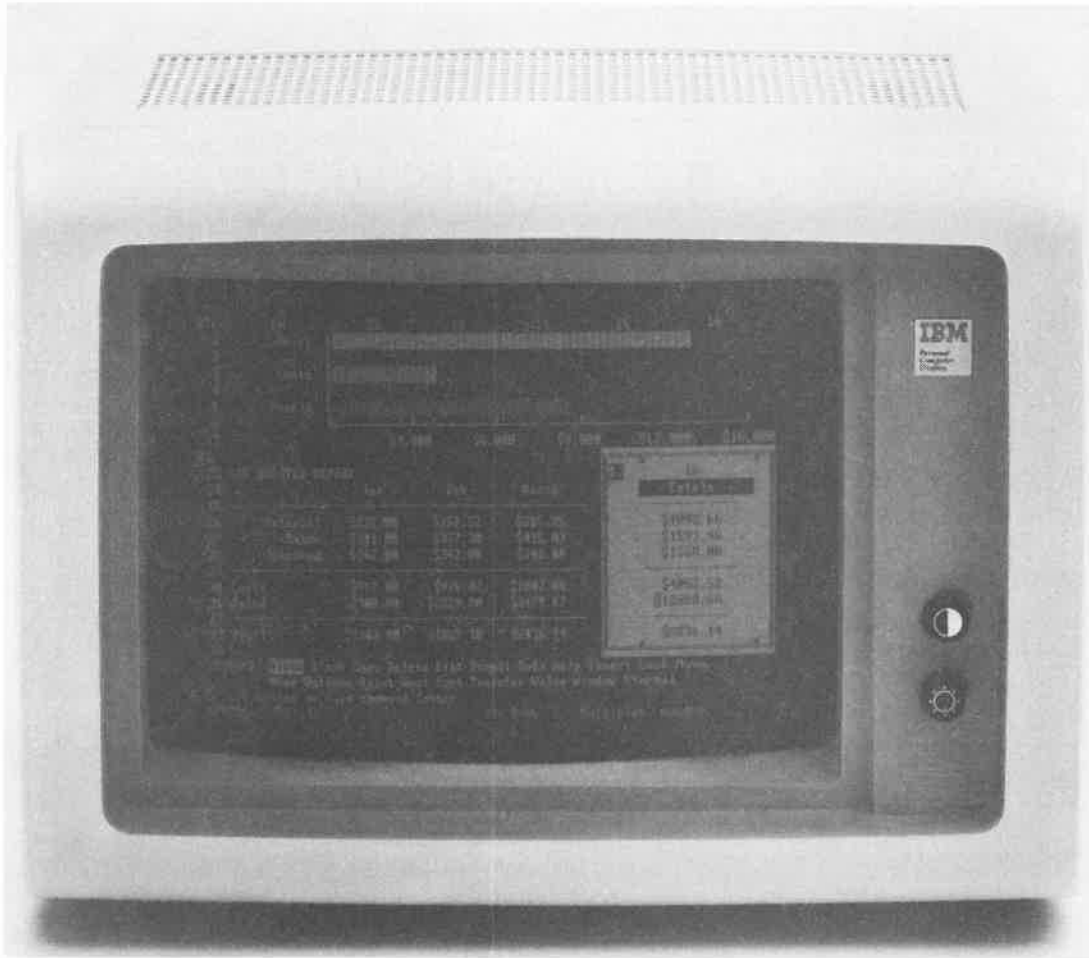
- Monitor screen size of 13 inches (340 mm) measured diagonally
- Side-operated brightness and contrast controls provided
- Horizontal scanning frequency of 15.75 KHz + or – 200 Hz
- Vertical drive of 60 Hz
- Temperature:
 - 32 to 112 degrees F (0 to 50 C) for system on
 - 32 to 131 degrees F (0 to 55 C) for system off
- Relative humidity: 8 to 80 degrees noncondensing
- Dimensions:
 - Width: 15.4 inches (392 mm)
 - Depth: 15.6 inches (407 mm)
 - Height: 11.7 inches (297 mm)
- Weight: Approximately 27 lb (12.3 kg)
- Electrical:
 - 120 volts, 60 Hz
 - 220 volts, 50 Hz

The 5532 is a customer-setup unit. It connects to the 5531 unit via a 5-foot (1.5-meter) signal cable and has a 6-foot (1.8-meter) power cord. It requires its own power source. The 5532 can be placed on top of the 5531 System Unit or on a desk or tabletop.

SECTION 30: MONOCHROME AND COLOR DISPLAYS

IBM 5151 Monochrome Display Model 1	Section 30:05
IBM 5153 Color Display Model 1	Section 30:10
IBM 4863 Color Display Model 1	Section 30:15
IBM 5154 Enhanced Color Display Model 1	Section 30:20
IBM 5175 Professional Graphics Display Model 1	Section 30:25

30:05 IBM 5151 Monochrome Display Model 1



Hardware Description

The 5151 Monochrome Display is a high-quality, high-resolution, direct-drive video monitor that displays alphanumeric data and, with the appropriate adapter, all-points-addressable graphics. A maximum of one 5151 display can be attached to the following:

- 5150 Personal Computer via the Monochrome Display and Printer Adapter or the Enhanced Graphics Adapter
- 5160 Personal Computer XT or XT/370 via the Monochrome Display and Printer Adapter or the Enhanced Graphics Adapter
- 5170 Personal Computer AT or AT/370 via the Monochrome Display and Printer Adapter or the Enhanced Graphics Adapter
- 3270 Personal Computer (3270-PC) via the 5151/5272 Adapter
- 3270 Personal Computer/Extended Graphics (3270-PG/GX) workstation via the Monochrome Display and Printer Adapter

The high resolution of the 5151 display is achieved by using more pels of resolution per square inch than regular monitors or TV sets. When the personal computer configuration is to be used primarily for viewing textual information for extended periods of time, the 5151 Monochrome Display is recommended instead of a color display.

When attached to the Monochrome Display and Printer Adapter, the 5151 display cannot be used to display all-points-addressable graphic images, such as those that can be created by programs written

using Advanced BASIC. However, a set of line and block characters is supported by the 5151 display for simple drawings and graphs when the 5151 is attached to the Monochrome Display and Printer Adapter or 5151/5272 Adapter. When attached to the Enhanced Graphics Adapter, all points addressable graphics and text modes are supported.

Highlights of the 5151 Monochrome Display are:

- When using the Monochrome Display and Printer Adapter:
 - Text mode only is supported.
 - Screen area displays 25 rows of 80 characters each (characters in green on a black background).
 - Characters are displayed using 7 × 9 pels in a 9 × 14 character box.
 - Resolution is 720 pels horizontal and 350 pels vertical.
 - A 256 character set is supported that includes uppercase and lowercase alphabetic characters, numbers, special characters, mathematical symbols, some foreign language characters, and graphics characters. The character set supported by the 5151 display is shown on the screen at one point during execution of the supplied diagnostics.
- When using the Enhanced Graphics Adapter:
 - Graphics and text modes are supported.
 - For graphics mode, the screen area displays 25 lines of 80 characters each using an 8 × 14 character box. Resolution is 640 × 350 pels.
 - For text mode, the screen area displays 25 lines of 80 characters each using a 9 × 14 character box, or 43 lines of 80 characters each using a 9 × 8 character box. Resolution is 720 × 350 pels.
 - User defined character sets (up to 8) are also supported.
- Character attributes provide underline, blinking, high intensity, reverse image (displaying the background in green and the characters in black), and nondisplay.

Physical characteristics of the 5151 Monochrome Display are:

- Screen size is 11.5 inches (283 millimeters) diagonally measured.
- Front-mounted brightness and contrast controls are easily adjusted by the operator.
- Screen is high-persistence green phosphor (P39) with an etched surface to reduce glare. The screen itself is also coated to reduce glare and soften reflections.
- Video signal is the maximum video bandwidth of 16.27 MHz. The screen is refreshed at 50 Hz.

Horizontal drive frequency is 18.432 KHz and transistor to transistor logic (TTL) compatible.

- Temperature requirements are:
 - 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
- Relative humidity requirements are:
 - 8% to 80% (noncondensing) for system on
 - 20% to 80% (noncondensing) for system off
- Dimensions are:
 - Width: 14.9 inches (380 mm)
 - Depth: 13.7 inches (350 mm)
 - Height: 11 inches (280 mm)
- Weight is approximately 17.3 lb (7.9 kg).
- Voltage is 120 volts, 60 Hz.

The 5151 display is a customer-setup unit. It plugs into and is powered on and off by the system unit in the configuration or the 5161 Expansion Unit. A three-foot (.914-m) power cable and a four-foot (1.22-m) signal cable are provided with the 5151 to connect it to the back of the system unit or 5161 unit. The 5151 display can be placed on top of or beside the system unit or the 5161 unit.

The optional Display Stand feature can be purchased for the 5151 display. The stand can be placed under the 5151 unit to permit the display to be tilted or swiveled for comfortable viewing. The stand has a length and width of 13.25 inches (336.6 mm) and a height of 4 inches (101.6 mm).

Operating Systems Supporting

The 5151 Monochrome Display is supported by the following IBM-Logo operating systems and control programs:

- IBM Personal Computer DOS (all versions)
- IBM Personal Computer/Interactive Executive (PC/IX)
- IBM PC XENIX™ System
- CP/M-86™
- UCSD p-System™
- VM/PC
- 3270-PC Graphics Control Program

Warranty Period

The warranty period is three months and the warranty service is Customer Carry-In Exchange.

30:05 IBM 5151 Monochrome Display Model 1

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

Single Unit Prices

5151 Monochrome Display (part number 5151001)	\$275
Display Stand (part number 6450216, feature code 0216)	\$69

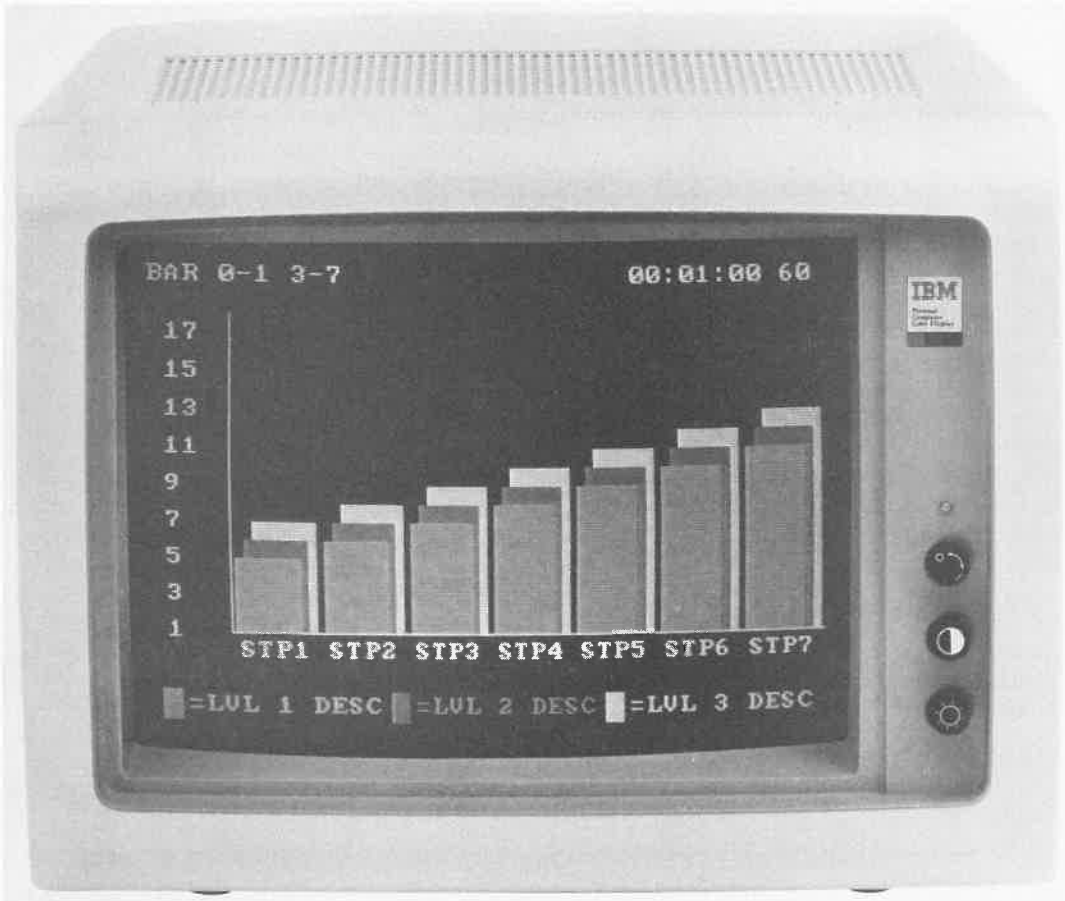
Discounts Available

The 5151 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.

30:10 IBM 5153 Color Display Model 1



Hardware Description

The 5153 Color Display is a medium- to high-resolution, direct-drive RGB (red, green, blue) monitor that displays text and all-points-addressable graphics in color. A maximum of one 5153 display can be attached to the following:

- 4860 PCjr via the Adapter Cable for IBM Color Display
- 5150 Personal Computer via the Color/Graphics Monitor Adapter or the Enhanced Graphics Adapter
- 5155 Portable Personal Computer via the Color/Graphics Monitor Adapter
- 5160 Personal Computer XT or XT/370 via the Color/Graphics Monitor Adapter or the Enhanced Graphics Adapter
- 5170 Personal Computer AT or AT/370 via the Color/Graphics Monitor Adapter or the Enhanced Graphics Adapter

The 5153 Color Display is recommended instead of a 5151 Monochrome Display when the personal computer configuration will be used primarily for graphics displays, color displays, and/or video games that require a color display. The 5153 provides lower resolution than the 5151 Monochrome Display for word processing or other text use.

30:10 IBM 5153 Color Display Model 1

Highlights of the 5153 Color Display are:

- When attached to the Color/Graphics Monitor Adapter, three modes of operation are supported:
 - Text mode supports 256 characters, up to 25 lines with either 40 or 80 characters per line, 2 or 16 colors, and resolutions of 320 pels horizontal, 200 pels vertical and 640 pels horizontal, 200 pels vertical. An 8 × 8 character box is used.
 - Medium-resolution (320 pels horizontal, 200 pels vertical) color graphics mode supports the use of two sets of four colors at a time. Each set provides three colors (green, red, brown in one and cyan, magenta, and white in the other) that can be used against the fourth background color (any of the 16 colors supported). Text can be printed in graphics mode also. An 8 × 8 character box is used.
 - High-resolution (640 pels horizontal, 200 pels vertical) black and white graphics mode supports the use of two colors (black and white) and an 8 × 8 character box.
- When attached to the Enhanced Graphics Adapter, the modes supported by the Color/Graphics Monitor Adapter and the following are supported:
 - 16 colors in medium-resolution (320 × 200 pels) mode for 40 columns with an 8 × 8 character box
 - 16 colors in high-resolution (640 × 200 pels) mode for 80 columns with an 8 × 8 character box
 - User-defined character sets (up to 8)
- The 16 colors provided are:

– Red	– Light blue
– Light red	– Brown
– Magenta	– Cyan
– Light magenta	– Light cyan
– Yellow	– Dark gray
– Green	– Light gray
– Light green	– Black
– Blue	– White
- The character attributes of reverse video, blinking, and highlighting are available in black and white graphics mode. Blinking on a per-character basis is available in color graphics mode.

Physical characteristics of the 5153 Color Display are:

- Monitor screen size of 13 inches (340 mm) measured diagonally
- Front-mounted brightness and contrast controls provided

- Vertical hold and vertical size controls provided on the rear panel
- Horizontal scanning frequency of 15.75 KHz + or – 200 Hz
- Vertical drive of 60 Hz
- 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
- Relative humidity:
 - 8% to 80% (noncondensing) for system on
 - 20% to 80% (noncondensing) for system off
- Dimensions:
 - Width: 15.4 inches (392 mm)
 - Depth: 15.6 inches (407 mm)
 - Height: 11.7 inches (297 mm)
- Weight: Approximately 26 lb (11.8 kg)
- Electrical:
 - 120 volts, 60 Hz
 - 220 volts, 50 Hz

The 5153 is a customer-setup unit. A 5-foot (1.5-meter) signal cable is provided to connect the 5153 to the back of the system unit in the configuration or to the 5161 Expansion Unit. The 5153 is not powered by the system unit or 5161 and requires its own power source. A 6-foot (1.8-meter) power cable is provided.

The 5153 display can be placed on top of or beside the 5150, 5155, 5160, or 5170 System Unit or the 5161 Expansion Unit. The 5153 display should not be placed on top of the 4860 System Unit because interference with the diskette drive can result.

The optional Display Stand feature can be purchased for the 5153 display. The stand can be placed under the 5153 unit to permit the display to be tilted or swiveled for comfortable viewing. The stand has a length and width of 13.25 inches (336.6 mm) and height of 4 inches (101.6 mm).

Operating Systems Supporting

The 5153 Color Display is supported by the following IBM-logo operating systems and control programs:

- IBM Personal Computer DOS (all versions)
- IBM Personal Computer/Interactive Executive (PC/IX)
- IBM PC XENIX™ System
- CP/M-86™
- UCSD p-System™
- VM/PC

Warranty Period

The warranty period is three months and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

Single Unit Prices

5153 Color Display (part number 5153001)	\$680
Display Stand (part number 6450216, feature code 0216)	\$69

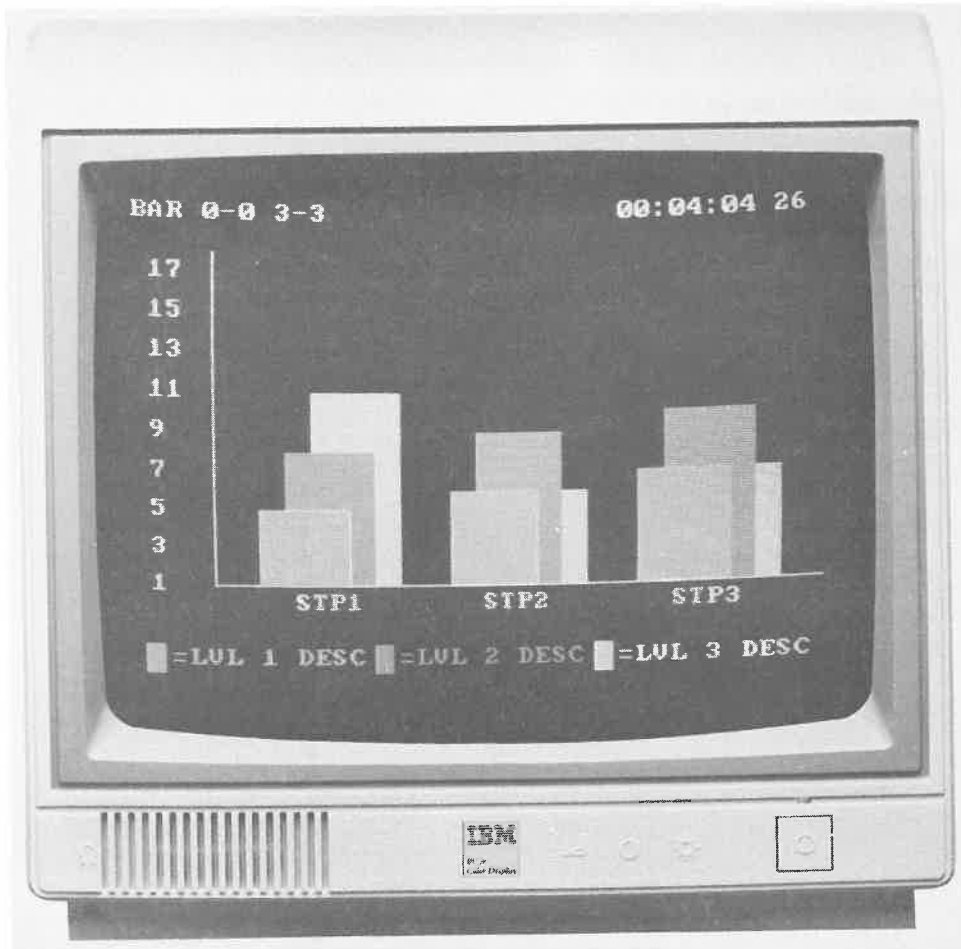
Discounts Available

The 5153 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.

30:15 IBM 4863 Color Display Model 1



Hardware Description

The 4863 Color Display is a medium-resolution, direct-drive RGB (red, green, blue) monitor that displays text and all-points-addressable graphics in color. The 4863 display is designed specifically for the PCjr configuration and can be attached to the 4860 via the Direct Drive (RGB) Video Connector.

The 4863 Color Display is a lower-cost display than the 5153 Color Display. The 4863 provides lower resolution than the 5153 for text mode of operation when 80 characters per line are used instead of 40. The medium-resolution all-points-addressable graphics mode of the 4863 and that of the 5153 are the same.

Highlights of the 4863 Color Display are:

- Two modes of operation are supported:
 - Text (alphanumeric)
 - Medium-resolution color graphics (all points addressable – APA)
- Text mode supports 256 characters, up to 25 lines with either 40 or 80 characters per line, 2 or 16 colors, and resolution of 320 × 200 pels.
- Medium-resolution color graphics mode supports the use of two sets of four colors at a time. Each set provides three colors (green, red, brown in one and cyan, magenta, and white in the other) that can be used against the fourth background color (any of the 16 colors supported). Text can be printed in graphics mode also. Resolution is 320 × 200 pels.

- The 16 colors provided are:
 - Red – Light blue
 - Light red – Brown
 - Magenta – Cyan
 - Light magenta – Light cyan
 - Yellow – Dark gray
 - Green – Light gray
 - Light green – Black
 - Blue – White
- Blinking on a character basis is available in color graphics mode.
- Internal speakers and an earphone connector are provided.

Physical characteristics of the 4863 Color Display are:

- Monitor screen size of 13 inches (340 mm) measured diagonally
- Has high contrast, non-glare screen
- Front-mounted brightness, contrast, and volume controls easily adjusted by the operator
- Vertical hold and vertical size controls provided on the rear panel
- Unit can be tilted up to 10 degrees
- Horizontal scanning frequency of 15.75 KHz + or – 200 Hz
- Vertical drive of 60 Hz
- Temperature:
 - 50 to 104 degrees F (10 to 40 C) for system on
 - 33 to 140 degrees F (1 to 60 C) for system off
- Relative humidity:
 - 8% to 80% (noncondensing) for system on
 - 20% to 80% (noncondensing) for system off
- Dimensions:
 - Width: 13.95 inches (354.4 mm)
 - Depth: 15.04 inches (382 mm)
 - Height: 12.9 inches (327.8 mm)
- Weight: approximately 26 lb (11.8 kg)
- Electrical: 120 volts, 60 Hz

The 4863 is a customer-setup unit and can be placed on top of or beside the 4860 unit. A 6-foot (1.8-meter) signal cable is provided to connect the 4863 to the back of the 4860 unit. The 4863 requires its own power source. The power cable provided is 6 feet (1.8 meters) in length.

Operating Systems Supporting

The 4863 Color Display is supported by IBM Personal Computer DOS as of Version 2.1.

Warranty Period

The warranty period is one year and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

Single Unit Prices

4863 Color Display (part number 4863001)	\$429
---	-------

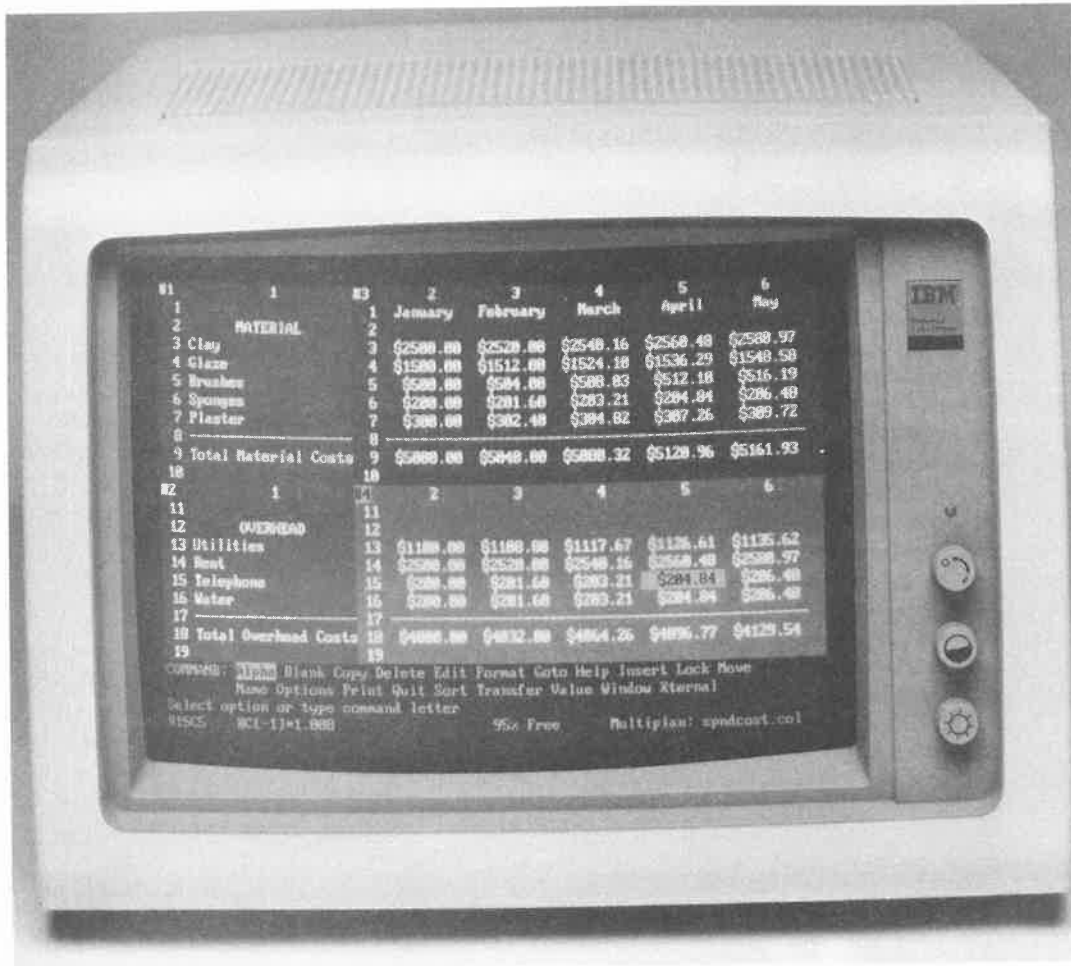
Discounts Available

The 4863 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.

30:20 IBM 5154 Enhanced Color Display Model 1



Hardware Description

The 5154 Enhanced Color Display is a high-resolution, direct-drive RGB (red, green, blue) monitor that displays text and all-points-addressable graphics in color. A maximum of one 5154 display can be attached to the following:

- 5150 Personal Computer via the Color/Graphics Monitor Adapter or the Enhanced Graphics Adapter
- 5160 Personal Computer XT or XT/370 via the Color/Graphics Monitor Adapter or the Enhanced Graphics Adapter
- 5170 Personal Computer AT or AT/370 via the Color/Graphics Monitor Adapter or the Enhanced Graphics Adapter

When attached to the Enhanced Graphics Adapter operating in enhanced display emulation mode or to the Color/Graphics Monitor Adapter, the 5154 operates in 5153 Color Display compatibility mode and supports 5153 characteristics as described in Section 30:10. When attached to the Enhanced Graphics Adapter operating in enhanced (not emulation) mode, the 5154 display supports a higher resolution for graphics mode (640 × 350 pels) than is supported by the 5153 and more colors to select from (up to 64).

Highlights of the 5154 Enhanced Color Display are:

- Text and graphics modes of operation are supported.
- For graphics mode using the Enhanced Graphics Adapter in enhanced mode, up to 16 colors

selected from a palette of 64 colors, 640 × 350 pels resolution, and an 8 × 14 character box are supported.

- For text mode using the Enhanced Graphics Adapter in enhanced mode, up to 16 colors selected from a palette of 64 colors, 640 × 350 pels resolution, 25 lines of 80 characters each (using an 8 × 14 character box) or 43 lines of 80 characters each (using an 8 × 8 character box) are supported. User defined character sets are supported for enhanced mode (up to 8).
- When attached to the Enhanced Graphics Adapter operating in enhanced display emulation mode or to the Color/Graphics Monitor Adapter, 640 × 200 pels and 320 × 200 pels resolution with 7 × 7 pels in an 8 × 8 character box are supported. Up to 16 colors are supported. Twenty-five lines of 40 or 80 characters are provided for text mode.

Physical characteristics of the 5154 Enhanced Color Display are:

- Monitor screen size of 13 inches (340 mm) measured diagonally
- Front-mounted brightness and contrast controls easily adjusted by the operator
- Vertical hold and vertical size controls provided on the rear panel
- High contrast and reduced glare provided by the dark etched screen
- Non-interlaced operation when attached to the Enhanced Graphics Adapter
- Horizontal scanning frequency of 15.75 KHz for the Color/Graphics Monitor Adapter or 22 KHz for the Enhanced Graphics Adapter in enhanced mode
- Vertical scan frequency of 50 to 60 Hz
- 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
- Relative humidity: 8% to 80% (noncondensing) for system on
- Dimensions:
 - Width: 15.5 inches (394 mm)
 - Depth: 17 inches (432 mm)
 - Height: 11.5 inches (292 mm)
- Weight: approximately 32 lb (14.5 kg)
- Electrical: 90 to 137 volts AC, 50/60 Hz

The 5154 is a customer-setup unit. A 3.6-foot signal cable is provided to connect the 5154 to the back of the system unit in the configuration or to the 5161 Expansion Unit. The 5154 is not powered by the system unit or 5161 and requires its own power source. The 5154 display can be placed on top of or beside the system unit or the 5161 unit.

The optional Display Stand feature can be purchased for the 5154 display. The stand can be placed under the 5154 unit to permit it to be tilted or swiveled for comfortable viewing. The stand has a length and width of 13.25 inches (336.6 mm) and a height of 4 inches (101.6 mm).

Operating Systems Supporting

The 5154 Enhanced Color Display is supported by the following IBM-logo operating systems and control programs when attached to the Color/Graphics Monitor Adapter or to the Enhanced Graphics Adapter operating in enhanced display emulation mode:

- IBM Personal Computer DOS (all versions)
- IBM Personal Computer/Interactive Executive (PC/IX)
- IBM PC XENIX™ System
- CP/M-86™
- UCSD p-System™
- VM/PC

When operating with the Enhanced Graphics Adapter in enhanced mode, the 5154 is supported by DOS.

Warranty Period

The warranty period is one year and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

30:20 IBM 5154 Enhanced Color Display Model 1

Single Unit Prices

5154 Enhanced Color Display (part number 5154001)	\$849
Display Stand (part number 6450216, feature code 0216)	\$69

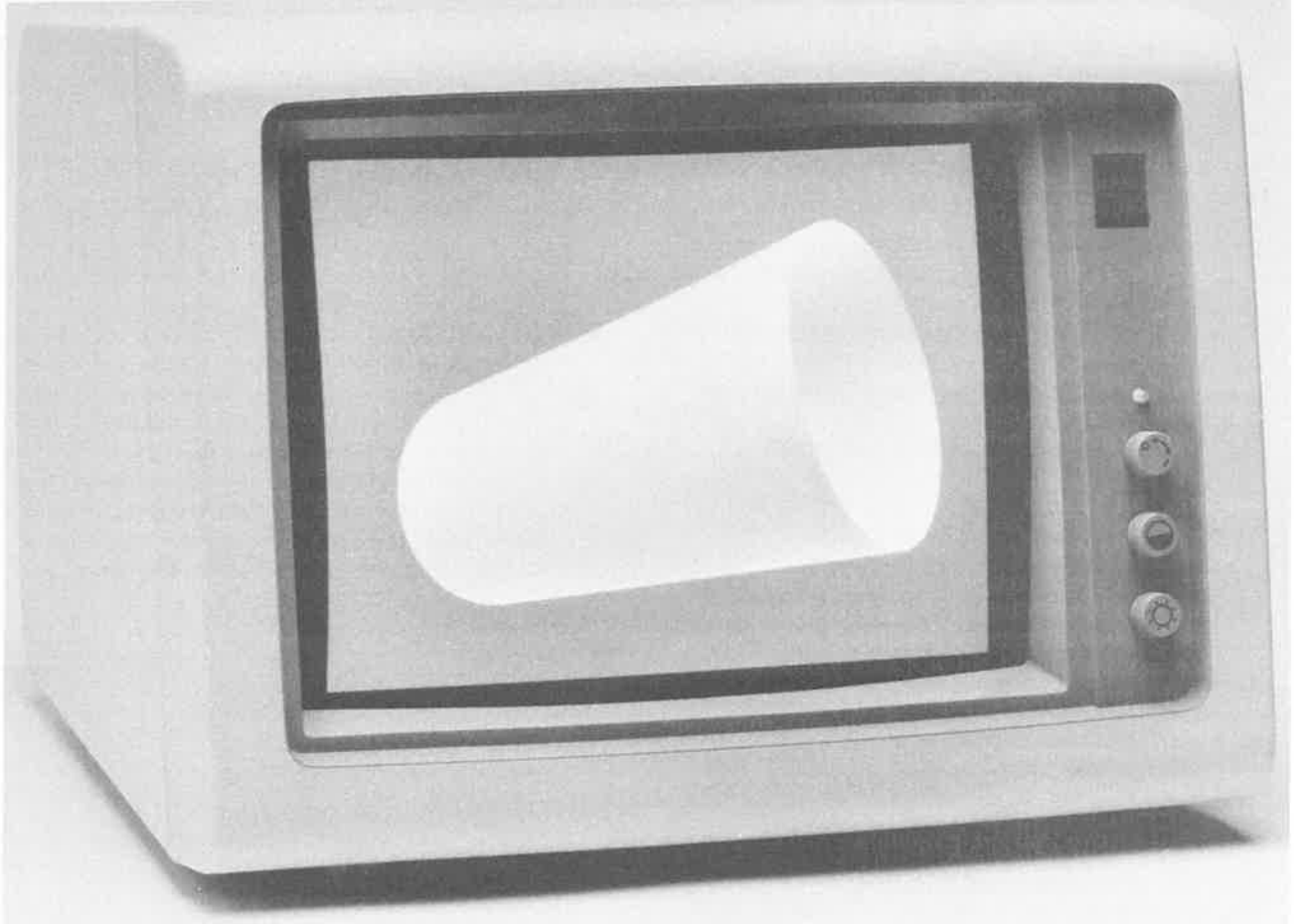
Discounts Available

The 5154 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.

30:25 IBM 5175 Professional Graphics Display Model 1



Hardware Description

The 5175 Professional Graphics Display is a high-definition, color, all-points-addressable graphics display that is designed for engineers, scientists, technicians, and designers. This display can be used for a wide range of specialized applications, including computer-aided manufacturing, computer-aided engineering, image processing, and business presentation graphics. A maximum of one 5175 display can be attached to the following:

- 5150 Personal Computer via the Professional Graphics Controller in the 5161 unit (not the 5150)
- 5155 Portable Personal Computer via the Professional Graphics Controller in the 5161 unit (not the 5155)
- 5160 Personal Computer XT or XT/370 via the Professional Graphics Controller
- 5170 Personal Computer AT or AT/370 via the Professional Graphics Controller

Highlights of the 5175 Professional Graphics Display are:

- Two modes of operation are supported:
 - Expanded graphics to support all the facilities of the 5175 display
 - Emulation to support the facilities of the Color/Graphics Monitor Adapter
- Expanded graphics mode provides 256 colors selected from a palette of 4096 colors.
- Resolution of 640 pels horizontal \times 480 pels vertical (400 pels vertical for emulation mode)

30:25 IBM 5175 Professional Graphics Display Model 1

and 67 pels per inch both horizontally and vertically are supported.

- An 8 × 16 character box (instead of 8 × 8 as provided by the Color/Graphics Monitor Adapter) and an enhanced text character set are supported for emulation mode.
- Blinking on a per character basis is available in color graphics mode.

Physical characteristics of the 5175 Professional Graphics Display are:

- Monitor screen size of 13 inches (340 mm) measured diagonally with anti-reflective coating and darkened screen to enhance contrast
- Viewing area of 9.45 × 7.09 inches (240 × 180 mm)
- Front-mounted brightness, contrast, and on/off controls provided
- Vertical hold and vertical size controls provided on the rear panel
- Horizontal scanning frequency of 30.48 KHz
- Vertical drive of 60 Hz (non-interlaced flicker-free refresh)
- Temperature: 60 to 90 degrees F (15.6 to 32.2 C) for system on
- Relative humidity: 8% to 80% (noncondensing) for system on
- Dimensions:
 - Width: 15.4 inches (392 mm)
 - Depth: 15.6 inches (407 mm)
 - Height: 11.7 inches (297 mm)
- Weight: approximately 26 lb (11.8 kg)
- Electrical: 90 to 137 volts, 60 Hz

The 5175 is a customer-setup unit. A 5-foot (1.5-meter) signal cable is provided to connect the 5175 to the back of the 5160 or 5170 System Unit or to the 5161 Expansion Unit for a 5150, 5155, or 5160 configuration. The 5175 requires its own power source. A 6-foot (1.8-meter) power cable is provided.

The 5175 display can be placed on top of or beside the 5150, 5155, 5160, or 5170 System Unit or the 5161 unit. The optional Display Stand can be purchased for the 5175 display. The stand can be placed under the 5175 unit to permit the display to be tilted or swiveled for comfortable viewing. The stand has a length and width of 13.25 inches (336.6 mm) and height of 4 inches (101.6 mm).

Operating Systems Supporting

The 5175 Professional Graphics Display is supported by IBM Personal Computer DOS.

Warranty Period

The warranty period is one year and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

Single Unit Prices

5175 Professional Graphics Display (part number 5175001)	\$1295
Display Stand (part number 6450216, feature code 0216)	\$69

Discounts Available

The 5175 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.

SECTION 31: PRINTERS

IBM 5152 Graphics Printer Model 2	Section 31:05
IBM 5181 Compact Printer Model 1	Section 31:10
IBM 5182 Color Printer Model 1	Section 31:15
IBM 3852 Color Printer Model 1	Section 31:20
IBM 5201 QUIETWRITER Printer Model 1	Section 31:25
IBM 5216 Wheelprinter Model 2	Section 31:30

31:05 IBM 5152 Graphics Printer Model 2



Hardware Description

The 5152 Graphics Printer Model 2 is a quality, dot matrix, impact, tabletop printer that can print graphic images as well as text characters on continuous single-part or multiple-part forms. It can be attached to the following:

- 4860 PCjr via the Parallel Printer Attachment
- 5150 Personal Computer via the Monochrome Display and Printer Adapter or the Printer Adapter
- 5155 Portable Personal Computer via the Printer Adapter
- 5160 Personal Computer XT or XT/370 via the Monochrome Display and Printer Adapter or the Printer Adapter
- 5170 Personal Computer AT or AT/370 via the Monochrome Display and Printer Adapter or the Serial/Parallel Adapter (parallel port)

- 3270 Personal Computer (3270-PC) via the Printer Adapter or Printer/Memory Adapter
- 3270 Personal Computer/Graphics and 3270 Personal Computer/Extended Graphics (3270-PC/G and GX) workstations via the Printer Adapter or Printer/Memory Adapter

The 5152 Model 2 printer has the following characteristics:

- Bidirectional printing (prints one line left to right and the next right to left, etc.)
- 80 characters per second nominal print speed
- Line buffer for performance
- 12 character styles
- Character font: 9 × 9 dot matrix

- Normal, compressed, emphasized, double-strike, subscript, superscript, double-width, and underline modes provided. Modes can be combined as shown below – those in the same column – (see examples in Figure 31-1):

Printer Modes	Combinations Supported			
Normal	X	X	X	
Compressed		X	X	X
Emphasized				X X X
Double-strike	X		X	X
Subscript	X		X	X
Superscript		X		X
Double-width	X	X	X	X X X
Underline	X	X	X	X X X

- Four print sizes: 5 characters per inch to 17.1 characters per inch
- Characters per line:
 - 80 (normal size), 10 characters per inch
 - 40 (double width size), 5 characters per inch
 - 132 (compressed size), 17.1 characters per inch
 - 66 (compressed double width size), 8.25 characters per inch
 - 80 (subscript), 10 characters per inch
 - 80 (superscript), 10 characters per inch
- Normal print size (for 80 characters per line):
 - .08 inches (2.1 mm) wide
 - .12 inches (3.2 mm) high
- Two character sets (shown in Figures 31-2 and 31-3) consisting of:
 - 96 standard ASCII characters (includes uppercase and lowercase)
 - Graphics characters (64)
 - European characters
 - Greek characters
 - Mathematical and various symbols
- Variable form length
- Skip to top of next page (manual or programmed)
- Horizontal tab stops controlled by programming
- Warning beep when out of forms or when activated from the system unit
- Printer self-test that does not require the system unit. (When the form feed and line feed push-buttons are held down and then the printer is powered on, rows of characters are printed continuously to test the operation of the printer. The printer must be offline to the system unit.)
- Replaceable print head
- Replaceable black ribbon cartridge good for 3 million characters (or about 10.4 hours of nonstop use)
- Adjustable pinfeed tractors for paper feed
- Continuous-form paper
- Paper width: 4 inches (101.6 mm) to 10 inches (254 mm)

- Copies: One original with two carbon copies
- Paper thickness: .012 inch (.3 mm) maximum including copies, .0025 inch (.064 mm) minimum
- Line spacing: 6 lines per inch or programmable
- Dimensions:
 - Width: 15.7 inches (400 mm)
 - Depth: 12 inches (305 mm)
 - Height: 4.2 inches (107 mm)
- Weight: Approximately 12 lb (5.5 kg)
- Electrical: 120 volts AC, 60 Hz (a 220- and a 240-volt model are also available for 50/60 Hz)
- Environmental requirements:
 - 41 to 95 degrees F (5 to 35 C)
 - 10% to 80% humidity (noncondensing)

Two DIP (dual inline package) switches are located within the 5152 unit (on the control circuit board). These switches control several functions, such as the character set to be used, form length, line spacing, and warning buzzer on or off. The switches are set to defaults at the factory (character set 1, 11-inch form length, 6 lines per inch, and error buzzer on, for example). Default settings can be changed during execution of a program using printer control codes. For a description of DIP switch functions and default settings and the printer control codes for the 5152 printer, see the *Options and Adapters Technical Reference* manual (6322509). Printer control codes are also given in the *Guide to Operations* manual that is supplied with the configuration.

The 5152 printer can be placed on top of the system unit or 5161 unit. Alternatively, the optional Printer Stand feature (shown on page 31-2) can be purchased for the 5152. It supports the 5152 printer and provides space-saving storage for fanfold paper below the printer. The stand can also be placed on the system unit or 5161 unit.

The 5152 Printer Model 2 is a customer-setup unit. The optional Printer Cable feature, which provides a six-foot (1.8-meter) signal cable, must be purchased to attach the 5152 to the back of the system unit in the configuration or to the 5161 Expansion Unit. The 5152 has a six-foot (1.8-meter) power cable and requires its own power source.

Operating Systems Supporting

The 5152 Model 2 is supported by the following IBM-logo operating systems and control programs:

- IBM Personal Computer DOS (all versions)
- IBM Personal Computer/Interactive Executive (PC/IX)
- IBM PC XENIX™ System

31:05 IBM 5152 Graphics Printer Model 2

- CP/M-86™
- UCSD p-System™
- VM/PC
- 3270-PC Control Program
- 3270-PC Graphics Control Program

Warranty Period

The warranty period is three months and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

STANDARD DOT MATRIX PRINT

COMPRESSED

COMPRESSED, DOUBLE STRIKE

COMPRESSED, DOUBLE WIDTH

COMPRESSED, DOUBLE STRIKE, DOUBLE WIDTH

EMPHASIZED

EMPHASIZED, DOUBLE STRIKE

EMPHASIZED, DOUBLE WIDTH

STANDARD, DOUBLE WIDTH

DOUBLE STRIKE, DOUBLE WIDTH

Figure 31-1. Examples of 5152 printing

Single Unit Prices

Item/Part Number/Feature Code	Single Unit Purchase Price (\$)
5152 Graphics Printer Model 2 (5152002)	449
Printer Cable (1525612) (5612)	45
Printer Stand (1525614) (5614)	45

Discounts Available

The 5152 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.

0	1	2	3	4	5	6	7	8	9
NUL							BEL		HT
10	11	12	13	14	15	16	17	18	19
LF	VT	FF	CR	SO	SI			DC2	
20	21	22	23	24	25	26	27	28	29
DC4				CAN			ESC		
30	31	32	33	34	35	36	37	38	39
		SP	!	"	#	\$	%	&	'
40	41	42	43	44	45	46	47	48	49
(	)	*	+	,	-	.	/	0	1
50	51	52	53	54	55	56	57	58	59
2	3	4	5	6	7	8	9	:	;
60	61	62	63	64	65	66	67	68	69
<	=	>	?	Ⓞ	A	B	C	D	E
70	71	72	73	74	75	76	77	78	79
F	G	H	I	J	K	L	M	N	O
80	81	82	83	84	85	86	87	88	89
P	Q	R	S	T	U	V	W	X	Y
90	91	92	93	94	95	96	97	98	99
Z	[	\	\]	^	_	`	a	b	c
100	101	102	103	104	105	106	107	108	109
d	e	f	g	h	i	j	k	l	m
110	111	112	113	114	115	116	117	118	119
n	o	p	q	r	s	t	u	v	w
120	121	122	123	124	125	126	127	128	129
x	y	z	{	|	}	~		NUL	

130	131	132	133	134	135	136	137	138	139	
					BEL		HT	LF	VT	
140	141	142	143	144	145	146	147	148	149	
FF	CR	SO	SI			DC2		DC4		
150	151	152	153	154	155	156	157	158	159	
		CAN			ESC					
160	161	162	163	164	165	166	167	168	169	
á	í	ó	ú	ñ	Ñ	à	ò	ì	␣	
170	171	172	173	174	175	176	177	178	179	
␣	½	¼	¡	«	»	▒	▒	▒	▒	
180	181	182	183	184	185	186	187	188	189	
†	†	†	†	†	†	†	†	†	†	
190	191	192	193	194	195	196	197	198	199	
†	†	†	†	†	†	†	†	†	†	
200	201	202	203	204	205	206	207	208	209	
†	†	†	†	†	†	†	†	†	†	
210	211	212	213	214	215	216	217	218	219	
†	†	†	†	†	†	†	†	†	†	
220	221	222	223	224	225	226	227	228	229	
▒	▒	▒	▒	▒	α	β	Γ	Π	Σ	σ
230	231	232	233	234	235	236	237	238	239	
μ	τ	ϕ	θ	Ω	δ	∞	∅	ε	∩	
240	241	242	243	244	245	246	247	248	249	
≡	±	≥	≤	∫	J	÷	≈	°	■	
250	251	252	253	254	255					
-	√	n	²	■	SP					

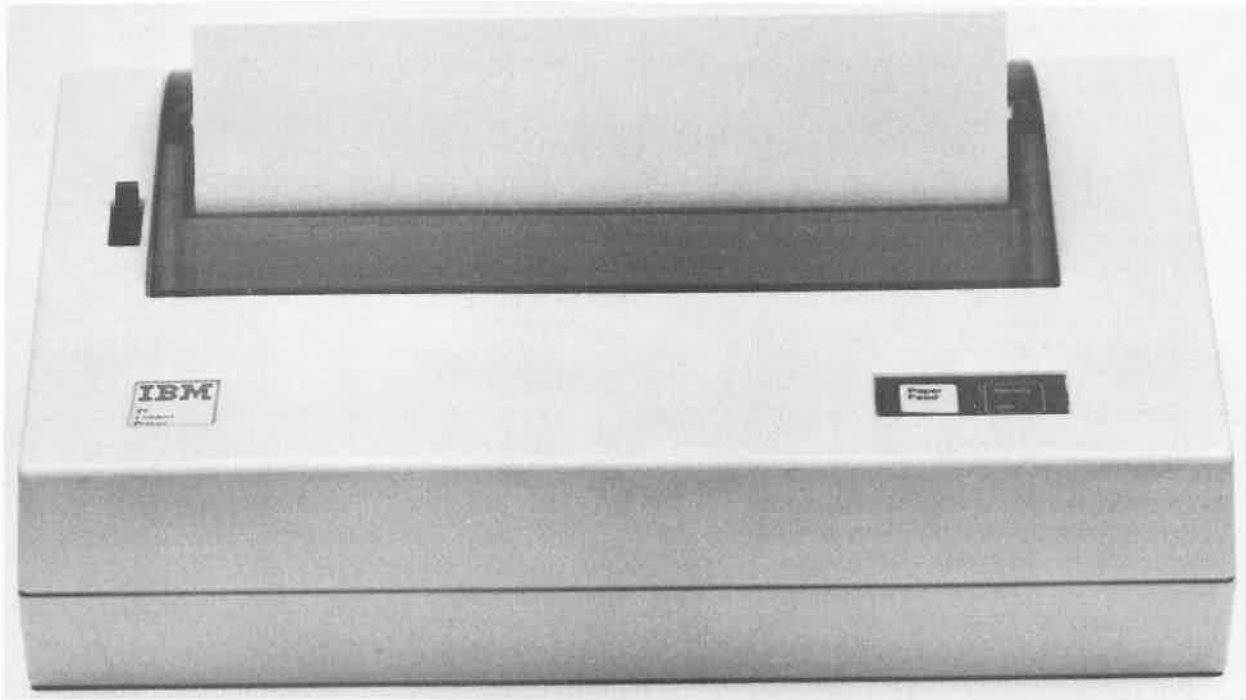
Figure 31-2. Character Set 1 for the 5152 Graphics Printer

0	1	2	3	4	5	6	7	8	9
NUL			♥	♦	♣	♠	BEL		HT
10	11	12	13	14	15	16	17	18	19
LF	VT	FF	CR	SO	SI			DC2	
20	21	22	23	24	25	26	27	28	29
DC4	§			CAN			ESC		
30	31	32	33	34	35	36	37	38	39
		SP	!	”	#	\$	%	&	'
40	41	42	43	44	45	46	47	48	49
(	)	*	+	,	-	.	/	0	1
50	51	52	53	54	55	56	57	58	59
2	3	4	5	6	7	8	9	:	;
60	61	62	63	64	65	66	67	68	69
<	=	>	?	⊙	A	B	C	D	E
70	71	72	73	74	75	76	77	78	79
F	G	H	I	J	K	L	M	N	O
80	81	82	83	84	85	86	87	88	89
P	Q	R	S	T	U	V	W	X	Y
90	91	92	93	94	95	96	97	98	99
Z	[	\	\]	^	_	`	a	b	c
100	101	102	103	104	105	106	107	108	109
d	e	f	g	h	i	j	k	l	m
110	111	112	113	114	115	116	117	118	119
n	o	p	q	r	s	t	u	v	w
120	121	122	123	124	125	126	127	128	129
x	y	z	{	|	}	~		ç	ü

130	131	132	133	134	135	136	137	138	139
é	â	ä	à	á	ç	ê	ë	è	ï
140	141	142	143	144	145	146	147	148	149
î	ì	Ä	Â	É	æ	Æ	ô	ö	ò
150	151	152	153	154	155	156	157	158	159
û	ù	ÿ	ö	ü	ç	£	¥	₪	₹
160	161	162	163	164	165	166	167	168	169
á	í	ó	ú	ñ	Ñ	à	o	ı	ƒ
170	171	172	173	174	175	176	177	178	179
⌋	½	¼	ı	«	»	▒	▒	▒	▒
180	181	182	183	184	185	186	187	188	189
†	†	†	†	†	†	†	†	†	†
190	191	192	193	194	195	196	197	198	199
†	†	†	†	†	†	†	†	†	†
200	201	202	203	204	205	206	207	208	209
†	†	†	†	†	†	†	†	†	†
210	211	212	213	214	215	216	217	218	219
†	†	†	†	†	†	†	†	†	†
220	221	222	223	224	225	226	227	228	229
▒	▒	▒	▒	α	β	Γ	Π	Σ	σ
230	231	232	233	234	235	236	237	238	239
μ	τ	ϕ	θ	Ω	δ	∞	∅	€	∩
240	241	242	243	244	245	246	247	248	249
≡	±	≥	≤	∫	J	÷	≈	°	■
250	251	252	253	254	255				
-	√	n	²	■	SP				

Figure 31-3. Character Set 2 for the 5152 Graphics Printer

31:10 IBM 5181 Compact Printer Model 1



Hardware Description

The 5181 Compact Printer Model 1 is a lightweight, low-cost, thermal, tabletop printer that prints text and all-points-addressable graphics on thermally-sensitive cut-sheet, roll, or fanfold paper. It can be attached to the following:

- 4860 PCjr via the standard Serial Port Connector (Parallel Printer Attachment must not be installed in the 4860)
- 5150 Personal Computer via the Compact Printer Connector Adapter attached to the Asynchronous Communications Adapter
- 5155 Portable Personal Computer via the Compact Printer Connector attached to the Asynchronous Communications Adapter
- 5160 Personal Computer XT or XT/370 via the Compact Printer Connector Adapter attached to the Asynchronous Communications Adapter

The 5181 Model 1 has the following characteristics:

- Print speed: 50 characters per second for standard character printing and 2400 pels per second for image printing
- Typical throughput of 25 characters per second
- Print matrix (thermal head technology): 5 × 8 dot matrix (5 × 7 for all alpha characters except lowercase)
- Print quality: 560 pels per 8-inch line, 8 pels vertically
- Unidirectional printing (left to right)
- Standard, compressed, double-width, and underline print modes provided. Combinations of modes are supported as follows:
 - Standard and underline
 - Compressed and underline
 - Double-width and underline
 - Compressed and double-width
 - Compressed, double-width, and underline
- Characters per line and inch:
 - 80 characters per line (standard), 10 characters per inch
 - 40 characters per line (double-width), 5 characters per inch
 - 136 characters per line (compressed), 17.5 characters per inch
 - 68 characters per line (compressed, double-width), 8.75 characters per inch
- Character set: 128 standard ASCII, total of 191 printable characters (see Figure 31-4)
- Paper width: 8.5 inches (21.6 cm)
- Single-sheet printing only (no copies)
- Print color: Black only

31:10 IBM 5181 Compact Printer Model 1

- Paper available from SSD as follows:
 - Roll 89 feet long, 2 rolls per box (1503923)
 - Cut-sheet package of 250 sheets (1503924)
 - Fanfold package of 250 pages (1503926)
 - All paper is 8.5 inches wide and each sheet or page is 11 inches long
- Line spacing: Selectable at 6 or 9 lines per inch
- Interface:
 - Serial EIA (modified RS-232C)
 - 1200 bits per second
 - 8-bit ASCII (two stop bits, no parity check)
 - 256-character buffer
- Dimensions:
 - Height: 3.5 inches (88.9 mm)
 - Width: 12.3 inches (312.4 mm)
 - Depth: 8.7 inches (221 mm)
- Weight: 6.6 lb (3 kg)
- Acoustics: 55 decibels (dB)
- Environmental characteristics:
 - Operating temperature: 41 to 104 degrees F (5 to 40 C)
 - Operating humidity: 10% to 80% noncondensing
- Electrical: 120 volts, 50/60 Hz

Printer control characters for the 5181 printer are contained in the *Guide to Operations* manual supplied with the configuration and *Options and Adapters Technical Reference* manual (6322509).

The 5181 Model 1 is a customer-setup unit. A 6-foot (1.8-meter) attachment cable is supplied with the 5181 Model 1 printer to connect it to the appropriate connector/adaptor. It requires its own power source and has a 6.5-foot (2-meter) power cable. This unit can be placed on top of the 4860 PCjr System Unit as well as on top of 5150, 5155, 5160, and 5161 units.

Operating Systems Supporting

The 5181 Model 1 is supported by the following IBM-logo operating systems and control programs:

- IBM Personal Computer DOS as of Version 2.1
- IBM Personal Computer/Interactive Executive (PC/IX)
- VM/PC

Warranty Period

The warranty period is one year and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

Single Unit Prices

Item/Part Number/Feature Code	Single Unit Purchase Price (\$)
5181 Compact Printer Model 1 (5181001)	175
Compact Printer Connector Adapter (6450102) (0102)	40

Discounts Available

The 5181 and its adapter 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

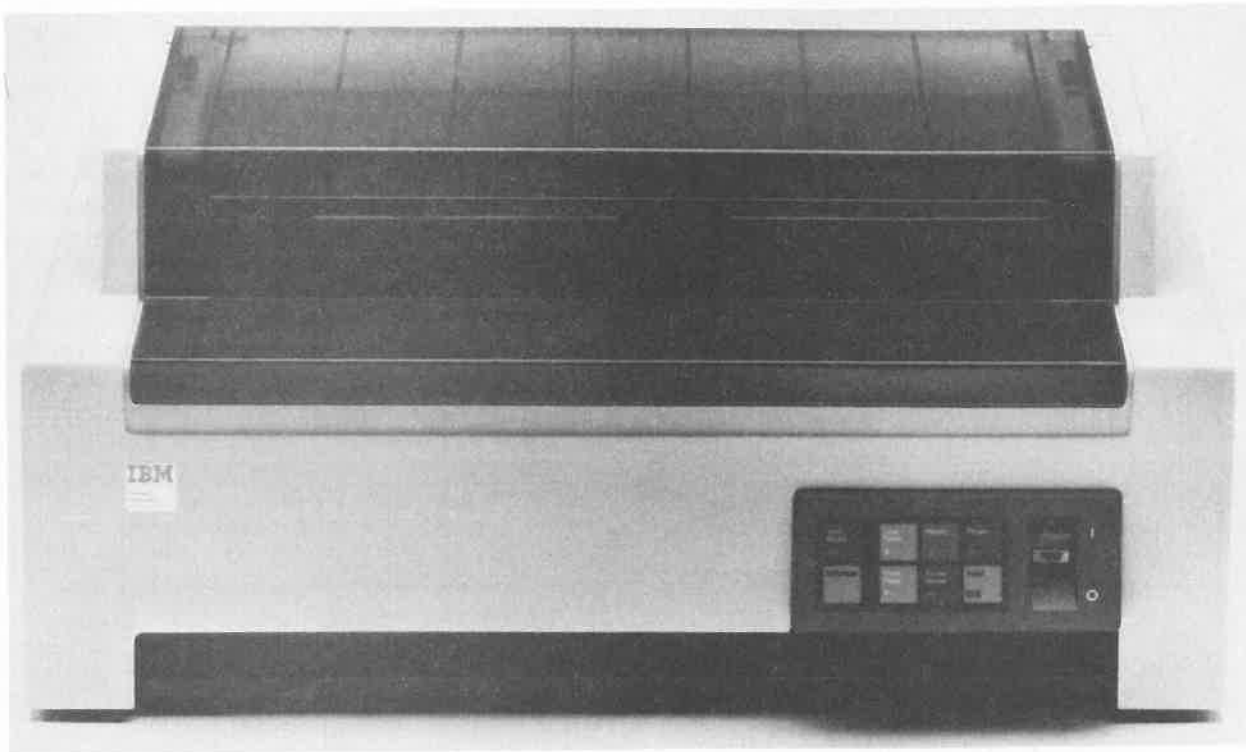
Single Delivery Quantity and Quantity Purchase Plan discounts are available from IBM Product Centers.

0	1	2	3	4	5	6	7	8	9
NUL			♥	♦	♣	♠	●	●	HT
10	11	12	13	14	15	16	17	18	19
LF	VT	FF	CR	SO	SI	◀	▶	DC2	!!
20	21	22	23	24	25	26	27	28	29
DC4	§	■	↕	CAN	↓	→	ESC	L	↔
30	31	32	33	34	35	36	37	38	39
▲	▼	SP	!	"	#	\$	%	&	'
40	41	42	43	44	45	46	47	48	49
(	)	*	+	,	-	.	/	0	1
50	51	52	53	54	55	56	57	58	59
2	3	4	5	6	7	8	9	:	;
60	61	62	63	64	65	66	67	68	69
<	=	>	?	⊙	A	B	C	D	E
70	71	72	73	74	75	76	77	78	79
F	G	H	I	J	K	L	M	N	O
80	81	82	83	84	85	86	87	88	89
P	Q	R	S	T	U	V	W	X	Y
90	91	92	93	94	95	96	97	98	99
Z	[	\	\]	^	_	`	a	b	c
100	101	102	103	104	105	106	107	108	109
d	e	f	g	h	i	j	k	l	m
110	111	112	113	114	115	116	117	118	119
n	o	p	q	r	s	t	u	v	w
120	121	122	123	124	125	126	127	128	129
x	y	z	{	|	}	~	DEL	Ç	ü

130	131	132	133	134	135	136	137	138	139
é	â	ä	à	å	ç	ê	ë	è	ï
140	141	142	143	144	145	146	147	148	149
î	ì	Ä	Å	É	æ	Æ	ô	ö	ò
150	151	152	153	154	155	156	157	158	159
û	ù	ÿ	ö	ü	ç	£	¥	₤	₣
160	161	162	163	164	165	166	167	168	169
á	í	ó	ú	ñ	Ñ	à	o	¿	┘
170	171	172	173	174	175	176	177	178	179
┘	½	¼	¡	«	»				
180	181	182	183	184	185	186	187	188	189
190	191	192	193	194	195	196	197	198	199
200	201	202	203	204	205	206	207	208	209
210	211	212	213	214	215	216	217	218	219
220	221	222	223	224	225	226	227	228	229
				α	β	Γ	Π	Σ	σ
230	231	232	233	234	235	236	237	237	239
μ	τ	ϕ	θ	Ω	δ	∞	∅	ε	∩
240	241	242	243	244	245	246	247	248	249
≡	±	≥	≤	∫	J	÷	≈	°	■
250	251	252	253	254	255				
-	√	∩	2	■	SP				

Figure 31-4. Character Set for the 5181 Compact Printer

31:15 IBM 5182 Color Printer Model 1



Hardware Description

The 5182 Color Printer Model 1 is a high-resolution, bidirectional, dot-matrix, tabletop printer that prints text and graphics in black or four or eight colors. Draft, correspondence, and near-letter-quality modes of printing are supported. This printer can be attached to the following:

- 5150 Personal Computer via the Monochrome Display and Printer Adapter or via the Printer Adapter
- 5155 Portable Personal Computer via the Printer Adapter
- 5160 Personal Computer XT or XT/370 via the Monochrome Display and Printer Adapter or the Printer Adapter
- 5170 Personal Computer AT or AT/370 via the Monochrome Display and Printer Adapter or a Serial/Parallel Adapter (parallel port)
- 3270 Personal Computer (3270-PC) workstation via the Printer Adapter or the Printer/Memory Adapter
- 3270 Personal Computer/Graphics and 3270 Personal Computer/Extended Graphics

(3270-PC/G and GX) workstations via the Printer Adapter or Printer/Memory Adapter

The 5182 Model 1 has the following characteristics:

- Four print modes: draft, text, near-letter-quality, and all-points-addressable graphics
- Print speed:
 - 200 cps for draft mode (the default speed)
 - 120 cps for text proportional spacing
 - 110 cps for text fixed spacing
 - 35 cps for near-letter-qualityThe print screen capability (PrtSc key) is supported for draft and text modes.
- Bidirectional printing
- Print head: Ballistic type using 9-wire (5 × 4 array) staggered design (250M-character life)
- Print matrix:
 - 9 × 9 draft mode
 - 24 × 9 text mode
 - 36 × 18 near-letter-quality mode
 - 24 × 14 line graphics mode
- Characters per line:
 - 132 (normal), 10 characters per inch
 - 66 (double width), 5 characters per inch
 - 225.7 (compressed), 17.1 characters per inch

- 175.5 (double width, compressed), 13.3 characters per inch
- 158.4 (average for proportional), 12 characters per inch average
- 132 (subscript), 10 characters per inch
- 132 (superscript), 10 characters per inch
- Character size/pitch:
 - .09 to .10 inch high
 - Double-width characters at each line density
 - Superscripting and subscripting via line indexing
 - Line graphic characters .167 inch high
 - Two aspect ratios (5:6 standard, 1:1 selectable)
- Graphics mode:
 - 82.5 × 82.5 pels per inch matrix (1.1 aspect ratio)
 - Each of upper eight head wires addressable by one bit of each byte sent
 - All points addressable
 - Print screen capability (PrtSc key) not supported in graphics mode
- Two character sets (shown in Figures 31-5 and 31-6) consisting of:
 - 96 standard ASCII characters (includes uppercase and lowercase)
 - Graphics characters
 - European characters
 - Greek characters
 - Mathematical and various symbols.

The ability to print all characters (including those used as printer control codes) is also provided (see Figure 31-7 for the all-printable character set). Character codes match those of the 5152 Graphics Printer Model 2 and 5151 and 5153 displays.
- Typestyles and font:
 - Typestyles for near-letter-quality, text, data, and graphics modes (all sans serif)
 - Helvetica-like font
- Character spacing: Fixed and proportional
- Automatic text justification: Software selectable
- Paper types:
 - Fanfold and cut-sheet in single ply
 - Up to four-part forms for fanfold
- Paper width: 5 to 14.875 inches (12.7 to 37.5 cm); print line width: 13.5 inches
- Paper feeds:
 - Tractor feed
 - Manual single sheet feed
- Forms length control:
 - Selectable by software or a switch
 - Forms lengths of 8.5, 11, 12, and 14 inches
 - Automatic perforation skipping
 - Top of forms control by operator when printer is offline
 - Arbitrary form lengths software selectable
- Line spacing:
 - 6 or 8 lines per inch, switch selectable
 - Arbitrary line spacing software selectable for bit-image graphics
- Programmable features: print mode, line spacing, line width, forms length, intercharacter spacing, margins, tabs, and automatic underline
- Slew rate: 7.5 inches per second (stepper-motor pinfeed tractor)
- Line buffering: automatic multiple line buffering of 6K bytes
- Ribbon:
 - Mixable color ribbon (eight colors) provided with each printer (a four-color and an all-black ribbon are also available)
 - Easily changed cartridge (.75 thick, 36 yards long)
 - 1.5 million-character color ribbon
- Colors: black, cyan, magenta, yellow, orange, green, violet, and brown
- Ribbon saver function for black ribbon (automatic lift of bands at end of page)
- Dimensions:
 - Height: 10 inches (244 mm)
 - Width: 22.75 inches (578 mm)
 - Depth: 14 inches (354 mm)
- Weight: 40 lb (18.4 kg)
- Acoustics: 64 decibels (dB)
- Power requirements (user selectable):
 - 120 volts, 60 Hz (factory set)
 - 200 volts, 50 or 60 Hz
 - 220 volts, 50 or 60 Hz
- Environmental requirements:
 - Operating temperature: 50 to 104 degrees F (10 to 40 C)
 - Operating humidity: 10% to 80% noncondensing
- Printer diagnostics:
 - Automatic power-on set
 - Operator-initiated self-test (repeats alphanumeric patterns and tests colors)
 - Host-driven test

A dual inline package (DIP) switch is present in the 5182 unit. It has switches that set the default for certain functions (character set used, line spacing, page length, characters per line, for example) when power is turned on. These functions can also be changed by programming using printer control codes. For a description of DIP switch functions and default settings and the printer control codes for the 5182, see the *Options and Adapters Technical Reference* manual (6322509). Printer control codes are also given in the *Guide to Operations* that is supplied with the configuration.

The 5182 can be placed on top of the system unit or 5161 unit. The Color Printer Paper Rack optional feature can be purchased. It is a wire rack that will hold single sheets or fanfold paper that has been printed.

31:15 IBM 5182 Color Printer Model 1

The 5182 Model 1 is a customer-setup unit. The optional Printer Cable feature, which provides a 6-foot (1.8-meter) cable, must be purchased to attach the 5182 to the back of the system unit or 5161 unit in the configuration. The 5182 has a 6.5-foot (2-meter) power cord and requires its own power source.

Operating System Support

The 5182 Model 1 is supported by the following IBM-logo operating systems and control programs:

- IBM Personal Computer DOS (all versions)
- IBM Personal Computer/Interactive Executive (PC/IX)
- IBM PC XENIX™ System
- VM/PC
- 3270-PC Control Program
- 3270-PC Graphics Control Program

Warranty Period

The warranty period is one year and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

Single Unit Prices

Item/Part Number/Feature Code	Single Unit Purchase Price (\$)
5182 Color Printer Model 1 (5182001)	1995
Color Printer Paper Rack (6450101) (0101)	25
Printer Cable (1525612) (5612)	45
Hardware Maintenance and Service Manual (2383)	23.25

Discounts Available

The 5182 and its 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.

0	1	2	3	4	5	6	7	8	9
NUL	☺	☹	♥	♦	♣	♠	BEL	BS	HT
10	11	12	13	14	15	16	17	18	19
LF	VT	FF	CR	SO	SI	▶	DC1	DC2	DC3
20	21	22	23	24	25	26	27	28	29
DC4	§	▬	↕	CAN	↓		ESC	└	↔
30	31	32	33	34	35	36	37	38	39
▲	▼	SP	!	"	#	\$	%	&	'
40	41	42	43	44	45	46	47	48	49
(	)	*	+	,	-	.	/	0	1
50	51	52	53	54	55	56	57	58	59
2	3	4	5	6	7	8	9	:	;
60	61	62	63	64	65	66	67	68	69
<	=	>	?	⊙	A	B	C	D	E
70	71	72	73	74	75	76	77	78	79
F	G	H	I	J	K	L	M	N	O
80	81	82	83	84	85	86	87	88	89
P	Q	R	S	T	U	V	W	X	Y
90	91	92	93	94	95	96	97	98	99
Z	[	\	\]	^	_	`	a	b	c
100	101	102	103	104	105	106	107	108	109
d	e	f	g	h	i	j	k	l	m
110	111	112	113	114	115	116	117	118	119
n	o	p	q	r	s	t	u	v	w
120	121	122	123	124	125	126	127	128	129
x	y	z	{	|	}	~		NUL	ü

130	131	132	133	134	135	136	137	138	139
é	â	ä	à	å	BEL	BS	HT	LF	VT
140	141	142	143	144	145	146	147	148	149
FF	CR	SO	SI	É	DC1	DC2	DC3	DC4	ò
150	151	152	153	154	155	156	157	158	159
û	ù	CAN	Ö		ESC	£	¥	₪	₣
160	161	162	163	164	165	166	167	168	169
á	í	ó	ú	ñ	Ñ	ª	º	¿	┘
170	171	172	173	174	175	176	177	178	179
┘	½	¼	¡	«	»	▒	▓	▔	▕
180	181	182	183	184	185	186	187	188	189
▖	▗	▘	▙	▚	▛	▜	▝	▞	▟
190	191	192	193	194	195	196	197	198	199
■	□	▢	▣	▤	▥	▦	▧	▨	▩
200	201	202	203	204	205	206	207	208	209
▪	▫	▬	▭	▮	▯	▰	▱	▲	△
210	211	212	213	214	215	216	217	218	219
▴	▵	▶	▷	▸	▹	►	▻	▼	▽
220	221	222	223	224	225	226	227	228	229
▾	▿	◀	◁	α	β	γ	π	Σ	σ
230	231	232	233	234	235	236	237	238	239
μ	τ	ϕ	θ	Ω	δ	∞	∅	ε	∩
240	241	242	243	244	245	246	247	248	249
≡	±	≥	≤	∫	J	÷	≈	◦	•
250	251	252	253	254	255				
•	√	∩	2	■	SP				

Figure 31-5. Character Set 1 for the 5182 Color Printer

31:15 IBM 5182 Color Printer Model 1

0	1	2	3	4	5	6	7	8	9
NUL	☺	☹	♥	♦	♣	♠	BEL	BS	HT
10	11	12	13	14	15	16	17	18	19
LF	VT	FF	CR	SO	SI	▶	DC1	DC2	DC3
20	21	22	23	24	25	26	27	28	29
DC4	§	▬	↕	CAN	↓		ESC	└	↔
30	31	32	33	34	35	36	37	38	39
▲	▼	SP	!	”	#	\$	%	&	'
40	41	42	43	44	45	46	47	48	49
(	)	*	+	,	-	.	/	0	1
50	51	52	53	54	55	56	57	58	59
2	3	4	5	6	7	8	9	:	;
60	61	62	63	64	65	66	67	68	69
<	=	>	?	⊙	A	B	C	D	E
70	71	72	73	74	75	76	77	78	79
F	G	H	I	J	K	L	M	N	O
80	81	82	83	84	85	86	87	88	89
P	Q	R	S	T	U	V	W	X	Y
90	91	92	93	94	95	96	97	98	99
Z	[	\	\]	^	_	`	a	b	c
100	101	102	103	104	105	106	107	108	109
d	e	f	g	h	i	j	k	l	m
110	111	112	113	114	115	116	117	118	119
n	o	p	q	r	s	t	u	v	w
120	121	122	123	124	125	126	127	128	129
x	y	z	{	|	}	~		NUL	ü

130	131	132	133	134	135	136	137	138	139
é	â	ä	à	å	ç	ê	ë	è	ï
140	141	142	143	144	145	146	147	148	149
î	ì	Ä	Â	É	æ	Æ	ô	ö	ò
150	151	152	153	154	155	156	157	158	159
û	ù	ÿ	ö	ü	ç	£	¥	₪	₯
160	161	162	163	164	165	166	167	168	169
á	í	ó	ú	ñ	Ñ	à	ó	¿	└
170	171	172	173	174	175	176	177	178	179
└	½	¼	¡	«	»	▒	▒	▒	▒
180	181	182	183	184	185	186	187	188	189
└	└	└	└	└	└	└	└	└	└
190	191	192	193	194	195	196	197	198	199
└	└	└	└	└	└	└	└	└	└
200	201	202	203	204	205	206	207	208	209
└	└	└	└	└	└	└	└	└	└
210	211	212	213	214	215	216	217	218	219
└	└	└	└	└	└	└	└	└	└
220	221	222	223	224	225	226	227	228	229
▒	▒	▒	▒	α	β	Γ	Π	Σ	σ
230	231	232	233	234	235	236	237	239	
μ	τ	ϕ	θ	Ω	δ	∞	∅	ε	∩
240	241	242	243	244	245	246	247	248	249
≡	±	≥	≤	∫	J	÷	≈	°	▪
250	251	252	253	254	255				
-	√	∩	2	■	SP				

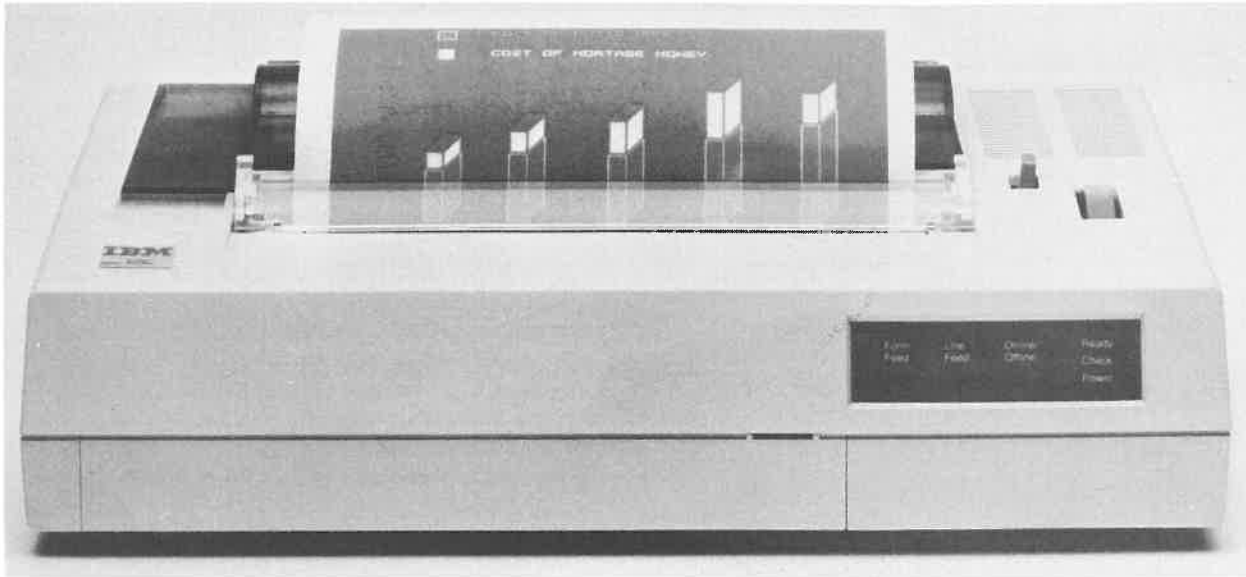
Figure 31-6. Character Set 2 for the 5182 Color Printer

0	1	2	3	4	5	6	7	8	9
NUL	☺	☹	♥	♦	♣	♠	•	◼	○
10	♂	♀	♪	♫	☀	▶	◀	↕	!!
20	π	§	▬	↕	↑	↓	→	←	↔
30	▲	▼	SP	!	”	#	\$	%	&
40	(	)	*	+	,	-	.	/	0 1
50	2	3	4	5	6	7	8	9	: ;
60	<	=	>	?	∂	A	B	C	D E
70	F	G	H	I	J	K	L	M	N O
80	P	Q	R	S	T	U	V	W	X Y
90	Z	[	\	\]	^	_	`	a	b c
100	d	e	f	g	h	i	j	k	l m
110	n	o	p	q	r	s	t	u	v w
120	x	y	z	{	|	}	~		Ç ü

130	131	132	133	134	135	136	137	138	139
é	â	ä	à	å	ç	ê	ë	è	ï
140	141	142	143	144	145	146	147	148	149
î	ì	Ä	Å	É	æ	Æ	ô	ö	ò
150	151	152	153	154	155	156	157	158	159
û	ù	ÿ	Ö	Ü	ç	£	¥	₪	₹
160	161	162	163	164	165	166	167	168	169
á	í	ó	ú	ñ	Ñ	á	o	¿	Γ
170	171	172	173	174	175	176	177	178	179
⌊	½	¼	ı	«	»	▒	▒	▒	
180	181	182	183	184	185	186	187	188	189
190	191	192	193	194	195	196	197	198	199
200	201	202	203	204	205	206	207	208	209
210	211	212	213	214	215	216	217	218	219
220	221	222	223	224	225	226	227	228	229
▒	▒	▒	▒	α	β	Γ	Π	Σ	σ
230	231	232	233	234	235	236	237	238	239
μ	τ	ϕ	θ	Ω	δ	∞	∅	ε	∩
240	241	242	243	244	245	246	247	248	249
≡	±	≥	≤	∫	J	÷	≈	◦	•
250	251	252	253	254	255				
•	√	∩	2	▒	SP				

Figure 31-7. All-Characters-Printable Character Set for the 5182 Color Printer

31:20 IBM 3852 Color Printer Model 1



Hardware Description

The 3852 Color Printer Model 1 is a drop-on-demand, ink-jet, tabletop printer that supports character, graphics, and graphic image printing on cut-sheet paper, roll paper, and transparencies. It can be attached to the following:

- 3270 Personal Computer (3270-PC) workstation via the Printer Adapter or Printer/Memory Adapter
- 3270 Personal Computer/Graphics and 3270 Personal Computer/Extended Graphics (3270-PC/G and GX) workstations via the Printer Adapter or Printer/Memory Adapter

The 3852 Model 1 has the following characteristics:

- Seven colors can be printed on a page: black, red, green, yellow, blue, magenta, and cyan.
- Two ink cartridges are provided (one black and one color). Cartridge life expectancy is 3.5 million characters for the color and 4 million characters for the black cartridge (about 500 pages per month).
- Text and graphics can be mixed on a page.
- Printing is done on special roll-fed paper, manually fed special cut-sheet paper, and manually

fed transparencies (for foils). The 3852 contains a paper cutter to cut the roll-fed paper.

- Two 12-pitch fonts are standard: 5152 Graphics Printer character set 2 (see Section 31:05) and 3270 MFI character set. The latter includes multilingual character support.
- Print resolution is 84 pels \times 63 pels per inch for text. For graphics and image printing, 84 pels \times 63 pels and 84 pels \times 84 pels per inch are available.
- Print speed is 37 characters per second for standard character printing and 3100 pels per second for graphics printing.
- Bold printing is available at approximately one-half the normal speed (activated by programming or a back panel switch).
- Characters per line and inch are:
 - 80 characters per line (standard), 10 characters per inch
 - 40 characters per line (double-width), 5 characters per inch
 - 136 characters per line (compressed), 17.5 characters per inch
 - 68 characters per line (compressed, double-width), 8.75 characters per inch
- Paper width is 8.5 inches (21.6 cm).
- Only single-sheet printing is supported (no copies).

- The 3852 Color Printer Starter Pac provides the following paper:
 - Two cartons of special roll paper, 8½ × 125 inches (4 rolls/carton)
 - One box of special transparency sheets, 8½ × 11 inches (50 sheets/box)
 - One package of special cut sheet paper, 8½ × 11 inches (250 sheets/package)
- Line spacing is 6 or 8 lines per inch.
- Dimensions are:
 - Height: 4.49 inches (114 mm)
 - Width: 15.75 inches (400 mm)
 - Depth: 11.61 inches (295 mm)
- Weight is 12.4 lb (5.6 kg).
- Acoustics are 55 decibels (dB).
- Environmental characteristics are:
 - Operating temperature: 41 to 104 degrees F (5 to 40 C)
 - Operating humidity: 10% to 80% noncondensing.
- Electrical requirements are 120 volts, 60 Hz.

The 3852 printer is a customer-setup unit. A 6-foot (1.8-meter) attachment cable is supplied with the 3852 printer to connect it to the workstation. The 3852 requires its own power source and has a 6.5-foot (2-meter) power cable. This unit can be placed on top of the 5271 or 5371 System Unit, 5378 unit, or 5161 unit.

Operating Systems Supporting

The 3852 Model 1 is supported by the following IBM-logo operating systems and control programs:

- IBM Personal Computer DOS as of Version 2.1
- 3270-PC Control Program
- 3270-PC Graphics Control Program

Warranty Period

The warranty period is three months and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange

- Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

Single Unit Prices

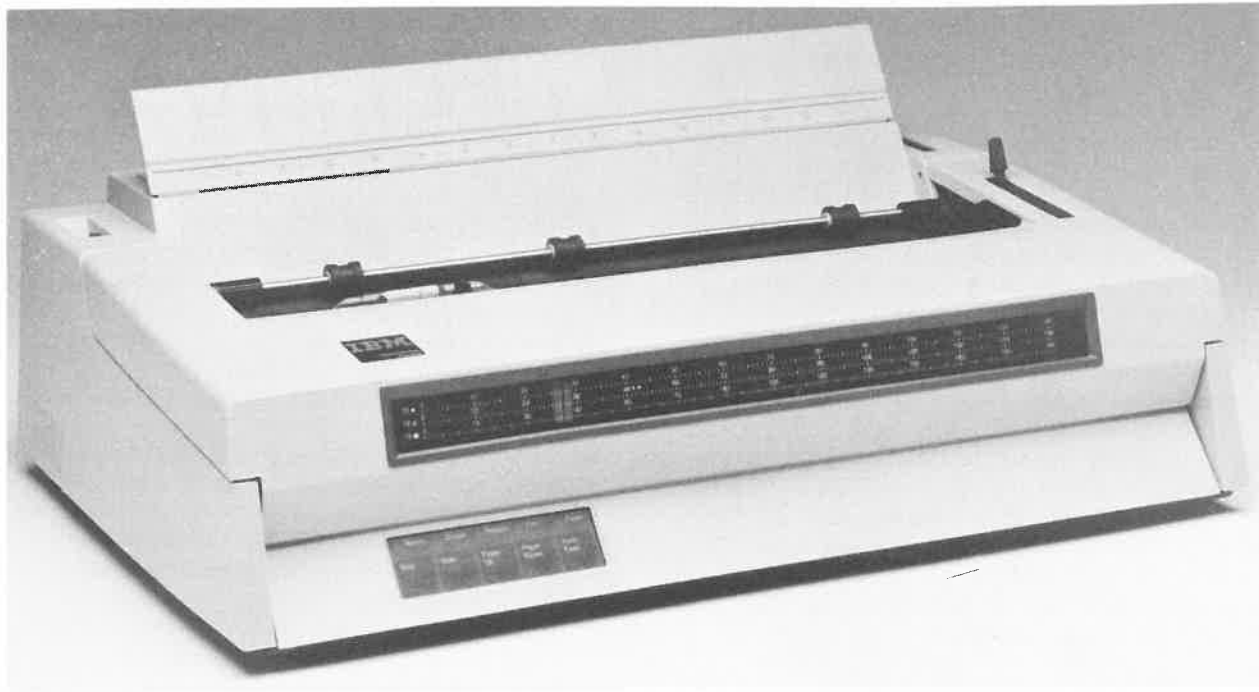
Item/Part Number/Feature Code	Single Unit Purchase Price (\$)
3852 Color Printer Model 1 (3852001)	900.00
Starter Pac (6050)	121.85

Discounts Available

The 3852 printer 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

31:25 IBM 5201 QUIETWRITER® Printer Model 1



Hardware Description

The 5201 QUIETWRITER® Printer is a very quiet, letter-quality, non-impact desktop printer that is designed for attachment to IBM personal computers. It offers an optional modular single-drawer sheet feed, an optional modular pinwheel forms feed, and a variety of fonts that easily plug into the printer. Any two fonts can be online at a given time.

The 5201 printer can be attached to the following:

- 4860 PCjr via the Parallel Printer Attachment
- 5150 Personal Computer via the Monochrome Display and Printer Adapter or the Printer Adapter
- 5155 Portable Personal Computer via the Printer Adapter
- 5160 Personal Computer XT or XT/370 via the Monochrome Display and Printer Adapter or the Printer Adapter
- 5170 Personal Computer AT or AT/370 via the Monochrome Display and Printer Adapter or the Serial/Parallel Adapter (parallel port)

- 3270 Personal Computer (3270-PC) workstation via the Printer Adapter or the Printer/Memory Adapter
- 3270 Personal Computer/Graphics and 3270 Personal Computer/Extended Graphics (3270-PC/G or GX) workstations via the Printer Adapter or Printer/Memory Adapter
- Non-IBM personal computers with a "Centronics-type" parallel interface

The 5201 Model 1 has the following characteristics:

- Character spacing: 10, 12, and 15 characters per inch (cpi) and proportionally spaced mode
- Print speed of 40 to 60 cps burst, depending on pitch used:
 - 60 cps at 15 cpi for data processing applications
 - 40 to 48 cps at 10 or 12 cpi for high-quality word processing
- Program-selectable vertical spacing in increments of 1/96 inch per line
- Maximum print line width of 13.2 inches (335 mm)

- Character sets: 252 characters per type font
- Four pitches and multiple type styles
- Fonts: IBM QUIET® Electronic Font PC:
 - Courier 10
 - Prestige Elite
 - Prestige 15
 - Boldface
 The Courier 10 font contains the entire IBM personal computer 252 character set, which includes alphameric characters, symbols, graphics characters, and foreign language characters.
- One or two type fonts online
- All font modules for the IBM QUIETWRITER® 7 Typewriter usable in the 5201 printer for word processing
- Ribbon: IBM QUIET® Non-Correcting Ribbon
 - easy-to-install drop-in cartridge with an average yield of 160,000 characters
- Print head: IBM QUIET® Printhead
- Cleaning cartridge: IBM QUIET® Cleaning Cartridge, provided in the accessory kit
- Programmable features: Line spacing, line width, forms length, margins, tabs, selectable character sets, auto underlining, double width, superscript, and subscript (can be invoked from the keyboard of a personal computer). Where possible, the control codes for the 5201 are consistent with those used by the 5152 Graphics Printer Model 2 for program compatibility.
- Paper weights: Optimum: 75 gm/sq. m to 90 gm/sq. m (20 to 24 lb bond – 25% or 50% cotton content)
- Optional paper handlers for cut sheet and continuous forms:
 - 8.5-inch (216 mm) wide paper can be fed automatically with cut-sheet feed
 - 2.5-inch to 14.5-inch (64 mm to 368 mm) pin-to-pin paper can be fed with the continuous forms feed
 - 3-inch to 15-inch paper (76 mm to 388 mm), including envelopes, can be manually inserted
- Removable cut-sheet tray with approximately .5-inch paper capacity (weight and paper thickness determines exact count)
- Single-part forms are supported.
- Dimensions and weight of 5201 printer only:
 - Height: 8.5 inches (216 mm)
 - Width: 21.3 inches (541 mm)
 - Depth: 14.4 inches (367 mm)
 - Weight: 22 lb (10 kg)
- Dimensions and weight of 5201 with sheetfeed only:
 - Height: 14 inches (355 mm)
 - Width: 18 inches (457 mm)
 - Depth: 11.5 inches (292 mm)
 - Weight: 32 lb (14.5 kg)

- Dimensions and weight of 5201 with pinwheel attached:
 - Height: 10.5 inches (266 mm)
 - Width: 21.3 inches (541 mm)
 - Depth: 16.2 inches (411 mm)
 - Weight: 25.3 lb (11.5 kg)
- Suitability for shipment by common carrier (such as UPS)
- Acoustics: 50 to 55 decibels (dB)
- Power requirements:
 - Low voltage (90 to 137 volts, 50 or 60 Hz)
 - High voltage (180-259 volts, 50 or 60 Hz)
- Environmental requirements:
 - Operating temperature: 50 to 104 degrees F (10 to 40C)
 - Operating humidity: 10% to 80% noncondensing
- Printer diagnostics:
 - Automatic power-on set
 - Operator-initiated self-test (repeats alphameric patterns)
 - Operator initiated wrap test using provided wrap plug

Included with the base model are a Courier 10 IBM QUIET Electronic Font PC, one ribbon cartridge, one printhead, one wrap plug, and one accessory kit. The accessory kit contains the IBM QUIETWRITER® Printer *Guide To Operations*, a line cord, a paper table, and the IBM QUIET Cleaning Cartridge.

The 5201 Model 1 is a customer-setup unit. It can be placed on top of the system unit or 5161 unit. The optional Printer Cable feature, which provides a 6-foot (1.8-meter) cable, must be purchased to attach the 5201 to the back of the system unit or 5161 unit in the configuration. The 5201 has a 6-foot (1.8-m) power cord and requires its own power source.

A brochure describing the 5201, G520-5033, is available. The *Guide to Operations* (S544-4034) provides additional information and is supplied with the printer. The *Hardware Maintenance and Service Manual* (S544-4037) with *Addendum for Sheetfeed* (SY20-8577) and *Technical Reference* (S544-4036) are also available.

Operating System Support

The 5201 is supported by the following IBM-logo operating systems and control program:

- IBM Personal Computer DOS as of Version 1.1
- CP/M-86™
- 3270-PC Control Program as of Version 1 Release 2

Warranty Period

The warranty period is three months and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

Discounts Available

The 5201 and its 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

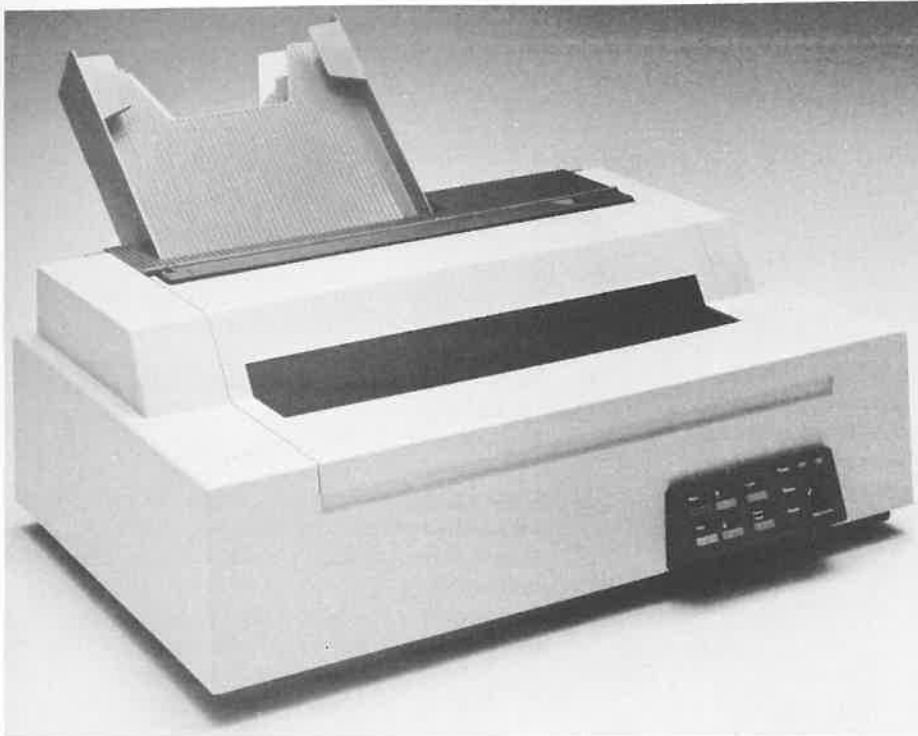
Single Delivery Quantity and Quantity Purchase Plan discounts are available from IBM Product Centers.

Single Unit Prices

Item/Part Number/Feature Code	Single Unit Purchase Price (\$)
5201 QUIETWRITER Printer Model 1 (5201001)	1395.00
IBM QUIET Cleaning Cartridge (1299633) (7930)	5.55
IBM QUIET Electronic Font PC:	
–Prestige Elite (1340803)	50.00
–Courier 10 (1340810)	50.00
–Prestige 15 (1340806)	50.00
–Boldface (1340830)	50.00
IBM QUIET Non-Correcting Ribbon (1299642)	12.00
IBM QUIET Printhead (1337488) (7940)	20.00
Line Cord (1342514) (7910)	7.75
Paper Table (1341078) (7920)	7.50
Pinwheel Forms Feed (7820)	75.00
Printer Cable (1525612) (5612)	45.00
Sheetfeed (7840)	350.00
Sheetfeed Paper Tray (8655073) (7880)	40.00

For a complete listing of IBM QUIET Electronic Fonts (including reorder numbers), see the typestyle brochure, G570-2099.

31:30 IBM 5216 Wheelprinter Model 2



Hardware Description

The 5216 Wheelprinter is a letter-quality, impact, printwheel, desktop printer that is designed for attachment to IBM personal computers. The 5216 uses the IBM Cartridge Printwheel II. Automatic cut-sheet and continuous-form paper feeding are standard facilities. Switching between the two types of feed is easily accomplished.

The 5216 printer can be attached to the following:

- 4860 PCjr via the Parallel Printer Attachment or serial port
- 5150 Personal Computer via the Monochrome Display and Printer Adapter, Printer Adapter, or Asynchronous Communications Adapter
- 5155 Portable Personal Computer via the Printer Adapter or Asynchronous Communications Adapter
- 5160 Personal Computer XT or XT/370 via the Monochrome Display and Printer Adapter, Printer Adapter, or Asynchronous Communications Adapter
- 5170 Personal Computer AT or AT/370 via the Monochrome Display and Printer Adapter or Serial/Parallel Adapter (serial or parallel port)
- 3270 Personal Computer (3270-PC) workstation via the Printer Adapter, Printer/Memory Adapter, or Asynchronous Communications Adapter
- 3270 Personal Computer/Graphics and 3270 Personal Computer/Extended Graphics (3270-PC/G and GX) workstations via the Printer Adapter, Printer/Memory Adapter, or Asynchronous Communications Adapter
- Non-IBM personal computers with an asynchronous serial or parallel interface compatible with that of IBM personal computers

The 5216 Model 2 has the following characteristics:

- Print speed is 25 cps burst.
- Printing is bidirectional.
- Character spacing is 10, 12, and 15 characters per inch and PSM (proportionally spaced mode).
- Program-selectable vertical spacing in increments of 1/48 inch per line is supported.

31:30 IBM 5216 Wheelprinter Model 2

- Maximum print line width is 13.2 inches (335 mm).
- Character set is a 96-character printwheel.
- Four pitches and multiple type styles, including word processing and ASCII printwheels, are available. Printwheels can be changed easily and quickly.
- Printwheel/fonts for ASCII are:
 - Courier 10
 - Courier 12
 - Courier 15
 - Prestige Elite
 - Artisan 10
 - Letter Gothic
 - Gothic 15
 - Boldface PSM
 - Essay PSM
- Printwheel/fonts for non-ASCII are:
 - Prestige Pica 10
 - Courier 10
 - Artisan 10
 - Rhetoric 10
 - Courier 10 (EBCDIC)
 - Boldface PSM
 - Modern PSM
 - Essay PSM
 - Essay Italic PSM
 - Prestige Elite
 - Courier 12
 - Letter Gothic
 - Light Italic
 - Script
 - Prestige Elite (Accounting)
 - Symbol 1
 - Symbol 2 (Office System 6)
 - Symbol 3 (6670 Information Distributor)
 - Prestige 15
 - Gothic 15
 - Courier 15

ASCII printwheels are recommended for IBM personal computers. Other printwheels may require additional host programming support.

- Printwheels are enclosed in protective plastic cartridges for durability and clean handling.
- Single-strike and multistrike drop-in film ribbon cartridges (black only) are available:
 - IBM 9756 ribbon: single-strike, 138,000 character yield for 10 pitch, 160,000 character yield for 12 pitch, and 190,000 character yield for 15 pitch (proportional spacing yield is dependent on character mix)
 - IBM 9757 ribbon: multistrike, 500,000 character yield
- Impression control is user-selectable.
- Programmable features are print mode, line spacing, line width, forms length, margins, tabs, print direction, printwheel tables (custom unique/non-ASCII), auto-underlining, and

DP/WP mode and are invoked from the keyboard of a personal computer.

- Where possible, the control codes for the 5216 are consistent with those used by the 5152 Graphics Printer Model 2 for program compatibility.
- Optimum paper weights are 75 gm/sq. m to 90 gm/sq. m (20 to 24 lb bond). Optimal cotton content is 25% or 50%.
- Paper handlers for cut-sheet and continuous forms are standard:
 - 8.5-inch (216 mm)-wide paper can be fed automatically with cut-sheet feed.
 - 2.7-inch to 14.9-inch (71 mm to 378 mm) pin-to-pin paper can be fed with the continuous forms feed.
 - 3.2-inch to 15.4-inch paper (81 mm to 391 mm), including envelopes, can be manually inserted.
- Removable cut-sheet tray with a capacity of up to 100 sheets is provided. Paper weight and thickness determine exact count.
- Single and multiple-part forms (original and three carbon copies) are supported.
- Dimensions of the 5216 printer only are:
 - Height: 8.8 inches (224 mm)
 - Width: 22.9 inches (581 mm)
 - Depth: 16.1 inches (409 mm)
- Dimensions of the 5216 with the paper tray are:
 - Height: 13.8 inches (350 mm)
 - Width: 22.9 inches (581 mm)
 - Depth: 22.2 inches (563 mm)
- The 5216 weighs 34.5 lb (15.7 kg).
- Compact design makes the 5216 suitable for shipment by common carrier (UPS or Federal Express, for example).
- Acoustics are 59 decibels (dB).
- Power requirements are 115 volts AC and 60 Hz.
- Environmental requirements are:
 - Operating temperature: 50 to 104 degrees F (10 to 40 C)
 - Operating humidity: 10% to 80% noncondensing
- Printer diagnostics are:
 - Automatic power-on set
 - Operator-initiated self-test (repeats alphabetic patterns)
 - Host independent

Included with the 5216 printer are a 96-character engraved-quality Courier 10 ASCII printwheel, one single-strike ribbon cartridge, a cut-sheet paper tray, a power cord, and the *IBM 5216 WheelPrinter Guide To Operations*, GA23-1006.

The 5216 Model 2 is a customer-setup unit. It can be placed on top of the system unit or 5161 unit. The optional serial or parallel Attachment Cable

feature, which provides a 6-foot (1.8-meter) cable, must be purchased to attach the 5216 to the back of the system unit or 5161 unit in the configuration. The 5216 has a 6-foot (1.8-m) power cord and requires its own power source.

The serial Attachment Cable is 19.5 feet (6 meters) and attaches to the 25-pin Asynchronous Communications Adapter in an IBM personal computer or the serial port in a PCjr. The parallel Attachment Cable is 6 feet (1.8 meters) and attaches to the parallel printer adapter in an IBM personal computer. The cable attaches to the 5216 printer via an interface module (serial – feature code 9002, or parallel – feature code 9001, as customer specified) that is supplied with the ordered cable. This module adds 1.55 inches to the depth of the 5216 printer.

A brochure describing the 5216 Printwheel Printer is available (G520-5032).

Operating System Support

The 5216 is supported by the following IBM-Logo operating systems and control program:

- IBM Personal Computer DOS as of Version 1.1
- CP/M-86™
- 3270-PC Control Program as of Version 1 Release 2

Warranty Period

The warranty period is three months and the warranty service is Customer Carry-In Exchange.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Customer Carry-In Repair
- 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

Single Unit Prices

Item/Part Number/Feature Code	Single Unit Purchase Price (\$)
5216 Wheelprinter Model 1 (5216001)	1795.00
Attachment Cable	
Serial (6031)	55.00
Parallel (6030)	55.00
Cut-Sheet Paper Tray:	
8.5 inches (8655073)	40.00
8.27 inches (8655088)	40.00
Multistrike ribbon (1299757)	15.25
Printwheels (1353XXX)	25.25
Single-strike ribbon (1299756)	9.10
Supply Starter Pac:	
Multistrike ribbons (6295112)*	154.00
Single-strike ribbons (6293724)**	158.00

* Includes ten multistrike ribbons, one Courier 10, and one Prestige Elite 12 printwheel

** Includes 18 single-strike ribbons, one Courier 10 printwheel, and one Prestige Elite 12 printwheel

Discounts Available

The 5216 and its 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

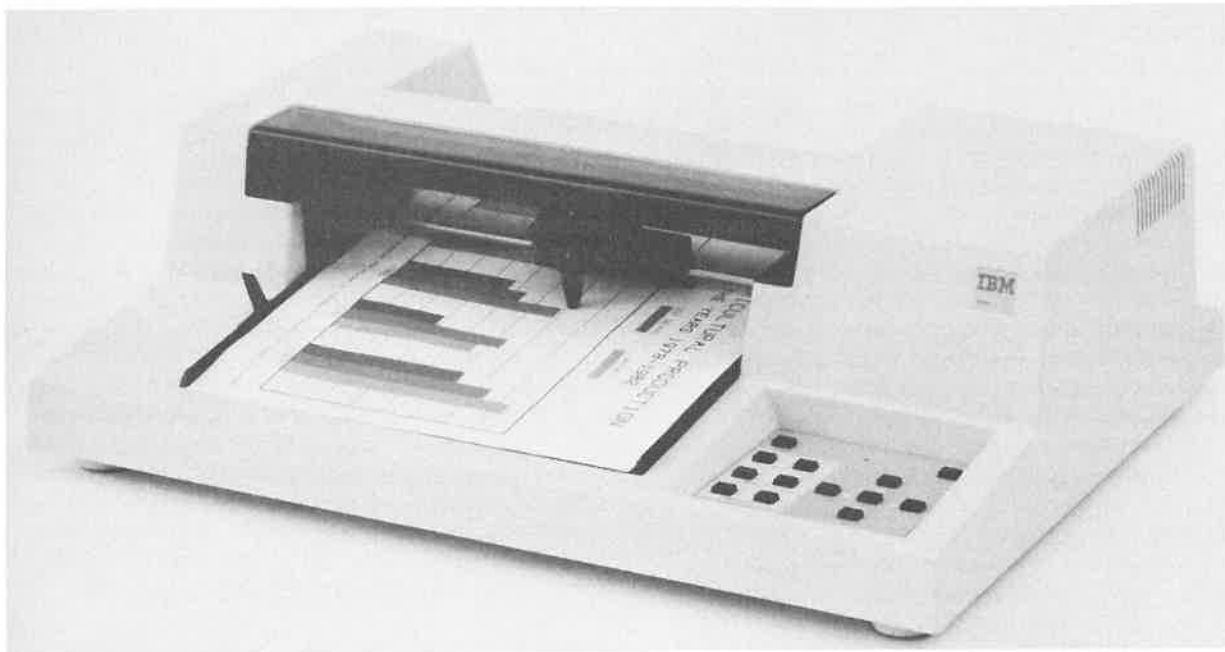
Single Delivery Quantity and Quantity Purchase Plan discounts are available from IBM Product Centers.

SECTION 32: COLOR PLOTTERS

IBM 7371 Color Plotter Section 32:05

IBM 7372 Color Plotter Section 32:10

32:05 IBM 7371 Color Plotter



Hardware Description

The 7371 Color Plotter is a low-cost, desktop, two-pen, high-resolution vector plotter. It can produce multicolor quality graphics on paper or transparency film with highly accurate registration and repeatability. The 7371 can be attached to the following:

- 5150 Personal Computer via the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter
- 5150 Personal Computer with the 3270 Personal Computer Attachment for the 3278 or 3279 via the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter
- 5155 Portable Personal Computer via the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter
- 5160 Personal Computer XT or XT/370 via the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter
- 5170 Personal Computer AT or AT/370 via the serial port of a Serial/Parallel Adapter or via the General Purpose Interface Bus Adapter
- 3270 Personal Computer via the Asynchronous Communications Adapter
- 3270 Personal Computer/Graphics and 3270 Personal Computer/Extended Graphics workstations via the IEEE-488 Adapter and Cable

The 7371 plotter has the following characteristics:

- The plotter can draw in two colors at a time. It can be stopped during picture plotting so that the pens can be changed to produce a drawing with more than two colors or with varying line widths.
- The paper size supported is 8½ × 11 inches (A) or 210 × 297 mm (A4). Drawing can also be done on transparency film to make overhead projection transparencies.
- Plotting ranges are:
 - A: 10.2 × 7.5 inches (257 × 191 mm)
 - A4: 10.7 × 7.5 inches (272 × 191 mm)

- Maximum pen-down plotter velocity is 15 inches (38.1 cm) per second with an acceleration of 2Gs. The pen-up velocity is 20 inches (50.8 cm) per second. Pen velocity is selectable via programming at rates of .38 to .1 cm per second in .38 cm/sec increments, causing the acceleration to fall to .5Gs.
- Two pen types are handled:
 - Fiber tip for paper with a choice of two widths and ten colors
 - Fiber tip for transparency film with a choice of two widths, seven colors, and fast drawing and hard wearing pen types
- Pens are capped to prevent drying when they are not in use (that is, when they are in the pen holder).
- High resolution (.001 inches or .025mm) at the maximum pen-down velocity provides smooth curved lines and consistently straight lines.
- Repeatability (the ability of a pen to return precisely to a given point) of .004 inches (.1 mm) for a given pen is provided. Pen-to-pen repeatability is .008 inches (.2 mm).
- A convenient front panel provides pushbutton controls for local and manual facilities (for example, paper and pen movement controls, pen selection and substitution control, and easy access to digitizing capability and scale points).
- A versatile drawing system provides:
 - Seven different dashed-line types
 - Writing of text in any direction with a choice of size and type styles
 - Labeling in five character sets, including three International Standards Organization (ISO) European sets
 - Support of character definitions
 - Ability to create arcs and circles using built-in plotter instructions.
- Programming for the 7371 is upward-compatible with that for the 7372, 7374, and 7375 Color Plotters.
- Dimensions are:
 - Width: 17 inches (432 mm)
 - Depth: 13.5 inches (343 mm)
 - Height: 5 inches (127 mm)
- Weight is 13.5 lb (6 kg).
- Electrical requirements are 120 volts, 60 Hz.
- Temperature requirements are:
 - 32 to 131 degrees F (0 to 55 C) for plotter operating
 - -40 to 167 degrees F (-40 to 75 C) for plotter not operating

DOS application programs that are available from IBM and that support the 7371 plotter attached to a stand-alone IBM personal computer include Framework™, IBM Personal Decision Series Graphics Edition, SlideWrite, SuperCalc3®, Symphony™, 1-2-3™, and the programs listed under

the Graphics Category in the "Application Programs By Category" table in Section 41:05. The 3270-PC Graphics Applications Program (3270-PC/GGXA) operating in a DOS session under DOS and the 3270-PC Graphics Control Program in a 3270-PC/G or GX also supports the 7371.

Host processor IBM-Logo application programs that support a 7371 attached to a host-connected IBM personal computer include Industry Standard Plotting Commands, Interactive Presentation Graphics, IBM Color Support for the GDDM Graphics Data File, and IBM System 34/36/38 Business Graphics Utilities.

The *7371 Color Plotter Guide to Operations* is supplied with the plotter. This manual includes problem determination procedures. The *7371/7372 Color Plotting Programming Manual* (feature code 5060) can be purchased.

The 7371 plotter is a customer-setup unit and requires its own power source. The RS-232C Cable is required to attach the 7371 to the Asynchronous Communications Adapter in a 5150, 5155, 5160, 5160 PC XT/370, or 3270-PC configuration or to the serial port of a Serial/Parallel Adapter in a 5170 or 5170 PC AT/370 configuration.

The General Purpose Interface Bus Adapter Cable is required to attach the 7371 to a 5150, 5155, 5160, or 5170 configuration via the General Purpose Interface Bus Adapter. This cable is also required to attach a 7371 to a 3270-PC/G or GX configuration via the IEEE-488 adapter (which is provided with one cable) if more than one device is attached to the IEEE-488 adapter.

See the 7371 and 7372 Color Plotter brochure, G520-1096, for additional information.

Operating Systems Supporting

The 7371 plotter is supported by the following IBM-Logo operating system and control program:

- IBM Personal Computer DOS
- 3270-PC Graphics Control Program

Warranty Period

The warranty period is three months and the warranty service is Customer Carry-In Repair.

32:05 IBM 7371 Color Plotter

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-in Exchange
 - Customer Carry-in Repair
- IBM Hourly Service: Customer Carry-In Repair at an IBM Service/Exchange Center. Problem determination procedures are included in the *Guide to Operations* manual.

Single Unit Prices

Item/Part Number/Feature Code	Single Unit Purchase Price (\$)
7371 Color Plotter (7371001)	1100
RS-232C Cable (2719931) (5030)	51
General Purpose Interface Bus Adapter Cable (2720020) (5040)	102

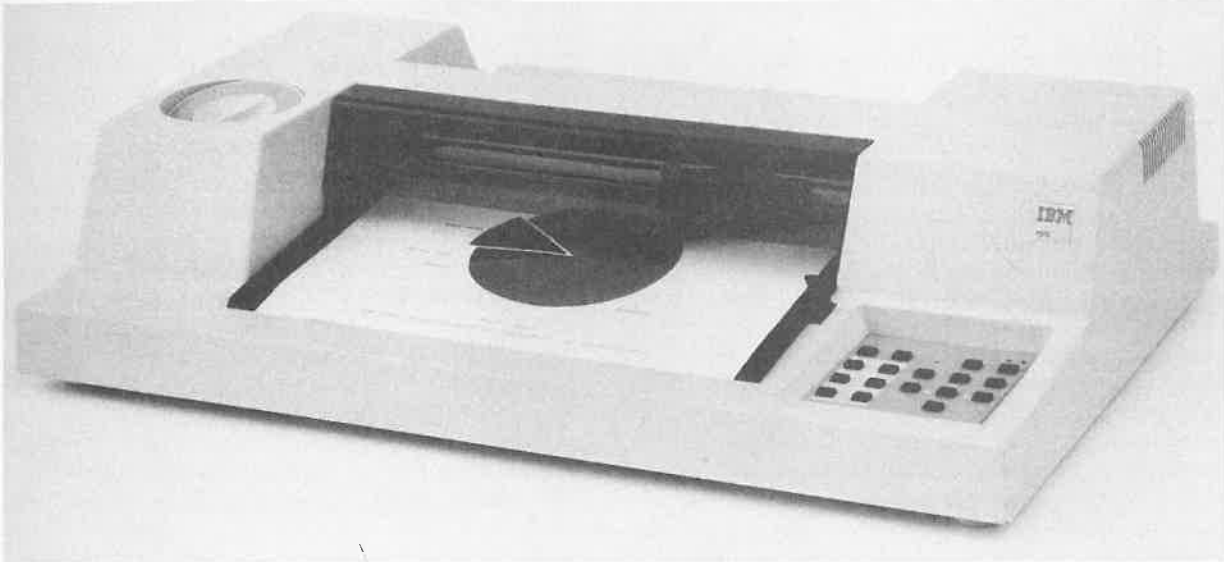
Discounts Available

The 7371 Color Plotter 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.

32:10 IBM 7372 Color Plotter



Hardware Description

The 7372 Color Plotter is a low-cost, desktop, six-pen, high-resolution vector plotter. It can produce multicolor quality graphics on paper or transparency film with highly accurate registration and repeatability. The 7372 can be attached to the following:

- 5150 Personal Computer via the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter
- 5150 Personal Computer with the 3270 Personal Computer Attachment for the 3278 or 3279 via the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter
- 5155 Portable Personal Computer via the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter
- 5160 Personal Computer XT or XT/370 via the Asynchronous Communications Adapter or General Purpose Interface Bus Adapter
- 5170 Personal Computer AT or AT/370 via the serial port of a Serial/Parallel Adapter or via the General Purpose Interface Bus Adapter
- 3270 Personal Computer via the Asynchronous Communications Adapter
- 3270 Personal Computer/Graphics and 3270 Personal Computer/Extended Graphics workstations via the IEEE-488 Adapter and Cable

The 7372 plotter has the following characteristics:

- The plotter can draw in six colors at a time, reducing the need for pen changing to increase the number of colors used. Pens are placed in an easy-to-load six-pen carousel. The plotter can be stopped during picture plotting so that the pens can be changed to produce a drawing with more than six colors or with varying line widths.
- The paper size supported is:
 - 8½ × 11 inches (A) or 210 × 297 mm (A4)
 - 11 × 17 inches (B) or 297 × 420 mm (A3)Drawing can also be done on transparency film to make overhead projection transparencies.
- Plotting ranges are:
 - A: 10.2 × 7.5 inches (257 × 191 mm)
 - A4: 10.7 × 7.5 inches (272 × 191 mm)
 - B: 16.3 × 10.15 inches (413.9 × 257.8 mm)
 - A3: 15.82 × 10.81 inches (401.9 × 274.6 mm)

32:10 IBM 7372 Color Plotter

- Maximum pen-down plotter velocity is 15 inches (38.1 cm) per second with an acceleration of 2Gs. The pen-up velocity is 20 inches (50.8 cm) per second. Pen velocity is selectable via programming at rates of .38 to .1 cm per second in .38 cm/sec increments, causing the acceleration to fall to .5Gs.
- Two pen types are handled:
 - Fiber tip for paper with a choice of two widths and ten colors
 - Fiber tip for transparency film with a choice of two widths, seven colors, and fast drawing and hard wearing pen types
- Pens are capped to prevent drying when they are not in use (that is, when they are in the pen holder).
- High resolution (.001 inches or .025mm) at the maximum pen-down velocity provides smooth curved lines and consistently straight lines.
- Repeatability (the ability of a pen to return precisely to a given point) of .004 inches (.1 mm) for a given pen is provided. Pen-to-pen repeatability is .008 inches (.2 mm).
- A convenient front panel provides pushbutton controls for local and manual facilities (for example, paper and pen movement controls, pen selection and substitution control, easy access to digitizing capability and scale points, and initiation of a built-in demonstration plot).
- A versatile drawing system provides:
 - Seven different dashed-line types
 - Writing of text upright or slanted in any direction, and with a choice of size and type styles
 - Labeling in 19 character sets, including International Standards Organization (ISO) European sets, Katakana, ASCII, and Roman 8 extensions
 - Support of character definitions
 - Ability to create arcs and circles using built-in plotter instructions
- The programming for the 7371 is upward-compatible with that for the 7372. Additional commands for the 7372 support area fill for arcs, circles, and bars; four drawing sizes; and six pen selections. The 7372 is also program-compatible with the 7374 and 7375 Color Plotters.
- Dimensions are:
 - Width: 22.4 inches (568 mm)
 - Depth: 14.5 inches (367 mm)
 - Height: 5 inches (127 mm)
- Electrical requirements are 120 volts, 60 Hz.
- Weight is 16 lb (7 kg).
- Temperature requirements are:
 - 32 to 131 degrees F (0 to 55 C) for plotter operating
 - -40 to 167 degrees F (-40 to 75 C) for plotter not operating

DOS application programs that are available from IBM and that support the 7372 plotter attached to a stand-alone IBM personal computer include Framework™, IBM Personal Decision Series Graphics Edition, SlideWrite, SuperCalc3® Symphony™, 1-2-3™, and the programs listed under the Graphics Category in the "Application Programs By Category" table in Section 41:05. The 3270-PC Graphics Applications Program (3270-PC/GGXA) operating in a DOS session under DOS and the 3270-PC Graphics Control Program in a 3270-PC/G or GX also supports the 7372.

Host processor IBM-Logo application programs that support a 7372 attached to a host-connected IBM personal computer include Industry Standard Plotting Commands, Interactive Presentation Graphics, IBM Color Support for the GDDM Graphics Data File, and IBM System 34/36/38 Business Graphics Utilities.

The *7371/7372 Color Plotter Guide to Operations* is supplied with the plotter. This manual includes problem determination procedures. The *7372 Color Plotting Programming Manual* (feature code 5060) can be purchased.

The 7372 plotter is a customer-setup unit and requires its own power source. The RS-232C Cable is required to attach the 7372 to the Asynchronous Communications Adapter in a 5150, 5155, 5160, 5160 PC XT/370, or 3270-PC configuration or to the serial port of a Serial/Parallel Adapter in a 5170 or 5170 PC AT/370 configuration.

The General Purpose Interface Bus Adapter Cable is required to attach the 7372 to a 5150, 5155, 5160, or 5170 configuration via the General Purpose Interface Bus Adapter. This cable is also required to attach a 7372 to a 3270-PC/G or GX configuration via the IEEE-488 adapter (which is provided with one cable) if more than one device is attached to the IEEE-488 adapter.

See the 7372 and 7372 Color Plotter brochure, G520-1096, for additional information.

Operating Systems Supporting

The 7372 plotter is supported by the following IBM-Logo operating system and control program:

- IBM Personal Computer DOS
- 3270-PC Graphics Control Program

Warranty Period

The warranty period is three months and the warranty service is Customer Carry-In Repair.

IBM Service Offerings

The following IBM service offerings are available:

- IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:
 - Warranty Options:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-In Exchange
 - Annual Maintenance:
 - IBM On-Site Exchange
 - Customer On-Site Exchange
 - Customer Carry-in Exchange
 - Customer Carry-in Repair
- IBM Hourly Service: Customer Carry-In Repair at an IBM Service/Exchange Center. Problem determination procedures are included in the *Guide to Operations* manual.

Single Unit Prices

Item/Part Number/Feature Code	Single Unit Purchase Price (\$)
7372 Color Plotter (7372001)	1900
RS-232C Cable (2719931) (5030)	51
General Purpose Interface Bus Adapter Cable (2720020) (5040)	102

Discounts Available

The 7372 Color Plotter 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.

SECTION 40: OPERATING SYSTEMS AND LANGUAGES

IBM Personal Computer Disk Operating System	40:05
IBM Personal Computer Interactive Executive	40:10
IBM Personal Computer XENIX System	40:15
CP/M-86	40:20
UCSD p-System	40:25

40:05 IBM Personal Computer Disk Operating System

Introduction

The IBM Personal Computer Disk Operating System (DOS), also referred to as PC-DOS, is a single-user, single-tasking operating system that supports all IBM personal computer configurations. While DOS is essentially a single-tasking system (only background file printing is supported), the TopView program can be used with DOS to support the concurrent operation of multiple application programs (see discussion under "Multiprogramming using the TopView Program" in this subsection).

DOS consists of several programs that provide an interface between IBM personal computer hardware and language and application programs. DOS provides input and output handlers for I/O devices, utility and service functions, and program development and testing facilities.

DOS is a general-purpose operating system that supports the execution of a wide variety of application programs (see Section 41) and several program development languages. It also supports the operation of control programs for specialized IBM personal computer configurations (VM/PC for the PC XT/370 and PC AT/370, and the 3270-PC Control Program and 3270-PC Graphics Control Program for 3270 Personal Computer workstations).

Also provided with DOS are Disk BASIC and Advanced BASIC, which provide extensions to the BASIC Interpreter contained in ROM of an IBM personal computer. One of these BASIC levels must be used by BASIC programs that access diskette or fixed disk drives.

Six versions of DOS, 1.0, 1.1, 2.0, 2.1, 3.0, and 3.1, have been released. Four versions, DOS 1.1, 2.1, 3.0, and 3.1 are currently available. Each version supports a common set of functions, while each successive level provides additional support in DOS and in Disk BASIC and Advanced BASIC.

DOS requires a portion of random access memory for its residence during system operation. For DOS Versions 1.0 and 1.1, 12Kb of memory is required. For DOS Versions 2.0 and 2.1, a minimum of 24Kb of memory is required. For DOS Versions 3.0 and 3.1, a minimum of 36Kb of memory is required. The use of certain commands (such as PRINT for background file printing) increases the resident memory requirement.

If Disk BASIC or Advanced BASIC is used, additional memory is required for BASIC residence. For Version 1.1, 8Kb or 13Kb is required for Disk BASIC or Advanced BASIC, respectively. For Version 2.1, 11Kb or 21Kb is required for Disk BASIC or Advanced BASIC, respectively. A configuration with a minimum of 48Kb is required when the BASIC extensions are used but most applications will require 64Kb or more.

DOS Versions 1.0 and 1.1 must be loaded into memory from diskette. As of Version 2.0, DOS can be loaded into memory from a 10Mb fixed disk or a diskette. As of Version 3.0, DOS can also be loaded into memory from a 20Mb fixed disk.

The user communicates requests to DOS via commands or file names entered via the keyboard, or via a command file contained on diskette or fixed disk. Commands are classified as internal or external. Internal command processors are resident in memory as part of the DOS program that is loaded during an initial program load (IPL). They do not require access to DOS on a diskette or fixed disk for their execution. External command processors are not resident in memory and must be loaded from the DOS program contained on an online diskette or a fixed disk. DOS communicates with the user via messages displayed on the screen.

DOS Version 1.1 is provided on one single-sided (160Kb) diskette that contains Disk BASIC and Advanced BASIC and several sample programs that illustrate BASIC and hardware features.

DOS Version 2.1 is provided on two diskettes. One diskette contains DOS programs and commands and Version 2.1 Disk BASIC and Advanced BASIC that support IBM personal computer configurations other than the PCjr. The second diskette contains the Linker and Debug programs that support program creation and testing, as well as sample programs that illustrate BASIC and hardware features. For the PCjr, the IBM PCjr BASIC program cartridge must be purchased if Disk BASIC and Advanced BASIC functions are to be used.

DOS Versions 3.0 and 3.1 are provided on two diskettes. One diskette (the DOS diskette) contains DOS programs and commands and Version 3.0/3.1 Disk BASIC and Advanced BASIC that support configurations other than PCjr. The second diskette (DOS supplemental programs diskette) contains the Linker and Debug programs, a sample device driver listing, and some BASIC programs.

For DOS Versions 1.1 and 2.0, the *Disk Operating System User's Guide*, Version 1.1 or 2.0 respectively, is provided as the DOS package. This binder contains the DOS diskette(s) and describes DOS facilities and how to use them. For DOS Version 2.1, the *Disk Operating System User's Guide Version 2.1* and *Disk Operating System Reference Version 2.1* are provided as of the DOS package. The *Disk Operating System Technical Reference Version 2.1* must be purchased separately from DOS Version 2.1 if desired (6024125 - \$30).

For DOS Versions 3.0 and 3.1, the *DOS Reference*, *DOS User's Guide*, and *Application Setup Guide* are provided as the DOS package. The *DOS Reference* contains the two DOS diskettes. The *Disk Operating System Technical Reference Version 3.0* (6024181 - \$40) or 3.1 must be purchased separately from DOS Version 3.0 or 3.1, respectively, if desired.

The functions provided by the Disk BASIC and Advanced BASIC that are provided with the DOS package are described in the BASIC reference manual that describes the BASIC Interpreter in ROM of an IBM personal computer. The current BASIC reference is provided with the purchased IBM personal computer system unit. The current BASIC manual (6361132) describes the facilities of cassette level, DOS Version 1.1, DOS Version 2.0/2.1, and DOS Version 3.0/3.1 BASIC as well as those of the BASIC Compiler Version 1.0. Differences among the versions are identified.

Configurations Supported

DOS supports the following IBM personal computer configurations:

- IBM PCjr. DOS Version 2.1 or later is required. One diskette drive and a minimum of 64Kb of memory are required; however, 128Kb of memory is recommended.
- IBM Personal Computer. All DOS versions support this configuration and require one diskette drive (single- or double-sided). DOS Version 1.1 requires a system unit with a minimum of 32Kb of memory or 48Kb if Disk BASIC or Advanced BASIC is used. DOS Versions 2.0 and later require a minimum of 64Kb of memory in the system unit with a minimum of 128Kb recommended when fixed disk storage is present in the configuration.
- IBM Portable Personal Computer. DOS Version 2.1 or later supports this configuration and operates in the minimum configuration.
- IBM Personal Computer XT. DOS Version 2.0 or later is required and operates in the minimum configuration.
- IBM Personal Computer XT/370 operating in PC mode. DOS Version 2.0 or later is required and operates in the minimum PC XT/370 configuration. The VM/PC program together with DOS is required to support VM/PC mode operations.
- IBM Personal Computer AT. DOS Version 3.0 or 3.1 is required and operates in the minimum configuration.
- IBM Personal Computer AT/370 operating in PC mode. DOS Version 3.0 or 3.1 is required and operates in the minimum PC AT/370 configuration. The VM/PC program together with DOS is required to support VM/PC mode operations.
- IBM 3270 Personal Computer. DOS Version 2.0 or 2.1 is required, as is the 3270-PC Control Program, and operates in the minimum 3270-PC configuration.
- IBM 3270 Personal Computer/Graphics and IBM 3270 Personal Computer/Extended Graphics workstations. DOS Version 2.1 and the 3270-PC Graphics Control Program are required and operate in the minimum configurations.
- IBM 5531 Industrial Computer. DOS Version 2.0 or later is required and operates in the minimum configuration.

Components

DOS provides an input/output support system, a command interpreter, and utility programs. It consists of the following components:

- Boot program, which is used to initial program load (IPL) DOS. This program is placed at the beginning of each diskette that is formatted using the DOS FORMAT command.
- IBMBIO.COM program, which is an input/output device handler that interfaces with Basic Input/Output System (BIOS) device routines in ROM. This program is resident in memory during system operation.
- IBMDOS.COM program, which consists of file management routines, blocking and deblocking routines for diskette, and service functions that can be accessed by programs executing under DOS control. This program is resident in memory during system operation.
- COMMAND.COM program, which accepts DOS commands entered from the keyboard or a command file and executes the appropriate program. The internal DOS commands are contained in this program, which is resident in memory during system operation.
- Utility programs that perform service functions (diskette/fixed disk formatting, copying, com-

paring, backup/restore, for example) and provide other functions (program development, sorting, background printing, for example). These programs are resident on the DOS diskette/fixed disk during system operation and are invoked using external DOS commands.

The IBMBIO.COM, IBMDOS.COM, and COMMAND.COM programs can be placed on a diskette when it is formatted using the DOS FORMAT command. These DOS files will not be listed when the directory of a diskette that contains them is listed.

Functions Supported

Functions in All Versions

DOS Versions 1.1 and later support the following:

- Automatic loading of DOS when a power-on or system reset is performed if the DOS diskette is in diskette drive A
- Entering date, time, and remarks
- Setting various printer and display screen options
- Setting options for an Asynchronous Communication Adapter
- Automatic execution of one program or DOS command, or a series of program commands each time DOS is IPLed (using a special batch file to specify what is to be executed)
- Execution of the DOS application program whose name is entered via the keyboard
- Execution of a series of commands or programs (batch processing using a batch file to specify the commands/programs to be executed)
- Suspension of the execution of a series of programs/commands in order to display messages or change diskettes (PAUSE command placed within a batch file)
- I/O handling (device drivers) for one or more 5¼-inch diskette drives (single-sided and double-sided), the 83-key keyboards for the supported configurations, IBM-Logo displays and printers that attach to IBM personal computers, and the Asynchronous Communications Adapter. Light pens, joysticks, and game paddles are not supported.
- Double-sided diskette capacity of 320Kb for DOS Version 1.1 and 360Kb for DOS Versions 2.0 and later. Sequential and direct processing of a diskette file is supported as is dynamic allocation of sectors for a file as required. The two diskette drives that can be installed in the system unit in most IBM personal computer configurations are addressed as A and B.

- File size up to 16 billion bytes
- Formatting, copying, and comparing diskettes, including transferring DOS to another diskette for backup
- Comparing, copying, displaying, erasing, combining, and renaming files on diskettes
- Listing the contents of a diskette directory on the display
- Analyzing a diskette directory and file allocation table to display a diskette and memory status report
- Causing printer output from the PrtSc key or for a parallel printer to be directed to an Asynchronous Communications Adapter
- Program creation and testing using the Line Editor (EDLIN), Linker (LINK), and DEBUG programs
- Conversion of .EXE files (executable programs created by the linker) to .COM type files (memory image files that require less diskette space and load faster)
- Random access memory up to 640Kb for Versions 1.1, 2.0, and 2.1 and up to 3Mb for Versions 3.0 and 3.1

The Line Editor (EDLIN) program can be used to create source language program or text files on diskette. The Line Editor manages the contents of a file on a line basis and operates on lines up to 253 characters in length. The Line Editor can be used to:

- Create new source program or text files and save them. Source program files can be input to compilers that operate under DOS.
- Update existing files and save both the updated and original files
- Delete, edit, insert, and display lines of a file
- Search for, delete, or replace text within one or more lines

The Linker (LINK) program is a linkage editor that accepts the output of DOS compilers and the Macro Assembler (object modules) and produces an executable program (relocatable load module). The Linker program does the following:

- Combines separately produced object modules. Modules produced by a high-level language and the Macro Assembler can be combined.
- Searches library files for definitions of unresolved external references
- Resolves external cross-references
- Produces a relocatable load module (.EXE file) on diskette. This is an object file that contains an executable program in machine language format.
- Produces a printable listing that shows the resolution of external references and any error messages

The DEBUG program is provided to execute and test executable programs, such as those produced by the Linker program. The DEBUG program provides several commands that can be used to execute, change, and display a file. A program can be changed in memory and reexecuted without a reassembly and link edit. The change file can be written to a diskette. Commands to compare two portions of memory, move the contents of a block of memory, and search for a string of characters are provided.

A TRACE command to execute one or more instructions and display the results and an UNASSEMBLE command to produce and display Assembler Language statements from a machine language program are also supported by the DEBUG program.

Additional Functions in Versions 2.0 and 2.1

DOS Versions 2.0 and 2.1 support all functions provided in DOS Version 1.1 and offer new facilities. In addition, extensions are included in the Disk BASIC and Advanced BASIC that are supplied with DOS Versions 2.0 and 2.1. The only difference between the support in DOS Versions 2.0 and 2.1 is that DOS Version 2.1 supports the IBM PCjr configuration (PCjr diskette drive, program cartridges, and the 5181 Compact Printer).

Application programs that execute under DOS Version 1.1 and that use standard (documented) programming protocols should execute under DOS Version 2.0 or 2.1 without modification. Direct calls to BIOS and access to the absolute memory locations of resident DOS Version 1.1 are examples of nonstandard protocols. Since more resident memory is required by DOS Versions 2.0 and 2.1 than by DOS Version 1.1 (24Kb versus 12Kb), some application programs may not be able to execute in the same IBM personal computer under DOS Version 2.0 or 2.1 as they did under DOS Version 1.1.

The following major functions are supported by DOS Versions 2.0 and 2.1 but not by DOS Version 1.1:

- One or more 10Mb-capacity fixed disk drives. The two fixed disk drives that can be included in most IBM personal computer configurations are addressed as C and D. Fixed disk initialization, backup, and restore are supported as are automatic (at power-on) and manual IPL from fixed disk (the C disk). Sector size is 512 bytes. Utility functions like those provided for diskette drives are also supported for files on disk drives

(copy, compare, erase, list directory, for example).

A fixed disk can be divided into up to four partitions if different operating systems are to be used. Each partition (a contiguous set of cylinders) is defined by the operating system that is to use it and is dedicated to that operating system.

One partition can be defined as the active partition. When a power-on or IPL is done without an operating system loaded in diskette drive A, the operating system contained in the active partition in the first fixed (C) disk, if any, is automatically loaded. The active partition can be changed at any time using DOS.

- 360Kb capacity per double-sided diskette (9 sectors per track). Diskettes with a 320Kb capacity (8 sectors per track) can also be read and written.
- One unique volume label on a diskette or fixed disk. The label can be written when the drive is formatted (placed in the directory). This volume label can be displayed using a command.
- Tree-structured directories on diskette or fixed disk drives. This facility permits one root directory and multiple subdirectories to be created to reduce directory search time when a large number of files exist on a diskette or fixed disk. The directory structure can be displayed.
- Multiple buffers per diskette drive or fixed disk drive. Up to 99 can be user-specified per diskette or fixed disk drive to improve performance for direct processing of files (such as is used in data base application programs).
- Verify (read) after write for diskette and fixed disk files
- Sorting of a file in ascending or descending ASCII collating sequence
- File recovery facility, which will recover a file that cannot be used because of a defective sector or recover all the files on a diskette or fixed disk if the directory is damaged
- Subcommands for batch processing that provide logic for job stream processing
- Printing of a list of files (from 1 to 10) overlapped with other processing (background printing). This function requires an additional 3200 bytes of resident memory. The list of files to be printed can be displayed and files can be deleted from the list.
- Reassignment of diskette and fixed disk drive letters (A, B, C, and D) so that a request for a given drive can be directed to a different drive (for example, direct a file to fixed disk instead of to a diskette)

- Loading of user-written I/O device support (device drivers) for devices not supported by DOS
- Printing of the image on a graphics display screen to a graphics printer (such as the 5152 Model 2) using the PrtSc and shift keys
- Redirection of standard input (keyboard) and output (display), permitting a program to receive its input from or direct its output to a device other than the standard DOS input and output devices (keyboard and display).
- Piping (pipelining) facility, which enables the standard output of one program to be used as the standard input to another program
- A configuration file that DOS will access each time it is initiated to establish certain configuration information (number of buffers per diskette/fixed disk, the names of device drivers, and other operational information)
- Changing of the standard DOS display console device to another input/output device (an Asynchronous Communications Adapter, for example).
- Switching the active console between a monochrome display and a color display attached to the same system unit.
- Clearing of the display screen by a command entered via the keyboard or a batch file

The guide *Learning to Use DOS Version 2* (feature code 4080) can be purchased. It provides step-by-step instruction about how to use DOS commands, including those that support fixed disk drives.

Additional Functions in Versions 3.0 and 3.1

DOS Versions 3.0 and 3.1 support all the functions provided in DOS Version 2.1. They also support the 5170 Personal Computer AT and AT/370 configurations and provide additional functions relative to DOS Version 2.1. However, they are not a substitute for DOS Version 2.1. The BASIC in DOS Versions 3.0 and 3.1 is also extended to support 5170 configurations and to allow additional programmer access to I/O device drivers and DOS.

Application programs that execute under DOS Versions 1.0 through 2.1 and that use standard (documented) programming protocols should execute under DOS Version 3.0 or 3.1 without modification. Direct calls to BIOS and access to the absolute memory locations of resident DOS Versions 1.0 through 2.1 are examples of nonstandard protocols.

Since more resident memory is required by DOS Versions 3.0 and 3.1 than by previous DOS versions (36Kb versus 24Kb or 12Kb), some application programs may not be able to execute in the same IBM

personal computer under DOS Version 3.0 or 3.1 as they did under a previous DOS version. In general, a minimum of 96Kb of memory is recommended for systems without fixed disk and a minimum of 128Kb for systems with fixed disk when DOS Version 3.0 or 3.1 is used.

The following major functions are supported by DOS Versions 3.0 and 3.1 but not by DOS Version 2.0 or 2.1:

- One or more 20Mb-capacity fixed disk drives. The same facilities are provided for the 20Mb-capacity fixed disk drives in 5170 configurations as for the 10Mb-capacity fixed disk drives for other configurations.
- One or more high-capacity (1.2Mb) diskette drives for 5170 configurations (same facilities as for 320Kb- and 360Kb-capacity diskette drives). Single- and double-sided diskettes with 160Kb or 180Kb per side continue to be supported.
- Realtime clock in the 5170
- Extended BACKUP and RESTORE commands to support transfer from fixed disk to fixed disk, diskette to fixed disk, and diskette to diskette, in addition to from fixed disk to diskette
- File sharing. When a file is opened, optionally a file sharing mode can be specified. The sharing modes allow a program to open a file for its exclusive use and permit other programs to read the file only, write the file only, or read and write the file. When file sharing is used, the total number of DOS files that can be open concurrently using file control blocks (FCBs) can be limited.
- Block locking. This facility permits access to all or part of a file to be restricted when the file is opened with a file sharing mode specified that permits sharing of the file.
- A command (ATTRIB) that sets the read attribute of a file to read-only or that displays the attribute of a file
- Virtual disk drives. One or more virtual disks referred to by a drive letter can be defined. Virtual disks are allocated in random access memory and for a 5170 configuration can be located in extended memory (in the 1Mb to 3Mb area of memory) if desired.

Note that in a 5170 configuration with 1Mb of random access memory installed, memory locations from 640Kb to 1Mb cannot be used for programs and data because these memory addresses are allocated for addressing other memory in the system (read only memory and memory on the display adapters, for example). A 5170 with more than 1Mb of memory can use

the extended memory only for virtual disk drives.

Virtual disk size can be specified (one byte to size of available memory), as can sector size (128, 256, or 512 bytes) and the number of directory entries for the virtual disk. A virtual disk operates faster than a real disk, since access is to memory rather than to a device; however, its contents are lost when power to the system unit is turned off so the contents of virtual disk must be written to a diskette or fixed disk if they are to be saved.

- Support for international keyboard layouts. Support of the U.S. English layout keyboard is the default keyboard support. For systems with one of the five international layouts, the SELECT command can be used to specify the keyboard layout to be supported and the format the operator will use for the country's date and time.
- Limiting the maximum number of drives that can be accessed. The limit can be 26 maximum or a number less than 26 that is greater than the number of physical drives (diskette and fixed disk) in the configuration.
- Additional and modified function calls to support enhanced file handling (see *DOS Technical Reference*)
- Additional error reporting facilities
- Printing the contents of a graphics display screen to the 5182 Color Printer in color or to the 5181 Compact Printer as well as to the 5152 Graphics Printer
- Large Linker that supports up to 1Mb

DOS Version 3.1 supports all the facilities of Version 3.0 and functions required to support the IBM PC Network. It is designed as a replacement for DOS Version 3.0.

Multiprogramming using the TopView Program

The TopView application program can be used with DOS Versions 2.0 and later to support the concurrent operation of multiple (including graphics) applications. As many applications as will fit in memory can be executed together.

TopView can be used in 5150 Personal Computer, 5155 Portable Personal Computer, 5160 Personal Computer XT, 5170 Personal Computer AT, and 3270-PC (5271) configurations with 256Kb or more of memory. Two double-sided diskette drives or one double-side diskette drive and one fixed disk drive are required in the IBM personal computer config-

uration. A tutorial is provided to aid in learning to use TopView facilities.

TopView supports one or more windows for each application and can display multiple windows simultaneously on the display screen except for graphics applications. Several graphics applications can be initiated under TopView but only one graphics application can operate at a time and uses a full-screen window. Sizing, moving, and scrolling of windows by the operator is supported for non-graphics applications.

TopView supports the 5151 Monochrome Display, 5153 Color Display, 5154 Enhanced Color Display, 5175 Professional Graphics Display, and Enhanced Graphics Adapter (in enhanced or emulation mode).

Transfer of data between executing applications is also provided. This enables the user to choose which and how many application programs are to be used together as if they were a single package, say a word processing program and a spreadsheet (as is provided by integrated software, such as 1-2-3™, Symphony™, or Framework™).

Optionally, a customer-supplied mouse device can be used instead of the keyboard. The following vendor-logo mouse devices are supported:

- Microsoft Mouse for IBM Personal Computers™ (part number 037-099 for a parallel interface or 039-099 for a serial interface)
- PC Mouse™ (part number 900120-214)
- Visi-On-Mouse™ (part number 69910-1011)

The TopView Programmer's ToolKit can be used to design and develop application programs that utilize the facilities of the TopView program. However, any DOS application program can be executed under TopView, since a special interface is not required.

For additional information about TopView and TopView Programmer's ToolKit, see the following:

- *IBM Personal Computer Seminar Proceedings Volume 2, Number 6-1, G320-9314*
- *TopView brochure, G520-4218*
- *TopView Programmer's ToolKit, G520-5035*

The following publications discuss installation procedures and implementation techniques for TopView and list many of the application programs that can operate with TopView:

- *TopView Application Guide—IBM Applications, G520-5072*
- *TopView Application Guide—Non-IBM Applications, G520-5101*

Languages Supported

DOS Versions 1.1 and later support operation of the following language translator programs:

- **BASIC Compiler.** This compiler supports ROM BASIC Interpreter functions and most functions of the Disk BASIC and Advanced BASIC provided with DOS. The BASIC Compiler converts programs written for execution using the BASIC Interpreter in ROM to executable modules to significantly reduce their execution time. The BASIC Compiler can execute in the following IBM personal computer configurations:
 - IBM PCjr with a minimum of 128Kb of memory and one diskette drive
 - IBM Personal Computer with a minimum of 64Kb of memory and one diskette drive
 - IBM Portable Personal Computer (minimum configuration)
 - IBM Personal Computer XT or AT (minimum configuration)
 - IBM Personal Computer XT/370 or AT/370 operating in PC mode (minimum configuration)
 - IBM 3270 Personal Computer workstations (minimum configurations)
 - IBM 5531 Industrial Computer (minimum configuration)
- **BASIC Programming Development System.** This package provides four utility functions (Text File Editor, Structured BASIC Processor, BASIC Formatter, and BASIC Cross Reference) that BASIC programmers can use to write, edit, and preprocess BASIC programs. This package can execute in the following IBM personal computer configurations:
 - IBM PCjr with a minimum of 128Kb of memory and one diskette drive
 - IBM Personal Computer with a minimum of 96Kb of memory and one diskette drive
 - IBM Portable Personal Computer (minimum configuration)
 - IBM Personal Computer XT or AT (minimum configuration)
 - IBM Personal Computer XT/370 or AT/370 operating in PC mode (minimum configuration)
 - IBM 3270 Personal Computer workstations (minimum configurations)
 - IBM 5531 Industrial Computer (minimum configuration)
- **COBOL Compiler.** This compiler supports American National Standard (ANS) Programming Language COBOL (X3.23-1974) as understood and interpreted by IBM as of February 1982. It provides relocatable object modules that must be converted to executable load modules using the DOS Linker program.

The COBOL compiler executes in the following IBM personal computer configurations:

- IBM PCjr with a minimum of 256Kb and one diskette drive (a virtual disk must be defined)
 - IBM Personal Computer with a minimum of 64Kb of memory and two diskette drives
 - IBM Portable Personal Computer with two diskette drives
 - IBM Personal Computer XT or AT (with two diskette drives)
 - IBM Personal Computer XT/370 or AT/370 operating in PC mode (minimum configuration)
 - IBM 3270 Personal Computer workstations with two diskette drives
 - IBM 5531 Industrial Computer (minimum configuration)
- **FORTRAN Compiler.** This compiler supports a version of FORTRAN-77 that includes the standard ANSI X3.9-1978 (subset level) and features from X3.9-1978 (full level). It produces relocatable object modules that must be converted to executable load modules using the DOS Linker program.

The FORTRAN compiler executes in the following IBM personal computer configurations:

- IBM PCjr with a minimum of 256Kb of memory and one diskette drive (a virtual disk must be defined)
 - IBM Personal Computer with a minimum of 128Kb of memory and two diskette drives
 - IBM Portable Personal Computer with two diskette drives
 - IBM Personal Computer XT with a minimum of 192Kb of memory, one diskette drive, and one fixed disk drive or 128Kb and two diskette drives
 - IBM Personal Computer AT with two diskette drives or one diskette drive and one fixed disk drive
 - IBM Personal Computer XT/370 or AT/370 operating in PC mode (minimum configuration)
 - IBM 3270 Personal Computer workstations with two diskette drives, or one diskette drive and one fixed disk drive
 - IBM 5531 Industrial Computer with a minimum of 192Kb
- **Pascal Compiler.** This compiler supports all the facilities of the International Standards Organization (ISO) Working Draft #6 with the exception of conformant array parameters (which are provided by the super array type) and many additional features. The compiler produces relocatable object modules that must be converted

to executable load modules using the DOS Linker program.

This compiler executes in the following IBM personal computer configurations:

- IBM PCjr with a minimum of 256Kb and one diskette drive (a virtual disk must be defined)
- IBM Personal Computer with a minimum of 128Kb of memory and two diskette drives
- IBM Portable Personal Computer with two diskette drives
- IBM Personal Computer XT with a minimum of 192Kb of memory, one diskette drive, and one fixed disk, or 128Kb and two diskette drives
- IBM Personal Computer AT with two diskette drives, or one diskette drive and one fixed disk drive
- IBM Personal Computer XT/370 or AT/370 operating in PC mode (minimum configuration)
- IBM 3270 Personal Computer workstations with two diskette drives, or one diskette drive and one fixed disk drive
- IBM 5531 Industrial Computer with a minimum of 192Kb
- APL Interpreter. This interpreter accepts one statement at a time, converts it to machine language instructions, executes the instructions, and proceeds to the next statement. It requires the optional Math Co-processor Option feature.

The APL Interpreter executes in the following IBM personal computer configurations:

- IBM Personal Computer with a minimum of 128Kb of memory and one diskette drive
- IBM Portable Personal Computer (minimum configuration)
- IBM Personal Computer XT or AT (minimum configuration)
- IBM Personal Computer XT/370 or AT/370 operating in PC mode (minimum configuration)
- IBM 3270 Personal Computer workstations (minimum configurations)
- IBM 5531 Industrial Computer (minimum configuration)
- Logo. Logo is an interactive interpreter. It is an educational language for students and adults that is designed to illustrate programming concepts and logical, mathematical, and geometric relationships.

Logo executes in the following IBM personal computer configurations:

- IBM PCjr with a minimum of 128Kb of memory and one diskette drive

- IBM Personal Computer with a minimum of 128Kb of memory and one diskette drive
- IBM Portable Personal Computer (minimum configuration)
- IBM Personal Computer XT or AT (minimum configuration)
- IBM Personal Computer XT/370 or AT/370 operating in PC mode (minimum configuration)
- IBM 3270 Personal Computer workstations (minimum configurations)
- IBM 5531 Industrial Computer (minimum configuration)
- Macro Assembler. Programmers familiar with the 8088, 8087, 80286, or 80287 micro-processor instruction set can use this assembler to produce programs that can operate faster than programs written in a high-level language, to access DOS internal functions, and to create relocatable object modules that can be combined with object modules created using the BASIC, COBOL, FORTRAN, or PASCAL compiler (using the DOS Linker program). The Logo Interpreter can call Assembler language subroutines also. Version 2 of this assembler is required to support the 80286 and 80287 micro-processors.

The Macro Assembler executes in the following IBM personal computer configurations:

- IBM PCjr with a minimum of 128Kb of memory and one diskette drive
- IBM Personal Computer with a minimum of 96Kb of memory and one diskette drive
- IBM Personal Computer XT or AT (minimum configuration)
- IBM Personal Computer XT/370 or AT/370 in PC mode (minimum configuration)
- IBM 3270 Personal Computer workstations (minimum configurations)
- IBM 5531 Industrial Computer (minimum configuration)

A discussion of the Macro Assembler is contained in *IBM Personal Computer Seminar Proceedings Volume 1, Number 2, G320-9307*. FORTRAN and Pascal are discussed in *IBM Personal Computer Seminar Proceedings Volume 2, Number 3, G320-9311*.

40:05 IBM Personal Computer Disk Operating System

One-Time Charges

DOS Version	Part Number	Feature Code	Price (\$)
1.1	6024001	4001	40
2.1	6024120	4120	65
3.0	6024180	4180	65
3.1	6024211	4211	65

Discounts Available

DOS is eligible for an IBM Personal Computer Licensed Program Quantity Discount Agreement (program category AAA), educational allowance, or Product Center Single Delivery Quantity Discount.

40:10 IBM Personal Computer Interactive Executive

Introduction

The IBM Personal Computer Interactive Executive (PC/IX) is a single-user, general-purpose, multi-tasking operating system that supports the 5150 Personal Computer, 5160 Personal Computer XT, 5170 Personal Computer AT, and 5160 Personal Computer XT/370 (in PC mode). PC/IX Version 1.1 (which supersedes Version 1.0) is required to support the 5170 Personal Computer AT.

PC/IX, developed for IBM by INTERACTIVE Systems Corporation of Santa Monica, California, is based on the IS/3 operating system of INTERACTIVE Systems. IS/3 is based on UNIX™ System III as licensed by AT&T Technologies, Inc. (formerly the Western Electric Company). PC/IX contains several enhancements to IS/3 that are specifically designed for the IBM personal computer configurations supported.

The UNIX operating system is written in a high-level language (the C language) and, therefore, is a portable operating system in the same way as is a high-level language translator (COBOL, FORTRAN, PL/I, etc.). Thus, those using UNIX or a UNIX-based operating system on another computer can use their UNIX knowledge as a base for using PC/IX on an IBM personal computer. In addition, programs written in the C language that operate under a UNIX operating system can be recompiled for execution under PC/IX on an IBM personal computer that has the required hardware resources.

PC/IX provides tools to support software development, document preparation, and text processing. It is designed to improve the productivity of users by being easy to understand and use, as well as easy to modify. PC/IX is a timesharing system that permits one user to perform more than one task at a time. Protection facilities are provided so that several users can utilize PC/IX on one system at different times, with each user having access only to files for which authorization is provided. Each user logs onto the PC/IX system and must supply a password if password protection is implemented.

The PC/IX operating system is fixed disk resident and requires more than half the capacity of a 10Mb fixed disk when all its options are loaded. PC/IX and DOS Version 2.0 or later for IBM personal computers can reside on the same fixed disk drive in separate partitions, and utilities to transfer files between PC/IX and DOS Version 2.0 or later are

provided in PC/IX. Each fixed disk in the configuration can have up to four partitions.

PC/IX provides input and output device handlers, processor and memory scheduling functions, accounting and I/O device error information, password protection to control user access to files, a full-screen text editor, extensive file management facilities, program development tools, and a control system to manage source code and text files.

PC/IX is provided on 19 diskettes that are grouped into subsets for ease of installation. The following function groups are supplied:

- Core functions (resident operating system, command language, and system utilities) on eight diskettes
- Programming support on four diskettes
- Communications support on one diskette
- Source code control system on one diskette
- Text processing support on one diskette
- Special-purpose functions on one diskette
- System accounting on one diskette
- Games on one diskette
- Maintenance on one diskette

The following publications and template are also provided with the PC/IX system:

- General Information Manual, GH20-6247
- User's Manual, SH20-6365, and binder, SH20-6364
- Programmer's Guide, SH20-6367, and binder, SH20-6366
- System Manager's Guide, SH20-6369, and binder, SH20-6368
- Text Processing Guide, SH20-6371, and binder, SH20-6370
- Keyboard template, SX20-0142

An overview of PC/IX is provided in G320-0552. *IBM Personal Computer Interactive Executive Installation Supplement*, G320-0565, provides supplemental information for the PC/IX System Manager.

Configurations Supported

PC/IX supports the following IBM personal computer configurations:

- IBM Personal Computer with a minimum of 256Kb of memory, one double-sided diskette drive, and one 10Mb fixed disk drive
- IBM Personal Computer XT with a minimum of 256Kb of memory, one double-sided diskette drive, and one 10Mb fixed disk drive
- IBM Personal Computer AT with a minimum of 256Kb of memory, one diskette drive, and one 20Mb fixed disk drive (as of Version 1.1)
- IBM Personal Computer XT/370 operating in PC mode (5160 Model 588 or 589 minimum configuration)

The required display device can be the 5151 Monochrome Display or the 5153 Color Display. The latter is supported in text mode only.

The following optional features are supported by PC/IX:

- Additional memory up to 640Kb (512Kb is recommended to fully utilize the multitasking facilities provided)
- Math Co-processor Option. Floating-point emulation is provided when the feature is not present.
- One or two Asynchronous Communications Adapters to connect the IBM personal computer to a UNIX host processor or to another IBM personal computer that is using PC/IX. Messages and files can be transferred among PC/IX users via electronic mail and communications support.
- One additional 10Mb or 20Mb Fixed Disk Drive (which may be used for applications that require large amounts of data or to improve system performance)
- Maximum of four diskette drives (additional three drives can be single- or double-sided). Single- and double-sided diskettes with 160Kb per side (8 sectors per track) and with 180Kb per side (9 sectors per track) are supported, as is the 1.2Mb diskette drive for the 5170.
- One or two printers: 5152 Graphics Printer Model 2, 5152 Matrix Printer Model 1, and/or 5182 Color Printer. Simultaneous operation of two parallel printers is supported.

Use of a monochrome and a color display attached to the same PC/IX hardware configuration is supported. A command is provided to switch usage between the two displays.

Components and Functions Supported

Basically, PC/IX consists of the Kernel (the resident supervisor), the shell (command processor), and utilities that perform the supported functions. The user interacts with the shell to request services and the shell invokes the appropriate utility to handle the request. The utilities and the shell request services from the Kernel.

PC/IX consists of the following functional components:

- The Kernel. This is the basic memory resident operating system. It manages system resources (processor time, memory allocation), provides device independent I/O support (device drivers), gathers accounting and device error information, and manages the file system. The file system consists of directories and files arranged in a hierarchical structure. Facilities for creating, accessing, moving, processing, and protecting directories and files are provided.

Other PC/IX components interface with the Kernel via a defined set of entry points (approximately 40), as is done in DOS. The entry points are designed to require as little calling overhead as possible and to isolate the caller from the internals of the Kernel code. The relative simplicity of the interface to the Kernel simplifies tailoring of the PC/IX system with user-written routines.

- Queuing system. This component supports job scheduling for output destined for printers and Asynchronous Communications Adapters. Output jobs can be scheduled to execute on a first-in first-out, shortest-job-next, or priority basis. Multiple-copy printing and job status inquiry are also supported.
- The interactive command interpreter shell. The shell component (which is similar in function to the DOS COMMAND.COM program) processes commands entered by the operator or via command files created by the user. Redirection of the standard input (keyboard) and the standard output (the display) to other device types is supported. Conditional command execution and command chaining (output of one command connected to the input of another command), which is also called pipelining, are also supported. The shell is a full programming language and thus permits new commands to be created easily by writing a shell script (command) file.
- File management utilities. These utilities support directory and file creating, copying, deleting, renaming, printing, sorting, merging, and archiving. A directory can be searched for files

having certain characteristics. A file can be searched for particular strings or combinations of strings. Files can be compared for line-by-line differences or common lines, and character translations can be done in a file. The ability to transfer files between PC/IX and DOS Version 2.0 or later and the inclusion of user-written device drivers for unsupported devices are supported.

- Status inquiry utilities. These utilities enable the user to determine what processes are active, obtain various system usage statistics, and request a disk usage summary by directory or for the entire file system.
- Editing facilities. Three editors (INed, ed, and sed) are provided. The user can select the editor to use on the basis of editing needs. INed is a full-screen editor with a large set of functions that are designed to be easy to learn and simple to use. Windowing, menus, and extensive help facilities are provided. For more sophisticated users, ed (an interactive context editor) and sed (a one-pass stream editor) provide a smaller set of editing functions than INed.
- Text formatting. Two text formatters (nroff for printer formatting and troff for phototypesetter formatting) are provided that offer extensive capabilities for the formatting of text.
- Program-writing tools. These tools include a C language compiler, Assembler and relocating loader for 8088 and 80286 microprocessor instructions, a debugger, a C cross-referencer, a symbol-table lister, and programs that support the organization and maintenance of object module libraries.

C is a general-purpose, high-level language that is designed for structured programming. It supports the use of hardware facilities at a level normally found only in an Assembler language, while providing machine-independent use of hardware facilities. This allows efficient use of hardware in an architecture-independent manner. PC/IX (like other UNIX-based operating systems) is written in the C language.

Programs written in the C language that operate under a version of UNIX on other computers can be converted for execution under PC/IX on a supported IBM personal computer that has the required hardware resources. The C source code for these programs must be recompiled using the PC/IX C compiler and then assembled using the PC/IX assembler to produce executable code that can execute in an IBM personal computer.

- Program development aids: Source Code Control System (SCCS) and MAKE. SCCS and MAKE are two subsystems that control and manage changes to files that contain programs

or text. SCCS controls the maintenance of program and text files. It provides facilities for storing, updating, and retrieving any version of a controlled file. It controls updating privileges to a file and records who made each change, and when and why the change was made.

MAKE can be used to maintain a large number of interrelated program files to ensure that whenever a change is made to one file, all dependent files are also updated so that the interrelated program files are kept up to date.

SCSS and MAKE are program development tools designed to solve many of the source code and document control problems that software development projects encounter when customer support, system testing, and program development are proceeding concurrently.

- System management tools. A variety of system management functions are supported. Included are system startup and shutdown, enabling/disabling access to the system via specified ports, performance monitoring, error logging, management of accounting functions, dumping and restoring of file systems, performing consistency checks on file systems, automatically or interactively repairing damaged file systems, and creating/mounting/unmounting file systems.

For additional general information about PC/IX, see *Personal Computer Interactive Executive General Information Manual*, GH20-6247.

The Interactive Executive (IX) RM/COBOL™ Compiler and Run Time Interpreter and IX RM/COBOL Run Time Interpreter licensed programs operate under PC/IX.

The RM/COBOL language is a GSA-certified COBOL (level 1) based on 1974 ANSI standards. Software developed using RM/COBOL on one system can execute on any RM/COBOL-compatible system. Designed for serious business computing, RM/COBOL provides the features needed for the efficient development and execution of business applications. Powerful interactive screen handling capabilities increase flexibility and speed program development. Interactive debugging is provided during program execution for more efficient program development.

The IX RM/COBOL Compiler and Run Time Interpreter is provided for developers of applications who need to compile and test on the same IBM personal computer. The IX RM/COBOL Run Time Interpreter is provided for users of IBM personal com-

40:10 IBM Personal Computer Interactive Executive

puters who need to execute business applications written in RM/COBOL.

One-Time Charges

Item	Part Number	Feature Code	Price (\$)
PC/IX Version 1.1	1753369	9358	900
IX RM/COBOL Compiler and Run Time Interpreter	6316996	9350	750
IX RM/COBOL Run Time Interpreter	6316997	9351	230

Discounts Available

PC/IX and the RM/COBOL programs are eligible for an IBM Personal Computer Licensed Program Quantity Discount Agreement (program category BBB for PC/IX and HHH for RM/COBOL), educational allowance, or Product Center Single Delivery Quantity Discount.

40:15 IBM Personal Computer XENIX System

Introduction

The IBM Personal Computer (IBM PC) XENIX™ System consists of an operating system and two optional components that run under the operating system:

- IBM PC XENIX Operating System
- IBM PC XENIX Software Development System
- IBM PC XENIX Text Formatting System

The IBM PC XENIX Operating System is a multi-user, multiprogramming, multitasking operating system that supports the 5170 Personal Computer AT operating in protected address mode. It is a comprehensive system, supporting over 150 commands.

The IBM PC XENIX Software Development System provides a set of application software development tools, which include a C compiler, an Assembler for the 80286 and 8088 microprocessors, interactive debugging facilities, and source code management facilities. The IBM PC XENIX Text Formatting System provides an extensive text processing system that includes two text editors, two formatters, and spelling verification.

The IBM PC XENIX System, developed for IBM by the Microsoft Corporation, is based on the UNIX™ System III, a timesharing system developed by AT&T Bell Laboratories. IBM PC XENIX contains several enhancements that are specifically designed for the IBM Personal Computer AT configuration as well as enhancements made by Microsoft and the University of California at Berkeley.

Most of the IBM PC XENIX System is written in a high-level language (the C language) and, therefore, is a portable operating system in the same way as is a high-level language translator (COBOL, FORTRAN, PL/I, etc.). Thus, those using UNIX or a UNIX-based operating system in another computer can use their UNIX knowledge as a base for using IBM PC XENIX in an IBM personal computer. In addition, programs written in the C language that operate under a UNIX operating system can be recompiled for execution under IBM PC XENIX in an IBM Personal Computer AT that has the required hardware resources.

The IBM PC XENIX Operating System supports from one to three users accessing the 5170 configuration simultaneously with protection provided for the operating system and each user's memory and

files. One user interacts with IBM PC XENIX via the required display while one or two other users interface via a local or remote terminal (including other IBM personal computers) connected to the serial (RS-232C) port of one or two Serial/Parallel Adapters in the 5170. Each user can execute more than one program at a time.

Communication between users accessing the same 5170 IBM PC XENIX configuration and between the 5170 IBM PC XENIX configuration and other IBM PC XENIX and/or UNIX configurations is also supported. Users of the same 5170 configuration can send and receive mail, print calendar information, and print general information and announcement files. A 5170 IBM PC XENIX configuration connected to another IBM PC XENIX/UNIX configuration via a serial (asynchronous communication) port can transfer files to and from the other configuration and send/receive messages.

The IBM PC XENIX System can be especially useful for engineering and scientific environments, application development, and the publishing industry. It can also benefit commercial environments.

The IBM PC XENIX System is fixed disk resident. IBM PC XENIX and DOS Version 2.0 or later for IBM personal computers can reside on the same fixed disk drive in separate partitions, and utilities to transfer files between IBM PC XENIX and DOS Version 2.0 or later are provided in IBM PC XENIX. Each fixed disk in the configuration can have up to four partitions.

The IBM PC XENIX *General Information Manual*, GC34-0607, and *IBM Personal Computer Seminar Proceedings Volume 2, Number 9*, G320-9316, can be ordered. They provide information about all three components of the IBM PC XENIX System. The *IBM PC XENIX System* brochure is also available.

IBM PC XENIX Operating System

The IBM PC XENIX Operating System supports the IBM Personal Computer AT with 512Kb of memory, one 1.2Mb diskette drive, one 20Mb fixed disk drive (a 5170 Model 99), and one display. The required display device can be the 5151 Monochrome Display or the 5153 Color Display. The latter is supported in text mode only. The

40:15 IBM Personal Computer XENIX System

standard battery-backed clock in the 5170 is also supported.

The following optional features for the 5170 are supported by the IBM PC XENIX Operating System:

- Additional random access memory up to 3Mb. IBM PC XENIX can support up to 16Mb of random access memory.
- Math Co-processor Option. Floating-point emulation is provided when the feature is not present.
- One or two Serial/Parallel Adapters to connect one or two users in addition to the primary user. One or two terminals can be connected to the RS-232C (serial) port of one or two Serial/Parallel Adapters. Connection can be local via a cable or remote via a modem. Remote terminals can be:
 - An IBM 3101 Model 11, 13, 21, or 23
 - A non-IBM ASCII terminal
 - Another IBM personal computer (PCjr, 5150 Personal Computer, 5160 Personal Computer XT, or 5170 Personal Computer AT) with an asynchronous communications adapter and an ASCII terminal emulator program (Asynchronous Communications Support Version 2, 3101 Emulator Program, or Personal Communications Manager)An asynchronous port can be used to connect the IBM Personal Computer AT to another IBM Personal Computer AT that is using IBM PC XENIX or to another IBM PC XENIX or UNIX processor. Messages and files can be transferred among IBM PC XENIX users using electronic mail and communications support.
- One additional direct access device for a total of three. The additional device can be a 20Mb fixed disk drive, a 1.2Mb diskette drive, or a 360Kb diskette drive. An additional fixed disk can be used for applications that require large amounts of data or to improve system performance.
- One additional display for a total of two (one 5151 and one 5153). A command is provided to switch usage between the two displays.
- One or two printers: 5152 Graphics Printer Model 2, 5152 Matrix Printer Model 1, and/or 5182 Color Printer. Simultaneous operation of two parallel printers is supported.

The IBM PC XENIX Operating System consists of the Kernel (the resident supervisor), the file system, three shells (command processors), and three editors that perform the supported functions. The user interacts with a shell to request services and the shell invokes the appropriate program to handle the request.

The IBM PC XENIX Operating System is provided on four 1.2Mb-capacity diskettes. The following publications are provided with the IBM PC XENIX Operating System:

- Installation Guide
- System Administration
- Basic Operation Guide
- Visual Shell
- Command Reference

The Kernel

This is the basic memory resident operating system. It manages system resources (processor time, memory allocation), provides device-independent I/O support (device drivers), gathers accounting and device error information, and manages the file system.

The Kernel supports the 80286 operating in protected address mode and dynamic memory management. It protects its own and each user's memory and controls access to the system and files by users. Each user must be authorized to log on to the IBM PC XENIX operating system and can access only these files and directories for which authorization exists. File sharing protection is also provided.

The Kernel supports a shared memory facility that allows a portion of system memory to be shared by multiple processes. This facility can be used to increase the speed of communication between processes.

The File System

The file system consists of directories and files arranged in a hierarchical structure. Directory and file creating, accessing, copying, moving, deleting, renaming, printing, sorting, merging, and archiving are supported. A directory can be searched for files having certain characteristics. A file can be searched for particular strings or combinations of strings. Files can be compared for line-by-line differences or common lines, and character translations can be done in a file (ASCII to/from EBCDIC, for example). The ability to transfer files between IBM PC XENIX and DOS Version 2.0 or later and the inclusion of user-written device drivers for unsupported devices are supported as well.

40:15 IBM Personal Computer XENIX System

subsystems that control and manage changes to files that contain programs or text. SCCS controls the maintenance of program and text files. It provides facilities for storing, updating, and retrieving any version of a controlled file. It controls updating privileges to a file and records who made each change, and when and why the change was made.

MAKE can be used to maintain a large number of interrelated program files to ensure that whenever a change is made to one file, all dependent files are also updated so that the interrelated program files are kept up to date.

SCCS and MAKE are program development tools designed to solve many of the source code and document control problems that software development projects encounter when customer support, system testing, and program development are proceeding concurrently.

The IBM PC XENIX Software Development System is provided on three high-capacity (1.2Mb) diskettes. The following publications are also provided with the system:

- IBM PC XENIX Software Development Guide
- IBM PC XENIX C Compiler Reference Manual
- IBM PC XENIX Programmer's Guide to Library Functions
- IBM PC XENIX Software Command Reference
- IBM PC XENIX Assembler

This system can operate in the minimum configuration required by the IBM PC XENIX Operating System (5170 Model 99).

IBM PC XENIX Text Formatting System

The IBM PC XENIX Text Formatting System is an optional, separately ordered package that operates with the IBM PC XENIX Operating System and provides extensive text processing facilities. It is designed to simplify the production of technical reports, memoranda, formal papers, and documentation. It has a high level of functional capability and is not intended for the casual user.

The IBM PC XENIX Text Formatting System supports two text editors (vi and ed) for document entry, simplified macro formatting packages (mm and mnt), two text formatters for more sophisticated formatting (nroff for printer formatting and troff for phototypesetter formatting), spelling verification (spell), and several Berkeley extensions for writing style analysis (diction, explain, and style). Extensive formatting facilities for the production of technical documents are included.

This system is provided on one high-capacity (1.2Mb) diskette. The IBM PC XENIX Text Formatting Guide and Installation Guide publications are included with the diskette. This system can operate in the minimum configuration required by the IBM PC XENIX Operating System (5170 Model 99).

One-Time Charges

Item	Part Number	Feature Code	Price (\$)
Operating System	6024207	4207	395
Software Development System	6024209	4209	455
Text Formatting System	6024208	4208	145

Discounts Available

The three IBM PC XENIX programs are eligible for an IBM Personal Computer Licensed Program Quantity Discount Agreement (program category AAA), educational allowance, or Product Center Single Delivery Quantity Discount.

Shells

A shell is an interactive command interpreter. The shell component (which is similar in function to the DOS COMMAND.COM program) processes commands entered by the operator or via command files created by the user. Redirection of the standard input (keyboard) and the standard output (the display) to other device types is supported. Conditional command execution and command chaining (output of one command connected to the input of another command), which is also called pipelining, are also supported.

Three shells (Bourne, Visual, and C) are provided in IBM PC XENIX to allow users to select the one best suited to their needs and experience. The Bourne shell is a full programming language as well as a command interpreter. It permits new commands to be created easily by writing a shell script command file. It is the most comprehensive of the three provided shells and is recommended for those who need to access the full capability of the IBM PC XENIX operating system or who are experienced users of a UNIX type of system.

The Visual shell is designed for casual users of IBM PC XENIX who need access only selected facilities. This shell presents a menu of the most commonly used system facilities. The user can select the desired function instead of entering command lines. In addition, selection of displayed file names can be made using the cursor instead of entering them using the keyboard. The Visual shell can be customized also. Commands and help files can be created and the shell can be tailored for different applications and more efficient operation.

The C-shell is a language interpreter that is similar in format to the C programming language.

Editors

Three editors (vi, ed, and sed) are provided. Selection of the editor to use can be based on editing needs. Vi (which stands for visual) is a full-screen editor with a large set of functions that are designed to be easy to learn and simple to use. Vi combines line-oriented and screen-oriented features to provide a powerful set of text editing operations. For more sophisticated users, ed (an interactive context line editor) and sed (a one-pass stream editor) provide a smaller set of editing functions than vi.

IBM PC XENIX Software Development System

The IBM PC XENIX Software Development System is an optional, separately ordered package that operates with the IBM PC XENIX Operating System and provides tools to develop and maintain software. It can be particularly useful in an environment in which several programmers are using the same 5170 configuration to work on the development of a single software project.

The IBM PC XENIX Software Development System provides a C language compiler, an assembler for the 80286, 80287, 8088, and 8087 microprocessors, a program for checking C source code standards (lint), interactive debugging for C programs (adb), lexical analyzer and compiler (lex and yacc), several popular Berkeley extensions (strings, xstr, and csh), and source code management tools (SCCS and MAKE).

C is a general-purpose, high-level language that is designed for structured programming. It supports the use of hardware facilities at a level normally found only in an Assembler language, while providing machine-independent use of hardware facilities. This allows efficient use of hardware in an architecture-independent manner. IBM PC XENIX (like other UNIX-based operating systems) is written in the C language.

The C compiler and assembler provided support the production of programs that will execute using the 80286 microprocessor operating in protected address mode under the IBM PC XENIX Operating System in a 5170 configuration and programs that will execute using the 8088 microprocessor under DOS on any IBM personal computer with the 8088. The latter programs can also execute under DOS in a 5170 configuration operating in real address mode. The generation of programs that use the 80287 or 8087 Math Co-processor Option is also supported by the C compiler and assembler.

Programs written in the C language that operate under a version of IBM PC XENIX or UNIX in other computers can be converted for execution under IBM PC XENIX in an IBM Personal Computer AT that has the required hardware resources. The C source code for these programs must be recompiled using the IBM PC XENIX C compiler and then assembled using the IBM PC XENIX assembler to produce executable code that can execute in the IBM Personal Computer AT.

Source Code Control System (SCCS) and MAKE are source code management tools. They are two

40:20 CP/M-86

Introduction

CP/M-86™ (Control Program/Microprocessor-86) is a single-user, single-tasking operating system that is diskette resident. It supports 5150 Personal Computer, 5155 Portable Personal Computer, and 5160 Personal Computer XT configurations. Fixed disk drives are not supported. CP/M-86 is a 16-bit version of the widely used CP/M operating system (developed by the Digital Research Corporation), which operates in systems with an 8-bit microprocessor. CP/M-86 is similar in operation to CP/M-80.

CP/M-86 consists of a set of programs that provide an interface between IBM personal computer hardware and language translator and application programs. It provides input and output handlers for various I/O devices, dynamic memory management, an 8088 Assembler Language translator, utility and service functions, and program development and testing facilities.

The user communicates requests to CP/M-86 by means of commands or file names entered via the keyboard or a command file on diskette. Commands are classified as built-in or transient utility. Built-in command processors are resident in memory as part of the CP/M-86 program that is loaded during initial program load (IPL). They do not require access to CP/M-86 on a diskette for execution. Transient utility command processors do not reside in memory and must be loaded from the CP/M-86 program contained on an online diskette. CP/M-86 communicates with the user via the bottom line of the display.

CP/M-86 is resident on a single diskette. A user's reference manual is provided with the diskette. CP/M-86 operates on a 5150 Personal Computer with at least one 160Kb diskette drive and 32Kb of memory. If the debugging program (DDT86) is to be used, 48Kb of memory is required. Use of the 8088 Assembler (ASM86) requires 64Kb. CP/M-86 operates in the minimum 5155 Portable Personal Computer or 5160 Personal Computer XT configuration. CP/M-86 requires 19Kb of memory for its residence during system operation.

Functions Supported

CP/M-86 supports the following:

- I/O handling for one to two 5¼-inch diskette drives or four logical drives, the 83-key keyboard, the 5151 Monochrome Display, the Color/Graphics Monitor Adapter, a light pen, the 5152 Graphics Printer Model 2, and the Asynchronous Communications Adapter
- Dynamic memory management that allows multiple programs to reside in random access memory simultaneously. Memory up to 1024Kb can be handled.
- Diskette capacity of 160Kb per side
- Formatting and copying diskettes
- Listing the contents of a diskette directory on the display (or only the files cataloged with the current user number) and the CP/M-86 system files
- Listing of statistical information about diskette files and verifying the directory
- Transferring CP/M-86 to another diskette
- Entering date and time
- Assigning text and control characters to function keys and keypad keys
- Setting of options for the Asynchronous Communications Adapter
- Assigning physical devices to logical devices (for example, a printer as the console output device)
- Automatic loading of CP/M-86 when power is turned on or system reset is performed when the CP/M-86 diskette is in diskette drive A
- Execution of application programs
- Execution of a series of commands contained in a file. A command file generator is provided to create the file.
- Program creation and testing using the line-oriented context editor (ED) program to enter and edit a source Assembler Language program, the 8088 Assembler (ASM86) program to assemble the program and produce an executable program, and the dynamic debugging tool (DDT-86) to interactively execute and debug programs. High-level language compilers that operate under CP/M-86 on an IBM Personal Computer are also available (as described later).
- Displaying text files on the display device
- Displaying information about how to use CP/M-86 commands (help function)
- Displaying of status on the bottom line of the display during system operation (status message, user number, actual or elapsed time, and date)

- Programming interface to CP/M-86 for handling unsupported I/O devices, managing memory, cursor and color control, and light pen input

User-written application programs and IBM-supplied CP/M-86 application programs can operate under CP/M-86 in a 5150, 5155, or 5160 configuration. Application programs supported by other versions of CP/M for other systems (CP/M-80 for 8-bit microprocessors, for example) can be converted for use with CP/M-86 in a 5150, 5155, or 5160 configuration. Conversion of the programs and any diskette files used by those programs is required.

Program conversion can be done by transferring the source statements of the program from the non-IBM system to the 5150/5155/5160 personal computer running CP/M-86 (usually via a communications link), modifying any program statements affected by language or hardware differences, and recompiling the program in the 5150/5155/5160 personal computer using the appropriate CP/M-86 language compiler. The diskette files for the converted programs must also be transferred from the non-IBM system to the 5150/5155/5160 personal computer running CP/M-86 and written to diskettes, since the 5150/5155/5160 personal computer diskette format and the diskette format used by other CP/M systems are not the same.

Languages Supported

Operation of the following language translator programs under CP/M-86 is supported:

- 8088 Assembler (ASM86). This assembler is provided as part of the CP/M-86 system. One diskette drive and 64Kb of memory minimum are required for assemblies.
- CBASIC Compiler. This compiler provides enhancements to the industry standard CBASIC language. One diskette drive and 64Kb of memory minimum are required for compilations.
- PL/I. This compiler is based on ANSI standards. It requires one diskette drive and 128Kb of memory minimum for compilations.
- Pascal/MT™. This package provides an integrated series of programs that permits development of programs using the Pascal language. It requires one diskette and 128Kb of memory minimum for compilations.
- Personal BASIC™. This program provides functions like those supported by the Advanced BASIC provided with DOS except for graphics commands. One diskette drive and 128Kb of memory minimum are required for compilation.

One-Time Charges

Item	Part Number	Feature Code	Price (\$)
CP/M-86	6024035	4035	240

Discounts Available

CP/M-86 is eligible for an IBM Personal Computer Licensed Program Quantity Discount Agreement (program category AAA), educational allowance, or Product Center Single Delivery Quantity Discount.

40:25 UCSD p-System

Introduction

The UCSD p-System™ is a single-user, single-tasking operating system that is diskette resident. It supports only the 5150 Personal Computer configuration. Fixed disk drives are not supported. The UCSD p-System, which is available for many non-IBM systems, is designed primarily to support program development. However, it can also be used to execute application programs, such as word processing, computer-assisted instruction, interactive business data processing, communications, process control, and scientific analysis.

The UCSD p-System is designed to be a processor-independent operating system. Its languages generate a machine-independent code (p-code) that can be executed in any processor that has a UCSD p-System interpreter to translate the p-code into machine-dependent code for that processor.

The UCSD p-System provided for the 5150 Personal Computer is an extended Version IV.0 of the operating system. It consists of a set of programs that provide I/O handling, dynamic memory allocation, program development and testing facilities, and utility functions.

The user communicates requests to the UCSD p-System via commands entered at the keyboard, and a menu-driven hierarchical command structure of multiple levels is supported. A prompt line is continually displayed at the top of the screen, with nearly all the current level commands displayed. Commands can also be entered using a command file contained on a diskette.

The UCSD p-System can be purchased with only the UCSD Pascal Compiler, with only the FORTRAN-77 compiler, or with both compilers. If one language is purchased initially, the other language can be purchased at a later time. The UCSD p-System (except for the interpreter) is written in the Pascal language.

The UCSD p-System consists of three components that are packaged as the following products:

- UCSD p-System with UCSD Pascal™
- UCSD p-System with FORTRAN-77
- UCSD Pascal Compiler
- FORTRAN-77 Compiler

The operating system portion of the UCSD p-System is provided on five diskettes. An Oper-

ations Guide, User's Guide, Beginner's Guide, and Internal Architecture Guide for the UCSD p-System are provided with the five diskettes. UCSD Pascal is provided on a single diskette with a UCSD Pascal Reference Manual. FORTRAN-77 is provided on a single diskette with a FORTRAN-77 Reference Manual.

The UCSD p-System with either language or both languages operates in a 5150 Personal Computer with at least 64Kb of memory and two diskette drives.

Functions Supported

UCSD p-System supports the following:

- I/O handling for one or two 5¼-inch diskette drives, the 83-key keyboard, the 5151 Monochrome Display, the 5153 Color Display, and the 5152 Graphics Printer Model 2
- Dynamic memory allocation and dynamic overlaying of programs
- A library of executable programs and program modules
- Dynamic loading of separately compiled or linked program modules during program execution so that one copy of a program module in the program library can be shared by many programs
- Formatting and copying diskettes
- Execution of application programs
- Execution of a series of commands contained in a diskette file
- A screen-oriented editor to create and modify source programs or text files
- A Macro Assembler for 8088 microprocessor instructions, which produces code that can be included in executable programs written in UCSD Pascal or FORTRAN-77
- A linker for link-editing assembler language object modules with UCSD Pascal or FORTRAN-77 object modules
- Generation by the UCSD Pascal and FORTRAN-77 compilers of p-code (pseudo code) programs, which contain universal pseudo-instructions that are machine-independent. A p-code program can be executed under the UCSD p-System in a 5150 Personal Computer using the interpreter included, which translates the machine-independent code into IBM personal computer machine-dependent code during execution. A p-code program created using the UCSD

40:25 UCSD p-System

p-System on a non-IBM system can be executed in a 5150 Personal Computer (with the required hardware resources) under the UCSD p-System for the 5150. The reverse is also true.

- A native code generator to convert machine-independent p-code programs to IBM personal computer machine code for improved execution performance

UCSD p-System Runtime Support

The UCSD p-System Runtime Support package can be installed in a 5150 Personal Computer configuration when UCSD p-System applications are to be run but program development facilities are not required. UCSD p-System Runtime Support provides the operating system portion of the UCSD p-System package that is required to support execution of UCSD p-System application programs. It also provides utility programs for formatting, copying, and maintaining diskettes. No program development facilities (language translators, linker, debugger, for example) are included.

The UCSD p-System Runtime Support Package permits the following without purchase of the complete UCSD p-System package:

- Programs generated using UCSD Pascal or FORTRAN-77 in a 5150 Personal Computer to be executed in another 5150 Personal Computer.
- UCSD p-System application programs generated using UCSD Pascal, FORTRAN-77, or UCSD p-System BASIC in a non-IBM system to be executed in a 5150 configuration.

Since UCSD p-System Runtime Support recognizes the Universal Media™ Diskette Format, diskettes created by the UCSD p-System running in non-IBM systems may be usable in a 5150 configuration without the need for conversion. Customers should consult the supplier of a particular UCSD p-System application program for a non-IBM system to determine if the diskettes it creates use the Universal Media Diskette Format.

Note that UCSD p-System Runtime Support does not support the execution of application programs created using the BASIC Compiler for a 5150 Personal Computer or the Displaywriter UCSD p-System BASIC compiler. It also does not support the execution of any UCSD language translator (UCSD Pascal, FORTRAN-77, or Macro Assembler).

The UCSD p-System Runtime Support package includes a single diskette and a reference manual. It

requires a minimum of 64Kb of memory and one single-sided diskette drive. Double-sided diskette drives are also supported.

One-Time Charges

Item	Part Number	Feature Code	Price (\$)
UCSD p-System with UCSD Pascal	6024016	4016	625
UCSD p-System with FORTRAN-77	6024017	4017	625
UCSD Pascal Compiler	6024033	4033	175
FORTRAN-77 Compiler	6024034	4034	175
UCSD p-System Runtime Support	6024040	4040	50

Discounts Available

The UCSD p-System products are eligible for an IBM Personal Computer Licensed Program Quantity Discount Agreement, educational allowance, or Product Center Single Delivery Quantity Discount. Program category is AAA for UCSD p-System with UCSD Pascal or FORTRAN-77, EEE for the UCSD Pascal Compiler or UCSD FORTRAN-77 Compiler, and DDD for UCSD p-System Runtime Support.

SECTION 41: APPLICATION PROGRAMS

PCjr Cartridges 41:05

Application Programs for IBM Personal
Computer Configurations 41:10

41:05 PCjr Cartridges

Cartridges Available

The following cartridges are available for the PCjr configuration:

- **MOUSER (6024087) (4087)** – An arcade-type game in which the objective is to trap, in an allotted time, all the mice overrunning a farmhouse.
- **SUBADVENTURE (6024088) (4088)** – An arcade-type game in which two players compete to find rare fish and keys to sunken treasure chests.
- **CROSSFIRE (6024091) (4091)** – An arcade-type game in which the player is challenged to defend the city from swarms of insects.
- **MINE SHAFT (6024092) (4092)** – An arcade-type game in which the player, searching for a fortune in diamonds, maneuvers a mining car around mine shafts.
- **PCjr Color Paint (6024299) (4299)** – A graphic design tool that provides the ability to draw pictures using up to 16 colors. Function selection and drawing are simplified with the help of easy-to-read menus, fill patterns, and the use of a mouse to aid in selection.
- **1-2-3™ (6187305) (9567)** – An integrated program that provides spreadsheet, graphics, and data base functions.
- **BASIC INTERPRETER (6024101) (4101)** – A superset of the Advanced BASIC provided for other IBM personal computer configurations. It supports musical applications (multivoice sound, noise, and volume control), advanced functions for light pens and joysticks, advanced graphics, communications functions, one parallel printer, sequential and direct processing of diskette files, and miscellaneous other functions. It also supports the execution of a BASIC program contained on a program cartridge loaded in the second cartridge slot. The BASIC program is loaded into memory from the cartridge and executed.

The arcade games and PCjr Color Paint cartridges can be used in a minimum PCjr configuration (4860 Model 4 with a TV or monitor attached via the PCjr Connector for TV feature). Player movement is accomplished using the keyboard or a joystick if one is attached. DOS is not required. PCjr Color Paint will use a diskette drive, if one is available, to store and retrieve pictures.

The BASIC INTERPRETER can also be used in a minimum PCjr configuration and does not require

DOS unless certain functions are used (diskette file support, date, and time of day, for example). The BASIC INTERPRETER requires 6Kb of resident memory when DOS is not used and 30Kb when DOS Version 2.1 is used.

Note that the BASIC INTERPRETER cartridge is required if DOS and BASIC are to be used together, since the BASIC Interpreter in PCjr ROM does not operate with DOS.

One-Time Charges

Cartridge/QDA Category	Single Unit Purchase Price (\$)
MOUSER	35
SUBADVENTURE	35
CROSSFIRE	35
MINE SHAFT	35
BASIC INTERPRETER	75
PCjr Color Paint (EEE)	99
1-2-3™ (EEA)	495

Discounts Available

PCjr cartridges may be eligible for an IBM Personal Computer Licensed Program Quantity Discount Agreement (as identified under "One-Time Charges") or educational allowance.

41:10 Application Programs for IBM Personal Computer Configurations

Programs Available

The following tables list the application programs, including programming languages, that are available from IBM and that support 4860 PCjr, 5150 Personal Computer, 5160 Personal Computer XT, and 5170 Personal Computer AT configurations. Included are IBM-logo programs, vendor-logo programs, and personally developed software. For IBM-logo programs and personally developed software, the warranty provisions in the IBM Program License Agreement apply.

Vendor-logo programs are produced by non-IBM sources and are not IBM-trademarked products. They are available from IBM as distributed by the program supplier. The terms and conditions included in the program package by the supplier are passed on to the customer through IBM. These programs are distributed by IBM on an "as is" basis. IBM makes no warranties with respect to the programs, express or implied, including but not limited to the implied warranties of marketability and fitness for a particular purpose. Any questions pertaining to warranty coverage should be addressed to the program supplier.

The IBM- and vendor-logo application programs are listed in the first table in alphabetical order within application type: business, communications, data base, education, emulation, entertainment, graphics, home/personal, integrated (providing a variety of functions), languages, professional, system software, and word processing. These application programs are also listed in the second table in alphabetical order without regard to type. A vendor-logo program is identified by an asterisk after its name. All trademarks are listed in Appendix B.

Listed for each IBM- and vendor-logo program is the operating system required, the program number and feature code, the single unit price, availability of a quantity discount agreement (QDA) or educational allowance, and IBM personal computer configurations supported. When a QDA is available, the program category is indicated. A QDA or educational allowance (one only) is available when the purchase is made from an IBM marketing representative. IBM Product Centers may also offer a quantity discount on certain programs (not the same as the QDA percentages).

A blank in a column under the heading *Personal Computer Configurations Supported* indicates the program has not been verified for operation in that

configuration. A dash (-) indicates the program is not applicable to the configuration. A "PC" or "XT" in the PC and PC XT column instead of "YES" indicates the program operates only in a 5150 Personal Computer or 5160 Personal Computer XT configuration, respectively.

The personally developed programs are listed in the third table in alphabetical order within family type: entertainment, education, productivity, programming, and business. Listed for each program is program number, single unit price, and IBM personal computer configurations supported. Value packages, which consist of a group of programs offered at a discount, are also listed. All these programs require DOS except those with an asterisk after program name.

Descriptions of many of the IBM-logo programs listed are contained in *The Guide to Personal Computer Offerings from IBM*, G520-0059, and/or *The Library of IBM Personal Computer Software Offerings*, G520-1107. Vendor-logo programs are described in *Personal Computer Software*, GB30-2037, and listed in the *Personal Computer Software Pocket Guide*, GB30-2479. The pocket guide is updated every two months. Subscriptions for the IBM guide and the vendor-logo publication and pocket guide are available through SLSS (Systems Library Subscription Service). Personally developed programs are described in *The Library* (6137591).

IBM-logo and vendor-logo personal computer programs can be purchased from IBM NAD or NMD marketing representatives, from IBM Product Centers, and via IBM Direct. All the programs listed in the first two tables can be purchased from an IBM marketing representative except those with two asterisks next to program name. These are vendor-logo programs that can be purchased at IBM Product Centers but not from IBM marketing representatives. For the vendor-logo programs, see the *Personal Computer Software* publication for places of purchase.

Personally developed programs can be purchased by telephone toll free (1-800-IBM-PCSW) or by mail using a form contained in *The Directory*. Some of these programs may be available in IBM Product Centers and participating authorized IBM Personal Computer dealers.

The program prices are subject to change between updates to this guide. IBM marketing representatives have the latest prices.

Application Programs By Category

BUSINESS

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
A Departmental Reporting System for the IBM Personal Computer (ADRS/PC)	DOS	6428092	9172	325.00	Z12	YES		YES	
Accounting Kit **	DOS	6187293	9554	2995.00	NO	NO	NO	YES	YES
Accounts Payable by Peachtree™ Version 1.1	DOS	6024059	4059	595.00	FFF	YES	NO	YES	YES
Accounts Receivable by BPI™	DOS	6024027	4027	425.00	EEE	YES	NO	PC	NO
Accounts Receivable by Peachtree™ Version 1.1	DOS	6024056	4056	595.00	FFF	YES	NO	YES	YES
Automated Information Management (program offering)	DOS	6410974	9219	395.00	Z11	NO	NO	YES	NO
BPI SERIES**:									
Accounts Payable	DOS	6187163	9424	595.00	NO	NO	NO	YES	NO
Accounts Payable Self Training	DOS	6187256	9517	70.00	NO	NO	NO	YES	NO
Accounts Receivable	DOS	6187164	9425	595.00	NO	NO	NO	YES	NO
Accounts Receivable Self Training	DOS	6187257	9518	70.00	NO	NO	NO	YES	NO
General Accounting	DOS	6187165	9426	595.00	NO	NO	NO	YES	NO
General Accounting Self Training	DOS	6187258	9519	70.00	NO	NO	NO	YES	NO
Information Management	DOS	6187166	9427	425.00	NO	NO	NO	YES	NO
Inventory Control	DOS	6187167	9428	795.00	NO	NO	NO	YES	NO
Job Cost	DOS	6187168	9429	795.00	NO	NO	NO	YES	NO
Payroll	DOS	6187169	9430	595.00	NO	NO	NO	YES	NO
Business Analyzer**	DOS	6187294	9556	395.00	NO	NO	NO	YES	YES
Business Library™*:									
Accounts Payable	DOS	6871412	9165	695.00	FFF	YES	NO	YES	YES
Accounts Receivable	DOS	6871411	9164	695.00	FFF	YES	NO	YES	YES
Information Retrieval	DOS	6871454	9264	395.00	EEE	YES	NO	YES	YES
Inventory Control and Bill of Materials	DOS	6871414	9167	795.00	FFF	YES	NO	YES	YES
Payroll System	DOS	6871413	9166	695.00	FFF	YES	NO	YES	YES
Purchase Order Tracking	DOS	6871416	9169	795.00	FFF	YES	NO	YES	YES
Sales Order Entry and Sales Analysis	DOS	6871415	9168	795.00	FFF	YES	NO	YES	YES
The General Ledger	DOS	6871409	9162	695.00	FFF	YES	NO	YES	YES
The Librarian	DOS	6871410	9163	95.00	EEE	YES	NO	YES	YES
Business Management Series:									
Accounts Extensions Edition	DOS	6410958	9201	245.00	EEE	YES	NO	YES	YES
Accounts Payable Edition	DOS	6410951	9194	695.00	FFF	YES	NO	YES	YES
Accounts Payable Training Edition	DOS	6410960	9203	95.00	EEE	YES	NO	YES	YES
Accounts Receivable Edition	DOS	6410952	9195	695.00	FFF	YES	NO	YES	YES
Accounts Receivable Training Edition	DOS	6410961	9204	95.00	EEE	YES	NO	YES	YES
Financial Extensions Edition	DOS	6410957	9200	245.00	EEE	YES	NO	YES	YES
General Ledger Edition	DOS	6410950	9193	695.00	FFF	YES	NO	YES	YES
General Ledger Training Edition	DOS	6410959	9202	95.00	EEE	YES	NO	YES	YES
Inventory Accounting Edition	DOS	6410955	9198	695.00	FFF	YES	NO	YES	YES
Inventory Accounting Training Edition	DOS	6410964	9207	95.00	EEE	YES	NO	YES	YES
Order Entry and Invoicing Edition	DOS	6410954	9197	695.00	FFF	YES	NO	YES	YES
Order Entry and Invoicing Training Edition	DOS	6410963	9206	95.00	EEE	YES	NO	YES	YES
Payroll Edition	DOS	6410953	9196	695.00	FFF	YES	NO	YES	YES
Payroll Training Edition	DOS	6410962	9205	95.00	EEE	YES	NO	YES	YES
Client Ledger System™**	DOS	6187208	9469	1595.00	NO	NO	NO	YES	YES

BUSINESS (cont'd)

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Dollars and Sense™ *	Supplied	6871482	9292	179.95	EEE	YES	YES	YES	NO
General Accounting by BPI™	DOS	6024026	4026	425.00	EEE	YES	NO	PC	NO
General Ledger by Peachtree™ Version 1.1	DOS	6024058	4058	595.00	FFF	YES	NO	YES	YES
IBM Accounting Solutions	DOS	6024152	4152	80.00	EEE	YES	YES	YES	YES
IBM Executive Solutions	DOS	6024151	4151	60.00	DDD	YES	YES	YES	YES
IBM Reporting Assistant	DOS	6024146	4146	129.00	EEE	YES	YES	YES	YES
Information Systems Management									
Analysis System (program offering)	DOS	6316974	9341	500.00	FFF	YES	NO	YES	NO
Instructional System: Administration	DOS	6428087	9175	400.00	EEA	YES		YES	
Instructional System: Authoring	DOS	6428072	9174	525.00	FFA	YES		YES	
Instructional System: Presentation	DOS	6428071	9173	85.00	EEA	YES		YES	
Insurance Agency System	DOS	6024065	4065	2500.00	GGG	YES	NO	PC	NO
Inventory Control by BPI™	DOS	6024030	4030	425.00	EEE	YES	NO	PC	NO
Inventory Control by Peachtree™									
Version 1.1	DOS	6024057	4057	595.00	FFF	YES	NO	YES	YES
Job Cost by BPI™	DOS	6024029	4029	550.00	FFF	YES	NO	PC	NO
Office Correspondence Retrieval									
System	DOS	6024160	4160	149.00	EEE	YES	NO	YES	YES
Payroll by BPI™	DOS	6024028	4028	425.00	EEE	YES	NO	PC	NO
Payroll by Peachtree™ Version 1.1	DOS	6024060	4060	595.00	FFF	YES	NO	YES	YES
Personal Decision Series:									
Host Attachment Products:									
Attachment/36 Edition	DOS	6316972	9235	150.00	EEE	YES	NO	YES	YES
Attachment/370 Edition	DOS	6316971	9234	200.00	EEE	YES	NO	YES	YES
Productivity Extensions:									
Appointment Calendar Edition	DOS	6410946	9189	70.00	EEE	YES	NO	YES	YES
Asset Catalog Edition	DOS	6410943	9363	60.00	DDD	YES	NO	YES	YES
Client Time/Cost Accounting Edition	DOS	6410945	9188	60.00	DDD	YES	NO	YES	YES
Mailing Labels Edition	DOS	6410942	9373	60.00	DDD	YES	NO	YES	YES
Prospect Tracking Edition	DOS	6410944	9362	60.00	DDD	YES	NO	YES	YES
Productivity Products:									
Advisor	DOS	6410941	9371	250.00	EEE	YES	NO	YES	YES
Data Edition	DOS	6410936	9367	250.00	EEE	YES	NO	YES	YES
Data Training Edition	DOS	6410947	9190	70.00	EEE	YES	NO	YES	YES
Graphs Edition	DOS	6410938	9368	200.00	EEE	YES	NO	YES	YES
Plans Edition	DOS	6410939	9369	150.00	EEE	YES	NO	YES	YES
Plans+ Edition	DOS	6410972	9215	300.00	EEE	YES	NO	YES	YES
Reports+ Edition	DOS	6410937	9370	150.00	EEE	YES	NO	YES	YES
Words Edition	DOS	6410940	9372	150.00	EEE	YES	NO	YES	YES
Personal Tax Planner**	DOS	6187297	9559	295.00	NO	NO	NO	YES	YES
ProKey™ *	DOS	6871526	9336	129.95	EEE	YES	YES	YES	YES
Rags to Riches™ Accounts Payable**	DOS	6187273	9534	99.00	NO	NO	YES	YES	NO
Rags to Riches™ Accounts Receivable**	DOS	6187274	9535	99.00	NO	NO	YES	YES	NO
Rags to Riches™ Accounts Sales**	DOS	6187275	9536	99.00	NO	NO	YES	YES	NO
Rags to Riches™ Ledger**	DOS	6187272	9533	99.00	NO	NO	YES	YES	NO
Time Accounting**	DOS	6187298	9560	895.00	NO	NO	NO	YES	YES

COMMUNICATIONS

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Asynchronous Communications Support Version 2	DOS	6024032	4032	60.00	DDD	YES	NO	YES	YES
Batch Communications Program (program offering)	DOS	6428147	9178	350.00	NO	NO	NO	YES	
Crosstalk™ XVI*	DOS	6871366	9122	195.00	EEE	YES	NO	YES	NO
DisplayComm Binary Synchronous Communications Version 1.1	DOS	6024210	4210	375.00	EEE	YES	NO	YES	YES
Dow Jones Reporter™	DOS	6024031	4031	100.00	EEE	YES	YES	YES	YES
Dow Jones Spreadsheet Link™ *	DOS	6871488	9298	249.00	EEA	YES	NO	YES	NO
LEXIS™/NEXIS™ Communications Session Manager (program offering)	DOS	6410973	9216	225.00	Z04	YES		YES	
PC/Colorview (program offering)	DOS	6410982	9226	105.00	EEE	NO	YES	YES	YES
PC/Videotex:									
5150, 5160, and 5170 configurations	DOS	6410985	9229	250.00	Z07	NO	—	YES	YES
PCjr	DOS	6316967	9230	220.00	Z01	NO	YES	—	—
Personal Communications Manager	DOS	6024100	4100	100.00	EEE	YES	YES	YES	YES
Personal Services/PC	DOS	6317013	7013	250.00	EEE	YES	NO	YES	YES
PROFS Personal Computer Connection (PROFS/PC ²)-program offering	DOS	6410984	9228	200.00	Z06	NO	NO	YES	YES
SmarTerm™ 100*	DOS	6871489	9299	149.00	EEE	YES	NO	YES	NO
Transporter™ *	DOS	6871367	9123	295.00	EEE	YES	NO	YES	YES
VTERM™ II*	DOS	6871491	9301	160.00	EEE	YES	NO	YES	NO
WESTLAW™ Communications Session Manager (program offering)	DOS	6248162	9186	350.00	Z02	YES		YES	

DATA BASE

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
CLOUT™ *	DOS	6187245	9506	249.00	EEE	YES	NO	YES	NO
Data Base Manager II-The Integrator™ *	DOS	6871331	9089	295.00	EEE	YES	NO	YES	YES
dBase II® *	DOS	6086009	9032	495.00	EEA	YES	NO	YES	NO
dBase III™ *	DOS	6187184	9445	700.00	FFA	YES	NO	YES	YES
FRIDAY!™ *	DOS	6871458	9268	295.00	EEA	YES	NO	YES	NO
IBM Filing Assistant	DOS	6024145	4145	149.00	EEE	YES	YES	YES	YES
InfoStar™ Plus*	DOS	6871302	9060	595.00	FFF	YES	NO	YES	NO
R:B 4000 Extended Report Writer*	DOS	6187246	9507	150.00	EEE	YES	NO	YES	NO
R:BASE™ Series 4000*	DOS	6871479	9289	495.00	EEE	YES	NO	YES	YES
T.I.M.® IV*	DOS	6871365	9121	395.00	EEE	YES	NO	YES	NO
UltraFile® *	DOS	6871525	9335	195.00	EEE	YES	NO	YES	NO
VisiFile® *	DOS	6871322	9008	149.00	EEE	YES	NO	YES	NO

EDUCATION (Home, School, Business)

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Adventures in Math	DOS	6024112	4112	35.00	NO	NO	YES	YES	NO
Arithmetic Games Set 1	DOS	6024024	4024	60.00	NO	NO	YES	YES	YES
Arithmetic Games Set 2	DOS	6024025	4025	60.00	NO	NO	YES	YES	YES
Assessing Personal Management Skills*	DOS	6871507	9317	350.00	EEE	YES	YES	YES	NO
ATI Skill Builder/Teach Yourself BASIC® *	DOS	6871280	9038	39.95	DDD	YES	YES	YES	NO
ATI Skill Builder/Teach Yourself PC-DOS*	DOS	6871281	9039	39.95	DDD	YES	YES	YES	NO
ATI Training Power™ for dBase II® Volumes I and II*	DOS	6871285	9043	75.00	EEE	YES	YES	YES	NO
ATI Training Power™ for VisiCalc® *	DOS	6871282	9040	75.00	EEE	YES	YES	YES	NO
ATI Training Power™ for WordStar® *	DOS	6871283	9041	75.00	EEE	YES	YES	YES	NO
BASIC Primer Version 1	DOS	6024053	4053	60.00	DDD	YES		YES	NO
BASIC Primer Version 2	DOS	6024129	4129	60.00	DDD	YES	YES	YES	NO
Bumble Games™	DOS	6024094	4094	40.00	NO	NO	YES	YES	YES
Bumble Plot™	DOS	6024096	4096	40.00	NO	NO	YES	YES	YES
Cdex™ Training for dBase II® *	Supplied	6871430	9240	69.95	EEE	YES	NO	YES	NO
Cdex™ Training for the Visicalc® Program*	Supplied	6871339	9095	69.95	EEE	YES	NO	YES	NO
Cdex™ Training for the Wordstar® Program*	Supplied	6871306	9064	69.95	EEE	YES	NO	YES	NO
Cell Growth and Mitosis*	DOS	6871471	9281	69.95	EEE	YES	YES	YES	NO
Comma Cat	DOS	6024293	4293	45.00	DDD	YES	YES	YES	YES
Computer Preparation for the SAT*	DOS	6187307	9569	79.95	EEE	YES	YES	YES	NO
Computers and Communications	DOS	6024069	4069	35.00	DDD	YES	YES	YES	YES
Defining Goals and Objectives*	DOS	6871512	9322	450.00	EEE	YES	YES	YES	NO
Dictionary Dog	DOS	6024067	4067	45.00	DDD	YES	YES	YES	YES
Electric Poet	DOS	6024172	4172	75.00	EEE	YES	YES	YES	YES
FaceMaker™ *	DOS	6086007	9031	34.95	NO	NO	NO	YES	NO
FACT TRACK	DOS	6024023	4023	90.00	NO	NO	YES	YES	NO
FriendlyWare™ PC Introductory Set*	DOS	6085985	9005	49.95	DDA	YES	NO	YES	NO
Gertrude's Puzzles	DOS	6024098	4098	45.00	NO	NO	YES	YES	YES
Gertrude's Secrets	Supplied	6024097	4097	45.00	NO	NO	YES	YES	YES
Ground Water – Earth Science Series	DOS	6024122	4122	49.00	DDD	YES	YES	YES	YES
Hydrologic Cycle – Earth Science Series	DOS	6024121	4121	49.00	DDD	YES	YES	YES	YES
Juggles Butterfly™	DOS	6024095	4095	35.00	NO	NO	YES	YES	YES
Karel the Robot	DOS	6024066	4066	150.00	NO	NO	YES	YES	NO
Leading Effectively*	DOS	6871510	9320	450.00	EEE	YES	YES	YES	NO
Leaf Structure and Function*	DOS	6871486	9296	69.95	DDD	YES	YES	YES	NO
Learning DOS2—A Private Tutor Course	DOS	6024068	4068	30.00	DDD	YES	YES	YES	YES
Learning to Program in BASIC—A Private Tutor Course	DOS	6024081	4081	35.00	DDD	YES	YES	YES	YES
Learning to Use DOS	DOS	6024080	4080	15.00	NO	NO	NO	YES	NO
Managing Time Effectively*	DOS	6871515	9325	450.00	EEE	YES	YES	YES	NO
Managing Your Business with the Lotus 1-2-3™ Program*	Supplied	6871428	9238	69.95	EEE	YES	NO	YES	NO
Managing Your Business with the Multiplan® Program*	Supplied	6871429	9239	69.95	EEE	YES	NO	YES	NO
MasterType™ *	DOS	6871484	9294	49.95	DDD	YES	YES	YES	NO
MATH BLASTER!™ *	DOS	6871443	9253	49.95	DDD	YES	YES	YES	NO
Metric I-Fundamentals of Decimals*	DOS	6871487	9297	49.00	DDD	YES	YES	YES	NO
Metric II-Math Applications*	DOS	6871517	9327	49.00	DDD	YES	YES	YES	NO

EDUCATION (cont'd)

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Metric III-Units of Measurement*	DOS	6871518	9328	49.00	DDD	YES	YES	YES	NO
Metric IV-Linear Units*	DOS	6871519	9329	49.00	DDD	YES	YES	YES	NO
Metric V-Area Density Measurements*	DOS	6871520	9330	49.00	DDD	YES	YES	YES	NO
Moisture in the Atmosphere -- Earth Science Series	DOS	6024124	4124	49.00	DDD	YES	YES	YES	YES
Monster Math	DOS	6024072	4072	30.00	NO	NO	YES	YES	NO
Multiplication Tables--A Private Tutor Course	DOS	6024070	4070	50.00	DDD	YES	YES	YES	YES
Passive Transport*	DOS	6871521	9331	69.95	EEE	YES	YES	YES	NO
PC Tutor™ *	DOS	6871287	9045	59.95	DDD	YES	NO	YES	NO
Photosynthesis & Light Energy *	DOS	6871522	9332	69.95	EEE	YES	YES	YES	NO
Plant Growth*	DOS	6871523	9333	69.95	EEE	YES	YES	YES	NO
Private Tutor	DOS	6024052	4052	50.00	DDD	YES	YES	YES	NO
Private Tutor Version 2	DOS	6024113	4113	50.00	DDD	YES	YES	YES	YES
Capitalization Skills	DOS	6024085	4085	46.00	DDD	YES	YES	YES	YES
Language Skills	DOS	6024084	4084	46.00	DDD	YES	YES	YES	YES
Punctuation Skills	DOS	6024083	4083	46.00	DDD	YES	YES	YES	YES
Spelling Skills	DOS	6024086	4086	46.00	DDD	YES	YES	YES	YES
Professor DOS™ *	DOS	6871423	9183	59.95	DDD	YES	NO	YES	NO
Programmed Inquiry Learning or Teaching (PILOT)	DOS	6316973	9340	200.00	EEE	YES		YES	
Question™ *	DOS	6871277	9035	45.00	DDD	YES	NO	YES	NO
Rocky's Boots	DOS	6024099	4099	50.00	NO	NO	YES	YES	YES
SAT Word Attack!™ Data Disk*	DOS	6187238	9499	19.95	NO	NO	NO	YES	NO
Snooper Troops 1™ *	DOS	6086004	9026	44.95	NO	NO	NO	YES	NO
Snooper Troops 2™ *	DOS	6086005	9027	44.95	NO	NO	NO	YES	NO
SPEED READER II™ *	DOS	6871441	9251	69.95	EEE	YES	YES	YES	NO
States'n Capst™ *	DOS	6871278	9036	39.95	NO	NO	YES	YES	NO
Story Machine™ *	DOS	6086006	9030	34.95	NO	NO	NO	YES	NO
Surface Water -- Earth Science Series	DOS	6024123	4123	49.00	DDD	YES	YES	YES	YES
Teacher's Quiz Designer	DOS	6024075	4075	70.00	EEE	YES	YES	YES	YES
Telemath Disk 1*	Supplied	6871376	9130	40.00	DDD	YES	NO	YES	NO
Telemath Disk 2*	Supplied	6871377	9131	40.00	DDD	YES	NO	YES	NO
Telemath Disk 3*	Supplied	6871378	9132	40.00	DDD	YES	NO	YES	NO
Telemath Disk 4*	Supplied	6871379	9133	40.00	DDD	YES	NO	YES	NO
Telemath Disk 5*	Supplied	6871380	9134	40.00	DDD	YES	NO	YES	NO
Telemath Disk 6*	Supplied	6871381	9135	40.00	DDD	YES	NO	YES	NO
Telemath Disk 7*	Supplied	6871382	9136	40.00	DDD	YES	NO	YES	NO
Telemath Disk 8*	Supplied	6871383	9137	40.00	DDD	YES	NO	YES	NO
Telemath Disk 9*	Supplied	6871384	9138	40.00	DDD	YES	NO	YES	NO
Telemath Disk 10*	Supplied	6871385	9139	40.00	DDD	YES	NO	YES	NO
Telemath Trial Size*	Supplied	6871386	9140	10.00	NO	NO	NO	XT	NO
Telemath Volume 1*	Supplied	6871373	9176	350.00	EEE	YES	NO	YES	NO
Telemath Volume 2*	Supplied	6871374	9177	350.00	EEE	YES	NO	YES	NO
The Instructorm™ *	DOS	6871288	9046	44.95	DDD	YES	NO	YES	NO
Thoughtware® Sampler*	DOS	6187217	9478	19.95	DDD	YES	YES	YES	NO
Turtle Power	DOS	6024109	4109	50.00	NO	NO	YES	YES	NO
Tutorial Set*	DOS	6871330	9088	94.00	EEE	YES	NO	YES	NO
Typing Tutor	DOS	6024013	4013	25.00	DDD	YES	NO	YES	NO

EDUCATION (cont'd)

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Understanding Personal Interaction Styles*	DOS	6871509	9319	350.00	EEE	YES	YES	YES	NO
Unlock the Mystery*	DOS	6187247	9508	29.95	DDD	YES	NO	YES	NO
US Geography Facts**	DOS	6187200	9461	39.95	NO	NO	NO	YES	NO
WORD ATTACK!™ *	DOS	6871442	9252	49.95	DDD	YES	YES	YES	NO
Word Whiz™ *	DOS	6871279	9037	39.95	DDD	YES	YES	YES	NO
World Geography Facts**	DOS	6187201	9462	39.95	NO	NO	NO	YES	NO
Writing to Read	DOS	6360700	0700	725.00	FFF	YES	YES	NO	NO

EMULATION

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Binary Synchronous 3270 Emulation Program	DOS	6024037	4037	700.00	FFF	YES	NO	YES	YES
Enhanced 5250 Emulation Program	DOS	6403674	2875	160.00	EEE	YES	NO	YES	YES
Graphics Terminal Emulator	DOS	6024206	4206	295.00	EEE	YES	NO	YES	YES
PC Network SNA Emulation Program	DOS	6322526	2526	375.00	EEE	YES	NO	YES	YES
Remote 5250 Emulation Program	DOS	6403685	2874	195.00	EEE	YES	NO	YES	YES
SNA 3270 Emulation and RJE Support	DOS	6024036	4036	700.00	FFF	YES	NO	YES	YES
3101 Emulation Program	DOS	6024042	4042	140.00	EEE	YES	NO	YES	YES
3278/79 Emulation Control Program	DOS	6024134	4134	235.00	EEE	YES	NO	YES	NO
5250 Emulation Program	DOS	6092651	2885	164.00	EEE	YES	NO	YES	NO
5520/Personal Computer Attachment Program									
Version 1	DOS	7033703	2888	164.00	EEE	YES	NO	PC	NO
Version 2	DOS	6109558	2884	284.00	EEE	YES	NO	YES	NO
Version 3	DOS	6403725	2895	384.00	EEE	YES	NO	YES	YES

ENTERTAINMENT

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Adventure	Supplied	6024006	4006	30.00	NO	NO	YES	YES	YES
Adventure in Serenia	Supplied	6024038	4038	35.00	NO	NO	YES	YES	YES
Animation Creation	DOS	6024082	4082	40.00	NO	NO	YES	YES	YES
Casino Games Version 1.05	DOS	6024054	4054	35.00	NO	NO	YES	YES	YES
Computer Stocks and Bonds™ *	DOS	6086016	9028	25.00	NO	NO	NO	YES	NO
Deadline™ *	DOS	6085998	9023	49.95	NO	NO	NO	YES	NO
Decathlon	Supplied	6024020	4020	35.00	NO	NO	NO	YES	NO
Flight Simulator*	Supplied	6871290	9048	49.95	DDA	YES	YES	YES	NO
FriendlyWare™ PC Arcade*	Supplied	6871361	9117	49.95	DDD	YES	NO	YES	NO
Golf's Best™ **	DOS	6187241	9502	49.95	NO	NO	YES	YES	NO
King's Quest	Supplied	6024093	4093	50.00	NO	NO	YES	NO	NO
Midway Campaign™ *	DOS	6085994	9021	21.00	NO	NO	NO	YES	NO
One Hundred and One Monochrome Mazes	DOS	6024064	4064	35.00	NO	NO	NO	YES	NO
Strategy Games Version 1.05	DOS	6024055	4055	30.00	NO	YES	YES	YES	YES
Temple of Apshai® *	DOS	6085990	9018	39.95	NO	NO	NO	YES	NO
Zork® I*	DOS	6085999	9024	49.95	NO	NO	NO	YES	NO
Zork® II*	DOS	6086000	9025	39.95	NO	NO	NO	YES	NO
Zork® III*	DOS	6871284	9042	39.95	NO	NO	NO	YES	NO

GRAPHICS

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
BPS Business Graphics™ *	DOS	6871470	9280	350.00	EEE	YES	NO	YES	YES
CHART-MASTER™ *	DOS	6871432	9242	375.00	EEE	YES	NO	YES	YES
DR Draw™ *	DOS	6871336	9401	400.00	EEE	YES	NO	YES	NO
DR Graph™ *	DOS	6871440	9250	295.00	EEE	YES	NO	YES	NO
ENERGRAPHICS™ *	DOS	6187234	9495	350.00	EEE	YES	NO	YES	NO
ENERGRAPHICS™ Plotter*	DOS	6187236	9497	100.00	EEE	YES	NO	YES	NO
FAST GRAPHSTM *	DOS	6871362	9118	350.00	EEE	YES	NO	PC	NO
Graphical File System	DOS	6024205	4205	175.00	EEE	YES	NO	YES	YES
Graphical Kernel System	DOS	6024203	4203	295.00	EEE	YES	NO	YES	YES
Graphics Development ToolKit	DOS	6024196	4196	350.00	EEE	YES	YES	YES	YES
Graphwriter™ Basic Set*	DOS	6871476	9286	395.00	EEE	YES	NO	YES	NO
Graphwriter™ Combination Set*	DOS	6871477	9287	595.00	EEE	YES	NO	YES	NO
Graphwriter™ Extension Set*	DOS	6871478	9288	395.00	EEE	YES	NO	YES	NO
IBM Graphing Assistant	DOS	6024147	4147	149.00	EEE	YES	YES	YES	YES
PCcrayon™ *	DOS	6871480	9290	59.95	DDD	YES	YES	YES	NO
PC Storyboard	DOS	6316998	9352	250.00	EEE	YES	YES	YES	YES
Plotting System	DOS	6024204	4204	225.00	EEE	YES	NO	YES	YES
SIGN-MASTER™ *	DOS	6187183	9444	245.00	EEE	YES	YES	YES	YES
Type Face™ *	DOS	6871333	9091	95.00	EEE	YES	NO	YES	NO
VCN ExecuVision™ *	DOS	6871483	9293	395.00	EEE	YES	NO	PC	NO
VCN Graphics*:									
Library One: The Border Collection	DOS	6187219	9480	80.00	EEE	YES	NO	YES	NO
Library Two: The Initials and Decorative Design Collection	DOS	6187220	9481	80.00	EEE	YES	NO	YES	NO
Library Three: The Industry and Business Catalog Collection	DOS	6187221	9482	90.00	EEE	YES	NO	YES	NO
Library Five: International Symbols and Landmarks Collection	DOS	6187223	9484	80.00	EEE	YES	NO	YES	NO
Library Six: The Maps and Regions Collection	DOS	6187224	9485	80.00	EEE	YES	NO	YES	NO
VisiTrend/Plot® *	DOS	6871324	9007	99.00	EEE	YES	NO	YES	NO

HOME/PERSONAL

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Andrew Tobias' Managing Your Money™ *	DOS	6187279	9540	199.95	EEE	YES	YES	YES	YES
Andrew Tobias' Managing Your Money™ with the IBM PCjr	DOS	6024301	4301	200.00	NO	NO	YES	NO	NO
Home Budget	DOS	6024047	4047	60.00	NO	NO	NO	YES	YES
Home Budget Jr	DOS	6024130	4130	45.00	NO	NO	YES	YES	YES
IBM Home Solutions	DOS	6024150	4150	60.00	NO	NO	YES	YES	YES
Mailing List Manager	DOS	6024049	4049	195.00	EEE	YES	YES	YES	YES
Personal Investor® *	DOS	6871329	9012	145.00	NO	NO	NO	YES	NO
The Home Accountant® Plus*	DOS	6086010	9010	150.00	NO	NO	NO	YES	NO
Time Manager™	DOS	6024019	4019	100.00	EEE	YES	YES	YES	NO

INTEGRATED

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Electric Desk™ *	DOS	6187242	9503	345.00	EEE	YES	NO	YES	YES
Electric Desk™ Jr.*	DOS	6187243	9504	295.00	EEE	YES	YES	NO	NO
Framework™ *	DOS	6187185	9446	695.00	FFA	YES	NO	YES	YES
Spotlight™ *	DOS	6187284	9545	149.95	EEA	YES	NO	YES	NO
SuperCalc3® Release 2*	DOS	6871375	9129	395.00	EEE	YES	NO	YES	YES
SuperCalc3® for PCjr*	DOS	6187170	9431	195.00	EEE	YES	YES	NO	NO
Symphony™ *	DOS	6187187	9448	695.00	FFA	YES	NO	YES	NO
WORD/MATH	PC/IX	6316989	9343	600.00	HHH	YES	NO	YES	YES
1-2-3™ *	DOS	6871325	9047	495.00	EEA	YES	NO	YES	YES
1-2-3™ for the 3270-PC*	DOS	6871468	9278	495.00	EEA	YES	—	—	—
and 3270-PC Control Program									

LANGUAGES

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
APL	DOS	6024077	4077	95.00	EEE	YES	NO	YES	YES
BASIC Compiler	DOS	6024003	4003	300.00	EEE	YES	YES	YES	YES
BASIC Programming Development System Version 1.05	DOS	6024046	4046	130.00	EEE	YES	YES	YES	YES
C™ *	DOS	6871466	9276	350.00	EEE	YES	NO	YES	NO
CBASIC Compiler™ *	DOS	6871343	9099	600.00	FFF	YES	NO	YES	NO
COBOL Compiler	DOS	6024011	4011	345.00	EEE	YES	YES	YES	YES
Digital Research FORTRAN 77™ *	DOS	6871437	9247	350.00	EEE	YES	NO	YES	NO
DR Assembler Plus Tool™ *	DOS	6871460	9270	200.00	EEE	YES	NO	YES	NO
FORMS-2™ *	DOS	6871463	9273	400.00	EEE	YES	NO	YES	NO
FORTRAN Compiler Version 2 Interactive FORTRAN Compiler (INFORT)—program offering	PC/IX	6410971	9214	250.00	HHH	NO	NO	YES	YES
IX RM/COBOL™ Compiler and Run Time Library	PC/IX	6316996	9350	750.00	HHH	YES	NO	YES	YES
IX RM/COBOL™ Run Time Interpreter	PC/IX	6316997	9351	230.00	HHH	YES	NO	YES	YES
Level II COBOL™ *	DOS	6871465	9275	1600.00	GGG	YES	NO	YES	NO
LOGO	DOS	6024076	4076	175.00	EEE	YES	YES	YES	YES
Macro Assembler Version 1	DOS	6024002	4002	100.00	EEE	YES	YES	YES	NO
Macro Assembler Version 2	DOS	6024193	4193	175.00	EEE	YES	YES	YES	YES
Pascal Compiler Version 2	DOS	6024128	4128	350.00	EEE	YES	YES	YES	YES
Pascal/MT +™ *	DOS	6871352	9108	400.00	EEE	YES	NO	YES	NO
PL/I*	DOS	6871350	9106	750.00	FFF	YES	NO	YES	NO
Professional Debug Facility	DOS	6024143	4143	150.00	EEE	YES	NO	YES	YES
Professional FORTRAN	DOS	6024200	4200	595.00	FFF	YES	NO	YES	YES
UCSD FORTRAN-77 Compiler	UCSD	6024034	4034	175.00	EEE	YES	NO	YES	NO
UCSD Pascal Compiler	UCSD p-System	6024033	4033	175.00	EEE	YES	NO	YES	NO

PROFESSIONAL

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Building Design and Construction									
TK! SolverPack™ *	DOS	6187285	9546	200.00	EEA	YES	NO	YES	YES
Client Files, Conflict and Dates System *	DOS	6187249	9510	450.00	EEE	YES	NO	YES	YES
Client & Lawyer Financial System*	DOS	6187248	9509	975.00	FFF	YES	NO	YES	YES
Doctor's Office Manager	DOS	6024157	4157	2500.00	GGG	YES	NO	YES	YES
Dow Jones Market Analyzer™ *	DOS	6871417	9170	349.00	EEE	YES	NO	PC	NO
Dow Jones Market Manager™ *	DOS	6871418	9171	299.00	EEE	YES	NO	PC	NO
Excellerator™ *	DOS	6187282	9543	8400.00	GGG	YES	NO	XT	YES
Financial Management TK! SolverPack™ *	DOS	6871342	9098	100.00	EEA	YES	NO	YES	YES
Harvard Total Project Manager™ *	DOS	6871481	9291	495.00	EEE	YES	NO	YES	NO
IBM Planning Assistant	DOS	6024148	4148	149.00	EEE	YES	YES	YES	YES
Interactive System Productivity Facility/ Personal Computer (ISPF/PC):									
EZ-VU Development Facility	DOS	6410980	9224	130.00	EEE	NO	YES	YES	YES
EZ-VU Runtime Facility	DOS	6316969	9232	55.00	DDD	NO	YES	YES	YES
Law Firm Financial Management*	DOS	6187250	9511	450.00	EEE	YES	NO	YES	YES
Litigation Support*	DOS	6187318	9580	450.00	EEE	YES	NO	YES	YES
MATH/LIBRARY™*	DOS	6187270	9531	440.00	EEE	YES	NO	YES	YES
Mechanical Engineering TK! SolverPack™ *	DOS	6871345	9101	100.00	EEA	YES	NO	YES	YES
Microsoft® Project*	DOS	6086003	9410	250.00	EEE	YES	YES	YES	YES
Multiplan™ Version 1.1	DOS	6024108	4108	250.00	EEE	YES	YES	YES	YES
NAG FORTRAN PC 50 Library*	DOS	6187277	9538	345.00	DDD	YES	NO	YES	YES
Planner Calc	DOS	6024074	4074	79.95	EEE	YES	YES	YES	NO
Project Scheduler 5000™ *	DOS	6871485	9295	345.00	EEE	YES	NO	YES	NO
Project Scheduler 5000™ Plus Graphics*	DOS	6085992	9406	395.00	EEE	YES	NO	YES	NO
Property Management*	DOS	6871317	9075	495.00	EEE	YES	NO	YES	NO
RS/1™	DOS	6317003	9356	2000.00	Z13	YES	NO	YES	YES
STAT/LIBRARY™ *	DOS	6187271	9532	440.00	EEE	YES	NO	YES	YES
Tax Decision™ *	DOS	6871434	9244	279.00	EEE	YES	NO	YES	NO
The Executive Package™ *	DOS	6871332	9090	95.00	EEE	YES	YES	YES	NO
The Tax Manager™ *	DOS	6086014	9011	250.00	NO	NO	NO	YES	NO
The Scientific Desk® *	DOS	6187278	9539	420.00	EEE	YES	NO	YES	YES
TK! Solver® *	DOS	6871314	9072	399.00	EEA	YES	NO	YES	NO
VisiCalc® Business Forecasting Model*	DOS	6092637	9016	100.00	EEE	YES	NO	YES	NO
VisiCalc® Version 1.2	DOS	6024004	4004	200.00	EEE	YES	YES	YES	YES
VisiSchedule® *	DOS	6871323	9009	195.00	EEE	YES	NO	YES	NO

SYSTEM SOFTWARE

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Access Manager™ *	DOS	6871461	9271	400.00	EEE	YES	NO	YES	NO
ANIMATOR™ *	DOS	6871467	9277	800.00	FFF	YES	NO	YES	NO
APL Data Interface for the IBM Personal Computer (APLDI/PC)	DOS	6410978	9221	325.00	Z05	NO	NO	YES	
Application Display Management System	DOS	6024119	4119	150.00	EEE	YES	YES	YES	YES
Cable Data Management System	DOS	6317002	—	450.00	NO	NO	NO	YES	YES
Cluster Program	DOS	6024107	4107	92.00	EEE	YES	YES	YES	YES
Cluster Program Five-Pack	DOS	6024182	4182	400.00	EEE	YES	YES	YES	YES
Copier Management Information System	DOS	—	1677	2000.00	NO	NO	NO	PC	NO
Data Acquisition and Control Adapter Programming Support	DOS	6024202	4202	160.00	EEE	YES	NO	YES	YES
Data Encoder	DOS	6024149	4149	100.00	EEE	YES	YES	YES	YES
Diskette Librarian	DOS	6024050	4050	45.00	DDD	YES	YES	YES	YES
Display Manager™ *	DOS	6871464	9274	500.00	FFF	YES	NO	YES	NO
File Command	DOS	6024062	4062	35.00	DDD	YES	YES	YES	YES
Fixed Disk Organizer	DOS	6024111	4111	50.00	DDD	YES	NO	YES	YES
General Purpose Interface Bus Adapter Program	DOS	6024201	4201	85.00	NO	NO	NO	YES	YES
IBM Local Area Network PrintManager	DOS	6317042	9396	800.00	NO	YES	NO	YES	YES
IBM PC Network Program	DOS	6024195	4195	75.00	EEE	YES	NO	YES	YES
Interactive Network and Message System (INNET/INMAIL)-program offering	PC/IX	6410976	9217	300.00	HHH	NO	NO	YES	
Microsoft® MOUSE*	DOS	6871347	9103	195.00	EEA	YES	NO	YES	YES
Personal Computer Organizer	DOS	6317027	9385	150.00	EEE	YES	NO	YES	YES
Print Screen Utility Program	DOS	6024186	4186	35.00	DDD	YES	NO	YES	NO
Response Time Estimator	DOS	6316968	9231	250.00	Z03	NO	YES	YES	YES
SlideWrite	DOS	6317034	7034	225.00	EEE	YES	NO	YES	YES
Sort Version 1	DOS	6024138	4138	175.00	EEE	YES	YES	YES	YES
TopView	DOS	6024131	4131	149.00	EEE	YES	NO	YES	YES
TopView Programmer's Tool	DOS	6024133	4133	395.00	EEE	YES	NO	YES	YES
Virtual Machine/Personal Computer (VM/PC) Release 1.1 (for PC XT/370 and AT/370)	DOS	6024175	4175	1150.00	AAA	YES	—	—	—
VM Bond (Personal Computer) Connectivity to VM Systems)	DOS	6317007	7007	125.00	EEE	YES	NO	YES	NO
VM/PC Bond Technical Coordinator Package	DOS	6314143	7077	275.00	EEE	YES	NO	YES	NO
3270-PC Color Graphics Applications (3270-PC/GGXA)	DOS	4421760	1508	395.00	JJJ	YES	—	—	—
								3270-PC Graphics Control Program	
3270 PC Control Program Version 1 Release 2.0	DOS	1837434	1505	300.00	CCC	YES	—	—	—
Version 1 Release 2.2	DOS	6423236	3010	300.00	CCC	YES	—	—	—
Version 2	DOS	6423236	3005	300.00	CCC	YES	—	—	—

SYSTEM SOFTWARE (cont'd)

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
3270-PC File Transfer Express (program offering)	DOS and 3270 PC Graphics Control Program	6317001	9360	75.00	EEE	YES	—	—	—
3270 Graphics Control Program	DOS	1887697	1507	450.00	CCC	YES	—	—	—
3270-PC High-Level Language Application Program Interface and 3270-PC Control Program	DOS	1753180	9357	130.00	EEE	NO	—	—	—
5218 Printer Driver Program	DOS	6293576	4472	175.00	EEE	YES	NO	YES	NO
5218 Printer Driver Program Convenience Pac	DOS	6113651	4470	200.00	EEE	YES	NO	YES	NO

WORD PROCESSING

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	Educ Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
BL Business Letter Series™ **	DOS	6187295	9557	195.00	NO	NO	NO	YES	YES
BL LetterWriter™ **	DOS	6187296	9558	395.00	NO	NO	NO	YES	YES
DisplayWrite Legal Support	DOS	6024190	4190	165.00	EEE	YES	NO	YES	YES
DisplayWrite Medical Support	DOS	6024197	4197	165.00	EEE	YES	NO	YES	YES
DisplayWrite 1	DOS	6024188	4188	95.00	EEE	YES	YES	YES	YES
DisplayWrite 2	DOS	6024189	4189	299.00	EEE	YES	NO	YES	NO
DisplayWrite 2 Version 1.1	DOS	6024198	4198	299.00	EEE	YES	NO	YES	YES
DisplayWrite 3	DOS	6024177	4177	349.00	EEE	YES	NO	YES	YES
EasyWriter™ Version 1.15	DOS	6024005	4005	175.00	EEE	YES	YES	YES	YES
Homeword™	DOS	6024090	4090	75.00	NO	NO	YES	NO	NO
IBM Writing Assistant	DOS	6024144	4144	149.00	EEE	YES	YES	YES	YES
MailMerge® *	DOS	6871328	9003	99.00	EEE	YES	NO	YES	YES
Microsoft® WORD*	DOS	6871348	9104	375.00	EEA	YES	YES	YES	YES
MultiMate™ *	DOS	6871408	9161	495.00	EEE	YES	NO	YES	YES
PCWriter	DOS	6024179	4179	199.00	EEE	YES	NO	YES	YES
Peach Text by Peachtree™	DOS	6024039	4039	400.00	EEE	YES	YES	YES	YES
Personal Editor	DOS	6024051	4051	100.00	EEE	YES	YES	YES	YES
Personal Word Perfect™ *	DOS	6871457	9267	195.00	EEE	YES	YES	YES	NO
Professional Editor	DOS	6024048	4048	130.00	EEE	YES	YES	YES	YES
Samna™ Software Sampler*	DOS	6187283	9544	12.95	NO	NO	NO	YES	NO
Script/PC	DOS	6024110	4110	275.00	EEE	YES	YES	YES	YES
SpellStar® *	DOS	6871327	9002	99.00	EEE	YES	NO	YES	NO
StarIndex® *	DOS	6871405	9158	99.00	EEE	YES	NO	YES	YES
T3™ *	DOS	6187281	9542	595.00	FFF	YES	NO	YES	YES
VisiWord™ Plus*	DOS	6871312	9070	195.00	EEE	YES	NO	YES	NO
Word Perfect™ *	DOS	6871456	9266	495.00	EEE	YES	NO	YES	YES
Word Proof	DOS	6024071	4071	60.00	DDD	YES	YES	YES	YES
Word III™ *	DOS	6086002	9409	550.00	FFF	YES	NO	YES	NO
WordMARC™ *	DOS	6187276	9537	495.00	DDD	YES	NO	YES	YES
WordStar® * *	DOS	6871326	9001	350.00	EEE	YES	YES	YES	YES
WordStar Professional® *	DOS	6871407	9160	495.00	FFF	YES	NO	YES	YES
WordStar® 2000*	DOS	6187311	9573	495.00	EEE	YES	NO	YES	YES
WordStar® 2000 Plus*	DOS	6187313	9575	595.00	FFF	YES	NO	YES	YES

Application Programs List in Alphabetic Sequence

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
A Departmental Reporting System for the IBM Personal Computer (ADRS/PC)	DOS	6428092	9172	325.00	Z12	YES		YES	
Accounting Kit**	DOS	6187293	9554	2995.00	NO	NO	NO	YES	YES
Access Manager™ *	DOS	6871461	9271	400.00	EEE	YES	NO	YES	NO
Accounts Payable by Peachtree™ Version 1.1	DOS	6024059	4059	595.00	FFF	YES	NO	YES	YES
Accounts Receivable by BPI™	DOS	6024027	4027	425.00	EEE	YES	NO	PC	NO
Accounts Receivable by Peachtree™ Version 1.1	DOS	6024056	4056	595.00	FFF	YES	NO	YES	YES
Adventure	Supplied	6024006	4006	30.00	NO	NO	YES	YES	YES
Adventures in Math	DOS	6024112	4112	35.00	NO	NO	YES	YES	NO
Adventure in Serenia	Supplied	6024038	4038	35.00	NO	NO	YES	YES	YES
Andrew Tobias' Managing Your Money™ *	DOS	6187279	9540	199.95	EEE	YES	YES	YES	YES
Andrew Tobias' Managing Your Money™ with the IBM PCjr	DOS	6024301	4301	200.00	NO	NO	YES	NO	NO
Animation Creation	DOS	6024082	4082	40.00	NO	NO	YES	YES	YES
ANIMATOR™ *	DOS	6871467	9277	800.00	FFF	YES	NO	YES	NO
APL	DOS	6024077	4077	95.00	EEE	YES	NO	YES	YES
APL Data Interface for the IBM Personal Computer (APLDI/PC)	DOS	6410978	9221	325.00	Z05	NO	NO	YES	
Application Display Management System	DOS	6024119	4119	150.00	EEE	YES	YES	YES	YES
Arithmetic Games Set 1	DOS	6024024	4024	60.00	NO	NO	YES	YES	YES
Arithmetic Games Set 2	DOS	6024025	4025	60.00	NO	NO	YES	YES	YES
Assessing Personal Management Skills*	DOS	6871507	9317	350.00	EEE	YES	YES	YES	NO
Asynchronous Communications Support Version 2	DOS	6024032	4032	60.00	DDD	YES	NO	YES	YES
ATI Skill Builder/Teach Yourself BASIC® *	DOS	6871280	9038	39.95	DDD	YES	YES	YES	NO
ATI Skill Builder/Teach Yourself PC-DOS*	DOS	6871281	9039	39.95	DDD	YES	YES	YES	NO
ATI Training Power™ for dBase II® Volumes I and II*	DOS	6871285	9043	75.00	EEE	YES	YES	YES	NO
ATI Training Power™ for VisiCalc® *	DOS	6871282	9040	75.00	EEE	YES	YES	YES	NO
ATI Training Power™ for WordStar® *	DOS	6871283	9041	75.00	EEE	YES	YES	YES	NO
Automated Information Management (program offering)	DOS	6410974	9219	395.00	Z11	NO	NO	YES	NO
BASIC Compiler	DOS	6024003	4003	300.00	EEE	YES	YES	YES	YES
BASIC Primer Version 1	DOS	6024053	4053	60.00	DDD	YES		YES	NO
BASIC Primer Version 2	DOS	6024129	4129	60.00	DDD	YES	YES	YES	NO
BASIC Programming Development System Version 1.05	DOS	6024046	4046	130.00	EEE	YES	YES	YES	YES
Batch Communications Program (program offering)	DOS	6428147	9178	350.00	NO	NO	NO	YES	
Binary Synchronous 3270 Emulation Program	DOS	6024037	4037	700.00	FFF	YES	NO	YES	YES
BL Business Letter Series™ **	DOS	6187295	9557	195.00	NO	NO	NO	YES	YES
BL LetterWriter™ **	DOS	6187296	9558	395.00	NO	NO	NO	YES	YES

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
BPI Series**:									
Accounts Payable	DOS	6187163	9424	595.00	NO	NO	NO	YES	NO
Accounts Payable Self Training	DOS	6187256	9517	70.00	NO	NO	NO	YES	NO
Accounts Receivable	DOS	6187164	9425	595.00	NO	NO	NO	YES	NO
Accounts Receivable Self Training	DOS	6187257	9518	70.00	NO	NO	NO	YES	NO
General Accounting	DOS	6187165	9426	595.00	NO	NO	NO	YES	NO
General Accounting Self Training	DOS	6187258	9519	70.00	NO	NO	NO	YES	NO
Information Management	DOS	6187166	9427	425.00	NO	NO	NO	YES	NO
Inventory Control	DOS	6187167	9428	795.00	NO	NO	NO	YES	NO
Job Cost	DOS	6187168	9429	795.00	NO	NO	NO	YES	NO
Payroll	DOS	6187169	9430	595.00	NO	NO	NO	YES	NO
BPS Business Graphics™ *	DOS	6871470	9280	350.00	EEE	YES	NO	YES	YES
Building Design and Construction									
TK! SolverPack™ *	DOS	6187285	9546	200.00	EEA	YES	NO	YES	YES
Bumble Games™	DOS	6024094	4094	40.00	NO	NO	YES	YES	YES
Bumble Plot™	DOS	6024096	4096	40.00	NO	NO	YES	YES	YES
Business Analyzer**	DOS	6187294	9556	395.00	NO	NO	NO	YES	YES
Business Library™ *:									
Accounts Payable	DOS	6871412	9165	695.00	FFF	YES	NO	YES	YES
Accounts Receivable	DOS	6871411	9164	695.00	FFF	YES	NO	YES	YES
Information Retrieval	DOS	6871454	9264	395.00	EEE	YES	NO	YES	YES
Inventory Control and Bill of Materials	DOS	6871414	9167	795.00	FFF	YES	NO	YES	YES
Payroll System	DOS	6871413	9166	695.00	FFF	YES	NO	YES	YES
Purchase Order Tracking	DOS	6871416	9169	795.00	FFF	YES	NO	YES	YES
Sales Order Entry and Sales Analysis	DOS	6871415	9168	795.00	FFF	YES	NO	YES	YES
The General Ledger	DOS	6871409	9162	695.00	FFF	YES	NO	YES	YES
The Librarian	DOS	6871410	9163	95.00	EEE	YES	NO	YES	YES
Business Management Series:									
Accounts Extensions Edition	DOS	6410958	9201	245.00	EEE	YES	NO	YES	YES
Accounts Payable Edition	DOS	6410951	9194	695.00	FFF	YES	NO	YES	YES
Accounts Payable Training Edition	DOS	6410960	9203	95.00	EEE	YES	NO	YES	YES
Accounts Receivable Edition	DOS	6410952	9195	695.00	FFF	YES	NO	YES	YES
Accounts Receivable Training Edition	DOS	6410961	9204	95.00	EEE	YES	NO	YES	YES
Financial Extensions Edition	DOS	6410957	9200	245.00	EEE	YES	NO	YES	YES
General Ledger Edition	DOS	6410950	9193	695.00	FFF	YES	NO	YES	YES
General Ledger Training Edition	DOS	6410959	9202	95.00	EEE	YES	NO	YES	YES
Inventory Accounting Edition	DOS	6410955	9198	695.00	FFF	YES	NO	YES	YES
Inventory Accounting Training Edition	DOS	6410964	9207	95.00	EEE	YES	NO	YES	YES
Order Entry and Invoicing Edition	DOS	6410954	9197	695.00	FFF	YES	NO	YES	YES
Order Entry and Invoicing Training Edition	DOS	6410963	9206	95.00	EEE	YES	NO	YES	YES
Payroll Edition	DOS	6410953	9196	695.00	FFF	YES	NO	YES	YES
Payroll Training Edition	DOS	6410962	9205	95.00	EEE	YES	NO	YES	YES
CTM *	DOS	6871466	9276	350.00	EEE	YES	NO	YES	NO
Cable Data Management System	DOS	6317002	—	450.00	NO	NO	NO	YES	YES
Casino Games Version 1.05	DOS	6024054	4054	35.00	NO	NO	YES	YES	YES
CBASIC Compiler™ *	DOS	6871343	9099	600.00	FFF	YES	NO	YES	NO
Cdextm Training for dBase II®*	Supplied	6871430	9240	69.95	EEE	YES	NO	YES	NO
Cdextm Training for the Visicalc® Program*	Supplied	6871339	9095	69.95	EEE	YES	NO	YES	NO
Cdextm Training for the Wordstar® Program*	Supplied	6871306	9064	69.95	EEE	YES	NO	YES	NO

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Cell Growth and Mitosis*	DOS	6871471	9281	69.95	EEE	YES	YES	YES	NO
CHART-MASTER™ *	DOS	6871432	9242	375.00	EEE	YES	NO	YES	YES
Client Files, Conflict and Dates System *	DOS	6187249	9510	450.00	EEE	YES	NO	YES	YES
Client Ledger System™ **	DOS	6187208	9469	1595.00	NO	NO	NO	YES	YES
Client & Lawyer Financial System *	DOS	6187248	9509	975.00	FFF	YES	NO	YES	YES
CLOUT™ *	DOS	6187245	9506	249.00	EEE	YES	NO	YES	NO
Cluster Program	DOS	6024107	4107	92.00	EEE	YES	YES	YES	YES
Cluster Program Five-Pack	DOS	6024182	4182	400.00	EEE	YES	YES	YES	YES
COBOL Compiler	DOS	6024011	4011	345.00	EEE	YES	YES	YES	YES
Comma Cat	DOS	6024293	4293	45.00	DDD	YES	YES	YES	YES
Computer Preparation for the SAT*	DOS	6187307	9569	79.95	EEE	YES	YES	YES	NO
Computer Stocks and Bonds™ *	DOS	6086016	9028	25.00	NO	NO	NO	YES	NO
Computers and Communications	DOS	6024069	4069	35.00	DDD	YES	YES	YES	YES
Copier Management Information System	DOS	—	1677	2000.00	NO	NO	NO	PC	NO
Crosstalk™ XVI*	DOS	6871366	9122	195.00	EEE	YES	NO	YES	NO
Data Acquisition and Control									
Adapter Programming Support	DOS	6024202	4202	160.00	EEE	YES	NO	YES	YES
Data Base Manager II-The Integrator™ *	DOS	6871331	9089	295.00	EEE	YES	NO	YES	YES
Data Encoder	DOS	6024149	4149	100.00	EEE	YES	YES	YES	YES
dBase II© *	DOS	6086009	9032	495.00	EEA	YES	NO	YES	NO
dBase III™ *	DOS	6187184	9445	700.00	FFA	YES	NO	YES	YES
Deadline™ *	DOS	6085998	9023	49.95	NO	NO	NO	YES	NO
Decathlon	Supplied	6024020	4020	35.00	NO	NO	NO	YES	NO
Defining Goals and Objectives*	DOS	6871512	9322	450.00	EEE	YES	YES	YES	NO
Dictionary Dog	DOS	6024067	4067	45.00	DDD	YES	YES	YES	YES
Digital Research FORTRAN 77™ *	DOS	6871437	9247	350.00	EEE	YES	NO	YES	NO
Diskette Librarian	DOS	6024050	4050	45.00	DDD	YES	YES	YES	YES
Display Manager™ *	DOS	6871464	9274	500.00	FFF	YES	NO	YES	NO
DisplayComm Binary Synchronous									
Communications Version 1.1	DOS	6024210	4210	375.00	EEE	YES	NO	YES	YES
DisplayWrite Legal Support	DOS	6024190	4190	165.00	EEE	YES	NO	YES	YES
DisplayWrite Medical Support	DOS	6024197	4197	165.00	EEE	YES	NO	YES	YES
DisplayWrite 1	DOS	6024188	4188	95.00	EEE	YES	YES	YES	YES
DisplayWrite 2	DOS	6024189	4189	299.00	EEE	YES	NO	YES	NO
DisplayWrite 2 Version 1.1	DOS	6024198	4198	299.00	EEE	YES	NO	YES	YES
DisplayWrite 3	DOS	6024177	4177	349.00	EEE	YES	NO	YES	YES
Doctor's Office Manager	DOS	6024157	4157	2500.00	GGG	YES	NO	YES	YES
Dollars and Sense™ *	Supplied	6871482	9292	179.95	EEE	YES	YES	YES	NO
Dow Jones Market Analyzert™ *	DOS	6871417	9170	349.00	EEE	YES	NO	PC	NO
Dow Jones Market Manager™ *	DOS	6871418	9171	299.00	EEE	YES	NO	PC	NO
Dow Jones Reporter™	DOS	6024031	4031	100.00	EEE	YES	YES	YES	YES
Dow Jones Spreadsheet Link™ *	DOS	6871488	9298	249.00	EEA	YES	NO	YES	NO
DR Assembler Plus Toolst™ *	DOS	6871460	9270	200.00	EEE	YES	NO	YES	NO
DR Draw™ *	DOS	6871336	9401	400.00	EEE	YES	NO	YES	NO
DR Graph™ *	DOS	6871440	9250	295.00	EEE	YES	NO	YES	NO
EasyWriter™ Version 1.15	DOS	6024005	4005	175.00	EEE	YES	YES	YES	YES
Electric Desk™ *	DOS	6187242	9503	345.00	EEE	YES	NO	YES	YES
Electric Desk™ Jr*	DOS	6187243	9504	295.00	EEE	YES	YES	NO	NO
Electric Poet	DOS	6024172	4172	75.00	EEE	YES	YES	YES	YES
ENERGRAPHICS™ *	DOS	6187234	9495	350.00	EEE	YES	NO	YES	NO
ENERGRAPHICS™ Plotter*	DOS	6187236	9497	100.00	EEE	YES	NO	YES	NO

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Enhanced 5250 Emulation Program	DOS	6403674	2875	160.00	EEE	YES	NO	YES	YES
Excelerator™ *	DOS	6187282	9543	8400.00	GGG	YES	NO	XT	YES
FaceMaker™ *	DOS	6086007	9031	34.95	NO	NO	NO	YES	NO
FACT TRACK	DOS	6024023	4023	90.00	NO	NO	YES	YES	NO
FAST GRAPHST™ *	DOS	6871362	9118	350.00	EEE	YES	NO	PC	NO
File Command	DOS	6024062	4062	35.00	DDD	YES	YES	YES	YES
Financial Management TK! SolverPack™ *	DOS	6871342	9098	100.00	EEA	YES	NO	YES	YES
Fixed Disk Organizer	DOS	6024111	4111	50.00	DDD	YES	NO	YES	YES
Flight Simulator*	Supplied	6871290	9048	49.95	DDA	YES	YES	YES	NO
FORMS-2™ *	DOS	6871463	9273	400.00	EEE	YES	NO	YES	NO
FORTRAN Compiler Version 2	DOS	6024127	4127	350.00	EEE	YES	YES	YES	YES
Framework™ *	DOS	6187185	9446	695.00	FFA	YES	NO	YES	YES
FRIDAY!™*	DOS	6871458	9268	295.00	EEA	YES	NO	YES	NO
FriendlyWare™ PC Arcade*	Supplied	6871361	9117	49.95	DDD	YES	NO	YES	NO
FriendlyWare™ PC Introductory Set*	DOS	6085985	9005	49.95	DDA	YES	NO	YES	NO
General Accounting by BPI™	DOS	6024026	4026	425.00	EEE	YES	NO	PC	NO
General Ledger by Peachtree™ Version 1.1	DOS	6024058	4058	595.00	FFF	YES	NO	YES	YES
General Purpose Interface									
Bus Adapter Program	DOS	6024201	4201	85.00	NO	NO	NO	YES	YES
Gertrude's Puzzles	DOS	6024098	4098	45.00	NO	NO	YES	YES	YES
Gertrude's Secrets	Supplied	6024097	4097	45.00	NO	NO	YES	YES	YES
Golf's Best™ **	DOS	6187241	9502	49.95	NO	NO	YES	YES	NO
Graphical File System	DOS	6024205	4205	175.00	EEE	YES	NO	YES	YES
Graphical Kernel System	DOS	6024203	4203	295.00	EEE	YES	NO	YES	YES
Graphics Development ToolKit	DOS	6024196	4196	350.00	EEE	YES	YES	YES	YES
Graphics Terminal Emulator	DOS	6024206	4206	295.00	EEE	YES	NO	YES	YES
Graphwriter™ Basic Set*	DOS	6871476	9286	395.00	EEE	YES	NO	YES	NO
Graphwriter™ Combination Set*	DOS	6871477	9287	595.00	EEE	YES	NO	YES	NO
Graphwriter™ Extension Set*	DOS	6871478	9288	395.00	EEE	YES	NO	YES	NO
Ground Water – Earth Science Series	DOS	6024122	4122	49.00	DDD	YES	YES	YES	YES
Harvard Total Project Manager™ *	DOS	6871481	9291	495.00	EEE	YES	NO	YES	NO
Home Budget	DOS	6024047	4047	60.00	NO	NO	NO	YES	YES
Home Budget Jr	DOS	6024130	4130	45.00	NO	NO	YES	YES	YES
Homeword™	DOS	6024090	4090	75.00	NO	NO	YES	NO	NO
Hydrologic Cycle – Earth Science Series	DOS	6024121	4121	49.00	DDD	YES	YES	YES	YES
IBM Accounting Solutions	DOS	6024152	4152	80.00	EEE	YES	YES	YES	YES
IBM Executive Solutions	DOS	6024151	4151	60.00	DDD	YES	YES	YES	YES
IBM Filing Assistant	DOS	6024145	4145	149.00	EEE	YES	YES	YES	YES
IBM Graphing Assistant	DOS	6024147	4147	149.00	EEE	YES	YES	YES	YES
IBM Home Solutions	DOS	6024150	4150	60.00	NO	NO	YES	YES	YES
IBM Local Area Network									
PrintManager	DOS	6317042	9396	800.00	NO	YES	NO	YES	YES
IBM PC Network Program	DOS	6024195	4195	75.00	EEE	YES	NO	YES	YES
IBM Planning Assistant	DOS	6024148	4148	149.00	EEE	YES	YES	YES	YES
IBM Reporting Assistant	DOS	6024146	4146	129.00	EEE	YES	YES	YES	YES
IBM Writing Assistant	DOS	6024144	4144	149.00	EEE	YES	YES	YES	YES
Information Systems Management									
Analysis System (program offering)	DOS	6316974	9341	500.00	FFF	YES	NO	YES	NO
InfoStar™ Plus*	DOS	6871302	9060	595.00	FFF	YES	NO	YES	NO
Instructional System: Administration	DOS	6428087	9175	400.00	EEA	YES		YES	

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Instructional System: Authoring	DOS	6428072	9174	525.00	FFA	YES		YES	
Instructional System: Presentation	DOS	6428071	9173	85.00	EEA	YES		YES	
Insurance Agency System	DOS	6024065	4065	2500.00	GGG	YES	NO	PC	NO
Interactive FORTRAN Compiler (INFORT) – program offering	PC/IX	6410971	9214	250.00	HHH	NO	NO	YES	YES
Interactive Network and Message System (INNET/INMAIL)-program offering	PC/IX	6410976	9217	300.00	HHH	NO	NO	YES	
Interactive System Productivity Facility/ Personal Computer (ISPF/PC):									
EZ-VU Development Facility	DOS	6410980	9224	130.00	EEE	NO	YES	YES	YES
EZ-VU Runtime Facility	DOS	6316969	9232	55.00	DDD	NO	YES	YES	YES
Inventory Control by BPI™	DOS	6024030	4030	425.00	EEE	YES	NO	PC	NO
Inventory Control by Peachtree™ Version 1.1	DOS	6024057	4057	595.00	FFF	YES	NO	YES	YES
IX RM/COBOL™ Compiler and Run Time Library	PC/IX	6316996	9350	750.00	HHH	YES	NO	YES	YES
IX RM/COBOL™ Run Time Interpreter	PC/IX	6316997	9351	230.00	HHH	YES	NO	YES	YES
Job Cost by BPI™	DOS	6024029	4029	550.00	FFF	YES	NO	PC	NO
Juggles Butterfly™	DOS	6024095	4095	35.00	NO	NO	YES	YES	YES
Karel the Robot	DOS	6024066	4066	150.00	NO	NO	YES	YES	NO
King's Quest	Supplied	6024093	4093	50.00	NO	NO	YES	NO	NO
Law Firm Financial Management*	DOS	6187250	9511	450.00	EEE	YES	NO	YES	YES
Leading Effectively*	DOS	6871510	9320	450.00	EEE	YES	YES	YES	NO
Leaf Structure and Function*	DOS	6871486	9296	69.95	DDD	YES	YES	YES	NO
Learning DOS2—A Private Tutor Course	DOS	6024068	4068	30.00	DDD	YES	YES	YES	YES
Learning to Program in BASIC—A Private Tutor Course	DOS	6024081	4081	35.00	DDD	YES	YES	YES	YES
Learning to Use DOS	DOS	6024080	4080	15.00	NO	NO	NO	YES	NO
Level II COBOL™ *	DOS	6871465	9275	1600.00	GGG	YES	NO	YES	NO
LEXIS™/NEXIS™ Communications Session Manager (program offering)	DOS	6410973	9216	225.00	Z04	YES		YES	
Litigation Support*	DOS	6187318	9580	450.00	EEE	YES	NO	YES	YES
LOGO	DOS	6024076	4076	175.00	EEE	YES	YES	YES	YES
Macro Assembler Version 1	DOS	6024002	4002	100.00	EEE	YES	YES	YES	NO
Macro Assembler Version 2	DOS	6024193	4193	175.00	EEE	YES	YES	YES	YES
Mailing List Manager	DOS	6024049	4049	195.00	EEE	YES	YES	YES	YES
MailMerge® *	DOS	6871328	9003	99.00	EEE	YES	NO	YES	YES
Managing Time Effectively*	DOS	6871515	9325	450.00	EEE	YES	YES	YES	NO
Managing Your Business with the Lotus 1-2-3™ Program*	Supplied	6871428	9238	69.95	EEE	YES	NO	YES	NO
Managing Your Business with the Multiplan® Program*	Supplied	6871429	9239	69.95	EEE	YES	NO	YES	NO
MasterType™ *	DOS	6871484	9294	49.95	DDD	YES	YES	YES	NO
MATH BLASTER!™ *	DOS	6871443	9253	49.95	DDD	YES	YES	YES	NO
MATH/LIBRARY™ *	DOS	6187270	9531	440.00	EEE	YES	NO	YES	YES
Mechanical Engineering TK! SolverPack™ *	DOS	6871345	9101	100.00	EEA	YES	NO	YES	YES
Metric I-Fundamentals of Decimals*	DOS	6871487	9297	49.00	DDD	YES	YES	YES	NO
Metric II-Math Applications*	DOS	6871517	9327	49.00	DDD	YES	YES	YES	NO

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Metric III-Units of Measurement*	DOS	6871518	9328	49.00	DDD	YES	YES	YES	NO
Metric IV-Linear Units*	DOS	6871519	9329	49.00	DDD	YES	YES	YES	NO
Metric V-Area Density Measurements*	DOS	6871520	9330	49.00	DDD	YES	YES	YES	NO
Microsoft® MOUSE*	DOS	6871347	9103	195.00	EEA	YES	NO	YES	YES
Microsoft® Project*	DOS	6086003	9410	250.00	EEE	YES	YES	YES	YES
Microsoft® WORD*	DOS	6871348	9104	375.00	EEA	YES	YES	YES	YES
Midway Campaign™ *	DOS	6085994	9021	21.00	NO	NO	NO	YES	NO
Moisture in the Atmosphere – Earth Science Series	DOS	6024124	4124	49.00	DDD	YES	YES	YES	YES
Monster Math	DOS	6024072	4072	30.00	NO	NO	YES	YES	NO
MultiMatem™ *	DOS	6871408	9161	495.00	EEE	YES	NO	YES	YES
Multiplan™ Version 1.1	DOS	6024108	4108	250.00	EEE	YES	YES	YES	YES
Multiplication Tables—A Private Tutor Course	DOS	6024070	4070	50.00	DDD	YES	YES	YES	YES
NAG FORTRAN PC50 Library*	DOS	6187277	9538	345.00	DDD	YES	NO	YES	YES
Office Correspondence Retrieval System	DOS	6024160	4160	149.00	EEE	YES	NO	YES	YES
One Hundred and One Monochrome Mazes	DOS	6024064	4064	35.00	NO	NO	NO	YES	NO
Pascal Compiler Version 2	DOS	6024128	4128	350.00	EEE	YES	YES	YES	YES
Pascal/MT +™ *	DOS	6871352	9108	400.00	EEE	YES	NO	YES	NO
Passive Transport*	DOS	6871521	9331	69.95	EEE	YES	YES	YES	NO
Payroll by BPI™	DOS	6024028	4028	425.00	EEE	YES	NO	PC	NO
Payroll by Peachtree™ Version 1.1	DOS	6024060	4060	595.00	FFF	YES	NO	YES	YES
PCcrayon™ *	DOS	6871480	9290	59.95	DDD	YES	YES	YES	NO
PC/Colorview (program offering)	DOS	6410982	9226	105.00	EEE	NO	YES	YES	YES
PC Network SNA Emulation Program	DOS	6322526	2526	375.00	EEE	YES	NO	YES	YES
PC Storyboard	DOS	6316998	9352	250.00	EEE	YES	YES	YES	YES
PC Tutor™ *	DOS	6871287	9045	59.95	DDD	YES	NO	YES	NO
PC/Videotex: 5150, 5160, and 5170 configurations	DOS	6410985	9229	250.00	Z07	NO	—	YES	YES
PCjr	DOS	6316967	9230	220.00	Z01	NO	YES	—	—
PCWriter	DOS	6024179	4179	199.00	EEE	YES	NO	YES	YES
Peach Text by Peachtree™	DOS	6024039	4039	400.00	EEE	YES	YES	YES	YES
Personal Communications Manager	DOS	6024100	4100	100.00	EEE	YES	YES	YES	YES
Personal Computer Organizer	DOS	6317027	9385	150.00	EEE	YES	NO	YES	YES
Personal Decision Series: Host Attachment Products:									
Attachment/36 Edition	DOS	6316972	9235	150.00	EEE	YES	NO	YES	YES
Attachment/370 Edition	DOS	6316971	9234	200.00	EEE	YES	NO	YES	YES
Productivity Extensions:									
Appointment Calendar Edition	DOS	6410946	9189	70.00	EEE	YES	NO	YES	YES
Asset Catalog Edition	DOS	6410943	9363	60.00	DDD	YES	NO	YES	YES
Client Time/Cost Accounting Edition	DOS	6410945	9188	60.00	DDD	YES	NO	YES	YES
Mailing Labels Edition	DOS	6410942	9373	60.00	DDD	YES	NO	YES	YES
Prospect Tracking Edition	DOS	6410944	9362	60.00	DDD	YES	NO	YES	YES
Productivity Products:									
Advisor	DOS	6410941	9371	250.00	EEE	YES	NO	YES	YES
Data Edition	DOS	6410936	9367	250.00	EEE	YES	NO	YES	YES
Data Training Edition	DOS	6410947	9190	70.00	EEE	YES	NO	YES	YES
Graphs Edition	DOS	6410938	9368	200.00	EEE	YES	NO	YES	YES
Plans Edition	DOS	6410939	9369	150.00	EEE	YES	NO	YES	YES
Plans+ Edition	DOS	6410972	9215	300.00	EEE	YES	NO	YES	YES

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
Reports+ Edition	DOS	6410937	9370	150.00	EEE	YES	NO	YES	YES
Words Edition	DOS	6410940	9372	150.00	EEE	YES	NO	YES	YES
Personal Editor	DOS	6024051	4051	100.00	EEE	YES	YES	YES	YES
Personal Investor® *	DOS	6871329	9012	145.00	NO	NO	NO	YES	NO
Personal Services/PC	DOS	6317013	7013	250.00	EEE	YES	NO	YES	YES
Personal Tax Planner**	DOS	6187297	9559	295.00	NO	NO	NO	YES	YES
Personal Word Perfect™ *	DOS	6871457	9267	195.00	EEE	YES	YES	YES	NO
Photosynthesis & Light Energy*	DOS	6871522	9332	69.95	EEE	YES	YES	YES	NO
Planner Calc	DOS	6024074	4074	79.95	EEE	YES	YES	YES	NO
Plant Growth*	DOS	6871523	9333	69.95	EEE	YES	YES	YES	NO
Plotting System	DOS	6024204	4204	225.00	EEE	YES	NO	YES	YES
PL/I*	DOS	6871350	9106	750.00	FFF	YES	NO	YES	NO
Print Screen Utility Program	DOS	6024186	4186	35.00	DDD	YES	NO	YES	NO
Private Tutor	DOS	6024052	4052	50.00	DDD	YES	YES	YES	NO
Private Tutor Version 2	DOS	6024113	4113	50.00	DDD	YES	YES	YES	YES
Capitalization Skills	DOS	6024085	4085	46.00	DDD	YES	YES	YES	YES
Language Skills	DOS	6024084	4084	46.00	DDD	YES	YES	YES	YES
Punctuation Skills	DOS	6024083	4083	46.00	DDD	YES	YES	YES	YES
Spelling Skills	DOS	6024086	4086	46.00	DDD	YES	YES	YES	YES
Professional Debug Facility	DOS	6024143	4143	150.00	EEE	YES	NO	YES	YES
Professional Editor	DOS	6024048	4048	130.00	EEE	YES	YES	YES	YES
Professional FORTRAN	DOS	6024200	4200	595.00	FFF	YES	NO	YES	YES
Professor DOS™ *	DOS	6871423	9183	59.95	DDD	YES	NO	YES	NO
Programmed Inquiry Learning or Teaching (PILOT)	DOS	6316973	9340	200.00	EEE	YES		YES	
PROFS Personal Computer Connection (PROFS/PC ²)-program offering	DOS	6410984	9228	200.00	Z06	NO	NO	YES	YES
Project Scheduler 5000™ *	DOS	6871485	9295	345.00	EEE	YES	NO	YES	NO
Project Scheduler 5000™ Plus Graphics*	DOS	6085992	9406	395.00	EEE	YES	NO	YES	NO
ProKey™ *	DOS	6871526	9336	129.95	EEE	YES	YES	YES	YES
Property Management*	DOS	6871317	9075	495.00	EEE	YES	NO	YES	NO
Question™ *	DOS	6871277	9035	45.00	DDD	YES	NO	YES	NO
Rags to Riches™ Accounts Payable**	DOS	6187273	9534	99.00	NO	NO	YES	YES	NO
Rags to Riches™ Accounts Receivable**	DOS	6187274	9535	99.00	NO	NO	YES	YES	NO
Rags to Riches™ Accounts Sales**	DOS	6187275	9536	99.00	NO	NO	YES	YES	NO
Rags to Riches™ Ledger**	DOS	6187272	9533	99.00	NO	NO	YES	YES	NO
R:B 4000 Extended Report Writer*	DOS	6187246	9507	150.00	EEE	YES	NO	YES	NO
R:BASE™ Series 4000*	DOS	6871479	9289	495.00	EEE	YES	NO	YES	YES
Remote 5250 Emulation Program	DOS	6403685	2874	195.00	EEE	YES	NO	YES	YES
Response Time Estimator	DOS	6316968	9231	250.00	Z03	NO	YES	YES	YES
Rocky's Boots	DOS	6024099	4099	50.00	NO	NO	YES	YES	YES
RS/1™	DOS	6317003	9356	2000.00	Z13	YES	NO	YES	YES
Samna™ Software Sampler*	DOS	6187283	9544	12.95	NO	NO	NO	YES	NO
SAT Word Attack™ Data Disk*	DOS	6187238	9499	19.95	NO	NO	NO	YES	NO
Script/PC	DOS	6024110	4110	275.00	EEE	YES	YES	YES	YES
SIGN-MASTER™ *	DOS	6187183	9444	245.00	EEE	YES	YES	YES	YES
SlideWrite	DOS	6317034	7034	225.00	EEE	YES	NO	YES	YES
SmarTerm™ 100*	DOS	6871489	9299	149.00	EEE	YES	NO	YES	NO
SNA 3270 Emulation and RJE Support	DOS	6024036	4036	700.00	FFF	YES	NO	YES	YES
Snooper Troops 1™ *	DOS	6086004	9026	44.95	NO	NO	NO	YES	NO
Snooper Troops 2™ *	DOS	6086005	9027	44.95	NO	NO	NO	YES	NO

Personal Computer
Configurations
Supported

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Allow Avail	Supported		
							PCjr	PC XT	PC AT
Sort Version 1	DOS	6024138	4138	175.00	EEE	YES	YES	YES	YES
SPEED READER II™ *	DOS	6871441	9251	69.95	EEE	YES	YES	YES	NO
SpellStar® *	DOS	6871327	9002	99.00	EEE	YES	NO	YES	NO
Spotlight™ *	DOS	6187284	9545	149.95	EEA	YES	NO	YES	NO
StarIndex® *	DOS	6871405	9158	99.00	EEE	YES	NO	YES	YES
States'n Cap™ *	DOS	6871278	9036	39.95	NO	NO	YES	YES	NO
STAT/LIBRARY™ *	DOS	6187271	9532	440.00	EEE	YES	NO	YES	YES
Story Machine™ *	DOS	6086006	9030	34.95	NO	NO	NO	YES	NO
Strategy Games.Version 1.05	DOS	6024055	4055	30.00	NO	YES	YES	YES	YES
SuperCalc3® Release 2*	DOS	6871375	9129	395.00	EEE	YES	NO	YES	YES
SuperCalc3® for PCjr*	DOS	6187170	9431	195.00	EEE	YES	YES	NO	NO
Surface Water - Earth Science Series	DOS	6024123	4123	49.00	DDD	YES	YES	YES	YES
Symphony™ *	DOS	6187187	9448	695.00	FFA	YES	NO	YES	NO
Tax Decision™ *	DOS	6871434	9244	279.00	EEE	YES	NO	YES	NO
Teacher's Quiz Designer	DOS	6024075	4075	70.00	EEE	YES	YES	YES	YES
Telemath Disk 1*	Supplied	6871376	9130	40.00	DDD	YES	NO	YES	NO
Telemath Disk 2*	Supplied	6871377	9131	40.00	DDD	YES	NO	YES	NO
Telemath Disk 3*	Supplied	6871378	9132	40.00	DDD	YES	NO	YES	NO
Telemath Disk 4*	Supplied	6871379	9133	40.00	DDD	YES	NO	YES	NO
Telemath Disk 5*	Supplied	6871380	9134	40.00	DDD	YES	NO	YES	NO
Telemath Disk 6*	Supplied	6871381	9135	40.00	DDD	YES	NO	YES	NO
Telemath Disk 7*	Supplied	6871382	9136	40.00	DDD	YES	NO	YES	NO
Telemath Disk 8*	Supplied	6871383	9137	40.00	DDD	YES	NO	YES	NO
Telemath Disk 9*	Supplied	6871384	9138	40.00	DDD	YES	NO	YES	NO
Telemath Disk 10*	Supplied	6871385	9139	40.00	DDD	YES	NO	YES	NO
Telemath Trial Size*	Supplied	6871386	9140	10.00	NO	NO	NO	XT	NO
Telemath Volume 1*	Supplied	6871373	9176	350.00	EEE	YES	NO	YES	NO
Telemath Volume 2*	Supplied	6871374	9177	350.00	EEE	YES	NO	YES	NO
Temple of Apschai® *	DOS	6085990	9018	39.95	NO	NO	NO	YES	NO
The Executive Package™ *	DOS	6871332	9090	95.00	EEE	YES	YES	YES	NO
The Home Accountant® Plus*	DOS	6086010	9010	150.00	NO	NO	NO	YES	NO
The Instructor™ *	DOS	6871288	9046	44.95	DDD	YES	NO	YES	NO
The Scientific Desk™ *	DOS	6187278	9539	420.00	EEE	YES	NO	YES	YES
The Tax Manager™ *	DOS	6086014	9011	250.00	NO	NO	NO	YES	NO
Thoughtware® Sampler*	DOS	6187217	9478	19.95	DDD	YES	YES	YES	NO
T.I.M.® IV*	DOS	6871365	9121	395.00	EEE	YES	NO	YES	NO
Time Accounting**	DOS	6187298	9560	895.00	NO	NO	NO	YES	YES
Time Manager™	DOS	6024019	4019	100.00	EEE	YES	YES	YES	NO
TK! Solver® *	DOS	6871314	9072	399.00	EEA	YES	NO	YES	NO
TopView	DOS	6024131	4131	149.00	EEE	YES	NO	YES	YES
TopView Programmer's Tool	DOS	6024133	4133	395.00	EEE	YES	NO	YES	YES
Transporter™ *	DOS	6871367	9123	295.00	EEE	YES	NO	YES	YES
Turtle Power	DOS	6024109	4109	50.00	NO	NO	YES	YES	NO
Tutorial Set*	DOS	6871330	9088	94.00	EEE	YES	NO	YES	NO
Type Faces™ *	DOS	6871333	9091	95.00	EEE	YES	NO	YES	NO
Typing Tutor	DOS	6024013	4013	25.00	DDD	YES	NO	YES	NO
T3™ *	DOS	6187281	9542	595.00	FFF	YES	NO	YES	YES
UCSD FORTRAN-77 Compiler	UCSD	6024034	4034	175.00	EEE	YES	NO	YES	NO
UCSD Pascal Compiler	p-System UCSD	6024033	4033	175.00	EEE	YES	NO	YES	NO
UltraFile® *	p-System DOS	6871525	9335	195.00	EEE	YES	NO	YES	NO

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Allow Avail	Personal Computer Configurations Supported		
							PC Jr	PC XT	PC AT
Understanding Personal Interaction Styles*	DOS	6871509	9319	350.00	EEE	YES	YES	YES	NO
Unlock the Mystery*	DOS	6187247	9508	29.95	DDD	YES	NO	YES	NO
US Geography Facts**	DOS	6187200	9461	39.95	NO	NO	NO	YES	NO
VCN ExecuVision™ *	DOS	6871483	9293	395.00	EEE	YES	NO	PC	NO
VCN Graphics:									
Library One: The Border Collection	DOS	6187219	9480	80.00	EEE	YES	NO	YES	NO
Library Two: The Initials and Decorative Design Collection	DOS	6187220	9481	80.00	EEE	YES	NO	YES	NO
Library Three: The Industry and Business Catalog Collection	DOS	6187221	9482	90.00	EEE	YES	NO	YES	NO
Library Five: International Symbols and Landmarks Collection	DOS	6187223	9484	80.00	EEE	YES	NO	YES	NO
Library Six: The Maps and Regions Collection	DOS	6187224	9485	80.00	EEE	YES	NO	YES	NO
Virtual Machine/Personal Computer (VM/PC) Release 1.1 (for PC XT/370 and AT/370)	DOS	6024175	4175	1150.00	AAA	YES	—	—	—
VisiCalc® Business Forecasting Model*	DOS	6092637	9016	100.00	EEE	YES	NO	YES	NO
VisiCalc® Version 1.2	DOS	6024004	4004	200.00	EEE	YES	YES	YES	YES
VisiFile® *	DOS	6871322	9008	149.00	EEE	YES	NO	YES	NO
VisiSchedule® *	DOS	6871323	9009	195.00	EEE	YES	NO	YES	NO
VisiTrend/Plot® *	DOS	6871324	9007	99.00	EEE	YES	NO	YES	NO
VisiWord™ Plus*	DOS	6871312	9070	195.00	EEE	YES	NO	YES	NO
VM Bond (Personal Computer Connectivity to VM Systems)	DOS	6317007	7007	125.00	EEE	YES	NO	YES	NO
VM/PC Bond Technical Coordinator Package	DOS	6314143	7077	275.00	EEE	YES	NO	YES	NO
VTERM™ II *	DOS	6871491	9301	160.00	EEE	YES	NO	YES	NO
WESTLAW™ Communications Session Manager (program offering)	DOS	6248162	9186	350.00	Z02	YES		YES	
WORD ATTACK!™ *	DOS	6871442	9252	49.95	DDD	YES	YES	YES	NO
WORD/MATH	PC/IX	6316989	9343	600.00	HHH	YES	NO	YES	YES
Word Perfect™ *	DOS	6871456	9266	495.00	EEE	YES	NO	YES	YES
Word Proof	DOS	6024071	4071	60.00	DDD	YES	YES	YES	YES
Word III™ *	DOS	6086002	9409	550.00	FFF	YES	NO	YES	NO
WordMARC™ *	DOS	6187276	9537	495.00	DDD	YES	NO	YES	YES
WordStar® *	DOS	6871326	9001	350.00	EEE	YES	YES	YES	YES
WordStar Professional® *	DOS	6871407	9160	495.00	FFF	YES	NO	YES	YES
WordStar® 2000 *	DOS	6187311	9573	495.00	EEE	YES	NO	YES	YES
WordStar® 2000 Plus*	DOS	6187313	9575	595.00	FFF	YES	NO	YES	YES
Word Whiz™ *	DOS	6871279	9037	39.95	DDD	YES	YES	YES	NO
World Geography Facts**	DOS	6187201	9462	39.95	NO	NO	NO	YES	NO
Writing to Read	DOS	6360700	0700	725.00	FFF	YES	YES	NO	NO
Zork® I*	DOS	6085999	9024	49.95	NO	NO	NO	YES	NO
Zork® II*	DOS	6086000	9025	39.95	NO	NO	NO	YES	NO
Zork® III*	DOS	6871284	9042	39.95	NO	NO	NO	YES	NO
1-2-3™ *	DOS	6871325	9047	495.00	EEA	YES	NO	YES	YES

Program Name	Operating System Required	Program Part Number	Program Feature Code	One-Time Charge (\$)	QDA Cat	EDU Allow Avail	Personal Computer Configurations Supported		
							PCjr	PC XT	PC AT
1-2-3™ for the 3270-PC *	DOS and 3270-PC Control Program	6871468	9278	495.00	EEA	YES	—	—	—
3101 Emulation Program	DOS	6024042	4042	140.00	EEE	YES	NO	YES	YES
3270-PC Color Graphics Applications (3270-PC/GGXA)	DOS and 3270-PC Graphics Control Program	4421760	1508	395.00	JJJ	YES	—	—	—
3270 PC Control Program	DOS	1837434	1505	300.00	CCC	YES	—	—	—
Version 1 Release 2.0	DOS	6423236	3010	300.00	CCC	YES	—	—	—
Version 1 Release 2.2	DOS	6423236	3005	300.00	CCC	YES	—	—	—
Version 2	DOS	6317001	9360	75.00	EEE	YES	—	—	—
3270-PC File Transfer Express (program offering)	DOS and 3270-PC Graphics Control Program	6317001	9360	75.00	EEE	YES	—	—	—
3270-PC Graphics Control Program	DOS	1887697	1507	450.00	CCC	YES	—	—	—
3270-PC High-Level Language Application Program Interface Program (program offering)	DOS and 3270-PC Control Program	1753180	9357	130.00	EEE	NO	—	—	—
3278/79 Emulation Control Program	DOS	6024134	4134	235.00	EEE	YES	NO	YES	NO
5218 Printer Driver Program	DOS	6293576	4472	175.00	EEE	YES	NO	YES	NO
5218 Printer Driver Program Convenience Pac	DOS	6113651	4470	200.00	EEE	YES	NO	YES	NO
5250 Emulation Program	DOS	6092651	2885	164.00	EEE	YES	NO	YES	NO
5520/Personal Computer Attachment Program	DOS	7033703	2888	164.00	EEE	YES	NO	PC	NO
Version 1	DOS	6109558	2884	284.00	EEE	YES	NO	YES	NO
Version 2	DOS	6403725	2895	384.00	EEE	YES	NO	YES	YES
Version 3	DOS	6403725	2895	384.00	EEE	YES	NO	YES	YES

Personally Developed Software

Program Name	Program Part Number	One-Time Charge (\$)	Personal Computer Configurations Supported		
			PCjr	PC XT	PC AT
ENTERTAINMENT FAMILY					
Backgammon*	6276502	19.95	YES	YES	YES
Blackjack	6276503	19.95	YES	YES	NO
Crypto-Mania	6276535	19.95	YES	YES	YES
Crypto-Mania Puzzle Pac	6276577	14.95	YES	YES	YES
Kaleidoscope	6276519	14.95	YES	YES	YES
Liptocoe*	6276569	19.95	YES	YES	NO
Music 101 (Trivia From Mozart to Motown)*	6276600	19.95	YES	YES	YES
Roadrunner Rescue	6276511	19.95	YES	YES	NO
Scattergrams	6276553	19.95	YES	YES	YES
Trivia 102*	6276599	19.95	YES	YES	YES
Word Seeking	6276534	19.95	YES	YES	YES
Zuran*	6276515	19.95	YES	YES	NO
3-K Trivia*	6276516	19.95	YES	YES	YES
EDUCATION FAMILY					
Adventures With Decimals*	6276506	24.95	YES	YES	YES
Adventures With Fractions*	6276505	24.95	YES	YES	YES
Adventures With Negative Numbers*	6276507	24.95	YES	YES	YES
Adventures With Decimals, Fractions, and Negative Numbers*	6276504	44.95	YES	YES	YES
Adventures With Whole Numbers*	6276571	24.95	YES	YES	YES
Algebra Tutor	6276529	29.95	YES	YES	YES
Beyond basic BASIC	6276532	19.95	YES	YES	YES
FORTRAN Tutor	6276567	19.95	YES	YES	YES
Matrix Madness*	6276512	19.95	YES	YES	YES
Morse Code Drills	6276525	14.95	YES	YES	YES
Multiplication Tables	6276601	24.95	YES	YES	YES
Private Tutor Presenter 1.1	6276602	19.95	YES	YES	YES
These United States	6276509	19.95	YES	YES	YES

Program Name	Program Part Number	One-Time Charge (\$)	Personal Computer Configurations Supported		
			PCjr	PC XT	PC AT
PRODUCTIVITY FAMILY					
DB/Editor/Writer	6276554	44.95	YES	YES	YES
DOS File Tracker	6276518	19.95	NO	YES	YES
DOS File View	6276593	19.95	YES	YES	YES
FileCommand II	6276558	19.95	YES	YES	YES
File Facility	6276530	19.95	YES	YES	YES
INFOPC	6276556	39.95	NO	YES	YES
PC Palette	6276537	39.95	YES	YES	YES
Personal Computer Picture Graphics	6276508	29.95	YES	YES	YES
Personal Print Control	6276573	29.95	YES	YES	YES
Personal Scientific Calculator	6276513	24.95	YES	YES	YES
Phone Directory On-line	6276522	24.95	NO	YES	YES
Print Buffer On-line	6276521	19.95	NO	YES	YES
Phone Directory & Print Buffer On-line	6276523	34.95	NO	YES	YES
Select-A-Font	6276514	19.95	YES	YES	YES
Short Hand	6276572	14.95	NO	YES	YES
The StarProof Bridge	6276536	14.95	YES	YES	YES
STATLIB 1	6276501	149.95	NO	YES	YES
STATLIB 2	6276539	149.95	NO	YES	YES
SuperC	6276575	19.95	YES	YES	YES
Utilities I	6276517	19.95	YES	YES	YES
Utilities II	6276520	19.95	YES	YES	YES
Utilities III	6276574	19.95	YES	YES	YES
WordProof II	6276564	39.95	YES	YES	YES
PROGRAMMING FAMILY					
DOS Enhanced Debug	6276594	24.95	YES	YES	YES
Object Library Maintenance	6276543	19.95	YES	YES	YES
Structured Assembler Translator	6276550	34.95	YES	YES	YES
BUSINESS FAMILY					
Executive Phone Directory	6276528	34.95	YES	YES	YES
Executive Phone Directory with message feature	6276533	39.95	YES	YES	YES
Executive Phone Directory build your own	6276524	149.95	NO	YES	YES
Member Services	6276566	29.95	NO	YES	YES
Portfolio Management System	6276538	99.95	NO	YES	YES
Project Planning and Scheduling	6276500	149.95	NO	YES	YES

Program Name	Program Part Number	One-Time Charge (\$)	Personal Computer Configurations Supported		
			PCjr	PC XT	PC AT
VALUE PACKAGES					
Assembler Programming Package:	6276558	49.95			
DOS Enhanced Debug			YES	YES	YES
Object Library Maintenance			YES	YES	YES
Structured Assembler Translator			YES	YES	YES
Creativity Package:	6276545	62.95			
Kaleidoscope			YES	YES	YES
PC Palette			YES	YES	YES
Personal Computer Picture Graphics			YES	YES	YES
Select-A-Font			YES	YES	YES
Family Game Package:	6276544	59.95			
Backgammon*			YES	YES	YES
Blackjack			YES	YES	NO
Roadrunner Rescue			YES	YES	NO
Zuran*			YES	YES	NO
3-K Trivia*			YES	YES	YES
Family Game Package II:	6276579	49.95			
Liptocoe*			YES	YES	NO
Music 101 (Trivia From Mozart to Motown)*			YES	YES	YES
Scattergrams			YES	YES	YES
Trivia 102*			YES	YES	YES
Fun-in-Learning Package:	6276549	68.95			
Beyond basic BASIC			YES	YES	YES
Crypto-Mania			YES	YES	YES
Matrix Madness*			YES	YES	YES
Morse Code Drills			YES	YES	YES
These United States			YES	YES	YES
Word Seeking			YES	YES	YES
Math Package:	6276547	49.95			
Adventures With Decimals, Fractions, and Negative Numbers*			YES	YES	YES
Algebra Tutor			YES	YES	YES
Personal Productivity Package:	6276581	74.95			
DB/Editor/Writer			YES	YES	YES
INFOPC			NO	YES	YES
Member Services			NO	YES	YES
Scientific Package:	6276548	194.95			
Personal Scientific Calculator/Writer			YES	YES	YES
STATLIB 1			NO	YES	YES
STATLIB 2			NO	YES	YES
System Support Package:	6276580	54.95			
DOS File View			YES	YES	YES
FileCommand II			YES	YES	YES
Personal Print Control			YES	YES	YES
SuperC			YES	YES	YES
Utilities Package:	6276546	56.95			
DOS File Tracker			NO	YES	YES
File Facility			YES	YES	YES
The StarProof Bridge			YES	YES	YES
Utilities I			YES	YES	YES
Utilities II			YES	YES	YES

Appendix A: IBM Service Offering Descriptions

Types of Service

One or more of the following types of service are available for IBM personal computer products under the IBM Maintenance Agreement and Amendment for IBM Service/Exchange Center Services:

- *IBM On-Site Repair.* IBM will provide warranty or maintenance service for the failing machine at the customer's site.
- *IBM On-Site Exchange.* IBM will deliver to the customer's site a functionally equivalent machine in good working order and replace the failing machine with this exchange machine. IBM will set up and test the exchange machine and remove the failing machine from the customer's premises.
- *Customer On-Site Exchange.* IBM will have a functionally equivalent machine in good working order delivered to the customer's site. The customer will disconnect the failing machine, connect the exchange machine, and return the failing machine to IBM, in accordance with IBM's instructions. IBM is responsible for both outbound and inbound shipping charges.
- *Customer Carry-In Exchange.* The customer will deliver the failing machine to any of more than 100 IBM Service/Exchange Centers or other IBM designated locations. IBM will exchange a functionally equivalent machine in good working order for the failing machine. The customer, in lieu of such delivery, may ship the failing machine, prepaid only, to one of the designated IBM Service/Exchange Centers. IBM will ship the exchange machine prepaid to the customer's location in the United States or Puerto Rico.
- *Customer Carry-In Repair.* The customer will deliver the failing machine to any of more than 100 IBM Service/Exchange Centers or other IBM designated locations. IBM will repair the machine and notify the customer as soon as it is ready for pick up. The customer, in lieu of such delivery, may ship the failing machine, prepaid only, to one of the designated IBM Service/Exchange Centers. IBM will repair the machine and ship it prepaid to the customer's location in the United States or Puerto Rico.

IBM maintenance agreement service is available by contacting IBM marketing representatives, the IBM Service/Exchange Communications Center (call toll

free 1-800-428-2569), IBM Product Centers, and IBM DIRECT (call toll free 1-800-IBM-2468).

IBM Hourly Service

In lieu of IBM maintenance agreement service, a customer can request IBM Hourly Service for a malfunctioning IBM personal computer product. Hourly service is obtained by calling the IBM Service/Exchange Communication Center (toll free 1-800-428-2569). The Center will give the customer instructions for delivering the machine or machine element for service.

For IBM Hourly Service, the customer may deliver the failing machine or machine element to any of more than 100 IBM Service/Exchange Centers or other IBM designated locations. IBM will repair the machine or machine element, and notify the customer as soon as it is ready for pick up. In lieu of delivery, the customer may ship the failing machine or machine element, prepaid in the original shipping container or equivalent, to one of the IBM Service/Exchange Centers designated for this delivery method. IBM will ship the repaired machine or machine element, at the customer's expense, to the customer's location within the United States and Puerto Rico.

Service will be provided at the IBM hourly rate and minimum in effect at the time of the repair. There are additional charges, as appropriate, for replacement parts, shipping, and other applicable expenses.

Appendix B: Trademarks

Name of Trademark	Company
Access Manager	Digital Research
Accounts Payable by BPI	BPI Systems, Inc.
Accounts Payable by Peachtree	Peachtree Software, Inc.
Accounts Receivable by BPI	BPI Systems, Inc.
Accounts Receivable by Peachtree	Peachtree Software, Inc.
ANIMATOR	Micro Focus Ltd.
AST ComboPlus	AST Research, Inc.
AST MegaPak	AST Research, Inc.
AST MegaPlus II	AST Research, Inc.
AST SixPakPlus	AST Research, Inc.
ATI Training Power	American Training International
BASIC	Microsoft Corporation
Business Library	Software Libraries
BPS Business Graphics	Business and Professional Software
Bumble Games	The Learning Company
Bumble Plot	The Learning Company
C	Digital Research
CBASIC Compiler	Digital Research
Cdex	Cdex Corporation
CHART-MASTER	Decision Resources, Inc.
Client Ledger System	TCS Software, Inc. and Financial Microsystems, Inc.
CLOUT	Microrim, Inc.
CompuServe	CompuServe, Inc.
Computer Stocks and Bonds	Avalon Hill Game Company
Concurrent CP/M-86	Digital Research
Context MBA	Context Management Systems
CP/M-86	Digital Research
Crosstalk	Microstuf, Inc.
Data Base Manager II – The Integrator	Alpha Software
dBase II	Ashton-Tate
dBase III	Ashton-Tate
Deadline	Infocom
Digital Research FORTRAN 77	Digital Research
Display Manager	Digital Research
Dollars and Sense	Monogram
Dow Jones Market Analyzer	Dow Jones and Company, Inc.
Dow Jones Market Manager	Dow Jones and Company, Inc.
Dow Jones News Service	Dow Jones and Company, Inc.
Dow Jones Reporter	Dow Jones and Company, Inc.
Dow Jones Spreadsheet Link	Dow Jones and Company, Inc.
DR Assembler Plus Tools	Digital Research
DR Draw	Digital Research
DR Graph	Digital Research
EasyWriter	Information Unlimited Software, Inc.
Electric Desk	Alpha Software
ENERGRAPHICS	Enertronic Research, Inc.
Exceleator	Intech Corporation
FaceMaker	Spinnaker Software

Appendix B: Trademarks

Name of Trademark	Company
FAST GRAPHS	Innovative Software, Inc.
FORMS-2	Micro Focus Ltd.
Framework	Ashton-Tate
FRIDAY!	Ashton-Tate
FriendlyWare	FriendlySoft, Inc.
General Accounting by BPI	BPI Systems, Inc.
General Ledger by Peachtree	Peachtree Software, Inc.
Golf's Best	1 Step Software, Inc.
Graphwriter	Graphic Communications, Inc.
Harvard Project Manager	Harvard Software
HomeWord	Sierra On-Line, Inc.
InfoStar	MicroPro International Corporation
Inventory Control by BPI	BPI Systems, Inc.
Inventory Control by Peachtree	Peachtree Software, Inc.
IRMA	Technical Analysis Corporation
Job Cost by BPI	BPI Systems, Inc.
Juggles Butterfly	The Learning Company
Level II COBOL	Micro Focus Ltd.
LEXIS	Mead Data Central
MailMerge	MicroPro International Corporation
Managing Your Money	Micro Education Corporation of America
MasterType	Scarborough Systems, Inc.
MATH BLASTER!	Davidson and Associates
MATH/LIBRARY	IMSL, Inc.
MBASIC	Microsoft Corporation
Microsoft	Microsoft Corporation
Midway Campaign	Avalon Hill Game Company
MultiMate	Softword Systems, Inc.
Multiplan	Microsoft Corporation
NEXIS	Mead Data Central
OMNINET	Corvus Systems, Inc.
Pascal/MT +	Digital Research
Payroll by BPI	BPI Systems, Inc.
Payroll by Peachtree	Peachtree Software, Inc.
PCcrayon	PC SOFTWARE
PC Mouse	Mouse Systems, Inc.
PC Tutor	Comprehensive Software Support
Peach Text by Peachtree	Peachtree Software, Inc.
Personal BASIC	Digital Research
Personal Investor	PBL Corporation
Personal Word Perfect	Satellite Software International
Professor DOS	Individual Software, Inc.
Project Scheduler 5000	Scitor
ProKey	Rose Soft, Inc.
Question	Alpha Software
QUIETWRITER	IBM Corporation
R:BASE	MicroRim Inc.
Rags to Riches	Chang Laboratories, Inc.
RM/COBOL	Ryan-McFarland Corporation
RS/1	Bolt, Beranek, and Newman
Samna	Samna Corporation
SAT Work Attack!	Davidson and Associates

Name of Trademark

Company

SELECTRIC	IBM Corporation
SIGN-MASTER	Decision Resources, Inc.
SmarTerm	Persoft, Inc.
Smartmodem	Hayes Microcomputer Products, Inc.
Snooper Troops 1	Spinnaker Software
Snooper Troops 2	Spinnaker Software
SPEED READER II	Davidson and Associates
SpellStar	MicroPro International Corporation
Spotlight	Software Arts, Inc.
StarIndex	MicroPro International Corporation
States'n Caps	Alphanetics
STAT/LIBRARY	IMSL, Inc.
Story Machine	Spinnaker Software
SuperCalc3	Sorcim Corporation
Symphony	Lotus Development Corporation
Tax Decisions	Eagle Software Publishing
Tektronix	Tektronix, Inc.
Teletype	Teletype Corporation
Temple of Apshai	Automated Simulations, Inc.
The Executive Package	Alpha Software
The Home Accountant Plus	Continental Software
The Instructor	Individual Software
The Scientific Desk	C. Abaci, Inc.
The Tax Manager	Taso, Inc.
Thoughtware	The Institute for Management Improvement
T.I.M.	Innovative Software, Inc.
Time Manager	Image Producers, Inc.
TK! Solver	Software Arts, Inc.
TK! SolverPack	Software Arts, Inc.
Touchtone	American Telephone and Telegraph
Transporter	Microstuf, Inc.
Type Faces	Alpha Software
T3	Triad Computing, Inc.
UCSD p-System	Regents of the University of California
UCSD Pascal	Regents of the University of California
UltraFile	Continental Software
Universal Media	SofTech Microsystems
UNIX	AT&T Bell Laboratories
VCN ExecuVision	VCN, Inc.
VisiCalc	VisiCorp
VisiFile	VisiCorp
VisiSchedule	VisiCorp
VisiTrend/Plot	VisiCorp
VisiWord	VisiCorp
VTERM	Coefficient Systems Corporation
WESTLAW	Satellite Software International
WORD ATTACK!	Davidson and Associates
Word Perfect	Satellite Software International

Appendix B: Trademarks

Name of Trademark	Company
Word III	Samna Corporation
WordMARC	MARC Software International, Inc.
WordStar	MicroPro International Corporation
WordStar Professional	MicroPro International Corporation
WordStar 2000	MicroPro International Corporation
Word Whiz	Alphanetics
XENIX	Microsoft Corporation
Zork	Infocom
1-2-3	Lotus Development Corporation

Appendix C: Modes of Operation for Display Adapters and the PCjr Video Subsystem

The following three tables indicate the BIOS-supported modes of operation that can be selected under program control for the Enhanced Graphics Adapter (EGA) and the IBM displays with which the modes operate: 5151 Monochrome Display, 5153 Color Display, and 5154 Enhanced Color Display.

The rightmost column in each table indicates whether the Enhanced Graphics Adapter mode is compatible with a PCjr video subsystem mode. The next to the rightmost column in each table indicates whether the Enhanced Graphics Adapter mode is compatible with modes supported by the Monochrome Display and Printer Adapter (for the 5151 display table) or the Color/Graphics Monitor Adapter (for the 5153 and 5154 display tables).

The maximum number of pages column indicates the maximum number of screens of display data that can be stored in EGA graphics memory at one time for each mode. For some of the modes listed, more than 64Kb of graphics memory is required to support the number of colors and/or maximum number of pages listed. The maximum pages column applies to the EGA only and does not indicate the maximum number of screens that can be stored in memory in the monochrome display adapter (one) or the Color/Graphics Monitor Adapter (4 or 8).

5151 Monochrome Display with EGA in Emulation Mode

Mode	Colors	Chars × Lines	Char Box	Pels	Pages (Max.)	Compatible with Monochrome Display Adapter	Compatible with PCjr Video Subsystem
Text	2	80 × 25	9 × 14	720 × 350	8	Yes	No
Text	2	80 × 43	9 × 8	720 × 350	4	No	No
Graphics	2	80 × 25	8 × 14	640 × 350	1	No	No
Graphics	2	80 × 25	8 × 14	640 × 350	2	No	No

5153 Color Display or 5154 Enhanced Color Display with EGA in Emulation Mode

Mode	Colors	Chars × Lines	Char Box	Pels	Pages (Max.)	Compatible with Color/Graphics Monitor Adapter	Compatible with PCjr Video Subsystem
Text	2	40 × 25	8 × 8	320 × 200	8	Yes	Yes
Text	16	40 × 25	8 × 8	320 × 200	8	Yes	Yes
Text	2	80 × 25	8 × 8	640 × 200	8	Yes	Yes
Text	16	80 × 25	8 × 8	640 × 200	8	Yes	Yes
Graphics	2	40 × 25	8 × 8	320 × 200	1	Yes	No
Graphics	2	80 × 25	8 × 8	640 × 200	1	Yes	Yes
Graphics	4	40 × 25	8 × 8	320 × 200	1	Yes	Yes
Graphics	16	40 × 25	8 × 8	320 × 200	8	No	Yes
Graphics	16	80 × 25	8 × 8	640 × 200	4	No	No

5154 Enhanced Color Display with EGA in Enhanced Mode

Mode	Colors	Chars × Lines	Char Box	Pels	Pages (Max.)	Compatible with Color/Graphics Monitor Adapter	Compatible with PCjr Video Subsystem
Text	16 of 64	80 × 25	8 × 14	640 × 350	8	No	No
Text	16 of 64	80 × 43	8 × 8	640 × 350	4	No	No
Graphics	4 of 64	80 × 25	8 × 14	640 × 350	1	No	No
Graphics	16 of 64	80 × 25	8 × 14	640 × 350	2	No	No

Index

A

- Adapter Cable for Cassette, PCjr 10-19
- Adapter Cable for IBM Color Display, PCjr 10-19
- Adapter Cable for Serial Devices, PCjr 10-21
- All Points Addressable Adapter 15-15
- application programs
 - listed by category 41-4
 - listed in alphabetic sequence 41-21
 - PCjr cartridges 41-2
 - personally developed 41-31
- Asynchronous Communications Adapter
 - 3270-PC 15-16
 - 3270-PC/G and GX 15-41
 - 5150 Personal Computer 11-25
 - 5155 Portable Personal Computer 12-5
 - 5160 Personal Computer XT 13-17
 - 5160 Personal Computer XT/370 14-14
 - 5531 Industrial Computer 20-11
- Asynchronous Communications Support Version 2, description 11-27
- Attachable Joystick, PCjr 10-19
- Attachment/36 Edition product 11-32
- Attachment/370 Edition product 11-36
- audio subsystem, PCjr 10-12

B

- Basic Input/Output System
 - 3270-PC 13-14
 - 3270-PC/G and GX 13-14
 - 4860 PCjr 10-10
 - 5150 Personal Computer 11-14
 - 5155 Portable Personal Computer 11-14
 - 5160 Personal Computer XT 13-14
 - 5160 Personal Computer XT/370 13-14
 - 5170 Personal Computer AT 16-13
 - 5170 Personal Computer AT/370 16-13
 - 5531 Industrial Computer 13-14
- BASIC-80 Interpreter
 - 3270-PC 13-14
 - 3270-PC/G and GX 13-14
 - 4860 PCjr 10-10
 - 5150 Personal Computer 11-14
 - 5155 Portable Personal Computer 11-14
 - 5160 Personal Computer XT 13-14
 - 5160 Personal Computer XT/370 13-14
 - 5170 Personal Computer AT 16-14
 - 5170 Personal Computer AT/370 16-14
 - 5531 Industrial Computer 13-14
- Batch Communications program offering 11-30
- battery backed clock
 - 5170 Personal Computer AT 16-14

- 5531 Industrial Computer 20-9
- Binary Synchronous Communications Adapter
 - 3270-PC 15-16
 - 5150 Personal Computer 11-28
 - 5155 Portable Personal Computer 12-17
 - 5160 Personal Computer XT 13-28
 - 5160 Personal Computer XT/370 14-17
 - 5170 Personal Computer AT 16-25
 - 5170 Personal Computer AT/370 17-15
 - 5531 Industrial Computer 20-12
- Binary Synchronous 3270 Emulation Program, description 11-28
- BIOS (See Basic Input/Output System)
- BIOS Update Kit, 5150 System Unit 11-46

C

- Cabling System
 - 3270-PC 15-7
 - 3270-PC/G and GX 15-32
 - 5150 Personal Computer 11-6
 - 5155 Portable Personal Computer 12-5
 - 5160 Personal Computer XT 13-5
 - 5160 Personal Computer XT/370 14-5
 - 5170 Personal Computer AT 16-5
 - 5170 Personal Computer AT/370 17-4
- Carrying Case, PCjr 10-21
- cartridge programs 41-2
- cartridge slots, PCjr 10-11
- Cassette Recorder Adapter, 5150 Personal Computer 11-16
- Cluster Adapter
 - 4860 PCjr 10-22
 - 5150 Personal Computer 11-38
 - 5155 Portable Personal Computer 12-19
 - 5160 Personal Computer XT 13-35
 - 5160 Personal Computer XT/370 14-18
 - 5170 Personal Computer AT 16-26
 - 5170 Personal Computer AT/370 17-16
 - 5531 Industrial Computer 20-13
- Cluster Cable Kit
 - 4860 PCjr 10-22
 - 5150 Personal Computer 11-38
 - 5155 Portable Personal Computer 12-19
 - 5160 Personal Computer XT 13-35
 - 5160 Personal Computer XT/370 14-18
 - 5170 Personal Computer AT 16-26
 - 5170 Personal Computer AT/370 17-16
 - 5531 Industrial Computer 20-13
- Color/Graphics Monitor Adapter
 - 5150 Personal Computer 11-21
 - 5155 Portable Personal Computer 12-13
 - 5160 Personal Computer XT 13-24

Index

- 5160 Personal Computer XT/370 14-15
 - 5170 Personal Computer AT 16-23
 - 5170 Personal Computer AT/370 17-14
 - 5531 Industrial Computer 20-10
 - Combination Adapter Cable, 5531 Industrial Computer 20-11
 - Combination Adapter, 5531 Industrial Computer 20-9
 - Communications Adapter Cable
 - 3270-PC 15-17
 - 5150 Personal Computer 11-30
 - 5155 Portable Personal Computer 12-18
 - 5160 Personal Computer XT 13-30
 - 5160 Personal Computer XT/370 14-17
 - 5170 Personal Computer AT 16-26
 - 5170 Personal Computer AT/370 17-16
 - 5531 Industrial Computer 20-12
 - communications adapters, maximum number
 - 5150 Personal Computer 11-5
 - 5155 Portable Personal Computer 12-5
 - 5160 Personal Computer XT 13-5
 - 5160 Personal Computer XT/370 14-5
 - 5170 Personal Computer AT 16-5
 - 5170 Personal Computer AT/370 17-4
 - 5531 Industrial Computer 20-3
 - compatibility
 - 3270-PC 15-7
 - 3270-PC/G and GX 15-33
 - 4860 PCjr 10-4
 - 5150 Personal Computer 11-6
 - 5155 Portable Personal Computer 12-5
 - 5160 Personal Computer XT 13-6
 - 5160 Personal Computer XT/370 14-5
 - 5170 Personal Computer AT 16-5
 - 5170 Personal Computer AT/370 17-5
 - 5531 Industrial Computer 20-3
 - Complementary Metal Oxide Semiconductor (CMOS) RAM 16-14
 - Composite Video Display, 5155 System Unit 12-13
 - configuration components
 - 3270-PC 15-4
 - 3270-PC/G and GX 15-30
 - 4860 PCjr 10-2
 - 5150 Personal Computer 11-3
 - 5155 Portable Personal Computer 12-3
 - 5160 Personal Computer XT 13-3
 - 5160 Personal Computer XT/370 14-3
 - 5170 Personal Computer AT 16-3
 - 5170 Personal Computer AT/370 17-3
 - 5531 Industrial Computer 20-2
 - configuration features
 - 3270-PC 15-5
 - 3270-PC/G and GX 15-31
 - 4860 PCjr 10-3
 - 5150 Personal Computer 11-4
 - 5155 Portable Personal Computer 12-3
 - 5160 Personal Computer XT 13-3
 - 5160 Personal Computer XT/370 14-3
 - 5170 Personal Computer AT 16-3
 - 5170 Personal Computer AT/370 17-3
 - 5531 Industrial Computer 20-2
 - connectivity highlights
 - 3270-PC 15-5
 - 3270-PC/G and GX 15-31
 - 4860 PCjr 10-3
 - 5150 Personal Computer 11-4
 - 5155 Portable Personal Computer 12-4
 - 5160 Personal Computer XT 13-4
 - 5160 Personal Computer XT/370 14-4
 - 5170 Personal Computer AT 16-4
 - 5170 Personal Computer AT/370 17-4
 - 5531 Industrial Computer 20-3
 - Connector for TV, PCjr 10-19
 - control unit terminal mode
 - 3270-PC 15-6
 - 3270-PC/G and GX 15-32
 - Copier Management Information System (CMIS) 11-45
 - Cordless Keyboard Overlays, PCjr 10-21
 - CP/M-86
 - functions supported 40-19
 - languages supported 40-20
 - overview 40-19
 - prices and discounts 40-20
 - customer responsibilities
 - 3270-PC 15-8
 - 3270-PC/G and GX 15-34
 - 4860 PCjr 10-5
 - 5150 Personal Computer 11-6
 - 5155 Portable Personal Computer 12-6
 - 5160 Personal Computer XT 13-6
 - 5160 Personal Computer XT/370 14-5
 - 5170 Personal Computer AT 16-6
 - 5170 Personal Computer AT/370 17-5
 - 5531 Industrial Computer 20-4
- D**
- Data Acquisition and Control Adapter and Panel
 - 5150 Personal Computer 11-24
 - 5155 Portable Personal Computer 12-16
 - 5160 Personal Computer XT 13-27
 - 5160 Personal Computer XT/370 14-16
 - 5170 Personal Computer AT 16-24
 - 5170 Personal Computer AT/370 17-15
 - Data Edition product 11-28
 - data security
 - 3270-PC 15-8
 - 3270-PC/G and GX 15-34
 - 4860 PCjr 10-5
 - 5150 Personal Computer 11-7
 - 5155 Portable Personal Computer 12-6
 - 5160 Personal Computer XT 13-6
 - 5160 Personal Computer XT/370 14-5
 - 5170 Personal Computer AT 16-6

5170 Personal Computer AT/370 17-6
 5531 Industrial Computer 20-4

dimensions
 3270-PC 15-11
 3270-PC/G and GX 15-36
 4860 PCjr 10-8
 5150 Personal Computer 11-11
 5155 Portable Personal Computer 12-10
 5160 Personal Computer XT 13-11
 5160 Personal Computer XT/370 14-8
 5170 Personal Computer AT 16-9
 5170 Personal Computer AT/370 17-8
 5531 Industrial Computer 20-6

DIP switches
 3270-PC 15-12
 3270-PC/G and GX 15-37
 5150 Personal Computer 11-13
 5152 Printer 31-3
 5155 Portable Personal Computer 12-11
 5160 Personal Computer XT 13-12
 5160 Personal Computer XT/370 14-10
 5170 Personal Computer AT 16-11
 5531 Industrial Computer 20-7

Direct memory access
 3270-PC 15-13
 3270-PC/G and GX 15-38
 5150 Personal Computer 11-14
 5155 Portable Personal Computer 12-11
 5160 Personal Computer XT 13-13
 5170 Personal Computer AT 16-13
 5170 Personal Computer AT/370 17-10
 5531 Industrial Computer 20-8

discounts available
 3270-PC 15-21
 3270-PC/G and GX 15-42
 4860 PCjr 10-23
 5150 Personal Computer 11-49
 5155 Portable Personal Computer 12-22
 5160 Personal Computer XT 13-46
 5160 Personal Computer XT/370 14-20
 5161 Expansion Unit Model 1 11-52
 5161 Expansion Unit Model 2 13-48
 5161 Expansion Unit Model 3 14-23
 5170 Personal Computer AT 16-30
 5170 Personal Computer AT/370 17-18
 5531 Industrial Computer 20-14

Disk Operating System
 components 40-3
 configurations supported 40-3
 functions supported in all versions 40-4
 functions supported in Versions 2.0 and
 2.1 40-5
 functions supported in Versions 3.0 and
 3.1 40-6
 languages supported 40-8
 overview 40-2
 prices 40-10
 TopView program 40-7

diskette characteristics

double-sided 11-17
 high capacity 16-16
 single-sided 11-16

DISOSS/370 11-28

Display Station Emulation Adapter
 3270-PC 15-17
 5150 Personal Computer 11-30
 5155 Portable Personal Computer 12-18
 5160 Personal Computer XT 13-30
 5160 Personal Computer XT/370 14-18
 5170 Personal Computer AT 16-26
 5531 Industrial Computer 20-12

DisplayComm Binary Synchronous Communications
 Program, description 11-29

DisplayWrite 2 program, description 11-27

Displaywriter/Personal Computer Attach Conven-
 ience Kit
 4860 PCjr 10-22
 5150 Personal Computer 11-44
 5155 Portable Personal Computer 12-19
 5160 Personal Computer XT 13-41
 5170 Personal Computer AT 16-27

distributed function terminal mode
 3270-PC 15-6
 3270-PC/G and GX 15-31

E

Enhanced Display Station Emulation
 Adapter 11-33
 5150 Personal Computer 11-33
 5155 Portable Personal Computer 12-18
 5160 Personal Computer XT 13-33
 5170 Personal Computer AT 16-26

Enhanced Graphics Adapter
 5150 Personal Computer 11-22
 5160 Personal Computer XT 13-25
 5160 Personal Computer XT/370 14-16
 5170 Personal Computer AT 16-23
 5170 Personal Computer AT/370 17-14

Enhanced 5250 Emulation Program 11-33

environmental characteristics
 3270-PC 15-11
 3270-PC/G and GX 15-36
 4860 PCjr 10-8
 5150 Personal Computer 11-51
 5155 Portable Personal Computer 12-10
 5160 Personal Computer XT 13-47
 5160 Personal Computer XT/370 14-8
 5170 Personal Computer AT 16-10
 5170 Personal Computer AT/370 17-8
 5531 Industrial Computer 20-6

Index

F

- file transfer utilities for System/34/36/38 11-32
- Fixed Disk and Diskette Drive Adapter
 - 5170 Personal Computer AT 16-15
 - 5170 Personal Computer AT/370 17-12
- Fixed Disk Drive Adapter
 - 3270-PC 15-15
 - 3270-PC/G and GX 15-40
 - 5160 Personal Computer XT 13-16
 - 5160 Personal Computer XT/370 14-13
 - 5161 Expansion Unit Model 1 11-51
 - 5531 Industrial Computer 20-9
- Floor Standing Enclosure, 5170 Personal Computer AT 16-28

G

- Game Control Adapter
 - 3270-PC 15-15
 - 5150 Personal Computer 11-20
 - 5155 Portable Personal Computer 12-15
 - 5160 Personal Computer XT 13-22
 - 5160 Personal Computer XT/370 14-16
 - 5170 Personal Computer AT 16-21
 - 5170 Personal Computer AT/370 17-13
- General Purpose Interface Bus Adapter
 - 5150 Personal Computer 11-25
 - 5155 Portable Personal Computer 12-17
 - 5160 Personal Computer XT 13-28
 - 5160 Personal Computer XT/370 14-17
 - 5170 Personal Computer AT 16-24
 - 5170 Personal Computer AT/370 17-15
- Graphics Memory Expansion Card
 - 5150 Personal Computer 11-22
 - 5160 Personal Computer XT 13-25
 - 5160 Personal Computer XT/370 14-16
 - 5170 Personal Computer AT 16-23
 - 5170 Personal Computer AT/370 17-14
- Graphics Memory Module Kit
 - 5150 Personal Computer 11-22
 - 5160 Personal Computer XT 13-25
 - 5160 Personal Computer XT/370 14-16
 - 5170 Personal Computer AT 16-23
 - 5170 Personal Computer AT/370 17-14

H

- High Capacity Diskette Drive
 - 5170 Personal Computer AT 16-16
 - 5170 Personal Computer AT/370 17-12

I

- I/O connectors, PCjr 10-13
- IBM PC Network
 - 5150 Personal Computer 11-39
 - 5155 Portable Personal Computer 12-19
 - 5160 Personal Computer XT 13-37
 - 5160 Personal Computer XT/370 14-18
 - 5170 Personal Computer AT 16-27
 - 5170 Personal Computer AT/370 17-16
- IBM PC Network SNA 3270 Emulation Program 11-42
- IBM Personal Computer AT/370 Option Kit, 5170 Personal Computer AT 16-27
- IBM Personal Computer XT/370 Option Kit
 - 5160 Personal Computer XT 13-43
 - 5531 Industrial Computer 20-13
- IBM 65/85/95-PC IPL/Diagnostic Diskette and Diagnostic Tool
 - 5150 Personal Computer 11-44
 - 5155 Portable Personal Computer 12-20
 - 5160 Personal Computer XT 13-42
 - 5170 Personal Computer AT 16-27
- IEEE-488 Adapter and Cable, 3270-PC/G and GX 15-40
- initial program load
 - 3270-PC 15-13
 - 3270-PC/G and GX 15-38
 - 4860 PCjr 10-10
 - 5150 Personal Computer 11-15
 - 5155 Portable Personal Computer 12-12
 - 5160 Personal Computer XT 13-14
 - 5160 Personal Computer XT/370 14-11
 - 5170 Personal Computer AT 16-14
 - 5170 Personal Computer AT/370 17-10
 - 5531 Industrial Computer 20-8
- instruction set, 80286 16-12
- instruction set, 8088
 - 3270-PC 13-13
 - 3270-PC/G and GX 13-13
 - 4860 PCjr 10-9
 - 5150 Personal Computer 11-13
 - 5155 Portable Personal Computer 11-13
 - 5160 Personal Computer XT 13-13
 - 5160 Personal Computer XT/370 13-13
 - 5531 Industrial Computer 13-13
- Internal Modem, PCjr 10-20
- IPL (see initial program load)

K

- keyboard
 - 3270-PC 15-18
 - 3270-PC/G and GX 15-41
 - 4860 PCjr 10-14
 - 5150 Personal Computer 11-18

5155 Portable Personal Computer 12-14
 5160 Personal Computer XT 13-20
 5160 Personal Computer XT/370 14-14
 5170 Personal Computer AT 16-18
 5170 Personal Computer AT/370 17-13
 5531 Industrial Computer 20-10
 Keyboard Adventure Program, PCjr 10-10
 Keyboard Cord, PCjr 10-21
 keylock feature
 3270-PC 15-18
 3270-PC/G and GX 15-18
 5150 Personal Computer 11-46
 5160 Personal Computer XT 13-43
 5160 Personal Computer XT/370 14-18
 5170 Personal Computer AT 16-18
 5170 Personal Computer AT/370 17-13
 Keylock Option Kit, 5531 Industrial
 Computer 20-11

L

Local Area Network PrintManager program 11-42

M

Math Co-processor Option
 3270-PC 15-13
 3270-PC/G and GX 15-38
 5150 Personal Computer 11-19
 5155 Portable Personal Computer 12-15
 5160 Personal Computer XT 13-21
 5160 Personal Computer XT/370 14-14
 5170 Personal Computer AT 16-20
 5170 Personal Computer AT/370 17-13
 5531 Industrial Computer 20-10
 microprocessor
 3270-PC 15-13
 3270-PC/G and GX 15-38
 4860 PCjr 10-9
 5150 Personal Computer 11-13
 5155 Portable Personal Computer 12-11
 5160 Personal Computer XT 13-13
 5160 Personal Computer XT/370 14-10
 5170 Personal Computer AT 16-12
 5170 Personal Computer AT/370 17-10
 5531 Industrial Computer 20-8
 minimum configuration and price
 3270-PC 15-5
 3270-PC/G and GX 15-30
 4860 PCjr 10-2
 5150 Personal Computer 11-3
 5155 Portable Personal Computer 12-3
 5160 Personal Computer XT 13-3
 5160 Personal Computer XT/370 14-3
 5170 Personal Computer AT 16-3

5170 Personal Computer AT/370 17-3
 5531 Industrial Computer 20-2
 models available
 IBM 5160 Personal Computer XT/370 14-8
 3270-PC 15-10
 3270-PC/G and GX 15-36
 4860 PCjr 10-7
 5150 Personal Computer 11-10
 5155 Portable Personal Computer 12-9
 5160 Personal Computer XT 13-10
 5170 Personal Computer AT 16-9
 5170 Personal Computer AT/370 17-8
 5531 Industrial Computer 20-6
 Monochrome Display and Printer Adapter
 3270-PC/GX 15-40
 5150 Personal Computer 11-21
 5160 Personal Computer XT 13-23
 5160 Personal Computer XT/370 14-15
 5170 Personal Computer AT 16-23
 5170 Personal Computer AT/370 17-14

O

operating systems supporting
 3270-PC 15-7
 3270-PC/G and GX 15-33
 4860 PCjr 10-4
 5150 Personal Computer 11-6
 5155 Portable Personal Computer 12-5
 5160 Personal Computer XT 13-6
 5160 Personal Computer XT/370 14-5
 5170 Personal Computer AT 16-5
 5170 Personal Computer AT/370 17-5
 5531 Industrial Computer 20-3
 optional features
 3270-PC 15-12
 3270-PC/G and GX 15-37
 4860 PCjr 10-8
 5150 Personal Computer 11-12
 5155 Portable Personal Computer 12-10
 5160 Personal Computer XT 13-11
 5160 Personal Computer XT/370 14-9
 5170 Personal Computer AT 16-10
 5170 Personal Computer AT/370 17-8
 5531 Industrial Computer 20-7

P

Parallel Printer Attachment, PCjr 10-20
 PC Support/36 11-32
 PC/Videotex 11-28
 PCjr cartridges 41-2
 Personal Communications Manager,
 description 11-27
 Personal Computer Interactive Executive

Index

- components and functions 40-12
- configurations supported 40-12
- overview 40-11
- price 40-14
- Personal Computer 3278 Attachment Option 11-33
- Personal Computer 3279 Attachment Option 11-34
- Personal Services/PC, description 11-28
- Power Expansion Attachment, PCjr 10-18
- power sources, number required
 - 3270-PC 15-8
 - 3270-PC/G and GX 15-34
 - 4860 PCjr 10-5
 - 5150 Personal Computer 11-7
 - 5155 Portable Personal Computer 12-6
 - 5160 Personal Computer XT 13-6
 - 5160 Personal Computer XT/370 14-5
 - 5170 Personal Computer AT 16-6
 - 5170 Personal Computer AT/370 17-5
 - 5531 Industrial Computer 20-4
- power supply
 - 4860 PCjr 10-16
 - 5150 Personal Computer 11-12
 - 5155 Portable Personal Computer 12-15
 - 5160 Personal Computer XT 13-21
 - 5160 Personal Computer XT/370 14-14
 - 5161 Expansion Unit Model 1 11-51
 - 5161 Expansion Unit Model 2 13-47
 - 5161 Expansion Unit Model 3 14-23
 - 5170 Personal Computer AT 16-20
 - 5170 Personal Computer AT/370 17-13
 - 5531 Industrial Computer 20-10
- prices
 - 3270-PC 15-21
 - 3270-PC/G and GX 15-42
 - 3852 Color Printer Model 1 31-17
 - 4860 PCjr 10-23
 - 4863 Color Display Model 1 30-9
 - 5150 Personal Computer 11-52
 - 5151 Monochrome Display Model 1 30-4
 - 5152 Graphics Printer Model 2 31-4
 - 5153 Color Display Model 1 30-7
 - 5154 Enhanced Color Display Model 1 30-12
 - 5155 Portable Personal Computer 12-21
 - 5160 Personal Computer XT 13-45
 - 5160 Personal Computer XT/370 14-19
 - 5161 Expansion Unit Model 1 13-48
 - 5161 Expansion Unit Model 2 13-48
 - 5161 Expansion Unit Model 3 14-23
 - 5170 Personal Computer AT 16-29
 - 5170 Personal Computer AT/370 17-17
 - 5175 Professional Graphics Display Model 1 30-14
 - 5181 Compact Printer Model 1 31-8
 - 5182 Color Printer Model 2 31-12
 - 5201 QUIETWRITER® Printer Model 1 31-20
 - 5216 Wheelprinter Model 2 31-23
 - 5531 Industrial Computer 20-14
 - 7371 Color Plotter 32-2
 - 7372 Color Plotter 32-5
- Printer Adapter
 - 3270-PC/G and GX 15-40
 - 5150 Personal Computer 11-22
 - 5155 Portable Personal Computer 12-16
 - 5160 Personal Computer XT 13-25
 - 5160 Personal Computer XT/370 14-15
- Printer Stand, 5152 Printer 31-3
- Printer/Memory Adapter
 - 3270-PC 15-13
 - 3270-PC/G and GX 15-38
- Processor (PC/370-P) Card, 5160 Personal Computer XT/370 14-11
- Processor (PC/370-P2) Card, 5170 Personal Computer AT/370 17-10
- Professional Graphics Controller
 - 5150 Personal Computer 11-24
 - 5155 Portable Personal Computer 12-16
 - 5160 Personal Computer XT 13-26
 - 5160 Personal Computer XT/370 14-16
 - 5170 Personal Computer AT 16-24
 - 5170 Personal Computer AT/370 17-15
- PROFS Personal Computer Connection (PROFS/PC²) 11-27
- programmable speaker
 - 3270-PC 15-14
 - 3270-PC/G and GX 15-39
 - 5150 Personal Computer 11-16
 - 5155 Portable Personal Computer 12-13
 - 5160 Personal Computer XT 13-15
 - 5160 Personal Computer XT/370 14-13
 - 5170 Personal Computer AT 16-15
 - 5170 Personal Computer AT/370 17-12
 - 5531 Industrial Computer 20-8
- Programmed Symbols Adapter, 3270-PC 15-15
- Prototype Adapter
 - 5170 Personal Computer AT 16-15
 - 5170 Personal Computer AT/370 17-14
- Prototype Card
 - 5150 Personal Computer 11-21
 - 5155 Portable Personal Computer 12-16
 - 5160 Personal Computer XT 13-23
 - 5160 Personal Computer XT/370 14-16
- publications
 - 3270-PC 15-9
 - 3270-PC/G and GX 15-35
 - 4860 PCjr 10-5
 - 5150 Personal Computer 11-8
 - 5155 Portable Personal Computer 12-7
 - 5160 Personal Computer XT 13-7
 - 5160 Personal Computer XT/370 14-6
 - 5170 Personal Computer AT 16-7
 - 5170 Personal Computer AT/370 17-6
 - 5531 Industrial Computer 20-4
- purchase locations
 - 3270-PC 15-8
 - 3270-PC/G and GX 15-34
 - 4860 PCjr 10-5

5150 Personal Computer 11-7
 5155 Portable Personal Computer 12-6
 5160 Personal Computer XT 13-7
 5160 Personal Computer XT/370 14-6
 5170 Personal Computer AT 16-6
 5170 Personal Computer AT/370 17-6
 5531 Industrial Computer 20-4

R

random access memory
 3270-PC 15-13
 3270-PC/G and GX 15-38
 4860 PCjr 10-10
 5150 Personal Computer 11-15
 5155 Portable Personal Computer 12-12
 5160 Personal Computer XT 13-14
 5160 Personal Computer XT/370 14-11
 5170 Personal Computer AT 16-15
 5170 Personal Computer AT/370 17-10
 5531 Industrial Computer 20-8

read only memory
 3270-PC 15-13
 3270-PC/G and GX 15-38
 4860 PCjr 10-9
 5150 Personal Computer 11-14
 5155 Portable Personal Computer 12-12
 5160 Personal Computer XT 13-13
 5160 Personal Computer XT/370 14-10
 5170 Personal Computer AT 16-13
 5170 Personal Computer AT/370 17-10
 5531 Industrial Computer 20-8

Realtime clock, 5170 Personal Computer AT and AT/370 16-14

Remote 5250 Emulation Program 11-33

S

self-study courses 11-9

serial port, PCjr 10-16

Serial/Parallel Adapter
 5170 Personal Computer AT 16-17
 5170 Personal Computer AT/370 17-13

Series/1 Intelligent Workstation Support
 PRPQ 11-27

Series/1 to Personal Computer
 Interconnect 11-43

service offerings
 description A-1
 3270-PC 15-8
 3270-PC/G and GX 15-34
 4860 PCjr 10-5
 5150 Personal Computer 11-7
 5155 Portable Personal Computer 12-6
 5160 Personal Computer XT 13-7

5160 Personal Computer XT/370 14-6
 5170 Personal Computer AT 16-7
 5170 Personal Computer AT/370 17-6
 5531 Industrial Computer 20-4

Setup program, 5170 Personal Computer AT and AT/370 16-14

SNA 3270 Emulation and RJE Support Program, description 11-29

Speech Attachment, PCjr 10-18

standard features
 3270-PC 15-10
 3270-PC/G and GX 15-36
 4860 PCjr 10-8
 5150 Personal Computer 11-11
 5155 Portable Personal Computer 12-10
 5160 Personal Computer XT 13-11
 5160 Personal Computer XT/370 14-8
 5170 Personal Computer AT 16-10
 5170 Personal Computer AT/370 17-8
 5531 Industrial Computer 20-6

Synchronous Data Link Control Communications
 Adapter
 3270-PC 15-16
 5150 Personal Computer 11-29
 5155 Portable Personal Computer 12-18
 5160 Personal Computer XT 13-29
 5160 Personal Computer XT/370 14-17
 5170 Personal Computer AT 16-25
 5170 Personal Computer AT/370 17-16
 5531 Industrial Computer 20-12

system board
 3270-PC 15-12
 3270-PC/G and GX 15-37
 4860 PCjr 10-9
 5150 Personal Computer 11-12
 5155 Portable Personal Computer 12-11
 5160 Personal Computer XT 13-11
 5160 Personal Computer XT/370 14-10
 5170 Personal Computer AT 16-11
 5170 Personal Computer AT/370 17-9
 5531 Industrial Computer 20-7

system expansion slots
 3270-PC 15-14
 3270-PC/G and GX 15-39
 5150 Personal Computer 11-15
 5155 Portable Personal Computer 12-12
 5160 Personal Computer XT 13-15
 5160 Personal Computer XT/370 14-12
 5170 Personal Computer AT 16-15
 5170 Personal Computer AT/370 17-12
 5531 Industrial Computer 20-8

system unit components
 3270-PC 15-12
 3270-PC/G and GX 15-37
 4860 PCjr 10-9
 5150 Personal Computer 11-13
 5155 Portable Personal Computer 12-11
 5160 Personal Computer XT 13-12
 5160 Personal Computer XT/370 14-10

Index

5170 Personal Computer AT 16-11
5170 Personal Computer AT/370 17-9
5531 Industrial Computer 20-7

T

Terminal Communications Adapter Kit 11-45
thermal sensor, 5531 Industrial Computer 20-10
Time-of-day clock
 3270-PC 13-14
 3270-PC/G and GX 13-14
 5150 Personal Computer 11-14
 5155 Portable Personal Computer 11-14
 5160 Personal Computer XT 13-14
 5160 Personal Computer XT/370 13-14
 5170 Personal Computer AT 16-14
 5170 Personal Computer AT/370 16-14
 5531 Industrial Computer 13-14
TopView program 40-7
TopView Programmer's ToolKit 40-7
transformer, PCjr 10-16

U

UCSD p-System
 functions supported 40-21
 overview 40-21
 prices and discounts 40-22
 Runtime Support 40-22

V

video subsystem, PCjr 10-12
Virtual diskettes
 DOS support 40-6
 PCjr 10-18
Virtual Machine/Personal Computer (VM/PC)
 introduction 14-24
 local CMS session 14-26
 performance 14-31
 remote 3101 emulation session 14-28
 remote 327X emulation session 14-27
 sessions supported 14-25
 TSOSERV 14-29
 VMPCSERV 14-28

W

warranty period
 3270-PC 15-8
 3270-PC/G and GX 15-34
 4860 PCjr 10-5
 5150 Personal Computer 11-7
 5155 Portable Personal Computer 12-6
 5160 Personal Computer XT 13-7
 5160 Personal Computer XT/370 14-6
 5170 Personal Computer AT 16-7
 5170 Personal Computer AT/370 17-6
 5531 Industrial Computer 20-4
weight
 3270-PC 15-11
 3270-PC/G and GX 15-36
 4860 PCjr 10-8
 5150 Personal Computer 11-11
 5155 Portable Personal Computer 12-10
 5160 Personal Computer XT 13-11
 5160 Personal Computer XT/370 14-8
 5170 Personal Computer AT 16-10
 5170 Personal Computer AT/370 17-8
 5531 Industrial Computer 20-6

X

XENIX System
 Operating System 40-15
 overview 40-15
 prices 40-18
 Software Development System 40-17
 Text Formatting System 40-18

Numerics

10Mb Fixed Disk Drive
 3270-PC 15-15
 3270-PC/G and GX 15-40
 5160 Personal Computer XT 13-16
 5160 Personal Computer XT/370 14-13
 5531 Industrial Computer 20-9
128Kb Memory Expansion Attachment,
 PCjr 10-17
128Kb Memory Expansion Option, 5170 Personal
 Computer AT 16-21
20Mb Fixed Disk Drive
 5170 Personal Computer AT 16-16
 5170 Personal Computer AT/370 17-12
256Kb Memory Expansion Option
 3270-PC 15-13
 5150 Personal Computer 11-20
 5155 Portable Personal Computer 12-15
 5160 Personal Computer XT 13-22

- 5531 Industrial Computer 20-11
- 256Kb Memory Module Kit, 5170 Personal Computer AT 16-21
- 3101 Emulation Program, description 11-26
- 3270 Personal Computer workstations overview 15-2
- 3270-PC Color Graphics Application program (3270-PC/GGXA) 15-53
- 3270-PC configuration overview 15-3
- 3270-PC Control Program
 - application program interface 15-25
 - browsing 15-26
 - copy functions 15-26
 - file transfer 15-27
 - installation 15-27
 - keystroke record/play function 15-26
 - online tutorial 15-27
 - plotter support 15-27
 - printer support 15-26
 - save/restore utility 15-26
 - screen management 15-25
 - sessions supported 15-24
 - windows 15-25
- 3270-PC File Transfer Express program 15-27
- 3270-PC Graphics Control Program
 - browsing 15-52
 - copy functions 15-52
 - file transfer 15-53
 - installation 15-27
 - keystroke record/play function 15-52
 - online tutorial 15-53
 - printer and plotter support 15-52
 - save/restore utility 15-52
 - screen management 15-51
 - sessions supported 15-50
 - support not provided by 3270-PC Control Program 15-50
 - windows 15-51
- 3270-PC High Level Language Application Program Interface 15-27
- 3270-PC/G and GX configuration overview 15-28
- 3277 Model 2 Device Emulation (PC/3277EM) Card, 5160 Personal Computer XT/370 14-12
- 3278/79 Emulation Adapter
 - 5150 Personal Computer 11-35
 - 5155 Portable Personal Computer 12-19
 - 5160 Personal Computer XT 13-33
 - 5160 Personal Computer XT/370 14-12
 - 5170 Personal Computer AT 16-28
 - 5170 Personal Computer AT/370 17-11
 - 5531 Industrial Computer 20-13
- 3295 Plasma Monitor 15-19
- 3852 Color Printer Model 1 31-16
- 4860 System Unit 10-7
- 4863 Color Display Model 1 30-8
- 4975 Printer
 - 5150 Personal Computer 11-5
 - 5160 Personal Computer XT 13-5
- 5-1/4 Inch Diskette Drive Adapter
 - 3270-PC 15-14
 - 3270-PC/G and GX 15-39
 - 5150 Personal Computer 11-16
 - 5155 Portable Personal Computer 12-14
 - 5160 Personal Computer XT 13-15
 - 5160 Personal Computer XT/370 14-13
 - 5531 Industrial Computer 20-9
- 5-1/4 Inch Double-Sided Diskette Drive
 - 3270-PC 15-15
 - 3270-PC/G and GX 15-39
 - 4860 PCjr 10-15
 - 5150 Personal Computer 11-17
 - 5155 Portable Personal Computer 12-14
 - 5160 Personal Computer XT 13-16
 - 5160 Personal Computer XT/370 14-13
 - 5170 Personal Computer AT 16-16
 - 5170 Personal Computer AT/370 17-13
 - 5531 Industrial Computer 20-9
- 5-1/4 Inch Single-Sided Diskette Drive
 - 5150 Personal Computer 11-16
 - 5160 Personal Computer XT 13-23
- 5083 Tablet Model 2 15-48
- 512Kb Memory (PC/370-M) Card, 5160 Personal Computer XT/370 14-11
- 512Kb Memory (PC/370-M2) Card, 5170 Personal Computer AT/370 17-11
- 512Kb Memory Expansion Option, 5170 Personal Computer AT 16-21
- 5150 System Unit 11-10
- 5151 Monochrome Display Model 1 30-2
- 5152 Graphics Printer Model 2 31-2
- 5153 Color Display Model 1 30-5
- 5154 Enhanced Color Display Model 1 30-10
- 5155 System Unit 12-9
- 5160 System Unit Model 589 14-8
- 5160 System Unit Models 68, 78, 86, and 87 13-10
- 5161 Expansion Unit Model 1
 - 3270-PC 15-22
 - 3270-PC/G and GX 15-49
 - 5150 Personal Computer 11-50
 - 5155 Portable Personal Computer 12-23
 - 5160 Personal Computer XT 13-47
 - 5160 Personal Computer XT/370 14-21
- 5161 Expansion Unit Model 2
 - 3270-PC 15-22
 - 3270-PC/G and GX 15-49
 - 5160 Personal Computer XT 13-47
 - 5160 Personal Computer XT/370 14-21
- 5161 Expansion Unit Model 3 14-22
- 5170 System Unit Model 599 17-8
- 5170 System Unit Models 68 and 99 16-9
- 5175 Professional Graphics Display Model 1 30-13
- 5181 Compact Printer Model 1 31-7
- 5182 Color Printer Model 1 31-10
- 5201 QUIETWRITER® Printer Model 1 31-18
- 5216 Wheelprinter Model 2 31-21

Index

- 5218 Printer Attachment Cable
 - 3270-PC 15-17
 - 3270-PC/G and GX 15-17
 - 5150 Personal Computer 11-45
 - 5155 Portable Personal Computer 12-20
 - 5160 Personal Computer XT 13-42
- 5218 Printer Attachment Cable and 5218 Printer Sharing 15-17
- 5218 Printer Sharing
 - 3270-PC 15-17
 - 3270-PC/G and GX 15-17
 - 5150 Personal Computer 11-45
 - 5155 Portable Personal Computer 12-20
 - 5160 Personal Computer XT 13-42
- 5250 Emulation Convenience Kit 11-32
- 5250 Emulation Program 11-31
- 5253 Emulation Installation Convenience Kit 11-31
- 5271 System Unit 15-10
- 5272 Color Display 15-19
- 5277 Mouse 15-47
- 5278 Display Attachment Unit 15-43
- 5279 Color Display 15-43
- 5371 System Unit 15-36
- 5378 display attachment units 15-44
- 5379 displays 15-44
- 5520/Personal Computer Attachment Program 11-30
- 5531 System Unit 20-6
- 5532 Industrial Color Display 20-15
- 64/256Kb Memory Expansion Option
 - 3270-PC 15-14
 - 3270-PC/G and GX 15-38
 - 5150 Personal Computer 11-20
 - 5155 Portable Personal Computer 12-15
 - 5160 Personal Computer XT 13-22
 - 5531 Industrial Computer 20-11
- 64Kb Memory and Display Expansion, PCjr 10-11
- 64Kb Memory Module Kit
 - 3270-PC 15-14
 - 3270-PC/G and GX 15-38
 - 5150 Personal Computer 11-20
 - 5155 Portable Personal Computer 12-15
 - 5160 Personal Computer XT 13-22
 - 5531 Industrial Computer 20-10
- 7371 Color Plotter 32-2
- 7372 Color Plotter 32-5
- 80286 microprocessor 16-12
- 80287 coprocessor 16-20
- 8087 coprocessor 11-19
- 8088 microprocessor
 - 3270-PC 15-13
 - 3270-PC/G and GX 15-38
 - 4860 PCjr 10-9
 - 5150 Personal Computer 11-13
 - 5155 Portable Personal Computer 12-11
 - 5160 Personal Computer XT 13-13
 - 5160 Personal Computer XT/370 14-10
 - 5531 Industrial Computer 13-13
- 8100 DPPX/SP Personal Computer RJE File Transfer PRPQ 11-30
- 8100 PC Adapter
 - 5150 Personal Computer 11-37
 - 5160 Personal Computer XT 13-34
 - 5170 Personal Computer AT 16-26

GC20-8210-0 (4/85)

You may use this form to communicate your comments about this publication, its organization, or subject matter, with the understanding that IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you.

Your comments will be sent to the author's department for whatever review and action, if any, are deemed appropriate.

Note: Copies of IBM publications are not stocked at the location to which this form is addressed. Please direct any requests for copies of publications, or for assistance in using your IBM system, to your IBM representative or to the IBM branch office serving your locality.

Possible topics for comment are:

Clarity Accuracy Completeness Organization Coding Retrieval Legibility

If you wish a reply, give your name, company, mailing address, and date:

Note: Staples can cause problems with automated mail sorting equipment. Please use pressure sensitive or other gummed tape to seal this form.

What is your occupation? _____

Number of latest Newsletter associated with this publication: _____

Thank you for your cooperation. No postage stamp necessary if mailed in the U.S.A. (Elsewhere, an IBM office or representative will be happy to forward your comments or you may mail directly to the address in the Edition Notice on the back of the title page.)

Reader's Comment Form

Cut or Fold Along Line

Fold and tape

Please Do Not Staple

Fold and tape



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 40 ARMONK, N.Y.

POSTAGE WILL BE PAID BY ADDRESSEE:

International Business Machines Corporation
Department 824
1133 Westchester Avenue
White Plains, New York 10604



Fold and tape

Please Do Not Staple

Fold and tape

A Guide to IBM Personal Computers Printed in U.S.A. GC20-8210-0



GC20-8210-0 (4/85)

You may use this form to communicate your comments about this publication, its organization, or subject matter, with the understanding that IBM may use or distribute whatever information you supply in any way it believes appropriate without incurring any obligation to you.

Your comments will be sent to the author's department for whatever review and action, if any, are deemed appropriate.

Note: Copies of IBM publications are not stocked at the location to which this form is addressed. Please direct any requests for copies of publications, or for assistance in using your IBM system, to your IBM representative or to the IBM branch office serving your locality.

Possible topics for comment are:

Clarity Accuracy Completeness Organization Coding Retrieval Legibility

If you wish a reply, give your name, company, mailing address, and date:

Note: Staples can cause problems with automated mail sorting equipment. Please use pressure sensitive or other gummed tape to seal this form.

What is your occupation? _____

Number of latest Newsletter associated with this publication: _____

Thank you for your cooperation. No postage stamp necessary if mailed in the U.S.A. (Elsewhere, an IBM office or representative will be happy to forward your comments or you may mail directly to the address in the Edition Notice on the back of the title page.)

Reader's Comment Form

Cut or Fold Along Line

Fold and tape

Please Do Not Staple

Fold and tape



NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

BUSINESS REPLY MAIL
FIRST CLASS PERMIT NO. 40 ARMONK, N.Y.



POSTAGE WILL BE PAID BY ADDRESSEE:

International Business Machines Corporation
Department 824
1133 Westchester Avenue
White Plains, New York 10604

A Guide to IBM Personal Computers Printed in U.S.A. GC20-8210-0

Fold and tape

Please Do Not Staple

Fold and tape



GC20-8210-0



A Guide to IBM Personal Computers Printed in USA GC20-8210-0

GC20-8210-00

