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**Personal Computer Family  
Service Information Manual**

# Preface

The purpose of this *Service Information Manual* (SIM) is to provide its user with the most frequently used service-related maintenance and reference information.

The SIM is not required to service the Personal Computer family of products. The SIM has been made available as a convenience to the user.

The SIM is divided into sections by product-specific information for each machine type with additional sections for general Personal Computer information.

This document can also be ordered by specifying Bill of Forms (BOF) 2481. Other items included in this BOF are diskettes, service summary cards, tabs, binders, and plastic diskette holders. Individual form numbers for these additional items are:

## Diskettes

IBM Advanced Diagnostic for the 5150, 5155, and 5160, Version 2.25	SA380033
IBM Advanced Diagnostic for the 5162 and 5170, Version 2.07	SA38-0034

## Service Summary Cards

5162 and 5170 Service Summary Card	SA38-0035
5150, 5155, and 5160 Service Summary Card	SA38-0036

## Printer Supplement

Printer Supplement	SA38-0040
Printer Supplement	SA38-0038
Plastic Diskette Holders 5.25Inch (2 U/M)	SA38-0015

## First Edition (January 1989)

This major revision obsoletes SR28-0280-02.

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\* INSTRUCTIONS \*

The *Personal Computer Family Service Information Manual* should be assembled in the following manner:

- Tabs should be inserted at the beginning of each appropriate chapter.
  - The plastic Summary Card Holder (located at the back of the tabs) should be inserted in Chapter 21, “Service Summary Cards.”
  - The Service Summary Cards should be inserted into the plastic Summary Card Holder.
- Plastic Diskette Holders should be inserted in Chapter 20, “Advanced Diagnostic Diskettes.”
  - The Advanced Diagnostic Diskettes should be inserted in the plastic Diskette Holders.

The assembled manual should then be placed in the three-ring binder provided with this package.

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# Safety

The following information has been included in this publication for the use and safety of IBM personnel.

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## General Safety during Work

Use these rules to ensure general safety:

- Observe good housekeeping in the area of the machines during maintenance and after completing it.
- Use only field-supply items (such as adhesives, cleaning fluids, lubricants, paints, and solvents) that have been approved by IBM, that is, are supplied under an IBM part number.
- When lifting any heavy object:
  1. Ensure that you can stand safely without slipping.
  2. Balance the weight of the object between your two feet.
  3. Use a slow lifting force. Never move suddenly or twist when you attempt to lift.
  4. Lift by standing or by pushing up with your leg muscles; this action removes the strain from the muscles in your back. *Do not attempt to lift any objects that you think are too heavy for you.*
- Do not perform any action that causes hazards to the customer or that makes the equipment unsafe.
- Put removed covers and other parts in a safe place, away from all personnel, while you are servicing the machine.
- Always keep your tool case away from walk areas so that other persons will not trip over it; for example, put it under a desk or table.
- Do not wear loose clothing that can be trapped in the moving parts of a machine. Ensure that your sleeves are fastened or are rolled up above the elbows. If your hair is long, fasten it.
- Do not wear jewelry, chains, metal-frame eyeglasses, or metal fasteners for your clothing.

Remember: A metal object lets more current flow if you touch a live conductor.
- Insert the ends of your necktie or scarf inside other clothing or fasten the necktie with a clip, preferably nonconductive, approximately 8 cm (3 in) from the ends.

- Wear safety glasses when you are:
  - Using a hammer to drive pins or similar parts
  - Drilling with a power hand-drill
  - Using spring hooks or attaching springs
  - Soldering parts
  - Cutting wire or removing steel bands
  - Cleaning parts with solvents, chemicals, or cleaning fluids
  - Working in any other conditions that might be hazardous to your eyes.
- Before you start the machine, ensure that other service representatives and the customer's personnel are not in a hazardous position
- After maintenance, reinstall all safety devices such as shields, guards, labels, and ground wires. Exchange any safety device that is worn or defective for a new one.

Remember: Safety devices protect personnel from hazards. You destroy the purpose of the devices if you do not reinstall them before completing your service call.
- Reinstall all covers correctly before returning the machine to the customer.

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## Safety with Electricity

Observe these additional rules when working on equipment powered by electricity:

- Find the room emergency power-off (EPO) switch or disconnecting switch. If an electrical accident occurs, you can then operate the switch quickly.
- Do not work alone under hazardous conditions or near equipment that has hazardous voltages. Always inform your manager of any possible problem or if you must work alone.

- Disconnect all power:
  - Before removing or installing main units
  - Before working near power supplies
  - Before doing a mechanical inspection of power supplies
  - Before installing changes in machine circuits.
- Before you start to work on the machine, unplug the machine's power cable. If you cannot unplug the cable easily, ask the customer to switch off the wall box switch that supplies power to the machine, and either:
  - Lock the wall box switch in the off position, or
  - Attach a DO NOT OPERATE tag, Z229-0237, to the wall box switch.

**Note:** A non-IBM attachment to an IBM machine can be powered possibly from another source and controlled by a different disconnecting switch or circuit breaker. If you determine that this condition is present, ensure that you remove (eliminate) this hazard before you start work.

- If you need to work on a machine that has *exposed* electrical circuits, observe the following precautions:
  - Ensure that another person, who is familiar with the power-off controls, is near you.
 

**Remember:** Another person must be there to switch off the power, if necessary.
  - **CAUTION:**  
**Some hand tools have handles covered with a soft material that does not insulate you when working with live electrical circuits.**

Use only those tools and testers that are suitable for the job you are doing.
  - Use only one hand when working with powered-on electrical equipment; keep the other hand in your pocket or behind your back.
 

**Remember:** There must be a complete circuit to cause electrical shock. By observing the above rule, you may prevent a current from passing through the vital parts of your body.
  - When using testers, set the controls correctly and use the IBM-approved probe leads and accessories intended for that **tester**.

– **CAUTION:**

**Many customers have, near their equipment, rubber floor mats that contain small conductive fibers to decrease electrostatic discharges. Do not use this wrong type of mat to protect yourself from electric shock.**

Stand on suitable rubber mats (obtained locally, if necessary) to insulate you from grounds such as metal floor strips and machine frames.

- Observe the special safety precautions when you work with very high voltages; these instructions are given in IBM safety service memorandums (SMs) and the safety sections of maintenance information. Use extreme care when measuring high voltages.
- Do not use worn or broken tools and testers.
- Ensure that electrical hand tools, such as power drills and Wire-Wrap<sup>1</sup> tools, are inspected regularly.
- Never *assume* that power has been disconnected from a circuit. First, *check* that it has been switched off.
- Always look carefully for possible hazards in your work area. Examples of these hazards are moist floors, nongrounded power extension cables, power surges, and missing safety grounds.
- Do not touch live electrical circuits with the glass surface of a plastic dental mirror. The surface is conductive; such touching can cause personal injury and machine damage.
- Unless the maintenance information specifically lets you, do not service the following parts *with power on them* when they are removed from their normal operating places in a machine:
  - Power supply units
  - Pumps
  - Blowers and fans
  - Motor generators

and similar units. (This rule ensures correct grounding of the units.)
- If an electrical accident occurs:
  - **Use caution; do not become a victim yourself.**
  - **Switch off power.**

<sup>1</sup> Trademark of the Gardner-Denver Co.

- **Send another person to get medical aid.**
- **If the victim is not breathing, decide whether to give rescue breathing.**

These actions are described below.

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## Emergency First Aid

When giving rescue breathing after an electrical accident:

- **Use Caution.** If the victim is still in contact with the electrical-current source, remove the power; to do this, you may need to use the room emergency power-off (EPO) switch or disconnecting switch.

If you cannot find the switch, use a dry wooden rod or some other nonconductive object to pull or push the victim away from contact with the electrical-current source.

- **Work Quickly.** If the victim is unconscious, he or she possibly needs rescue breathing. If the heart has stopped beating, the victim may also need external cardiac compression,

**Only a trained and certified person<sup>2</sup> should perform external cardiac compressions.**

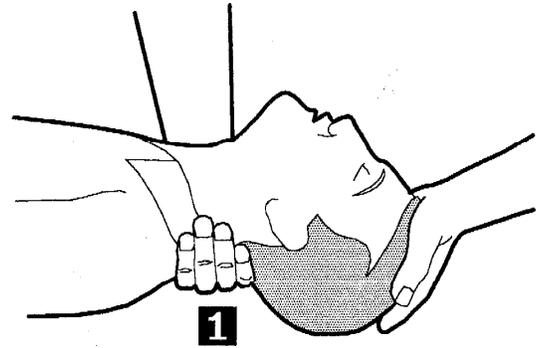
- **Get Medical Aid.** Call a rescue group, an ambulance, or a hospital immediately.

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## Rescue Breathing Procedures

**Determine if the victim needs rescue breathing:**

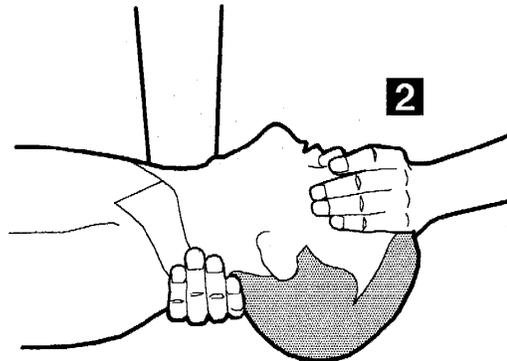
1. Prepare the victim:
  - a. Ensure that the victim's airway is open and not obstructed. Check the mouth for objects (such as chewing gum, food, dentures, or the tongue) that can obstruct the flow of air.
  - b. Place the victim on his or her back, then put one hand under the victim's neck and the other hand on the victim's forehead.
  - c. Lift the neck with one hand  and press the forehead backward with the other hand.



2. **Look, listen, and feel** to determine if the victim is breathing freely:
  - a. Put your cheek near the victim's mouth and nose.
  - b. Listen and feel for the breathing-out of air. At the same time, look at the victim's chest and upper abdomen to see if they move up and down.

**If the victim is not breathing correctly and you decide that you want to give rescue breathing:**

3. Continue to press on the victim's forehead with your hand and pinch together the victim's nostrils  with the thumb and finger.



4. **CAUTION:**  
**Use extreme care when giving rescue breathing to a victim who possibly has breathed-in toxic fumes. Do not breathe-in air that the victim has breathed-out.**

Open your mouth wide and take a deep breath. Make a tight seal with your mouth<sup>3</sup> around the victim's mouth  and blow into it.

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<sup>2</sup> If you want to be trained in giving this aid, ask a suitable organization (such as the Red Cross) in your area.

<sup>3</sup> A rescue-breathing face covering (mask) or similar unit can be used if you have been taught how to use it.

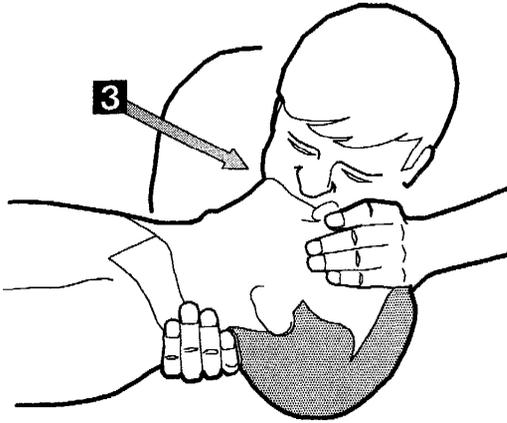
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## Reporting Accidents

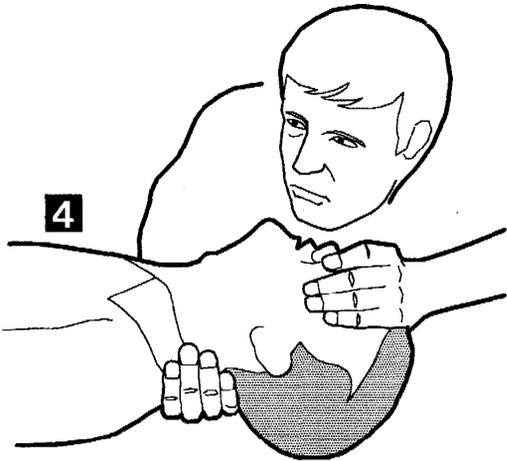
Report to your manager or to your IBM site all accidents, possible hazards, and accidents that nearly occurred.

**Remember:** An accident that nearly occurred can be caused by a design problem. Quick reporting ensures quick solving of the problem.

Report also each small electric shock, because the conditions that caused it need only differ slightly to cause serious injury.



5. Remove your mouth and let the victim breathe out while you check that the victim's chest  moves down.



6. Repeat steps 4 and 5 once every 5 seconds until the victim breathes normally again or until medical aid comes.

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# Chapter 1 . General Information

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## How to Use This Manual

The purpose of this *Service Information Manual* (SIM) is to provide its users with the most frequently used Personal Computer service-related maintenance and reference information.

The SIM is not required to service the Personal Computer family of products. This SIM has been made available as a convenience to the servicer. This manual is not designed to provide total product support; its purpose is to supplement the *Hardware Maintenance Library* (HMS/HMR).

Also included with this manual are two advanced diagnostic diskettes and Service Summary Cards for use with the 5150, 5155, 5160, 5162, and 5170.

The advanced diagnostics should be used to:

- Test each area of the system
- Isolate problems to specific areas of the system through the use of error codes
- Verify correct installation and operation of the system.

Information about many Personal Computer options is available in this manual. However, if additional option information is required, refer to the *Hardware Maintenance Service* (HMS) manual for your machine.

**Note:** K is used interchangeably with Kb to mean 1024 bytes.

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## Safety Inspection Guide

The intent of this inspection guide is to assist you in identifying potentially unsafe conditions on products included in this manual. Each machine, as it is designed and built, has required safety items installed to protect the users and service personnel from injury. This guide addresses only those items. However, good judgment should be used to identify potentially unsafe conditions not covered by this inspection guide.

If any unsafe conditions are present, a determination must be made on how serious the apparent hazard could be and whether you can continue without first correcting the problem.

Consider these conditions and the safety hazards they present:

- Electrical hazards, especially primary power; primary voltage on the frame can cause serious or fatal electrical shock.
- Explosive hazards; a damaged CRT face or bulging capacitor can cause serious injury.
- Mechanical hazards; loose or missing hardware can cause serious injury.

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## IBM Personal Computer, 5150/51 60-Based Systems

To inspect the IBM Personal Computer:

1. Set the power switch to off and disconnect the power cord from the electrical outlet.
2. Check the exterior covers for damage (loose, broken, or sharp edges).
3. Check the power cord for the following:
  - a. A third-wire ground connector in good condition. Use a meter to measure third-wire ground continuity for 0.1 ohms or less between the external ground pin and the frame ground as specified in the *Hardware Maintenance Library*.
  - b. The cord set should be the appropriate molded type as specified in the *Hardware Maintenance Library*.
  - c. Insulation must not be frayed or worn.
4. Remove the cover-mounting screws from the rear panel, and remove the cover.
5. Check for any obvious non-IBM alterations. Use good judgment as to the safety of any non-IBM alterations.
6. Check inside the unit for any obvious unsafe conditions, such as metal filings, contamination, water or other liquids, or signs of fire or smoke damage.
7. Check for worn, frayed, or pinched cables.
8. Ensure that the voltage specified on the voltage tag (back panel of the machine) matches the voltage of the power receptacle. If in doubt, the voltage should be verified.
9. Examine the power supply and verify the following:
  - a. Ensure that the non-removable fasteners in the power-supply cover have not been removed or tampered with.
  - b. Ensure that the grommet is installed where the internal power cables come through the frame of the power supply.
10. Check for the following labels:
  - a. Caution. Hazardous Area. Do not remove this cover. Trained service people only. No serviceable components inside.

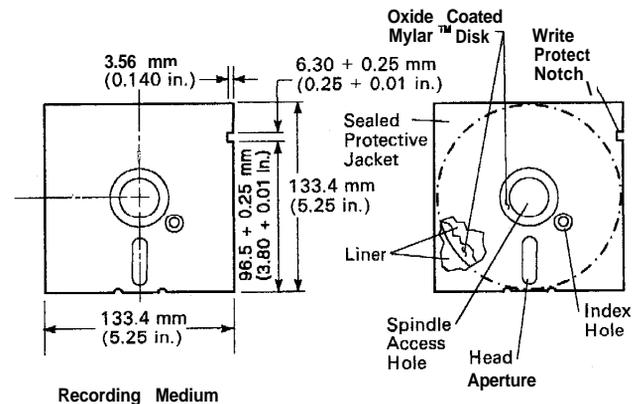
## IBM Personal Computer AT@ 5170-Based Systems

To inspect the IBM Personal Computer AT:

1. Set the power switch to off and disconnect the power cord.
2. Check exterior covers for damage (loose, broken, or sharp edges).
3. Check the power cord for the following:
  - a. A third-wire ground connector in good condition. Use a meter to measure third-wire ground continuity for 0.1 ohms or less between the external ground pin and the frame ground as specified in the *Hardware Maintenance Library*.
  - b. Insulation must not be frayed or worn.
4. Remove the back panel from the system unit.
5. Remove the five cover-mounting screws from the rear panel, and remove the cover.
6. Check for any obvious non-IBM alterations. Use good judgment as to the safety of any non-IBM alterations.
7. Check inside the unit for any obvious unsafe conditions, such as metal filings, contamination, water or other liquids, or signs of fire or smoke damage.
8. Check for worn, frayed, or pinched cables.
9. Ensure that the voltage specified on the voltage tag (back panel of the machine) matches the voltage of the power receptacle. If in doubt, the voltage should be verified.
10. Examine the power supply and verify the following:
  - a. On universal power supplies, ensure that the input voltage selection switch is set correctly.
  - b. Ensure that tamper-resistant fasteners in the power supply cover have not been removed or tampered with.
  - c. Ensure that the grommet is installed where the internal power cables come through the frame of the power supply.
11. Check for the following labels:
  - a. "Battery warning: Do not dispose of battery unit in fire or water. See instruction for disposal in the battery installation instructions."
  - b. Caution. Hazardous Area. Do not remove this cover. Trained service people only. No serviceable components inside.
12. Check the condition of the battery.

## Diskette Description

The recording medium is a flexible, magnetic disk enclosed in a protective jacket. The protected disk, free to rotate within the jacket, is continuously cleaned by the soft fabric lining of the jacket during normal operation. Read/write/erase head access is made through an opening in the jacket. Openings for the drive hub and diskette index hole are also provided. The following figure is a drawing of the diskette used with the IBM 5.25-Inch Diskette Drive.



LEX41771

Figure 1-1. 5.25-Inch Diskette, Simplified

<sup>1</sup>Trademark of E. I. du Pont de Nemours and Co., Inc.

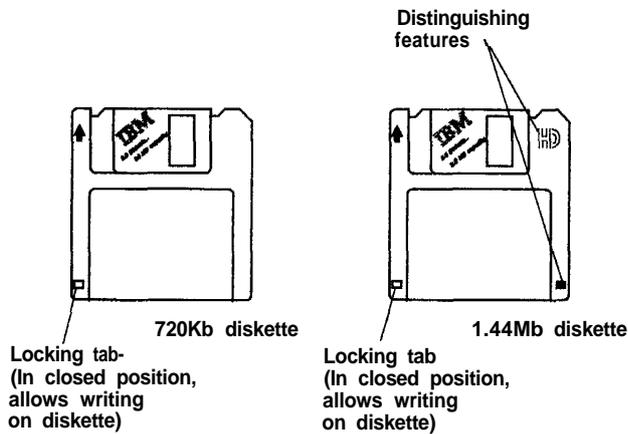
### Types of 5.25-Inch Diskettes

You can use the following types of diskettes to read and write information:

- Single-sided (160Kb/180Kb)
- Double-sided (320Kb/360Kb)
- High-capacity (1.2Mb).

It is important to remember that if you write on a single-sided or double-sided diskette using a high-capacity diskette drive, you might not be able to read the diskettes in a single- or double-sided diskette drive.

## Types of 3.5-Inch Diskettes



Note:  
Format 1 .0Mb media to 720Kb  
Format 2.0Mb media to 1.44Mb

LX42345

Figure 1-2. 3.5Inch Diskette Types

The 3.5-inch diskette consists of a metal positive drive disk attached to the bottom of the circular magnetic recording surface. This assembly is permanently encased in a hard plastic shell. The 1Mb and 2Mb 3.5inch diskettes can be differentiated by examining the top surface of the plastic case. The 2Mb 3.5inch diskette has the letters HD in the top upper right corner of the plastic case and a square opening on the top lower right corner. The 1Mb 3.5inch diskettes have no such marking.

The slim, compact size of the 3.5inch diskette and the permanent hard plastic shell in which it is encased provide easy transportability. A metal shutter at the front of the diskette covers and protects the magnetic recording surface when the diskette is not in use.

When the diskette is properly inserted into the system, metal shutter end first, the shutter is opened automatically to allow read or write activities. A write protect sensor on the bottom of the plastic case can be positioned to protect the data stored on the diskette. When the square opening on the top lower left corner of the diskette is open (you can see through the hole), the diskette is write protected and cannot be written.

The write protect interlock is located on the bottom right corner of the plastic shell.

It is important to note that some 3.5-inch diskettes containing valuable programs, such as system diagnostics,

will not have this selectable write protect interlock in order to prevent accidental overwriting.

Note: 720Kb diskette drives can use only the 1Mb diskettes.

## Media/Drive Compatibility Table

The following table identifies the minimum supported level of DOS required to read, write, or format the applicable media in the installed diskette drives.

DOS levels are downward compatible with respect to diskette formatting; therefore, prior formats are supported.

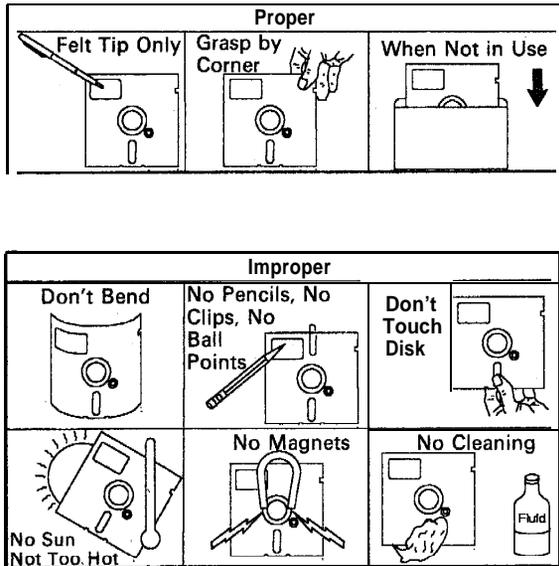
	Operation	5.25-Inch Drives	5.25-Inch Drives	3.5-Inch Drives
		PCjr™ PC XT™ Portable 4869	AT XT 286	Convertible 4865 External Internal B
5.25-inch diskette formatted to:				
160Kb	Read, Write, Format	DOS 1.00 DOS 1.00 DOS 1.00	DOS 3.00 NO No	N/A
180Kb	Read, Write, Format	DOS 2.00 DOS 2.00 DOS 2.00	DOS 3.00 NO No	N/A
320Kb	Read, Write, Format	DOS 1.10 DOS 1.10 DOS 1.10	DOS 3.00 No No	N/A
360Kb	Read, Write, Format	DOS 2.00 DOS 2.00 DOS 2.00	DOS 3.00 DOS 3.00 DOS 3.00	N/A
1.2Mb	Read, Write, Format	No No No	DOS 3.00 DOS 3.00 DOS 3.00	N/A
3.5-inch diskette formatted to:				
720Kb	Read, Write, Format	N/A	N/A	DOS 3.20 DOS 3.20 DOS 3.20

Figure 1-3. Media/Drive Compatibility Table

To use this chart, find your diskette drive and IBM Personal Computer across the top of the table. Then, coming down the left column, find your media. The intersection of the read, write, format row and your diskette drive and IBM Personal Computer column identifies the minimum DOS level required to support the function. Where **N/A** appears, it indicates either unreliable operation will occur or the product cannot perform the function.

## Diskette Care

The figure below shows proper and improper ways of handling your diskettes. Proper handling will greatly reduce the possibility of damaging them.

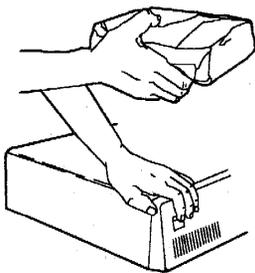


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Figure 1-4. Diskette Handling Procedures

## Handling Static-Sensitive Devices

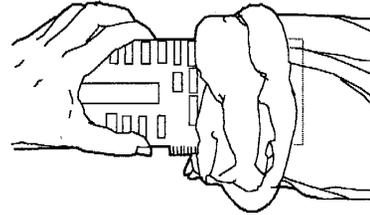
Some of the components that make up the options for your IBM Personal Computer can be damaged by electrostatic discharges. To prevent this damage, the options are wrapped in a conductive, anti-static bag; certain precautions must be taken before removing an option from its bag:



LEX40288

Figure 1-5. Option Static Charge

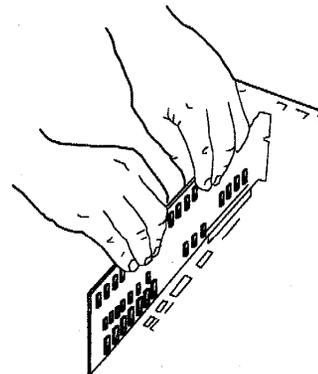
1. Wear the ESD wrist band any time ESD sensitive devices are handled. This will place your body, the option, and the system unit at the same ground potential, thus preventing an accidental static discharge.



LEX40289

Figure 1-6. Anti-Static Bag Removal

2. Carefully remove the option from its anti-static bag. Be sure to grasp circuit boards by the edges only; do not touch the component pins or solder joints. Grasp diskette drives by their frames to avoid touching the electronics board. Grasp chips by their narrow ends only, not by their pins.

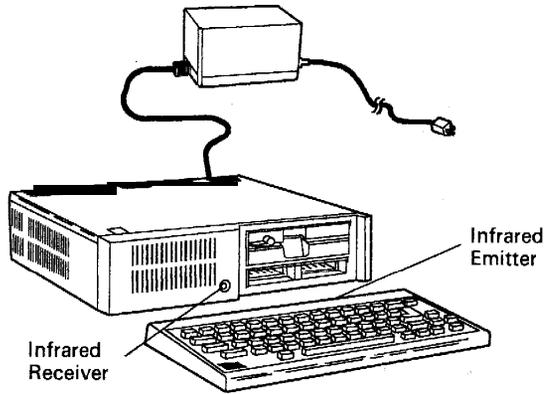


LEX40290

Figure 1-7. Option Insertion

3. When inserting an option adapter into the system board, hold the adapter by its top edge or upper corners.

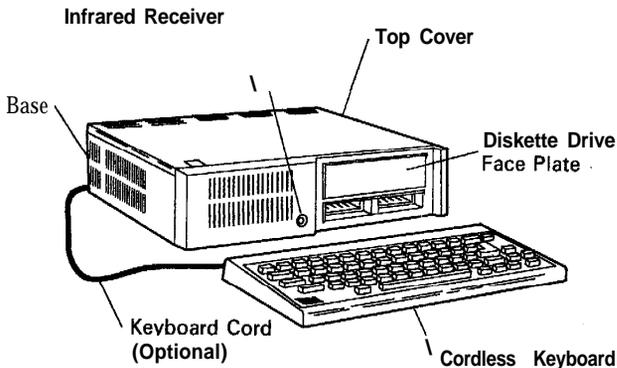
# Chapter 2. 4860 PCjr



LEX40065

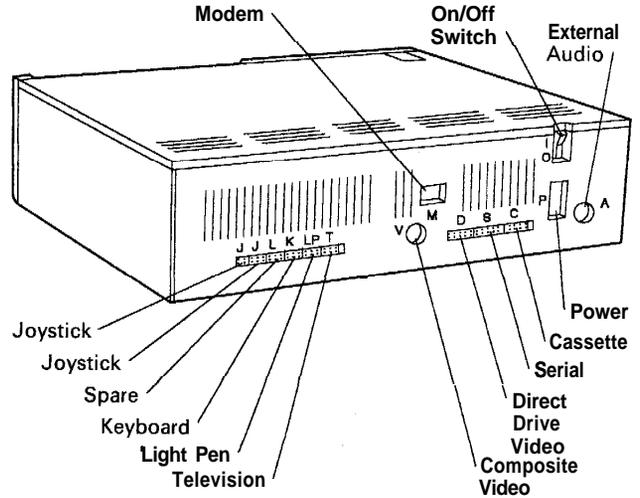
Figure 2-1. 4860 PCjr

The 4860 is a low-cost, compact, desktop microcomputer. It is available in two models, the 04 and 67. It utilizes an 8088 Microprocessor, 64Kb of random access memory (RAM), and two cartridge slots. Features include a 360Kb disk drive and memory expansion up to 512Kb.



LEX40066

Figure 2-2. 4860 PCjr (Front view)



LEX40067

Figure 2-3. 4860 PCjr (Rear view)

## Unit Specifications

<b>Size</b>	
Height	97 mm (3.8 in)
Length	354 mm (13.9 in)
Depth	290 mm (11.4 in)
<b>Weight</b>	
With Diskette Drive	3.71 kg (8 lb 4 oz)
W/o Diskette Drive	2.61 kg (5 lb 8 oz)
<b>Environment</b>	
Air Temperature	
System On	15.6° to 32.2°C (60° to 90°F)
System Off	10° to 43°C (50° to 110°F)
Humidity	
System On	8% to 80%
System Off	8% to 80%
<b>Heat Output</b>	283 BTU/hr max.
<b>Noise Level</b>	45 dBa
<b>Electrical</b>	
Nominal	120V AC
Minimum	104V AC
Maximum	127VAC
kva	0.082 max.

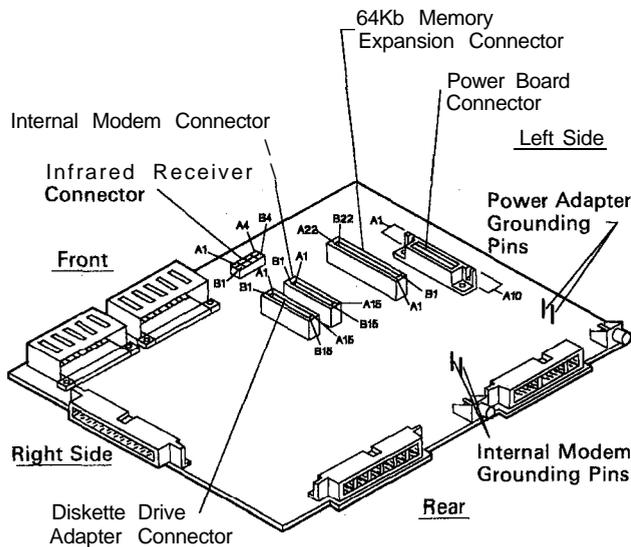
Figure 2-4. 4860 System Unit Specifications

## Interface Locations

Interface.	Location
Compact printer	Compact printer
Diskette drive	Diskette-drive adapter
Display	System board and 64Kb memory and display expansion
Graphics printer	Parallel printer attachment
Internal modem	Internal modem
Joystick	System board
Keyboard	System board
Light pen	System board
Memory	System board and 64Kb memory and display expansion
RS232C	System board
Sound	System board

Figure 2-5. 4860 Interface Locations

## System Board



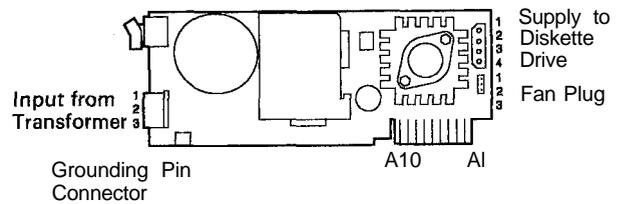
LEX40068

Figure 2-6. 4860 System Board

The system board contains the following major functional components:

- 8088 Microprocessor
- 64Kb read-only memory (ROM)
- 128Kb ROM cartridge interface
- 64Kb dynamic RAM
- 64Kb memory and display expansion interface
- Serial port (RS232)
- Audio alarm (beeper)
- Sound subsystem
- Cassette interface
- Joystick interface
- Keyboard interface
- Modem interface
- Diskette interface
- Video/graphics subsystem
- Light pen interface
- I/O expansion bus
- 9-level interrupt.

## Power Supply



LEX40069

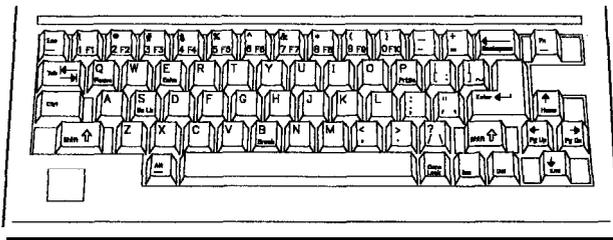
Figure 2-7. 4860 Power Board (Component Side)

The system power supply is a 33-watt, three-voltage-level, two-stage supply. The first stage is an external power transformer that provides a single fuse-protected, extra-low, AC-voltage output. The second stage is an internal, printed circuit board, which is vertically mounted into the system board. The second stage converts the transformer's AC output into three DC output levels.

Power is supplied to the system board through a printed circuit board edge connector. The diskette drive is powered through a separate 4-pin connector mounted on the front edge of the power board. The power for the diskette drive fan is provided by a 3-pin, Berg-type connector mounted directly below the diskette drive connector. Power is removed from the system board and diskette drive by a switch mounted on the rear of the power board. Both the switch and the transformer connector are accessible from the rear of the system.

---

## Cordless Keyboard



LEX41744

Figure 2-8. 4860 Cordless Keyboard

The keyboard is a low-profile, 62-key, detached keyboard with full-travel keys. The keys are arranged in a standard typewriter layout with the addition of a function key and cursor-control keys.

The keyboard is battery powered and communicates to the system unit with an infrared (IR) link. The IR link makes the remote keyboard a truly portable hand-held device. An optional cord connection to the system unit is available. Power is sent to the keyboard and serially encoded data is received by the system unit through the optional cord. When connected, the cord's keyboard connector removes the battery power, and the -CABLE CONNECT signal disables the infrared receiver circuit. The disabling of the circuit also allows other infrared devices to be used without interfering with the system. The data, which is received through the IR link or by the cord, have the same format.

The keyboard electronics are designed with low-power, complementary metal-oxide semiconductor (CMOS) integrated circuitry for battery power operations. Four AA-size batteries are required. Because the keyboard is normally in the standby power-down mode, which uses very little power, no on/off switch is needed.

The 4860 Keyboard was manufactured in two versions. The old Chicklet version was replaced with the version that is currently in use. The new keyboard is electronically identical to the older version but is improved mechanically for easier use. It has bigger keys that are easier to press, and the key designations are on the key tops rather than printed on the keyboard itself.

The 4860 Keyboard is a field replaceable unit (FRU); nothing on it can be repaired. Batteries in the keyboard are the customer's responsibility. A failing keyboard should be replaced.

---

## General Information

### Connector Guides

PCjr connector guides help eliminate the possibility of connector pins being broken on the 4860 PCjr Planar Board. The connector guides snap into the back cover of the system unit. The installation of these guides requires no tools; however, the system unit and attached devices must be powered off, as the cables need to be removed to facilitate installation of the guides. P/N6447163 provides guides along with instructions necessary for installation. The part is a no-cost item and can be ordered through normal parts distribution. If system unit diagnostics require the use of service plugs, the connector guides must be carefully removed and reinstalled at the completion of the repair activity.

### PCjr Diskette Drive. Inserts

There is no specified part number for a shipping insert for the PCjr diskette drive. Use the generic insert P/N6447190 available from distribution. Trim off approximately 0.5 inch, or remove the back tab of the generic insert. This will allow clearance for the latch lever to swing into the lock position without interference.

---

## 4860 PCjr Diagnostics

### Error Codes

You might have an error code or an audio response during the power-on self test (POST). If you have both an error code and an audio error, disregard the audio error and perform advanced diagnostics on the FRU indicated.

POST Error	Problem Area	Probable Cause
No beep. No image or image on screen wrong.	Power	System Board or Power Board
One beep. No image or image on screen wrong.	Display	System Board or 64Kb Memory and Display Expansion
Two beeps. No image or image on screen wrong.	Power	System Board or Power Board
Three beeps. No image or image on screen wrong.	Memory	64Kb Memory and Display Expansion
Advanced POST or portion of it goes into loop.	System Board	System Board
No beep. ERROR OAXX	Memory	System Board
No beep. ERROR OBXX	Memory	64Kb Memory and Display Expansion
No beep. ERROR OCXX	Memory	64Kb Memory and Display Expansion
No beep. ERROR 1YXX	Memory	System Board
No beep. ERROR 2000	Keyboard	Keyboard
No beep. ERROR 21XX	Infrared	Infrared Receiver
No beep. ERROR 22XX	Keyboard	Keyboard
No beep. ERROR 23XX	Cassette or Serial	System Board
No beep. ERROR 24XX	Modem	Internal Modem
No beep. ERROR 25XX	Cartridge	
No beep. ERROR 26XX	Diskette Drive	Diskette Drive Adapter
No beep. ERROR 27XX	Cluster	Cluster Adapter
No beep. ERROR 28XX	Speech	Speech Adapter
Any ERROR message not listed in this table.	Service Plug	Ensure that Service Plug is good and installed correctly. Repeat advanced POST. If same message, replace System Board.

Figure 2-9. 4360 PCjr Advanced POST Error Table

## General Diagnostic Tips

### Required Items for Diagnostics

In order to perform all of the advanced diagnostics, you must have:

- A system unit
- A known good display television receiver
- A service plug, P/N6447196
- A POST-loop plug, P/N6447197
- A parallel printer attachment wrap plug, P/N8529228
- A serial wrap plug, P/N6447198
- A Triplet Model 310 Multimeter (or equivalent).

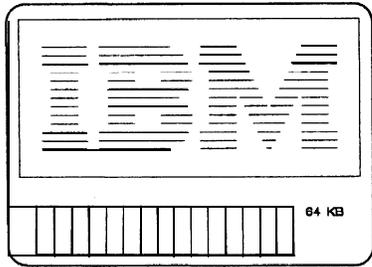
### How to Perform Advanced POST

Before you perform advanced POST, do the following:

1. Set the system unit's power switch to off.
2. Set the display's power switch to off.
3. Connect the power transformer's power cord to a functioning, properly grounded outlet.
4. Install all connectors securely in their proper locations.
5. Remove any cartridge, cassette, or diskette from the system unit and attached devices.
6. If the cordless keyboard is being used without its optional keyboard cord:
  - Position the keyboard within 12 inches of the front of the system unit.
  - Remove any obstructions between the infrared (IR) emitter in the back of the keyboard and the IR receiver on the system unit.
7. Plug the service plug into the system unit J connectors.
8. Turn the display's brightness, contrast, and volume controls to midrange.
9. Set the display's power switch to on.
10. Set the system unit's power switch to on.

Advanced POST begins as soon as the system unit power switch is set to on. It takes as long as 1 minute to complete. While advanced POST is running:

- You see a stable IBM logo and 16-color test pattern on your screen.



LEX40136

Figure 2-10, Screen Test Pattern

If advanced POST detects a failure, you will receive an incorrect audio response (no beep, two beeps, or three beeps), an incorrect screen, an error message, or any combination of these. In these cases, see Figure 2-9 on page 2-4 for the recommended action.

After you have followed the above steps once, all you have to do when asked to perform advanced POST is:

1. Set the system unit's power switch to off.
2. Wait 5 seconds.

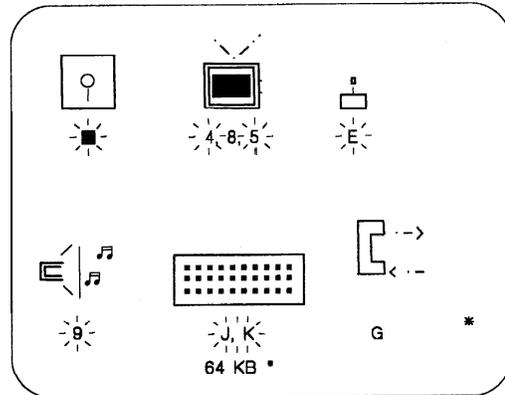
## How to Perform Advanced Tests

Advanced tests are the tests you choose from the advanced-test menu. The advanced-test menu is stored in the system unit's read-only memory (ROM).

When you are asked to bring up the advanced-test menu, follow these steps:

1. Set the system unit's power switch to on.
2. Wait until advanced POST completes and the BASIC screen appears.
3. Press and hold the Ctrl and Alt keys, and then press the Ins key.
4. Release all keys when the screen goes blank.

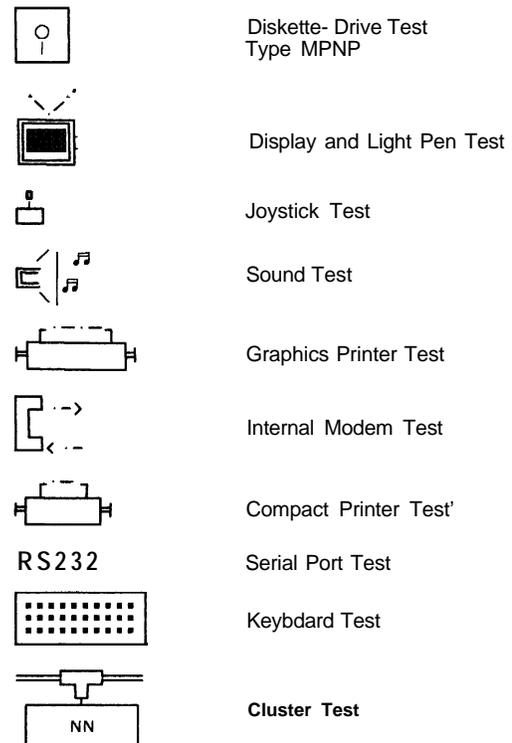
The IBM logo appears, the diskette drive (if attached) red light switches on for a moment, and you hear one beep. Then the advanced-test menu appears.



LEX40137

Figure 2-11. Advanced-Test Menu

The advanced-test menu consists of symbols, with each symbol representing one area of the IBM PCjr. The letters or numbers below the symbols are IDs of tests you can perform. A quick way to determine if you are looking at the advanced-test menu or the customer-level-test menu (they look similar) is to observe the ID under the joystick symbol. The advanced-test level has an *E* there. The customer-level has a 6.



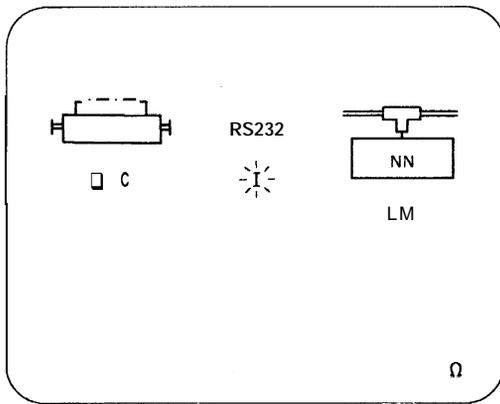
LEX40138

Figure Z-12. Advanced Test Symbols

Some symbols and IDs appear on the advanced-test menu only when their particular options are attached to the system unit.

If you see an \* in the lower right-hand corner of the advanced-test menu, the menu has another page of symbols. When the cursor is moved to the last ID on the screen, moving it again causes this next menu page to appear.

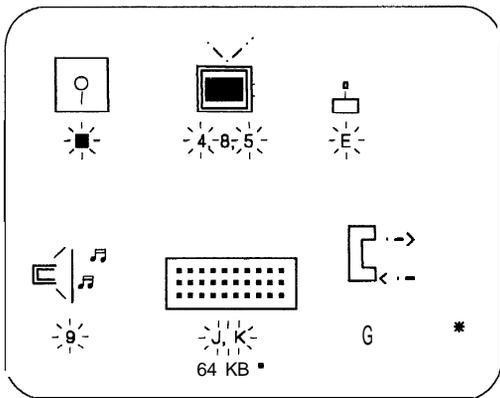
On the last menu page, an Ω is in the lower right-hand corner. When the cursor is moved to the last ID on this screen, moving it again causes the first menu page to reappear.



LEX40139

Figure 2-13. Last Menu Page

When the IBM PCjr senses the presence of a device interface, the ID under the symbol for that device blinks. The device interface is the electronic circuitry necessary for the system unit to control a particular device. In Figure 2-14, the interfaces for diskette drive, display, joystick, and sound are sensed.



LEX40140

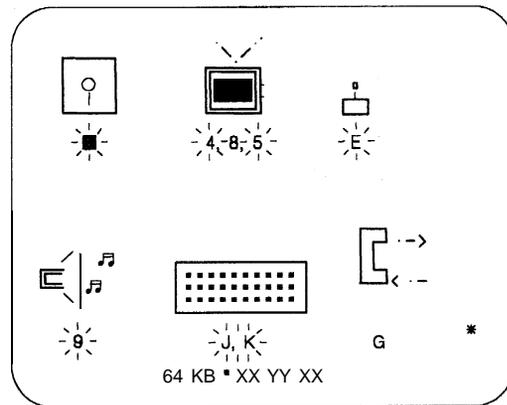
Figure 2-14. Interface Device Sensory

The IDs for joystick and sound always blink because their interfaces are on the system board. The blinking does *not* mean a joystick or external speaker is installed.

The diskette drive interface is on the diskette drive adapter. The ID under the diskette drive symbol therefore blinks only when the diskette drive adapter is installed.

The IDs 4 and 5 under the display symbol blink all the time. ID 8 blinks when the 64Kb memory and display expansion is present.

While the advanced-test menu is on your screen, a memory test is running continuously. The number incrementing at the bottom of the screen shows what segment of memory is being tested. If a memory failure is detected, the number stops incrementing and the \* next to it is replaced by an error message. If this failure occurs, make a note of the error message and go to PIC "Memory."

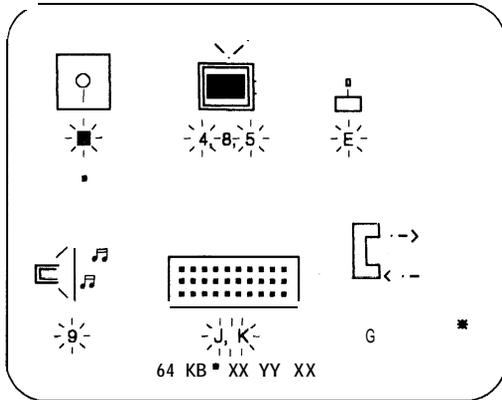


LEX40141

Figure 2-15. Memory Segment Testing

You move the cursor to the test's ID by pressing the Ins key. When you are ready to start the test, press the Enter key and the test begins.

The test is finished when a message appears under the symbol's ID. If \* appears, no failure was detected.



LEX40142

Figure 2-16. Test Completion

If something other than \* appears, a failure was detected.

If you want to stop a test that is running, press the FN key, and then press the B key. Depending on which test is running, you can get one of several responses after pressing FN-B. The following table lists the responses.

Test Running	Response to Pressing FN-B
Diskette drive Graphics printer Compact printer Internal modem Sound	(If the system unit beeps, press FN-B again.) Test may not stop immediately. Message is "FFFF."
Display RS232	Test stops immediately. Message is "FFFF."
Keyboard	The FN and B keys must be shown on the screen before using them to abort the test. Test stops immediately. Message is *.
Joystick Light pen	Test stops immediately. Message is *.

Figure 2-17. Response Messages

The "FFFF" message lets you know that the test was stopped before completion.

When you want to remove the advanced-test menu from your screen, press and hold the **Ctrl and Alt keys**, and then press the Del key,

## Customer Error Codes

When requesting service, customers may reference an error code found in the Error Message Table on page 6-17 of the Guide to Operations (GTO) manual. These are not advanced diagnostic error codes and cannot be found in the *Hardware and Maintenance Service (HMS)* manual. A list of the codes follow:

Error	Action
A D G X	Have system serviced.
B	Keyboard problem; move away from bright light.
C	Cassette problem; if the cassette is not in use, press Enter and continue.
E	Modem problem; if modem is not required, press Enter to continue.

These errors are for reference only. Actual failures should be determined by using the advanced diagnostics.

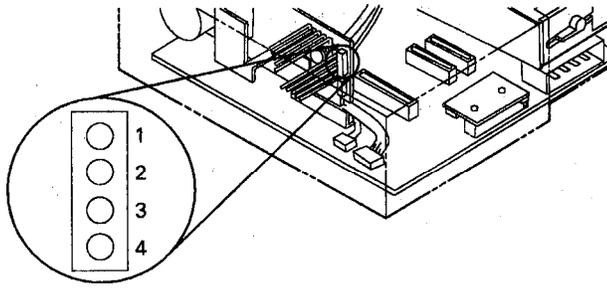
## Power Diagnostic Tips

### Diskette Drive Voltage at the Power Board

The voltages at the diskette drive power cable connector on the power board should be within the ranges listed below.

	Low V DC	High V DC
Pin 1 to Pin 2	+ 11.4	+ 12.6
Pin 4 to Pin 3	i-4.7	+ 5.3

Figure 2-18. Diskette Drive Power Board Voltage Levels



LEX40143

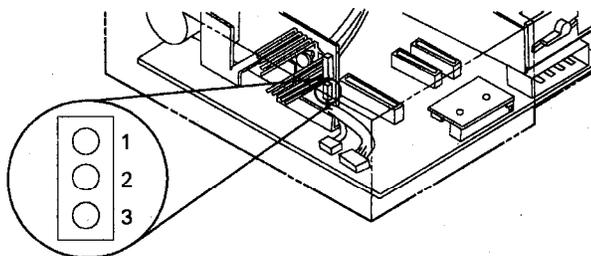
Figure 2-19. Diskette Drive Pin Placement

### Diskette Drive Fan Voltage at the Power Board

The voltages at the diskette drive fan connector on the power board should be within the ranges listed below.

	LowV DC	HighV DC
Pin 2 to Pin 1	+ 11.4	+ 12.6
Pin 2 to Pin 3	+ 11.4	+ 12.6

Figure 2-20. Fan Power Board Voltage Levels



LEX40144

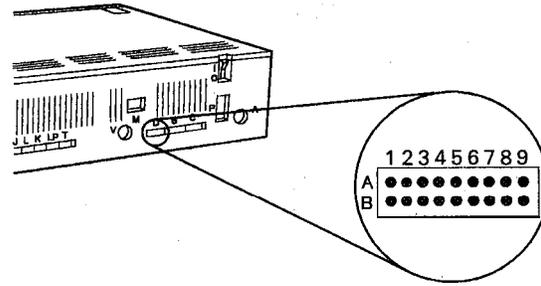
Figure 2-21. Fan Power Board Pin Placement

### Display Voltage at the System Board

The voltages at connector D should be within the ranges listed below.

	Low V DC	High V DC
Pin A2 to Pin A4	1.9	2.3
Pin A2 to Pin A5	1.8	2.3
Pin A2 to Pin A6	0.0	1.0
Pin A2 to Pin A7	1.7	2.3
Pin A2 to Pin B1	0.1	0.3
Pin A2 to Pin B3	0.3	0.5

Figure 2-22. Display Board Voltage Levels



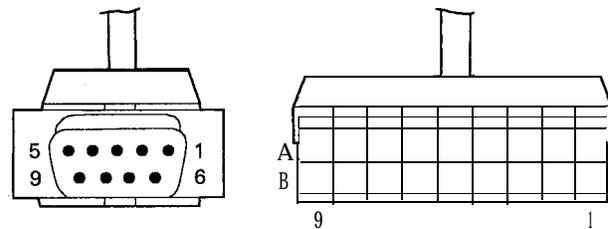
LEX40145

Figure 2-23. Display Board Pin Placement

### Continuity of Color Display Adapter Cable

S-pin Connector from Position	2 x S-pin Connector to Position
1	B9
2	B5
3	A5
4	A1
5	A4
6	A6
Not used	
8	B3
9	B1

Figure 2-24. Color Display Adapter Cable Connections



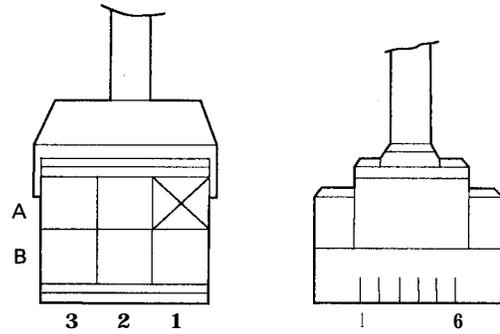
LEX40146

Figure 2-25. Color Display Connector Locations

## Continuity of Serial Device Adapter Cable

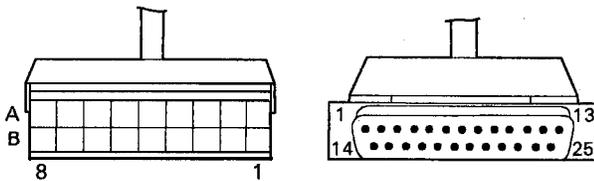
25-pin Connector from Position	2 x 5-pin Connector to Position
1	B1
2	A4
3	A5
4	A3
5	A7
6	A6
7	B2
8	A5
20	A2

Figure 2-26. Serial Device Adapter Cable Continuity



LEX40148

Figure 2-29. Keyboard Cable Pin Placements



LEX40147

Figure 2-27. Serial Device Adapter Cable Pin Placement

## Continuity of Keyboard Cable

2 x 3 Connector from Pin	Keyboard Plug to Pin
A2	5
B2	2
B3	4

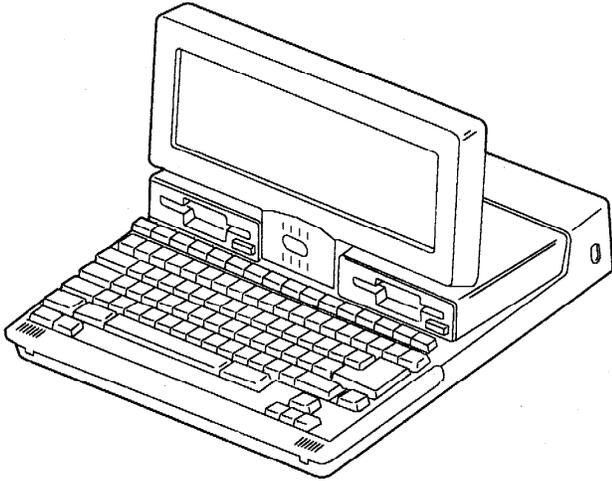
Figure 2-28. Keyboard Cable Continuity Connections

C

C

C

## Chapter 3. 5140 PC Convertible



LEX41040

Figure 3-1. 5140 PC Convertible

### System Information

The IBM 5140 PC Convertible is a portable personal computer designed for professional applications and personal productivity. It is designed to enhance personal computing capability with multiple power options. The uniqueness of the system unit is the integration of microprocessor, display diskette drives, keyboard, memory, battery power supply, and optional modem within a full function system that can be carried in one hand and used in most environments. The IBM 5140 maintains compatibility with 5.25-inch drive systems through asynchronous communications and 3.5-inch drive options (IBM 4865) on existing PCs.

The IBM PC Convertible features an 80C88 Microprocessor and 256Kb of user memory. User memory can be expanded to 512Kb with the addition of 128Kb memory cards installed by the user. The 3.5-inch diskette drive is a double-sided drive with 720Kb of (formatted) storage capacity.

The 80-column x 25-line detachable liquid crystal display features a bonding process that reduces glare and increases visibility.

### Unit Specifications

<b>Size</b>	
Height	68.0 mm (2.68 in)
Length	374.0 mm (14.72 in)
Width	312.0 mm (12.28 in)
<b>Weight</b>	
	5.5 kg (12.17 lb)
<b>Environment</b>	
Air Temperature	
System On	10° to 40°C (50° to 105°F)
System Off	0.6° to 51.7°C (33 to 125°F)
Humidity	
System On	5 to 95%
System Off	5 to 95%
<b>Electrical</b>	
	{AC adapter input range} 90.265V, 50/60 Hz AC

Figure 3-2. 5140 Specifications

### Power Sources

Several sources for power are available for the 5140 PC Convertible. They are:

#### IBM PC Convertible AC Adapter

The AC Adapter is designed to be used by the system while simultaneously charging the internal battery. The AC Adapter supports 110V AC or 220V AC operation.

#### Battery Pack

The battery pack contains eight rechargeable NiCad cells packaged into a single unit. It resides inside the system unit and plugs onto the power supply card under the unit's covers. When fully charged, the battery pack will provide approximately eight hours of operation. This time will vary depending upon the amount of usage of the higher consumption devices, such as diskette drives.

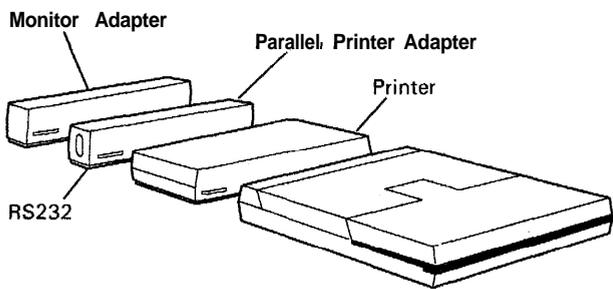
## IBM PC Convertible Battery Charger

The battery charger is designed to be used to trickle charge the internal batteries of the system. It does not provide sufficient power output to allow system operation while the batteries are being charged.

## IBM PC Convertible Automobile Power Adapter

The Automobile Power Adapter is designed to power the system unit while simultaneously charging the system battery pack. The adapter attaches to the system unit and plugs into the cigarette lighter outlet in a vehicle with a 12V negative-ground electrical system.

## Options



LEX41041

Figure 3-3. Option Configuration

## IBM PC Convertible Printer

The IBM PC Convertible Printer is a matrix printer designed to attach to the back of the IBM PC Convertible and to draw its power from the system unit's battery pack. An all-points-addressable (APA) mode is provided for graphics.

## IBM PC Convertible Monochrome Display

The IBM PC Convertible Monochrome Display is a 9-inch composite video display with **80 x 25** and **40 x 25** text modes and 640 x 200 and 320 x 200 graphics support.

## IBM PC Convertible Color Display

The IBM PC Convertible Color Display is a 13-inch RGBI direct drive display with 320 x 200 lines graphics support and text modes of 40 x 25 and 80 x 25. The display includes a speaker for external audio output.

## IBM PC Convertible Cathode Ray Tube (CRT) Display Adapter

The IBM PC Convertible CRT Display Adapter attaches to the IBM PC Convertible and is operable when the system is powered with the AC Adapter. The IBM PC Convertible Monochrome Display, the IBM PC Convertible Color Display, the IBM Personal Computer Color Display, and the IBM PCjr Color Display are supported.

## IBM PC Convertible Internal Modem

The IBM PC Convertible Internal Modem gives users the capability of communication between the IBM PC Convertible and other compatible systems over existing telephone lines at speeds of either 300 or 1200 baud.

## IBM PC Convertible Serial/Parallel Adapter

The IBM PC Convertible Serial/Parallel Adapter provides an RS232C asynchronous communications interface and a parallel printer interface.

## Supported Options

The IBM Personal Computer options that are supported on the IBM 5140 are:

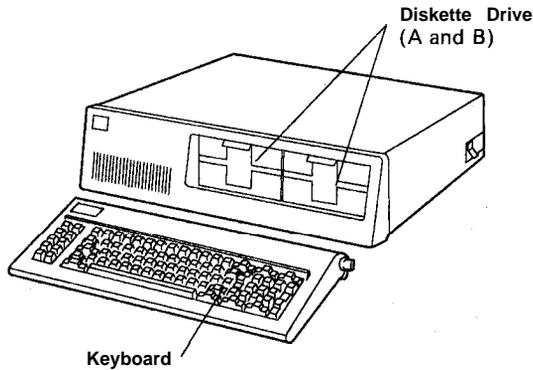
- IBM 5152 Graphics Printer
- IBM 4201 Proprinter
- IBM Personal Computer Printer Cable
- IBM 5153 PC Color Display
- IBM 4863 PCjr Color Display
- IBM Communications Adapter Cable.

## Diagnostic Tip

### Error Code 5103

When running diagnostics on the 5140 PC and it responds with a 5103 error, make sure that there is paper in the printer, the ribbon is installed correctly, and the ribbon cassette is not out of ribbon. Any of these conditions can cause a 5103 error.

# Chapter 4. 5150 PC



LEX40671

Figure 4-1. 5150 P C

The 5150 PC uses a 16-bit 8088 Processor, 16Kb to 640Kb of RAM. It uses 0, 1, or 2 diskette drives with a storage range of 160Kb to 320Kb. The 5150 has five I/O slots and a 4-channel direct memory access (DMA) 40Kb ROM.

## Unit Specifications

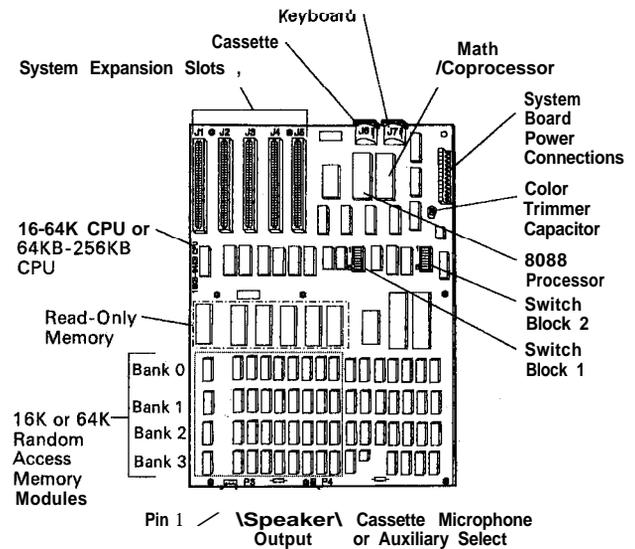
System Unit Size	
Height	142 mm (5.5 in)
Length	500 mm (19.6 in)
Depth	410 mm (16.1 in)
Weight	
	11.4 kg (25 lb)
Power Cable	
Length	1.83 m (6 ft)
Size	18 AWG
Environment	
Air Temperature	
System On	15.6° to 32.2°C (60° to 90°F)
System Off	10° to 43°C (50° to 110°F)
Humidity	
System On	8% to 80%
System Off	20% to 80%
Heat Output	365 BTU/hr max.
Noise Level	56 dBa

Figure 4-2 (Part 1 of 2). 5150 PC1 Specifications

Electrical	
Nominal	120V AC
Minimum	104V AC
Maximum	127V AC
kva	0.22 max.

Figure 4-2 (Part 2 of 2). 5150 PC1 Specifications

## System Board



LEX40072

Figure 4-3. 5150 System Board

The system board fits horizontally in the base of the system unit. It is a multilayer, single-land-per-channel design with ground and internal planes provided. DC power and a signal from the power supply enter the board through two 6-pin connectors. Other connectors on the board are for attaching the keyboard, audio cassette, and speaker. Five 62-pin card edge sockets are also mounted on the board. The I/O channel is bussed across these five I/O slots.

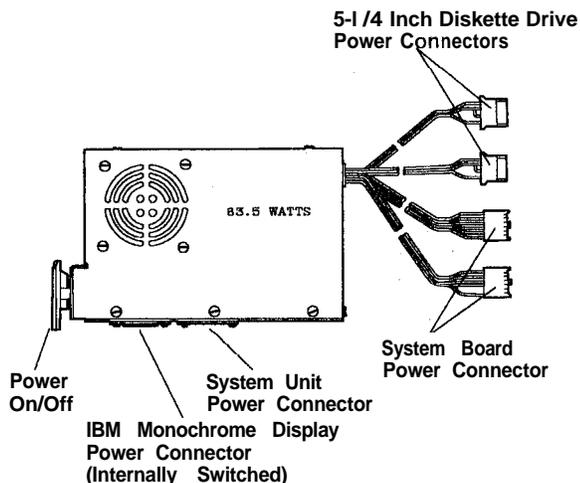
Two dual in-line package (DIP) switches (two eight-switch packs) are mounted on the board and can be read under program control. The DIP switches provide the system software with information about the installed options, how much storage the system board has, what type of display adapter is installed, what operation modes are desired when power is switched on (color or black-and-white, 80- or 40-character lines), and the number of diskette drives attached.

The system board consists of five functional areas: the microprocessor subsystem and its support elements, the read-only memory (ROM) subsystem, the read/write (R/W) memory subsystem, integrated I/O adapters, and the I/O channel. The read/write memory is also referred to as random access memory (RAM).

## Microprocessor

The heart of the system board is the Intel 8088 Microprocessor. This is an 8-bit external-bus version of Intel's 16-bit 8086 Microprocessor and is software-compatible with the 8086. Thus, the 8088 supports 16-bit operations, including multiply and divide, and supports 20 bits of addressing. It also operates in maximum mode, so a co-microprocessor can be added as a feature. The microprocessor operates at 4.77 MHz.

## Power Supply



LEX40073

Figure 4-4. Power Supply

The system power supply is located at the right rear of the system unit. It is an integral part of the system-unit chassis. Its housing provides support for the rear panel, and its fan furnishes cooling for the whole system.

It supplies the power and reset signal necessary for the operation of the system board, installed options, and the keyboard. It also provides a switch AC socket for the IBM Monochrome Display and two separate connectors for power to the 5.25-inch diskette drives.

The two different power supplies available are designed for continuous operation at 63.5 watts. They have a fused 120V AC or 220/240V AC input and provide four regulated DC output voltages: 7 A at

+5V DC, 2 A at +12V DC, 0.3 A at -5V DC, and 0.25 A at -12V DC. These outputs are overvoltage, overcurrent, open-circuit, and short-circuit protected. If a DC overload or overvoltage condition occurs, all DC outputs are shut down as long as the condition exists.

The +12V DC and -12V DC power the EIA drivers and receivers on the Asynchronous Communications Adapter.

The +12V DC also powers the system's dynamic memory and the two internal 5.25-inch diskette drive motors. It is assumed that only one drive is active at a time. The +5V DC powers the logic on the system board and diskette drives and allows about 4 A of +5V DC for the adapters in the system-unit expansion slots. The -5V DC is for dynamic memory bias voltage; it tracks the +5V DC and +12V DC very quickly at power on and has a longer delay on power off than the +5V DC and +12V DC outputs. All four power supply DC voltages are bussed across each of the five system-unit expansion slots.

## Keyboard

The IBM Personal Computer keyboard has a permanently attached cable that connects to a DIN connector at the rear of the system unit. This shielded 5-wire cable has power (+5V DC), ground, two bidirectional signal lines, and one wire used as a reset line. The cable is approximately 182.88 cm (6 ft) long and coiled, like that of a telephone handset.

The keyboard uses a capacitive technology with a microprocessor (Intel 8048) performing the keyboard scan function. The keyboard has two tilt positions for operator comfort (5 or 15-degree tilt orientation).

The keyboard has 83 keys arranged in three major groupings. The central portion of the keyboard is a standard typewriter keyboard layout. On the left side are 10 function keys. These keys are defined by the software. On the right is a 15-key keypad. These keys are also defined by the software but have legends for the functions of numeric entry, cursor control, calculator pad, and screen edit.

The keyboard interface is defined so that system software has maximum flexibility in defining certain keyboard operations. This is accomplished by having the keyboard return scan codes rather than American Standard Code for Information Interchange (ASCII) codes. In addition, all keys are typematic (if held down, they will repeat) and generate both a make and a break scan code. For example, key 1 produces scan code hex 01 on make and code hex 81 on break. Break codes are formed by adding hex 80 to make codes. The keyboard I/O driver can define keyboard keys as shift keys or typematic, as required by the application.

The microprocessor in the keyboard performs several functions, including a power-on self test when requested by the system unit. This test checks the microprocessor ROM, tests memory, and checks for stuck keys. Additional functions are keyboard scanning, buffering of up to 16 key scan codes, maintaining bidirectional serial communications with the system unit, and executing the handshake protocol required by each scan-code transfer.

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## 5150/5160-Based System Diagnostics

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### General Diagnostic Tips

#### Power-On Self Test

Each time you set the system unit's power switch to on, the power-on self test (POST) executes. The POST takes 13 to 90 seconds to complete, depending on the options installed.

The POST checks the following:

- System board
- Memory expansion adapters
- Keyboard
- Primary display
- Diskette drive and adapter
- Fixed disk drive and adapter (if available).

To start the POST:

1. Turn on all external devices, including printer, display, and plotter.
2. Set the power switch on the expansion unit (if attached) to on.
3. Set the system unit power switch to on.
4. Turn the brightness and contrast knobs fully clockwise. (If you have a color monitor, ensure that it is set to on.)
5. Watch (and listen) for the following responses:
  - a. A cursor appears on the display in approximately 4 seconds.
  - b. While the memory is being tested, the memory size appears in the top left corner of the screen and increases in 64Kb increments until the total system memory is tested. This is not applicable to the 5150 PC.
  - c. One short beep is heard when the POST is successfully completed.
  - d. The IBM Personal Computer basic screen appears if a diskette or an operating system is not automatically loaded from a fixed disk drive.

## Vertical Mounting Not Supported

IBM does not support operating the 5160 in a vertical position. Loss of customer data could occur if the system is operated in this manner.

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## Power Diagnostic Tips

### Dead Machine Tips

- Verify that the outlet has good power and that power cord is good.
- Disconnect all external I/O cables from PC (external I/O may cause power problems).
- If installed, remove the math coprocessor.
- Remove disk drive power connectors one at a time from the disk drive logic board (a failing logic board may cause power problems).
- Check voltages exiting power supply to system board.
- Check system board ohm resistance.

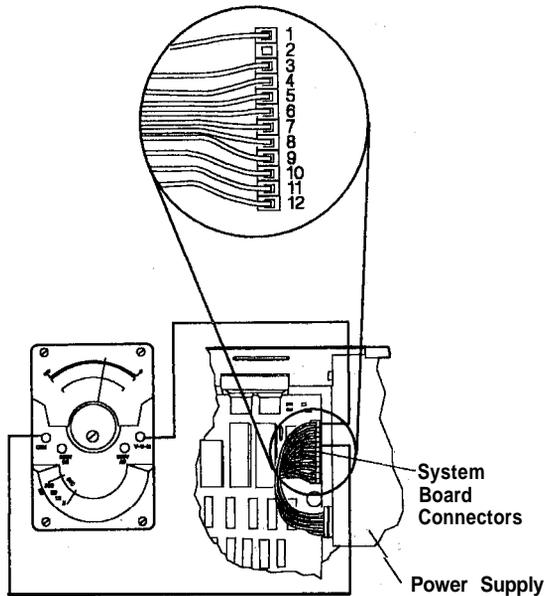
### System Board Power

1. Set the power switch on the system unit to off.
2. Set your meter to the 12V DC scale.
3. Refer to Figure 4-6 on page 4-4 and connect the common lead to pin 5 and the voltage lead to pin 1 of the system board power connector.
4. Set the power switch on the system unit to on.
5. Check for a voltage reading of 2.4V DC to 5.2V DC.

Leave your meter set on the 12V DC scale and check the rest of the power supply voltages to the system board (see Figure 4-5.)

Voltage Connectors			
Min V DC	Max V DC	-Lead	+ Lead
+ 4.8	+5.25	5	10
+ 4.6	+ 5.5	9	6
+ 11.5	+ 12.6	7	3
+ 10.9	+ 13.2	4	8

Figure 4-5. Power Supply Voltages



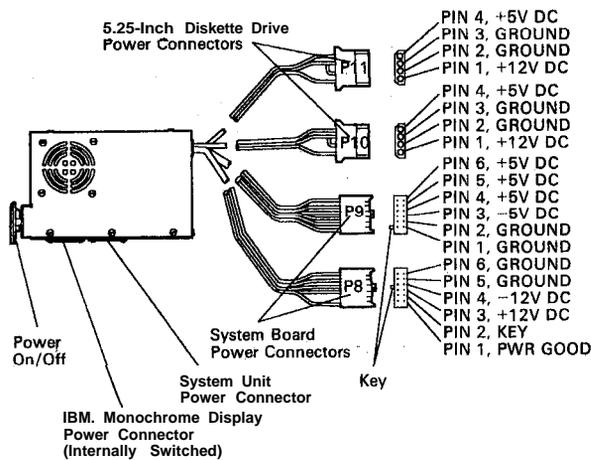
LEX40155

Figure 4-6. Board Power Connectors

## Power Supply Voltage Checks

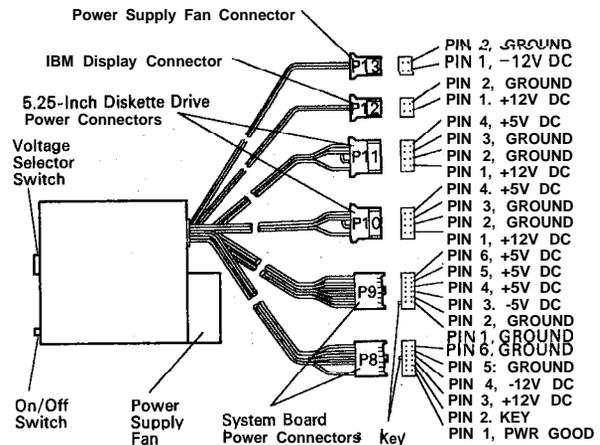
If the power supply is not connected, to the system board or the disk/diskette drives, the power supply voltages cannot be correctly measured unless loaded with a 1.5-ohm, 25-watt resistor. The resistor must be connected across the power supply connector P 9 pins 1 and 6.

There is a 3-ohm, 25-watt wire-wound resistor P/NO337213 available. Use two resistors in parallel to obtain 1.5-ohms resistance.



LEX40156

Figure 4-7. Voltage Checks



LEX40157

Figure 4-8. 5155 Portable PC

## System/Memory Diagnostic Tips

### Failing Memory Module Isolation

There are times when diagnostics do not show when a memory problem is present on a machine. If a customer program or another diagnostic fails, the following procedure may be helpful in identifying the failing memory module.

A failing memory module can be isolated by changing the configuration switch settings. Each bank of memory modules is either 64Kb or 16Kb depending on the system board. When a memory failure is detected, reducing the size of memory by an entire bank can be achieved by changing the system configuration switches.

The following procedure should be used while running memory diagnostics:

1. Configure the switch settings to reduce one bank of memory at a time until the memory error is no longer present.
2. When the error is no longer present, the last bank of modules eliminated is the failing bank.
3. The failing module can be identified by configuring the machine back to the switch settings of the last failure. Then, swap out individual modules of the failing bank until the error goes away.

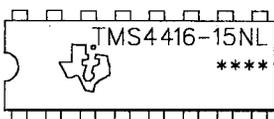
## Potential Memory Module Problem on Adapter Cards

Replace adapter cards containing potentially defective soldered memory modules and pluggable memory modules on the Enhanced Graphics Adapter (EGA) Expansion card when diagnostics indicate an adapter or memory module failure.

## Machines and Devices Affected

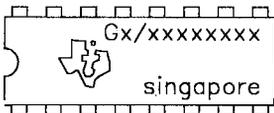
Type	Device Description
4450	EGA Expansion Card
4455	EGA Card
5150	PS AT Card
5160	PS XT Card
5161	Extended Graphics Adapter (XGA) Card
5170	All Points Addressable (APA) Card
5271	
5273	
5373	
5531	
7531	
7532	

Replace memory modules numbered 8535 through 8544 that are labeled plant code G when diagnostics indicate a memory module or adapter failure. When the memory modules are soldered, refer only to the number code 8635 through 8544 on the top of the memory module and replace the adapter card if applicable. When the memory modules are pluggable, refer to both top and bottom view and replace all of the affected modules during a repair action. The affected modules do not affect data.



\*\*\*\* = 8535 Through 8544 Numbering

Top View



G = Plant Affected

Bottom View

LEX41870

64Kb memory module locations are designated by location numbers on the adapter card. Refer to the

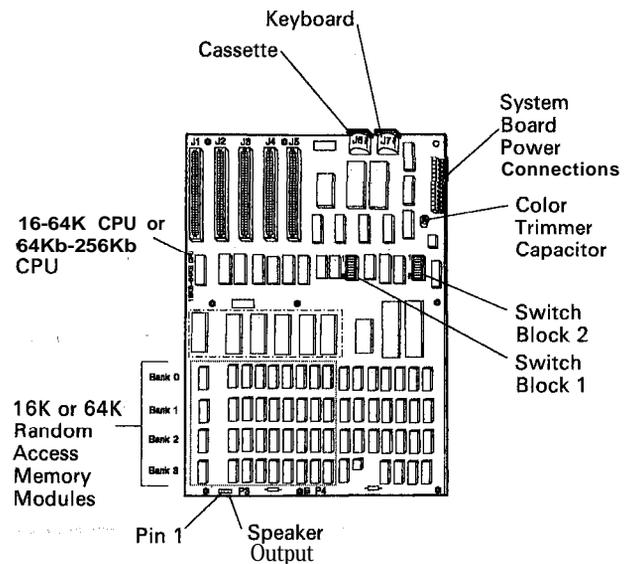
Hardware Maintenance and Service (HMS) manual maintenance analysis procedures (MAPs) for bank and module locations.

- EGA Memory Expansion card (P/N6323468) has pluggable memory modules (P/N8854219) located in bank 01, 02, and 03.

The following adapters have soldered modules:

Adapters	Modules Positions
EGA Card (P/N8654215)	U1, 2, 10, 11, 40, 41, 50, and 51
APA Card (P/N8654390)	U65, 78, 91, and 103
PS XT Card (P/N8654381)	U10, 23, 36, 49, 62, and 75
XGA AT Card (P/N2683118)	U11, 12, 24, 25, 38, 39, 52, 53, 63, 64, 74, and 75.

## 5150/4450 Failing Memory Module Bit/Bank Location



LEX40149

Figure 4-9. 5150/4450 Memory Module Bit/Bank Location

## 16Kb to 64Kb System Unit

When there is a memory failure, the address of the failure appears as a 4-character alphanumeric error code, followed by 201. If the first character of the error code is 0, you have a system board failure. The second character 0, 4, 8, or C indicates which bank has the failing module. The third and fourth characters of the 4-character error code indicate which bit (module) of the bank failed (P, 0, 1, 2, 3, 4, 5, 6, 7). For example,

error code OC40 201 means that the module indicated by the arrow in Figure 4-10 on page 4-6 (bank 3, bit 6) is the one that failed.

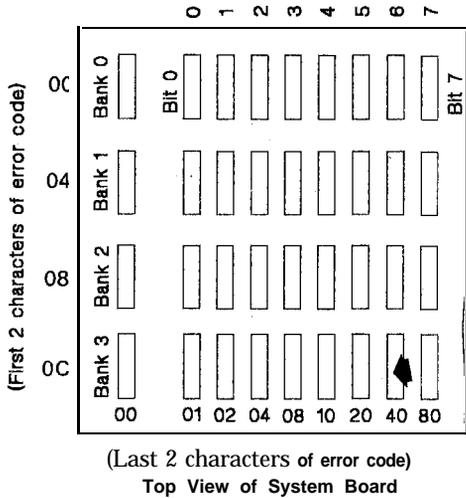


Figure 4-10. System Board (Top View)

### 64Kb to 256Kb System Unit

When there is a memory failure, the address of the failure appears as a 4-character alphanumeric error code, followed by 201. If the first character of the error code is 0, 1, 2, or 3, you have a system board failure. The 0, 1, 2, or 3 indicates which bank has the failing module. The third and fourth characters of the 4-character error code indicate which bit (module) of the bank failed (P, 0, 1, 2, 3, 4, 5, 6, or 7). For example, error code 3040 201 means that the module indicated by the arrow in Figure 4-11 (bank 3, bit 6) is the one that failed.

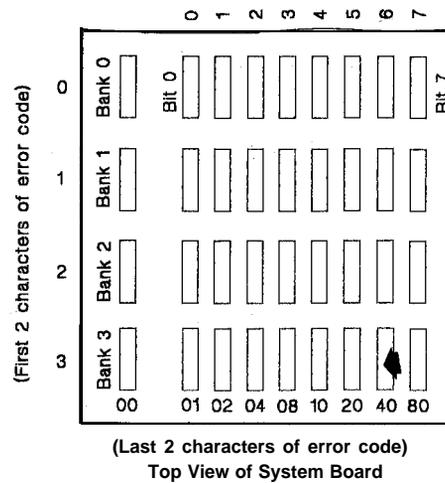
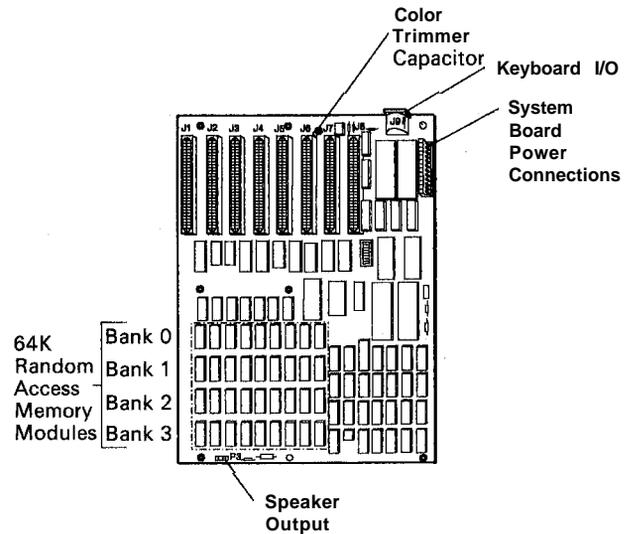


Figure 4-11. System Board (Top View)

### 5160/5155/XT370/5531/4455 Failing Memory Module Bit/Bank Location



Note: Banks 0 and 1 may contain 256K RAM modules on 5160 modules 088, 089, 267, 268, 277, and 278.

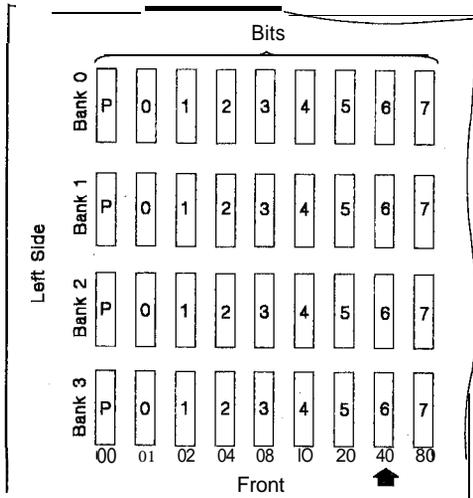
LEX41700

Figure 4-12. 5160/5155/XT370/5531/4455 Bit/Bank Location

When there is a memory failure, the address of the failure appears as a 7-character alphanumeric error code, followed by 201. If the first character of the error code is 0, 1, 2, or 3, you have a system board failure. The 0, 1, 2, or 3 indicates which bank has the failing module. The sixth and seventh characters of

the 7-character error code indicate which bit (module) of the bank failed (P, 0, 1, 2, 3, 4, 5, 6, 7). For example, error code 3COO0 40 201 means that the module indicated by the arrow in Figure 4-13 (bank 3, bit 6) is the one that failed.

Memory error, memory lock, or a blank display may occur if you plug one or more chips in wrong when you are replacing the system board or system memory.



LEX40153

Figure 4-13. System Board (Top View)

## 256Kb/640Kb System Board Memory Problems

The E-2 jumper located next to the power supply on the system board is needed to support 256Kb modules in banks 0 and 1. Without this jumper, 640Kb on the system board will appear in POST and diagnostics as 256Kb.

## 256Kb/640Kb System Board Labeled Wrong

PC XT 5160s (Models 088, 089, 267, 277, 278) have some system boards labeled wrong. The boards are labeled 64Kb/256Kb. They should be labeled 256Kb/640Kb. A 256Kb/640Kb board can be identified by looking for the presence of a module in position U84. The 64Kb/256Kb board has no module in this position.

## Interrupt Level Information

Interrupt levels are used by PCs to prioritize operations. Diagnostics will not necessarily fail on a PC with interrupt conflicts, yet the operator will keep getting errors. Although the customer is responsible for solving interrupt conflicts, an IBM service representative can use this information to reduce diagnostic time, NTFs, unnecessary parts replacements, and callbacks.

To determine whether an unusual PC problem is caused by conflicting interrupt levels, follow these steps:

- A. Load the advanced diagnostics diskette, go to the list of installed devices, and copy that list.
- B. Examine the adapter cards installed in the system unit and expansion unit. If any cards are located that are not on the list from Step 1, add them to the list.
- C. Sort the list into the following interrupt levels:
  1. Keyboard
  2. Enhanced Graphics Adapter  
3278/79 Emulation Adapter  
Primary PC Network Adapter
  3. ALT ASYNC Communications Adapter (COM2)  
ALT BISYNC Communications Adapter (COM2)  
ALT Serial/Parallel Adapter-Serial Port  
ALT PC Network Adapter  
SDLC Communications Adapter  
PC Cluster Adapter (selected by a jumper)  
Display Station Emulation Adapter (selected by a jumper)
  4. ASYNC Communications Adapter (COM1)  
BISYNC Communications Adapter (COM1)  
Serial/Parallel Adapter-Serial Port  
SDLC Communications Adapter
  5. Fixed Disk Adapter (except in Personal Computer AT)  
ALT Serial/Parallel Adapter-Parallel Port  
Display Station Emulation Adapter (selected by a jumper)
  6. Diskette Drive Adapter
  7. Printer Adapter Monochrome and Printer Adapter  
Cluster Adapter (selected by a jumper)  
Serial/Parallel Adapter-Parallel Port  
General Process Interface Bus (GPIB) Adapter(s)  
Data Acquisition Adapter(s).
- D. If you find two cards with the same interrupt, remove one of them and see whether the failure symptom disappears.

These steps are similar to the intermittent problem steps in the HMS manual. The most important point of this tip is that when a failure symptom is isolated to

one adapter card, that card is not necessarily defective, but may be incompatible with the other cards in the PC. Incompatibility can also be caused by factors other than interrupt (such as memory address and DMA). Also, conflicting interrupts will not always cause failures.

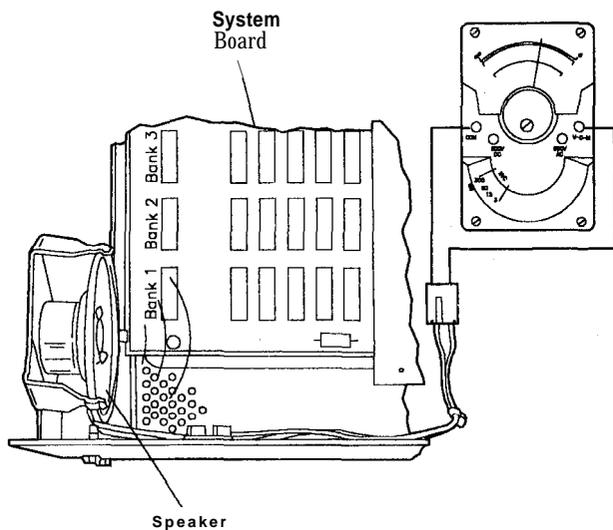
Note: Some adapter cards have a jumper for interrupt selection. For those cards and for cards not listed here (including non-IBM cards), see the card's setup guide or technical specifications. Due to rapid product announcements, this list cannot describe all the available IBM PC option cards.

## Math Coprocessor Installation (5150 Only)

Installation of the math coprocessor feature requires the replacement of the 8088 Processor module on the system board and addition of an 8087 Math Coprocessor module. If the 8088 Processor is soldered to a 16Kb/64Kb system board (P/N8529205 or P/N8529328), which prevents installation of a new 8088, the board must be replaced with a new 16Kb/64Kb system board from stock. See ECA004.

## Speaker Continuity

1. Set the power switch on the system unit to off.
2. Set your meter to the ohms x 1 scale.
3. Remove the speaker connector from the system board.
4. Connect the meter leads to the speaker, as shown, to check for continuity.



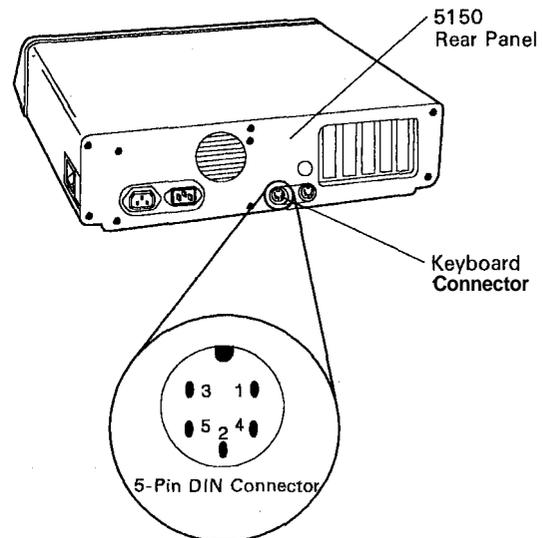
LEX40160

Figure 4-14. Speaker Continuity Check

## Keyboard Voltage Check at System Board

Pin TTL Signal	Signal Level
1 + Keyboard Clock	+5V DC
2 + Keyboard Data	+5V DC
3 -Keyboard Reset (Not used by keyboard)	
Power Supply Voltages	Voltage
4 Ground	0
5 +5 Volts	+5V DC

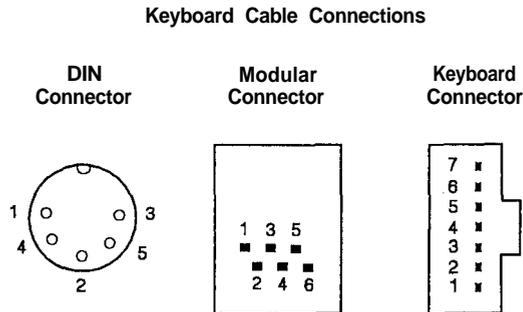
Figure 4-15. Keyboard Interface Connector Specifications



LEX40161

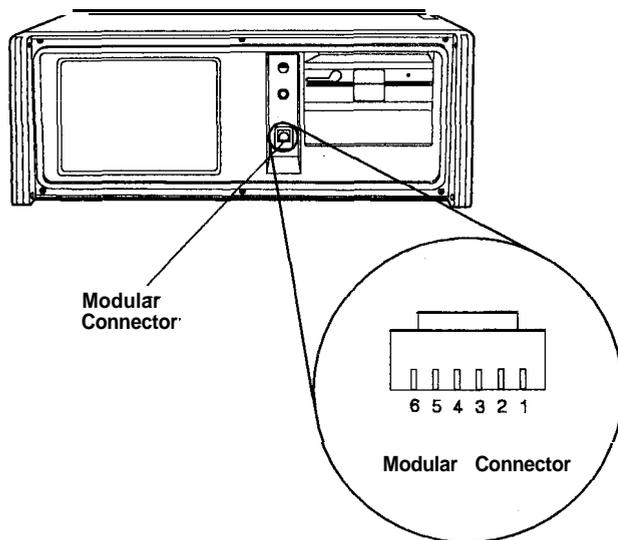
Figure 4-16. Keyboard Connector Location

## 5155 Portable Keyboard Voltage Check



LEX40162

Figure 4-17. Keyboard Cable Connections



LEX40163

Figure 4-18. Modular Connector Location

## Diskette Drive/Fixed Disk Drive Diagnostic Tips

### Hard-Sector Diskettes

Hard-sectored, double-index-hole diskettes will not work with IBM PC products. Soft-sectored, single-index-hole diskettes must be used.

### Diskette Drive Type 2 Read/Write Errors

If you are experiencing read/write errors on PCs equipped with Type 2 diskette drives, check the file control card on the diskette drive. If the numbers stamped or printed along the left edge of the card are 010, remove capacitor C39 from the card. This capacitor is mounted on the lower left corner of the card. This is the opposite end from the power connector. The capacitor is mounted between modules 4B and 5B. This capacitor is generating noise on the card, which causes the errors.

### Terminating Resistor on Replacement Drives

When replacing a disk/diskette drive, the terminating resistor should be installed on the replacement drive, if one was installed on the defective drive.

Intermittent problems can occur if the disk/diskette drive cable is not terminated. The cable is terminated by the use of a terminator resistor installed on the unit logic card. When replacing a disk/diskette drive, check to see whether a terminator is installed on the defective drive. If so, install a terminator resistor on the replacement drive. The terminator resistor should be installed on the drive that is the last physical unit on the cable. Both the disk and diskette drive cables must have terminating resistors.

### Diskette Drive Errors

Read/write errors can occur when the display is mounted on the system unit. The errors might be caused by the flyback transformer in the display. The problem can occur with both the color and monochrome monitors. The transformer creates a magnetic field around the PC, which causes the errors. The preferred solution to the problem is to move the display; if this cannot be done, replace the failing diskette drive. Some of the diskette drives are less susceptible than others to this problem.

## Track 40 Error/Type 3 Drives

The Type 3 diskette drive will not read data from track 40 of diskettes. The IBM specifications allow the use of tracks 0 - 39 and the Type 3 drive meets these specifications. The use of track 40 or above is not supported by IBM. Some software vendors have used track 40 in their software packages.

The Type 3 drive can be identified by a large heat sink on the rear of the drive logic board. Further identification can be made by checking for an E at the beginning of the serial number. The serial number on the Type 3 drive is located inside the drive on the right front corner and is visible through the top of the drive with the diskette removed and the diskette latch open.

## DISKCOPY Problems Using Type 3 Diskette Drive

DOS DISKCOPY might not function correctly under certain unique circumstances, when using the same diskette drive for both source and target diskettes on the PC (5150) and PC XT (5160).

The DOS DISKCOPY procedure might not function correctly on a Personal Computer or Personal Computer XT which has a Type 3 diskette drive(s), less than 416Kb of memory, and is using an unformatted target diskette. To prevent this problem, use formatted target diskettes when running DISKCOPY. After using DISKCOPY, a directory should be run to ensure that all files were copied. If the use of formatted diskettes is not an acceptable solution, exchange the diskette drive. See ECA015.

## Diskette Drive Inserts

Diskette drive inserts can be ordered from Parts Distribution, using P/N6447190. The inserts prevent head damage when the unit is shipped. An insert should be placed inside the diskette drive for the following conditions:

- Shipping a machine to and from a repair center
- Returning a machine to customers when transportation is involved
- Returning defective drives.

This insert should be used on the 5150 and 5160 Types 1, 2, and 3 diskette drives only.

## Diskette Drive Cable Continuity

1. Set the meter on the ohms x 1 scale.
2. Refer to Figure 4-19 and check the continuity of the signal cable. The meter should indicate approximately 0 ohms.

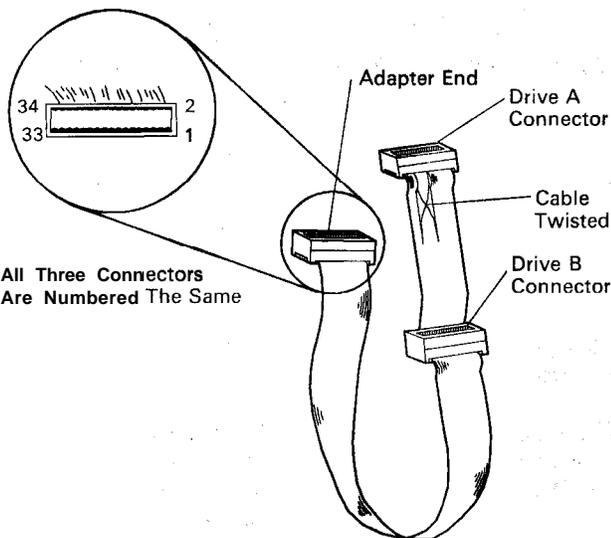
Diskette Drive A Signal-Cable Connector		Diskette Drive A Signal-Cable Connector	
Even Pin Diskette	Numbering Adapter	Odd Pin Diskette	Numbering Adapter
2	2	1	1
4	4	3	3
6	6	5	5
8	8	7	7
10	16	9	9
12	14	11	15
14	12	13	13
16	10	15	11
18	18	17	17
20	20	19	19
22	22	21	21
24	24	23	23
26	26	25	25
28	28	27	27
30	30	29	29
32	32	31	31
34	34	33	33
Diskette Drive B Signal-Cable Connector		Diskette Drive B Signal-Cable Connector	
Even Pin Diskette	Numbering Adapter	Odd Pin Diskette	Numbering Adapter
2	2	1	1
4	4	3	3
6	6	5	5
8	8	7	7
10	10	9	9
12	12	11	11
14	14	13	13
16	16	16	15
18	18	17	17
20	20	19	19
22	22	21	21
24	24	23	23
26	26	25	25
28	28	27	27
30	30	29	29
32	32	31	31
34	34	33	33

Figure 4-19. Diskette Drive Connector Adapters

## Diskette Drive Cable

Check the diskette drive signal cable for shorts as follows:

1. Set the power switch on the system unit (and expansion unit, if attached) to off.
2. Disconnect the diskette drive signal cable from the Diskette Drive Adapter and the diskette drive.
3. Carefully inspect the cable connectors for bent or broken contacts. Inspect the connectors on the adapter and on the diskette drive logic board for cracks or corrosion.
4. Set the meter on the ohms x 1K scale.
5. Using the adapter end of the cable, check for shorts by touching the other meter probe to pin 2. The meter should indicate infinity. Check pin 2 to pin 3, pin 3 to pin 4, and so on until all pins have been checked.



LEX40158

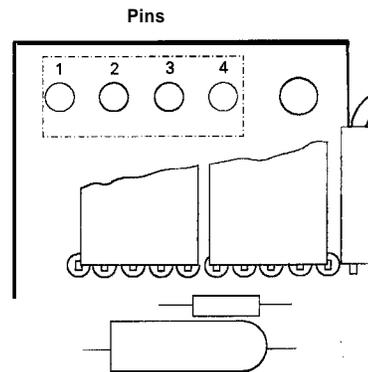
Figure 4-20. Diskette Drive Cable Connectors

## Diskette Drive Power

Check the diskette drive power connector for the voltages shown in the table below.

Diskette Drive Power Connector			
Min V DC	Max V DC	-Lead	+ Lead
+ 4.8	+5.2	2	4
+ 11.6	+ 12.6	3	1

Figure 4-21. Diskette Drive Power Connector Voltages



LEX40159

Figure 4-22. Connector Pins

## Moving System with Fixed Disk

**Warning:** Normal shipping and handling can result in permanent loss of all data on the fixed disk drives and increase the possibility of shipping damage for a 5160 or a 5161.

To prepare the system unit and expansion unit fixed disk for moving, use the following procedure.

Load the diagnostic routines and select Option-3, Prepare Fixed Disk for Relocation. This moves the disk head over the highest available cylinder (beyond the data area). This is the designated position when moving the system or expansion unit.

Fixed Disks Ready for Shipping appears on the monitor when the relocation routine completes successfully. **The system or expansion unit is now ready to be prepared for shipment.**

## Determining Available Space on Fixed Disk

DOS CHKDSK checks for the amount of usable space on the disk surface. Do not replace the fixed disk if the usable area exceeds the specified disk capacity; that is, 10 or 20 megabytes. The following process may be used to determine the number of bytes required for different capacity drives:

Note: 1 byte = 1.024

$1.024 \times \text{Disk Capacity} = \text{Total Number of Bytes Required}$

Examples follow:

$1.024 \times 10,000,000 = 10,240,000$  bytes  
(10Mb)

$1.024 \times 20,000,000 = 20,480,000$  bytes  
(20Mb)

$1.024 \times 30,000,000 = 30,720,000$  bytes  
(30Mb)

After determining the number of bytes required, refer the customer to the DOS manual to run the CHKDSK procedure.

To calculate the number of good bytes on the disk, do the following:

Subtract Bytes in Bad Sectors  
From Bytes Total Disk Space.

If the resulting number is greater than the calculated total number of bytes required (above), the drive is good. This tip also applies to the 5170 hard files.

## Insufficient Storage Space

The following information may be used in conjunction with the advanced diagnostics in diagnosing problems encountered involving insufficient storage space on the 5160 20Mb Fixed Disk.

Note: The customer should have backed up the system and the data files prior to beginning any repair actions. Backup may not be possible after the repair action has taken place.

- Ensure that when the customer runs the DOS CHKDSK, the number of Bytes in Bad Sectors is subtracted from Bytes Total Disk Space. If the resulting number is 20,480,000 bytes (20Mb) or greater, the fixed disk drive is good and should not be replaced.

If the resulting number is less than 20Mb:

- Ensure that a 20Mb Fixed Disk Adapter is installed. (Check for the presence of the drive type switch block.)
- Ensure that the switch settings on the Fixed Disk Adapter card are set for the correct drive type.

Upon completion of the repair action, the customer may need to do the following:

1. Perform the DOS FDISK command.
2. Run the DOS CHKDSK command to ensure that the fixed disk has 20Mb or more of usable storage space.
3. Run the DOS FORMAT command.
4. Do a restore of the system and data files.

## 20M b Type 13 Identification Label

5160 Models 088 and 089 contain a 20Mb fixed disk drive. The 20Mb Type 13 drive manufactured by IBM can be identified by the designation WD25 on a label at the upper left-hand side of the black cover enclosing the drive when the Type 13 sticker is not present.

## 1 0Mb Fixed Disk Noise

IBM-manufactured Personal Computer fixed disks of 10Mb, serial number F274092 or lower, could create a high-pitched noise.

IBM-manufactured fixed disks with a serial number of F274092 or lower could produce a high-pitched noise from the static eliminator during normal customer operation. This will not cause any operational problems. If your system is exhibiting this noise problem, ensure that all data/programs on the fixed disk are backed up. Replace the fixed disk.

The drive can be identified by a black cover over the disk area and a label at the rear of the drive which reads Manufactured by IBM. See ECA019.

## Formatting a Fixed Disk Drive

**Warning:** Formatting will destroy all data on the fixed disk drive. After formatting your fixed disk drive, the drive will have to be made ready to accept data. Refer to your disk operating system manual for the needed commands. The backup data may then be loaded onto the fixed disk drive.

Before replacing a failing fixed disk drive, first try to format it, then run the diagnostic tests again. After formatting it, perform the diagnostic tests. Because formatting destroys all data on the drive, do it as the last step before replacing the drive. After you format the drive, you may reload the data from your backup diskette.

To format a fixed disk drive:

1. Set the power switch on the system unit (and expansion unit, if attached) to off.
2. Install the fixed disk drive and connect any data and control connectors that were disconnected during testing.
3. Insert your advanced diagnostics diskette in drive A.
4. Set the power switch on the expansion unit (if attached) and system unit to on.
5. After the diskette loads, press **0** (RUN DIAGNOSTIC ROUTINES), then Enter.
6. Depending on the configuration of your system, questions about attached devices might appear on your screen. Press Y or N as required, then press Enter.
7. Press Y or N (IS THE LIST CORRECT?) then Enter. (If the list is not correct, follow the instructions on your screen and correct the list before answering yes. If you cannot correct the list, you still must answer yes before you can continue.)
  - a. When the System Checkout menu appears, press **0** (RUN TEST ONE TIME), then Enter.
9. Select 17 (FIXED DISK DRIVE(S) & ADAPTER), then press Enter.
10. Press 2 (FORMAT FIXED DISK), then Enter.
11. When ENTER DRIVE ID C/D appears, press C or D (depending on which drive you want to format), then press Enter.
12. When ARE YOU SURE YOU WANT TO CONTINUE appears, press Y, then Enter.
13. Before turning system over to customer or transferring customer data to fixed disk, perform the DOS FDISK and then the DOS FORMAT. This will further ensure proper operation of the fixed disk. See your DOS manual for FDISK and FORMAT procedures.

## Installing Fixed Disk Drive Cable

### 10Mb Fixed Disk Drive

When installing the cable P/N8529271 from the 10Mb or 10Mb/20Mb Adapter card to the 10Mb fixed disk drive, the cable must be plugged into the adapter with the trace wires facing up, away from the system board.

### 20Mb Fixed Disk Drive

When installing the cable P/N6480086 from the 10Mb/20Mb Adapter card to the 20Mb fixed disk drive, the cable must be plugged into the adapter with the trace wire facing down, toward the system board.

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## Communications Diagnostic Tips

### ASync Card Jumper

Expansion slot 8 on the system board is slightly different in that any card placed in that slot is expected to respond with a Card Selected Signal. Only one IBM card provides this signal, the Asynchronous (ASync) Communications Adapter. To provide this signal, the ASync Communications card must have Jumper J-13 installed. Any card placed in that slot that does not provide a Card Selected Signal will not be recognized as being installed.

### 1101 Errors

When running the asynchronous diagnostics on a 5150 PC or a 5160 PC XT, the ASync card P/N8529150 must be set for RS232C Interface. Otherwise, 1101 errors will result during testing. After testing, return the card to its original position if the customer uses current loop interface.

### Down-Level DSEA (IBM Customer Engineer Only)

There are two levels of the PC Display Station Emulation Adapter (DSEA). The early level, P/N6851163, was shipped only to IBM internal accounts. It has a twinaxial connector attached directly to the adapter bracket. The new level was shipped to customers and is P/N6851206. It has a 15-pin D-type shell connector attached to the adapter bracket. IBM customer engineers service the new level of adapter only. Internal sites with the early level card must go through AAS to acquire the new level.

## Communication Problems with Professional Graphics Controller

Machines Affected: 5160, 5161, and 5170

Early level professional graphics controllers (PGCs), FRU P/N6181765, may be subject to communication difficulties when installed in a system with communication adapters. Affected PGCs may limit transmission speed to 300 baud. Text received at higher speeds may be garbled. The current level of PGC allows transmission speeds up to 9600 baud.

Early level cards have the assembly number 6323697 printed on the left edge of the component side of the memory card (the only card whose component side is completely visible). Later level cards have the 6323697 covered and the assembly numbers 6448811 or 62X0914 printed under the J2 connector. J2 is located in the upper left component side of the same card.

The current level card corrects these communication performance problems by allowing line speeds up to 9600 baud.

Early level cards (assembly number 6323697) that exhibit these communication limitations should be replaced with the new FRU, number 62X0912. See ECA013.

Note: PGCs with the assembly number 62X0914 are the only level PGCs that will operate in the PC AT Model 339. The Model 339 uses an 8 MHz system clock and requires the 62X0914 assembly to operate.

## Configuring Personal Computer with Displaywriter Attachment

Refer to the IBM *Displaywriter Personal Computer Attach Program Description Operation* manual, G544-2280. In Chapter 3, "Customer Setup," the referenced documentation fails to instruct the customer on how to configure the Asynchronous Communications Adapter properly in conjunction with this feature. The adapter should be set to COM1. The Asynchronous Communications Adapters are already configured from the supplier for COM1 and RS232C. The feature will fail to operate with the adapter configured in the current loop mode. Refer to the *Hardware Maintenance and Service* manual for the adapter configurations.

## Communication Problems when DSEA Is Installed

5150 (PC) and 5160 (PC XT) communications-related problems can be caused by down-level system boards.

Some PC and PC XT communications-related problems cannot be resolved with normal diagnostics when the Display Station Emulation Adapter (DSEA) is installed. Symptoms include, but are not limited to:

- No communications at all
- One or more units dropping offline at any time
- Seemingly unrelated error codes (301, 516, 508, 548, and others) at various times or simultaneously on a single unit.

If all ASYNC, BISYNC, SDLC, and/or DSEA parameters are correct, look at the system board to identify the processor module, located in position U35 (5150) or U28 (5160). If the module is an AMD 8237 or 9517, look for the presence of a 74LS32 module in one of the following locations on the system board.

On the 5150 System Board, the 74LS32 module will be located in position U101 or the spare position. On the 5160 System Board, the 74LS32 module will be located in position U90 or the spare position. System boards without the 74LS32 module in one of the above locations, and experiencing problems with DSEA, should be replaced. See ECA005.

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## 5150/5160-Based System Diagnostic Information

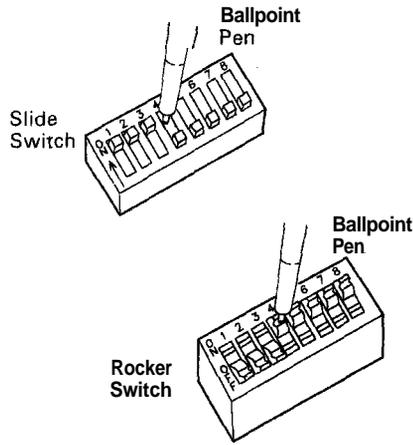
For a Symptom-to-FRU Index and additional diagnostics information, refer to the Service Summary cards supplied with this manual.

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## 5150 PC Switch Settings

Switches in your system are set to reflect the addition of memory and other installed options. Switches are located on the system board, Extender card, and memory expansion options.

The switches are dual in-line package (DIP) switches and are easily set with a ballpoint pen. Refer to the charts on the following pages to determine the correct switch settings for your system. Slide DIP switches are set by sliding the switch with a ballpoint pen, while rocker switches are set by pressing the rocker to the desired position, as shown in Figure 4-23.



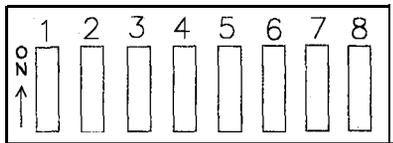
LEX40106

Figure 4-23. DIP Slide and Rocker Switch

**Note:** The system board type (16Kb/64Kb CPU system board or 64Kb/256Kb CPU system board) is printed on the left edge of the system board.

The following figures show switches on the system board. These settings are necessary for the system to address the attached devices and to specify the amount of memory on the system board.

### Switch Block 1

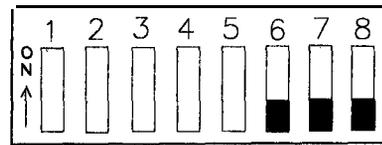


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Switch Position	Switch Function
1-7-8	Number of 5.25-inch diskette drives installed.
2	Math coprocessor: off if coprocessor is installed; must be on if coprocessor is not installed.
3-4	Amount of memory on the system board.
5-6	Type of display adapters installed.

Note: Total system memory includes memory options.

### Switch Block 2

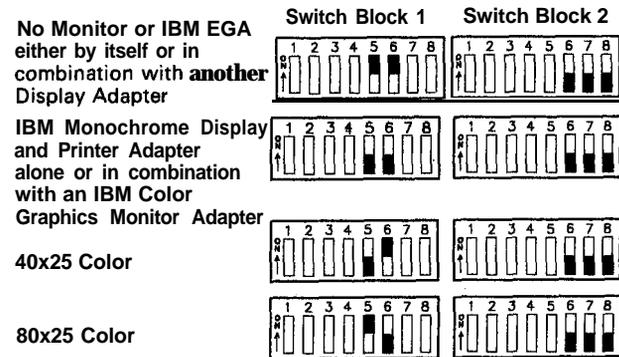


LEX40188

Switch Position	Switch Function
1-2-3-4-5	Amount of memory options installed.
6-7-8	Always in the off position.

### Monitor Type Switch Settings

The following shows the settings for positions 5 and 6:

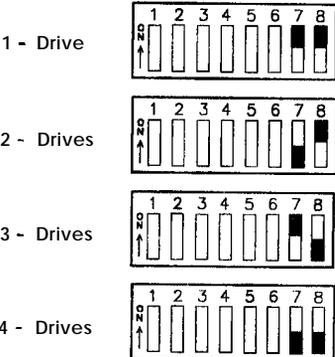


LEX40311

Figure 4-24. Monitor Type Switch Settings

# Diskette Drive Switch Settings

The following are the settings for positions 7 and 8, switch 1 is always on:



LEX40240

| Figure 4-25. 5.25Inch Diskette Drive Switch Settings

# Extender Card Switch Settings

The following chart shows the switch settings of the extender card switch block in conjunction with memory of various sizes:

System Memory	Extender Card Switch Block	Memory Segment
16K to 64K		1
96K to 128K		2
160K to 192K		3
224K to 256K		4
288K to 320K		5
352K to 384K		6
416K to 448K		7
480K to 512K		8
544K to 576K		9
608K to 640K		A

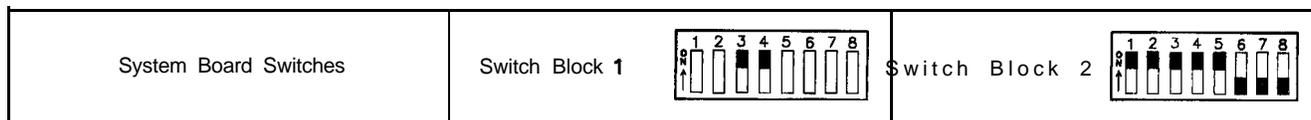
LEX40194

Figure 4-26. Extender Card Switch Settings

## Switch Settings: System Board Memory (16Kb-64Kb CPU)

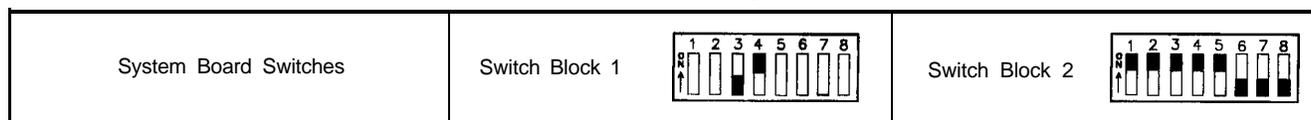
The following figures show switch settings for a range of system board memory from 16Kb to 64Kb, plus additional memory up to 576Kb.

### 16Kb Total Memory



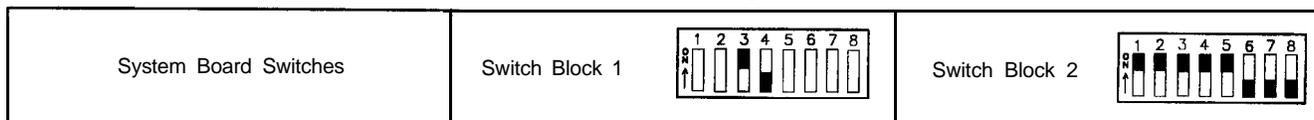
LEX40195

### 32Kb Total Memory



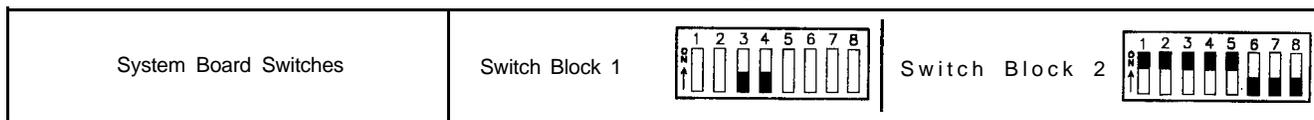
LEX40196

### 48Kb Total Memory



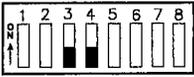
LEX40197

### 64Kb Total Memory



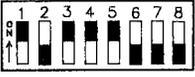
LEX40198

**96Kb Total Memory (32Kb + 64Kb on System Board)**

System Board Switches	Switch Block 1 	Switch Block 2 	
	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 32K option			

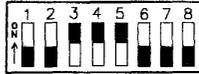
LEX40199

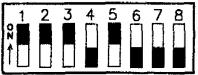
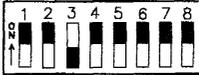
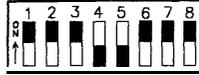
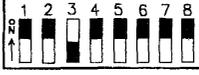
**128Kb Total Memory (64Kb + 64Kb on System Board)**

System Board Switches	Switch Block 1 	Switch Block 2 	
	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed			
1 - 64K option			
2 32K options			 

LEX40200

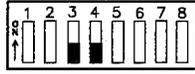
**160Kb Total Memory (96Kb + 64Kb on System Board)**

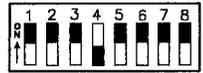
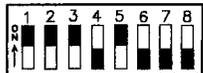
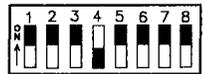
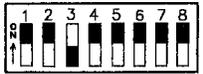
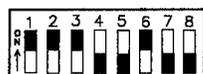
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed 1 - 32K option			
1 - 64K option 1 - 32K option			
3 - 32K options			  

LEX40201

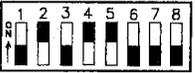
**192Kb Total Memory (128Kb + 64Kb on System Board)**

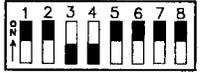
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K option installed 1 - 64K option			
2 - 64K options		 	
1 - 64/256K option with 64K installed 2 - 32K options			 
1 - 64K option 2 - 32K options			 
1 - 64/256K option with 128K installed			

LEX40202

**224Kb Total Memory (160Kb + 64Kb on System Board)**

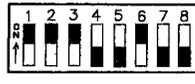
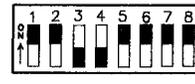
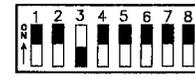
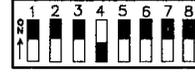
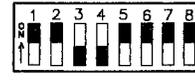
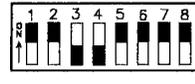
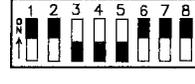
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed 1 - 64K option 1 - 32K option			
2 - 64K options 1 - 32K option		  	
1 - 64/256K option with 128K installed 1 - 32K option			

LEX40203

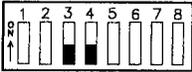
**256Kb Total Memory (192Kb + 64Kb on System Board)**

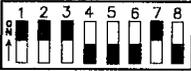
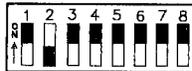
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed			
1 - 64/256K option with 128K installed 1 - 64K option			
1 - 64/256K option with 64K installed 2 - 64K options		 	
3 - 64K options		  	
1 - 64/256K option with 128K installed 2 - 32K options			 

LEX40204

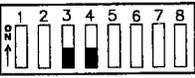
**288Kb Total Memory (224Kb + 64Kb on System Board)**

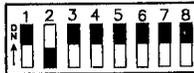
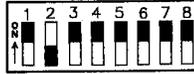
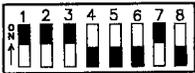
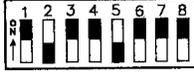
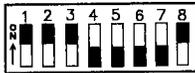
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed 1 - 32K option			
1 - 64/256K option with 128K installed 1 - 64K option 1 - 32K option			

LEX40205

**320Kb Total Memory (256Kb + 64Kb on System Board)**

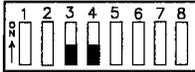
System Board Switches	Switch Block 1 	Switch Block 2 
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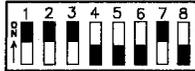
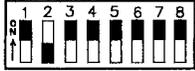
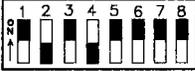
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 128K installed 2 - 64K options		  	
1 - 64/256K option with 192K installed 1 - 64K option			
1 - 64/256K option with 192K installed 2 - 32K options			  
*1 - 64/256K option with 256K installed	* 		

LEX40206

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**352Kb Total Memory (288Kb + 64Kb on System Board)**

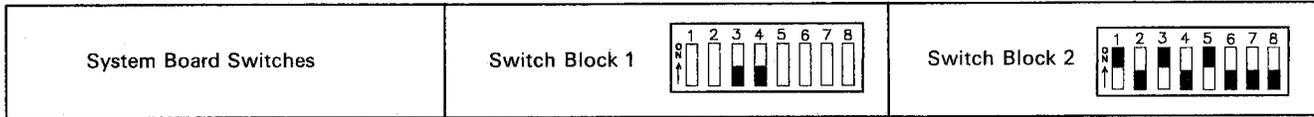
System Board Switches	Switch Block 1 	Switch Block 2 
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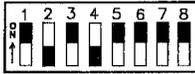
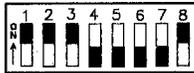
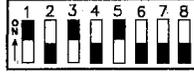
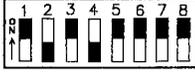
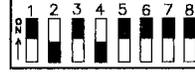
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed 1 - 64K option 1 - 32K option			
*1 - 64/256K option with 256K installed 1 - 32K option	* 		

LEX40207

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**384Kb Total Memory (320Kb + 64Kb on System Board)**



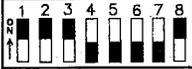
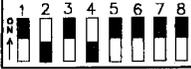
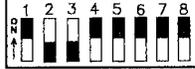
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed 2 - 64K options		  	
*1 - 64/256K option with 256K installed 1 - 64/256K option with 64K installed	*   		
*1 - 64/256K option with 256K installed 1 - 64K option	* 		
*1 - 64/256K option with 256K installed 2 - 32K options	* 		  

LEX40208

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**416Kb Total Memory (352Kb + 64Kb on System Board)**

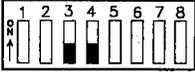
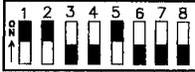
System Board Switches	Switch Block 1 	Switch Block 2 
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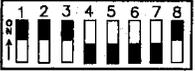
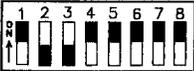
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
*1 - 64/256K option with 256K installed 1 - 64/256K option with 64K installed 1 - 32K option	*   		
*1 - 64/256K option with 256K installed 1 - 64K option 1 - 32K option	* 		

LEX40209

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**448Kb Total Memory (384Kb + 64Kb on System Board)**

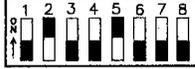
System Board Switches	Switch Block 1 	Switch Block 2 
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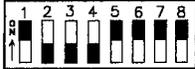
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
*1 - 64/256K option with 256K installed 1 - 64/256K option with 64K installed 1 - 64K option	*  		
*1 - 64/256K option with 256K installed 2 - 64K options	* 	 	
*1 - 64/256K option with 256K installed 1 - 64/256K option with 128K installed	*  		

LEX40210

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**480Kb Total Memory (416Kb + 64Kb on System Board)**

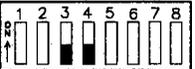
System Board Switches	Switch Block 1 	Switch Block 2 
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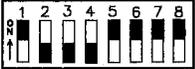
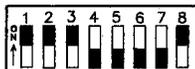
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
<p>*1 - 64/256K option with 256K installed 1 - 64/256K option with 128K installed 1 - 32K option</p>	<p>*   </p>		<p></p>

LEX40211

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**512Kb Total Memory (448Kb + 64Kb on System Board)**

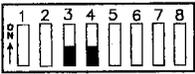
System Board Switches	Switch Block 1 	Switch Block 2 
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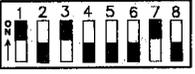
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
<p>*1 - 64/256K option with 256K installed 1 - 64/256K option with 128K installed 1 - 64K option</p>	<p>*   </p>	<p></p>	
<p>*1 - 64/256K option with 256K installed 1 - 64/256K option with 192K installed</p>	<p>*   </p>		

LEX40212

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**544Kb Total Memory (480Kb + 64Kb on System Board)**

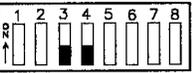
System Board Switches	Switch Block 1 	Switch Block 2 
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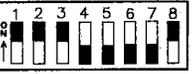
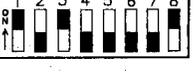
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
*1 - 64/256K option with 256K installed *1 - 64/256K option with 192K installed 1 - 32K option	  		

LEX40213

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**576Kb Total Memory (512Kb + 64Kb on System Board)**

System Board Switches	Switch Block 1 	Switch Block 2 
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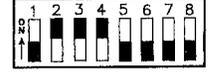
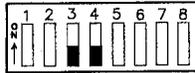
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
*1 - 64/256K option with 256K installed 1 - 64/256K option with 192K installed 1 - 64K option	*   		
*2 - 64/256K option with 256K installed	*   * 		

LEX40214

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**608Kb Total Memory (544Kb + 64Kb on System Board)**

System Board Switches	Switch Block 1	Switch Block 2
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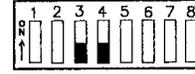
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
*2 - 64/256K option with 256K installed 1 - 32K option	*  		

LEX40215

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**640Kb Total Memory (576Kb + 64Kb on System Board)**

System Board Switches	Switch Block 1	Switch Block 2
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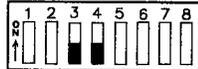
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
*2 - 64/256K option with 256K installed 1 - 64K option	*  		
*2 - 64/256K option with 256K installed 1 - 64/256K option with 64K installed	*  *  		

LEX40216

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

# Switch Settings: System Board Memory (64Kb-256Kb CPU)

## 64Kb Total Memory

System Board Switches	Switch Block 1 	Switch Block 2 
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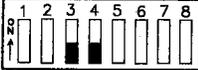
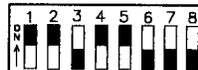
LEX40217

## 128Kb Total Memory

System Board Switches	Switch Block 1 	Switch Block 2 
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LEX40218

## 192Kb Total Memory

System Board Switches	Switch Block 1 	Switch Block 2 
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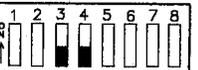
LEX40219

## 256Kb Total Memory

System Board Switches	Switch Block 1 	Switch Block 2 
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LEX40220

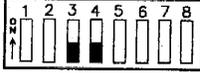
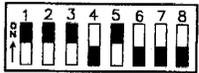
## 288Kb Total Memory (32Kb + 256Kb on System Board)

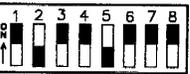
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 32K option			

LEX40221

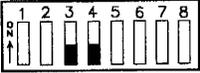
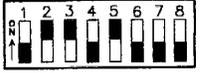
**320Kb Total Memory (64Kb + 256Kb on System Board)**

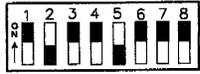
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed			
1 - 64K option			
2 - 32K options			 

LEX40222

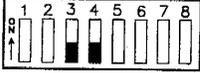
**352Kb Total Memory (96Kb + 256Kb on System Board)**

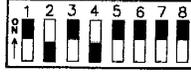
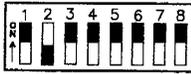
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed 1 - 32K options			
1 - 64K option 1 - 32K option			
3 - 32K options			  

LEX40223

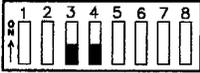
**384Kb Total Memory (128Kb + 256Kb on System Board)**

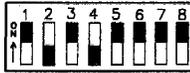
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed 1 - 64K option			
2 - 64K options		 	
1 - 64/256K option with 64K installed 2 - 32K options			 
1 - 64K option 2 - 32K options			 
1 - 64/256K option with 128K installed			

LEX40224

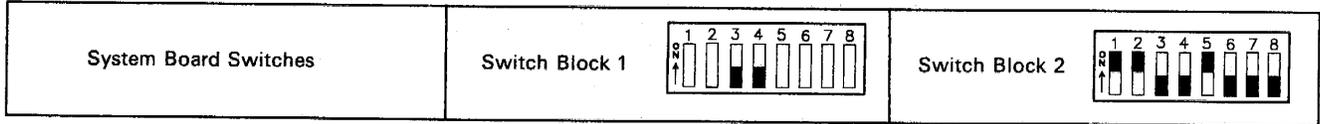
**416Kb Total Memory (160Kb + 256Kb on System Board)**

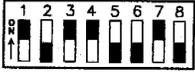
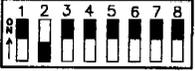
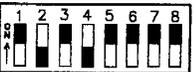
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed 1 - 64K option 1 - 32K option			
2 - 64K options 1 - 32K option		 	
1 - 64/256K option with 128K installed 1 - 32K option			

LEX40225

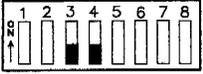
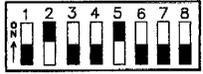
**448Kb Total Memory (192Kb + 256Kb on System Board)**



	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed			
1 - 64/256K option with 128K installed 1 - 64K option			
1 - 64/256K option with 64K installed 2 - 64K options		 	
3 - 64K options		  	
1 - 64/256K option with 128K installed 2 - 32K options			 

LEX40226

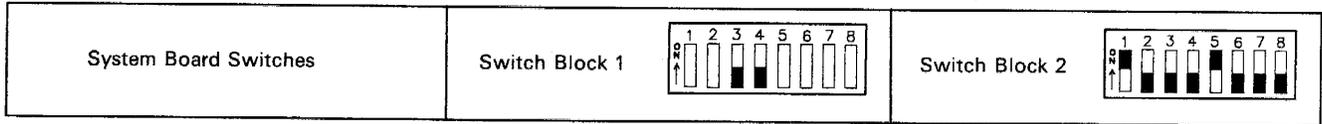
**480Kb Total Memory (224Kb + 256Kb on System Board)**

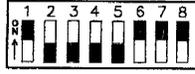
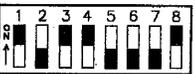
System Board Switches	Switch Block 1 	Switch Block 2 
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	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed 1 - 32K option			
1 - 64/256K option with 128K installed 1 - 64K option 1 - 32K option			

LEX40227

**512Kb Total Memory (256Kb + 256Kb on System Board)**

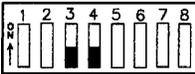


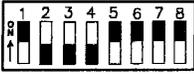
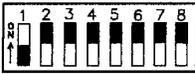
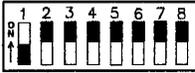
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 128K installed 2 - 64K options		  	
1 - 64/256K option with 192K installed 1 - 64K option			
1 - 64/256K option with 192K installed 2 - 32K options			  
*1 - 64/256K option with 256K installed	* 		

LEX40228

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**544Kb Total Memory (288Kb + 256Kb on System Board)**

System Board Switches	Switch Block 1 	Switch Block 2 
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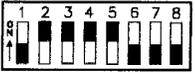
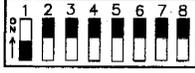
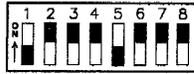
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed 1 - 64K option 1 - 32 option			
* 1 - 64/256K option with 256K installed 1 - 32 option	* 		

LEX40229

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**576Kb Total Memory (320Kb + 256Kb on System Board)**

System Board Switches	Switch Block 1 	Switch Block 2 
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	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed 2 - 64K options		  	
*1 - 64/256K option with 256K installed 1 - 64/256K option with 64K installed	*   		
*1 - 64/256K option with 256K installed 1 - 64K option	* 		
*1 - 64/256K option with 256K installed 2 - 32K options	* 		  

LEX40230

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**608Kb Total Memory (352Kb + 256Kb on System Board)**

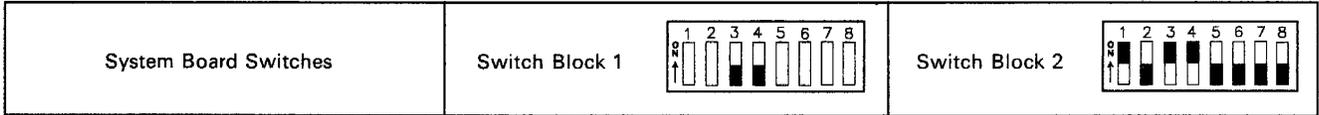
System Board Switches	Switch Block 1		Switch Block 2	
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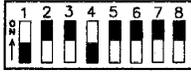
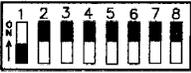
	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
* 1 - 64/256K option with 256K installed 1 - 64/256K option with 64K installed 1 - 32K option	<p>*</p> 		
*1 - 64/256K option with 256K installed 1 - 64K option 1 - 32K option	<p>*</p>		

LEX40231

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**640Kb Total Memory (384Kb + 256Kb on System Board)**

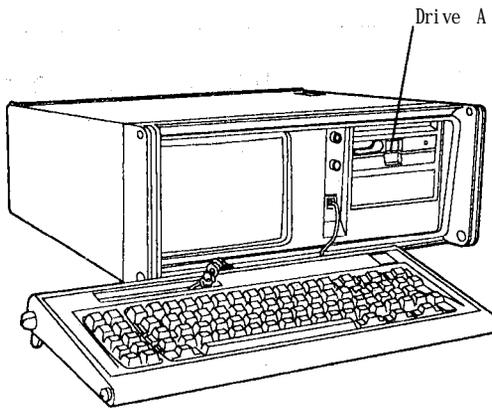


	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
*1 - 64/256K option with 256K installed 1 - 64/256K option with 64K installed 1 - 64K option	*   		
*1 - 64/256K option with 256K installed 2 - 64K options	*   	  	
*1 - 64/256K option with 256K installed 1 - 64/256K option with 128K installed	*   		

LEX40232

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

# Chapter 5. 5155 Portable



LEX41803

Figure 5-1. 5155 Portable

The 5155 consists of a lightweight casing with a carrying handle containing a built-in 9-inch amber composite display and one 5.25-inch Slimline, double-sided diskette drive (with space available for an optional second drive). The system board is the same as that of the 5160 PC XT with 256Kb of memory.

## Unit Specifications

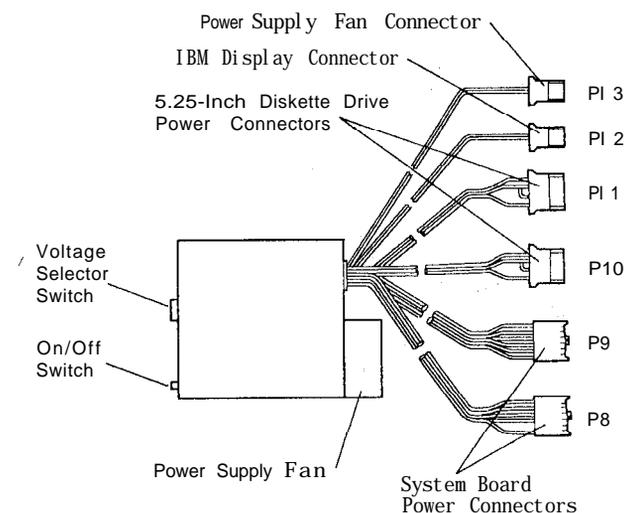
<b>Size</b>	
Height	204 mm (8 in)
Width	500 mm (20 in)
Depth	430 mm (17 in)
<b>Weight</b>	13.6 kg (30 lb)
<b>Power Cable</b>	
Length	1.83 m (6 ft)
Size	18 AWG
<b>Environment</b>	
Air Temperature	
System On	15.6 deg. to 32.2 deg. C (60 deg. to 90 deg. F)
System Off	10 deg. to 43 deg. C (50 deg. to 110 deg. F)
Humidity	
System On	8% to 88%
System Off	20% to 80%
<b>Heat Output</b>	650 BTU/hr max.

Figure 5-2 (Part 1 of 2). 5155 Specifications

Noise Level	49.5 dBa System unit with monochrome display and expansion unit attached.
<b>Electrical</b>	
Nominal	120V AC
Minimum	104V AC
Maximum	127V AC
kva	0.32 max.

Figure 5-2 (Part 2 of 2). 5155 Specifications

## Power Supply



LEX40075

Figure 5-3. 5155 Power Supply and Connectors

The system unit's power supply is a 114-watt, switching regulator that provides five outputs. It supplies power for the system unit and its options, the power supply fan, diskette drive, composite display, and keyboard. All power levels are protected against overvoltage and overcurrent conditions. The input voltage selector switch has 115V AC and 230V AC positions. If a DC overload or overvoltage condition exists, the power supply automatically shuts down until the condition is corrected, and the power supply is switched off and then on.

The internal 5.25-inch diskette drive uses the + 5V DC and the + 12V DC power levels. Both the + 12V DC and -12V DC power levels are used in the drivers and receivers of the optional communications adapters. The display uses a separate + 12V DC power level.

The + 5V DC, -5V DC, +12V DC, and -12V DC power levels are bussed across the system expansion slots.

## Keyboard

The IBM Portable Personal Computer keyboard cable is a detachable, 4-wire, shielded cable that connects to a modular connector in the front panel of the system unit. The cable has power (+ 5V DC), ground, and two bidirectional signal lines in it. It is 762 mm (30 in) long and is coiled.

All other functions of the keyboard are identical to the 5150 keyboard.

---

## 5155 PC Portable Diagnostic Information

For diagnostic information, refer to "5150/5160-Based System Diagnostics" on page 4-3. For a Symptom-to-FRU Index and further diagnostic information, refer to the Service Summary cards supplied with this manual.

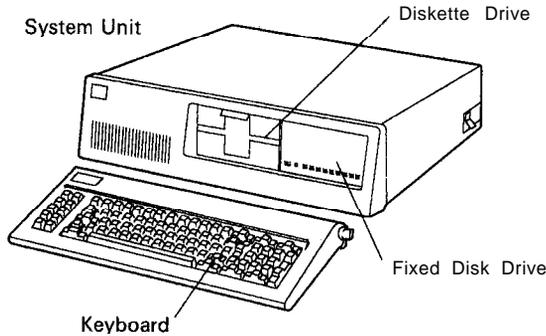
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## 5155 PC Portable Switch Settings

For 5155 PC switch setting information, refer to "5160 PC XT Switch Settings" on page 6-3.

**Note:** 5155 PC and 5160 PC XT switch settings are the same.

# Chapter 6. 5160 PC XT



LEX40076

Figure 6-1. 5160 PC XT

The 5160 Personal Computer XT is an extended version of the 5150 Personal Computer. A typical PC XT features one 5.25-inch, 360Kb diskette drive, 256Kb memory, Asynchronous Communications Adapter, and a 10Mb or 20Mb fixed disk drive. There are numerous configurations ranging from stand-alone models to host interactive models.

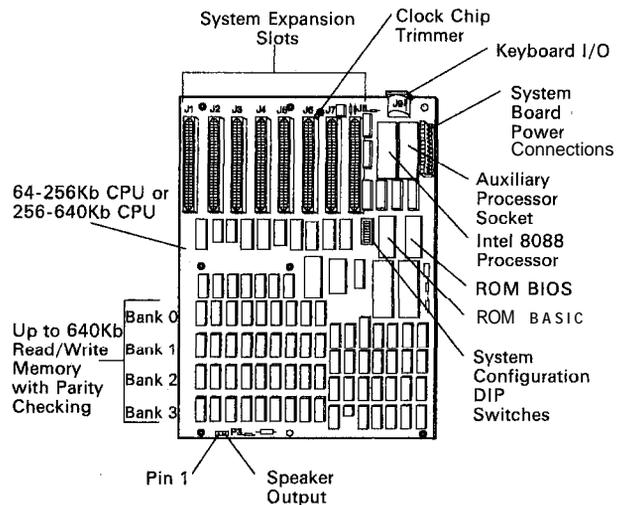
## Unit Specifications

<b>System Unit Size</b>	
Height	142 mm (5.5 in)
Length	500 mm (19.6 in)
Depth	410 mm (16.1 in)
<b>Weight</b>	
	14.5 kg (32 lb)
<b>Power Cable</b>	
Length	1.83 m (6 ft)
Size	18 AWG
<b>Environment</b>	
<b>Air Temperature</b>	
System On	15.6° to 32.2°C (60° to 90°F)
System Off	10° to 43°C (50° to 110°F)
<b>Humidity</b>	
System On	8% to 80%
System Off	20% to 80%
<b>Heat Output</b>	750 BTU/hr max.

<b>Noise Level</b>	49.5 dBa System unit with monochrome display and expansion unit attached.
<b>Electrical Nominal</b>	120V AC
<b>Minimum</b>	104V AC
<b>Maximum</b>	127V AC
<b>kva</b>	0.41 max.

Figure 6-2 (Part 2 of 2). 5160 Specifications

## System Board



LEX40077

Figure 6-3. 5160 System Board Component Diagram

The system board fits horizontally in the base of the system unit of the Personal Computer XT and Portable Personal Computer. It is a multilayer, single-land-per-channel design with ground and internal planes provided. DC power and a signal from the power supply enter the board through two 6-pin connectors. Other connectors on the board are for attaching the keyboard and speaker. Eight 62-pin card-edge sockets are also mounted on the board. The I/O channel is bussed across these eight I/O slots. Slot J8 is slightly different from the others in that any card placed in it is expected to respond with a card selected signal whenever the card is selected.

A dual in-line package (DIP) switch (one 8-switch pack) is mounted on the board and can be read under program control. The DIP switch provides the system

programs with information about the installed options, how much storage the system board has, what type of display adapter is installed, what operation modes are desired when power is switched on (color or black-and-white, 80- or 40-character lines), and the number of diskette drives attached.

The system board contains the adapter circuits for attaching the serial interface from the keyboard: These circuits generate an interrupt to the microprocessor when a complete scan code is received. The interface can request execution of a diagnostic test in the keyboard.

The system board consists of five functional areas: the processor subsystem and its support elements, the read-only memory (ROM) subsystem, the read/write (R/W) memory subsystem, integrated I/O adapters, and the I/O channel.

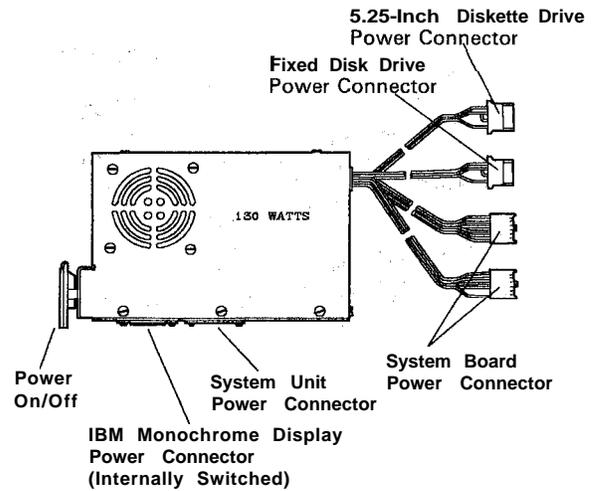
## Microprocessor

The heart of the system board is the Intel 8088 Microprocessor. This is an 8-bit external-bus version of Intel's 16-bit 8086 Microprocessor and it is software-compatible with the 8086. Thus, the 8088 supports 16-bit operations, including multiply and divide, and supports 20 bits of addressing. It also operates in maximum mode so a co-microprocessor can be added as a feature. The microprocessor operates at 4.77 MHz.

Standard Features	5160 Models													
	00	01	02	03	04	05	06	07	08	09	10	11	12	13
128Kb Memory														
256Kb Memory	x	x	x											
512Kb/640Kb* Memory														
360Kb Diskette Drive, Full-High	1	2	1	1									1	1
360Kb* Diskette Drive, Half-High														
10Mb Fixed Disk Drive														
20Mb* Fixed Disk Drive														
10Mb/20Mb Fixed Disk Drive Adapter														
ASYN Comm Adapter														
83-Key Keyboard	x	x	x	x	x									
101-Key Keyboard*														
PC/370 - M Card														
PC/370 - P Card														
PC/3277 - EM Card														
Color Graphics Adapter														
Printer/Register Adapter, Unique														
Internal Modem Adapter, Unique														
Extender Card	x	x	x	x	x									

\* Denotes features that are supported only on 5160 Models 088, 089, 267, 268, 277, and 278.

## Power Supply



LEX40078

Figure 6-4. 5160 Power Supply

The system DC power supply is a 130-watt, four voltage-level switching regulator. It is integrated into the system unit and supplies power for the system unit, its options, and the keyboard. The supply provides 15 A of +5V DC,  $\pm 5\%$ ; 4.2 A of +12V DC,  $\pm 5\%$ ; 300 mA of -5V DC,  $\pm 10\%$ ; and 250 mA of -12V DC,  $\pm 10\%$ . All power levels are regulated with overvoltage and overcurrent protection. There are two power supplies, 120V AC and 220/240V AC. Both are fused. If DC overcurrent or overvoltage conditions exist, the supply automatically shuts down until the condition is corrected. The supply is designed for continuous operation at 130 watts.

The system board takes approximately 2 to 4 A of +5V DC, thus allowing approximately 11 A of +5V DC for the adapters in the system expansion slots. The +12V DC power level is designed to power the internal 5.25-inch diskette drive and the 10Mb fixed disk drive. The -5V DC level is used for analog circuits in the diskette adapter's phase-lock loop. The +12V DC and -12V DC are used for powering the Electronic Industries Association (EIA) drivers for the communications adapters. All four power levels are bussed across the eight system expansion slots.

The IBM Monochrome Display has its own power supply, receiving its AC power from the system unit's power system. The AC output for the display is switched on and off with the power switch and is a nonstandard connector, so only the IBM Monochrome Display can be connected.

## Keyboard

The 83-key keyboard is standard on all 5160 models, excluding Models 089, 268, and 278.

The 101-key keyboard is standard on 5160 Models 089, 268, and 278.

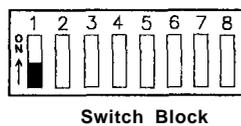
Both the 83-key keyboard and the 101-key keyboard are interchangeable only on 5160 Models 088, 089, 267, 268, 277, and 278. Models 088, 267, and 277 are identical to Models 089, 268, and 278, respectively, with the exception of the keyboards.

## 5160 PC XT Diagnostic Information

For diagnostic information, refer to "5150/5160-Based System Diagnostics" on page 4-3. For a Symptom-to-FRU Index and additional diagnostics information, refer to the Service Summary cards supplied with this manual.

## 5160 PC XT Switch Settings

Figure 6-5 shows switches on the system board. These settings are necessary for the system to address the attached devices and to specify the amount of memory on the system board.



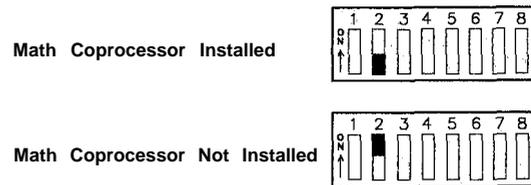
LEX40233

Figure 6-5. Switch Block

Switch Position	Switch Function
1	Normal operation, off (set to on to loop POST).
2	Math coprocessor: off if coprocessor is installed; on if coprocessor is not installed.
3-4	Amount of memory on the system board.
5-6	Type of monitor you are using.
7-8	Number of 5.25-inch diskette drives attached.

## Math Coprocessor Switch Settings

Figure 6-6 shows the settings for position 2:

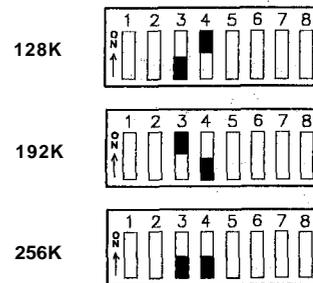


LEX40234

Figure 6-6. Math Coprocessor Switch Settings

## System Board Memory Switch Settings

The following figures show the settings for positions 3 and 4 for the amount of memory on the system board.

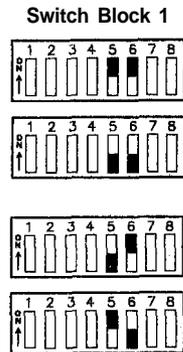


LEX40235

## Display Adapter Switch Settings

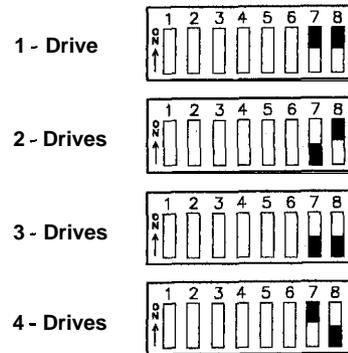
The following figures show the settings for positions 5 and 6:

No Display or IBM EGA either by itself or in combination with another Display Adapter  
 IBM Monochrome Display and Printer Adapter alone or in combination with an IBM Color Graphics Monitor Adapter  
 40x25 Color  
 80x25 Color



## Diskette Drive Switch Settings

The following are the settings for positions 7 and 8:



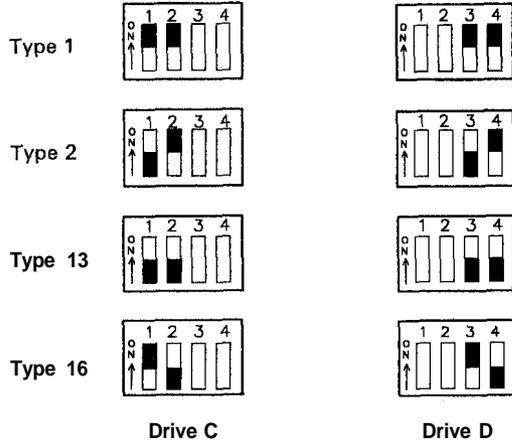
LEX43131

LEX40240

Figure 6-7. Monitor Type Switch Settings

Note: See Chapter 10, "3270 PC Products," for 3270 unique switch settings.

## 10/20Mb Fixed Disk Drive Adapter Card Switch Settings

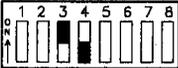
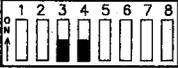


LEX41701

**Note:** Type 1 is an IBM 10Mb Fixed Disk Drive.

# Memory Option Switch Settings

6160 PC XT with a 256Kb/640Kb system board; Models 088, 089, 267, 268, 277, 278 only.

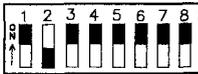
PC XT™ With 256/640 System Board (Note 1)	
Total Memory (Note 2)	System Board Switch Settings
256K	
512K	
576K	
640K	
<p><b>Note 1:</b> The system board's identifier is located on its left edge.</p> <p><b>Note 2:</b> Memory adapters are not supported on 256/640K system boards.</p>	

LEX41702

## Memory Option Switch Settings

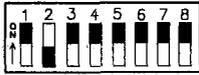
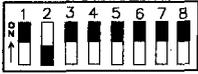
5160 PC XT with a 64Kb/256Kb system board.

### 288Kb Total Memory (32Kb + 256Kb on System Board)

	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 32K option			

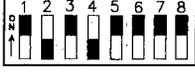
LEX40241

### 320Kb Total Memory (64Kb + 256Kb on System Board)

	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed			
1 - 64/256K option			
2 - 32K options			 

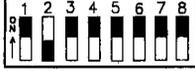
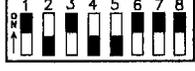
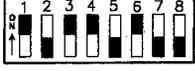
LEX40242

**352Kb Total Memo (96Kb + 256Kb on System Board)**

	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed 1 - 32K option			
1 - 64K option 1 - 32K option			
3 - 32K options			  

LEX40243

**384Kb Total Memory (128Kb + 256Kb on System Board)**

	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed 1 - 64K option			
2 - 64K options		 	
1 - 64/256K option with 64K installed 2 - 32K options			 
1 - 64K option 2 - 32K options			 
1 - 64/256K option with 128K installed			

LEX40244

**416Kb Total Memory (160Kb + 256Kb on System Board)**

	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 64K installed 1 - 64K option 1 - 32K option			
2 - 64K options 1 - 32K option		 	
1 - 64/256K option with 128K installed 1 - 32K option			

LEX40245

**448Kb Total Memory (192Kb + 256Kb on System Board)**

	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed			
1 - 64/256K option with 128K installed 1 - 64K option			
1 - 64/256K option with 64K installed 2 - 64K options		 	
3 - 64K options		  	
1 - 64/256K option with 128K installed 2 - 32K options			 

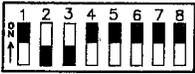
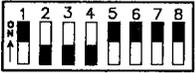
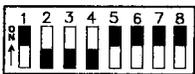
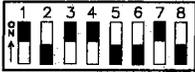
LEX40246

**480Kb Total Memory (224Kb + 256Kb on System Board)**

	64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed 1 - 32K option			
1 - 64/256K option with 128K installed 1 - 64K option 1 - 32K option			

LEX40247

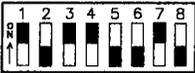
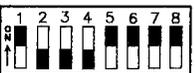
**512Kb Total Memory (256Kb + 256Kb on system Board)**

	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 128K installed 2 - 64K options		 	
1 - 64/256K option with 192K installed 1 - 64K option			
1 - 64/256K option with 192K installed 2 - 32K options			 
*1 - 64/256K option with 256K installed	* 		

LEX40248

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**544Kb Total Memory (288Kb + 256Kb on System Board)**

	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed 1 - 64K option 1 - 32K option			
*1 - 64/256K option with 256K installed 1 - 32K option	* 		

LEX40249

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

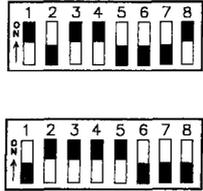
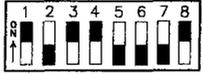
**576Kb Total Memory (320Kb + 256Kb on System Board)**

	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
1 - 64/256K option with 192K installed 2 - 64K options			
*1 - 64/256K option with 256K installed 1 - 64/256K option with 64K installed	* 		
"1 - 64/256K option with 256K installed 1 - 64K option	* 		
"1 - 64/256K option with 256K installed 2 - 32K options	* 		

LEX40250

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

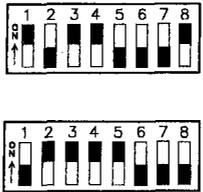
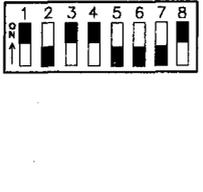
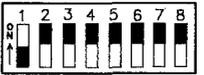
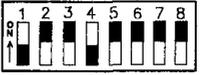
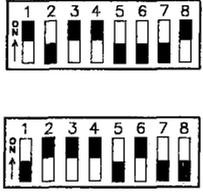
**608Kb Total Memory (352Kb + 256Kb on System Board)**

	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
*1-64/256K option with 256K installed 1-64/256K option with 64K installed 1-32K option	* 		
*1-64/256K option with 256K installed 1-64K option 1-32K option	* 		

LEX40251

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

**640Kb Total Memory (384Kb + 256Kb on System Board)**

	*256K Option or 64/256K Option Card Switches	64K Option Card Switches	32K Option Card Switches
*1-64/256K option with 256K installed 1-64/256K option with 64K installed 1-64K option	* 		
*1-64/256K option with 256K installed 2-64K options	* 	 	
*1-64/256K option with 256K installed 1-64/256K option with 128K installed	* 		

\* The switch setting for the 256Kb option is the same as that for the 64Kb/256Kb option with 256Kb installed.

## Extender Card Switches

Set the switches on the extender card to reflect total system memory.

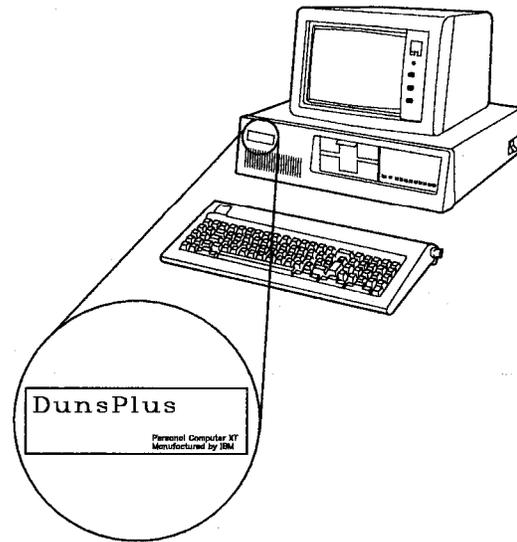
System Memory	Extender Card Switch Block
16K to 64K	
96K to 128K	
160K to 192K	
224K to 256K	
288K to 320K	
352K to 384K	
416K to 448K	
480K to 512K	
544K to 576K	
608K to 640K	

LEX40253

Note: Model 5160 XT/370 (20Mb) must have extender card switches set for 608Kb to 640Kb.

Figure 6-8. Extender Card Switch Settings

## 5160 DunsPlus System



LEX40109

Figure 6-9. 5160 DunsPlus System

The DunsPlus\* system consists of a unique 5160 IBM Personal Computer XT (Model 788), IBM 5153 Color Display, and an IBM 5152 Graphics Printer, or an optional NEC\* letter-quality printer and its own unique software. It can be used for desktop computing as well as access to data bases on remote computers. The IBM customer engineer will install both the hardware and software for the DunsPlus system.

The DunsPlus system is a specially designed IBM PC XT built by IBM exclusively for the Dun & Bradstreet Company. Maintenance is accomplished by IBM customer engineers using the *DunsPlus Installation and Service* manual, the *PC XT Hardware and Maintenance Service* (HMS) manual, and the DunsPlus support center. Both installation and service are guided by the *DunsPlus Installation and Service* manual. The DunsPlus support center will screen both installation and service calls. The IBM customer engineer will supply DunsPlus with type and serial numbers on installations or element exchange incidents and major code on FRU replacement incidents. The feedback to DunsPlus is accomplished via direct entry into the DunsPlus system Communications Link/Electronic Call Reporting Procedure (guided by the *DunsPlus Installation and Service* manual).

\* Registered Trademark

## Installation

Installation of a DunsPlus system is accomplished by following the directions in the *DunsPlus Installation and Service* manual, which is included in the customer ship group. The IBM customer engineer will be required to install both the hardware and software for each DunsPlus system. The IBM customer engineer must bring to each installation a copy of the *PC XT HMS* manual and the current advanced diagnostic diskette (Version 2.05 or later).

To install:

1. Unpack and assemble the system unit, including connection of the DunsPlus system cables.
2. Run system diagnostic tests, including the modem loop-back test, to verify proper operation.
3. Format the fixed disk and install the DunsPlus supplied software using the DunsPlus Installation and Service Diskette.
4. Perform the Communications Link/Electronic Call Reporting Procedure provided by DunsPlus.

Any problems encountered while installing a DunsPlus system should be handled by calling the DunsPlus support center hotline. The telephone numbers for DunsPlus support will be supplied to the IBM service representative via IBM dispatch.

## Hardware Installation

Before starting any DunsPlus installation, the IBM customer engineer should be familiar with the *DunsPlus Installation and Service* manual. This manual is part of the customer ship group and will be included in the first container to be opened (marked OPEN FIRST). After the initial installation, and after each service call, the servicer is required to do a communication link checkout. This is accomplished by following the procedure in the *DunsPlus Installation and Service* manual. The checkout procedure for the communication link is part of the DunsPlus software package. The DunsPlus software must be installed prior to running the communication link checkout procedure.

## Software Installation

The IBM customer engineer will install the DunsPlus software from the customer-supplied diskettes onto the fixed disk in the DunsPlus system. This will be accomplished by first inserting the DunsPlus Installation and Service Diskette, switching power on, and then following the prompts on the menu driven screens. The step-by-step instructions on installing the DunsPlus software are included in the *DunsPlus Installation and Service* manual.

## DunsPlus Installation and Service Manual

A copy of the *DunsPlus Installation, and Service* manual will be shipped with each system and an additional two copies will be shipped to each IBM BO servicing DunsPlus installations. The DunsPlus Installation and Service Diskette is included with the manual.

## Maintenance

The DunsPlus system will be serviced in a unique manner. IBM customer engineers will provide on-site installation of the hardware and software, and on-site service of the hardware. The hardware is the same as other PC XTs, except for two new adapters that have their own diagnostics and PICs.

Both installation and service will be directed by the *DunsPlus Installation and Service* manual in conjunction with the *PC XT HMS* manual. Some of the DunsPlus diagnostics are installed on the advanced diagnostic diskette and some are installed on the fixed disk. The diagnostics installed on the fixed disk are maintained by DunsPlus. The unique diagnostics that are on the advanced diagnostic diskette can only be invoked after the diagnostic program senses it is being run on a DunsPlus system.

A DunsPlus support center will provide an interface between a DunsPlus user and IBM customer engineer. The DunsPlus support center will provide the IBM customer engineer with FRU/element exchange information when placing a service call. The IBM customer engineer will also be furnished with the DunsPlus host dialing sequence to be used in testing the communication link and to report service call information at the completion of each service call.

The *DunsPlus Installation and Service* manual and its own special diskette will be shipped with each system as part of the shipping group.

## Service Calls

Service calls are placed via DunsPlus customer support, which screens the calls prior to notifying IBM. Installations are handled in the same manner. Using this technique, DunsPlus customer support will not only minimize installation problems but also reduce unnecessary service calls. Whenever possible, the IBM customer engineer will be asked to bring a particular FRU to a service call (again minimizing outage).

## Electronic Call Reporting

The IBM customer engineer will supply the DunsPlus support center (via direct entry into the DunsPlus system) the following information:

- Machine type and serial for repairs, element exchange, and installations
- Major code for FRU replacement incidents.

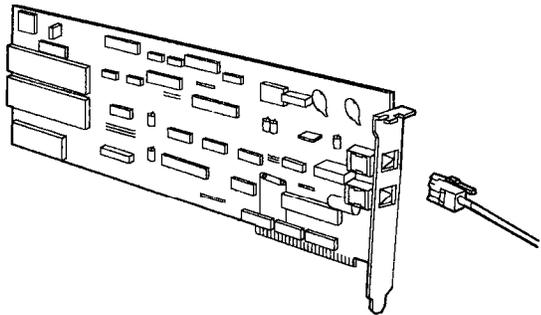
Internal IBM incident reporting will remain the same.

## DunsPlus Hardware

Two new pieces of hardware and a specific hardware rule are part of the DunsPlus system:

- The Internal Modem Adapter is a microprocessor-based modem that operates at 300 or 1200 bps and provides auto-dial and auto-answer capabilities.
- The Printer/Register Adapter is like the Parallel Printer Adapter with special register for DunsPlus system security. It is not interchangeable with a Parallel Printer Adapter.

### Internal Modem Adapter



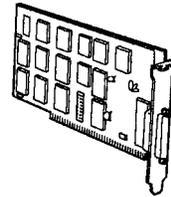
LEX40044

Figure 6-10. Internal Modem Adapter

The Internal Modem Adapter contains auto-call logic that is used by the customer to establish a connection with the host system. The DunsPlus documentation may refer to autocal as Dialer or Auto-Dialer. The Internal Modem Adapter functions as an alternate Asynchronous Communications Adapter with a built-in modem. The advanced diagnostic tests identify this adapter as Alt Async Communications Adpt on the Installed Devices screen. When the advanced diagnostics have finished testing the adapter, they will direct the IBM customer engineer to the *DunsPlus Installation and Service* manual to complete the communication link test. The part number for the Internal Modem Adapter will be included in the *DunsPlus*

*Installation and Service* manual. The adapter is easily identified by the two modular telephone jacks on the rear of the adapter. The telephone plugs into the bottom receptacle and the wall connector plugs into the top receptacle.

### Printer/Register Adapter



LEX40110

Figure 6-11. Printer/Register Adapter

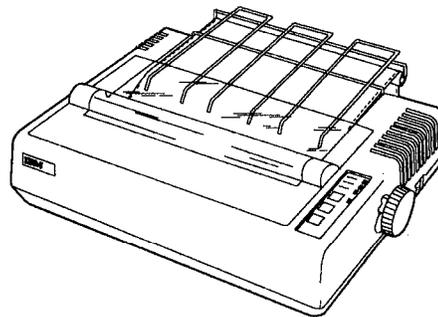
The Printer/Register Adapter is included in the DunsPlus system. It contains the normal Parallel Printer Adapter as well as an 8-bit register used by the DunsPlus system for security. This 8-bit register stores the users' identification, which allows them access to the DunsPlus network. The part number for the Printer/Register Adapter is included in the *DunsPlus Installation and Service* manual.

## Printers

Two printers are available for the DunsPlus system:

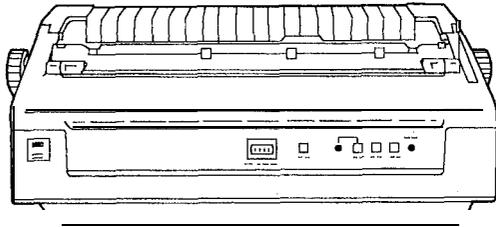
- The standard IBM 80 CPS Graphics Printer (5152)
- The NEC Model 3550 Letter-Quality Printer, which is a FRU.

Both printers are serviced on an exchange basis through IBM Service.



LEX40111

Figure 6-12. IBM 5152 Printer



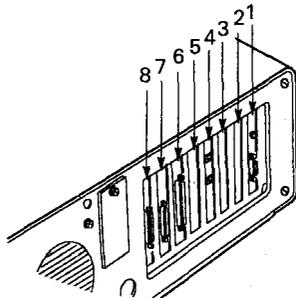
LEX40112

Figure 6-13. NEC 3550 Printer

## FRU Locations

The FRU locations on the PC XT board are fixed. They are shown in Figure 6-14 and are as follows:

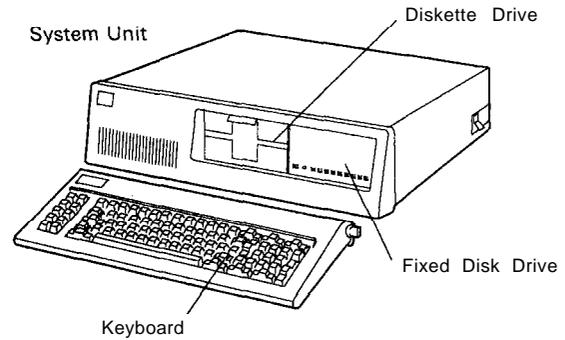
- Position 1 Color/Graphics Monitor Adapter
- Position 2 Open
- Position 3 Open
- Position 4 Internal Modem Adapter
- Position 5 Fixed Disk Adapter
- Position 6 Diskette Drive Adapter
- Position 7 Printer/Register Adapter
- Position 8 Asynchronous Communications Adapter.



LEX40113

Figure 6-14. PC XT Board FRU Locations

## 5160 XT/370



LEX40128

Figure 6-15. 5160 XT/370

The XT/370 is an extended version of the 5160 XT with 256Kb of memory on the system board. The system unit has two XT/370 Adapter cards plugged into the system board:

- The Processor card (PC/370-P) in expansion slot 4
- The 512Kb Memory card (PC/370-M) in expansion slot 3.

Options available include:

- A Remote Display Terminal Device Emulation Adapter card
- IBM 3278/79 Emulation Adapter.

Note: A Remote Display Terminal Device Emulation Adapter card can be in expansion slot 2.

The XT/370 can be used as a 10Mb system (one fixed disk drive in the system unit) or a 20Mb system (two fixed disk drives in an expansion unit).

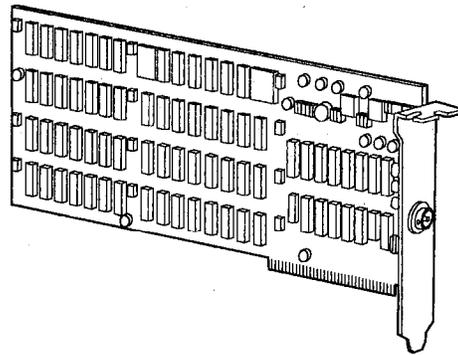
**Note:** Older models of the PC XT/370 might contain a PC/3277EM card. (This option provides 3277-2 emulation when the PC XT/370 is attached to a host system.)

## Unit Specifications

<b>System Unit Size</b>	
Height	142 mm (5.5 in)
Length	500 mm (19.6 in)
Depth	410 mm (16.1 in)
Weight	14.5 kg (32 lb)
<b>Power Cable</b>	
Length	1.83 m (6 ft)
Size	18 AWG
<b>Environment</b>	
Air Temperature	
System On	15.6° to 32.2°C (60° to 90°F)
System Off	10° to 42°C (50° to 110°F)
Humidity	
System On	8% to 80%
System Off	20% to 80%
Heat Output	650 BTU/hr
Noise Level	49.5 dBa System unit with monochrome display and expansion unit attached.
<b>Electrical</b>	
Nominal	120V AC
Minimum	104V AC
Maximum	127V AC
<b>Keyboard</b>	
Size	
Height	57 mm (2.2 in)
Length	500 mm (19.6 in)
Depth	200 mm (7.87 in)
Weight	2.9 kg (6.5 lb)

Figure 6-16. 5160 XT/370 Specifications

## PC/3277EM Card

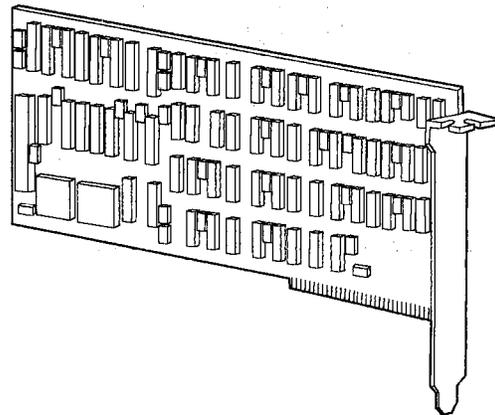


LEX40129

Figure 6-17. PC/3277EM Card (Used in PC XT/370 only)

The PC/3277EM card allows the PC XT/370 to emulate a 3277-2 terminal when the PC XT/370 is linked to a host system. This card also allows additional functions to those of the 3277 when supported with suitable software. These additional functions include the ability to print single screens, complete listings, or other files on the PC XT printer, and the ability to transfer data between the PC XT/370 and the host system disks.

## PC/370-P Card

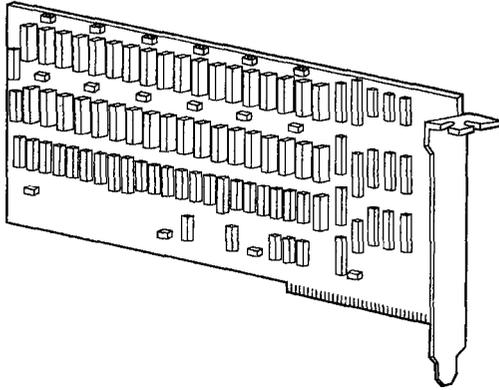


LEX40130

Figure 6-18. PC/370-P Card

The PC/370-P card is the center of the S/370 operations for the PC XT/370. The PC/370-P card contains the microprocessors and control circuits that enable the PC XT/370 to execute S/370 instructions.

## PC/370-M Card

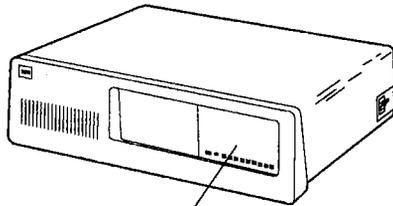


LEX40131

Figure 6-19. PC/370-M Card

The PC/370-M card contains 512Kb of parity-checked, random access memory (RAM), which can be used by either the PC/370-P card or by the PC XT. This provides 512Kb of memory for use in S/370 mode, or a total of 640Kb of memory for use in PC XT mode.

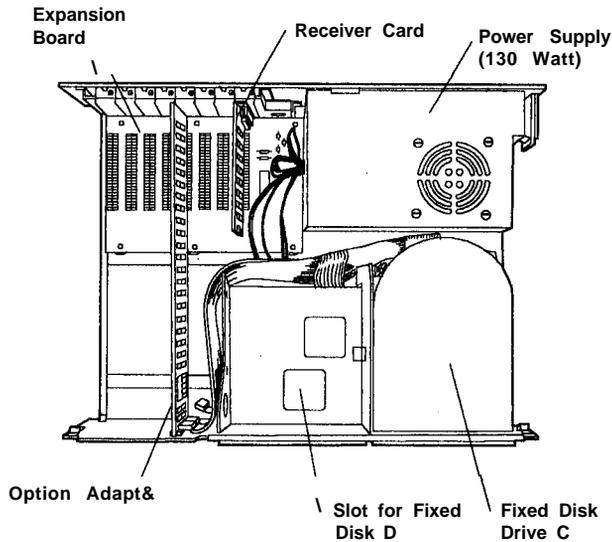
# Chapter 7. 5161 Expansion Unit



10Mb Fixed Disk Drive

LEX40079

Figure 7-1. 5161 Expansion Unit



LEX40080

Figure 7-2. 5161 Expansion Unit (Cover Removed)

Note: This unit is not supported on 5160 Models 088, 089, 267, 268, 277, and 278.

The 5161 Expansion Unit provides additional configuration flexibility for the 5150 Personal Computer and the 5160 Personal Computer XT. Each expansion unit contains a 10Mb fixed disk drive and eight option extension card slots. One additional 10Mb fixed disk drive may be installed for a total of 20Mb of fixed disk storage. The power supply used in the expansion unit is a PC XT 130-watt power supply.

The IBM Expansion Unit option enhances the system unit by adding expansion slots in a separate unit. This option consists of an Extender card, expansion unit cable, and the expansion unit. The expansion unit con-

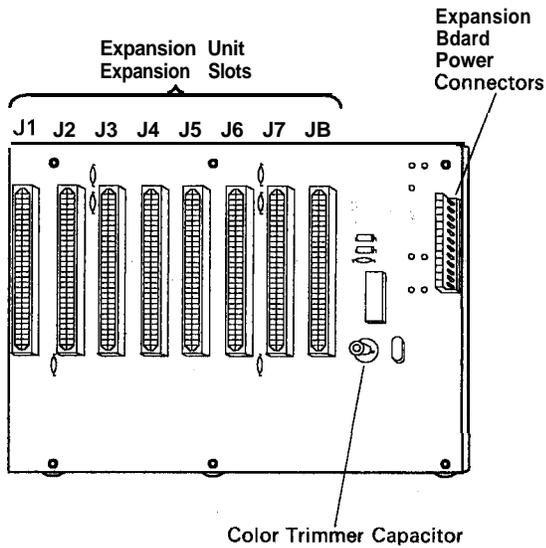
tains a power supply, an expansion board, and a Receiver card. This option utilizes one expansion slot in the system unit to provide seven additional expansion slots in the expansion unit.

## Unit Specifications

<b>Size</b>	
Height	142 mm (5.5 in)
Length	500 mm (19.6 in)
Depth	410 mm (16.1 in)
<b>Weight</b>	
	14.9 kg (33 lb)
<b>Power Cable</b>	
Length	1.83 m (6 ft)
Size	18 AWG
<b>Signal Cable</b>	
Length	1 m (3.28 ft)
Size	22 AWG
<b>Environment</b>	
Air Temperature	
System On	15.6° to 32.2°C (60° to 90°F)
System Off	10° to 43°C (50° to 110°F)
Humidity	
System On	8% to 80%
System Off	20% to 80%
<b>Heat Output</b>	
	750 BTU/hr
<b>Noise Level</b>	
	49.5 dBA
	Expansion unit attached to system unit with monochrome display
<b>Electrical</b>	
Nominal	120V AC
Minimum	104V AC
Maximum	127V AC
kva	0.41 max.

Figure I-Y. 5161 Specifications

## Expansion Board



LEX40081

Figure 7-4. 5161 Expansion Board

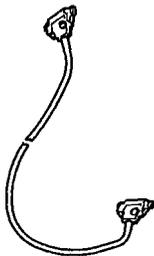
The expansion board is a support board that carries the I/O channel signals from the option adapters and Receiver card.

Decoupling capacitors provided on the expansion board aid in noise filtering.

### Using Expansion Slot 8

Any card placed in expansion slot 8 is expected to respond with a card select signal. Only one IBM Card provides this signal, the Asynchronous Communications Adapter. In order to provide this signal, jumper J13 must be installed on the card. Any card not providing this signal will not be recognized.

## Expansion Unit Cable



LEX40082

Figure 7-5. Expansion Unit Cable

The expansion unit cable consists of a 56-wire, foil-shielded cable terminated on each end with a 62-pin D-shell male connector. Either end of the expansion unit cable can be plugged into the extender card or the receiver card.

## Extender Card Switch Settings

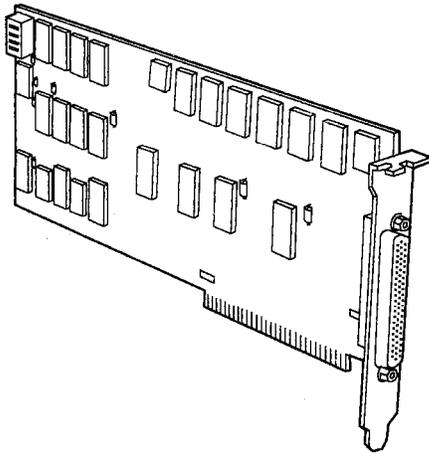
The following chart shows the switch settings of the extender card switch block in conjunction with memory of various sizes. The adapter is found inside the system unit, not in the 5161 Expansion Unit.

System Memory	Extender Card Switch Block	Memory Segment
16K to 64K		1
96K to 128K		2
160K to 192K		3
224K to 256K		4
288K to 320K		5
352K to 384K		6
416K to 448K		7
480K to 512K		8
544K to 576K		9
608K to 640K		A

LEX40194

Figure 7-6. Extender Card Switch Settings

## Extender Card, P/N6323445



LEX40083

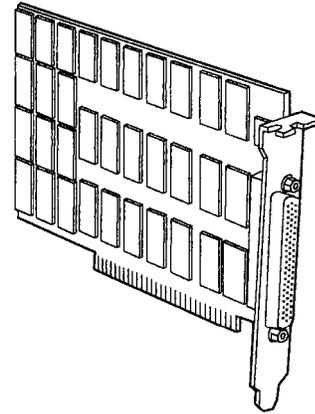
Figure 7-7. Extender Card (Right View)

The Extender card is a four-plane card. It redrives the I/O channel to provide sufficient power to avoid capacitive effects of the cable. The Extender card presents only one load per line of the I/O channel.

The Extender card has a wait-state generator that inserts a wait state on memory-read and memory-write operations (except refreshing) for all memory contained in the expansion unit. The address range for wait-state generation is controlled by switch settings on the Extender card.

The dual in-line package (DIP) switch on the Extender card should be set to indicate the maximum contiguous read/write memory in the system unit.

## Receiver Card, P/N8529251

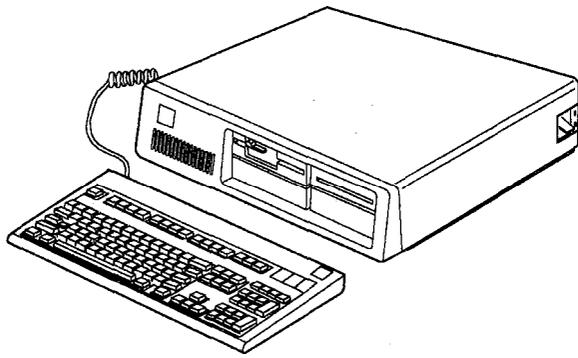


LEX40084

Figure 7-8. Receiver Card (Right View)

The Receiver card is a four-plane card that fits in expansion slot 8 of the expansion unit. It redrives the I/O channel to provide sufficient power for additional options and to avoid capacitive effects. Directional control logic is contained on the Receiver card to resolve contention and direct data flow on the I/O channel. Steering signals are transmitted back through the expansion unit cable for use on the Extender card.

# Chapter 8. 5162 PC XT Model 286



LEX42627

Figure 8-1. 5162 PC XT

The IBM Personal Computer XT Model 286 is an enhancement of the Personal Computer XT family. A standard configuration includes an Intel 80286 6 MHz Microprocessor with zero wait-state, 640Kb of memory, one diskette drive, and one fixed disk. Extensive special features and software are available which provide compatibility with the rest of the IBM PC family.

## Unit Specifications

System Unit Size	
Height	142 mm (5.5 in)
Length	500 mm (19.6 in)
Depth	410 mm (16.1 in)
Weight	12.7 kg (28 lb)
Power Cable Length	1.8 m (6 ft)
Environment	
Air Temperature	
System On	15.6° to 32.2°C (60° to 90°F)
System Off	10° to 43°C (50° to 110°F)
Humidity	
System On	8% to 80%
System Off	20% to 80%
Heat Output	824 BTU/hr max.

Noise Level	46 dBa System Unit without display or printer attached
Electrical	
Range 1 (57-63 Hz)	
Nominal	115V AC
Minimum	90V AC
Maximum	137V AC
Range 2 (47-53 Hz)	
Nominal	230V AC
Minimum	180V AC
Maximum	265V AC
Lithium Battery	6.0V DC 1 amp/hr capacity UL Approved

Figure 8-2 (Part 2 of 2). 5162 Specifications

## 5162 PC XT Standard Features

The following are standard features of the 5162 Model 286:

- Power supply
  - 157-watt
  - Internally switched to support 115V AC or 230V AC.
- System board
  - 80286 Microprocessor
  - 6 MHz Clock
  - 8 Expansion Slots
    - 5 with a 36-pin and 62-pin card edge socket
    - 3 with only the 62-pin card edge socket.
  - 640Kb base random access memory (RAM)
  - Complementary metal oxide semiconductor (CMOS) RAM to maintain the system setup configuration
  - Battery to keep CMOS active when power is off.
- Speaker
- Half-high 1.2Mb diskette drive
- 20Mb fixed disk drive
- 101/102-key keyboard.

## Incompatible Adapters

Certain option adapters are not compatible when used in the same system.

The following adapters should not be installed together in the 5162 System Unit:

- Synchronous Data Link Control (SDLC)
- Alternate Binary Synchronous Communications (Alt. BSC).

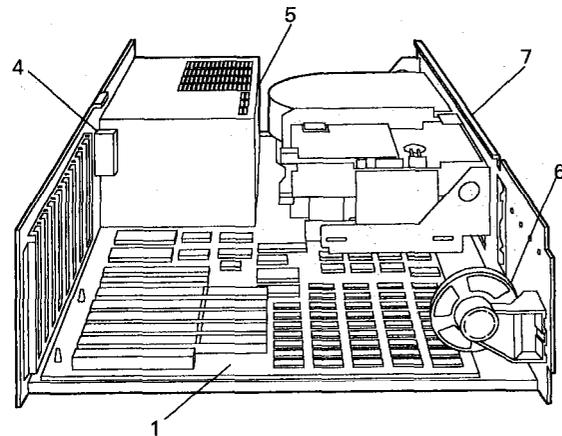
Problems might occur in the system because of adapters that share the same interrupt level. Check the adapter interrupt levels to be sure that they do not conflict. If the adapters have selectable interrupt levels, be sure their jumpers are not set for the same level.

Some options not supported by the IBM Personal Computer XT Model are:

- Expansion Unit
- AT 128Kb Memory Expansion
- AT 512Kb Memory Expansion
- AT 128Kb/640Kb Memory Expansion
- AT Fixed Disk and Diskette Drive Adapter
- 256Kb Memory Expansion
- 64Kb/256Kb Memory Expansion
- 64Kb Memory Module Kit
- Full-high diskette drives
- AT 30Mb Fixed Disk Drive
- AT 20Mb Fixed Disk Drive
- 10Mb fixed disk drive
- AT Prototype card
- Diskette Drive Adapter
- Fixed Disk Adapter
- 8087 Math Coprocessor
- Professional Graphics Adapter and Display
- Game Control Adapter
- Color printer
- Other keyboards.

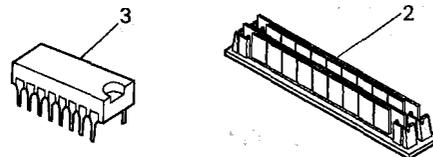
## System Differences

This section shows the differences between the PC XT 5162 and the rest of the PC family.



LEX42454

Figure 8-3. 5162 System Unit (Left Side View, Cover Removed)



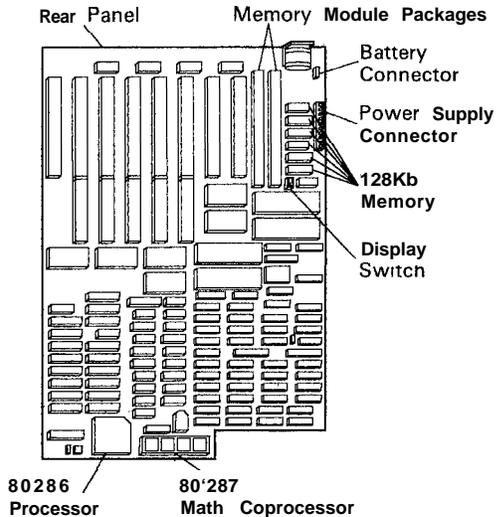
LEX42651

Figure 8-4. 5162 System Unit Memory Modules

Asm - Index	Description
<b>2-1</b>	System Board
-2	256Kb Memory Module Package
-3	64Kb x 4 Memory Module
-NS	Parity Module, System Board
-4	Battery Holder
-5	Power Supply
-6	Speaker Assembly
-7	Base Frame Assembly

## System Board

The 640Kb System Board uses two 256Kb memory module packages and a 128Kb memory blank consisting of two parity modules and four 64Kb x4 memory modules.



LEX42455

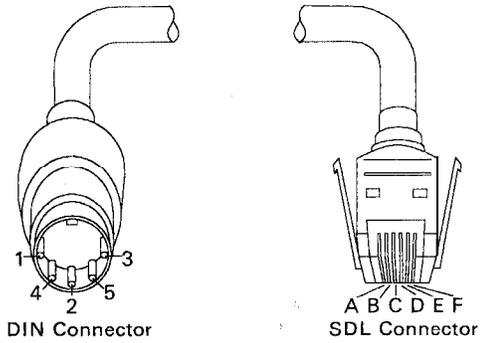
Figure 8-5. 5162 System Board

## Keyboard

The 5162 PC XT Keyboard is a 101/102-key keyboard. This keyboard has a serial interface and attaches to a 5-pin connector in the back of the 5162 via a 9-foot coiled cable.

## Cabling

The keyboard cable connects to the system with a 5-pin DIN connector and to the keyboard with a six-position SDL connector. The following table shows the pin configuration and signal assignments.



DIN Connector Pins	SDL Connector Pins	Signal Name	Signal Type
1	D	+KBD CLK	Input/Output
2	B	+KBD DATA	Input/Output
3	F	Reserved	
4	C	Ground	Ground
5	E	+5.0 Vdc	Power
Shield	A	Not used	
	Shield	Frame Ground	

LEX42456

Figure 8-6. 5162 Keyboard Connectors

## Serial/Parallel Adapter

One Serial/Parallel Adapter is standard in the 5162. This adapter provides one serial port and one parallel port.

## 20Mb Fixed Disk Drive

The fixed disk drive used in the 5162 PC XT can store up to 20Mb of data. Reading from and writing to this drive is initiated in the same way as the other models of PC XT; however, the 5162 PC XT Fixed Disk and Diskette Drive Adapter may be addressed from different BIOS locations.

## High-Capacity Diskette Drive

One 5.25-inch high-capacity diskette drive in addition to the standard high-capacity diskette drive can be installed in a 5162 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.

The second high-capacity diskette drive is installed below the standard high-capacity diskette drive in the 5162 and addressed as drive B. It is mutually exclusive with the 5.25-inch 360Kb diskette drive, 3.5-inch internal diskette drive, and the 4865 Model 002 External 3.5-inch Diskette Drive.

The high-capacity diskette drive uses a different 5.25-inch diskette from that used in the IBM PC configurations with the 8088 Microprocessor to achieve a 1.2Mb capacity. This drive can also read from both sides of a double-sided, 320Kb/360Kb-capacity, 5.25-inch diskette or from one side of a single-sided, 160Kb/180Kb-capacity, 5.25-inch diskette. However, if these diskettes have been written on by a high-capacity diskette drive they might not be readable.

Note: Diskettes designed for use in this drive cannot be used in either a 160Kb/180Kb or 320Kb/360Kb diskette drive in the 1.2Mb mode.

### 5.25-Inch 360Kb Diskette Drive

One 5.25-inch 360Kb diskette drive can be installed in a 5162 System Unit in addition to the standard high-capacity diskette drive. It attaches to the Fixed Disk and Diskette Drive Adapter and is offered to read and write 5.25-inch diskettes that are to be used in IBM Personal Computer configurations that do not have a 5.25-inch (1.2Mb) high-capacity diskette drive.

This diskette drive can read and write single-sided (160Kb/180Kb capacity) and double-sided (320Kb/360Kb capacity), double-density, soft-sectored, 5.25-inch diskettes. This drive is required in the 5162 to maintain diskette portability only if writing is to be done to single- and/or double-sided diskettes that are also used in IBM Personal Computer configurations without a 5.25-inch high-capacity diskette drive. Such diskettes can be read-only using the high-capacity diskette drive.

### 3.5-Inch Internal Diskette Drive

One 3.5-inch internal diskette drive with a 720Kb capacity can be installed in a 5162 unit to provide approximately 2Mb of online diskette storage when a second 5.25-inch high-capacity diskette drive, the 5.25-inch 360Kb diskette drive, or the 4865 Model 002 External 3.5-inch Diskette Drive is not installed. This 3.5-inch drive is a half-height drive that is installed below the standard high-capacity diskette drive. It attaches to the Fixed Disk and Diskette Drive Adapter and is addressed as B.

This 3.5-inch diskette drive reads and writes the 3.5-inch doubled-sided, high-capacity (2 HC) diskette and is housed in a rigid plastic case that contains a built-in write-protect switch. The plastic cases have an integrated protection mechanism (a metal, spring-loaded slide cover) for the area of the diskette that will be accessed by the read/write heads of the diskette drive. DOS Version 3.2 is required to use a 3.5-inch diskette drive.

## Fixed Disk and Diskette Drive Adapter

One Fixed Disk and Diskette Drive Adapter is present in slot 6 and is the only Fixed Disk and Diskette Drive Adapter that can be installed in a 5162 configuration.

Up to three drives, two diskette drives, and one fixed disk drive can be attached to this adapter. The two attached diskette drives can be:

- Two 5.25-inch high-capacity diskette drives
- One high-capacity diskette drive and one 5.25-inch 360Kb diskette drive
- One high-capacity diskette drive and one 3.5-inch diskette drive (3.5-inch internal diskette drive or 4865 Personal Computer 3.5-Inch External Diskette Drive Model 002).

The External Diskette Drive Adapter provided with the 4865 Model 002 External 3.5-Inch Diskette Drive also attaches to the Fixed Disk and Diskette Drive Adapter.

## Power Supply

The system power supply located inside the system unit provides power for the system board, the adapters, the diskettes drives, the fixed disk drive, the keyboard, and the IBM Monochrome Display.

## Inputs

The power supply can operate at 110V AC, 4.6A or 220/240V AC, 2.3A at frequencies of either 60 ±3 Hz or 50 ±3 Hz. The power supply automatically adjusts to input voltages of 110V AC or 220V AC. The following figure shows the input requirements.

Range	Voltage (V AC)	Current (Amps)
115V AC	Minimum 90	Maximum 4.6
	Maximum 137	
230V AC	Minimum 180	Maximum 2.3
	Maximum 265	

Figure 8-7. 5170 Input Requirements

## outputs

The power supply provides + 5, -5, + 12, and -12V DC. The following figure shows the load current and regulation tolerance for these voltages. The power to the IBM Monochrome Display is controlled by the power supply.

**Warning:** The voltage provided to the monochrome display from the power supply is the same as the input line voltage to the power supply. Ensure that the monochrome display is the correct model for the input line voltage.

Nominal Output	Load Current (A)		Regulation Tolerance
	Minimum	Maximum	
+5V DC	4.0	20.0	+5% to -4%
-5V DC	0.0	0.3	+10% to -8%
+12V DC	1.0	4.2	+5% to -4%
-12V DC	0.0	0.25	+10% to -9%

Figure 8-8. 5162 DC Load Requirements

## DC Output Protection

An overcurrent condition will not damage the power supply.

## Output Voltage Sequencing

Under normal conditions, the output voltage levels track within 50 milliseconds of each other when power is applied to or removed from the power supply, provided at least minimum loading is present.

## No-Load Operation

No damage or hazardous conditions occur when primary power is applied with no load on any output level. In such cases, the power supply may switch off, and a power-on reset will be required. The power supply requires a minimum load for proper operation.

## Power-Good Signal

The power supply provides a power-good signal to indicate proper operation of the power supply.

When the supply is switched off for a minimum of 1 second and then switched on, the power-good signal is generated, assuming there are no problems. This signal is a logical AND of the DC output-voltage sense signal and the AC input-voltage sense signal. The power-good signal is also a TTL-compatible high level for normal operation and a low level for fault conditions. The AC fail signal causes power-good to go to a low level at least 1 millisecond before any output voltage falls below the regulation limits. The operating point used as a reference for measuring the 1 millisecond is normal operation at minimum line voltage and maximum load.

The DC output-voltage sense signal holds the power-good signal at a low level when power is switched on until all output voltages have reached their minimum sense levels. The power-good signal has a turn-on delay of at least 100 milliseconds but not longer than

500 milliseconds and is capable of sourcing 2 milliamperes and sinking 10 milliamperes.

The following figure shows the minimum sense levels for the output voltages.

Level (V DC)	Minimum (V DC)
+5	+4.5
-5	-4.3
+12	+10.8
-12	-10.2

Figure 8-9. 5162 Sense Levels

## Connectors

The following figure shows the pin assignments for the power-supply output connectors.

Load Point	Voltage (V DC)
P8-1	Power Good*
P8-2	+5
P8-3	+12
P8-4	-12
P8-5	Ground
P8-6	Ground
P9-1	Ground
P9-2	Ground
P9-3	-5
P9-4	+5
P9-5	+5
P9-6	+5
P10-1	+12
P10-2	Ground
P10-3	Ground
P10-4	+5
P11-1	+12
P11-2	Ground
P11-3	Ground
P11-4	+5

\* See Power-Good Signal

Figure 8-10. 5162 Power Supply Output Connectors

## Battery

The 5162 battery is a 6-volt, life-long lithium battery, which is attached to the battery connector at the back of the system board.

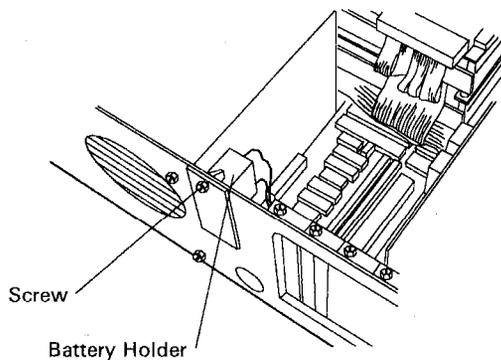
The 5162 battery is considered a FRU part, P/N72X8498, which carries the one-year warranty of the 5162 system unit. The battery FRU part carries the normal go-day parts warranty.

When replacement of the battery is required, follow the directions below:

- Power off the system.
- From the rear of the system unit, remove the screw in the battery holder door.
- Replace the battery using caution to insert the battery in the correct position with the battery terminals facing into the system unit.

**Note:** 5162 System Units are shipped with the battery in the reserve position to prolong life expectancy of the battery.

Disregard the battery replacement instructions and part number provided in the 5162 *Guide to Operations* manual, Section 3.



LEX42457

Figure 8-11. 5162 Battery Location

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## 5162 PC XT/286 Diagnostic/Switch Setting Information

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### Error Codes

You might have an error code or an audio response during power-on self test (POST). If you have both an error code and an audio error, disregard the audio error and perform advanced diagnostics on the FRU indicated.

### Power-On Self Test

The POST is initiated automatically with each power on of the system. The POST can be invoked at any time by pressing the Ctrl key, the Alt key, and the Del key at the same time, then releasing them.

The POST is a series of system checks and initialization that verifies the correct operation of the base

system. Two classifications of malfunctions that can be detected during the POST are critical and non-critical.

Critical malfunctions prevent the system from operating, at all or could cause incorrect results that are apparent to the user.

Non-critical malfunctions are those that cause incorrect results that might not be apparent to the user.

If a critical error is detected during the POST, an attempt is made to indicate the error and all testing will halt. On a non-critical error, an error code is displayed and the testing is stopped. Testing can be continued on a non-critical error by pressing the F1 key.

After a successful POST, in which no critical errors are detected, a single short beep will be generated. Control is then given to the system boot strap loader.

It is important to remember that the POST does not test all areas, but only those that allow the system to be operational enough to run the advanced diagnostics program.

---

## 5162 PC XT/286 Diagnostics

For a Symptom-to-FRU Index and additional diagnostic information, refer to the Service Summary Cards supplied with this manual.

---

## Memory Switch Settings

The switches on the memory options are divided into two sections:

- Switches 1-5 determine the starting address for the expansion memory installed on the option.
- Switches 6, 7, and 8 are not used on the 512Kb/2Mb Memory Expansion option.

### Starting Address (Switches 1 through 5)

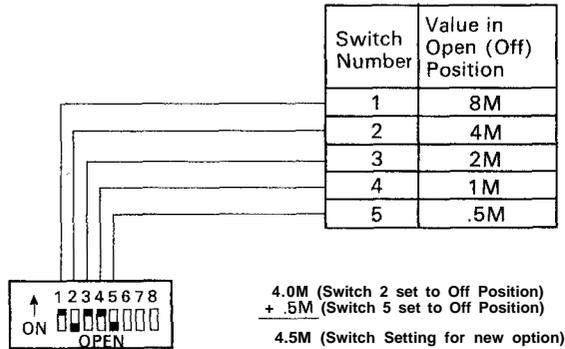
The switch settings can be determined through the following procedure. Assume you have 3.5Mb of expansion memory installed in your system and you are installing another memory option.

1. Establish your starting address by adding the amount of expansion memory already installed (3.5Mb) to the starting address for expansion memory.

3.5M (Amount of expansion memory installed)  
+1.0M (Starting address for expansion memory)  
4.5M (Starting address for next option)

LEX42507

2. In the following table, find the values that, when added, equal 4.5Mb.



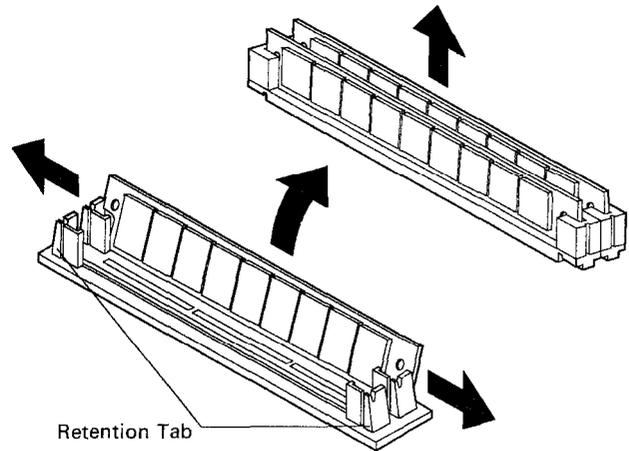
LEX42508

Figure 8-12. Memory Switch Settings

## Memory Module Package

1. Power off the system.
2. Remove the system unit cover.
3. Find the failing memory module package on the system board (MAP 0200: Memory, in the *HMS* manual).
4. Grasp the memory module packages and lift them from the system board.

**Note:** Some memory module packages are held in place by two retention tabs. The rear memory module package must be removed first. Gently spread the two tabs apart while lifting at a slight angle on the memory module package.



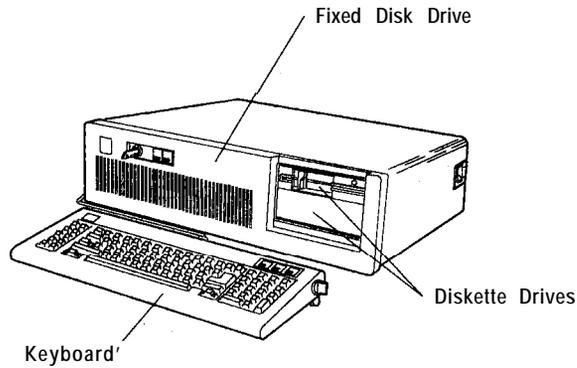
LEX42509

Figure 8-13. Memory Module Package

## 5162 PC XT/286 Switch Setting Information

For further information on Memory Expansion Adapter switch settings, refer to Chapter 17.

# Chapter 9. 5170 Personal Computer AT



LEX41703

Figure 9-1. 5170 Personal Computer AT

The 5170 Personal Computer AT features the 32bit, 80286 Processor, 7-channel direct memory access (DMA), 12SKb read-only memory (ROM), 256Kb or 512Kb random access memory (RAM) on system board, RAM expandable to 3Mb with 512Kb Memory Expansion options, eight I/O slots, keyboard, one 1.2Mb high-capacity diskette drive, a 20Mb or 30Mb fixed disk drive, and a keylock for security.

## System Differences

This section shows the differences between the IBM Personal Computer AT and the rest of the IBM Personal Computer family.

### 5170 Base Models

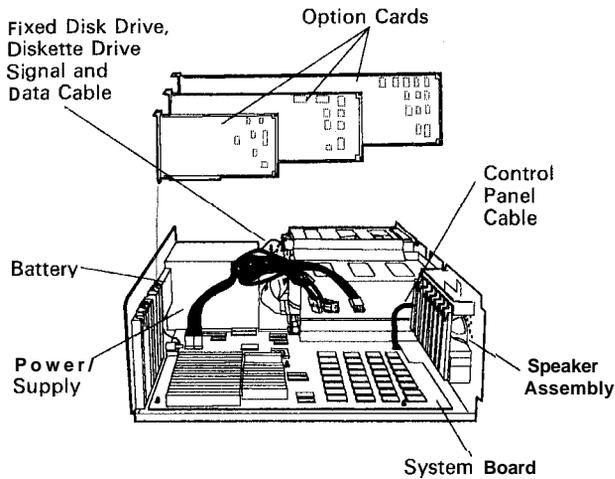
There are five base models of the Personal Computer AT; the different models can be identified by serial number ranges.

Model	Serial Number Range
068	5000000 - 5999999
099	0000001 - 0999999
239	6000000 - 6999999
319/339	7000000 - 7999999

## Unit Specifications

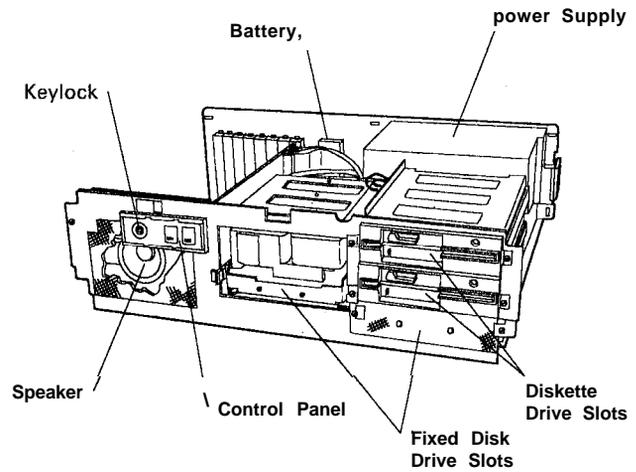
<b>System Unit Size</b>	
Height	162 mm (6.8 in)
Length	540 mm (21.3 in)
Depth	439 mm (17.3 in)
Weight	19.05 kg (42 lb)
<b>Power Cable</b>	
Length	1.8 m (6 ft)
Size	18 AWG
<b>Environment</b>	
Air Temperature	
System On	15.6° to 32.2°C (60° to 90°F)
System Off	10° to 43°C (50° to 110°F)
Humidity	
System On	8% to 80%
System Off	20% to 80%
Altitude	
	2133.6 m 7000 ft max.
Heat Output	1100 BTU/hr
Noise Level	42 dBa Meets Class 3
<b>Electrical</b>	
VA - 450	
Range 1	
Nominal	120V AC
Minimum	104V AC
Maximum	127V AC
kva	.635 max.
Range 2	
Nominal	230V AC
Minimum	200V AC
Maximum	240V AC
kva	0.575 max.

Figure 9-2. 5170 Specifications



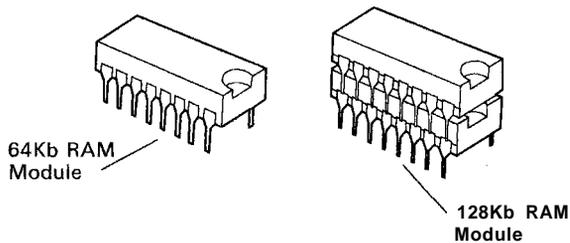
LEX40086

Figure 9-3. 5170 System Unit (Rear View, Cover Removed)



LEX40088

Figure 9-5. 5170 System Unit (Front View, Cover Removed)



LEX40087

Figure 9-4. 5170 System Unit RAM Modules

## System Board

The IBM Personal Computer AT system board uses an Intel 80286 Microprocessor that is generally compatible with the Intel 8088 Microprocessor used in the rest of the IBM Personal Computers.

The system board expansion slots in the IBM Personal Computer AT have a 36-pin connector in addition to the 62-pin connector. Adapters designed to make use of the 36-pin connector are not compatible with the rest of the IBM Personal Computers.

## Keyboard

The IBM Personal Computer AT utilizes two styles of keyboards. The 84-key unit is used on the Models 068, 099, 239, and 319. The 101-key enhanced unit is used on the Model 339 only. However, it may be used on the Model 319, but it is not supported on the other models.

## 20Mb Fixed Disk Drive

The fixed disk drive used in the IBM Personal Computer AT can store up to 20Mb of data. Reading from and writing to this drive is initiated in the same way as with the Personal Computer XT; however, the IBM Personal Computer AT Fixed Disk and Diskette Drive Adapter may be addressed from different BIOS locations.

## 30Mb Fixed Disk Drive

The 30Mb disk drive is a standard feature on Models 239, 319, and 339 and is available as an option on other models. The 30Mb fixed disk drive can be purchased as a 30Mb upgrade kit and installed in Models 068 and 099. The 30Mb upgrade kit includes the 30Mb fixed disk drive and two BIOS modules to be installed on the system board.

## High-Capacity Diskette Drive

This diskette drive is capable of reading and writing diskettes in 160Kb/180Kb, 320Kb/360Kb, and 1.2Mb modes. However, if a diskette formatted in either the 160Kb/180Kb or 320Kb/360Kb mode is written on by this diskette drive, that information can only be read by a high-capacity diskette drive.

Note: Diskettes designed for use in this drive cannot be used in either a 160Kb/180Kb or a 320Kb/360Kb diskette drive in the 1.2Mb mode.

## Hardware Considerations

The following are hardware features of the IBM Personal Computer AT that are not supported by the rest of the IBM Personal Computer Family.

### Adapters

The IBM Personal Computer AT 128Kb Memory Expansion Option, the IBM Personal Computer AT 512Kb Memory Expansion Option, the IBM Personal Computer AT Prototype Adapter, and the IBM Personal Computer AT Fixed Disk and Diskette Drive Adapter use the additional 36-pin system board expansion slot and are not compatible with the rest of the IBM Personal Computer Family.

The IBM Personal Computer AT does not support:

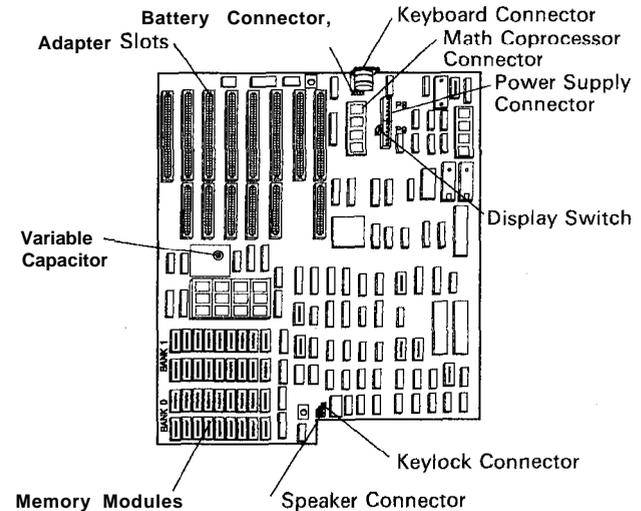
- Expansion unit
- IBM Asynchronous Communications Adapter
- IBM 64Kb/256Kb Memory Expansion Adapter
- IBM Printer Adapter
- Other keyboards.

### Incompatible Adapters

Certain option adapters conflict with each other when used in the same system. The following adapters should not be installed together in your system unit:

- Synchronous Data Link Control (SDLC)
- Alternate Binary Synchronous Communications (Alt. BSC).

## System Board



Front

LEX40089

Figure 9-6. 5170 System Board (Full Size, Front View)

Full-Size Dimensions: 13.5 x 12.

Down-Size Dimensions: 13.5 x 9.5 (not shown).

The system board has the following components:

- Intel 80286 Microprocessor
- System support function:
  - 7-channel direct memory access (DMA)
  - 16-level interrupt
  - System clock
  - Three programmable timers.
- 64Kb ROM subsystem, expandable to 128Kb
- Either a 256Kb or a 512Kb RAM subsystem
- Speaker attachment
- Complementary metal oxide semiconductor (CMOS) memory RAM to maintain system configuration
- Real-time clock
- Battery backup for CMOS configuration table and real-time clock
- Keyboard attachment
- Eight input/output (I/O) slots:
  - 6 with a 36- and a 62-pin card-edge socket
  - 2 with only the 62-pin card-edge socket.

## Memory

The full-size system board has four banks of memory sockets, each supporting nine 128Kb x 1 modules for a total maximum memory size of 512Kb with parity checking.

The down-size system has two rows of nine 256Kb x 1 memory modules for a total of 512Kb of memory with parity checking.

## Microprocessor

The Intel 80286 Microprocessor has a 24-bit address bus, a 16-bit data bus and extensive instruction set, DMA and interrupt support capabilities, a hardware fixed-point multiply and divide, integrated memory management, four-level memory protection, 1 gigabyte (1,073,741,824 bytes) of virtual address space for each task, and two operating modes: the 8086-compatible real-address mode and the protected virtual-address mode.

## Interface

The keyboard uses a bidirectional serial interface to carry signals between the keyboard and system unit.

## Sequencing Key Code Scanning

The keyboard is able to detect all keys that are pressed, and their scan codes will be sent to the interface in correct sequence, regardless of the number of keys held down. Keystrokes entered while the interface is inhibited (when the keylock is on) will be lost. Keystrokes are stored only when the keyboard is not serviced by the system.

## Buffer

The keyboard has a 16character first-in/first-out (FIFO) buffer where data is stored until the interface is ready to receive it.

A buffer-overflow condition will occur if more than 16 codes are placed in the buffer before the first keyed data is sent. The 17th code will be replaced with the overrun code, hex 00. (The 17th position is reserved for overrun codes). If more keys are pressed before the system allows a keyboard output, the data will be lost. When the keyboard is allowed to send data, the characters in the buffer will be sent as in normal operation, and new data entered will be detected and sent.

## Keys

All keys are classified as make/break, which means when a key is pressed, the keyboard sends a make code for that key to the keyboard controller. When the key is released, its break code is sent (the break code for a key is its make code preceded by hex FO).

All keys are typematic. When a key is pressed and held down, the keyboard continues to send the make code for the key until the key is released. The rate at which the make code is sent is known as the typematic rate (typematic rate is described under Set Typematic Rate/Delay). When two or more keys are held down, only the last key pressed repeats at the typematic rate. Typematic operation stops when the last key pressed is released, even if other keys are still held down. When a key is pressed and held down while the interface is inhibited, only the first make code is stored in the buffer. This prevents buffer overflow as a result of typematic action.

## Power Supply

The system's power supply is contained inside the system unit and provides power for the system board, adapters, diskette drives, fixed disk drives, keyboard, and the IBM Monochrome Display.

## Inputs

The power supply can operate at a frequency of either  $60 \pm 3$  Hz or  $50 \pm 3$  Hz, and it can operate at 110V AC, 5 A or 220/240V AC, 3.0 A. The voltage is selected with the switch above the power-cord plug at the rear of the power supply. The following figure shows the input requirements:

Range	Nominal Voltage (V AC)	Current (Amps)
115V AC	Minimum 100	Maximum 5.0
	Maximum 125	
230VAC	Minimum 200	Maximum 3.0
	Maximum 240	

Figure 9-7. 5170 Input Protection

Note: The maximum in-rush current is 100 A.

## outputs

The power supply provides +5, -5, +3.2, and -12V DC. The following figure shows the load current and regulation tolerance for the voltages.

Nominal Output	Load Current (A)		Regulation Tolerance
	Minimum	Maximum	
+5V DC	7.0	19.8	+5% to -4%
-5V DC	0.0	0.3	+10% to -8%
+12V DC	2.5	7.3	+5% to -4%
-12V DC	0.0	0.3	+10% to -9%

Figure 9-8. 5170 DC Load Requirements

Note: The power supply also supplies either 115V AC or 230V AC for the IBM Monochrome Display.

## Output Protection

If any output becomes overloaded, the power supply will switch off within 20 milliseconds. An overcurrent condition will not damage the power supply.

### Dummy Load

If no fixed disk drive is connected to the power supply, a dummy load may be connected to P10. The dummy load is 5 ohms, 50-watt resistor.

## Output Voltage Sequencing

Under normal conditions, the output voltage levels track within 300 milliseconds of each other when power is applied to, or removed from, the power supply, provided at least minimum loading is present.

### No-Load Operation

No damage or hazardous conditions occur when primary power is applied with no load on any output level. In such cases, the power supply may switch off, and a power-on cycle will be required. The power supply requires a minimum load for proper operation.

### Power-Good Signal

The power supply provides a power-good signal to indicate proper operation of the power supply.

When the supply is switched off for a minimum of 1 second and then switched on, the power-good signal is generated, assuming there are no problems. This signal is a logical AND of the DC output-voltage sense signal and the AC input-voltage sense signal. The power-good signal is also a TTL-compatible high level for normal operation or a low level for fault conditions. The AC fail signal causes power-good to go to a low level at least 1 millisecond before any output

voltage falls below the regulation limits. The operating point used as a reference for measuring the 1 millisecond is normal operation at minimum line voltage and maximum load.

The DC output-voltage sense signal holds the power-good signal at a low level when power is switched on until all output voltages have reached their minimum sense levels. The power-good signal has a turn-on delay of at least 100 milliseconds but not longer than 500 milliseconds. The following figure shows the minimum sense levels for the output voltages.

Level (V DC)	Minimum (V DC)
+5	+4.5
-5	-4.3
+12	+10.8
-12	-10.2

Figure 9-9. 5170 Sense Levels

## Fan-Out

Fan-out is the number of inputs that one output can drive. The power-good signal can drive six standard TTL loads.

---

## General Information

### Speaker

The system unit has a 2.25-inch permanent-magnet speaker, which can be driven from:

- The I/O-port output bit
- The timer/counter's clock-out
- Both.

### Jumper

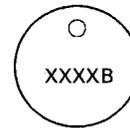
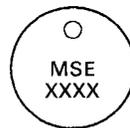
The system board has a 3-pin, Berg-strip connector. The placement of a jumper across the pins of the connector determines whether the system board's second 256Kb of RAM is enabled or disabled.

The following shows how the jumper affects RAM.

Jumper Positions	Function
1 and 2	Enable second 256Kb of system board RAM
2 and 3	Disable second 256Kb of system board RAM

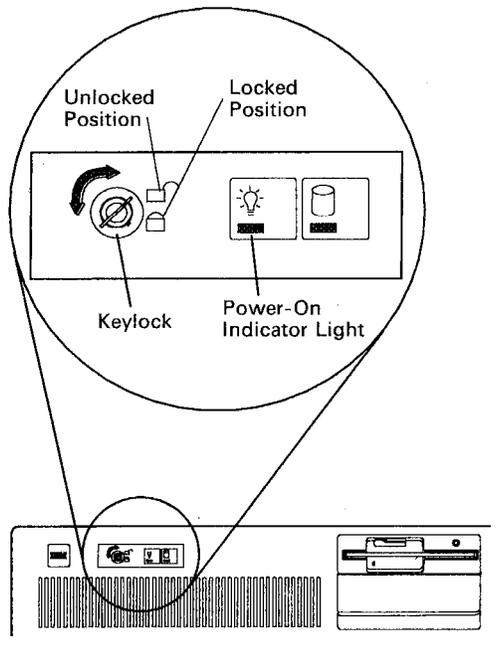
Figure 9-10. 5170 RAM Jumper

Note: See Figure 9-14 on page 9-7. The normal mode is the enable mode. The disable mode permits the second 256Kb of RAM to reside on adapters plugged into the I/O bus.



LEX40092

## System Unit Keylock



LEX40091

Figure 9-11. 5170 System Unit Keylock

The keylock deactivates the keyboard and locks the cover *on* for security. You can lock the system whether the power is on or off. Turn the key clockwise to lock the system or counterclockwise to unlock it. The key may be removed in either position.

When the system unit's power is on, the green power-on indicator light is on.

Duplicate keys for system unit keylock devices are the responsibility of the customer. Key reorder information is located in the 5170 *Guide to Operations* manual.

Customers can obtain information for ordering IBM Personal Computer AT replacement keys and their cost by writing to the address listed below. The lock manufacturer is identified by information on the tag included with the keys. Include the lock number (1501419) and the tag number with your correspondence.

Chicago Lock Co.  
4311 W. Belmont Ave.  
Chicago, IL 60641

Fort Lock Co.  
3000 North River Road  
River Grove, IL 60171

Figure 9-12. Replacement Key Addresses

## General Diagnostic Tips

### Power-On Self Test

Each time you set the system unit's power switch to on, the power-on self test (POST) executes. The POST takes 13 to 90 seconds to complete, depending on the options installed.

The POST checks the following:

- System board
- Memory Expansion Adapters
- Keyboard
- Primary display
- Diskette Drive and Adapter
- Fixed Disk Drive and Adapter (if available).

To start the POST:

1. Turn on all external devices, including printer, display, and plotter.
2. Set the system unit power switch to on.
3. Turn the brightness and contrast knobs fully clockwise. (If you have a color monitor, ensure that it is set to on.)
4. Watch (and listen) for the following responses:
  - a. A cursor appears on the display in approximately 4 seconds.
  - b. The keyboard status lights blink on, then off.
  - c. While the memory is being tested, the memory size appears in the top left corner of the screen and increases in 64Kb increments until the total system memory is tested.
  - d. The keyboard status lights again blink on, then off.
  - e. One short beep is heard when the POST is successfully completed.
  - f. The IBM Personal Computer basic screen appears if a diskette or an operating system is not automatically loaded from a fixed disk drive.

## 5170 System Setup

The setup program is on the advanced diagnostics diskette. You need to know what options are installed in your system unit to run the setup program.

To set up the system:

1. Remove the system unit's cover.
2. Make a list of the option adapters installed in your system.
3. Look at the labels on the front of the fixed disk drives and make a note of the type of drives installed.
4. Look at the front bezel of the diskette drive and make a note of the type of drive installed. (The bezel of a double-sided diskette drive has an asterisk; the bezel of a high-capacity drive is not marked.)
5. Ensure that the jumpers in your system are installed correctly.
6. Ensure that all switches are set correctly.

**Note:** If you receive an error code, troubleshoot any error identifications other than 16X first. If the only error code you receive is 16X, and you cannot correct the setup program, check battery voltage.

7. Insert the advanced diagnostics diskette into drive A.
8. Set the system unit's power switch to on.

The setup program will prompt you for the following information:

<b>Time</b>	Allows you to set or change the time.
<b>Date</b>	Allows you to set or change the date.
<b>Diskette Drives</b>	Select the number and type (high-capacity or double-sided) installed.
<b>Fixed Disk Drives</b>	Select a number and type (20Mb or 30Mb) of fixed disk installed.
<b>Memory Amount</b>	Select the amount of base and expansion memory installed.
<b>Display</b>	Set the primary display if two display adapters are installed.

**Note:** If Menu 2 - Select an Option appears after the POST, select option 4 (SETUP) and verify that the options are correctly set.

### Jumper

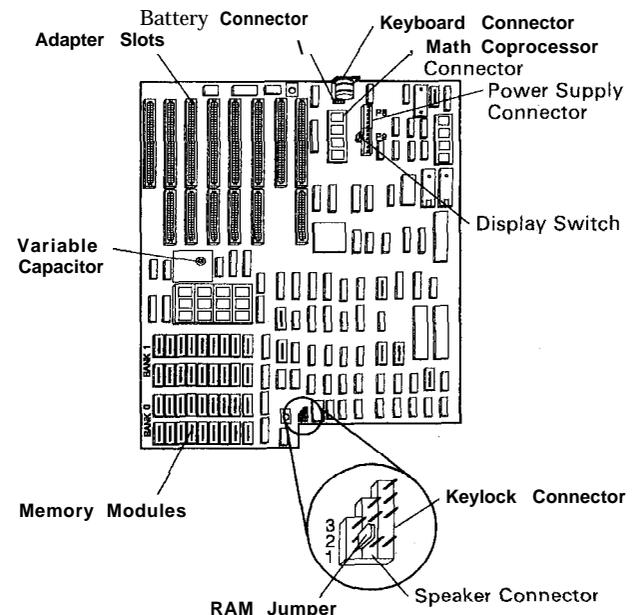
The system board has a 3-pin, Berg-strip connector. The placement of a jumper across the pins of the connector determines whether the system board's second 256Kb of RAM is enabled or disabled.

Jumper Positions	Function
1 and 2	Enable second 256Kb of system board RAM
2 and 3	Disable second 256Kb of system board RAM

Figure 9-13. 5170 Jumper Positions for Full-Size System Board Only

The RAM jumper in the disable position (256Kb RAM) allows the user to utilize additional RAM provided on option cards without fully populating the system board.

**Note:** All 20Mb drives manufactured by IBM or for IBM are Type 2 and 30Mb drives are Type 20. Also, to enter the correct type (20) for a 30Mb drive requires diagnostics at Level 2.0 or higher and the correct level of BIOS.



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Figure 9-14. 5170 System Board (Full Size, Top View)

Full-Size Dimensions: 13.5 x 12.

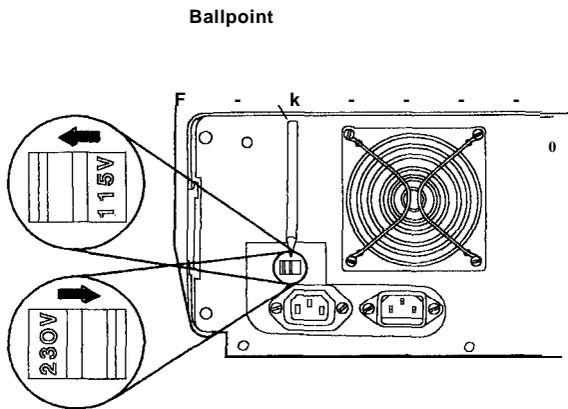
Down-Size Dimensions: 13.5 x 9.5 (not shown).

### Input Voltage Requirements

The 115/230V AC selector switch at the rear of the system unit's power supply must be set for the voltage present at the outlet.

Switch Position	Voltage Range
115V AC	100 to 125V AC
230V AC	200 to 240V AC

Figure 9-15. Input Voltage Switch Page



LEX40166

Figure 9-16. Input Voltage Switch Location

## Removal of Locked Cover

To remove the top cover when the lock is in the locked position, the 5170 must remain on a flat surface. (The five cover screws in the rear of the system unit must be removed before performing this procedure.) Locate the system unit to gain access to approximately 3 inches of the bottom of the unit at the front side. There is a small gap between the frame and the top cover underneath the system unit. While standing in front of the system unit, insert a screwdriver in this gap from the bottom going up approximately 2 to 3 inches in line with the lock. Pull the screwdriver toward you and in an upward motion. This will raise the cover lip over the lock latch, and the top cover can now be removed. To run diagnostics under this condition, remove one wire from the lock switch. This will enable the keyboard.

## Power Diagnostic Tips

### Power Supply Failures

Some 5170 power supplies might fail after being powered on for 2 or more hours, then properly work after power off and the machine cools down. If this problem is experienced, the power supply must be replaced.

## System Board Voltage

To check the system board voltage:

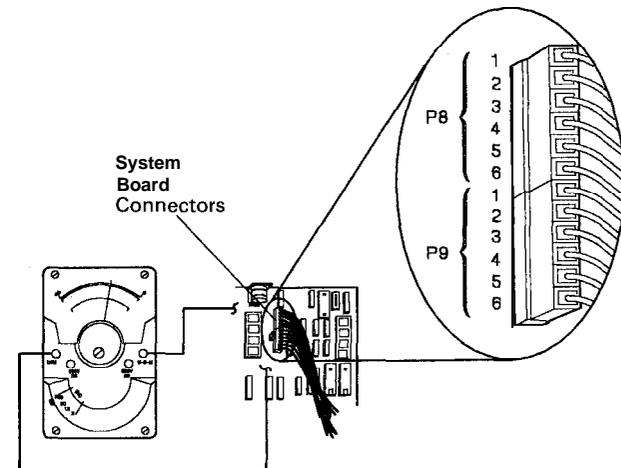
1. Set the system unit's power switch to off.
2. Remove the system unit's cover.
3. Set your meter to the 12V DC scale. Connect the common lead to pin 5 and the voltage lead to pin 1 on the system board's power connector P8.
4. Set the system unit's power switch to on.
5. Check for a voltage of 2.4V to 5.2V DC.

Check the rest of the power supply voltages at the system board:

1. Set your meter to the 12V DC scale.
2. Refer to Figure 9-17 and check the system board's power connectors for the correct voltages.

Voltage Connectors			
Min V DC	Max V DC	-Lead	+ Lead
+4.8	+ 5.25	P8-5	P9-4
+4.6	+5.5	P9-3	P8-6
+ 11.5	+ 12.6	P9-1	P8-3
+ 10.9	+ 13.2	P8-4	P9-2

Figure 9-17. Correct Voltage at Connectors



LEX40177

Figure 9-18. System Power Supply

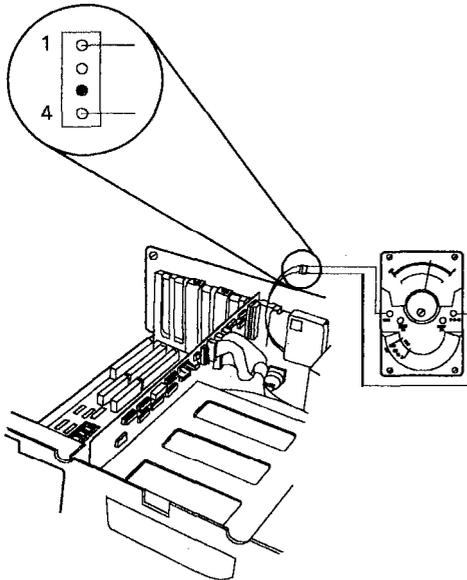
## Battery Voltage

To check battery voltage:

1. Set the system unit's power switch to off.
2. Remove the system unit's cover.
3. Disconnect battery from system board.
4. Set your meter to the 12V DC scale. Connect the common lead to pin 1 and the voltage lead to pin 4 on the battery connector. Check for a voltage of 6.0V DC minimum.

Note: A 161 Battery Defective or New Battery Installed message appears during the first POST after a battery installation or replacement. If you just installed a new battery, run the setup program.

When checking the battery voltage, you must disconnect the battery from the system board. The drain from the system board will cause various readings if you attempt to check the voltage with it plugged into the system board.



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Figure 9-19. Battery Voltage Check

## System/Memory Diagnostic Tips

### Blank Display/No Beep During Power-On Reset (POR)

Some 5170 planar boards were manufactured in error with the math coprocessor socket installed with the notch to the rear of the board. The installation instructions state to align the coprocessor notch to the socket notch. If the coprocessor is installed with the notch to the rear, the system will fail during power-on diagnostics, the display will be blank, and there will be no beep. Installing the coprocessor with the notch to the front of the planar will correct this problem.

### Interrupt Levels

Interrupt levels are used by PCs to prioritize operations and are also known as groups or interrupt requests (IRQs). Diagnostics will not necessarily fail on a PC with interrupt conflicts, yet the operator will keep getting errors. Although the customer is responsible for solving interrupt conflicts, an IBM customer engineer can use this information to reduce diagnostic time, no trouble founds (NTFs), unnecessary parts replacements, and callbacks.

To determine if an unusual PC problem is caused by conflicting interrupt levels, follow these steps:

1. Load the advanced diagnostics diskette, go to the list of installed devices, and copy that list.
2. Examine the adapter cards installed in the system unit and expansion unit. If any cards are located that are not on the list from Step 1, add them to the list.
3. Sort the list into the following interrupt levels:

**Note:** Some adapter cards have a jumper for interrupt selection. For those cards and for cards not listed here (including non-IBM cards), see the card's setup guide or technical specifications. Due to rapid product announcements, this list cannot describe all the available IBM PC option cards.

- a. Keyboard
- b. Enhanced Graphics Adapter  
3278/79 Emulation Adapter  
Primary PC Network Adapter
- c. ALT ASYNC Communications Adapter (COM2)  
ALT BISYNC Communications Adapter (COM2)  
ALT Serial/Parallel Adapter-Serial Port  
ALT PC Network Adapter  
SDLC Communications Adapter  
PC Cluster Adapter (selected by a jumper)

- Display Station Emulation Adapter (selected by jumper)
- d. ASYNC Communications Adapter (COM1)  
BISYNC Communications Adapter (COM1)  
Serial/Parallel Adapter---Serial Port  
SDLC Communications Adapter
- e. Fixed Disk Adapter (except in Personal Computer AT)  
ALT Serial/Parallel Adapter-Parallel Port  
Display Station Emulation Adapter (selected by a jumper)
- f. Diskette Drive Adapter
- g. Printer Adapter Monochrome and Printer Adapter PC  
Cluster Adapter (selected by a jumper)  
Serial/Parallel Adapter-Parallel Port  
 GPIB Adapter(s)  
Data Acquisition Adapter(s).

4. If you find two cards with the same interrupt, remove one of them and see if the failure symptom disappears.

These steps are similar to the intermittent problem steps in the *Hardware Maintenance and Service* (HMS) manual. The most important point of this tip is that when a failure symptom is isolated to one adapter card, that card is not necessarily defective, but might be incompatible with the other cards in the PC. Incompatibility can also be caused by factors other than interrupt (such as memory address and DMA). Also, conflicting interrupts will not always cause failures.

## New 5170 System Boards

The memory module sockets located on system boards P/N8286112, P/N6480170, and P/N6480072 have been redesigned. The contacting surface for the memory modules is located below the top of the pin holes and is not visible from the top of the socket. The new style socket provides a good contact surface for the memory module and is functionally equivalent to the old style.

**Note:** When replacing a system board, remember to reinstall the math coprocessor (if present) in the new system board.

## Memory Error Isolation

This hint is to help diagnose memory and/or parity check errors if memory bank and bit position is not found during either the power-on self test (POST) or memory diagnostics.

Read each step of the following instructions before beginning:

1. Set the system unit's power switch to off.
2. Remove all installed Memory Expansion Adapters.
3. Set the system unit's power switch to on.

4. Run the setup program.  
(Ensure that the memory size is correctly set.)
5. Repeat the diagnostic test that failed.

**Note:** If the diagnostic test passes on bare system memory configuration, you might have a memory failure on one of your Memory Expansion Adapters.

6. Set the system unit's power switch to off.
7. Install one Memory Expansion Adapter at a time to test.

**Note:** If you have a 128Kb Memory Expansion Adapter, install it first.

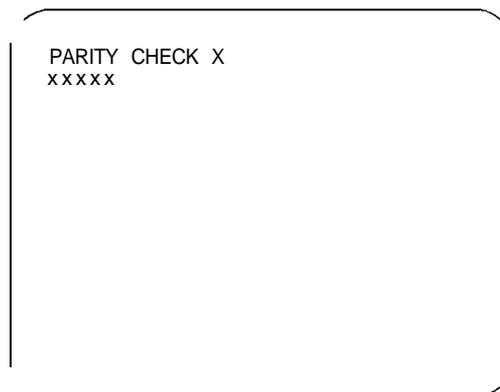
8. Set the system unit's power switch to on.
9. Run the setup program.  
(Ensure that the memory size is correctly set.)
10. Repeat the diagnostic test that failed.

When a memory error is present and location cannot be isolated, it is best to break down the system's memory in sections to locate the most probable point of origin.

## Parity Checks

Parity check 1 indicates a system board parity error. Parity check 2 indicates a Memory Expansion Adapter parity error.

If the memory test ended without returning a lo-character error message, the message might be a parity check message, as in Figure 9-20.



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Figure 9-20. Parity Check Message

After a parity check error, the memory is scanned to see if a failing address can be identified. If identified, the address is displayed as a 5-character alphanumeric code under the parity check message. If the failing address cannot be identified, five question marks are displayed under the parity check message.

The first character of a parity check error code identifies the failing bank. For example, error code 40000 indicates that bank 1 of the system board is failing.

First Character of Parity Error	Failing Memory Bank
0, 1, 2, or 3	System board bank 0
4, 5, 6, or 7	System board bank 1

Figure 9-21. Parity Check Code

If the first character of the parity check error code is 0, 1, 2, 3, 4, 5, 6, or 7, replace the 18 memory modules in the failing bank. If the same parity check error code occurs, replace the system board.

If the first character of the parity check error is 8 or 9, replace the 18 memory modules of the base Memory Expansion Adapter. If the same error code occurs, replace the adapter.

### Parity Check 2 ?????? Message on 5170 Models 068-099

The 5170 Models 068 and 099 system units with system board P/N8286112, an Enhanced Graphics Adapter, and the 0.5Mb to 2Mb Memory Expansion Adapter installed will experience a Parity Check 2 ?????? message if a soft boot (Ctrl, Alt, Del) function is performed.

If you have a system with the above configuration and error message, install ECA024.

### Memory Errors Bit/Bank Locations

First Two Characters of Error Code	Problem Area
00, 01, 02, or 03 04, 05, 06, 07	System Board
08 or 09	128Kb Memory Expansion Adapter
10, 11, 12, 13, 14, 15, 16, 17	512Kb Expansion Memory Adapter 1
18, 19, 1A, 1B, 1C, 1D, 1E, 1F	512Kb Memory Expansion Adapter 2

Figure 9-22 (Part 1 of 2). Memory Problem Area Location

First Two Characters of Error Code	Problem Area
20, 21, 22, 23, 24, 25, 26, 27	512Kb Memory Expansion Adapter 3
28, 29, 2A, 2B, 2C, 2D, 2E, 2F	512Kb Memory Expansion Adapter 4
30, 31, 32, 33, 34, 35, 36, 37	512Kb Memory Expansion Adapter 4

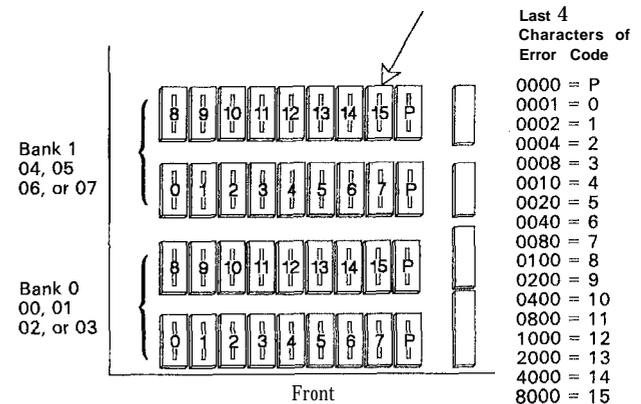
Figure 9-22 (Part 2 of 2). Memory Problem Area Location

### System Board Errors

A 10-character error code that begins with 00, 01, 02, 03, 04, 05, 06, or 07, indicates a system board memory failure.

The first 2 characters of your error code indicate which bank has the failing memory module. The last 4 characters indicate the failing module of the bank. For example, error code 04002 8000 corresponds to the failing module indicated by the arrow in the Figure 9-23.

Refer to Figure 9-23 and find the failing module for your error code.



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Figure 9-23. System Board (Top View)

Note: Replace both parity (P) modules in the failing bank if the last 4 characters of your error code are 0000.

## 128Kb Memory Expansion Errors

A lo-character error code that begins with 08 or 09 indicates a 128Kb Memory Expansion Adapter failure. The last 4 characters of your error code indicate the failing module of the bank. For example, error code 080002 0004 corresponds to the failing module indicated by the arrow in the Figure 9-24.

Find the 128Kb Memory Expansion Adapter (it is the only Memory Expansion Adapter with no switches).

Refer to Figure 9-24 and find the failing module for your error code.

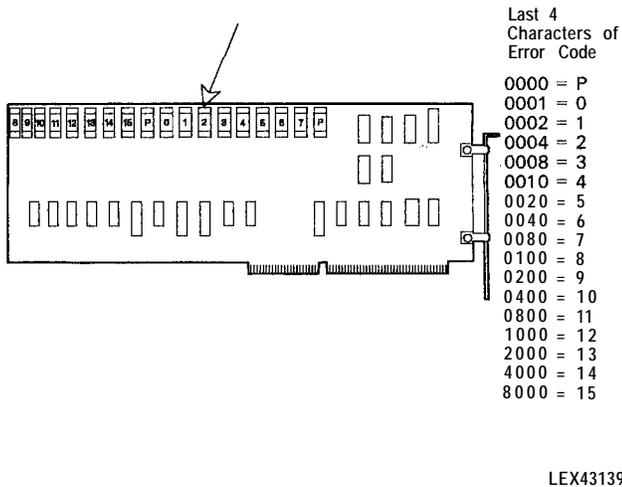


Figure 9-24. Failing Module Location

Note: Replace both parity (P) modules if the last 4 characters of your error code are 0000.

## 512Kb Memory Expansion Errors

Refer to Figure 9-25 and find the first 2 characters of your error code (make a note of the failing bank, 0 or 1).

Compare the switch settings shown for those characters with those of all 512Kb Memory Expansion Adapters in your system. The failing adapter is the one with switch settings that match those in Figure 9-25.

First 2 Characters Of Error Code	Bank	Memory Expansion Adapter Switch Settings							
		1	2	3	4	5	6	7	8
10, 11, 12, 13 14, 15, 16, 17	0	On	On	On	Off	On	On	On	On
	1	On	On	On	Off	On	Off	On	Off
18, 19, 1A, 1B 1C, 1D, 1E, 1F	0	On	On	On	Off	Off	On	On	On
	1	On	On	On	Off	Off	Off	On	Off
20, 21, 22, 23 24, 25, 26, 27	0	On	On	Off	On	On	On	On	On
	1	On	On	Off	On	On	Off	On	Off
28, 29, 2A, 2B 2C, 2D, 2E, 2F	0	On	On	Off	On	Off	On	On	On
	1	On	On	Off	On	Off	Off	On	Off
30, 31, 32, 33 34, 35, 36, 37	0	On	On	Off	Off	On	On	On	On
	1	On	On	Off	Off	On	Off	On	Off

Figure 9-25. Failing Adapter Location

The first 2 characters of your error code indicate which bank has the failing memory module. The last 4 characters indicate the failing memory module of the bank. For example, error code 100002 0080 corresponds to the failing module indicated by the arrow in Figure 9-26. Refer to Figure 9-26 and find the failing module for your error code.

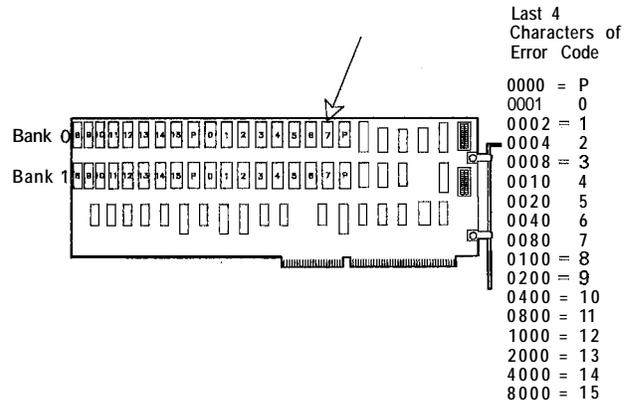


Figure 9-26. Failing Module Location

Note: Replace both parity (P) modules if the last 4 characters of your error code are 0000.

## Parity 1 Check

Some planar boards, P/N8286112 with the RAM jumper, J18, were installed on the wrong pins. For a 256Kb planar, this jumper should be on pins 2 and 3, and for a 512Kb planar on pins 1 and 2. If the jumper is installed wrong and an Enhanced Graphics Adapter (EGA) is installed, the system will get parity 1 checks on a soft boot operation (Ctrl, Alt, Del). The system might not fail diagnostics with the standard configuration. There might be adapters other than the EGA that will produce this failure.

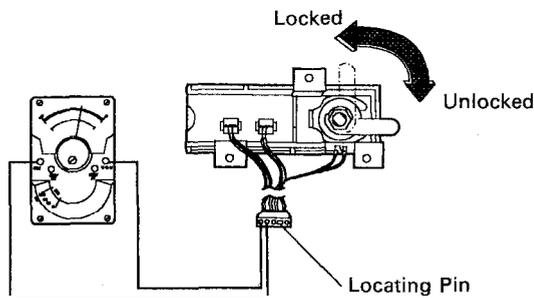
## System Clock

If the 5170 is operating under DOS and the time and date are changed, the system clock is not updated. You must go to the time and date function to update the system clock. If the system clock is not operating correctly, the system board must be changed.

## Keylock Switch Continuity

To check keylock switch continuity:

1. Set the system unit's power switch to off.
2. Remove the system unit's cover.
3. Disconnect the control panel cable from the system board.
4. Set your meter to the ohms x 1 scale.
5. Check the control panel's switch, as shown in Figure 9-27.
  - Keylock locked = continuity (0 ohms)
  - Keylock unlocked = no continuity (infinity).



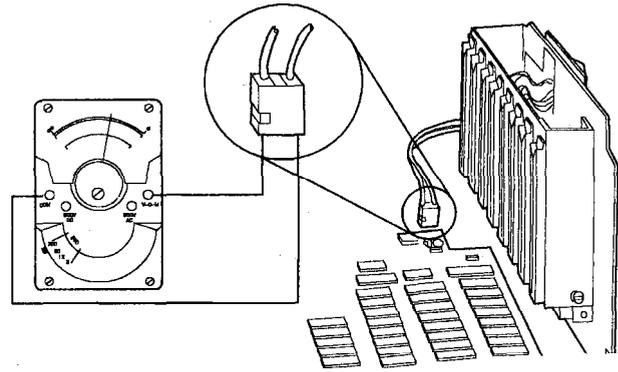
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Figure 9-27. Keylock Switch Continuity Check

## Speaker Continuity

To check speaker continuity:

1. Set the system unit's power switch to off.
2. Set your meter to the ohms x 1 scale.
3. Disconnect the speaker cable from the system board.
4. Refer to Figure 9-28 and check the continuity of the speaker.



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Figure 9-28. Speaker Continuity Check

## Keyboard Failures

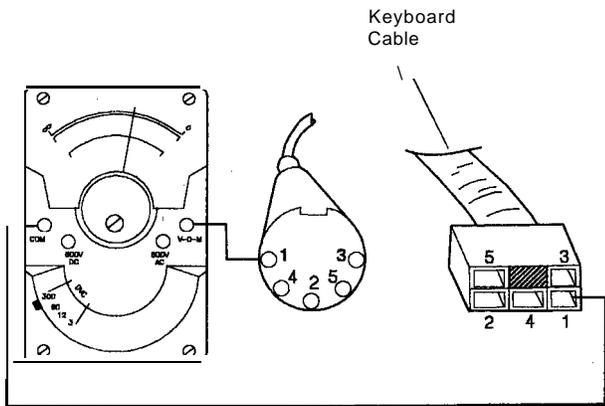
If a keyboard failure occurs at setup time, remove the keyboard covers and check to see whether the cable is plugged into the connector. The apparent cause for the cable coming loose is that the black insulation extends too far inside the keyboard. To relieve the pressure on the connection, you can trim the insulation to within 0.5 inch of the opening where it comes through the keyboard or split the insulation the same distance. This problem will be fixed on future keyboards.

## Keyboard Cable Continuity

To check keyboard cable continuity:

1. Set the system unit's power switch to off.
2. Disconnect the keyboard cable from the keyboard.
3. Refer to Figure 9-29 on page 9-14 and check the keyboard cable for continuity.

Note: Check the continuity of wires 1, 2, 4, and 5 (wire 3 is not used).



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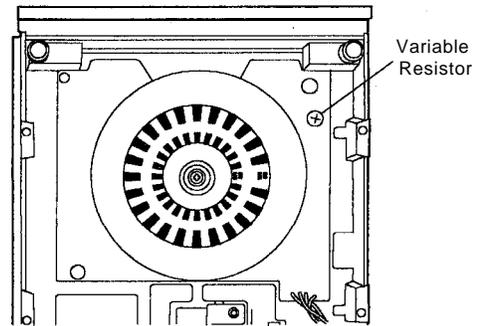
Figure 9-29. Keyboard Cable Continuity Check

## Diskette Drive/Fixed Disk Drive Diagnostic Tips

### Diskette Drive Motor Speed Adjustment

To adjust the diskette drive motor speed:

1. Insert the advanced diagnostics diskette into drive A.
2. Set the system unit's power switch to on.
3. Advance to Diagnostic Menu 9.
4. In Menu 9, select option 4 (Speed Test), for the diskette drive you are testing. The drive-motor speed and the adjustment specification appear on the screen.
5. The indicated speed should be 1640 to 1695. If it is not, continue to Step 6.
6. The adjustment for the drive-motor speed is a variable resistor on the diskette drive circuit board (on the underside of the diskette drive). To adjust the speed, carefully insert an insulated screwdriver into the resistor's slot. Turn the screw until the speed shown on the screen is within the required specifications.



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Figure 9-30. Diskette Drive (Bottom View)

### Erroneous Diskette Drive Failures

If a diskette drive failure is reported and replacing the drive and/or the adapter card does not resolve the problem, remove the cables from the fixed disk drive and remove the fixed disk from the setup table. Rerun the diagnostics and/or have the customer rerun the job. If no failures occur, replace the fixed disk drive.

### Formatting Scratch Diskettes

The 5170 Advanced Diagnostic Diskette includes an option to format a scratch diskette for diagnostic use. When performing this routine the proper diskette media must be used to ensure reliable results. Otherwise, CRC errors might occur during the format routine.

Use the following diskettes for reliable results:

- 1.2Mb drive: use only high-capacity scratch diskettes.
- 360Kb drive: use only dual-density scratch diskettes.

**Note:** The 5170 Diagnostic Diskette is a dual-density diskette. Dual-density diskettes (P/N6023450) and high-density diskettes (P/N6109660) can be ordered through administrative personnel as a supply item, not as a repair part or tool. Customers experiencing diskette format errors under DOS should verify that they are correctly using the DOS format parameters for the drive-type and media-type being used. Refer to the DOS manual for media interchangeability rules under DOS.

## Diskette/Disk File Limitations

Floppy diskettes are limited to 64, 112, or 224 files in their root directory, depending on the type of diskette and the type of format used. Fixed disks can have up to 512 files in the root directory, depending on the size of the DOS partition.

If the allowed number is exceeded in either case, disk full errors will result. The problem can be resolved by placing the excess files in subdirectories. See the DOS technical reference for additional information.

## Disk/Diskette Adapter Replacement

The Disk/Diskette Adapter, P/N8286125, has a resistor pack on the card guide edge of the adapter. This resistor pack is located approximately 1.5 inches from the top of the adapter and is labeled Z2.

Caution should be used when replacing this adapter because the resistor could hit the card guide and crack or break the resistor. If this happens, a damaged resistor could cause solid or intermittent 17XX errors, fixed disk type failures. When replacing the dual card, P/N8286125, the redesigned guide that has been provided should be used. This guide is beveled to prevent component damage.

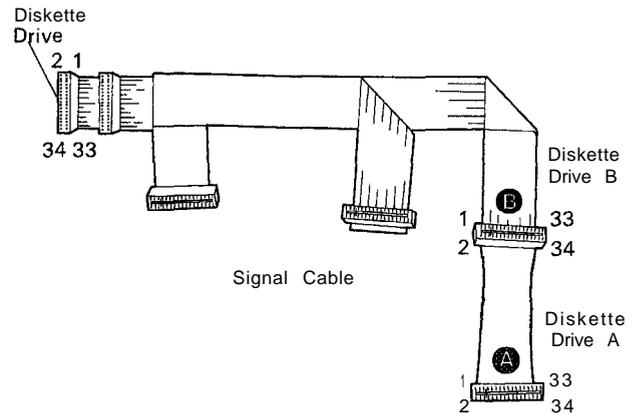
## Diskette Drive Signal Cable Continuity

To check continuity of the diskette drive signal cable:

1. Set the system unit's power switch to off.
2. Check the diskette drive's signal cable for continuity. The line numbers at one end of the cable match the line numbers at the other end, except for those in Figure 9-31.

Diskette Drive A Signal Cable Connector		Diskette Drive B Signal Cable Connector	
Pin Numbering		Pin Numbering	
Drive End	Adapter End	Drive End	Adapter End
10	16	10	10
11	15	11	11
12	14	12	12
14	12	14	14
15	11	15	15
16	10	16	16

Figure 9-31. Signal Cable Line Numbers



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Figure 9-32. Signal Cable Line Numbers

## Format D: Drive When C: Was Specified

DOS sometimes formats what a user believed to be the D: drive when the C: drive was specified. This usually happens after one of the fixed disks has been replaced or a diagnostic format has been run on one of the hard files. This only occurs on systems with two fixed disk drives.

When FDISK is not run before Format, DOS will not recognize the first drive as C:, but will think the next drive (D:) is C: and format it. The safest way to avoid the problem is to always run FDISK before formatting. Choose option 4 Display Partition Data, and if there is no partition, use option 1 Create DOS Partition to create one.

When DOS boots up, it first asks the BIOS how many fixed disks are installed on the machine. If any are found, DOS will then go out and read the partition table from each drive to see if any space on that disk is assigned to DOS. If so, it will then assign that drive a drive letter sequentially starting with C: if there are two or fewer diskette drives, or the next available drive letter if there are more than two diskette drives.

Note what happens when the first drive has not been FDISKed and the FORMAT C: command is given. DOS will not find any space allocated for it on the first drive and will go to the next drive and look there for a DOS partition. If one is found there, it assumes it to be the first drive, names it C:, and begins formatting as instructed.

## Program for Parking Heads on Fixed Disk

Shutdown.exe on the customer diagnostics diskette in the *Guide to Operations* manual is for parking the heads on the fixed disk. It is a stand-alone version of the Prepare System for Moving module. Shutdown.exe should be copied to the fixed disk before executing. If executed from the diskette drive, Shutdown.exe will cause the diskette drive to run continuously.

## Caution Preparing System for Move

Do not use PC diagnostics (customer or advanced) to prepare the system for moving on a Personal Computer AT 5170. Using the PC diagnostics for this purpose can damage the data on the fixed disk. The failing symptom would be that the system fails to boot from the fixed disk. To recover from this situation, you must reformat the fixed disk because the data on cylinder zero has been altered. If the label on the diagnostic diskette does not say Personal Computer AT, do not use the diskette on any model of the Personal Computer AT.

## Personal Computer AT — Diagnostics Error 1712

Error **1712** occurs while running advanced diagnostics against the fixed disk drives. This error can occur on a system that has no legitimate problem if one of the following situations exists:

1. The technician boots DOS 3.1 from the fixed disk and then invokes COMMAND from the diagnostic diskette in drive A.
2. The technician boots a copy of the diagnostic diskette that was made by doing a COPY \*.\* of the diagnostics to a diskette that previously had DOS 3.1 resident.

Either of these situations will result in an error 1712 while performing test 4, ERROR DETECTION AND CORRECTION test, from the fixed disk diagnostic menu.

The correct method of performing diagnostic tests is to boot the original diagnostic diskette on the machine to be tested.

## Fixed Disk Problems

The following service tips and techniques can be useful for diagnosing fixed disk problems on the Personal Computer AT (5170). They are recommended for use during initial setup and at the beginning of a service call.

Before using the service aid, check the following items:

- Setup configuration record
- Placement of drive terminator resistors
- DOS level (must be 3.0 or above)
- Cable continuity
- Power supply voltage switch setting
- Power supply voltages.

## General Tips for Fixed Disk Problems

1. Run PREPARE SYSTEM FOR MOVING (Option 3 on the main diagnostic menu) prior to moving the system unit or removing/replacing a fixed disk drive. This will move the read/write heads off the data area of the disk to prevent damage to the media.
2. When formatting the fixed disk drive with the advanced diagnostics, use CONDITIONAL FORMAT. If CONDITIONAL FORMAT will not run, perform an UNCONDITIONAL FORMAT followed by a SURFACE ANALYSIS. If an UNCONDITIONAL FORMAT is performed, the defective cylinder/head information found on the front label of the fixed disk must be entered at the start of the routine.
3. Any new cylinder/head locations flagged as defective during CONDITIONAL FORMAT or SURFACE ANALYSIS should be noted on the label at the front of the fixed disk.
4. It is recommended that DOS FDISK and DOS FORMAT be performed (by the customer or a customer engineer) on a replaced fixed disk prior to returning the system to the customer or prior to leaving the customer location. This will further ensure proper functioning of the replaced drive.
5. To enable booting from the fixed disk, DOS FORMAT loads the three system files at the beginning of the fixed disk DOS partition. This requires five contiguous error-free cylinders at the beginning of the partition. If cylinders 0, 1, 2, 3, or 4 have any defective tracks flagged, the DOS 3.0 format routine will fail with a track 0 error or a Disk Unsuitable For System Disk error. To resolve this situation, the customer can move the beginning of the DOS partition beyond the defective cylinder by redoing DOS FDISK with new values. Otherwise, the disk must be replaced. DOS 3.1 will automatically start loading the system files beyond the defective cylinder. It will be transparent to the customer.

To use the following Symptom/Action table, locate the symptom in the column on the left. Read across the row and perform the steps in the order given until the problem is resolved.

With the exception of System Won't Boot from Fixed Disk, all symptoms and actions are applicable to either fixed disk drive C or D.

Symptom	Steps					
	1	2	3	4	5	6
Post Error 1780 or 90	2	4	7	8		
Post Error 1782	5	6	8			
Cold Start Problem	1	3	2	7	8	
System Won't Boot from Fixed Disk	2	1	3	4	7	8
Read/Write Errors	2	1	3	7	8	
Fixed Disk Write Fault or 1706 Error Code	2	6	8			
Files or Data Lost	2	1	31	7	8	
Intermittent Errors	2	3	1	4	7	8
Track 0 Error during DOS Format	1	3	2	7	8	

Figure 9-33. Symptom/Action Table

## Fixed Disk Trouble Shooting

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Perform the following steps to determine the cause of fixed disk problems:

1. Initial checkout
  - a. Power off the system unit and remove the system unit cover.
  - b. Power on the system unit and load the Personal Computer AT Advanced Diagnostics Diskette and select the FIXED DISK DRIVE(S) and ADAPTER test.
  - c. Select Option 6, READ VERIFY.
  - d. If a 1796 error occurs, see Fixed Disk Write Fault in Figure 9-33.
  - e. If any tracks or cylinders between 1 and 10 are flagged defective or shown as UNABLE TO READ, refer to Step 4 on page 9-16 and Step 5 on page 9-16 of "General Tips."
  - f. If more than 20 tracks are shown as UNABLE TO READ, go to Step 6 on page 9-18 of "General Tips."
  - g. Return to the Symptom/Action Table.
2. Power Supply Connector Check
  - a. Power off the system unit and remove the system unit cover.
  - b. Power on the system unit, load the advanced diagnostics diskette, and select the FIXED DISK DRIVE(s) and ADAPTER test.
  - c. Select Option 5, RUN ALL TESTS.
  - d. Lightly tap the power supply connector at the fixed disk drive with an insulated tool or a pencil (see Figure 9-34).
- e. If no error occurs return to the Symptom/Action Table.
- f. If an error occurs the power connector might be loose. To correct this problem, gently squeeze the female power connector contacts together to create a tighter connection.
- g. Repeat Step 2; if no error occurs, go to Step 8.
- h. If errors continue, return to the Symptom/Action Table.
3. Fixed Disk Drive Vertical Operation
  - a. Run PREPARE SYSTEM FOR MOVING to move the read/write heads off the data area, then power down the system.
  - b. Carefully stand the system unit on end (power on/off switch pointing up.) Ensure that the power supply end is up (see Figure 9-35 on page 9-18).

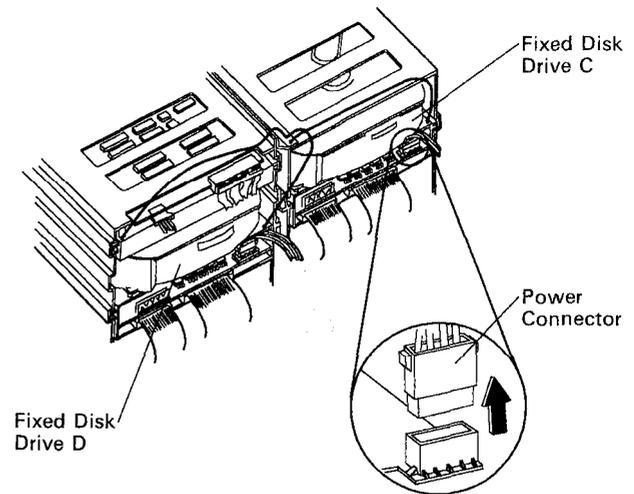
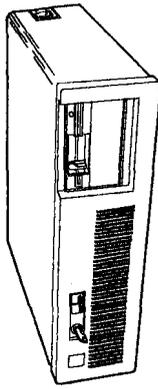


Figure 9-34. Power Connector

### CAUTION:

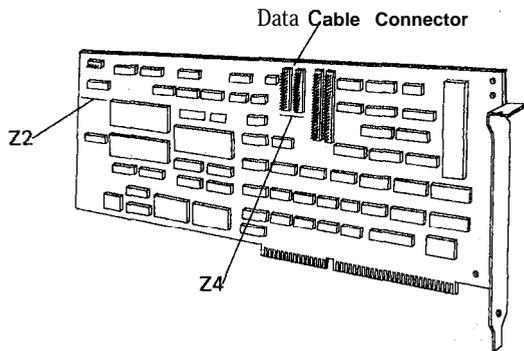
**You might need two people to move the system unit. It weighs approximately 50 pounds.**



LEX40173

Figure 9-35. Vertical Operation

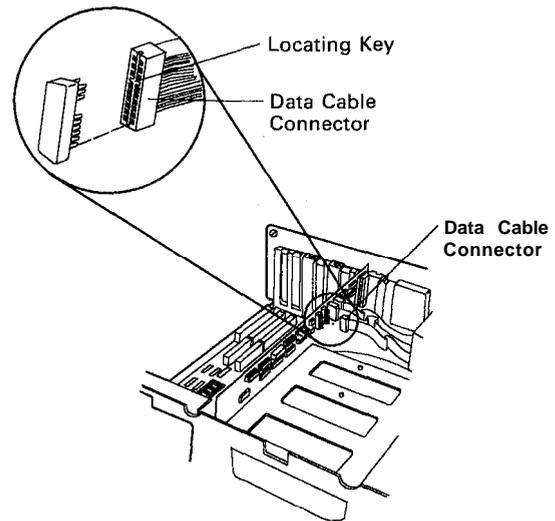
- c. Power on the system unit and load the advanced diagnostics diskette and select the FIXED DISK DRIVE(S) AND ADAPTER test.
  - d. Select option 5, RUN ALL TESTS.
  - e. Select option 6, READ VERIFY.
  - f. If no error occurs, return to the Symptom/Action Table.
  - g. If an error occurs, run PREPARE SYSTEM FOR MOVING and shut off power. Restore the system to the horizontal position and go to 6.
4. Fixed Disk/Diskette Drive Adapter Visual Checks
- a. Visually inspect resistor pack Z2 for cracks or damage (see Figure 9-36).



LEX40174

Figure 9-36. Fixed Disk/Diskette Adapter Visual Checks

- b. Inspect data cable connections for proper seating (see Figure 9-37). Resistor pack 24 might be interfering with the connector.



LEX40175

Figure 9-37. Data Cable Connection

- c. If either visual defect is found, go to Step 5 of this section. Otherwise, return to the Symptom/Action Table.
5. Replace Fixed Disk/Diskette Drive Adapter
- a. Remove the Fixed Disk/Diskette Drive Adapter.
  - b. Carefully install the replacement adapter to avoid damage to resistor pack Z2 and ensure proper connector seating.
  - c. If the replacement card fails, reseat the card, all cables, and retest the adapter prior to replacing it.

Note: Damaged or defective adapters might cause read/write errors on the fixed disk. If READ VERIFY still shows any tracks as UNABLE TO READ, a CONDITIONAL FORMAT might be required to remove the bad data.

- d. Go to Step 8 on page 9-19 of this section.
6. Replace Fixed Disk Drive
- a. Load the advanced diagnostics and select option 3, PREPARE SYSTEM FOR MOVING.
  - b. Remove the failing fixed disk drive and install the replacement.
  - c. Power on the system unit and load the advanced diagnostics and select the FIXED DISK DRIVES(S) AND ADAPTER test.
  - d. Select option 5, RUN ALL TESTS.
  - e. Select option 6, READ VERIFY.
  - f. If the replacement drive fails, remove and reseat all cables and retest the drive prior to replacing it.
  - g. Go to Step 8 on page 9-19 of this section.

Note: If UNABLE TO READ problems persist after the fixed disk is replaced, it might indicate a defective disk drive or the problem

might be caused by a defective Fixed Disk/Diskette Drive Adapter or power supply.

#### 7. Fixed Disk Drive Format

Warning: Formatting results in a complete loss of data on the fixed disk drive; refer to the DOS manual and ensure that all customer information has been backed up.

Note: CONDITIONAL FORMAT, UNCONDITIONAL FORMAT, and SURFACE ANALYSIS will post the current cylinder number as they move through their routines. If the time between cylinders is greater than 5 *seconds* replace the Fixed Disk/Diskette Drive Adapter (see Step 5 on page 9-18) and perform a CONDITIONAL FORMAT. If the time between cylinders still exceeds 5 *seconds* replace the fixed disk drive.

- a. Load the advanced diagnostics diskette and select the FIXED DISK DRIVE(S) AND ADAPTER test.
- b. Select option 1, CONDITIONAL FORMAT.

Note: CONDITIONAL FORMAT will mark those tracks listed on the front drive label and tracks identified as bad during a surface analysis as unusable. Any defective tracks that are not already listed on the drive label should be added to the list.

- c. If no error occurs during CONDITIONAL FORMAT, go to Step 7g, this section.
- d. If an unrecoverable error occurs during CONDITIONAL FORMAT, select option 2, UNCONDITIONAL FORMAT.
- e. Use the label on the front of the fixed disk drive as input for the bad track data at the start of the routine.
- f. After an UNCONDITIONAL FORMAT, retry the CONDITIONAL FORMAT. If the CONDITIONAL FORMAT fails, replace the fixed disk drive. See Step 6 on page 9-18 in this section and retry the CONDITIONAL FORMAT. If it still fails, replace the Fixed Disk/Diskette Adapter. See Step 5 on page 9-18 in this section.
- g. If this is a replacement fixed disk drive, repeat Step 3 on page 9-17 in this section and then go to Step 8 in this section.
- h. If this is not a replacement fixed disk drive, go to Step 8 in this section.

#### 8. Final Checkout

- a. Re-check all cable connections.
- b. Install the system unit cover.
- c. Power on the system unit, load the advanced diagnostics, and select the FIXED DISK DRIVE(S) AND ADAPTER test.
- d. Select option 5, RUN ALL TESTS.
- e. Select option 6, READ VERIFY.
- f. If any errors occur refer to the *Personal Computer AT Hardware Maintenance and Service manual*.

If DOS is installed, ensure that the system will boot properly from the fixed disk.

If this is a replacement fixed disk and DOS is not installed, it is recommended that DOS FDISK and DOS FORMAT be performed (by the customer or an IBM customer engineer) to load the DOS system files. Ensure that the system will then boot properly from the fixed disk before returning the system to the customer or leaving the customer location.

- g. Return to the main diagnostic menu and select option 3, PREPARE SYSTEM FOR MOVING.
- h. Power the system unit off.

### Formatting a 5170 Fixed Disk (20Mb/30Mb)

Before replacing a fixed disk, attempt to format the disk as follows:

Warning: Formatting results in complete loss of data. Refer to the DOS manual and back up all data if possible.

1. Ensure that all power and data cables connected to the diskette drive(s) and fixed disk are tight.
2. Load advanced diagnostics, select option SYSTEM CHECKOUT, and verify that the installed option list is correct.
3. Select option 17, FIXED DISK AND ADAPTER.
4. Select FORMAT MENU, enter desired drive, and select CONDITIONAL FORMAT.
5. Always perform conditional format first. If CONDITIONAL FORMAT fails to complete, UNCONDITIONAL FORMAT should be performed.

Note: UNCONDITIONAL FORMAT should always be followed by a SURFACE ANALYSIS.

6. Tracks found to be defective since the last SURFACE ANALYSIS will be displayed at the end of the CONDITIONAL FORMAT or SURFACE ANALYSIS. The defective cylinder and head should be added to the defective track label on the front of the fixed disk.
7. Before turning the system over to the customer or transferring customer data back onto the fixed disk, perform the DOS FDISK, then DOS FORMAT. (See the DOS manual for FDISK and FORMAT description.)

## Types of Format

**SURFACE ANALYSIS:** The SURFACE ANALYSIS procedure does a complete read/write operation on all tracks. SURFACE ANALYSIS will flag any tracks that are determined defective during the read/write operations. SURFACE ANALYSIS does not save a record of previously flagged tracks.

**CONDITIONAL FORMAT:** The CONDITIONAL FORMAT procedure identifies and flags defective tracks by performing a SURFACE ANALYSIS. It also saves a record of all defective tracks flagged as defective during manufacturing as well as any found defective during the last CONDITIONAL FORMAT or SURFACE ANALYSIS. CONDITIONAL FORMAT writes the sector IDs and reads them back for verification.

**UNCONDITIONAL FORMAT:** UNCONDITIONAL FORMAT does not perform a SURFACE ANALYSIS. This format should be performed only when CONDITIONAL FORMAT is not successful. UNCONDITIONAL FORMAT ignores error conditions and writes the necessary sector IDs without reading them back for verification. The SURFACE ANALYSIS must always be performed after UNCONDITIONAL FORMAT is used to ensure that there are no defective areas left unflagged.

The purpose of UNCONDITIONAL FORMAT is to remove any erroneous defect flags caused by a faulty Fixed Disk Adapter card or other system malfunction. These erroneous defect flags, if not removed, would make the fixed disk appear to have too many defective areas and cause unnecessary replacement of the fixed disk.

## Failure to Recognize Drive C

If you experience this problem, you should remove all cards from the system unit except the Disk/Diskette Attachment card and the Display Attachment card. Retry the load operation both by power on and soft load several times. If diagnostics and read verify do not indicate a problem, but the problem persists, replace the fixed disk drive.

## DOS Loading Problems

Cylinders 1, 2, 3, and 4 must be defect free for DOS 3.0 to operate correctly. If any of these tracks are found to be defective, the fixed disk should be replaced. DOS 3.0 requires that the disk have at least 14 contiguous non-defective tracks to load. If one of these tracks is defective when you attempt to load DOS, you will receive a cylinder zero-- defective error (logical cylinder zero, not physical cylinder zero). If a customer does not want the fixed disk replaced for this problem, perform FDISK and answer *no* to the question: Do

you wish to use the entire fixed disk for DOS and try loading DOS starting at cylinder 004 or higher? If this does not resolve the problem, the fixed disk must be replaced.

## Software Loading Problems

A limited number of Personal Computer software applications might fail to load or cause the system to hang up. However, these software applications might not fail on all systems. For instance, the same application might run on one 5170 and fail on another.

Software applications that use and/or check for the presence of a math coprocessor must be installed using the information in the technical reference manuals.

This information can be found in the BIOS listing under the interrupt 11 preamble. The technical reference manuals for some systems indicate that Bit-1 of the AX register is not used. However, it is used to detect the presence of a math coprocessor.

Other techniques used can yield unreliable results and are not supported by IBM.

Users' questions should be referred to their software vendor or point of sale.

## Backup/Restore Problems

A DOS 3.0 backup command error might manifest itself in different ways: as a file sharing error or an out-of-sequence error during a restore operation. If errors of these types are experienced or suspected, a patch diskette is available upon request through the point of sale.

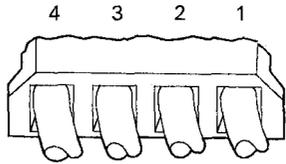
## Fixed Disk/Diskette Drive Voltage

To check the voltage of a fixed disk/diskette drive:

1. Check the voltages at the diskette drive's power connector as shown below.  
Note: If the system unit has two diskette drives, check the voltages at both connectors.
2. Check the voltages at the failing fixed disk drive's power connector as shown below.

Power Connectors			
Min V DC	Max V DC	-Lead	+ Lead
+ 4.8	+ 5.2	2	4
+ 11.5	+ 12.6	3	1

Figure 9-38. Correct Voltage at Connectors



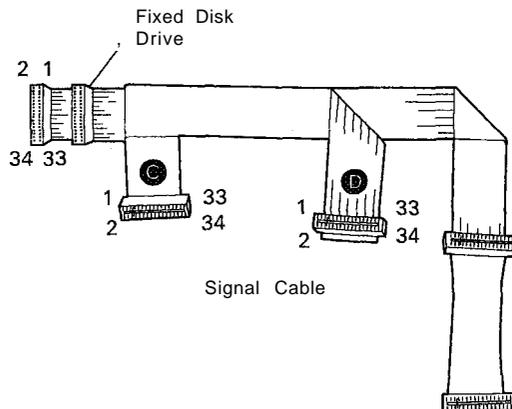
LEX40178

Figure 9-39. Power Connector Locations

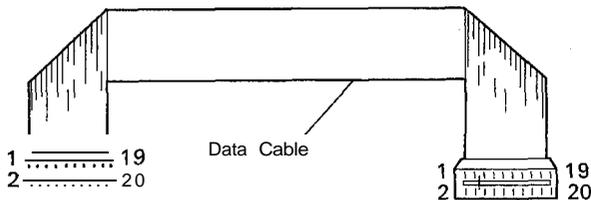
## Fixed Disk Signal/Data Cables Continuity

To check continuity of the fixed disk signal/data cables:

1. Turn the system unit's power switch to off.
2. Remove the system unit's cover.
3. See Figure 9-40 and check the fixed disk drive's data and signal cables for continuity.



LEX40179



LEX40180

Figure 9-40. Signal/Data Cable Continuity Check Points

## Stack Errors Using DOS 3.1 and 3.2

A fatal stack error can occur in DOS Release 3.1 and 3.2.

DOS 3.2 defaults to nine stack pages: nine successive depressions of the pause key cause an error. The depression of any other key resumes operation and clears the stack. The situation also occurs with DOS 3.1. However, no error message is given.

## 5170 Model Identification

A variety of problems can occur if replacement parts for Personal Computers are installed in the wrong model. The following is an example:

- Installing a 5170 Model 239 System Board (P/N6480170) in a 5170 Model 339 will result in the incorrect operation of the 101-key keyboard.

In order to avoid such situations, the model number of the machine being repaired should be known. The model number can be determined by checking the bar code label located on the rear panel of the machine. The 5170 model numbers 339 and 239 will be indicated on this label. The absence of a model number on a 5170 indicates it is a Model 099 or 068.

## 5170 System Information

The following is a cross-reference that will assist in identifying the correct replacement system board for base models of the Personal Computer AT. The base models are 068, 099, 239, 319, and 339.

Serial No. Range	FRU No.	Model	BIOS Part No.
3000001 - 5999999	8286112	068/099	6181028, 6191029,  * 1503107, 1503108, * 1503109, 1503110,  * 6180957, 6108958, * 6180959, 6180960,  * 6181024, 6181025, * 6181026, 6181027,
6000000 - 6999999	6480170	239	6480090, 6480091,  6448894, 6448895,  6480090, 6480091,
7000000 - 7999999	6489922	319/339	61X9265, 61X9266  62X0820, 61X0821

\* Indicates a set of four BIOS modules.

Any numbers other than the ones listed above on BIOS modules in a Personal Computer AT are for the Model 239. Also, there are two different system boards for this model: P/N6480170 (large board) and P/N6480072 (small board).

The BIOS modules sockets are located in positions U17, U27, U37, and U47 on the system board. If the system board has four BIOS modules, all sockets will be filled, but if there are only two BIOS modules they will be located in positions U27 and U47.

Since swapping BIOS modules between system boards can either downgrade or upgrade a system to a different model and possibly affect system performance, these modules should never be swapped from one system board to another.

The system board for Models 068 and 099 do not support the use of an IBM 30Mb Fixed Disk Drive. However, a customer may purchase a 30Mb fixed-disk upgrade kit. This kit will include a set of BIOS modules that when installed will convert the Model 068 or 099 System Board to a Model 239 System Board.

FRU No./ Memory Size	Type/ Mod.	Planar Bd. Memory Module	Full	Half	BIOS Date Codes
P/N8286112-256Kb	068/099	128Kb	X		1/10/84
P/N6480170-256Kb	068/099/239/599	128Kb	X		6/10/85
P/N6480072-512Kb	239/739	256Kb		X	6/10/85
P/N6489922-512Kb	319/339	256Kb		X	11/15/85

## Potential Overwriting Problem with Two Diskette Drives

A combination of changing diskettes and accessing the drives might cause the diskette drive change latch to be erroneously reset.

This could happen only if the user:

- Had diskettes in drives A and B
- Performs an operation on the diskette in drive A
- Changes diskettes in drive A (diskette change latch set)
- Performs an operation on diskette in drive B (accessing drive B, which will cause the diskette change latch for drive A to be reset).

The next operation performed on the diskette presently in drive A could use the file allocation table and directory of the diskette that was previously in drive A. This could result in the file allocation table, directory, or data being overwritten.

If the above symptoms occur, inspect the manufacturer's label on the rear of the drive. If the first 3 digits of the g-digit number below the bar code are 345 or 346 and there is no label next to the manufacturer's label with P/N59X7184, replace the 1.2Mb diskette drive(s).

The 360Kb drive is software controlled and is not affected. Refer to ECA016.

## Problem with Format A:/4 (DOS 3.2) and 5170 Model 339

DOS Release 3.2 command Format A:/4, used to format 360Kb diskettes on the 1.2Mb diskette drive, does not function properly on a 5170 Model 339. The format command displays large amounts of bad diskette space.

To circumvent the problem, enter the command DIR with the diskette mounted before issuing a format command.

## 5250 Remote Emulation Problem with SDLC Card

The remote 5250 Emulator either will not come up, or else it drops the line after a short period when using SDLC in a 5170.

There is a critical timing link between the CPU, the SDLC card, and the emulator program. Because of the timing incompatibility, a data overrun condition is created by software, and the terminal drops. The same card will work perfectly in a 5150 or a 5160, and with 3270 emulation on any PC.

A patch is needed for the 5250 Emulation Program. This patch is on the HONE Equal System as item number 434CH. DOS Debug should be used, and prior knowledge of this program is required. Marketing should be contacted for this patch.

Remote emulation cannot be run on the 5170 Model 339, because the Enhanced Keyboard is not supported.

## S/370 Channel Emulator

### Diagnostic Information

Additional diagnostics, beyond the normal PC AT diagnostics, are required to service this feature. For this reason, a separate Problem Determination Diskette and a *Hardware Maintenance and Service* (HMS) manual are included with each S/370 Channel Emulator ship group. These diagnostics and the *Guide to Operations* (GTO) manual should be kept and made available to you at the installation by the customer. The HMS will direct you on how to use the menu-driven tests that will isolate failures in this feature to the card or cable and verify proper operation.

The ship group diagnostics perform extensive checks on the internal operations of the card while connected to devices (no disconnection required). A channel wrap test, also available on the Problem Determination Diskette, can be run from the 5170 by following instructions located in the HMS. This diagnostic test can be run using 3090, 308X, or 43XX wrap connectors. This choice is provided through a simple menu-driven selection.

When the wrap diagnostic test must be run, it is an IBM customer engineer (CE) responsibility to obtain one of the following pairs of wrap connectors:

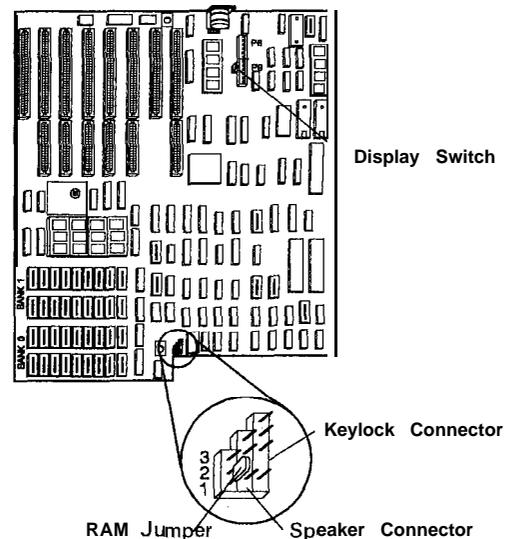
- 3090 Wraps - P/N5479141 and P/N5479139.
- 308X Wraps - P/N6028031 and P/N6028032
- 43XX Wraps - P/N8483772 and P/N8483773.

Since channel problem isolation requires I/O isolation from the 5170 containing this feature, a CE trained on the attached device should perform the channel wrap

diagnostic test when needed. This test will aid in isolation to the failing FRU for channel-related problems in the S/370 Channel Emulator or the attached I/O device. The test will identify the failing line providing the line name and the channel cable pin number. An ohmmeter can then be used to isolate the FRU with the failing line.

Successful completion of the internal card test verifies proper operation of 90% of this feature. Successful wrap tests conducted with the wrap plugs attached at the end of the interface cable verify proper operation of the entire feature. For a 3820 attachment, any simple customer job, when successfully sent to the printer from the remote host, will verify the proper operation of the complete system attachment.

## 5170 PC AT Switch Settings



LEX40254

Figure 9-41. 5170 System Board (Full Size, Front View)

Full-Size Dimensions: 13.5 x 12.

Down-Size Dimensions: 13.5 x 9.5 (not shown).

### Jumper

The system board has a 3-pin, Berg-strip connector. The placement of a jumper across the pins of the connector determines whether the system board's second 256Kb of RAM is enabled or disabled.

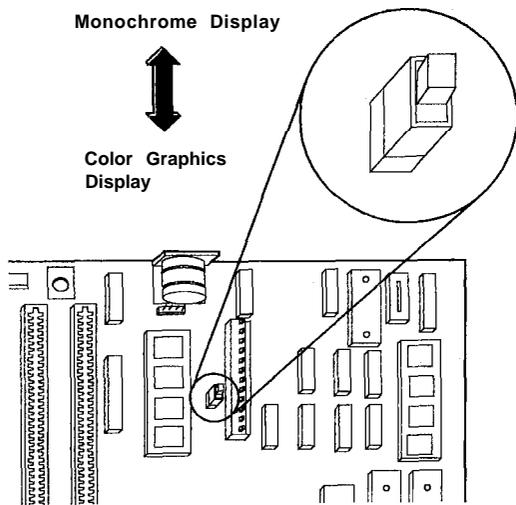
Jumper Positions	Function
1 and 2	Enable second 256Kb of system board RAM
2 and 3	Disable second 256Kb of system board RAM

Figure 9-42. Jumper Positions

The RAM jumper in the disable position (256Kb RAM), enables the user to utilize additional RAM provided on option cards without fully populating the system board.

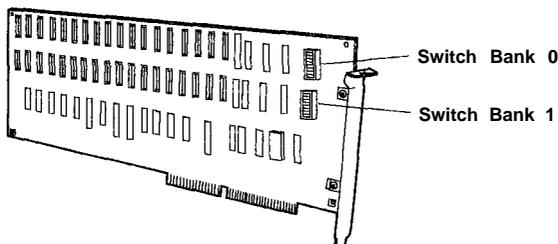
**Note:** The normal position is enable mode. The disable mode permits the second 256Kb of RAM to reside on adapters plugged into the I/O bus. This also pertains to cards like the Enhanced Graphics which have memory to support their function.

### Type of Display Adapter Switch



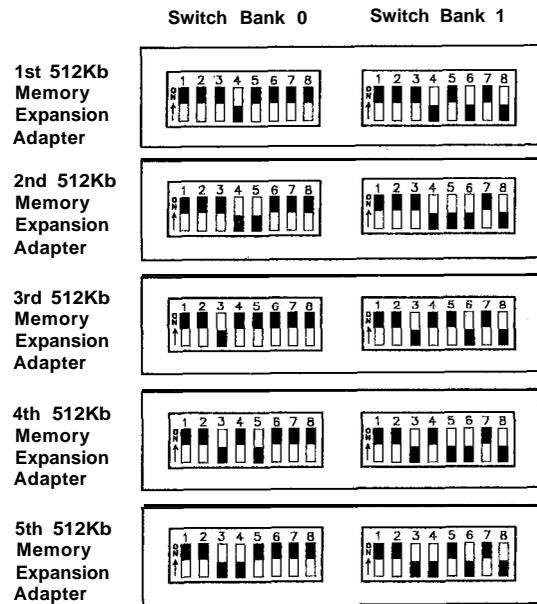
LEX40090

Figure 9-43. 5170 System Board Video Switch



LEX40256

Figure 9-44. 5170 Memory Expansion Switch Bank Location



LEX40257

Figure 9-45. 512Kb Memory Expansion Adapter Switch Settings

### 5170 Memory Adapters Switch Settings

Definitions:

Base Memory	Memory Address 0 ~ 640Kb
Reserved Memory	Memory Addresses 640Kb - 1Mb
Expansion Memory	Memory Addresses 1Mb and up.

The purpose of the eight position switches on the Memory Expansion Adapters is:

Switches 1 - 5	Starting address in the expansion memory area
Switches 6 - 8	Special assignments for each type of memory option.

#### Switches 1-5

The first Memory Expansion card will always have a starting address of 1Mb. Other Memory Expansion Adapters' starting addresses are dependent upon the amount of memory previously installed in the system.

Switch Settings	The off position will enable:
1	8Mb
2	4Mb
3	2Mb
4	1Mb
5	0.5Mb

Example: Assume you have 3.5Mb of expansion memory installed in your system and you are installing another memory option.

1.0Mb	Starting address for expansion memory
3.5Mb	Amount of expansion memory installed
<hr/>	
4.5Mb	Starting address of new memory option to be installed

New memory option should have switches 2 and 5 off and 1, 3, and 4 on.

The 512Kb Memory Expansion Card has two banks of eight switches each. Switches 1 – 5 on both banks are set the same.

### Switches 6, 7, and 8

Switches 6, 7, and 8 are dependent on the type of memory option.

### 128Kb Memory Expansion Adapter

- No switches
- Adds 128Kb to base memory.

### 128Kb/640Kb Memory Expansion Adapter

This card, fully populated, will provide 128Kb to the base memory and 512Kb to expansion memory.

128Kb/640Kb with only 128Kb installed:

Switches	6	7	8
	Off	On	Off

Adds 128Kb to base memory.

128Kb/640Kb fully populated or with only 512Kb of system expansion memory installed:

Switches	6	7	8
	On	On	Off

Adds 512Kb to expansion memory.

### 512Kb Memory Expansion Option

	<b>Bank 0</b>			<b>Bank 1</b>		
Switches	6	7	8	6	7	8
	On	On	On	Off	On	Off

This card adds 512Kb to expansion memory.

### 512Kb/2Mb Memory Expansion Option

This option adds from 512Kb to 2Mb of expansion memory.

### 0.5Mb to 3Mb or 0.5Mb to 6Mb Memory Expansion Option

Switches 6 and 7 are set for the amount of base memory in the system.

Switches	6	7
256Kb	On	Off
512Kb	Off	On
640Kb	Off	Off

640Kb must be allocated to base memory. If the system has less than 640Kb of base memory, a portion of memory on the Expansion Adapter card is used as base memory. When switches 6 and 7 are set for the actual amount of base memory in the system, the system determines the amount of memory needed from the Expansion Adapter card to bring base memory up to 640Kb.

If multiple 0.5Mb to 6Mb Memory Expansion cards are installed, the card with the highest address has switches 6 and 7 set for the actual base memory in the system. Switches 6 and 7 on the other cards are set to indicate 640Kb of base memory.

There cannot be any gap between newly added memory and existing memory in the expansion memory area. If multiple memory expansion cards are used, the 0.5Mb to 6Mb Expansion card must always be the last card if a portion of its memory is used for base memory.

Switch 8-Used to enable (switch on) or disable (switch off) the I/O ports on the card.

### 0.5Mb to 3Mb or 0.5Mb to 6Mb Memory Expansion Adapter Setup

**Note:** The 0.5Mb to 3Mb *Hardware Maintenance and Service* (HMS) manual has been replaced with the 0.5Mb to 6Mb HMS.

The *Hardware Maintenance Service* manual for the 0.5Mb to 6Mb Memory Expansion Adapter (G570-2239) might be confusing. The switches on the adapter are rocker type switches. A red dot is at each end of the switch. To set the switch, depress the red dot at the appropriate on or off end. The opposite end will protrude, making the red dot visible. Example: A switch set to the off position will have the dot visible at the on-side of the switch.

After installing a 0.5Mb to 6Mb Memory Expansion Adapter, you must run the setup function location on the diagnostic diskette.

Boot the system using the diagnostic diskette and at the menu screen select Option 4 (Set-Up Function).

When the following screen is displayed:

```

BASE MEMORY IS COMPOSED OF
-- 256KB
-- 512KB
-- 640KB OF BASE MEMORY CONSISTING
AND 128KB ON THE 128KB MEMORY
EXPANSION OPTION.
BASE MEMORY SIZE IS XXXKB
IS THIS CORRECT (Y/N)

?
**

```

Note: The line BASE MEMORY SIZE IS XXXKB will display 256, 512, or 640 in the XXX position. If XXX displays 640, answer yes. The next screen will ask for expansion memory size.

If XXX displays any other number, answer no. The next screen will display:

```

ENTER CORRECT BASE MEMORY SIZE
(256, 512, 640)
?

```

Enter 640 at this screen.

The following screen will appear:

```

EXPANSION MEMORY SIZE
0
512
1824
1536
2048

*
*
ENTER THE CORRECT EXPANSION MEMORY SIZE
?

```

To enter the correct expansion memory size, perform the following two calculations:

1. 640Kb minus the amount of base memory installed in your system board (256Kb, 512Kb, or 640Kb).
2. Amount of memory installed in your Expansion Adapter card minus the number found in Step 1.

Note: The amount of memory installed in your Expansion Adapter card is 512Kb for 0.5Mb, 1024Kb for 1Mb, 2048 for 2Mb (2 x 1024), 3072Kb for 3Mb (3 x 1024), and so on.

The correct expansion memory size will be equal to the number found in Step 2.

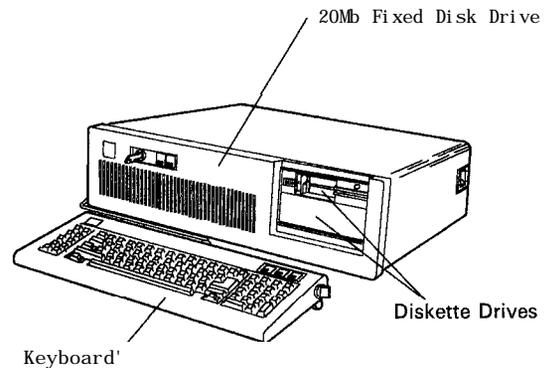
Example: You are installing a 0.5Mb to 3Mb Memory Expansion Adapter with 3Mb of storage installed. Your system board has 512Kb of storage.

The correct expansion memory size is:

1.  $640\text{Kb} - 512\text{Kb} = 128\text{Kb}$
2.  $(3 \times 1024\text{Kb}) - 128\text{Kb} = 3072\text{Kb} - 128\text{Kb} = 2944\text{Kb}$

Expansion memory size is 2944Kb.

## 5170 AT/370



LEX40132

Figure 9-46. 5170 AT/370

The AT/370 is an extended version of the 5170 AT, with 512Kb of memory on the system board. The system unit has an AT/370 Adapter, which consists of two cards plugged into adjacent expansion slots in the system board:

- The 512Kb Memory card (PC/370-M2)
- The Processor card (PC/370-P2).

Options available include:

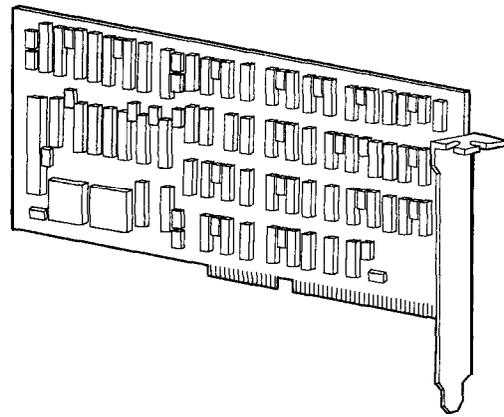
- A Remote Display Terminal Device Emulation Adapter card
- 3278/79 Emulation Adapter.

## Unit Specifications

<b>System Unit Size</b>	
Height	162 mm (6.8 in)
Length	540 mm (21.3 in)
Depth	439 mm (17.3 in)
<b>Weight</b>	<b>19.05 kg (42 lb)</b>
<b>Power Cable</b>	
Length	1.8 m (6 ft)
Size	18 AWG
<b>Environment</b>	
Air Temperature	
System On	15.6° to 32.2°C (60° to 90°F)
System Off	10° to 43°C (50° to 110°F)
Humidity	
System On	3% to 80%
System Off	20% to 80%
Altitude	2133.6 m (7000 ft) max.
<b>Heat Output</b>	<b>1100 BTU/hr</b>
<b>Noise Level</b>	<b>42 dBa</b>
Meets Class 3	
<b>Electrical</b>	
VA · 575	
Range 1	
Nominal	120V AC
Minimum	104V AC
Maximum	127V AC
Range 2	
Nominal	230V AC
Minimum	200V AC
Maximum	240V AC

Figure 9-47. 5170 AT/370 Specifications

## PC/370-P2 Card

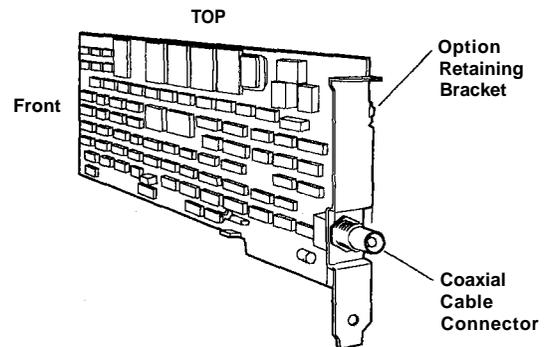


LEX40133

Figure 9-48. PC/370-P2 Card

The PC/370-P2 card is the center of the S/370 operations for the PCAT/370. The PC/370-P2 card contains the microprocessors and control circuits that enable the PCAT/370 to execute S/370 instructions.

## 3278/79 Emulation Adapter

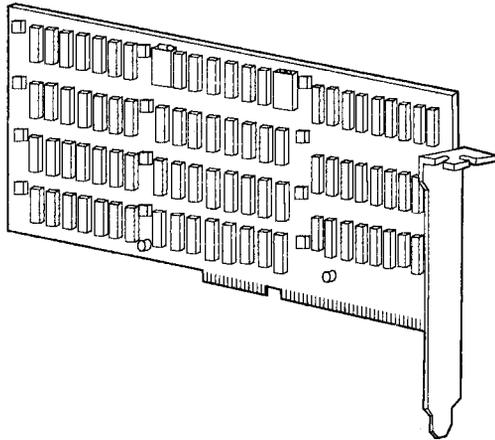


LEX40134

Figure 9-49. IBM Personal Computer 3278/79 Emulation Adapter

The 3278/79 Emulation Adapter allows the PCAT/370 to emulate a 3278/79 terminal when the PCAT/370 is linked to a host system. This card also allows additional functions to those of the 3278/79 when supported with suitable software. These additional functions include the ability to print single screens, complete listings or other files on the Personal Computer AT printer, and the ability to transfer data between the PCAT/370 and the host system disks.

## PC/370-M2 Card



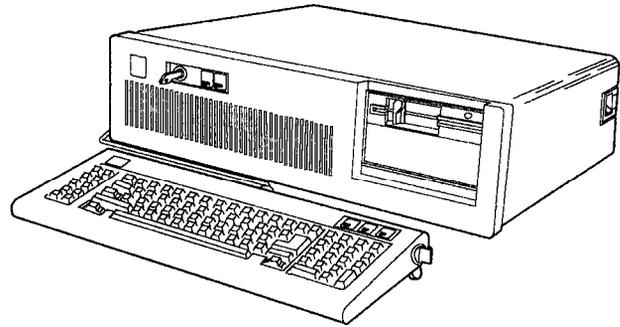
LEX40135

Figure 9-50. PC/370-M2 Card

The PC/370-M2 card contains 512Kb of parity-checked RAM, which can be used by either the PC/370-P2 card or by the Personal Computer AT. In S/370 mode, this applies 480Kb of memory for program use and 32Kb of control storage for microcode use. From the IBM Personal Computer AT, only 128Kb of S/370 memory is addressable at any one time.

## Personal Computer AT Store Controller

This section contains information specific to the Personal Computer AT Store Controller. Additional system information that is common to the base system (5170 AT) can be found in the 5170 product specific section. Information that is unique to the store controller is included in this section. Unique parts for the store controller can be found in the parts section of this document under the title of 5170 AT Store Controller.



LEX42628

Figure 9-51. Store Controller

The store controller system unit (based on the 5170 Personal Computer AT) operates with the 4680 Operating System Programs. These licensed programs provide the 5170 Model 8XX Store Controller with the capability to control the IBM 4683 Point of Sale Terminal with a multitasking, multiuser environment necessary for the user to run application programs, manage system services, and define system configuration data. Attachment is provided for the 5170 Keyboard and a display unit. The display can be either the 5151 Monochrome Display or a 5153 Color Display. This system can attach to a host system via any of the communication adapters; however, it is not host dependent.

Model 899	Includes a new system board and a Store Loop Adapter. All other available features are the same as the Model 099.
Model 839	Includes a new system board and a Store Loop Adapter. All other available features are the same as the Model 239.
Model 849	Includes a new system board and a Store Loop Adapter. All other available features are the same as the Model 339.
Model 819	This is a special bid model. It is the same as the Model 849 with the IBM 30Mb Hard File and the Serial/Parallel card removed.
Model 820	This is a special bid model. It is the same as the Model 849 with the IBM 30Mb Hard File, the Serial/Parallel card, and the Loop Adapter card removed. It has the Token-Ring Adapter added (FC 3391 and FC 3390).

Input to the system is via a keyboard (same as the appropriate base Models 099, 239, 339, and 849).

## Loop Adapter, P/N6347798

This is an S-Loop Adapter and allows the store controller to drive up to 64 4683 Model 001s. Each 4683 Model 001 can have a 4683 Model 002 attached. The 4683 Terminal can have multiple I/O devices attached. This adapter is standard in the store controller models of the 5170 Personal Computer AT.

A store controller can support up to two loop adapters. If your controller has two adapters installed, one must be jumpered to serve loop 1, and the second adapter must be jumpered as loop 2. A marked decal is on the end of the adapter to which the loop cable connects.

## Multiprotocol Communications Adapter, P/N62361 78

This adapter, a new feature available for all 5170 models, provides the capability to select under program control the desired communication protocol to be used. Supported protocols are asynchronous, binary synchronous, or SDLC. The interface is an EIA RS232C. In asynchronous mode, a programmable baud generator allows operation from 50 to 9600 baud. The user can select 5-, 6-, 7-, or 8-bit characters with 1, 1.5, or 2 stop bits. In synchronous mode, the adapter operates in half-duplex. The maximum transmission rate is 9600 bits per second (bps), as generated by the attached modem or other data communication equipment. The interrupt levels are programmable.

## 4683 Model 2 Attachment Adapter Kit, FC 8314

This feature code can be installed in a PC-5150, PC-5160, PC-5170 (Model 339), and the Personal System/2 Model 8530. It allows direct attachment of one or two 4683 Model 002 Point of Sale Terminals (POSTs). In this configuration, the PC operates as a store controller and the 4683-002 as a POST for the small store environment.

The small store configuration uses DOS 3.3 or later as an operating system. Application code is provided by the user; IBM provides I/O driver code to interface between PC-DOS and the 4683-002 I/O devices. The driver code is a licensed program that is not warranted by IBM. It will be the user's responsibility to get it serviced.

The 4683-002 diagnostics have also been modified to run from the PC under PC-DOS. A new, problem determination manual, *IBM 4683 Model 002 Attachment Adapter System Problem Determination Manual*, SA27-3790, is shipped with each feature. This document tells how to run and interpret the diagnostic and verification tests, and how to configure the user's system for the unique I/O configuration. The diag-

nostic results (error messages/symptoms) will be compatible with the diagnostic results for the 4680 system. The IBM customer engineer must be aware, however, that the PC controller and the 4683-2s will be offline to the user while the diagnostics are being run. It is possible for the application coder to include the capability of running the application and the diagnostics concurrently, but this should not be assumed.

## System Board

The system board for the Models 839 and 899 uses a 6 MHz oscillator. The Models 819 and 849 use an 8 MHz oscillator. All of these models use the Intel 80286 E Step Microprocessor. When operating the controller with the 4680 program products, the E Step Microprocessor allows multitasking. Due to this program requirement other system boards part numbers cannot be used in the store system environment.

## 4800 Baud Modem

A special 4800 baud RPQ modem is being used with the 5170 Personal Computer AT Store Controller. This is an under-the-cover modem. It operates at 4800 bps with a backup half-speed of 2400 bps. The interface is EIA RS232. It operates synchronously and uses automatic adaptive equalization. There is a voltage surge protection on telecommunication line connections. A *User's Guide*, GA27-3782, is supplied with the feature. With the *User's Guide* is a diagnostic diskette, P/N6164858, which allows stand-alone testing of the modem.

## Loop Cables

The loop cabling used in the 4680 Store System complies with the IBM Cabling System. These cables have a modular connector on one end and a data connector on the other. The data connectors are self-shorting when disconnected. However, note that if the cable is disconnected at the modular connector end, at the terminal or controller, the loop will be opened. If the loop is opened, all the terminals on that loop will go offline. The standard loop cable from the Controller Loop Adapter card is P/N6316840.

A different loop cable, P/N63X4998, is part of the special bid for the Model 819. When either end of this cable is disconnected the loop is opened. The customer should supply a shorting plug at each receptacle.

Note: The customer receptacle is not serviced by IBM. The service strategy for the controller loop cable is to replace the cable assembly.