

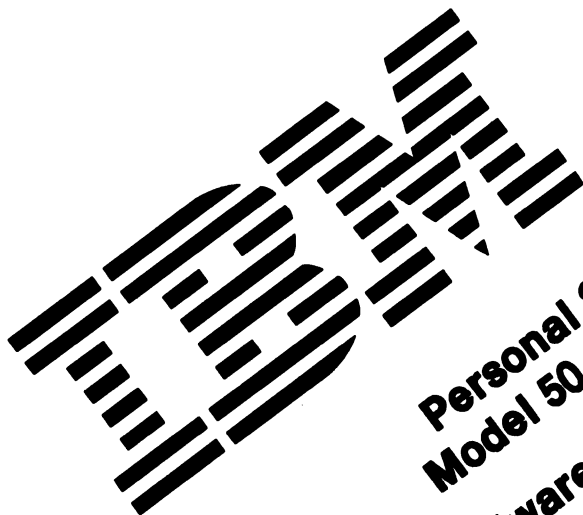
**Personal System/2
Model 50
Hardware Maintenance
Reference**

March 21, 1990

Part Number 64F3989

Form Number S64F-3989-00





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Safety Information

Refer to the *Hardware Maintenance Reference General Information* pamphlet in this manual for the following safety information:

- General Safety
- Electrical Safety.

First Edition (March 1990)

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Product Description

The IBM^{*} Personal System/2^{*} Model 50 computers use the IBM Micro Channel^{*} architecture. The features of the various types of Model 50 are:

- Security: cover lock and power-on password
- System board:
 - 10-MHz 80286 Microprocessor
 - 80287 Math Coprocessor connector
 - 1MB (MB = 1,048,576 bytes) random access memory (RAM); expandable to 2MB on some models
 - 64 bytes of complementary metal-oxide semiconductor random access memory (CMOS RAM)
 - Read-only memory basic input/output system (ROM BIOS)
 - Video graphics array (VGA)
 - Three expansion slots
 - Fixed-disk-drive adapter slot
 - Serial port
 - Parallel port
 - Diskette-drive controller
 - Keyboard connector
 - Pointing-device connector
 - Display connector.
- Power supply:
 - Automatically switches to the 100 – 125 Vac or 200 – 240 Vac range
 - 50 or 60 Hz
 - 94 watts.
- Battery (to keep CMOS RAM active when power is off)
- Speaker
- 101/102-key keyboard
- Fixed-disk-drive adapter (on some models)
- Fixed disk drives supported (see “Fixed Disk Drives” on page 6).

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Security

Cover Lock

The cover lock is on the back of the system unit and can be unlocked with the user's key.

If the keys for the cover lock are lost, a new cover-lock assembly can be ordered (see the parts section in the *Hardware Maintenance Service* pamphlet for the system you are servicing). The new assembly contains two keys. Use one of the new keys, along with a pair of pliers, to force the old cover lock open.

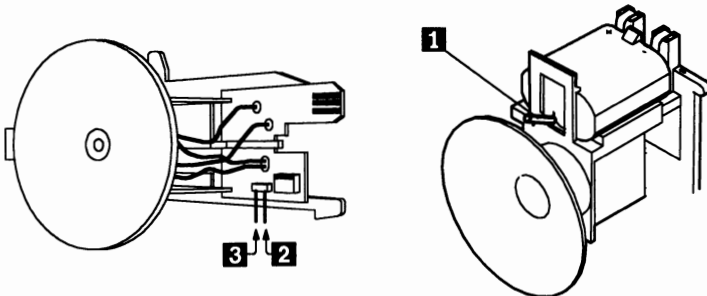
Power-On Password

A power-on password denies access to the system when the system is powered-on. To service a system with an active and *unknown* power-on password, power-off the system and, do *one* of the following depending on which battery and speaker assembly is installed:

- If the assembly has pins, short pins **2** and **3** together.
- If the assembly has no pins, insert a meter lead into connector **1** and short the other end of the lead to frame ground.

With the assembly shorted, power-on the system. This deactivates the power-on password. Remove the short after the POST is finished.

To reactivate the power-on password, start the system with the Reference Diskette in drive A, select the **Set features** option, and follow the instructions.



System-Board Features

The major features of the system board are:

- 80286 Microprocessor
- CMOS RAM
- ROM BIOS
- VGA
- Serial port
- Parallel port
- Diskette-drive controller
- Keyboard connector
- Pointing-device connector.

Microprocessor

The microprocessor interprets and carries out instructions. The 80286 Microprocessor is a 16-bit processor and operates in two modes: real-address mode and virtual-address (protected) mode. The microprocessor speed is 10 MHz.

CMOS RAM

The CMOS RAM provides 64 bytes of storage. The first 50 bytes are used to store system-configuration and security information. The real-time clock uses the remaining 14 bytes to track the date, time, and battery level.

The data stored in CMOS RAM is kept active by the battery when the system is powered-off. If the stored data is lost due to a depleted or removed battery, the data can be restored using one of the following methods:

- If the user has a customized configuration that uses settings other than the default, run the restore configuration program on the user's backup copy of the Reference Diskette.
- If the configuration uses the default settings, run the automatic configuration program on the Reference Diskette.

ROM BIOS

ROM BIOS contains the instructions and routines that control the keyboard, diskette drives, fixed disk drive, displays, and other major input/output devices in the system. Some adapters have their own ROM modules containing extended BIOS routines that work with the system-board ROM BIOS. The routines for performing the power-on self-test (POST) are also contained in the ROM BIOS.

VGA

The VGA is a graphics controller on the system board. The VGA supports color and monochrome analog direct-drive displays in a variety of modes, including alphanumeric text mode, and all-points-addressable (APA) graphics mode.

The VGA supports a maximum of 720-by-400 picture elements (PELs) in the text mode and 640-by-480 PELs in the graphics mode. The VGA can support 256 colors or 64 shades of gray at one time. Composite video is not supported.

One expansion slot on the system board extends farther to the rear of the system board than the others. This extended expansion slot accommodates video adapters that are designed to interface with the system-board VGA. Some of these adapters have a display connector of their own. The extended expansion slot also supports all adapters designed to be installed in the shorter slots.

Serial Port

The serial port is fully programmable and supports asynchronous communications. The 25-pin, D-shell connector provides the signals to drive a device with a standard 25-contact, RS-232 connector. The connected device is identified by the system configuration as either SERIAL 1 or SERIAL 2.

If adapters with serial ports are installed in the system, they can be configured from SERIAL 1 to SERIAL 8.

Note: Conflicts occur when using multiple communication lines if two or more lines are addressed the same. Select the **Set configuration** option on the Reference Diskette. Select **View configuration** to verify that no lines are addressed the same.

Parallel Port

The parallel port allows the attachment of devices that accept eight bits of parallel data at standard transistor-transistor-logic (TTL) levels. The port has a 25-pin, D-shell connector and is designed primarily for printers. However, the port can be used as an input/output port for any device or application that matches the input/output capabilities of the port. When adapters with additional parallel ports are installed, the system can support three different devices, each addressed separately as PARALLEL 1, PARALLEL 2, or PARALLEL 3.

Note: Conflicts occur when two or more devices have the same address. Select the **Set configuration** option on the Reference Diskette. Select **View configuration** to verify that no lines are addressed the same.

Diskette-Drive Controller

The controller connects to the diskette drives through a single 40-pin connector on the system board. Signals and voltages are supplied through a bus adapter that plugs into the connector. These signals and voltages can operate two IBM 3.5-inch diskette drives.

Keyboard Connector and Pointing-Device Connector

The two 6-pin connectors at the rear of the system board are for a keyboard and a pointing device (mouse). The keyboard connector is marked with a small keyboard figure molded into the back panel; the unmarked connector is for the pointing device. The interface logic is the same for both. A fuse on the system board protects the system board, keyboard, and pointing device.

Option Compatibility

The Model 50 uses only those adapters that are specifically designed for it. For supported options, see the parts section in the *Hardware Maintenance Service* pamphlet for the system you are servicing .

Drive and Diskette Compatibility

The following provides information concerning the identification of diskette drives.

Diskette Drive	Identifying Mark
3.5 Inch - 720KB	None
3.5 Inch - 1.44MB	1.44 on the Eject Button

The following addresses the compatibility of diskettes to diskette drives.

Diskette Capacity	720KB Drive	1.44MB Drive
1.0MB	Read/Write	Read/Write
2.0MB	Not Compatible	Read/Write

Note: For additional information, see "Diskette Drives and Diskettes" in the *IBM Personal System/2 Hardware Maintenance Reference General Information* pamphlet in this manual.

Fixed Disk Drives

Several fixed disk drives are available for PS/2 systems. The fixed disk drive and fixed-disk-drive interface must be the same. For example, an enhanced small device interface (ESDI) adapter must be used with an ESDI drive. For supported fixed disk drives, see the parts section in the *Hardware Maintenance Service* pamphlet for the system you are servicing.

Before moving the computer, select **Move the computer** on the Reference Diskette to park the fixed-disk-drive heads.

Terminators

Diskette Drives: do not use or require terminators.

ESDI and ST506 Fixed Disk Drives: do not use or require terminators.

SCSI Fixed Disk Drives: one or more cables are used to connect the fixed-disk adapters to the fixed disk drives. For each cable used, the last drive on the cable must have a terminator.

The location, quantity, and appearance of the terminator may vary from drive to drive. An identification label or tag (usually "T-RES") is attached to the terminator for easy identification.

Note: For additional information, see "SCSI Devices" in the "Options and Adapters (Micro Channel)" section of this manual.

Operating Requirements

This section describes the operations that occur from the time the system is powered-on until the minimum operating requirements are met.

Power Supply

The power supply automatically switches to either the 100–125 Vac or the 200–240 Vac range. The ac input is converted to dc outputs that supply the system with proper operating voltages.

When the system is powered-off for 10 seconds or more and then powered-on, the power supply generates a 'power good' signal that resets system logic. The presence of the 'power good' signal indicates that the power supply is operating properly and that the minimum under-voltage sense levels have been established. This means that all system-board power requirements have been met.

Output (Vdc)	Minimum Under-Voltage Sense Level (Vdc)
+ 5.0	+ 4.5
+12.0	+10.8
-12.0	-10.2

The 'power good' signal turns on the green power-good light on the front of the system. If the green light is not on, the power supply is not functioning properly.

Power-On Self-Test (POST)

The POST is initiated automatically each time the system power is turned on.

The POST is a series of system checks and initializations that verify the correct operation of the system unit. The POST tests only those areas that allow the system to be operational enough to run advanced diagnostics. The POST can detect two types of errors: critical and noncritical.

Critical errors prevent the system from operating or cause incorrect results that are apparent to the user. Examples of critical errors include microprocessor or interrupt-controller errors. If the POST detects a critical error, all testing stops and the microprocessor attempts to display the error.

Noncritical errors cause incorrect results that might not be apparent to the user. An example of a noncritical error would be a serial communications failure. If the POST detects a noncritical error, the microprocessor attempts to display an error code and all testing stops. Pressing the F1 key allows testing to continue.

When the Reference Diskette is in drive A, and a noncritical error is detected, the system displays the POST error message along with a message generated from the Reference Diskette. The Reference Diskette message instructs the user to take a specific action to correct the error.

After a successful POST, one short beep occurs. Control is then given to a BIOS routine called the system bootstrap loader. The bootstrap loader attempts to load an operating system or a program from either a diskette or the fixed disk drive. If neither is present in the system, the Insert Diskette icon is displayed (see the *IBM Personal System/2 Micro Channel Diagnostics* pamphlet in this manual. This icon indicates that a diskette should be inserted into drive A. After the diskette is inserted, press the F1 key to resume operation. If the F1 key is pressed when no diskette is in the diskette drive, the IBM Cassette BASIC screen appears.

System Memory

System-Board Memory

The Model 50 system board has at least 1MB of memory installed at the time of shipment. Additional memory can be installed by adding memory-expansion adapters. The system can support up to 16MB of memory.

Memory-Expansion Adapters

An optional memory adapter, the 80286 Memory Expansion Adapter, is available to extend the capabilities of the Model 50. The 80286 Memory Expansion Adapter is shipped with one 80286 Memory Expansion Kit. Three 80286 Memory Expansion Adapters can be installed in the system. Each adapter can have three 80286 Memory Expansion Kits installed. The adapters can be installed in any of the 32-bit expansion slots on the system board. For other supported options, see the parts section in *Hardware Maintenance Service* pamphlet for the system you are servicing.

Memory Requirements and Limitations

The system board *does not* have to be fully populated before adding 80286 Memory Expansion Adapters, and each memory-expansion adapter *does* not have to be filled to capacity before adding another memory-expansion adapter.

When memory is added or removed from the system, run the set configuration program on the Reference Diskette.

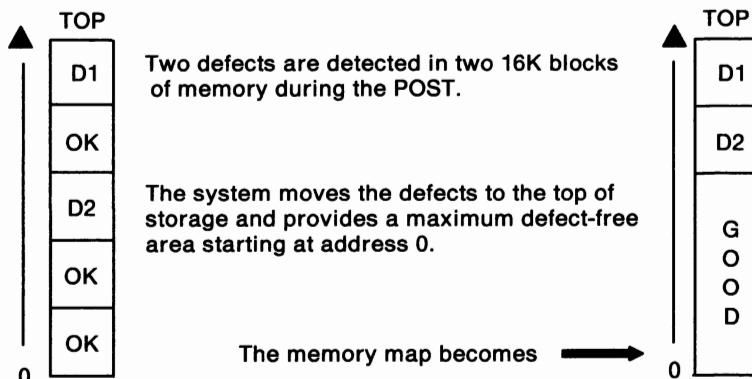
Memory Errors

The Model 50 reallocates memory in 1MB blocks.

If the first 1MB of memory on the system board has a memory error, no memory reallocation occurs and an error message is displayed.

If the first 1MB of memory on the system board has no memory errors, but a memory error occurs in either the additional system-board memory or the memory-expansion-adapter memory, reallocation occurs.

Reallocation allows the system to function with up to two noncritical memory errors, however, the memory capacity is reduced. To recover the maximum memory when defects are present, the defective addresses are arranged in a chain at the top of memory. The rest of addressable memory is then available for use.



The first time the POST detects an error in memory outside the first 1MB, it displays an error message and gives the user a choice of continuing with memory reallocation or correcting the error. The address of the error is then stored.

The next time POST is run, it reads the stored address and automatically reallocates memory without displaying an error message. When three or more errors occur, memory reallocation does not take place and the system displays an error message. All errors must then be corrected.

Stored memory errors can be detected by running the advanced diagnostic memory tests.

Specifications

Size

- Width: 360 mm (14.1 in.)
- Depth: 420 mm (16.5 in.)
- Height: 140 mm (5.5 in.).

Weight

- Minimum configuration: 9 kg (20 lb)
- Maximum configuration: 11 kg (24 lb).

Environment

- Temperature:
 - Power on: 15.6° to 32.2°C (60° to 90°F)
 - Power off: 10° to 43°C (50° to 110°F).
- Humidity:
 - Power on: 8% to 80%
 - Power off: 20% to 80%.
- Maximum altitude: 2134 m (7000 ft).

Heat Output

494 British thermal units (BTUs) per hour (144.8 watts per hour).

Electrical

- Input voltage (Sinewave input is required)
 - Low Range:
 - Minimum: 90 Vac
 - Maximum: 137 Vac.
 - High Range:
 - Minimum: 180 Vac
 - Maximum: 265 Vac.
- Input kilovolt-amperes (kVA)
 - Minimum Configuration (as shipped from IBM):
Approximately .11 kVA
 - Maximum Configuration: Approximately .27 kVA.

Special Tools

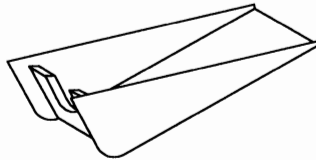
The following special tools are required to service the Model 50.

Volt-Ohm Meter

A meter similar to the Triplett Model 310.¹

Snap Tool

This tool (IBM part 72X8547) is used to pull up the snaps within the system. The tool is stored in the system unit in front of the battery and speaker assembly.



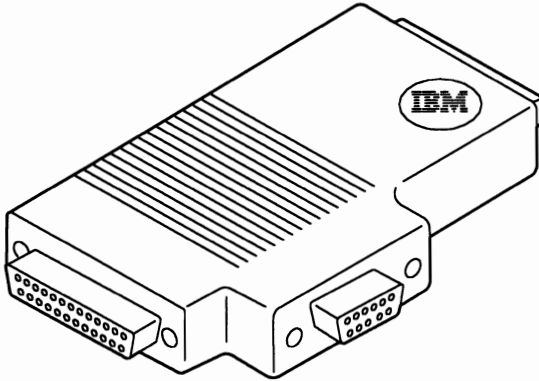
¹ Manufactured by Triplett Corporation, Bluffton, Ohio 45817, U.S.A.

Wrap Plug

The Tri-Connector wrap plug (IBM part 72X8546) is used during the advanced diagnostic tests of the serial and parallel ports.

The Tri-Connector wrap plug replaces the following:

- (IBM part 8529228) Printer Adapter wrap plug
- (IBM part 8286126) Serial Port wrap plug
- (IBM part 8529280) Communications Adapter wrap plug
- (IBM part 62X1083) Communications wrap plug 25-pin
- (IBM part 62X1084) Communications wrap plug 9-pin.



Removals and Replacements

The arrows in the removals and replacements show the direction of movement to remove a FRU, to turn a screw, or to press a tab to release a FRU. The arrows are marked in numeric order to show the correct sequence of removal.

When other FRUs must be removed prior to removing the failing FRU, they are listed at the top of the page. Go to the removal procedure for each FRU listed, remove the FRU, and then continue with the removal of the failing FRU.

To replace a FRU, reverse the removal procedure and follow any notes that pertain to replacement. See "Locations" for internal cable connection and arrangement information.

CAUTION:

Before removing any field replaceable unit (FRU), power-off the system, unplug all power cords from their electrical outlets, and disconnect any interconnecting cables.

Warning: The system board, adapters, memory modules, and the math coprocessor are sensitive to, and can be damaged by, electrostatic discharge. Establish personal grounding by touching a ground point with one hand before touching these units.

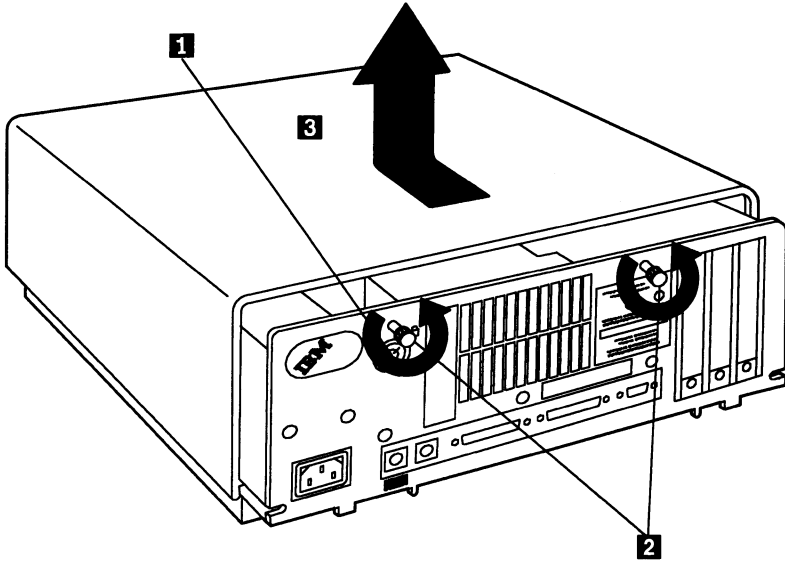
Note: An electrostatic discharge (ESD) strap may be used to establish personal grounding.

1005 Cover

CAUTION:

Before removing any field replaceable unit (FRU), power-off the system, unplug all power cords from their electrical outlets, and disconnect any interconnecting cables.

Note: Unlock the cover lock **1**.



1010 Battery and Speaker Assembly

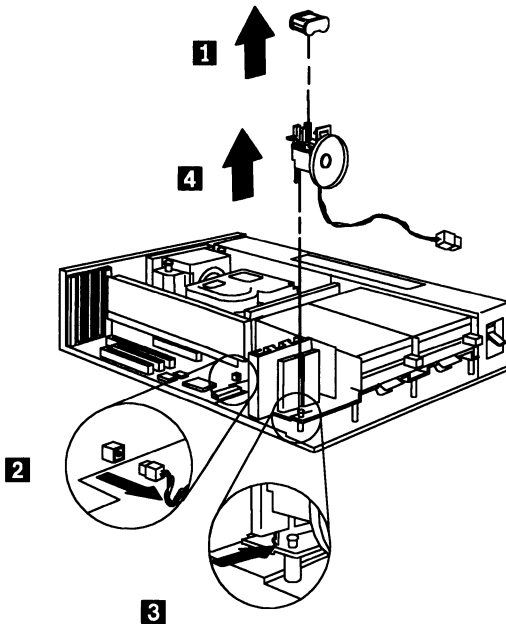
CAUTION:

The lithium battery presents a fire, explosion, or severe burn risk. Do not recharge it, remove the polarized connector from it, disassemble it, heat it above 100°C (212°F), incinerate it, or expose its cell contents to water. Dispose of the battery as required by local ordinances or regulations. When replacing the battery, use only Part No. 72X8498. Use of another battery could result in ignition or explosion of the battery. Replacement batteries can be ordered from IBM or IBM Authorized Dealers.

Warning: To avoid accidentally discharging the battery, remove it before disconnecting the battery and speaker assembly cable. Connect the cable before replacing the battery.

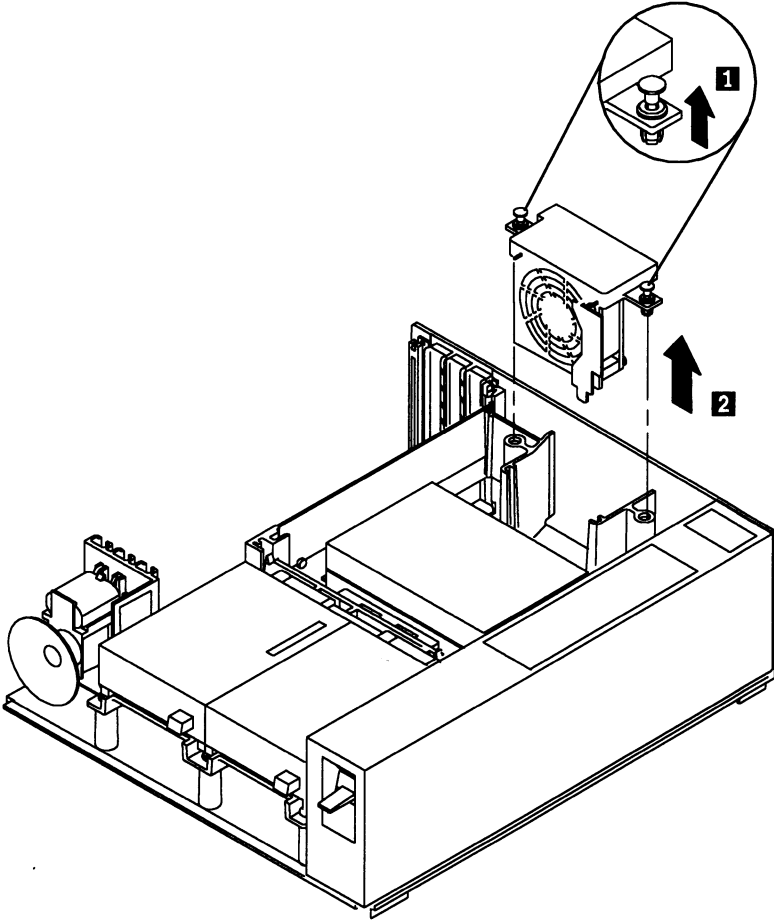
- Cover (1005)

Note: The cable **2** might not be present in all systems.



1015 Fan Assembly

- Cover (1005)

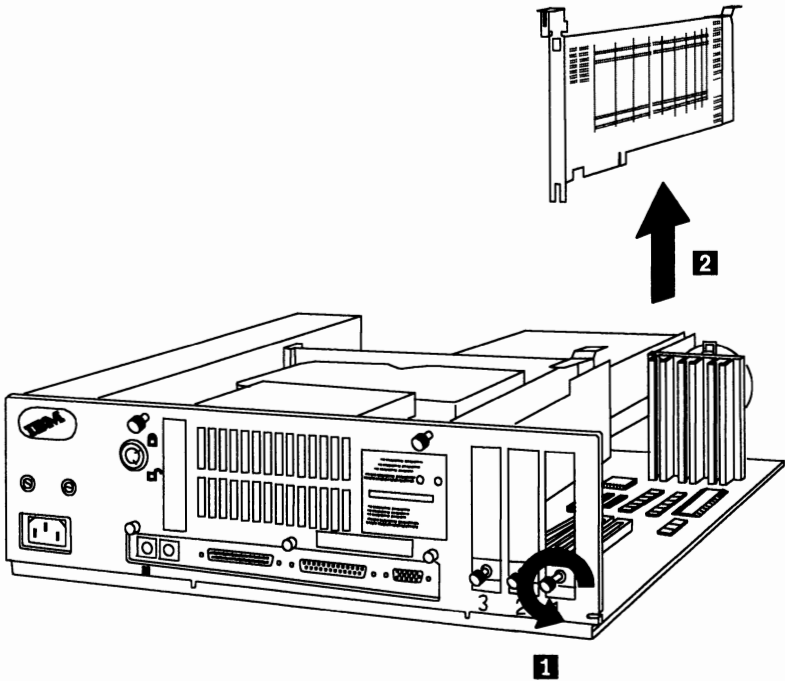


1020 Adapters

- Cover (1005)

Note: Before replacing an adapter, note the locations of the adapter and cables. When replacing an adapter, install the replacement adapter in the same slot as the adapter that was removed.

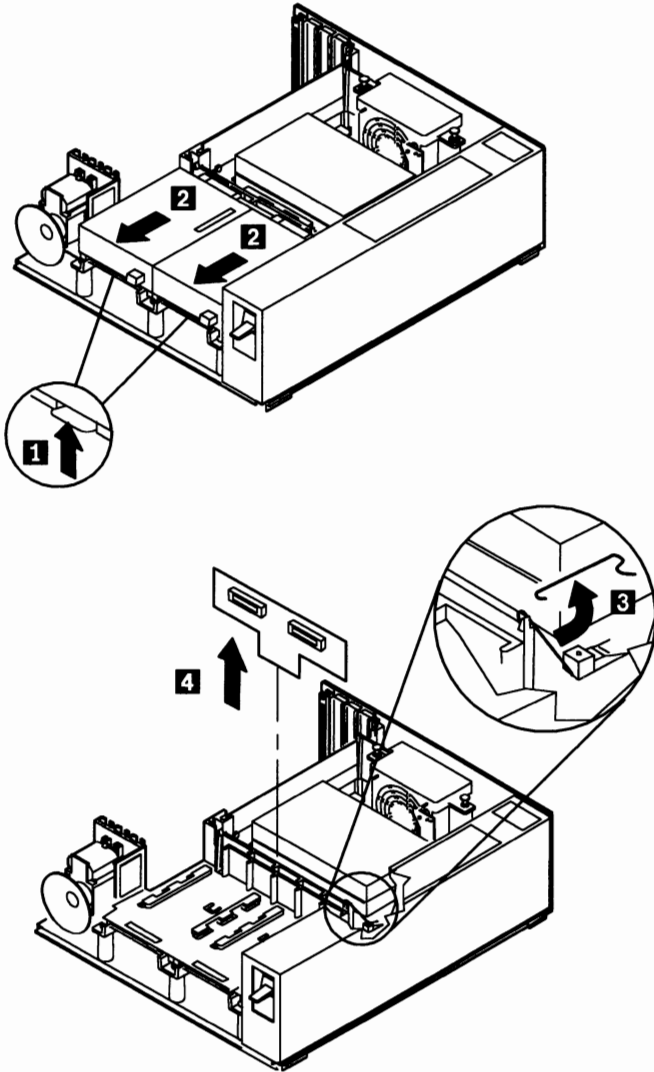
Stored configuration information depends on the location of the adapter. If the replacement adapter is installed in a different location, run the set configuration program on the user's Reference Diskette to reset the system-configuration information.



1025 Diskette Drives and Bus Adapter

- Cover (1005)

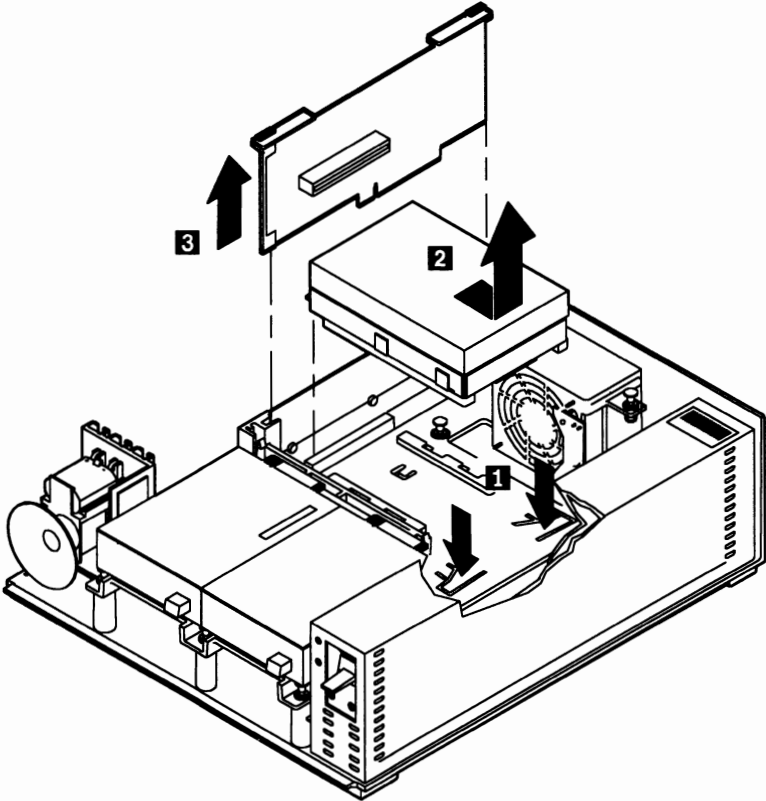
Note: The retainer shown in **3** might not be present on all systems.



1030 Fixed Disk Drive and Adapter

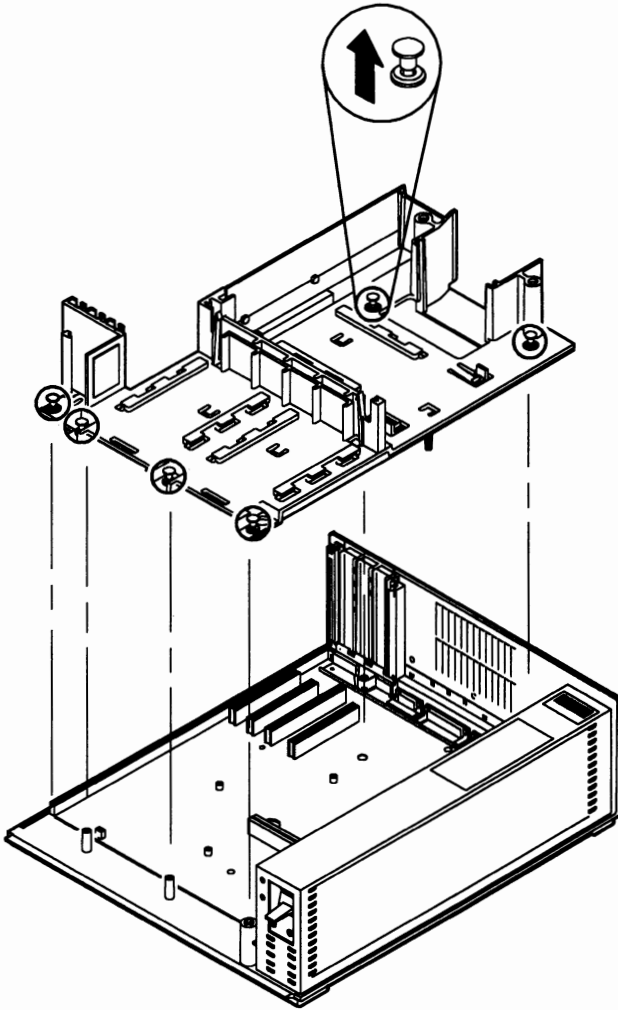
Warning: Improper shipping or handling can result in permanent loss of all data and formatting on the fixed disk drive. Have the user back up all information on the fixed disk drive. Before removing the fixed disk drive, select **Move the computer** on the Reference Diskette to park the fixed-disk-drive heads.

- Cover (1005)



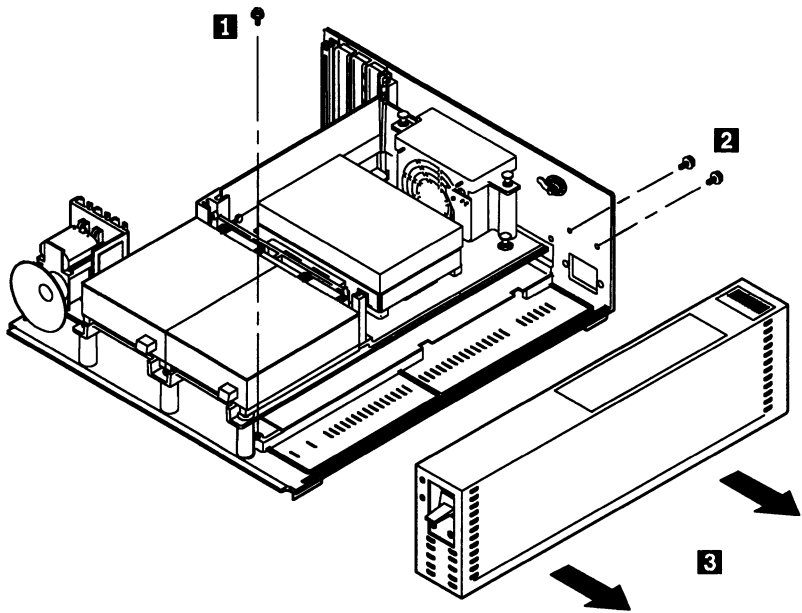
1035 Support Structure

- Cover (1005)
- Battery and speaker assembly (1010)
- Fan assembly (1015)
- Adapters (1020)
- Diskette drives and bus adapter (1025)
- Fixed disk drive and adapter (1030).



1040 Power Supply

- Cover (1005)

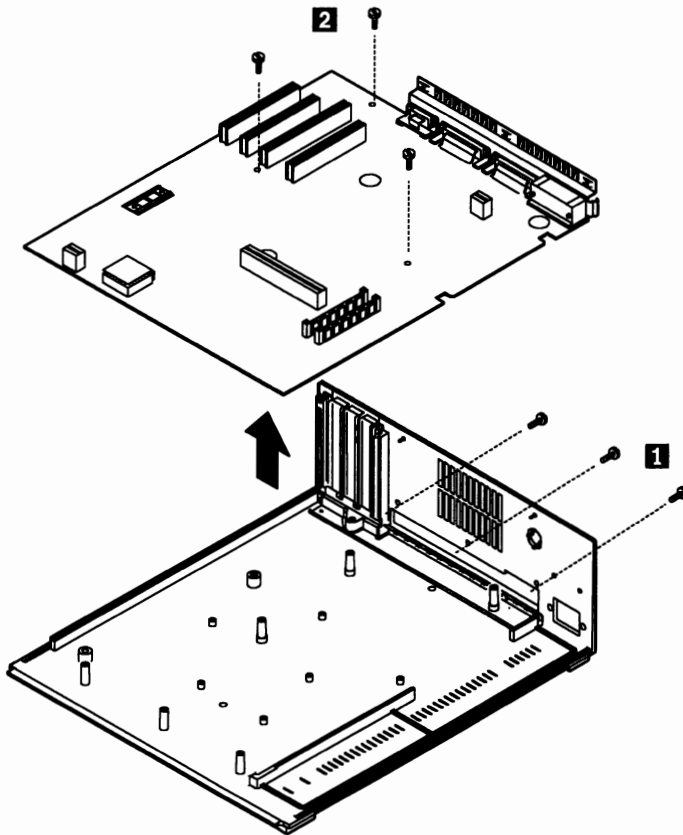


1045 System Board

- Cover (1005)
- Support structure (1035)
- Power supply (1040)
- Math coprocessor, if installed (1050)
- Memory-module packages (1055).

Notes:

1. Disconnect all cables from the system board.
2. When a new system board is installed, run the restore configuration program on the Reference Diskette to restore time and date and any unique configuration data.



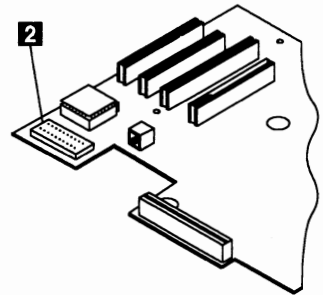
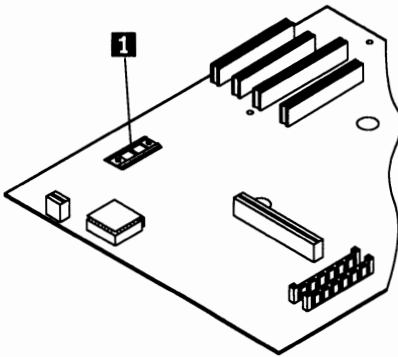
1050 Math Coprocessor

- Cover (1005)
- Adapter in expansion slot 1, if installed (1020).

Warning: Remove the math coprocessor carefully. Do not bend the pins when removing the math coprocessor. The math coprocessor can be damaged by electrostatic discharge, prying between the module and connector, or prying between the connector and system board. Establish personal grounding by touching a ground point with one hand before touching the math coprocessor.

Notes:

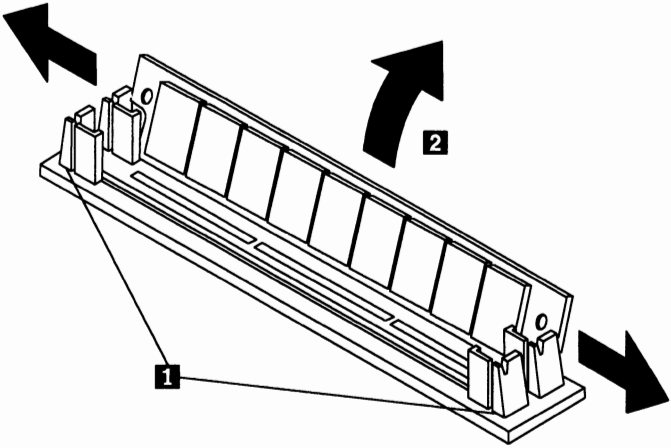
1. When replacing the math coprocessor, align the notch on the math coprocessor to the rear of the system unit (Type 1) **1**, or to the left side of the system unit (Type 2) **2**. If the math coprocessor is not installed correctly, the system will not operate.
2. The Model 50 uses a 10-MHz math coprocessor. Use of the wrong math coprocessor could cause intermittent errors. For the proper part number, see the parts section in the *Hardware Maintenance Service* pamphlet for the system you are servicing.



1055 Memory-Module Packages

- Cover (1005)
- Support structure (1035).

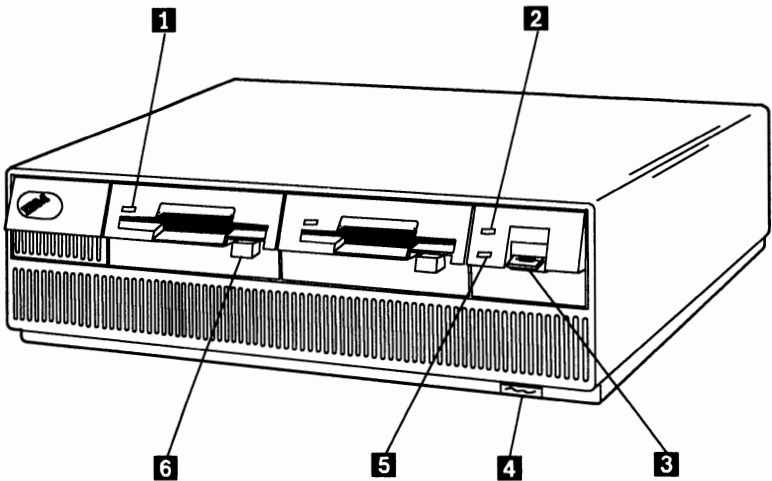
Note: For Type 1 system boards, remove the memory-module package closest to the diskette-drive bus-adaptor slot first.



Locations

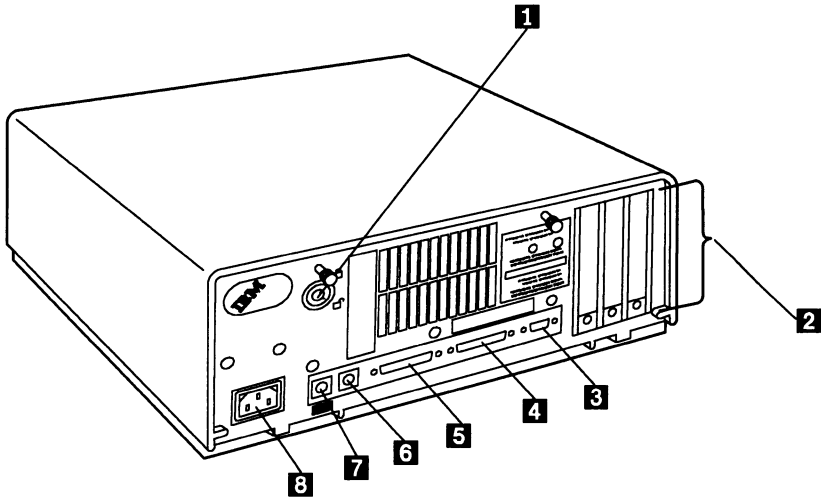
Front View

- 1 Diskette-drive in-use light
- 2 Power-good light
- 3 Power switch
- 4 Serial number
- 5 Fixed-disk-drive in-use light
- 6 Diskette-eject button.



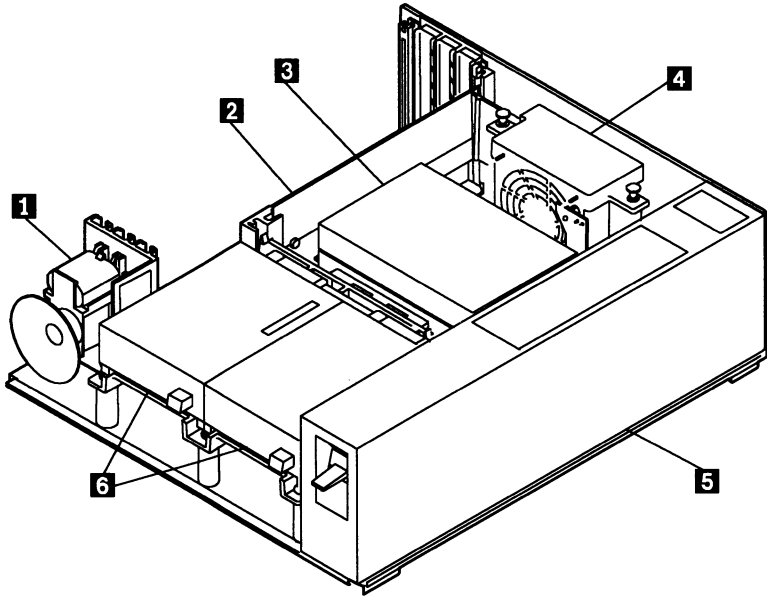
Rear View

- 1 Cover lock
- 2 Expansion slots
- 3 Display connector
- 4 Serial port
- 5 Parallel port
- 6 Pointing-device connector
- 7 Keyboard connector
- 8 Power-cord connector.



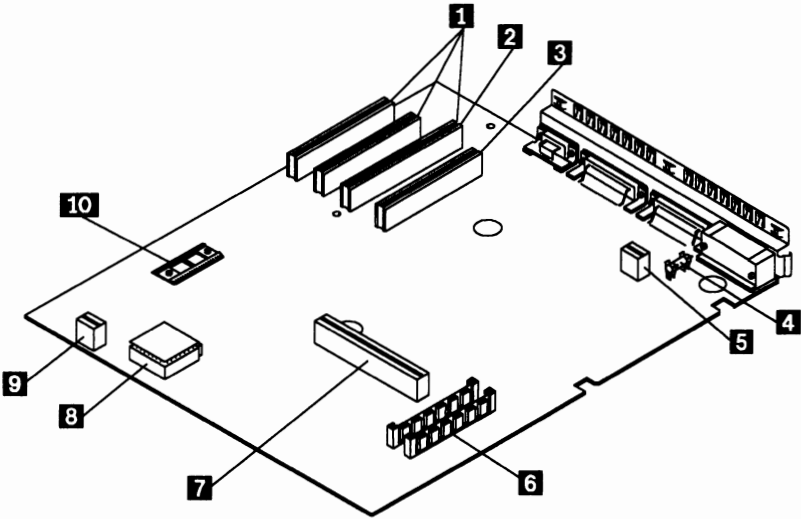
Interior View

- 1 Battery and speaker assembly
- 2 Fixed-disk-drive adapter
- 3 Fixed disk drive
- 4 Fan assembly
- 5 Power supply
- 6 Diskette drives.



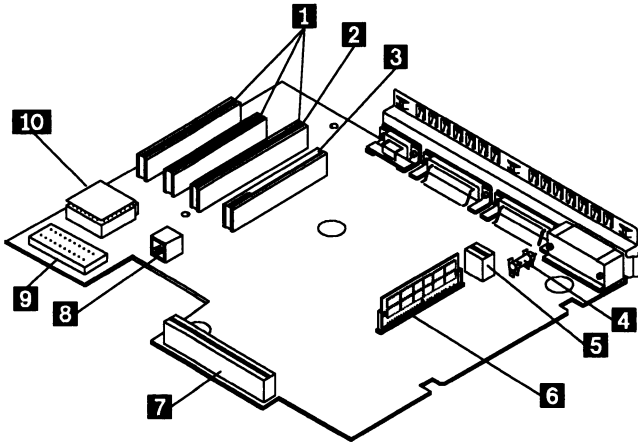
System Board (Type 1)

- 1 Expansion slots
- 2 Extended video-adapter slot
- 3 Fixed-disk-drive bus-adapter slot
- 4 Fuse
- 5 Fan-assembly connector
- 6 Memory-module package connectors
- 7 Diskette-drive bus-adapter slot
- 8 80286 Microprocessor
- 9 Battery and speaker assembly connector
- 10 80287 Math Coprocessor connector.



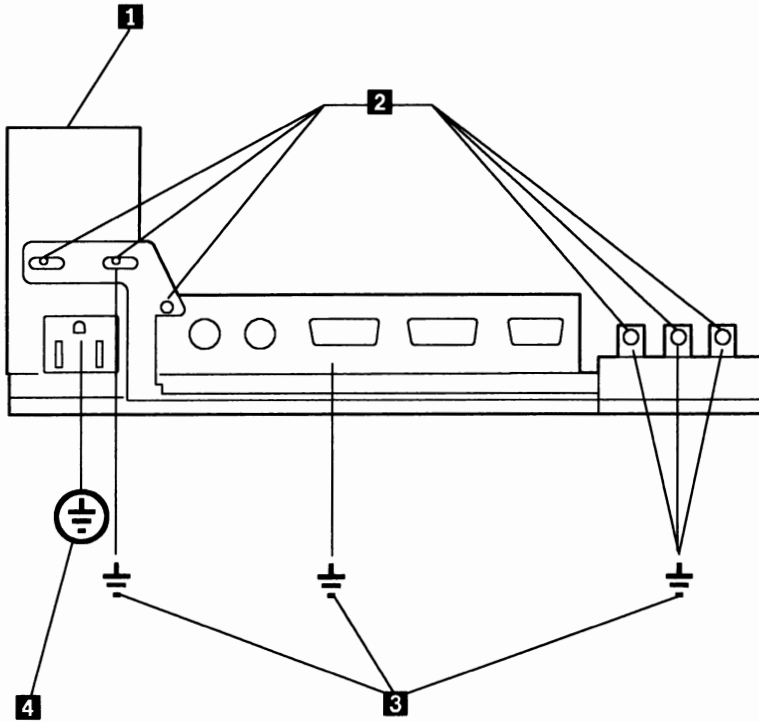
System Board (Type 2)

- 1 Expansion slots
- 2 Extended video-adaptor slot
- 3 Fixed-disk-drive bus-adaptor slot
- 4 Fuse
- 5 Fan assembly connector
- 6 Memory-module package connector
- 7 Diskette-drive bus-adaptor slot
- 8 Battery and speaker cable connector
- 9 80287 Math Coprocessor connector
- 10 80286 Microprocessor.



Safety Grounds

- 1 Power supply
- 2 Screw connection
- 3 Chassis ground
- 4 Primary ground.









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