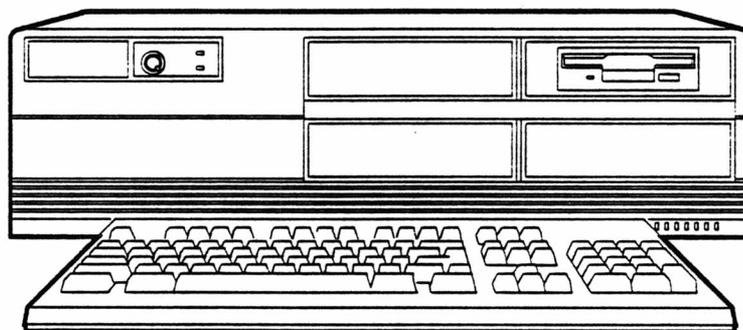
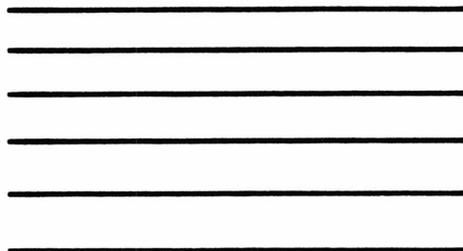




Groupe Bull



Z 3 8 6 / 3 3 E

Service Manual

860-236

585-335



Copyright © 1990 by Zenith Data Systems Corporation

This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at DFARS 252.227-7013 (Oct. 1988); or, if provided under a contract or subcontract with NASA or a civilian agency of the Government, this material may be reproduced in accordance with the provisions of the contract or subcontract with Zenith Data Systems Corporation, Hilltop Road, St. Joseph, Michigan 49085. **All other rights reserved.**

Trademarks

MS-DOS® and XENIX® are registered trademarks of Microsoft Corporation.
OS/2™ is a trademark of IBM.

Printed in the United States of America

Contents

Chapter 1 — Introduction

Related Materials	1-2
Tools	1-2
Safety Precautions	1-3
Base Computer	1-3
Optional Hardware	1-5

Chapter 2 — Disassembly and Options

Managing Power Supply Capacity	2-1
Static Precautions	2-2
Cover Removal/ Installation	2-2
Circuit Card Removal/ Installation	2-3
80387/3167 Coprocessor Installation	2-6
OEM ROM Installation	2-7
SIMM Module Installation/ Removal	2-8
Disk Drive Installation	2-10
Drive Chassis Removal	2-10
3.5-Inch Floppy Disk Drive Installation	2-12
5.25-Inch Floppy Disk Drive Installation	2-13
Hard Disk Drive Installation	2-14
SCSI Tape Backup Unit Installation	2-15
Mounting Disk Drives	2-16
Blank Panel Removal	2-19
Disk Drive Removal	2-19
Real-Time Clock IC Replacement	2-20
Real-Time Clock IC Disposal	2-21
Cache Card Removal/ Installation	2-22
LED/Keylock, Card Guide, and Speaker Removal/ Installation	2-23
Auxiliary Fan Removal/ Installation	2-25
System Board Removal/ Installation	2-26
Power Supply Removal/ Installation	2-27

Chapter 3 — Operation

Powerup	3-1
Resetting the Computer	3-2
The Monitor Program	3-2
Entering the Monitor Program	3-3
Boot Command	3-4
User Tests	3-5

Chapter 4 — Hardware Configuration

Static Precautions	4-1
I/O Card	4-2
Disk Controller Card	4-3
Z-559 High-Performance VGA Card (Part Number 152-37-J1)	4-5
High-Performance VGA Card (Part Number 152-19-J1)	4-5
Keyboard	4-6

Chapter 5 — Troubleshooting

Static Precautions	5-1
Troubleshooting Procedure	5-2
Powerup	5-2
Status LEDs	5-3
Troubleshooting Charts	5-4
Disk-Based Diagnostics	5-16
Power-Up and Error Messages	5-17

Chapter 6 — Parts List**Specifications**

Chapter 1

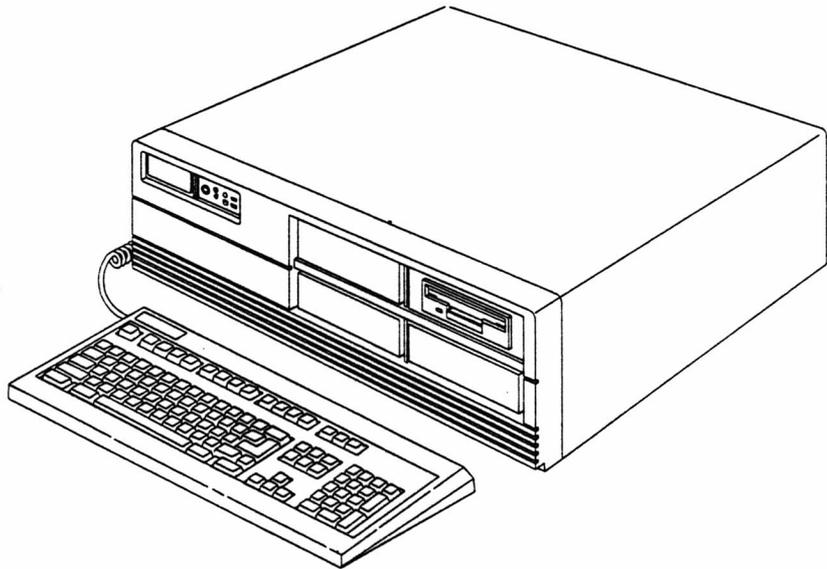
Introduction

The Z-386/33E is a 33 MHz, 80386-based Extended Industry Standard Architecture (EISA) PC/AT-compatible computer. EISA architecture offers increased processing power while maintaining backward compatibility with traditional PC and AT hardware and software. The computer supports from 4 to 20 megabytes of memory on the system board using 1- or 4-megabyte SIMMs (single in-line memory modules), or up to 4-gigabytes of memory using EISA-compatible cards in the EISA expansion slots. A 16K cache memory is standard.

The EISA Configuration Utility (ECU) supplied with this computer introduces a new concept in hardware configuration. The ECU allows the user to select options and set parameters using a model on the monitor screen. This allows the user to configure the system and install options primarily through software, with a minimum of time and effort spent setting switches and installing jumpers (refer to the *Z-386/33E Owner's Manual*). Computer features include:

- VGA-compatible video output
- Two serial ports
- One bi-directional parallel port
- 1.4M, 3.5-inch floppy disk drive
- 150M or 320M hard disk drive (depending on model)
- 5.25-inch floppy disk drive support
- 5.25-inch tape backup drive support
- Real-time clock with calendar
- 101-key keyboard
- Password protection
- Supports MS-DOS[®], XENIX[®], and OS/2[™] operating systems
- EISA mass-storage controller with SCSI port
- Four open EISA expansion slots (ISA backward-compatible).

Figure 1-1. *The Z-386/33E Computer*



This manual includes operation, configuration, and troubleshooting procedures to the major assembly level.

Related Materials

The following materials are available from Zenith Data Systems:

- *Z-386/33E Owner's Manual* — part number 595-4541
- *Z-386/33E Technical Reference Manual* — part number 595-4653
- Disk-Based Diagnostics:
 - Model number CB-31-07 (3.5-inch)
 - Model number CB-51-07 (5.25-inch).

Tools

Use the following tools to install, maintain, and repair this computer:

- #1 Phillips screwdriver
- #2 Phillips screwdriver
- 3/16-inch flat-bladed screwdriver
- 9-pin serial loopback connector (part number 438-73)
- 25-pin parallel loopback connector (part number 438-64).

Safety Precautions



Warning: Avoid shock and personal injury. Use the following precautions when servicing this computer:

1. Disconnect AC power before opening the cabinet.
2. Remove all jewelry.
3. Verify correct line cord selection.
4. Use a grounded AC power source.

Base Computer

The base computer provides all processing functions, disk drive operations, keyboard and video interfacing.

The computer contains the following major assemblies:

- System board
- Floppy and hard disk drives
- VGA video card
- Enhanced 101-key keyboard
- EISA disk drive controller card
- I/O card
- COM2 filter card
- Cache memory card
- Power supply.

System Board — The system board contains all circuitry for processing and interfacing within the computer:

- CPU
- Memory
- Power and expansion
- Four EISA (also ISA-compatible) expansion slots
- Sockets for optional 80387 numeric coprocessor and Weitek 3167 extended math coprocessor.

I/O Card — The I/O card contains the circuitry for implementing the serial ports, parallel port, and other functions:

- Battery backed real-time clock/calendar
- EISA configuration EEPROM
- Diagnostic LEDs
- BIOS and option ROMs
- System setup and control
- Password EEPROM
- Keyboard interface circuitry
- Speaker interface.

COM2 Filter Card — This small auxiliary card connects to the I/O card with a ribbon cable to provide the second serial port, COM2. The card does not occupy an expansion slot.

Disk Drives — The computer supports four types of floppy disk drives:

- 720K, 3.5-inch
- 1.4M, 3.5-inch
- 360K, 5.25-inch
- 1.2M, 5.25-inch.

The computer also supports two types of hard disk drives (5.25-inch half-height and 5.25-inch full-height drives). The disk controller provided with the computer supports ESDI (enhanced small device interface) and SCSI (small computer systems interface) hard disk drives. Two types of ESDI hard disk drives are available (depending on the computer model):

- 150M
- 320M.

Note: The factory-supplied drive controller card does not support ST-506 hard disk drives. If an ST-506 type drive is to be used, the factory-supplied controller card must be replaced with an appropriate ST-506 controller card (and CFG file).

Power Supply — The power supply provides the following outputs: +5 VDC, -5 VDC, +12 VDC, and -12 VDC. See the specifications section of this manual and Chapter 2 for information on managing power supply capacity when adding hardware options.

Keyboard — The computer has an enhanced 101-key keyboard.

Cache Card — The cache card provides a high-speed SRAM buffer between the CPU and the main system memory, and provides fast access to program data and instructions. The card provides 16K of SRAM.

Optional Hardware

- ZA-3800-AU Memory Upgrade Kit for Disk Controller Card
- ZA-3800-CI 80387 Numeric Coprocessor
- ZA-3800-CW Weitek 3167 Extended Math Coprocessor
- ZA-3800-ME 1M RAM Expansion Kit
- ZA-3800-MK 4M RAM Expansion Kit
- ZA-3800-TD 150M SCSI Tape Backup Drive
- ZD-14 3.5-inch, 1.4M Internal Floppy Disk Drive
- ZD-12 5.25-inch, 1.2M Internal Floppy Disk Drive
- ZD-207-7 5.25-inch, 360K Internal Floppy Disk Drive
- MA-660 Computer Stand.

Chapter 2

Disassembly and Options

This chapter provides procedures for disassembling the computer and installing various hardware options.

Managing Power Supply Capacity

Notice: Before adding hardware options to this computer, read this section on managing power supply capacity.

The power supply in this computer provides 21 amps of current at +5 volts DC. The basic system uses 15.9 amps, leaving 5.1 amps for additional disk drives or option cards. When adding drives or cards to the system, be sure the total current requirement of all options is no more than 5.1 amps. Attempting to use more current than is available may reduce system reliability and cause the computer to malfunction. Some typical current requirements are:

- 5.25-inch half-height hard disk drive: .7 amps
- 5.25-inch full-height hard disk drive: 2 amps
- 3.5-inch floppy disk drive: .2 amps
- 5.25-inch floppy disk drive: .5 amps
- tape backup drive: .7 amps
- average EISA option card: 2.3 amps
- average ISA option card: 2 amps.

Check with the manufacturer of the specific option to be added for the exact current requirement of that option.

Static Precautions

To protect ICs and circuit boards:

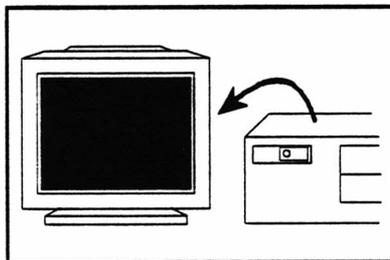
- Do not remove any static-sensitive device from its protective packaging until you are ready to install it.
- Equalize the static electricity between the work surface, the device, and you by touching the work surface with one hand, then picking up the device with the other hand.
- Once you have removed the device from its protective packaging, do not set it down until it is installed in the computer or returned to its protective packaging.

Cover Removal/ Installation

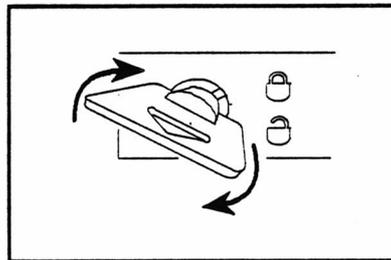


Warning: To prevent shock, disconnect the computer from the AC power source before removing the cover.

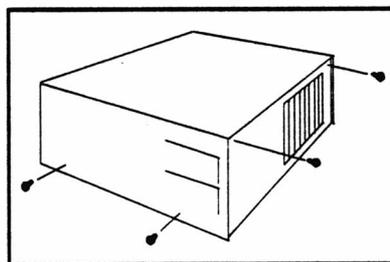
To remove the computer cover:



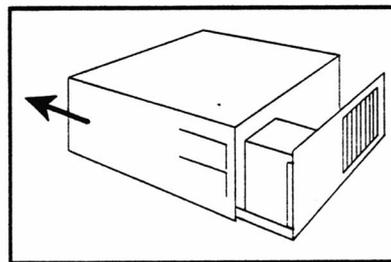
A. Disconnect and set the video monitor aside.



B. Unlock the computer cover.



C. Remove the cover screws from the back and sides.



D. Lift the cover up and slide it off the chassis. Make sure the computer cover does not bind on internal cables or connectors.

To reinstall the cover, perform the above steps in reverse order.

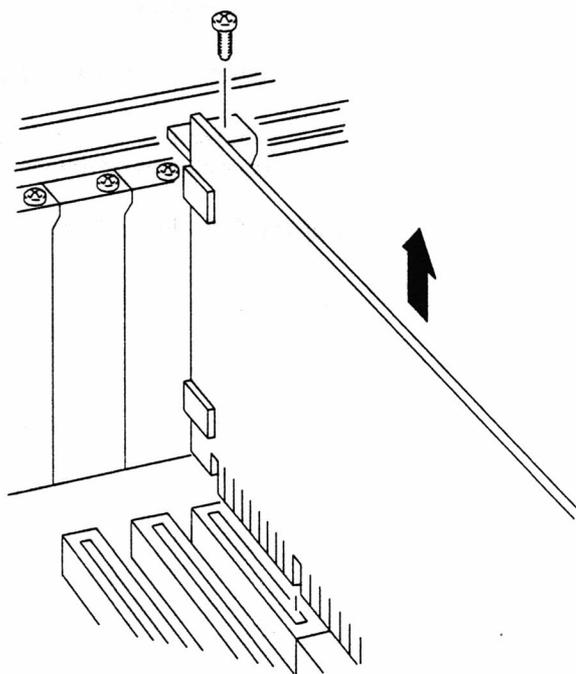
Circuit Card Removal/ Installation

Notice: Use static precautions.

To remove a circuit card:

1. Remove the cover as described previously.
2. Remove any cables attached to the card. Note their location and orientation so they can be properly reattached later.
3. Refer to Figure 2-1 and remove the screw that secures the circuit card to the computer chassis. Save the screw. Grasp the card and lift it until it is free of the connector.

Figure 2-1. Circuit Card Removal



4. Place the card in protective packaging.

To install a circuit card in the computer:

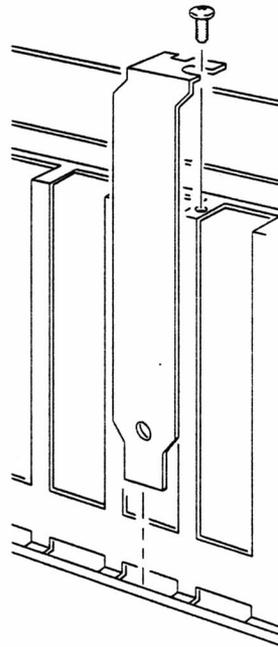
1. Refer to Table 2-1 and select the expansion slot for the new card.

Table 2-1. Expansion Slot Assignments

SLOT	CONNECTOR	BUS	CARD
1	P100	EISA	VGA video
2	P101	EISA	Open
3	P102	EISA	Open
4	P103	EISA	Open
5	P104	EISA	Open
6	P105	ZDS	ZDS I/O card
7	P106	EISA	EISA disk drive controller

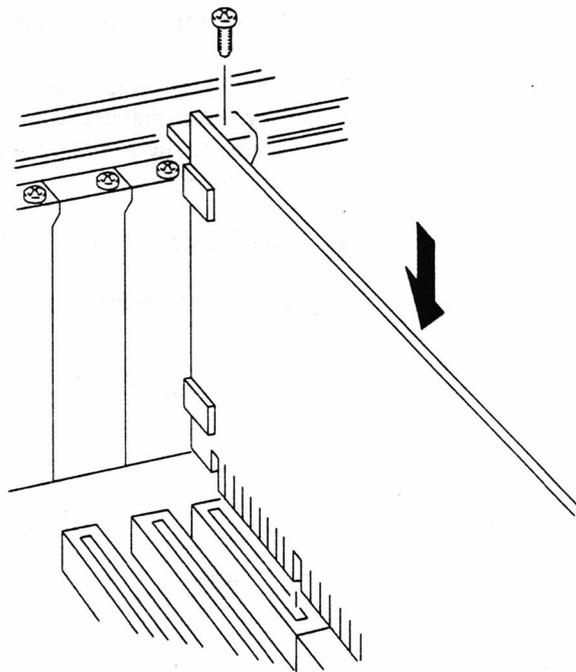
2. Before installing the new card(s), run the ECU program to reconfigure the computer. Refer to the Owner's Manual for further information on the ECU. After running the ECU, turn off and unplug the computer.
3. Remove the cover as described earlier.
4. Remove and save the screw and blank cover plate from the computer chassis at the slot location selected (see Figure 2-2).

Figure 2-2. Blank Panel Removal



5. Refer to Figure 2-3 and position the new card over the slot. Carefully push the card down until it is securely seated. Secure the card with the screw removed in step 4.

Figure 2-3. *Circuit Card Installation*



6. Refer to circuit card documentation and attach any required peripheral cables.
7. Replace the cover.

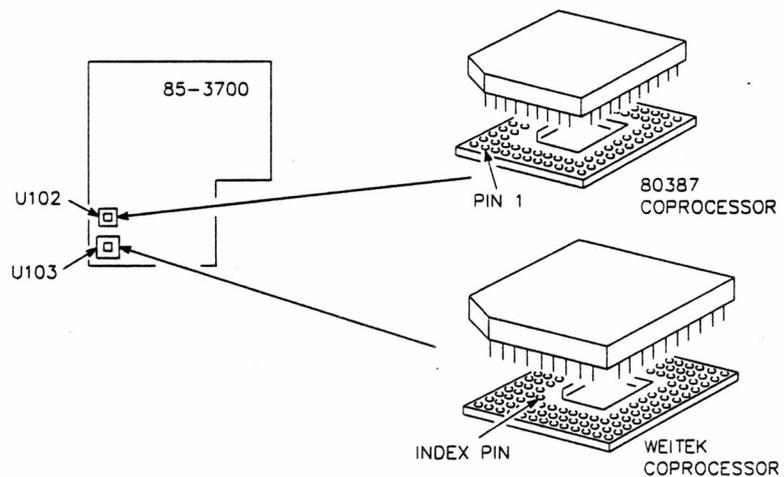
80387/3167 Coprocesor Installation

Notice: Use static precautions.

To install an optional 80387 or 3167 coprocessor:

1. Remove the cover as described earlier.
2. Remove any expansion cards installed in the system board that may make installation of the numeric coprocessor(s) difficult. (Refer to the previous section for details on removing expansion circuit cards.)
3. Use Figure 2-4 to locate the numeric coprocessor sockets.

Figure 2-4. Numeric Coprocessor Socket Locations



4. Insert the IC(s) into the socket(s) as shown in Figure 2-4.
5. Replace any expansion cards previously removed and reattach cables.
6. Replace the cover.
7. Coprocessors are automatically made available to the system when the computer is turned on and booted; no configuration is necessary.

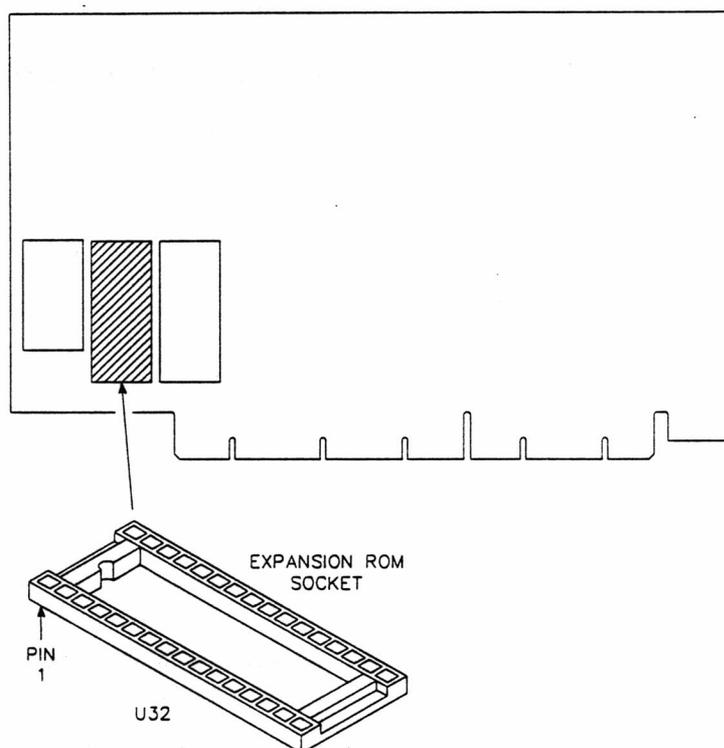
OEM ROM Installation

Notice: Use static precautions.

To install an OEM ROM:

1. Remove the computer cover as described earlier.
2. Remove the two cables from the I/O card. Note the orientation of the cables for reassembly later.
3. Remove the I/O card from the computer (see instructions earlier in this chapter for circuit card removal).
4. Locate the empty IC socket (U32) on the I/O card shown, in Figure 2-5.

Figure 2-5. OEM ROM Socket Location



5. Carefully insert the ROM IC into the socket.
6. Reinstall the I/O card into slot P105; secure it with THE screw.
7. Reconnect the two cables disconnected in step 2.
8. Replace the cover.

SIMM Module Installation/Removal

Before adding or removing memory, run the ECU program to reconfigure the computer. Refer to the Owner's Manual for information on the ECU program and additional memory information. Note that when changing memory, 4-megabyte SIMMs must be installed on 4-megabyte boundaries (4M, 8M, 12M, or 16M).

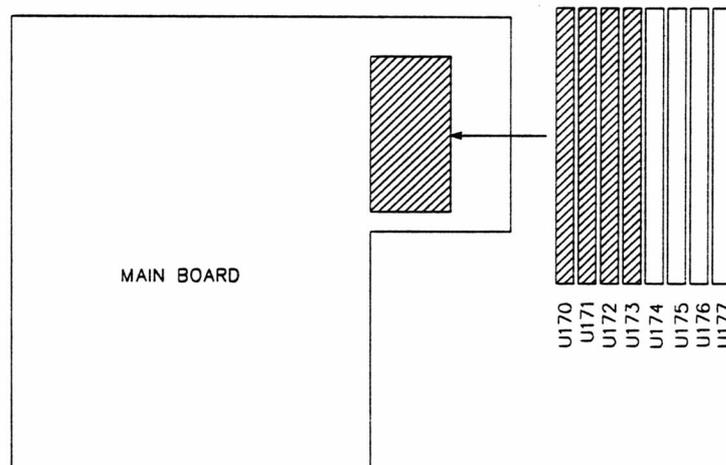
Turn off and unplug the computer.

Notice: Use static precautions.

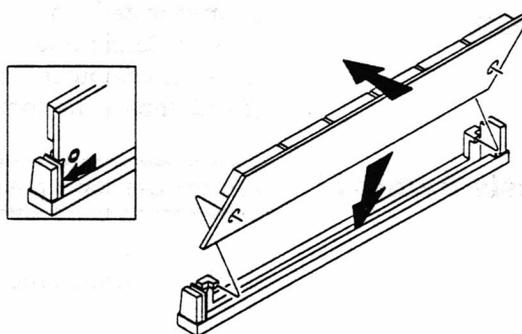
To install SIMMs (single in-line memory modules):

1. Remove the cover as described earlier.
2. Refer to Figure 2-6 and locate the SIMM sockets on the system board.

Figure 2-6. SIMM Socket Locations



3. Position the SIMM with the component side facing away from the power supply.
4. Tip the SIMM slightly toward the power supply and guide it into the socket on the system board, as shown in Figure 2-7.

Figure 2-7. SIMM Removal/Installation

5. Gently push the SIMM to the left until it is upright. There is a distinct click when the latches at each end of the socket snap over the ends of the SIMM.
6. Perform the ROM-based memory tests described in Chapter 3 to verify that all memory banks are functioning properly.
7. Run the disk-based memory diagnostic tests to thoroughly check the new memory. Refer to the diagnostics manual for testing instructions.
8. Replace the cover.

To remove a SIMM:

1. Remove the cover.
2. Use a small flat-bladed screwdriver to release the latches at each end of the module, as shown in Figure 2-7.
3. Gently tip the module toward the power supply and lift it out.
4. Perform the ROM-based memory tests described in Chapter 3 to verify that all memory banks are functioning properly.
5. Run the disk-based memory diagnostic tests to thoroughly check the new memory. Refer to the diagnostics manual for testing instructions.
6. Replace the cover.

Disk Drive Installation

Before installing or removing a disk drive, refer to the Owner's Manual for drive installation procedures, and configuration procedures using the EISA Configuration Utility program. Run the ECU program to reconfigure the computer before installing the new disk drive(s). Then turn off and unplug the computer.

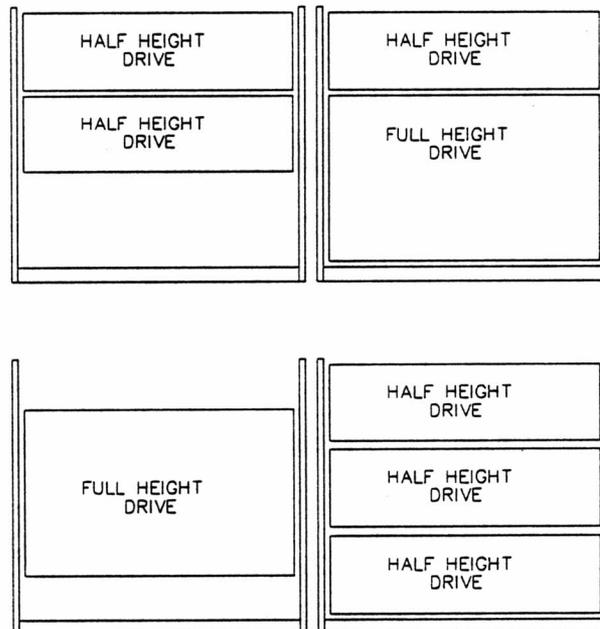
Drive Chassis Removal

Notice: Use static precautions.

Use the following procedures to install or remove any optional drives.

1. Place a shipping insert or an old disk in the floppy disk drive(s) to protect the read/write heads during disassembly.
2. Remove the cover as described previously.
3. Refer to Figure 2-8 and select a slot for the drive.

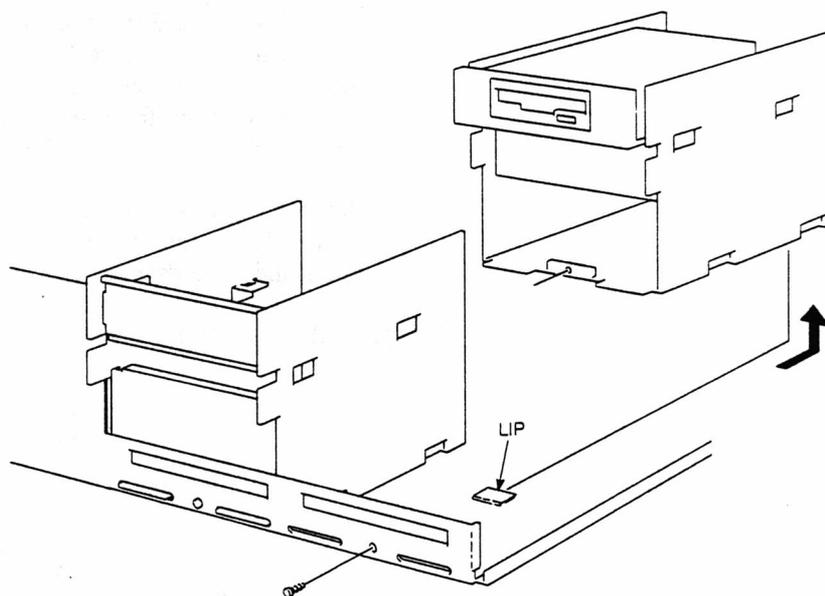
Figure 2-8. Drive Locations



Notice: You cannot install a full-height, 5.25-inch drive in the bottom of the left drive chassis.

4. Disconnect any cables connected to drives already installed in the chassis. Note the orientation of these cables for reassembly later.
5. Remove and save the screw that secures the drive chassis to the main chassis.
6. Refer to Figure 2-9 and slide the drive chassis back until it clears the lip on the computer chassis. Lift the drive chassis up and out of the computer.

Figure 2-9. Drive Chassis Removal



3.5-Inch Floppy Disk Drive Installation

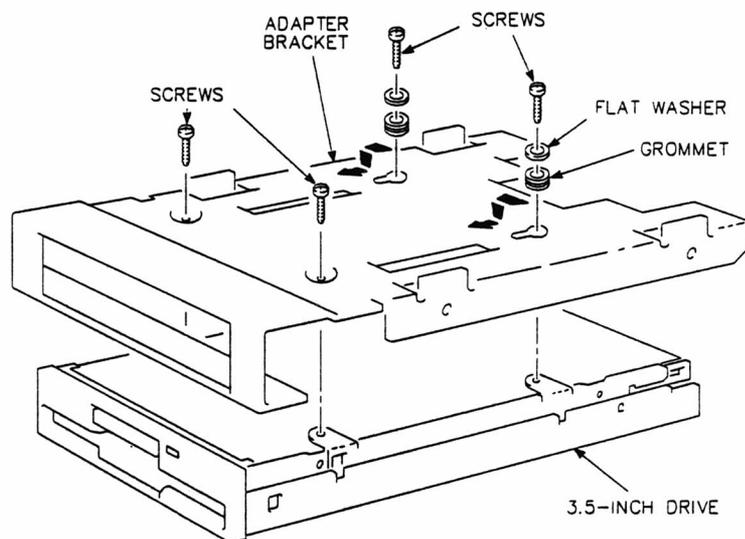
This computer supports two types of 3.5-inch floppy disk drives:

- 3.5-inch, 1.4M high-density drive
- 3.5-inch, 720K double-density drive.

To install either drive:

1. Unpack the 3.5-inch floppy disk drive.
2. Set the configuration jumpers, switches, or termination resistors according to the document supplied with the drive. In this computer, each drive-select designation must represent the second logical drive (DS1 with drives supplied by Zenith Data Systems). Other drive manufacturers may use DS0 or DS1 as the second logical drive designation. Check their documentation.
3. Refer to Figure 2-10 and turn the disk drive adapter bracket upside down. Insert the two rubber grommets into the two key holes and slide them into place.

Figure 2-10. Adapter Bracket Mounting



4. Turn the disk drive upside down and place the adapter bracket over the drive as shown in Figure 2-10. Line up the screw holes in the bracket with the corresponding holes in the bottom of the drive.
5. Secure the disk drive to the adapter bracket as follows:
 - Start the two longest screws through the two grommets and rear holes of the bracket, then into the disk drive. Do not tighten these screws at this time.
 - Start two screws through the front holes of the bracket and into the disk drive.
 - Tighten all four screws.
6. Proceed to "Mounting Disk Drives" later in this chapter.

5.25-Inch Floppy Disk Drive Installation

This computer supports the following types of 5.25-inch floppy disk drives:

- 5.25-inch, half-height 1.2M high-density drive
- 5.25-inch, half-height 360K double-density drive.

To install either type:

1. Carefully unpack the 5.25-inch floppy disk drive.
2. Set the configuration jumpers, switches, or termination resistors according to the document supplied with the drive. In this computer, each drive-select designation must represent the second logical drive (DS1 with drives supplied by Zenith Data Systems). Other drive manufacturers may use DS0 or DS1 as the second logical drive designation. Check their documentation.
3. Proceed to "Mounting Disk Drives" later in this chapter.

Hard Disk Drive Installation

This computer supports two types of hard disk drives. The disk controller provided with the computer supports ESDI (enhanced small device interface) and SCSI (small computer systems interface) hard disk drives.

Note: The factory-supplied drive controller card does not support ST-506 types of hard disk drives. If an ST-506 type drive is to be used, the factory-supplied controller card must be replaced with an appropriate ST-506 controller card (and CFG file).

The following drives can be installed:

- 5.25-inch, half-height hard disk drive
- 5.25-inch, full-height hard disk drive.
- 3.5-inch, hard disk drive.

To install a 5.25-inch hard disk drive:

1. Carefully unpack the hard disk drive.
2. Set the configuration jumpers, switches, or termination resistors according to the document supplied with the drive. In this computer, each drive-select designation must represent the second logical drive (DS1 with drives supplied by Zenith Data Systems). Other drive manufacturers may use DS0 or DS1 as the second logical drive designation. Check their documentation.
3. Proceed to "Mounting Disk Drives" later in this chapter.

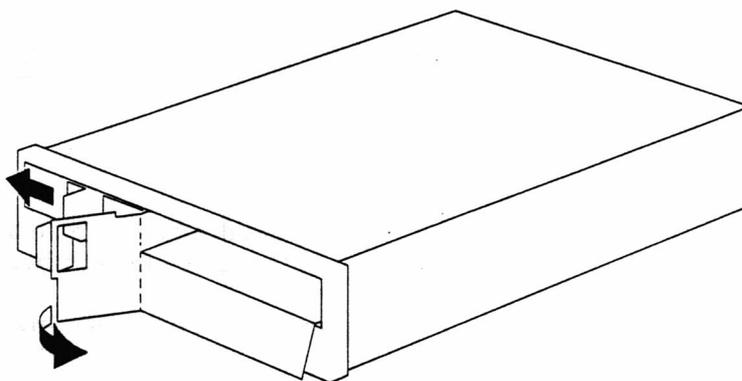
To install a 3.5-inch hard disk drive:

Follow the procedure outlined earlier for 3.5-inch floppy disk drive installation. An adapter bracket may be needed to mount the drive in a 5.25-inch slot.

SCSI Tape Backup Unit Installation

The computer supports a 5.25-inch SCSI (small computer system interface) magnetic tape backup unit.

1. Set the configuration jumpers, switches, or termination resistors according to the document supplied with the drive. In this computer, each drive-select designation must represent the second logical drive (DS1 with drives supplied by Zenith Data Systems). Other drive manufacturers may use DS0 or DS1 as the second logical drive designation. Check their documentation.
2. Slide the eject button to the left and remove the cardboard shipping insert from the unit.

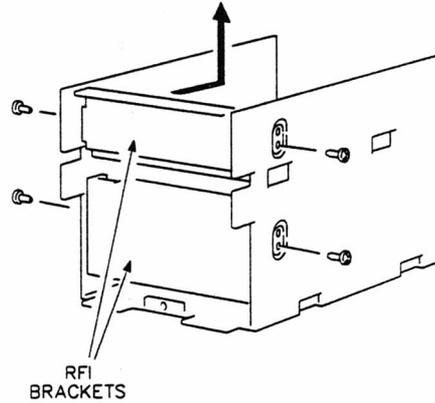


3. Proceed to "Mounting Disk Drives" on the next page.

Mounting Disk Drives

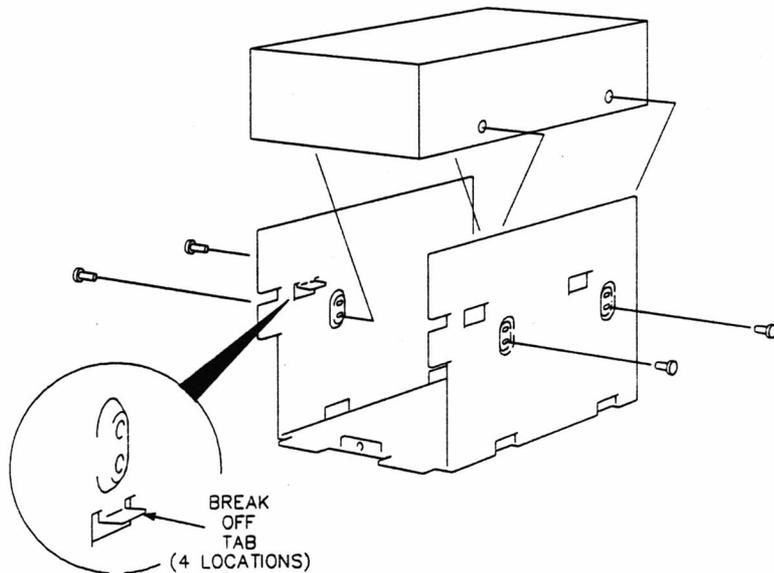
1. Remove the screws that secure the RFI bracket(s) to the drive chassis, as shown in Figure 2-11. Remove the appropriate RFI bracket(s).

Figure 2-11. RFI Brackets Removal



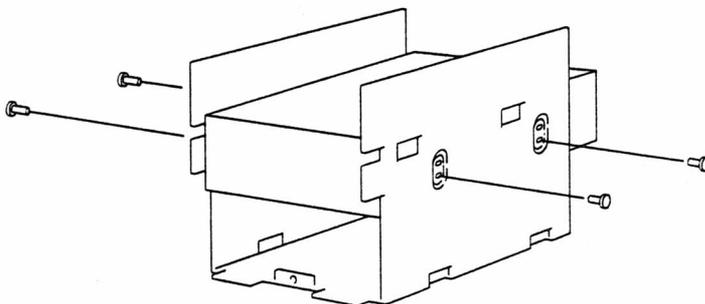
2. To install a full-size hard disk drive (shown in Figure 2-12), break off the drive support tabs as shown in the inset.

Figure 2-12. Full-Height Drive Mounting



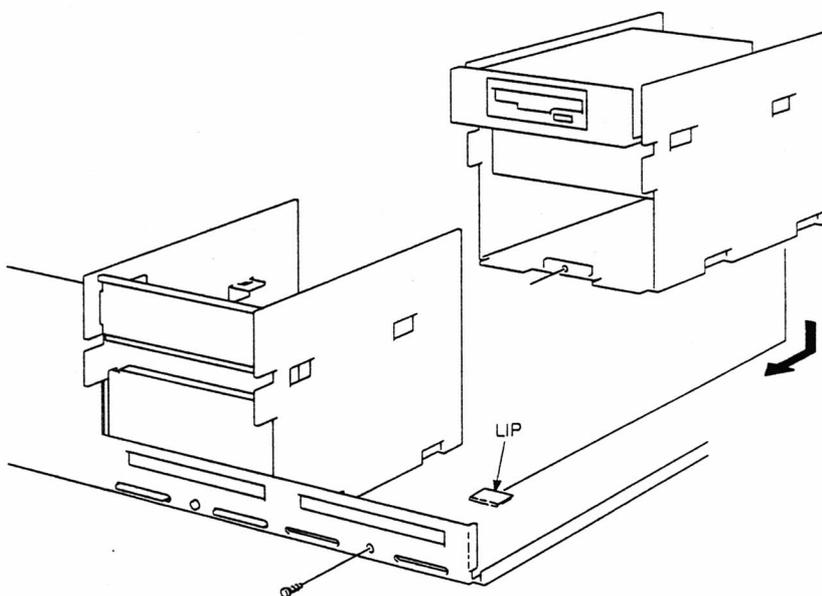
3. Secure the drive to the chassis using the four screws packed with the drive, as shown in Figure 2-13. The 3.5-inch drives require the adapter bracket described earlier. Use the four screws to mount the adapter bracket in the drive chassis, or to mount the drive directly in the chassis if no bracket is needed.

Figure 2-13. Mounting Drive to Drive Chassis



4. Place the drive chassis in the computer, as shown in Figure 2-14.

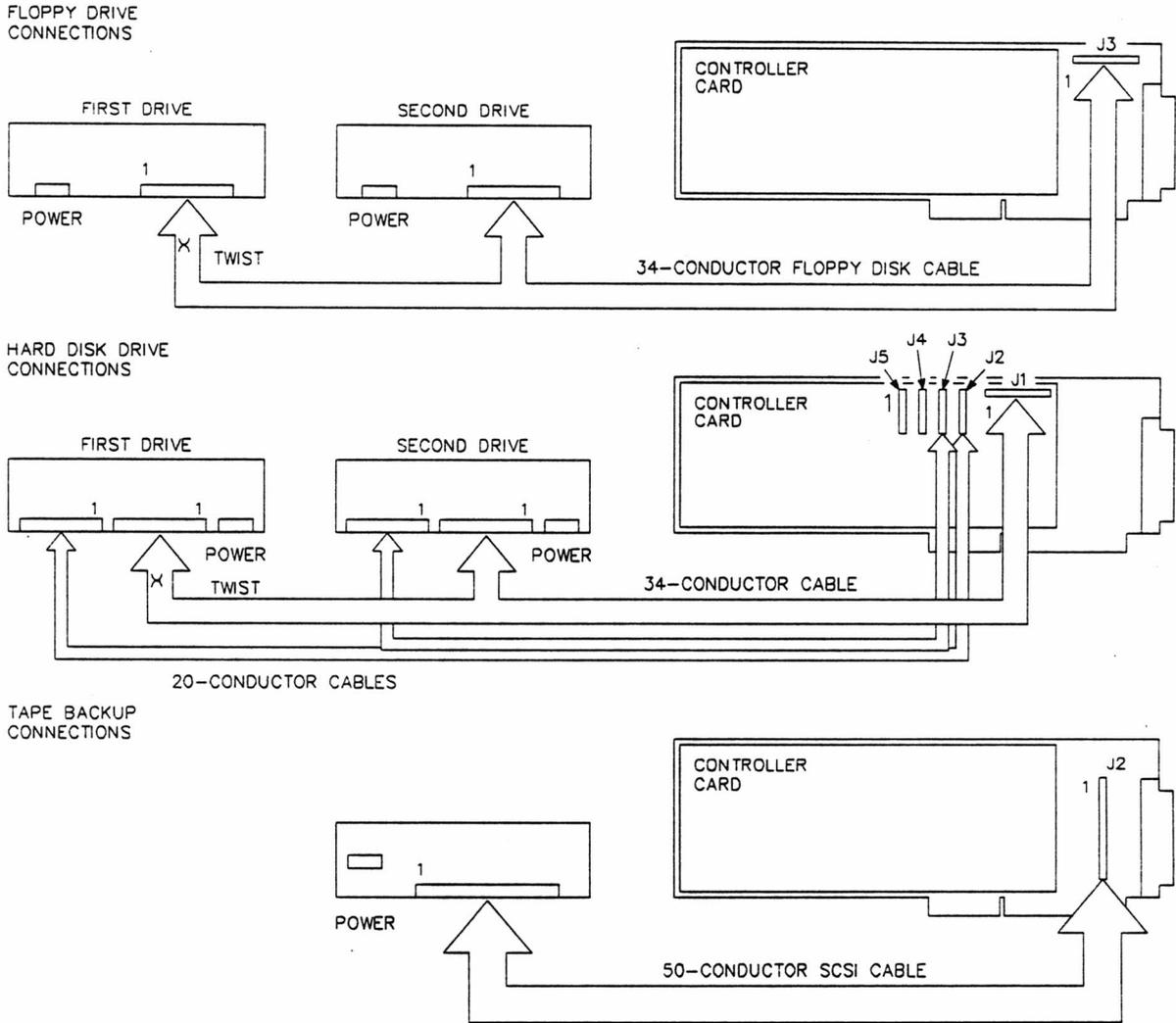
Figure 2-14. Drive Chassis Reinstallation



5. Slide the drive chassis forward into the lip on the base of the main chassis.
6. Use the screw removed earlier and secure the drive chassis to the front of the computer.

7. Connect the power cables(s) to the drive(s). Connect the appropriate cables to the back of the disk drive(s) and to the controller card. Be sure to match the stripe on the cables to the pin 1 location on the drives and the card (pin 1 is normally marked by a number 1 or an arrow). The cable with the twist **must be** connected to the first drive. Refer to Figure 2-15.

Figure 2-15. Disk Drive Cable Connections

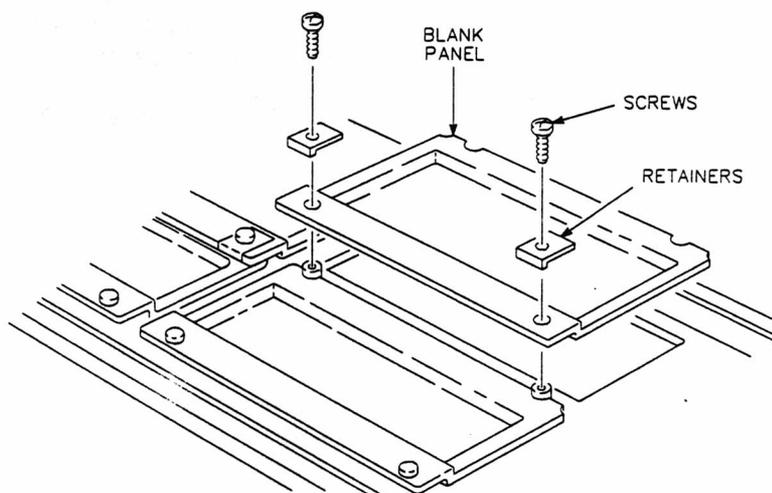


Notice: When connecting the 4-conductor power cable to most 3.5-inch disk drives, an adapter cable must be used.

Blank Panel Removal

1. If you installed a drive that extends beyond the main chassis, remove the screws and retainers that secure the blank panel.
2. Remove the blank panel, then replace the screws and retainers to secure the remaining blank panel. Refer to Figure 2-16.

Figure 2-16. *Blank Panel Removal*



3. Discard any unneeded blank panels, screws, and retainers.
4. Install the cover as described at the beginning of this chapter.
5. Reconnect the monitor and any peripherals.

Disk Drive Removal

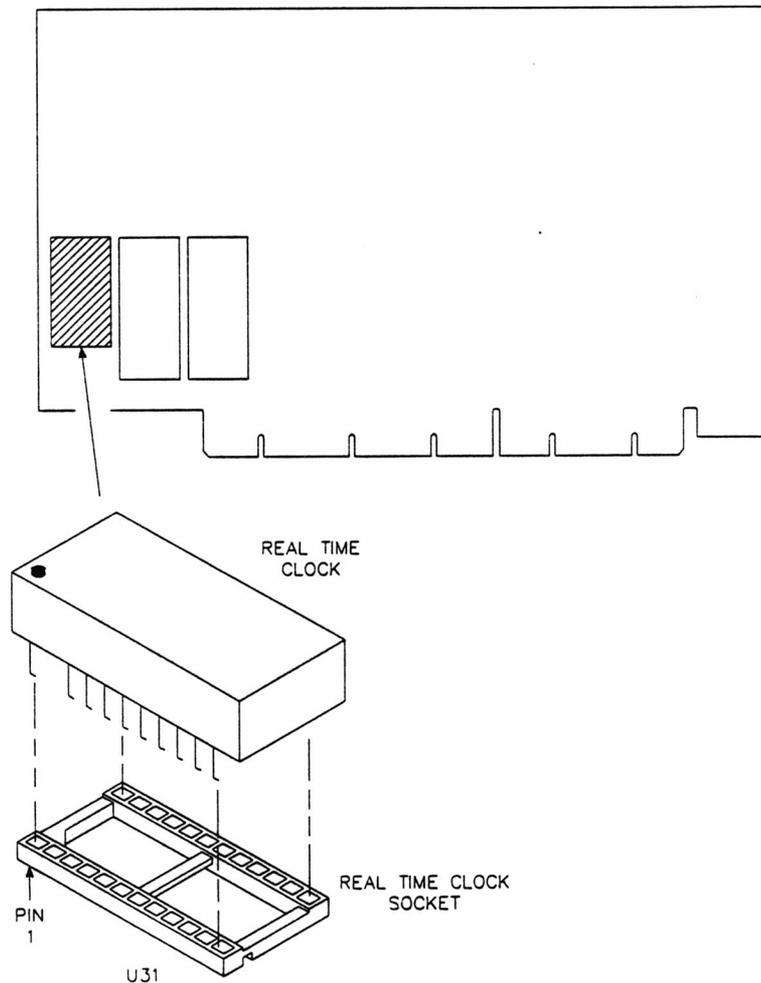
To **remove** disk drive(s), perform the disk drive **installation** procedures in reverse order.

Real-Time Clock IC Replacement

Important: This procedure deletes all configuration information stored in the CMOS RAM. Note the current setup data before removing the real-time clock IC (RTC) to allow re-entry of the correct data after reassembly.

The RTC contains a lithium battery for backing up setup/configuration information stored in the CMOS RAM inside the RTC IC. The RTC is located on the I/O card, as shown in Figure 2-17. Remove the RTC IC and dispose of it properly.

Figure 2-17. Real-Time Clock Replacement





Caution: The real-time clock IC contains a lithium battery. It is safety-sealed and must not be opened. To prevent explosion hazards, avoid shorting the battery. Do not attempt to recharge it. Use the disposal procedure described in this section.

Notice: Use static precautions.

To replace the RTC:

1. Remove the cover as described earlier.
2. Disconnect the LED/speaker/keylock cable from the I/O card.
3. Disconnect the ribbon cable from the I/O card, noting the orientation of the stripe for reassembly.
3. Remove the I/O card.
4. Carefully remove the RTC using a small, flat-bladed screwdriver to pry it out of socket location U31 (refer to Figure 2-17).
5. Carefully insert the new RTC. Be sure to align the dot on the IC as shown in Figure 2-17.
6. When the system is powered up, an error message may appear indicating a CMOS problem. This is normal. Run the ECU configuration software to reconfigure the system.

Real-Time Clock IC Disposal



Caution: The real-time clock IC contains a lithium battery. It is safety-sealed and must not be opened. To prevent explosion hazards, avoid shorting the battery. Do not attempt to recharge it.

Proper disposal of the RTC:

1. Clip all exposed IC leads. Do not short any leads together!
2. Wrap the IC in insulating tape to prevent accidental shorting.
3. Pack the IC so it cannot be crushed.
4. Dispose of the IC in the trash.

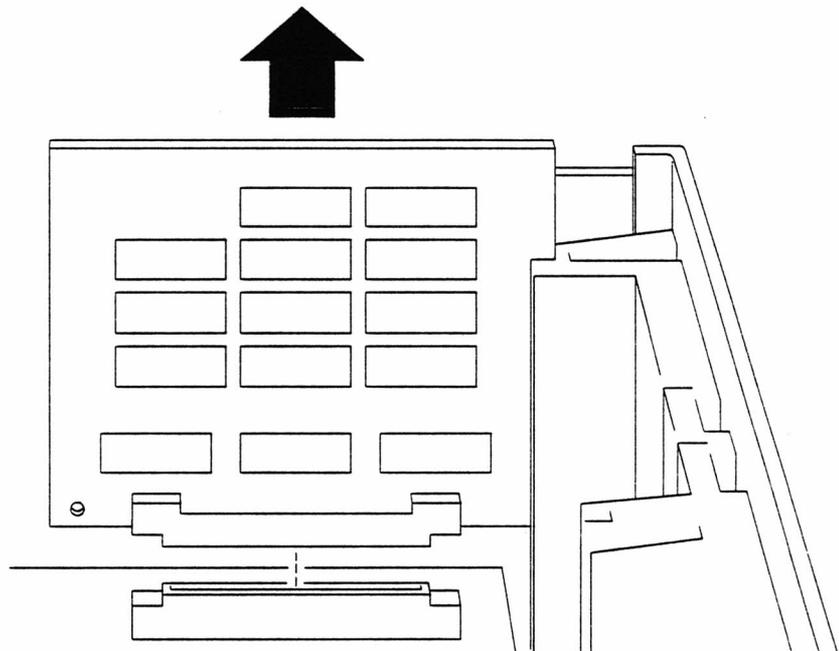
Cache Card Removal/ Installation

Notice: Use static precautions.

To remove the cache card:

1. Remove the cover as described earlier.
2. Refer to Figure 2-18 and remove the cache card by grasping it and lifting it straight up and out of the connector.

Figure 2-18. Cache Card Removal



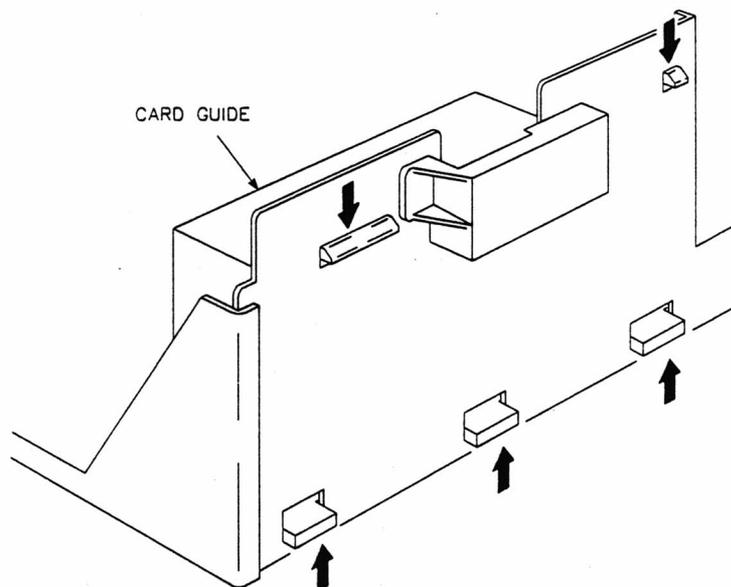
3. Place the card in protective packaging.
4. Install a new cache card in the same location. Refer to the circuit card installation procedures described earlier.

LED/Keylock, Card Guide, and Speaker Removal/Installation

Notice: Use static precautions.

1. Remove the cover as described earlier.
2. Remove all circuit cards as described earlier. Note the orientation of cables for reassembly later.
3. Refer to Figure 2-19 and release the top tabs on the card guide by pushing them down and inward.

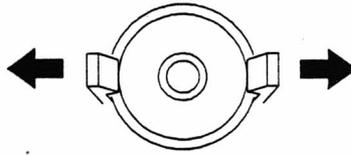
Figure 2-19. Card Guide Removal



4. Lift the card guide so the bottom tabs align with the holes in the front of the chassis. Push the tabs through the chassis and remove the card guide.

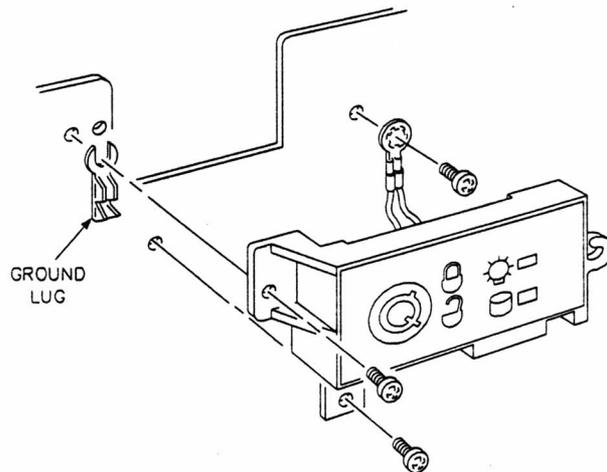
5. Refer to Figure 2-20 and remove the speaker from the card guide.

Figure 2-20. Speaker Removal



6. Refer to Figure 2-21 and remove the three screws that secure the LED/speaker/keylock assembly to the chassis. Note the location of the ground lug for reassembly.

Figure 2-21. LED/Speaker/Keylock Removal



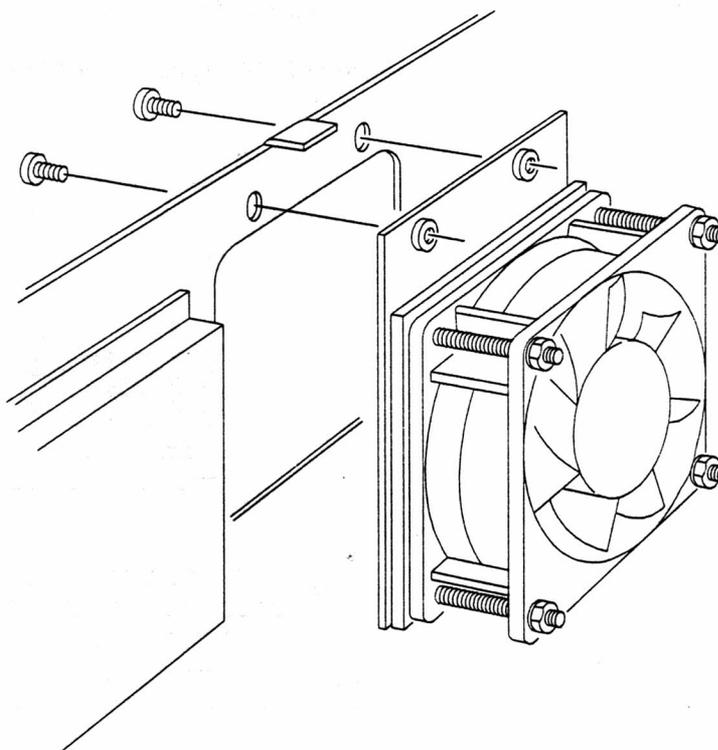
7. To install a new LED/speaker/keylock assembly, reverse the preceding steps.

Auxiliary Fan Removal/ Installation

To remove the auxiliary fan:

1. Remove the cover as described earlier and locate the auxiliary fan (located on the rear panel of the chassis).
2. Disconnect the fan cable from the system board.
3. Refer to Figure 2-22 and remove the two screws that secure the fan assembly to the computer chassis.

Figure 2-22. Auxiliary Fan Removal



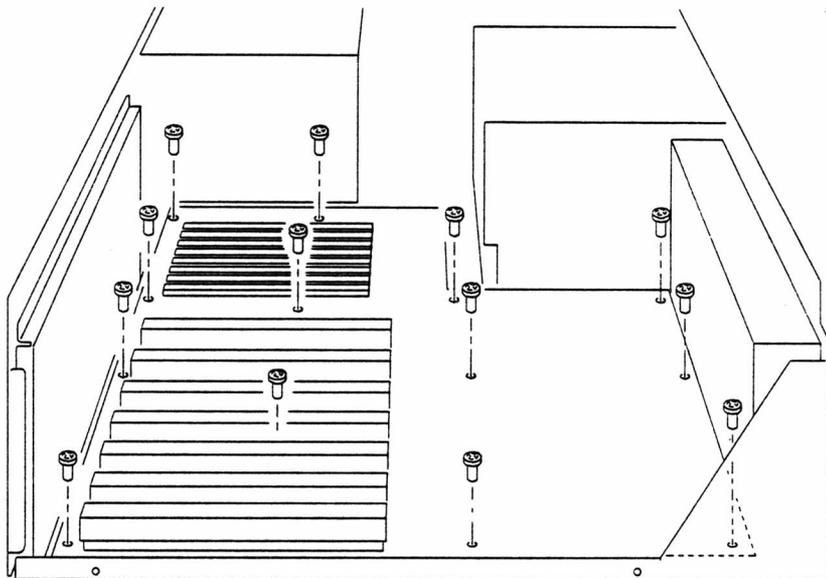
4. Lift the fan assembly out of the computer.
5. To install a new fan assembly, reverse the preceding steps.

System Board Removal/ Installation

Notice: Use static precautions.

1. Remove the cover as described earlier.
2. Remove all circuit cards as described earlier.
3. Remove the auxiliary fan assembly as described earlier.
4. Disconnect the power supply connector from the system board.
5. Refer to Figure 2-23 and remove the screws that secure the system board to the chassis.

Figure 2-23. System Board Removal

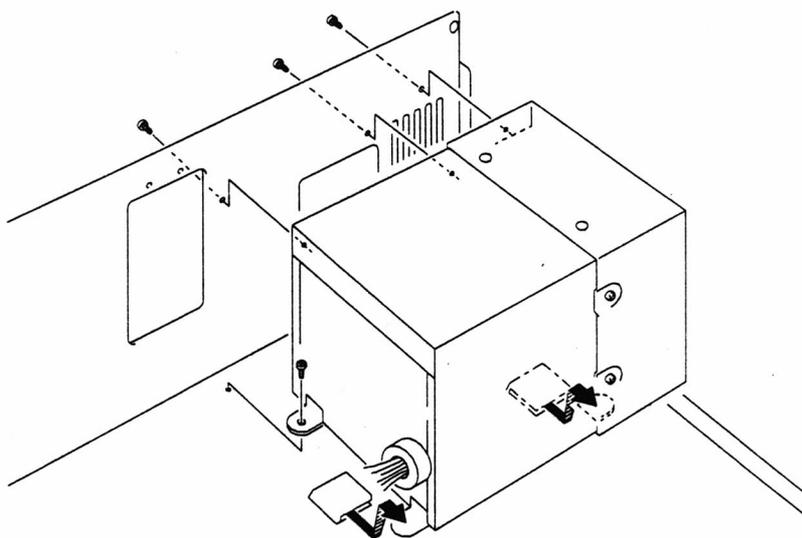


6. Lift the system board out of the computer.
7. To install a new system board, reverse the preceding steps.

Power Supply Removal/Installation

1. Remove the cover as described earlier.
2. Remove the auxiliary fan as described earlier.
3. Disconnect the power supply from the system board.
4. Disconnect power cables from the disk drives.
5. Remove the four screws that secure the power supply to the chassis, as shown in Figure 2-24.

Figure 2-24. Power Supply Removal



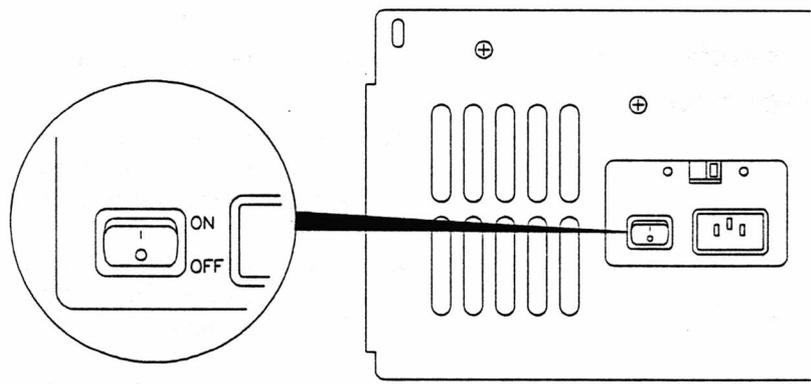
6. Slide the power supply forward about one-half inch until it clears the two retaining tabs on the chassis bottom (under the power supply).
7. Lift the power supply out of the computer chassis.
8. To install a new power supply, reverse the preceding steps.

This chapter describes powerup, resetting the computer, the Monitor program, and other operating information.

Powerup

Refer to Figure 3-1 and turn on the computer.

Figure 3-1. Power Switch



When power is applied:

- The power supply fan and auxiliary fan start
- The keyboard resets (status LEDs blink), NUM LOCK remains lit
- Disk drives initialize (access indicators light, heads seek)
- Internal power-up self-tests run/complete
- A blinking cursor appears on the display
- The operating system loads from the hard disk drive or the floppy disk drive (autoboot option configured).

If the operating system is not installed, or it is not present on the disk, one of the following error messages appears:

+++ DISK ERROR: Drive not ready! +++

No bootable partitions!

No system

Not a bootable partition

Install the operating system software according to its documentation.

If the computer detects faults during the power-up sequence, error messages may appear on the display (if the computer can drive the display). For further information on error messages, consult the Owner's Manual and Chapter 5 of this manual.

Resetting the Computer

There are three different ways to reset the computer:

1. Press and hold the CTRL, ALT, and DEL keys, then release them. This resets the CPU, reinitializes the computer and initiates the autoboot sequence (soft reset).
2. Press and hold the CTRL, ALT, and INS keys, then release them. This resets the CPU, reinitializes the computer and enters the Monitor program (soft reset).
3. Turn the computer off, wait 15 seconds, then turn it back on. All circuits are reset to the power-on state (hard reset).

The Monitor Program

The MFM-300 Monitor program contains:

- Power-up tests to detect problems that would prevent additional tests or an operating system from loading.
- The boot command to load the operating system.
- User-selectable tests to check the disk drives, keyboard, and memory.
- Video commands to display a color bar or set video and scroll modes.
- Programming commands.

Entering the Monitor Program

To enter the Monitor program use the following command:

CTRL-ALT-INS — Press and hold the CTRL, ALT, and INS keys and then release them. A message similar to the following appears:

```
MFM-300 Monitor, Version x.xx
Memory size: xxxK + xxxxK + xxK Cache
Enter "?" for help.
->_
```

The first line indicates the ROM version. The second line indicates how much memory is installed, including base, extended, and cache memory. The third line gives the syntax for the help command. The Monitor prompt on the fourth line indicates the Monitor program is waiting for a command entry.

Press the question mark (?) key, then press ENTER to display the Monitor program command summary menu.

All of the commands listed in the command summary may be used. Use the syntax (exact command entry) shown, type the command, then press ENTER. If the syntax is wrong, the computer reports that an invalid command was entered. The command syntax uses:

- Brackets [*option*] indicate optional entries.
- Braces { *choice* | *choice* } indicate a choice of entries.
- Angle braces <*variable*> indicate specified variables.

Boot Command

The boot process loads the operating system from a disk into computer memory. The command syntax is:

```
B[{F|W}] [{0|1|2|3}] [:<PARTITION>]
```

Extend the boot command to BF (boot from floppy) or BW (boot from Winchester, a reference to the hard disk) to boot a specific drive. If more than one drive type is installed, add the drive numbers (0 or 1) and partition numbers as required.

Error messages appear if an attempt is made to boot from a non-existent drive. To correct this, access the Monitor program and enter the correct boot command. For more information about error messages, refer to the Owner's Manual and Chapter 5 of this manual.

Notice: If the computer has been configured in such a way that it is not possible to boot, use the XR command. At the Monitor prompt, entering XR will load a default configuration and allow the computer to boot. The ECU program should then be used to reconfigure the system. This command is useful only when the computer has been configured in such a way as to make it unbootable.

User Tests

The Monitor program contains five user-selectable tests. To access the test menu, type TEST at the Monitor prompt and press ENTER. The following menu appears:

CHOOSE ONE OF THE FOLLOWING:

1. DISK READ TEST
2. KEYBOARD TEST
3. BASE MEMORY TEST
4. EXTENDED MEMORY TEST
5. POWER-UP TEST
6. EXIT

ENTER YOUR CHOICE:

To run a test, type the number that corresponds to the test. With the exception of the keyboard test, each test continues to run until an error is detected or the test is halted.

To stop a test, press the ESC key once. Press the ESC key a second time to return to the test menu. There you can select another test or select EXIT to return to the Monitor prompt.

All tests, except for the keyboard test, display a test count similar to the following:

SAMPLE TEST

TEST COUNT = x

TYPE <ESC> TO ABORT

If an error is detected during the test, information about the error appears on the display.

Disk Read Test — This test continuously reads the first sector of track 0 on the test drive. To change the test drive, manually boot from the drive you want to test. It is not necessary for the boot operation to actually load the operating system. To run the test, there must be a formatted disk in the drive.

Successful completion of this test indicates only that the drive can read from the disk. If the computer still fails to boot, problems could exist with memory or related control circuits.

Keyboard Test — This test checks the operation of most keys on the keyboard. Valid entries display an ASCII character or symbol and a key scan code each time a key is pressed. The following keys cannot be tested:

PRINT SCREEN
SCROLL LOCK
PAUSE
CAPS LOCK
SHIFT
CTRL
ALT
NUM LOCK
ESC

The Technical Reference Manual for this computer contains a detailed list of scan codes.

Base Memory Test — This test checks all memory in the first megabyte of the system memory map, including video memory.

A clicking sound can be heard while the test is running. When the test reaches the video memory area, a series of moving patterns appears on the screen.

Extended Memory Test — This test checks all installed memory above the 1 megabyte base memory area. Since no video memory exists in this area, no patterns appear.

Power-Up Test — This test continuously repeats the power-up tests used during startup. This test checks the following:

- Crystal frequencies
- Interrupt controllers
- DMA controllers
- Disk drive controller
- Timer 1 interrupt
- CPU
- ROM
- RAM.

Chapter 4

Hardware Configuration

This chapter describes jumper and switch settings for computer hardware. For information about connector pinouts refer to the specifications section at the end of this manual. This computer's ECU configuration program (see the Owner's Manual for information on the ECU program) minimizes hardware configuration requirements. Most configuration is accomplished in software using the ECU program. When hardware options are installed or changed, the ECU program must be run first, before actually making the hardware changes.



Static Precautions

Warning: To prevent shock, disconnect the computer from the AC power source before servicing.

To prevent component damage from static discharges, use the following precautions:

- Do not remove any static-sensitive device from its protective packaging until it is ready to be installed.
- Equalize the static electricity between the work surface, the device, and you by touching the work surface with one hand, then picking up the device with the other hand.
- Once the device is removed from its protective packaging, do not set it down or let go of it until it is either installed in the computer or returned to its protective packaging.

I/O Card

Figure 4-1 and Table 4-1 provide jumper locations and descriptions for the I/O card.

Figure 4-1. I/O Card Jumper Locations

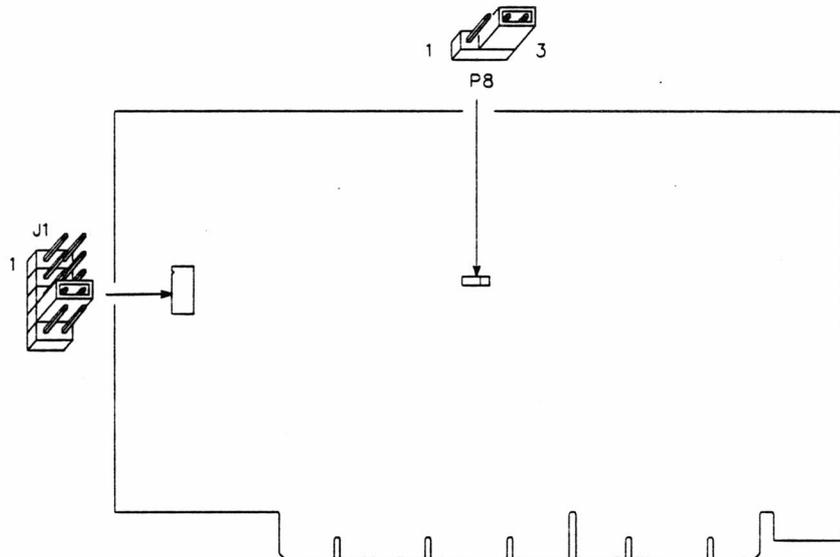


Table 4-1. I/O Card Jumper Settings

JUMPER	SETTING	DESCRIPTION
P8	1-2	Power-On Self-Test (POST) binary LEDs
	2-3 ¹	Normal diagnostic LED definitions
J1	1-2	Not assigned
	3-4	Not assigned
	5-6	Not assigned
	7-8 ¹	ON for color video
	9-10	OFF for AT keyboard

NOTE
1. Factory setting.

Disk Controller Card The disk controller provided with the computer supports ESDI hard disk drives, SCSI devices, and floppy disk drives.

Note: The factory-supplied drive controller card does not support ST-506 types of hard disk drives. If an ST-506 type drive is to be used, the factory-supplied controller card must be replaced with an appropriate ST-506 controller card (and CFG file).

This card contains one configurable switch (SW1). Figure 4-2 shows the switch and Table 4-2 describes the switch settings.

Figure 4-2. Disk Controller Card Switch Location

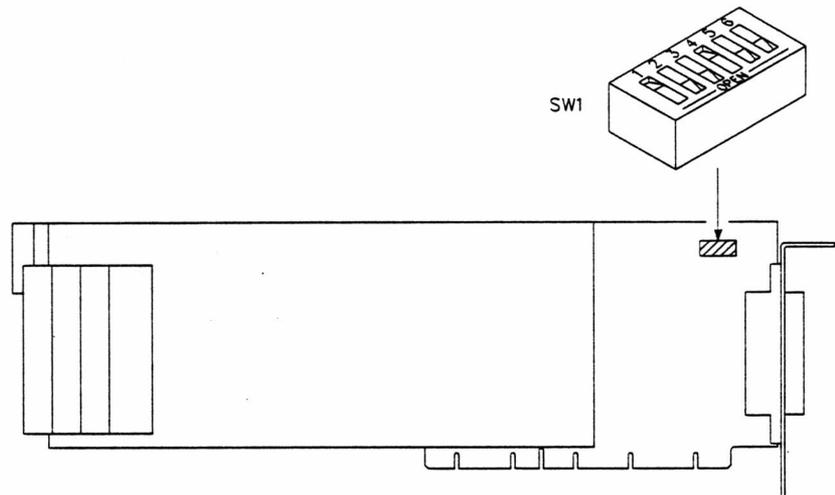


Table 4-2. Disk Controller Card Switch (SW1) Description

SECTION	SETTING	FUNCTION
1	OPEN	Reduce write current-reverse logic
1	CLOSED ¹	Reduce write current-standard logic
2	OPEN ¹	Primary port address selected
2	CLOSED	Secondary port address selected
3	OPEN ¹	Auto-deselect disabled
3	CLOSED	Auto-deselect enabled
4	OPEN	1M x 9 SIMM modules
4	CLOSED ¹	256K x 9 SIMM modules
5	OPEN ¹	SIMMs at sites 14A, 15A, 16A, 17A
5	CLOSED	SIMMs at sites 14A, 16A
6	OPEN ¹	Floppy controller enabled
6	CLOSED	Floppy controller disabled
NOTE		
1. Factory setting.		

The disk controller card contains several jumpers. Figure 4-3 and Table 4-3 provide jumper locations and descriptions.

Figure 4-3. Disk Controller Card Jumper Locations

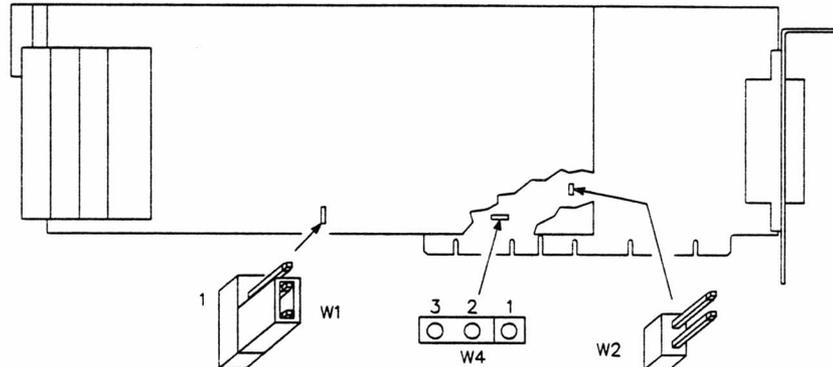


Table 4-3. Disk Controller Card Jumper Descriptions

JUMPER	SETTING	FUNCTION
W1	1-2 2-3 ¹	Scratchpad SRAM size of 2K x 8 Scratchpad SRAM size of 8K x 8
W2	1-2	Off ¹ — At power on or after an EISA soft reset, the ISA-compatible HDC and FDC register sets are accessible independent of the EISA card enable function On — At power on or after an EISA soft reset, only the slot-specific registers are accessible.
W4	1-2 ¹ 2-3	HDC will support IRQ14 (some units may not have jumper block, but instead are hard wired in this position by a circuit board trace). HDC will support IRQ15.
NOTE		
1. Factory setting.		

Z-559 High-Performance VGA Card (Part Number 152-37-J1)

This card contains two jumper options. Figure 4-4 and Table 4-4 describe the jumper settings. The factory default settings are generally the best option for most computer systems.

Figure 4-4. Z-559 VGA Card Jumper Locations

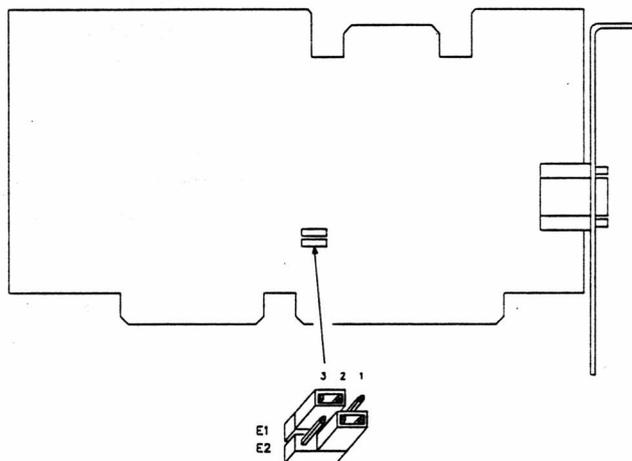


Table 4-4. Z-559 VGA Card Jumper Descriptions

JUMPER	SETTING	DESCRIPTION
E1	1-2	Enables vertical interrupt, IRQ2.
	2-3 ¹	Disables vertical interrupt, IRQ2.
E2	1-2 ¹	Full decode of 16-bit ROM in the C000 - C7FF memory segment is enabled.
	2-3	Decode of the 16-bit ROM in memory segment C000 - DFFF is enabled ² .

NOTES

1. Factory setting.
2. May cause memory address conflicts with some EMS cards or other peripherals.

High-Performance VGA Card (Part Number 152-19-J1)

Some models of the computer are shipped with this high-performance 16-bit video display card. This card provides 31 kHz analog video signals, has a default VGA display mode, and also emulates EGA, CGA, MDA, and HGC display modes.

The card includes an eight-segment switch which has no impact on the configuration of the card. There are no jumper blocks on this card.

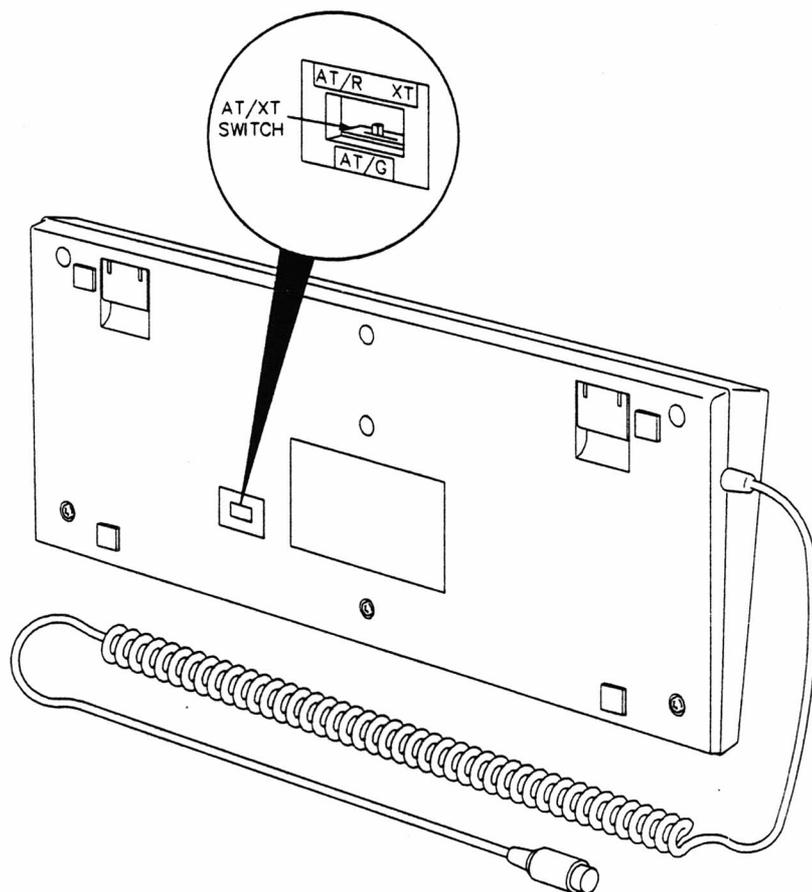
Keyboard

The computer has a 101-key keyboard. The keyboard features auto-repeat, audible feedback, and software programmability.

Keyboard Configuration — The computer ships with either of two keyboard models. Both keyboards are configurable for XT- or AT-compatible operation. On some models, a switch is located beneath the logo nameplate. Before plugging in the keyboard, use a small screwdriver to gently pry up the nameplate. The switch positions are labeled AT and XT. Position the switch in the AT position for use with this computer.

Other models have the XT/AT switch located on the bottom of the keyboard (shown in Figure 4-5). Before connecting the keyboard to the computer, check the setting of this switch. The switch has three positions:

Figure 4-5. Keyboard Configuration



- AT/R — AT-compatible (Red LEDs)
- AT/G — AT-compatible (Green LEDs)
- XT — XT-compatible

The LEDs are located in the SCROLL LOCK, NUM LOCK, and CAPS LOCK keys. For this computer, set the switch in the AT/R for red LED indicators, or in the AT/G for green LED indicators.

Chapter 5

Troubleshooting

This chapter provides information on troubleshooting the computer. This information will assist in diagnosing problems to the major assembly level.



Static Precautions

Warning: To prevent shock, disconnect the computer from the AC power source before servicing.

To prevent component damage from static discharges, use the following precautions:

- Do not remove any static-sensitive device from its protective packaging until it is ready to be installed.
- Equalize the static electricity between the work surface, the device, and you by touching the work surface with one hand, then picking up the device with the other hand.
- Once the device is removed from its protective packaging, do not set it down or let go of it until it is either installed in the computer or returned to its protective packaging.

Troubleshooting Procedure

To successfully troubleshoot this computer as quickly as possible, follow this procedure:

1. Run the ECU program to verify the correct configuration of the base computer system and any optional cards; be sure peripherals such as disk drives, printers, and other I/O devices, have been enabled. The ECU program allows you to view switch settings and recommended default settings for cards which may require hardware configuration (refer to Chapter 4 for hardware configuration information). This information may be printed for reference later. If the computer is properly configured, proceed to the next step.
2. Remove the cover (refer to Chapter 2) and check for damage to circuit cards or chassis parts, such as dented or bent metal parts, nicked or cut wires, cracked circuit boards, evidence of heat damage such as discoloration or melting, connector pins bent or touching, and broken socket connectors. If the problem is not evident, proceed to the next step.
3. The troubleshooting charts, included later in this chapter, offer a structured approach to servicing this computer.

Powerup

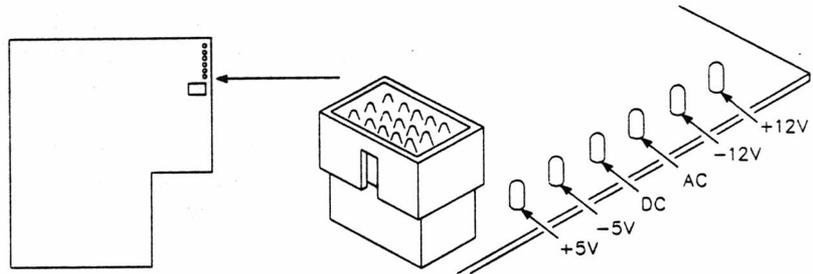
At powerup, the computer begins an initialization process to check internal circuits and components. If the computer encounters a problem during this process, an error message appears on the monitor screen. These error messages are explained in detail later in this chapter. Some initialization actions produce a visual or audible signal. The following events should occur when power is applied to the computer:

1. The power supply and auxiliary fans start.
2. The keyboard resets, status LED's blink, and the NUM LOCK LED remains lit.
3. Disk drives initialize (access indicators light, heads seek).
4. Prompt appears on the monitor display.
5. Internal power-up self-tests complete.
6. Computer attempts to autoboot.

Status LEDs

There are two sets of status LEDs in the computer. The power status group is located on the system board where the power supply connector plugs onto the system board. As the computer powers up, all of these LEDs turn on. The last two to light are the AC and DC indicators. Figure 5-1 illustrates these LED's and the associated signals.

Figure 5-1. Power Status LEDs

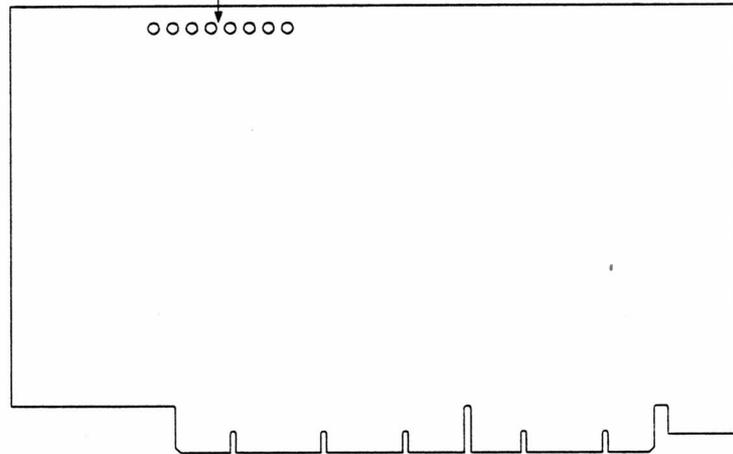


The second set of LEDs is located on the top edge of the I/O card. Figure 5-2 illustrates this group of LEDs.

Figure 5-2. I/O Card Status LEDs

CPU ROM RAM INT DSK RDY ENP PWR

○ ○ ○ ○ ○ ○ ○ ○



As the computer powers up, all the I/O card status LEDs light and then, one by one, go out. As each LED goes out, it indicates that the computer has passed a portion of the internal power-up tests. If the computer is configured to autoboot, only the PWR LED will remain lit. If a Monitor prompt appears on the display, the RDY and PWR LEDs remain lit. The status LEDs are used in the troubleshooting charts that follow to assist in repairing the computer.

Troubleshooting Charts

Notice: Before removing circuit cards from the computer, be sure power is disconnected. Do not remove circuit cards with power applied, as damage to circuit card or computer (or both) may result.

The following charts are organized to simplify troubleshooting efforts. Start with the General System Troubleshooting Chart, Figure 5-3. This chart provides immediate repair recommendations or directs you to other, more detailed charts. These charts identify the faulty assembly or recommend further tests to isolate the problem. Follow the sequence through until the problem is located and repaired.

Each block in the chart represents a step in troubleshooting the computer. Some blocks contain a smaller numbered block. The smaller block is a reference to the notes that appear on the troubleshooting charts.

Dashed lines found in the charts indicate a sequence of steps to be performed to solve the problem. Perform the steps in the order indicated. They are listed with the most likely solution first, and the least likely solution last.

Figure 5-3. General System Troubleshooting Chart

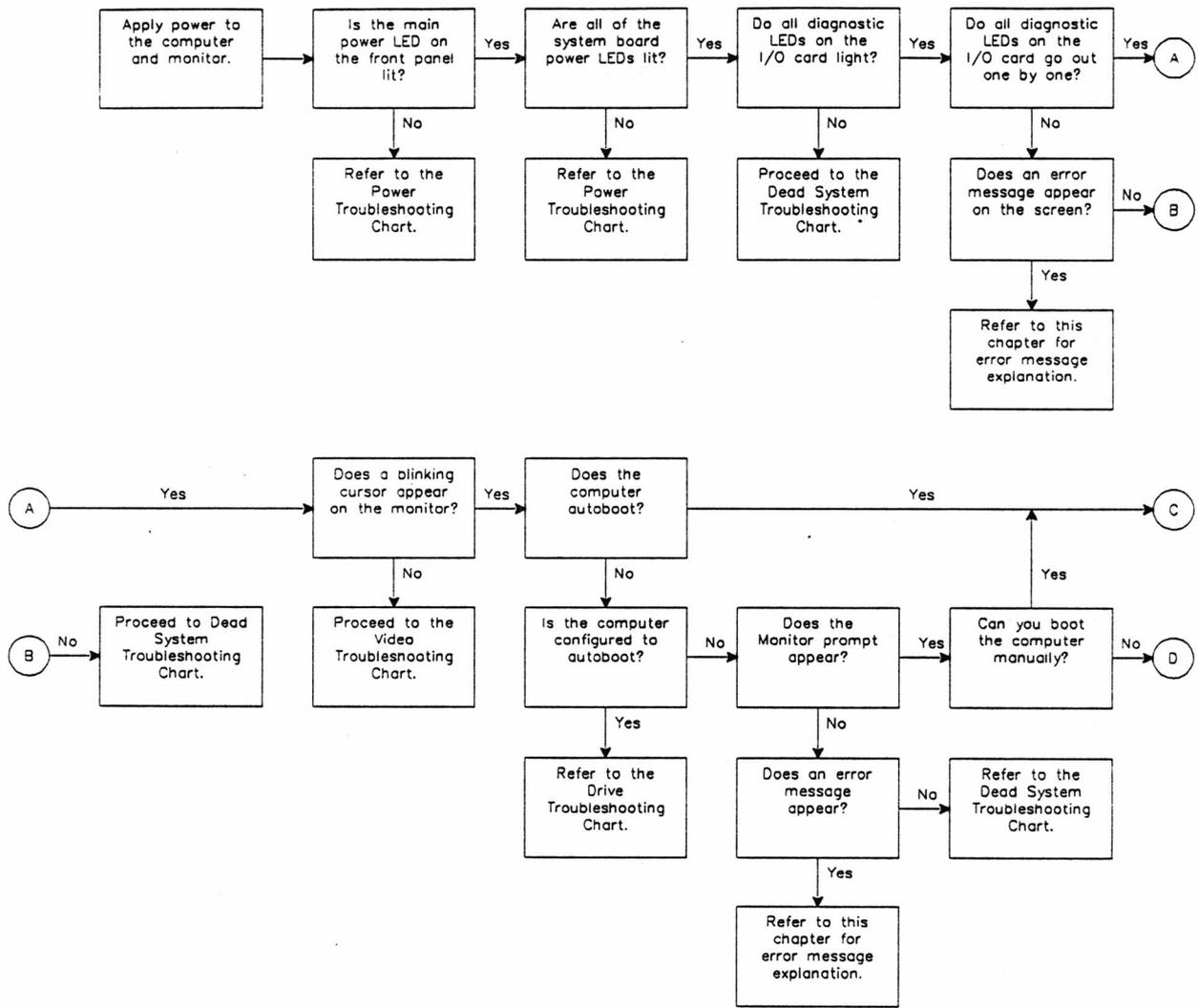


Figure 5-4. General System Troubleshooting Chart (continued)

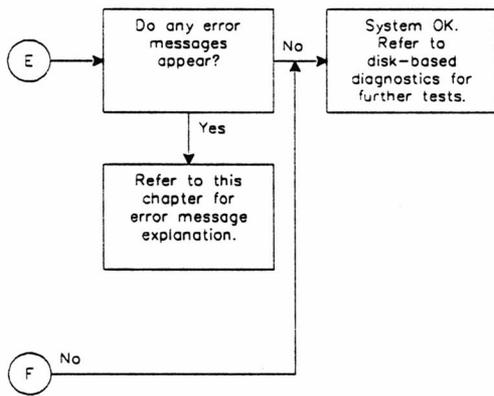
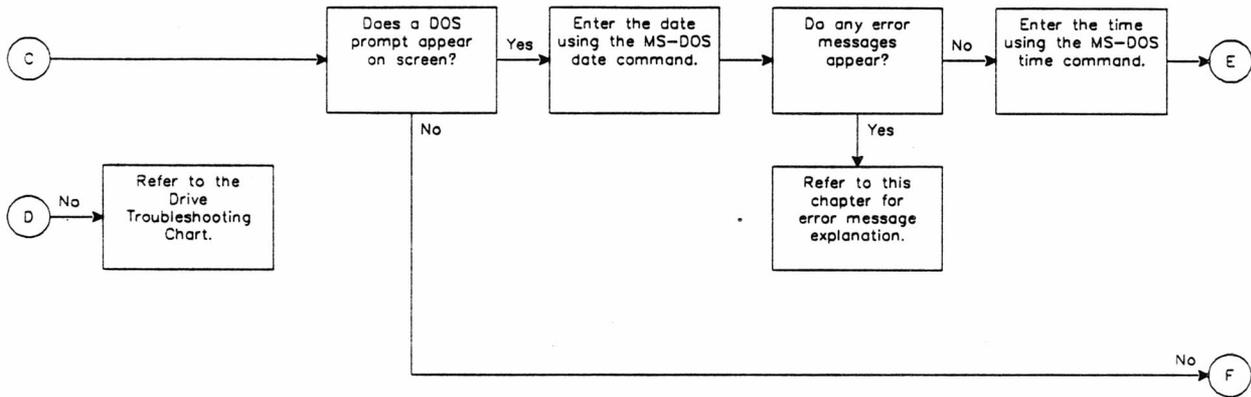


Figure 5-5. Dead System Troubleshooting Chart

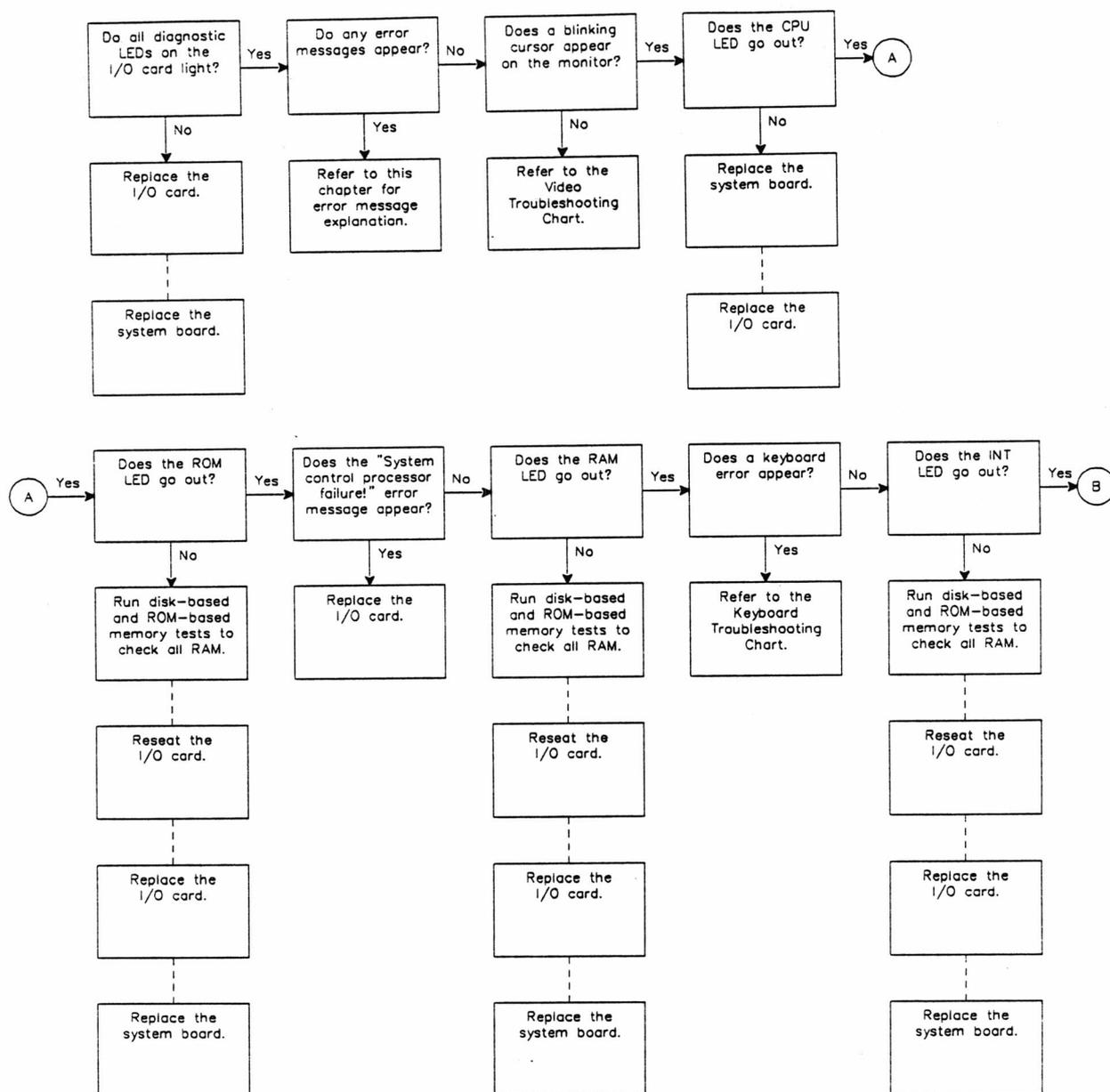


Figure 5-6. Dead System Troubleshooting Chart (continued)

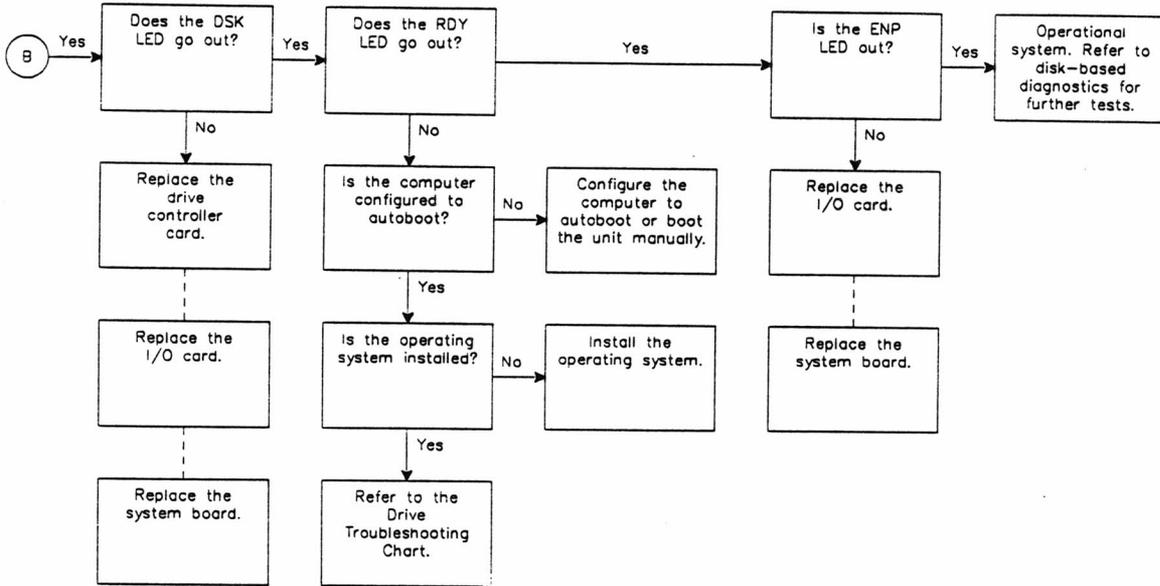


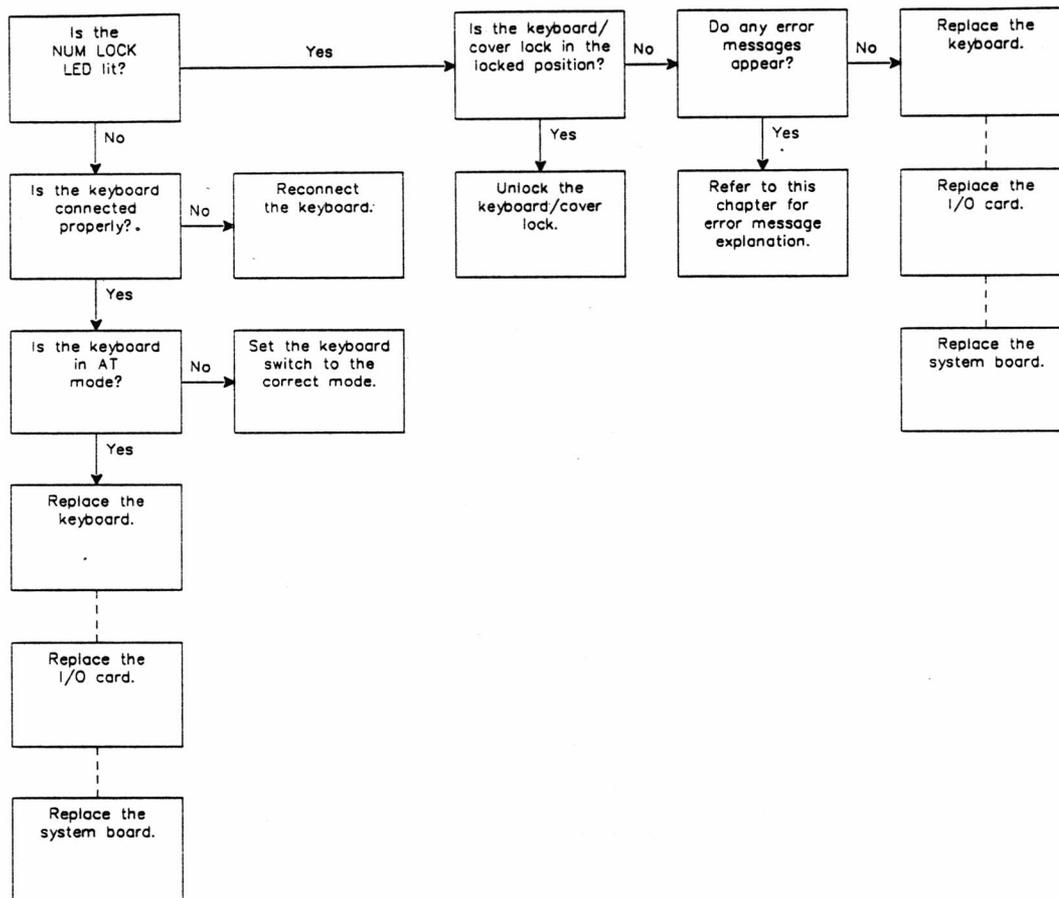
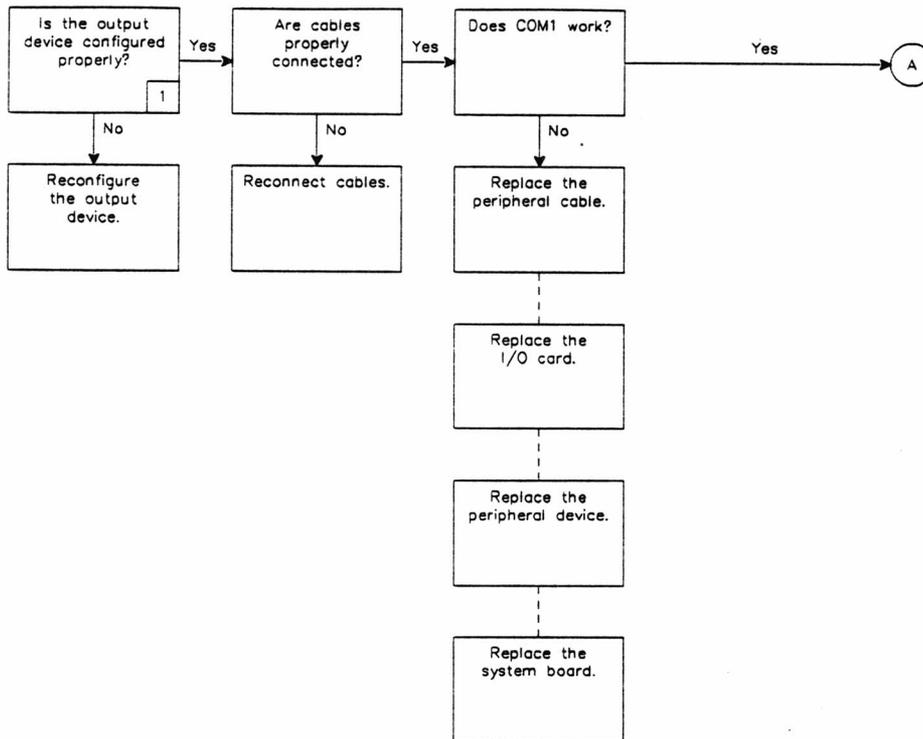
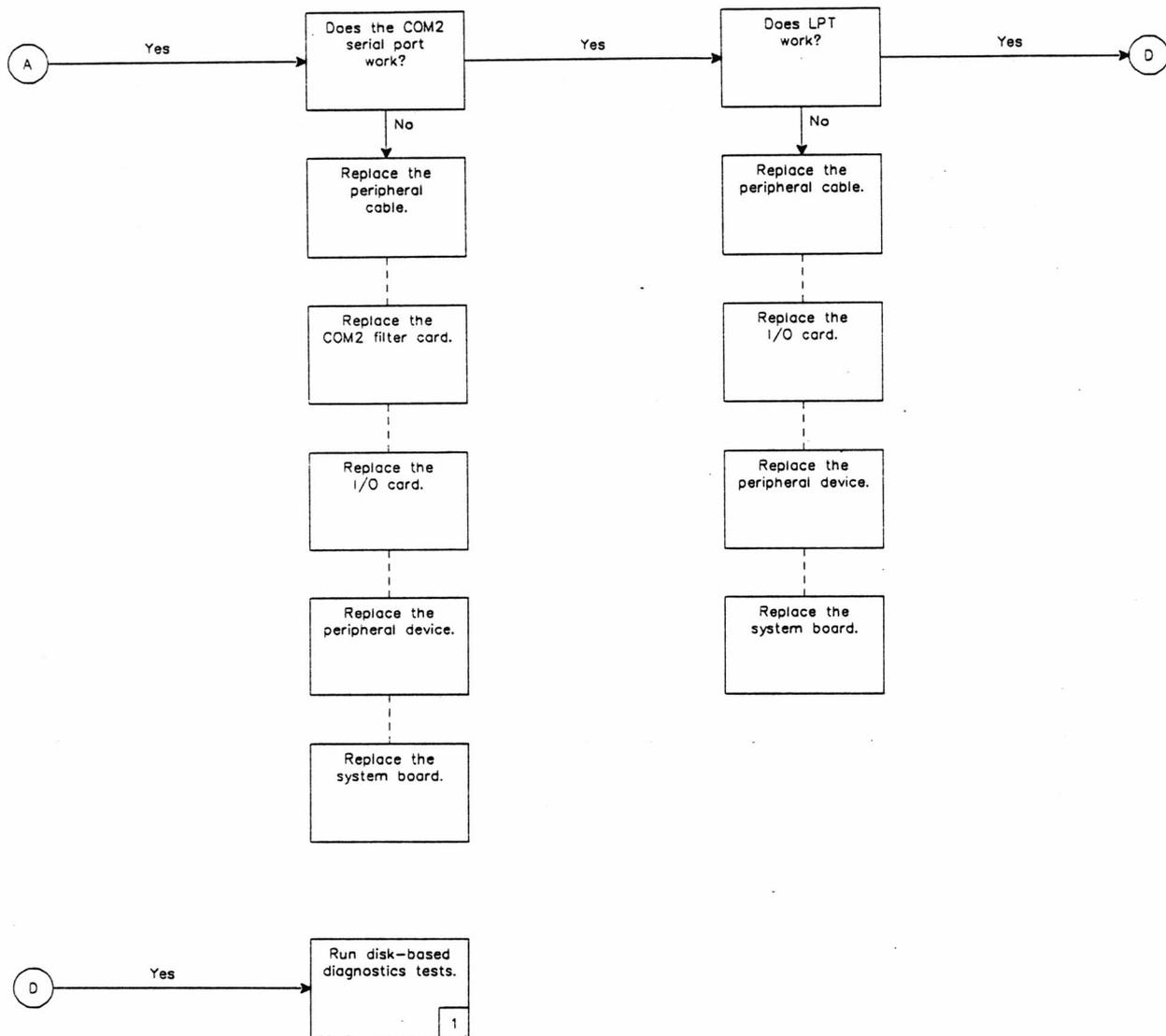
Figure 5-7. Keyboard Troubleshooting Chart

Figure 5-8. Parallel/Serial Port Troubleshooting Chart**NOTES**

1. Run the ECU program to verify proper computer configuration, I/O device(s) configuration, and to verify that the device(s) is enabled. Check the peripheral device documentation to verify hardware configuration.

Figure 5-9. Parallel/Serial Port Troubleshooting Chart (continued)



NOTES

1. Disk-based diagnostics tests require the serial loopback connector (438-73) and the parallel loopback connector (438-64).

Figure 5-10. Drive Troubleshooting Chart

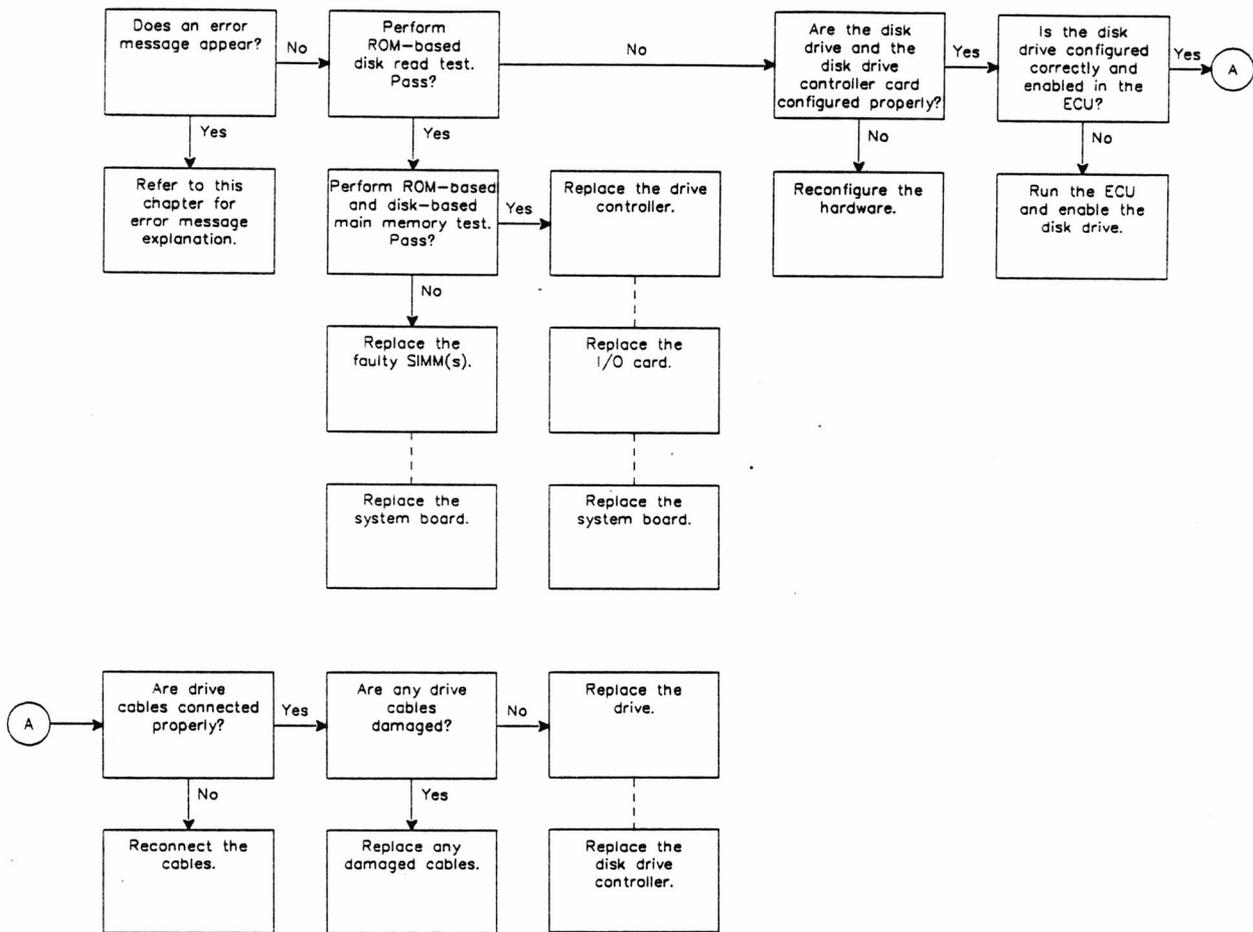
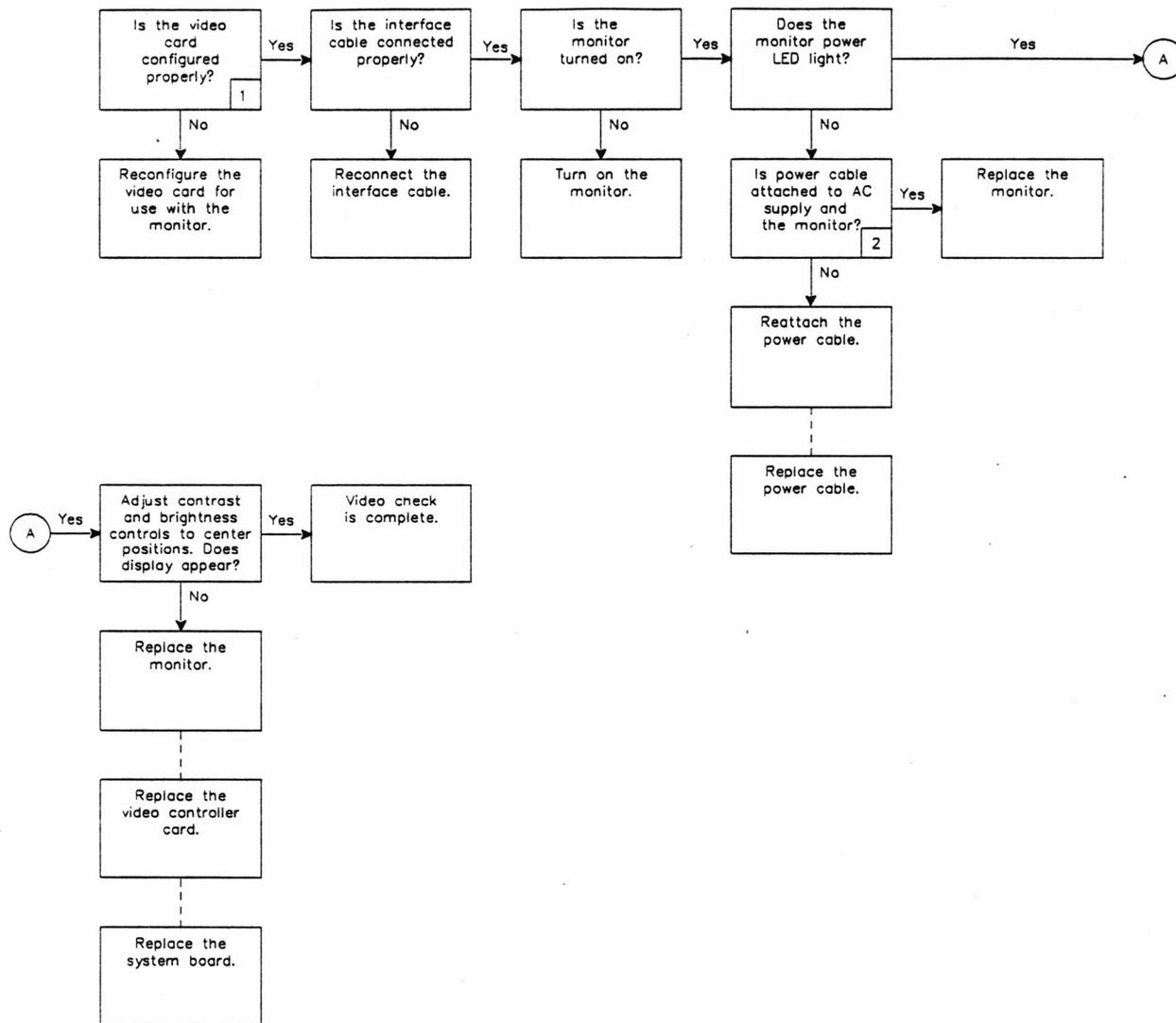
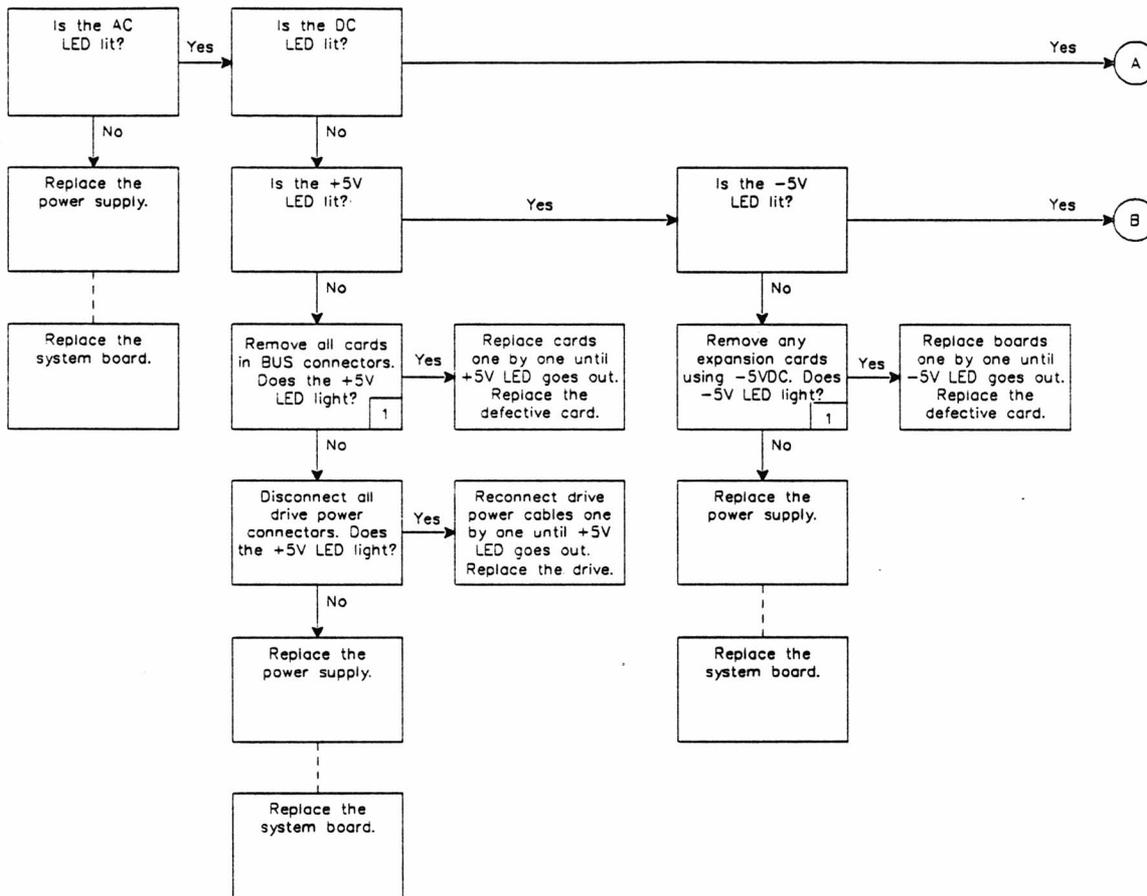


Figure 5-11. Video Troubleshooting Chart



NOTES

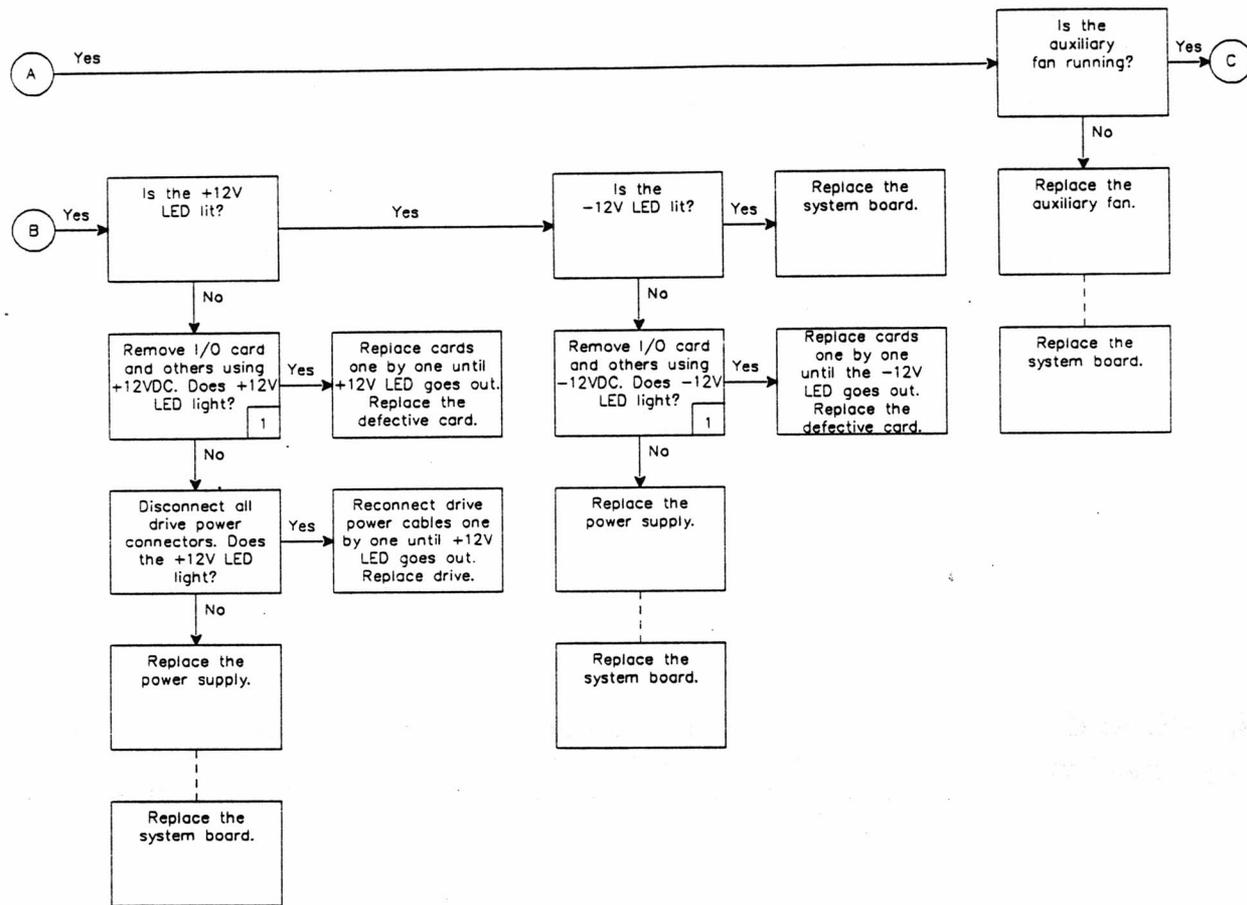
1. Refer to Chapter 4 in this manual or manufacturer's documentation for hardware configuration information. Also, run the ECU to verify proper configuration.
2. On some monitors, the power cable cannot be removed. Replace monitor instead.

Figure 5-12. Power Troubleshooting Chart

NOTES

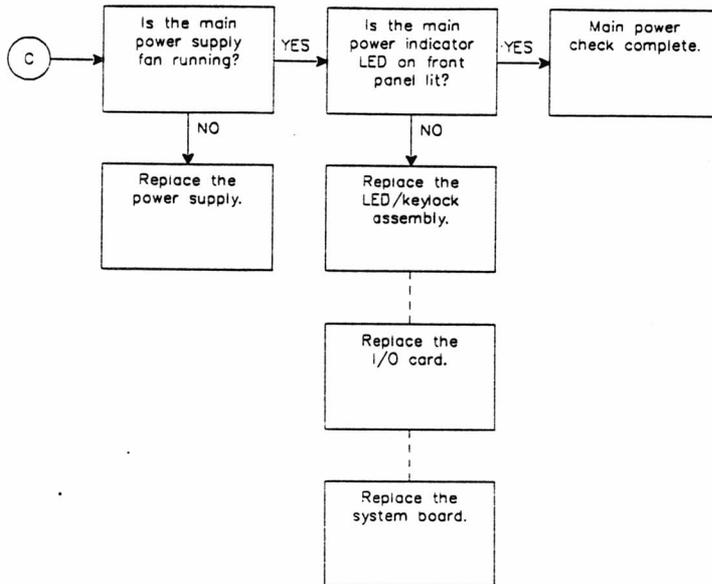
1. Do not remove or install cards with power applied. Refer to Chapter 2, for information on power capacity of this computer.

Figure 5-13. Power Troubleshooting Chart (continued)



NOTES

- 1. Do not remove or install cards with power applied.

Figure 5-14. Power Troubleshooting Chart (continued)

Disk-Based Diagnostics

An optional disk-based diagnostics package is available for this computer. The disk-based diagnostics provide a more extensive and detailed series of tests. Refer to Chapter 1 of this manual for model numbers.

Power-Up and Error Messages

If the computer encounters any problems during self-tests or power-up, it displays a message on the monitor. The following error messages are listed in alphabetical order, with descriptions of the probable cause(s), and suggested steps to correct the problem.

DISK ERROR: Bad disk controller!

This message occurs if a disk drive cable is damaged or not securely connected, if the controller card is not seated properly, or if a hardware failure occurs.

Corrective steps:

- Inspect the disk drive power and data cables for nicks or damage.
- Make certain all cables are properly connected.
- Reseat the drive controller card.
- Use the ROM-based disk read test to determine whether the drive or the controller card is at fault. (It may also help to run the disk-based diagnostics program.) Replace the failing unit.

DISK ERROR: CRC error!

This error indicates a faulty disk (unformatted disk, corrupted data on the disk, etc.), a hardware failure, or a loose or faulty drive cable. The problem could also be with the drive controller card.

Corrective steps:

- Try another disk. If the problem disappears, the first disk is bad. Copy any readable files to a good disk and reformat the faulty disk. If bad sectors are reported, discard the disk.
- If more than one disk drive is installed in the computer, try the other disk drive. If the second disk drive works, replace the first drive.
- Inspect all power and signal cables for nicks or damage.
- Inspect all cables for proper installation.
- Replace the disk controller card with the same model card as the original.

DISK ERROR: Data corrected!

The computer detected an error, but was able to correct the data.

Corrective steps:

- If this message occurs on a regular basis, refer to "DISK ERROR: CRC error."
- Use disk-based diagnostics to test the drive.

DISK ERROR: Disk not bootable!

The computer attempted to boot an unformatted or non-system disk, or the disk is not usable.

Corrective steps:

- Make certain that the floppy disk is bootable and properly engaged in the drive. If not, reformat the disk and install the operating system.
- Try using another copy of the applications software or data disk.
- When using a hard disk drive, make sure a bootable partition is specified. If not, specify the correct partition and reboot.
- For a hard disk drive, first try to reinstall the operating system. If necessary, back up the drive and use PREP to reinitialize the disk. Reformat the drive and install the operating system. As a last resort, replace the hard disk drive.

DISK ERROR: DMA overrun!

The problem is caused by a DMA hardware failure.

Corrective steps:

- Replace the I/O card.
- If the problem remains, replace the system board.

DISK ERROR: Drive not ready!

There is no disk in the floppy drive, the disk is not fully inserted, or a drive hardware failure occurred. This message also appears if the computer attempts to access a non-existent disk drive.

Corrective steps:

- Verify that the correct drive was specified.
- Make certain the disk is fully inserted in the drive, and the door is closed and latched. Try a different bootable disk in the floppy disk drive and retry the boot command. Run the disk-based diagnostics program to find the problem.
- If this message occurs when using the hard disk drive, try to reboot the computer. If problems persist, run the disk-based diagnostics to isolate the problem.
- Replace the drive.

DISK ERROR: Invalid address mark!

This message occurs if the hard or floppy disk is damaged or has not been properly formatted.

Corrective steps:

- Copy any readable files to a good disk and reformat the faulty disk. If bad sectors are reported, discard the disk.
- If the problem occurs on a hard disk, three options are available:
 - Reformat the hard disk.
 - Run PREP, then reformat the hard disk.
 - Replace the hard disk drive.

Note: FORMAT and PREP will destroy all data on the drive. Copy any readable files to floppy disks before proceeding.

DISK ERROR: Invalid data read!

The floppy disk is damaged or was not properly formatted.

Corrective steps:

- Copy any readable files to a good disk and format the faulty disk. If bad sectors are reported, discard the disk.

DISK ERROR: Must run configuration utility to boot from hard drive!

The ECU configuration program contains incorrect hard disk drive configuration information.

Corrective steps:

- Use the ECU program to specify the correct hard disk drive type for the boot drive (see the Owner's Manual for ECU information).

DISK ERROR: Sector not found!

The computer attempted to access an unformatted or damaged floppy disk.

Corrective steps:

- Copy any readable files to a good disk and reformat the faulty disk. If bad sectors are reported, discard the disk.

DISK ERROR: Seek failure!

The computer attempted to access an unformatted or damaged floppy disk.

Corrective steps:

- Copy any readable files to another disk and format the original disk. If bad sectors are reported, discard the disk.

Divide by zero!

The power-up self-tests failed or a software failure occurred. This message may also appear if the computer is turned off, then back on again quickly.

Corrective steps:

- Try another copy of the software, or have the customer contact the software manufacturer or dealer to report the problem. Unless this message occurs during the power-up sequence, the problem is likely to be in the software.
- Turn the computer off, wait 15 seconds, then turn it back on again. If the message reappears, replace the system board.

Error reading partition boot code

This message indicates a problem in the hard disk drive media such as a bad first logical sector.

Corrective steps:

- Check the hard disk drive setup using the ECU program.
- Back up the hard disk drive.
- Remove the partition where the error message is generated and recreate the partition (maps out the bad sector).
- Reinstall the operating system on the new partition.
- As a last resort, prep the entire hard disk drive and reinstall the partitions and operating system.

Errors found! Please press <Esc> to continue

This message will be displayed at the bottom of the screen following another error message. The first message indicates what error halted operation. Its purpose is to make the user aware that errors exist before continuing the boot process.

Corrective steps:

- Refer to the first error message and follow the instructions to resolve that problem.

Errors found: Please unlock keyboard then press <Esc> to continue

The computer was powered up with the keyboard locked (mechanically or by software).

Corrective steps:

- Unlock the keyboard/cover lock.
- Enter the required password.

ERROR: Bad configuration information found in CMOS!

This message normally appears after real-time clock replacement. It also could indicate a problem in the RTC chip.

Corrective steps:

- Use the ECU configuration program to verify or re-enter the configuration information.
- Refer to Chapter 2 and replace the real-time clock IC (contains the backup battery).

ERROR: Bad SIMM Module on Expansion Board!

This message indicates a problem on an expansion memory card.

Corrective steps:

- Check memory SIMMs on the expansion card to be sure they are properly seated.
- Swap the installed SIMMs with each other. If the problem disappears, the module was not installed correctly. If the problem moves, a module is defective.
- Use the disk-based diagnostics program to test extended memory. If the tests identify a faulty SIMM module, replace the SIMM or the card.

ERROR: Bad SIMM Module on Main Board! Chip: UXXX!

A faulty or improperly installed SIMM on the system board can cause this error message to be generated.

Corrective steps:

- Reseat the indicated SIMM, UXXX.
- Replace the indicated SIMM, UXXX.
- Run the disk-based diagnostics for more extensive memory tests.

**ERROR: Base memory size error! SETUP: XXXK ACTUAL:
XXXX**

The amount of base memory specified in the ECU program does not agree with the amount of base memory identified during powerup. For example, the system may have been configured for 640K of base memory, but at powerup the computer sees only 512K of base memory. The message can also indicate a faulty or improperly installed SIMM or expansion memory card.

Corrective steps:

- Use the ECU program to verify the correct base memory size.
- Inspect the SIMMs for proper installation.
- Use the disk-based diagnostics for more extensive tests. If the computer does not boot, replace the first SIMM and try again (this problem could also be caused by a problem on the I/O card). If the tests identify a faulty SIMM, replace it. If the tests identify a CMOS RAM failure, or a problem with the Monitor ROM, replace the I/O card. If the tests identify a memory problem on an expansion memory card, replace that card. If the tests are inconclusive, replace the system board.

**ERROR: Base memory size too small! SETUP: XXXX
ACTUAL: YYYY
Reconfiguring actual base memory as 512K**

The base memory size specified during configuration does not agree with the actual base memory size installed in the computer. In order to run the ECU configuration program, there must be at least 512K of base memory specified. This message may also be generated because of a missing or defective expansion memory card, or defective system memory on the system board.

Corrective steps:

- The computer will automatically correct this configuration error by temporarily reconfiguring actual base memory as 512K to allow the user to configure the computer using the ECU program. If the ECU program is not run to correct the configuration error, the error message will continue to appear whenever the system is booted up.
- Run the ECU program to properly reconfigure the computer, allocating at least 512K of memory as base memory.
- An expansion memory card may cause this message to be generated if the user configured the computer with less than 512K of base memory on the system board, and the remainder of base memory on an expansion memory card. If the card is missing or defective, the message will appear. Install or replace the expansion memory card, or use the ECU to reconfigure the computer to increase base memory on the system board to a minimum of 512K.
- Defective system board memory may also generate this error message. If after doing the preceding steps the problem persists, run the disk-based diagnostics program to locate the defective system board SIMM and replace it.
- As a last resort, replace the system board.

ERROR: Cache circuit card DATA RAM failure! Chip: U7XX!

This message indicates that the cache card is not fully inserted in the socket, the socket is defective, or possibly indicates a faulty DATA RAM chip.

Corrective steps:

- Reseat the cache card.
- Replace the cache card.
- Replace the system board.

ERROR: Cache circuit card failure!

This message indicates that the cache circuit card is not fully inserted in the socket, the socket is defective, or the card has failed.

Corrective steps:

- Reseat the cache card.
- Replace the cache card.
- Replace the system board.

ERROR: Cache circuit card Tag RAM failure! Chip: U7XX!

This message indicates that the cache card is not fully inserted in the socket, the socket is defective, or possibly indicates a faulty Tag RAM chip.

Corrective steps:

- Reseat the cache card.
- Replace the cache card.
- Replace the system board.

ERROR: Cannot reset drive!

The disk is not properly installed in the drive, the drive door/latch is not closed, or a hardware failure has occurred.

Corrective steps:

- Check the floppy disk to be sure it is inserted correctly in the drive.
- Make sure the drive door is fully closed.
- Replace the drive or the disk controller.

ERROR: CMOS Memory Failure!

The internal CMOS memory (real-time clock) failed the power-up test.

Corrective steps:

- Replace the real-time clock IC on the I/O card as detailed in Chapter 2.

ERROR: CPU failure!

Either the CPU or supporting circuitry suffered a hardware failure.

Corrective steps:

- Replace the I/O card.
- Replace the system board in the computer.

ERROR: Expansion Bus timeout. Current Bus Master is slot: z!

An EISA master card on the expansion bus held the bus too long. The error message gives the slot number of the master causing the problem. Slot 0 would indicate a CPU problem or a problem with the I/O card.

Corrective steps:

- Replace the expansion card in the slot indicated by the error message.
- If slot 0 is indicated, replace the I/O card and, as a last resort, replace the system board.

**ERROR: Extended memory size error! SETUP: XXXXXX
ACTUAL: XXXXXX**

The amount of extended memory specified in the ECU configuration utility program does not agree with the amount of extended memory identified during powerup. A faulty or improperly installed SIMM can also create this problem.

Corrective steps:

- Use the ECU program to verify the memory size entry.
- Inspect all SIMMs for proper installation.
- Use the disk-based diagnostics program to test extended memory. If the computer will not boot, replace the first SIMM and try again. If the tests identify a faulty SIMM, replace it. If the problem is on a memory card, replace the indicated memory module, or the card.

ERROR: Fail-safe timer timeout!

This indicates either a software applications problem (a software task is taking too long), or possibly a faulty fail-safe timer chip on the system board.

Corrective steps:

- Try another copy of the software applications program, or have the customer contact the software manufacturer or dealer to report the problem.
- If the problem occurs during the power-up sequence, the timer chip is probably faulty. Turn the computer off, wait 15 seconds, and turn it back on. If the message reappears, replace the system board.

ERROR: Invalid command!

Some internal process (usually math related) created an illegal processor state. Otherwise, a hardware failure occurred. This error also occurs when an illegal command is entered.

Corrective steps:

- Check to be sure the command syntax is correct and re-enter the command.
- Try another copy of the software, or have the customer contact the software manufacturer or dealer to report the problem.
- Replace the system board.

ERROR: IOCHK from Expansion Board in slot z!

This error indicates a problem with a card in the slot indicated. Generally the problem is caused by a memory parity error on the card, or possibly a backplane problem.

Corrective steps:

- Replace the expansion card in the indicated slot.
- If the problem persists, replace the system board.

ERROR: Keyboard not responding or not connected!

The keyboard is not properly connected, or the cable is damaged. This error may also be generated if the computer is powered up after certain peripheral devices (such as a printer) are powered up.

Corrective steps:

- Verify that the keyboard is properly connected (see Owner's Manual for proper connection procedure and Chapter 4 of this manual for keyboard configuration information).
- Replace the keyboard.
- If this message occurs frequently, make sure that the computer and peripheral devices are powered up at the same time.

ERROR: Memory parity failure!

The power-up tests detected a memory parity failure.

Corrective steps:

- Inspect all SIMMs for proper installation.
- Use the disk-based diagnostics program to check memory. If the computer does not boot, replace the first SIMM on the system board and try again. If the tests identify a faulty SIMM, replace it or the expansion card the SIMM is on. If not, replace the system board.

ERROR: No configuration in non-volatile memory!

This indicates that the EISA configuration data has been lost or corrupted in the 8K x 8 EEPROM on the I/O card. This error message normally appears when a new I/O card is installed and it is powered up for the first time.

Corrective steps:

- Run the ECU configuration program to restore the lost configuration data.
- If the problem persists, it may indicate a faulty 8K x 8 EEPROM. Replace the I/O card and reconfigure the computer.

ERROR: Non-maskable interrupt!

This message warns of an impending power failure. Either the AC power supply has failed (blown fuse or circuit breaker), the supply has dropped below acceptable operating levels (brownout), or a glitch in the AC source caused the problem. The message also appears if a software program issues an undefined interrupt. Certain machine language commands entered from the Monitor program can also cause this error.

Corrective steps:

- Turn off the computer. If the power supply is at fault, replace it.
- If the AC supply is at fault, do not apply power to the computer system until the supply problem is corrected.
- If a software problem is suspected, have the customer contact the software manufacturer for assistance.

ERROR: Non-volatile memory checksum failure!

The EISA configuration 8K x 8 EEPROM memory has been corrupted. It could be caused by a faulty non-volatile memory chip or, in rare cases, by a software error.

Corrective steps:

- Run the ECU to reconfigure the non-volatile memory.
- If the problem occurs during the power-up tests, the cause may be due to a faulty 8K x 8 EEPROM chip and the I/O card should be replaced.
- If the problem occurs only while running a certain software program, have the customer contact the software manufacturer or dealer for assistance.

ERROR: Please replace the back-up battery!

This message is normal after replacing the back-up battery. It can also mean the back-up battery is weak and should be replaced.

Corrective steps:

- If the battery (real-time clock IC) was recently replaced, use the ECU configuration program to enter the proper configuration information for the computer.
- Refer to Chapter 2 and replace the real-time clock IC (contains the battery), then run the ECU configuration program.

ERROR: ROM checksum failure!

The Monitor ROM failed the power-up self-test. This message may also appear if the computer is turned off, then back on very quickly.

Corrective steps:

- Turn the computer off, wait 15 seconds, and turn it back on.
- If the message reappears, replace the I/O card.

ERROR: Slot z, ID XXXXXXXX: Board ID does not match non-volatile memory!

EISA expansion cards are manufactured with an ID for that particular product. If the actual manufacturer-assigned ID does not match this EISA card configured in the ECU configuration data, this error message is generated.

This error message also can occur if the user configured the system to accept an EISA card in a certain slot, but installed a different EISA card in that slot. The system expects to find an EISA card in that slot with a certain ID, but instead finds an EISA card in the slot with a different ID.

Corrective steps:

- Be sure the EISA card that was configured to be in the slot is the one actually located there.
- If problem remains, replace the EISA expansion card.

ERROR: Slot z, ID XXXXXXXX Board not ready!

EISA cards have a set period of time to respond when addressed or this error message is generated.

Corrective steps:

- If this error occurs frequently, replace the EISA card in the indicated slot.

ERROR: Slot z, ID XXXXXXXX Missing board!

The configuration data in the non-volatile memory tells the computer to expect an EISA card in the indicated slot, but the card does not appear to the computer to be there.

Corrective steps:

- Run the ECU configuration program to reconfigure the computer with the correct information.
- If the error occurs again, replace the expansion card.

ERROR: Slot z, ID XXXXXXXX Slot is not empty!

The computer has been configured to indicate that there is no card in the indicated slot. However, an EISA card with the indicated ID is found in that slot.

Corrective steps:

- Reconfigure the system using the ECU configuration program.

ERROR: Slot z, ID XXXXXXXX Unexpected board ID encountered!

The slot indicated is configured to contain a non-EISA card, but an EISA card is found there.

Corrective steps:

- Reconfigure the system using the ECU configuration program.

ERROR: Software generated non-maskable interrupt!

This error message is generated by the fail-safe timer timeout, or possibly the bus master timeout, and is usually due to a problem in an application software program.

Corrective steps:

- Try another copy of the program, or have the customer contact the software manufacturer or dealer to report this problem.
- If this message is generated during the power-up sequence, it could indicate a timer chip problem. Turn the computer off, wait for 15 seconds, then turn the computer back on. If the message appears again, replace the system board.

ERROR: System control processor failure!

The system control processor failed the power-up self-test. This message may also appear if the computer is turned off, then on again quickly.

Corrective steps:

- Turn the computer off, wait for 15 seconds, then turn it back on. If the message reappears, replace the I/O card.

ERROR: Timer interrupt failure!

The interrupt controller or timing logic failed the power-up self-test. This message may also appear if the computer is turned off, then on again quickly.

Corrective steps:

- Turn the computer off, wait for 15 seconds, and turn it back on. If the message reappears, replace the system board.

ERROR: Wild hardware interrupt!

An unexpected error or memory failure occurred while running a program.

Corrective steps:

- Turn the computer off, wait 15 seconds, and turn it back on. Rerun the program.
- If the message occurs at the same place during the operation of a program, it may be software-related. Have the customer contact the software manufacturer or dealer and report the problem.
- If the message occurs randomly, use the disk-based diagnostics to test the computer. Replace any faulty assemblies.

ERROR: Wild Interrupt!

An unexpected error or memory failure occurred while running a program.

Corrective steps:

- Turn the computer off, wait 15 seconds, and turn it back on. Rerun the program.
- If the message occurs at the same place during the operation of a program, it may be software-related. Have the customer contact the software manufacturer or dealer and report the problem.
- If the message occurs randomly, use the disk-based diagnostics to test the computer. Replace any faulty assemblies.

Fatal Error: Cannot Continue!

This message only appears immediately following another error message. The first message indicates what error halted operation.

Corrective steps:

- Refer to the first error message and follow the instructions to resolve that problem.

Non-system disk

The computer attempted to boot from a formatted disk or partition without an operating system.

Corrective steps:

- Make certain a valid drive is selected for the boot operation.
- Install the operating system. Refer to the operating system documentation for instructions.
- Reboot.

Non-maskable interrupt received!

This message warns of an impending power failure. Either the AC power supply has failed (blown fuse or circuit breaker), or the supply has dropped below acceptable operating levels (brownout). The message also appears if a software program issues an undefined interrupt. Certain machine language commands entered from the Monitor program can also cause this error.

Corrective steps:

- Turn the computer off. If the power supply is at fault, replace it. If the AC supply is at fault, do not restore power to the computer until the problem is resolved.
- If a software problem is suspected, have the customer contact the software manufacturer for assistance.

Overflow!

This message appears if a power-up self-test failed, or if the computer is turned off, then back on very quickly. This problem can also be software-related. It also may occur when a software program attempts an invalid operation.

Corrective steps:

- Reboot the computer and run the application again.
- Try another copy of the program or have the customer contact the software manufacturer or dealer to report the problem.
- Unless this message occurs during the power-up sequence, the problem is probably software-related. Turn the computer off, wait for 15 seconds, and turn it back on. If the message reappears, replace the system board.

Chapter 6 Parts List

This chapter provides parts lists and exploded views of the base computer hardware.

Figure 6-1. Cabinet and External Parts

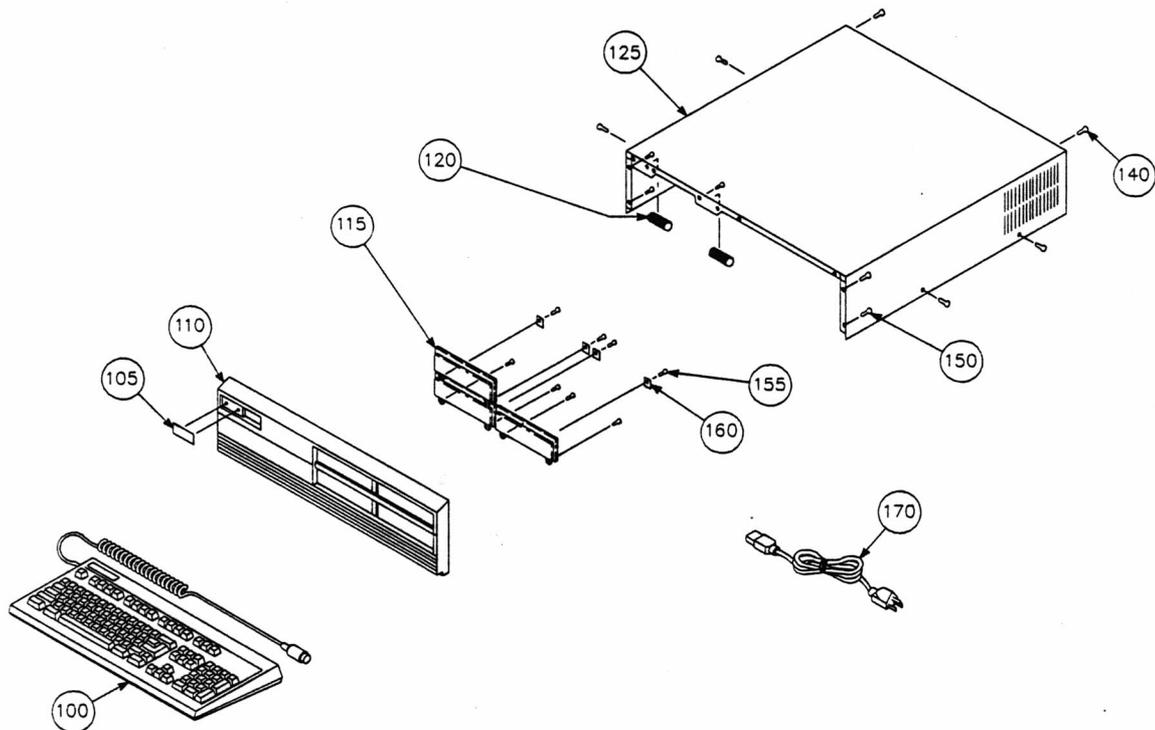


Table 6-1. Parts List for Cabinet and External Parts

Reference Number	Part Number	Part Description
100	163-40-4	Keyboard, 101-key
105	391-746-8	Nameplate
110	203-2332	Panel, front, plastic
115	203-2333	Panel, drive, plastic
120	73-261	Gasket, EMI, stainless mesh
125	90-1368-3	Cover, cabinet, top, office tan
140	250-1594	Screw, pan, phillips, 6-32 x .375
150	250-1556	Screw, pan, phillips, 6-BT x .375
155	250-1593	Screw, phillips, truss, 6-AB x .375
160	258-730	Spring, retainer clip
170	89-65	Line cord, shielded, US

Figure 6-2. Chassis, Brackets, Mounting Hardware, and Drive Cables

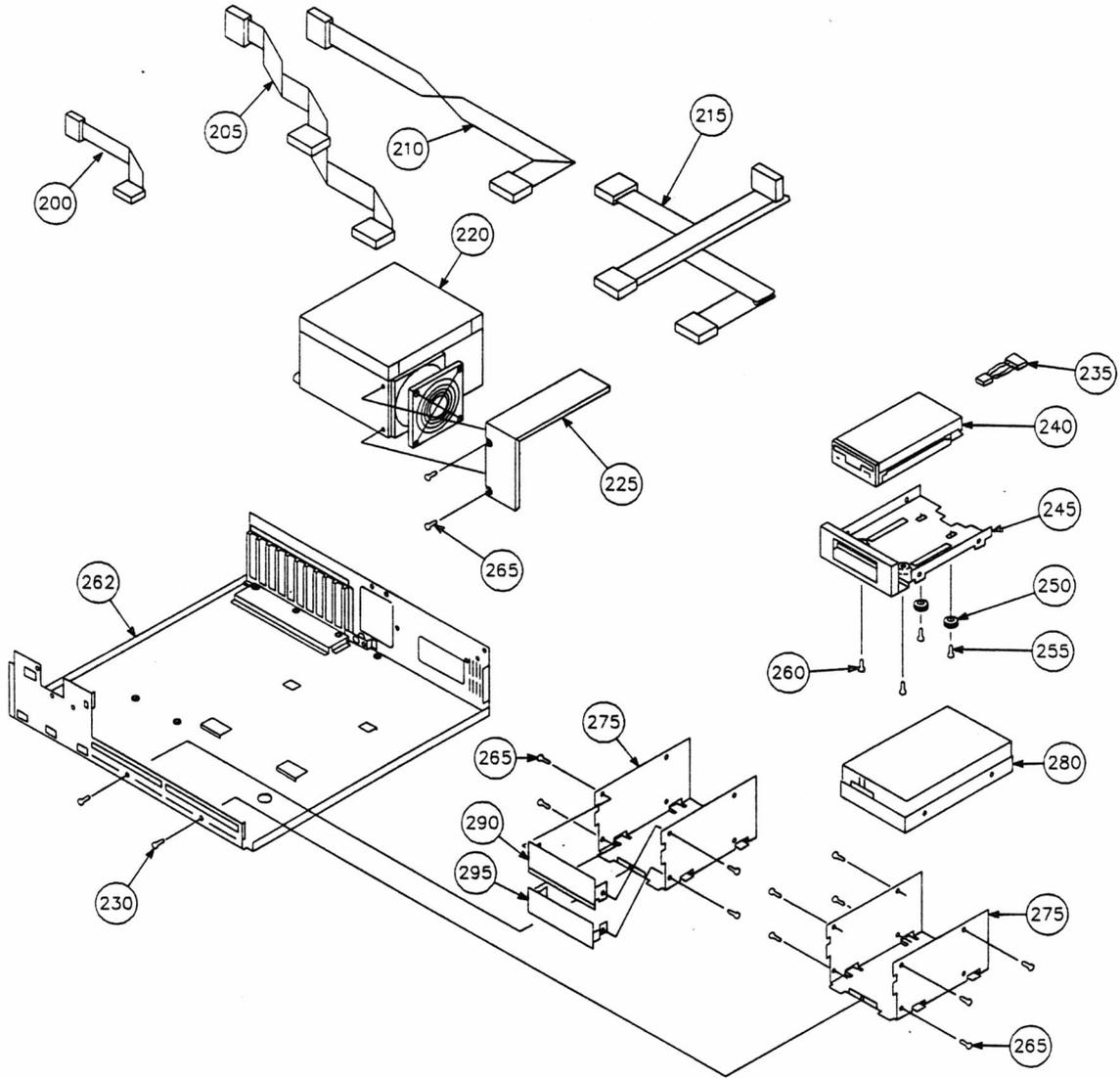
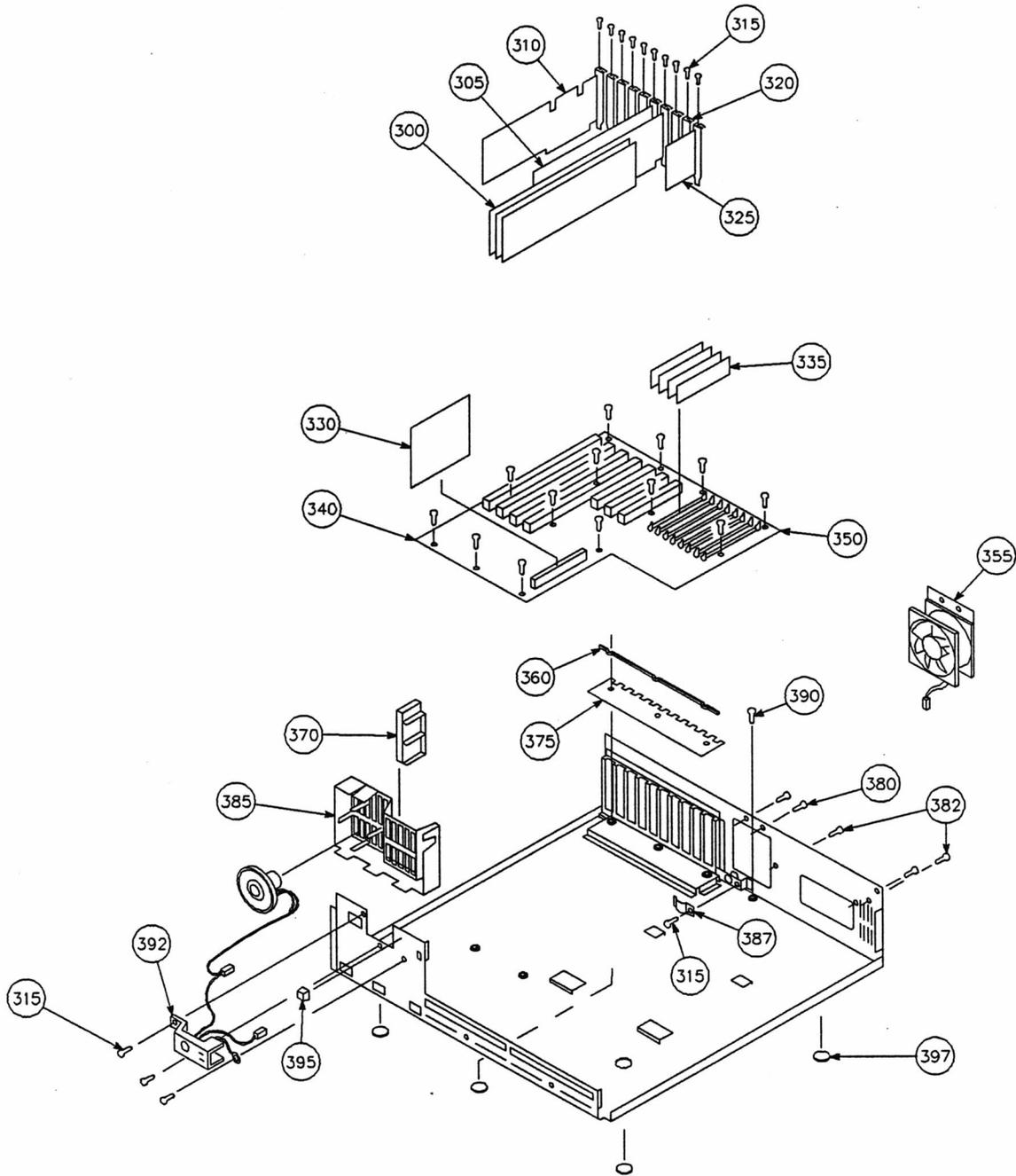


Table 6-2. Parts List for Brackets and Mounting Hardware

Reference Number	Part Number	Part Description
200	134-2100	Cable assembly, 10-pin, serial port extension
205	134-1990	Cable assembly, 34-pin, floppy disk/tape drive
210	134-1984	Cable, ribbon, 20-pin, hard drive
215	134-2086	Cable, ribbon, 34-pin, hard drive
220	234-890	Power supply
225	204-2886	Bracket, fan diffuser
230	250-1549	Screw, pan, phillips, 6-CA x .500
235	134-1884	Cable assembly, 4-pin, power adapter for 3.5-inch floppy disk drive
240	151-1088-E2	Disk drive, floppy, 3.5-inch, 1.44M
245	204-3121-2	Adapter, tray, for 3.5-inch floppy drive
250	73-59	Grommet, neoprene, drive mounting
255	250-1595	Screw, truss, phillips, 4-40 x .375
260	250-1411	Screw, pan, phillips, 4-40 x .250
262	200-1569-2	Chassis, main
265	250-1538	Screw, pan, phillips, 6-32 x .250 ¹
275	200-1568	Chassis, disk drive, steel
280	151-1096-K1	Disk drive, hard, ESDI, 150M, 18 ms or
	151-1160-U1	Disk drive, hard, ESDI, 383M, 16 ms
290	204-2968	Panel, metal, disk drive bracket, (internal, top)
295	204-3107	Panel, metal, disk drive bracket, (internal, bottom)
NOTE		
1. Some drives require metric screw, part number 810-18 (M3.0 x 8mm, phillips).		

Figure 6-3. Circuit Cards



Parts List

Table 6-3. Parts List for Circuit Cards and Cables

Reference Number	Part Number	Part Description
300	152-33-A2	Controller, disk drive, EISA/FDD/SCSI
305	240-7813-1J	Controller, I/O
310	152-37-J1	Controller, video, VGA
		or
	152-19-J1	Controller, video, VGA16
315	250-1538	Screw, pan, phillips, 6-32 x .250
320	204-3205	Bracket, blank, expansion slot cover
325	181-7662-10	Card, COM2 filter
330	181-7741-10	Card, cache, 4K x 32
335	443-1661	SIMMs, system board, 1M
340	250-1150	Screw, pan, phillips, 6-32 x .500
350	240-7812-2C	Board, system
355	100-1938	Fan, auxiliary
360	266-1243	Spring, retainer, molded
370	94-654	Adapter, PCB guide, molded
375	258-775	Spring, flat, stainless steel
380	250-1325	Screw, pan, phillips, 6-32 x .250
382	250-1594	Screw, pan, phillips, 6-32 x .375
385	94-682	Card guide, molded
387	204-3166	Bracket, keyboard, ground
390	250-1557	Screw, pan, phillips, 6-32 x .187
392	100-1945	Assembly, keyboard lock/LED
395	261-49-80	Foot, square, rubber
397	261-64	Foot, round, cork

Specifications

CPU

Processor	Intel 80386, 32-bit architecture
Optional Coprocessors	Intel 80387 numeric coprocessor or Weitek WTL 3167 extended math coprocessor (supported simultaneously)
Clock Speed	33 MHz CPU and coprocessor

Memory

System Memory

SIMMs	4M EISA-compatible RAM (standard); expandable to 20M (see Chapter 4 in the Owner's Manual, in the section on Adding SIMMs)
EMS	256K EMS direct hardware support; 64K page frame address D0000H - DFFFFH
Cache	4K x 32 direct-mapped (standard); 95% data read efficiency
Queue	16-instruction buffer to distribute memory and I/O write commands; FIFO organization (first instruction in, first out)

I/O Card

ROM	64K read-only memory to store BIOS code and Monitor program code; functionality is transferred to RAM at powerup
EEPROM	Non-volatile memory to store user password (I/O card component location U14) 8K x 8 EEPROM provides non-volatile memory to store EISA configuration (I/O card component location U6)
Real-time Clock	The RTC chip provides the clock/calendar functions, as well as 50 bytes of battery backed CMOS RAM for storage of AT-compatible configuration data, including floppy drive type, hard drive type, video, memory, etc.

Expansion Bus

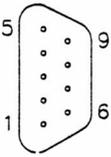
ISA Cards	Supports up to 12M of ISA-compatible RAM
EISA Cards	Supports up to 4G of EISA-compatible RAM
Total RAM	4G of EISA-compatible RAM (including 12M of ISA-compatible RAM)

Power Requirements

Line Voltage	90 VAC to 132 VAC or 180 to 264 VAC (switch-selectable)
Line Frequency	47 to 63 Hertz
Power Supply Output	+5 VDC @ 21A, +12 VDC @ 7.5A, -12 VDC @ .3A, -5 VDC @ .3A (power supply can supply a total of 200W output)

Input/Output
Serial

Two serial ports configurable as COM1 (address 3F8H) or COM2 (address 2F8H) support baud rates of 110, 150, 300, 600, 1200, 2400, 4800, and 9600 bits/second; selectable protocols

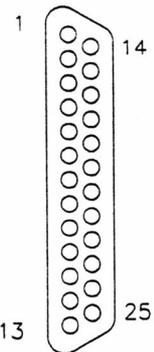
	PIN	SIGNAL
	1	Carrier Detect (CD)
	2	Receive Data (RD)
	3	Transmit Data (TD)
	4	Data Terminal Ready (DTR)
	5	Ground
	6	Data Set Ready (DSR)
	7	Request to Send (RTS)
	8	Clear to Send (CTS)
	9	Ring Indicate (RI)

Specifications

Parallel

One parallel port configurable as LPT1 (address 378H) or LPT2 (address 278H); designated as an output or input port

PIN	SIGNAL
1	Strobe
2 - 9	Data bits 0 - 7
10	Acknowledge
11	Busy
12	Page end
13	Select
14	Auto feed
15	Error
16	Initialize printer
17	Select input
18 - 25	Ground

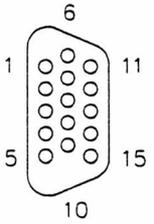


Video

High-Performance VGA (Part Number 152-37-J1)

Compatibility	100% VGA register- and BIOS-level compatible; supports EGA, CGA, MDA, and Hercules formats as a subset of VGA
Display Memory	256K of video DRAM Eight sockets for additional 256K of video DRAM (optional)
Bus Interface	16-bit PC/AT (ISA) type interface
Vertical Sync	40 to 70 Hz, depending on video mode and monitor
Signal Type	Analog RGB; 0 to 0.714 V; 75 ohm impedance

PIN	SIGNAL
1	Red
2	Green
3	Blue
4	Monitor type sense
5	Not used
6	Red return (ground)
7	Green return (ground)
8	Blue return (ground)
9	Key (no pin)
10	Sync return (ground)
11	Monitor type sense
12	Monitor type sense
13	Horizontal sync (+)
14	Vertical sync (-)
15	No connection

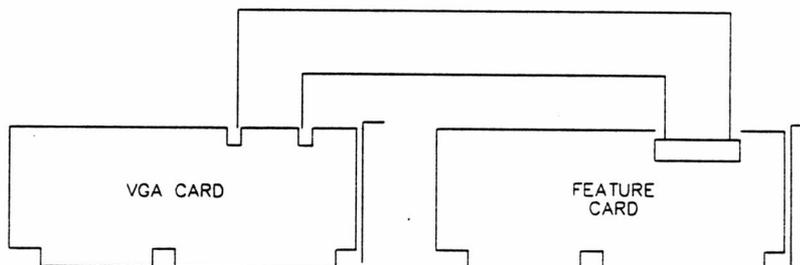


Monitor Timing

The Z-559 card is capable of providing the 31.49 kHz horizontal sync signal required by most analog monitors. In addition it can provide various other horizontal timing signals necessary for extended graphics modes for driving variable frequency and interlaced displays (31.0, 31.1, 31.5, 35.0, and 35.5 kHz). Please note that not all monitors are capable of displaying extended graphics. See the Z-386/33E Owner's Manual for further information.

Features Connector

One standard VGA features connector is used to connect the VGA card to a compatible high-resolution card (and monitor)



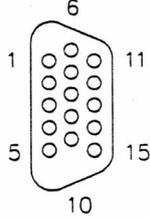
Pin Assignments

	PIN	SIGNAL	PIN	SIGNAL
<p>COMPONENT SIDE</p>	Y1	C0	Z1	GND
	Y2	C1	Z2	GND
	Y3	C2	Z3	GND
	Y4	C3	Z4	FC Data EN
	Y5	C4	Z5	FC Sync EN
	Y6	C5	Z6	FC Clock EN
	Y7	C6	Z7	NC
	Y8	C7	Z8	GND
	Y9	FC clock	Z9	GND
	Y10	FC blank	Z10	GND
	Y11	FC H sync	Z11	GND
	Y12	FC V sync	Z12	NC
	Y13	NC	Z13	NC
<p>FOIL SIDE</p>				

Specifications

High-Performance VGA (Part Number 152-19-J1)

Compatibility	100% VGA register- and BIOS-level compatible; supports EGA, CGA, and MDA formats as a subset of VGA
Display Memory	256K of dynamic RAM
Horizontal Sync	31.49 kHz
Vertical Sync	50 to 70 Hz
Signal Type	Analog RGB; 0 to 0.714 V; 75 ohm impedance

	PIN	SIGNAL
	1	Red video
	2	Green video
	3	Blue video
	4	Monitor type sense
	5	Ground
	6	Red ground
	7	Green ground
	8	Blue ground
	9	No connection
	10	Sync ground
	11	Monitor type sense
	12	Monitor type sense
	13	Horizontal sync
	14	Vertical sync
	15	No connection

Note: The feature connector pinout is the same as outlined for the 152-37-J1 card above.

Disk Drives

Floppy Media

Standard 3.5-inch, high-capacity 1.4M floppy disk drive; supports 1.4M disks and 720K disks. Drive bay support for up to three additional floppy disk drives.

- Standard 3.5-inch 1.4M
- Optional 3.5-inch 720K
- Optional 5.25-inch 360K
- Optional 5.25-inch 1.2M

Fixed Media

Standard 150M or 320M capacity (depending on computer model). The disk drive controller card shipped with the computer supports ESDI and SCSI hard disk drives. If ST-506 support is required, the disk drive controller must be replaced with an appropriate ST-506 controller. Drive bay support for:

- One full-height 5.25-inch hard disk drive
- Up to three half-height 5.25-inch hard disk drives
- Up to three 3.5-inch hard disk drives (mounted in a 5.25-inch adapter bracket).

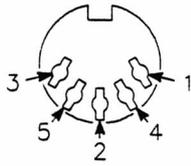
Magnetic Tape Media

Support for one SCSI magnetic tape backup unit added to the drive bay assembly (as if it were a 5.25-inch disk drive). Interfaces to the SCSI port on the disk controller card.

Keyboard

Key layout	101 keys including alphanumeric, cursor control, numeric, and programmable function keys; support for 102-key keyboard.
Features	Audible feedback; key repetition; tactile keys; PC-AT compatibility.
Options	Supports operating system device drivers for foreign languages and extended character sets.
Cable interface	Connects to the computer through a 5-pin DIN connector on the rear panel.

Keyboard Connector Pin Assignments

	PIN	SIGNAL
	1	Clock
	2	Data
	3	Reset
	4	Ground
	5	+5 Volts

Cabinet

Dimensions

Width	21.00 inches (53.34 cm)
Depth	16.26 inches (41.30 cm)
Height	6.26 inches (15.90 cm)

Weight

41.00 pounds (18.45 kg) base unit weight (without video monitor)

Environmental

Operating Temperature	50 to 95 degrees F (10 to 35 degrees C)
Storage Temperature	-40 to +125 degrees F (-40 to +52 degrees C)
Humidity	Operating — 20% to 80% relative humidity (non-condensing) Storage — 20% to 80% relative humidity (non-condensing)

Audio

Speaker	One 8-ohm, 2-inch round speaker
---------	---------------------------------