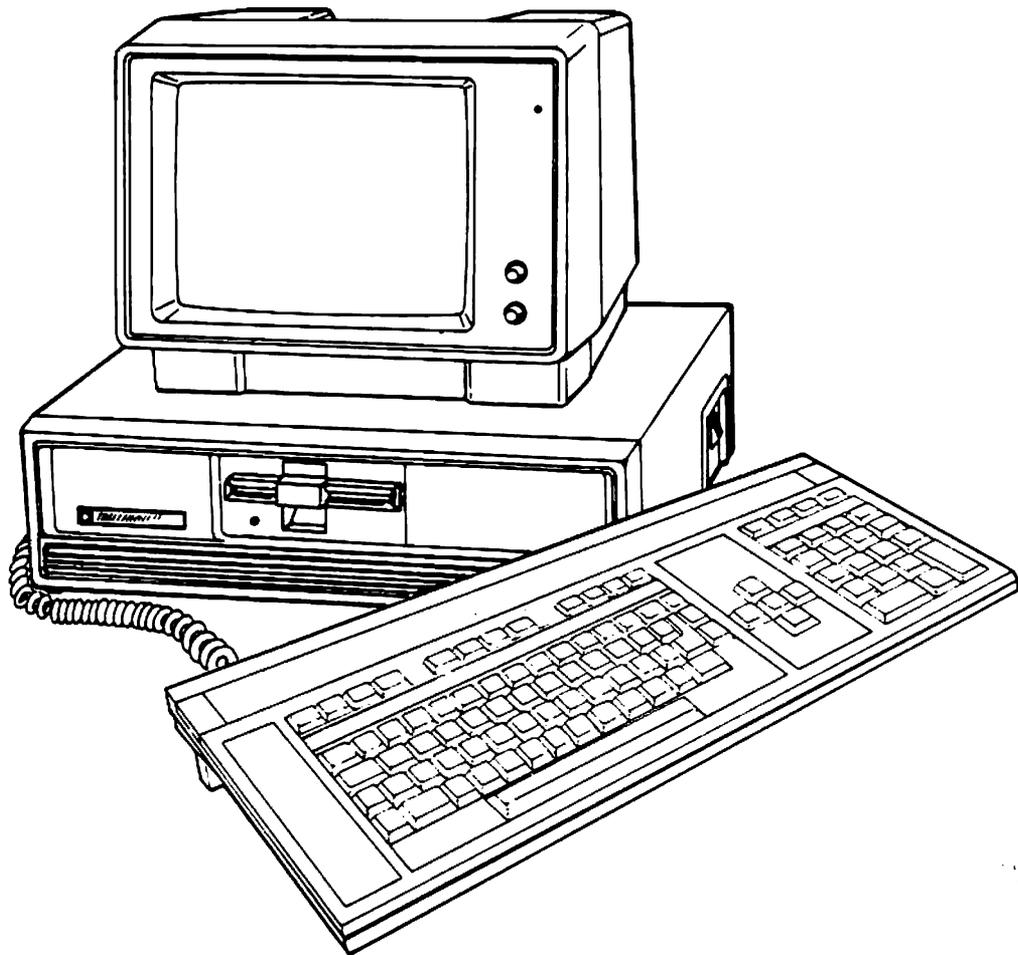


# Texas Instruments Professional Computer

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## Maintenance Handbook



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**CHANGE NOTICES**

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# Preface

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This handbook guides technical personnel in operating, troubleshooting, and repairing the Texas Instruments Professional Computer. It provides detailed information for installing the system, installing options, running and interpreting diagnostics, and removing and replacing field-replaceable assemblies. This handbook provides a systems description section to assist the technician or user in understanding the general computer operation.

This handbook presents a structured troubleshooting approach. Failure indications are presented, followed by a step, or series of steps, leading to the identification of a faulty assembly. The reader is then directed to the section entitled "Assembly Removal and Replacement" for completion of the repairs.

This handbook is not intended to provide detailed information for the repair of individual boards or other field-replaceable assemblies. Such information is beyond the scope of this handbook. Technical information which would be useful to programmers, hardware and software designers, engineers, and other technical personnel may be found in the *Texas Instruments Professional Computer Technical Reference Manual* (TI Part No. 2223216-0001).

The computer's design permits quick and easy replacement of all boards and other field-replaceable assemblies. As a result, the actual time required to repair the computer is measured in minutes, rather than in hours or days.

This handbook is divided into six sections.

Section 1 provides a physical description of the Texas Instruments Professional Computer and identifies options and accessories.

Section 2 provides instructions for preparing the site, unpacking the equipment, making cable connections, applying power, and performing installation checkout. It also provides instructions for the installation and checkout of various options.

Section 3 provides a systems description of each major functional assembly.

Section 4 explains the diagnostic tests and the meaning of error messages. It provides instructions for other tests and measurements to isolate faults to the replaceable assembly or board.

Section 5 provides instructions for the replacement of faulty assemblies.

Section 6 contains a list of replacement assemblies for the Texas Instruments Professional Computer.

Appendix A contains information on the advanced diagnostics tests.

Appendix B contains a list of error messages and their meanings.

Appendix C contains option manuals.

Appendix D contains instructions on the care and use of diskettes, and in using MS-DOS operating instructions.

Appendix E contains MS-DOS error messages.

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# Section 1

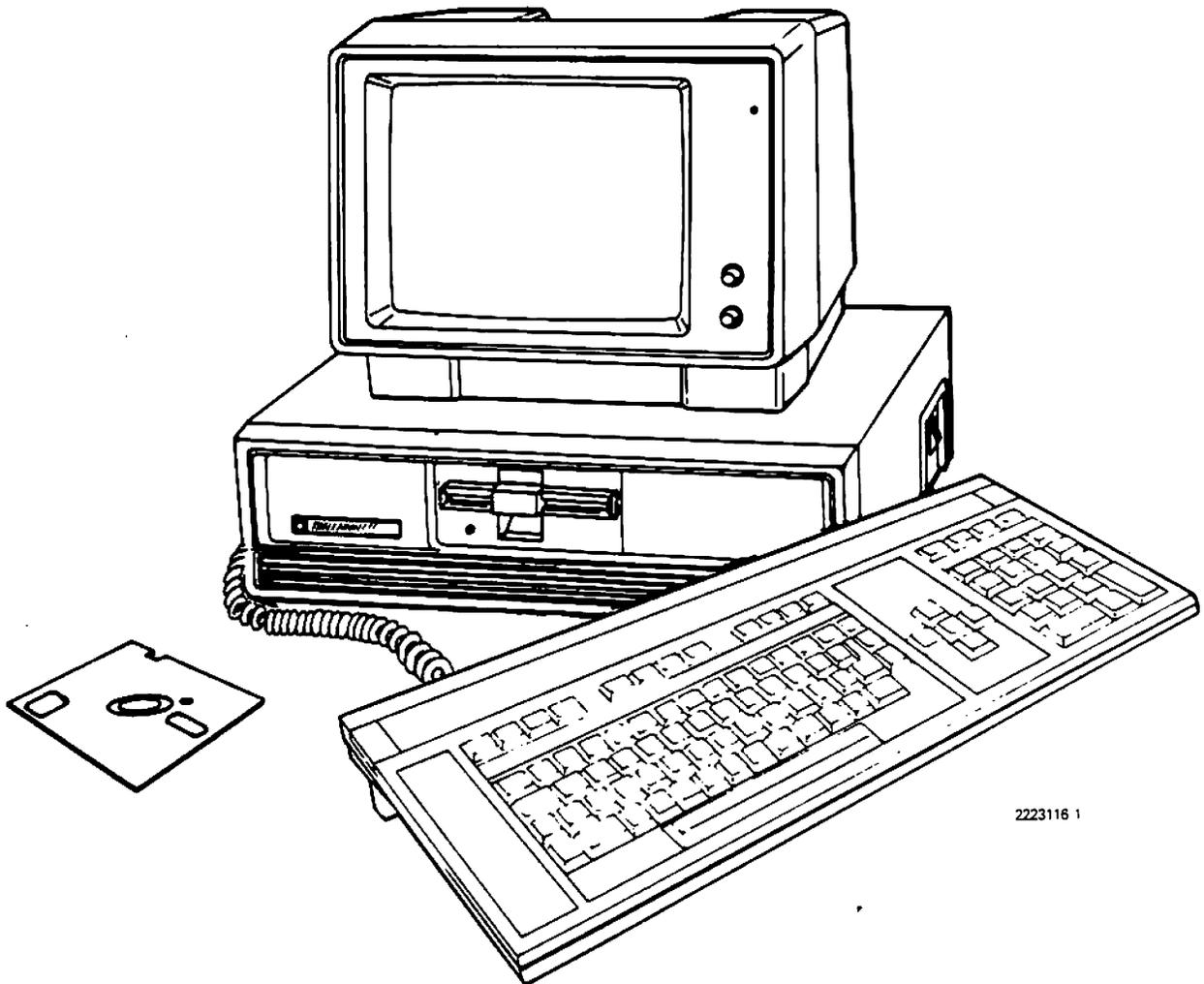
## Introduction and Overview

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### 1.1 INTRODUCTION

The Texas Instruments Professional Computer, with its wide variety of options, is an extremely

powerful tool that provides the user with unique capabilities not available with many large main-frame computer systems. The Texas Instruments Professional Computer is shown in Figure 1-1.



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Figure 1-1. The Texas Instruments Professional Computer

The Texas Instruments Professional Computer performs self-diagnostic testing at every power-up. Fault isolation is provided for the user through power-up self-tests, diskette-based diagnostics, diskette-based advanced diagnostics, and other troubleshooting steps. Faulty assemblies can be readily isolated and replaced with a minimum of repair time.

## **1.2 SYSTEM COMPONENTS**

The Texas Instruments Professional Computer standard system consists of three units.

The system unit contains the main board, an expansion bus with five card-edge connectors for the installation of option boards, a CRT controller board, one diskette drive (installed) with space for a second drive (diskette or Winchester), a fan, and a power supply. The system unit board contains 8 kbytes of boot/system ROM (read-only memory), 64 kbytes of dynamic RAM (random-access memory), and a parallel printer port.

The low-profile keyboard unit has 97 keys, including a numeric keypad, a cursor cluster, and 12 function keys. It uses an on-board microprocessor for scanning the key-switches and converting keystrokes into codes for serial transmission to the system unit via a six-wire telephone-type coiled cable.

The standard display unit is monochrome. An optional color display unit is available. To use either of the display units for graphics, the Graphics Video Controller Option Kit (TI Part No. 2223236-0001) must be installed.

## **1.3 OPTIONS AND ACCESSORIES**

The following eight options are available for the Texas Instruments Professional Computer.

### **1.3.1 Expansion RAM**

The expansion RAM option is a printed wiring board with one, two, or three 64-kbyte banks of memory installed. A memory upgrade kit of nine

integrated-circuit (IC) chips is available for installation on a previously installed expansion RAM option board. Each kit of nine ICs adds 64 kbytes of memory. Using this option, you may add a total of 64, 128, or 192 kbytes, to the system unit's standard 64 kbytes of memory.

### **1.3.2 Diskette Drives**

The diskette drives option provides two configurations for diskette mass storage. You may install a second 320-kbyte drive in the right front of the system unit. The system unit contains the necessary power and control cable harnesses, and connectors required for installation. Both drives must be 320-kbyte capacity units, since the system unit board is jumpered for the type of drives installed. The option kit consists of the drive assembly, mounting hardware, and a manual.

### **1.3.3 Winchester Disk Drive and Controller**

The Winchester disk drive and controller option consists of a 5 1/4-inch Winchester drive, a Winchester controller board, cables, and mounting hardware. The Winchester is mounted on the right front of the system unit. The computer is initialized, or "booted up" by the operating system located on the Winchester drive. The diskette drive is used for initial formatting and transfer of the operating system to the Winchester drive. After the operating system is transferred to the Winchester drive, the diskette drive is used for the transfer of files and programs to and from the Winchester drive and for backup of files on the Winchester disk.

### **1.3.4 Synchronous-Asynchronous Communications Board**

The synchronous-asynchronous communications (sync-async comm) board option consists of a board with an EIA RS-232-C port for communications with external devices, including modems and serial printers. Asynchronous and synchronous transmission are supported. It is capable of operating from 50 baud to 19 200 baud in asynchronous mode, and at any rate up to 50 000 baud in synchronous mode. A printed wiring board and a manual are provided.

### **1.3.5 Internal Modems**

The internal modems option is a direct-connect modem. Two separate options are available. One provides communications compatibility with the Bell System 103 data set, and the other provides communications compatibility with the Bell System 212A data set. Both are answer/originate full-duplex modems with integral data coupler employing binary-phase, coherent-frequency, shift-keying modulation. The options include an asynchronous-synchronous interface identical to the communications option board integrated into the modem. A printed wiring board, telephone cable, and manual are provided.

### **1.3.6 Graphics Video Controller**

The graphics video controller option provides high-resolution raster graphics with either monochrome or color display. The option kit consists of a printed wiring board (to be installed on a CRT controller board) and a manual. Two versions of the option are available. A single-plane board is available for two colors or monochrome only, and a three-plane board is available for eight-color or eight-gray scale applications.

### **1.3.7 Color Display Unit**

The color display unit option provides a high-resolution 13-inch display with a resolution of 720 horizontal by 300 vertical picture elements (pixels). The color display unit interfaces with the system unit by a 9-pin D-type connector and cable on the rear of the system unit. The option consists of the color display unit, interconnect cable, and a manual.

### **1.3.8 Clock and Analog Interface**

The clock and analog interface option contains a crystal-controlled time base. This time base provides the date (month, day, year, day of week) and the time (hours, minutes and seconds). The time can be provided in a 12-hour format with A.M. or P.M. markers, or in a 24-hour format. The clock and analog interface option has on-board battery backup and automatic power-off sensing. This option also provides for analog signal input. User-furnished joysticks, paddles, or a light pen may be connected.

### **1.3.9 Future Options**

Additional options will soon be available to expand the capabilities of your Texas Instruments Professional Computer.

# Section 2

## Installation

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### 2.1 INTRODUCTION

This section describes site preparation and setup considerations for the Texas Instruments Professional Computer. This section provides information on cable connections, configuration verification, and system checkout. System checkout consists of running the diagnostics diskette and interpreting the results.

The Texas Instruments Professional Computer will perform well in most modern office environments. Very few special arrangements are required. However, some preinstallation organization of the computer site will improve operator efficiency and ensure equipment reliability.

### 2.2 SITE PREPARATION

The layout of the workspace should be carefully planned so that it has a positive effect on work efficiency and user comfort. The effect is particularly noticeable when the computer operator is expected to be at the keyboard for extended periods of time.

Plan ahead for the installation of the computer. Sketch out a floor plan that shows the locations of existing or required power outlets, telephone line, and modem (if one is to be used). Consider the following items during your site planning.

- Workstation space and clearance should be adequate for operator convenience and comfort.
- Power cord length, and type and location of ac electrical outlets (with proper voltage, frequency, phase, and current rating) should be compatible with, and adequate for, the equipment used. (The system unit power cord is a standard three-conductor cord 1.8 m (6 ft) in length.)
- Power and communication cable paths exiting the system unit rear panel must be protected and must not create a hazard by lying across pathways or accessways.
- A telephone with outside line(s) should be near the computer if a modem is to be used.
- Some sites may have high ambient electromagnetic fields caused by nearby industrial, medical, power generation, radio frequency, or radar equipment. Building or facilities engineering personnel may help in identifying problem areas.

The Texas Instruments Professional Computer should be kept as far as possible from the electromagnetic sources listed above. If this cannot be done, consider the following.

- Install a separate dedicated branch circuit for use by the computer alone.
- Install ac line filters on the equipment that is causing the problem.
- Install ac line voltage stabilization and filtering equipment on the computer power circuit.

## 2.2.1 AC Power Requirements

### WARNING

**Do not attempt to use a receptacle or extension cord that does not accommodate a three-conductor plug. Do not cut the grounding prong from the plug. Any attempt to operate the computer without an adequate ground may result in dangerous electrical shock to you, as well as damage to the computer and data.**

For the personal safety of the operator, as well as for proper operation, you must ground the computer by plugging the power cord into a mating three-prong grounded receptacle. The receptacle must be grounded in accordance with the National Electrical Code, and local codes and ordinances. Any of the following conditions may cause a possible safety hazard or result in computer malfunction.

- Open safety ground
- Safety ground connected to hot conductor in the receptacle
- Safety ground connected to neutral conductor in the receptacle
- Safety ground connected to conduit only
- Hot and neutral connections reversed in the receptacle

If a properly wired wall receptacle is not available, it is the responsibility and obligation of the user to have such a receptacle installed by a qualified electrician.

All computers are sensitive to fluctuations in the ac power from the wall receptacle. This is rarely a problem unless the computer is operating on the same branch circuit as copying machines, water coolers, typewriters, or other appliances which produce power-line transients. If the computer

malfunctions as a result of the operation of such devices, it is the user's responsibility to relocate the computer to a different branch circuit, or to install appropriate transient-suppression devices.

The Texas Instruments Professional Computer is equipped with a specially designed ac line filter which eliminates the effects of most frequently encountered power-line fluctuations. If fluctuations are severe, it may be necessary to perform at least one of the following steps. Perform step 1, and if that doesn't alleviate the problem, perform step 2, and so on.

1. Install transient-suppression or isolation devices on the equipment causing the problem.
2. Repair or replace any defective or arcing relays or switches.
3. Install a special line filter designed for computers and other sensitive electronic equipment.
4. Install a separate branch circuit for the Texas Instruments Professional Computer.

## 2.2.2 Static Electricity and Lightning

When people walk across carpet, they often generate high electrostatic charges. These may be discharged through computer equipment, and may cause interference or disruption of operations. When electrostatic charges are discharged to a magnetic diskette, data can be erased. The following can contribute to static electricity problems.

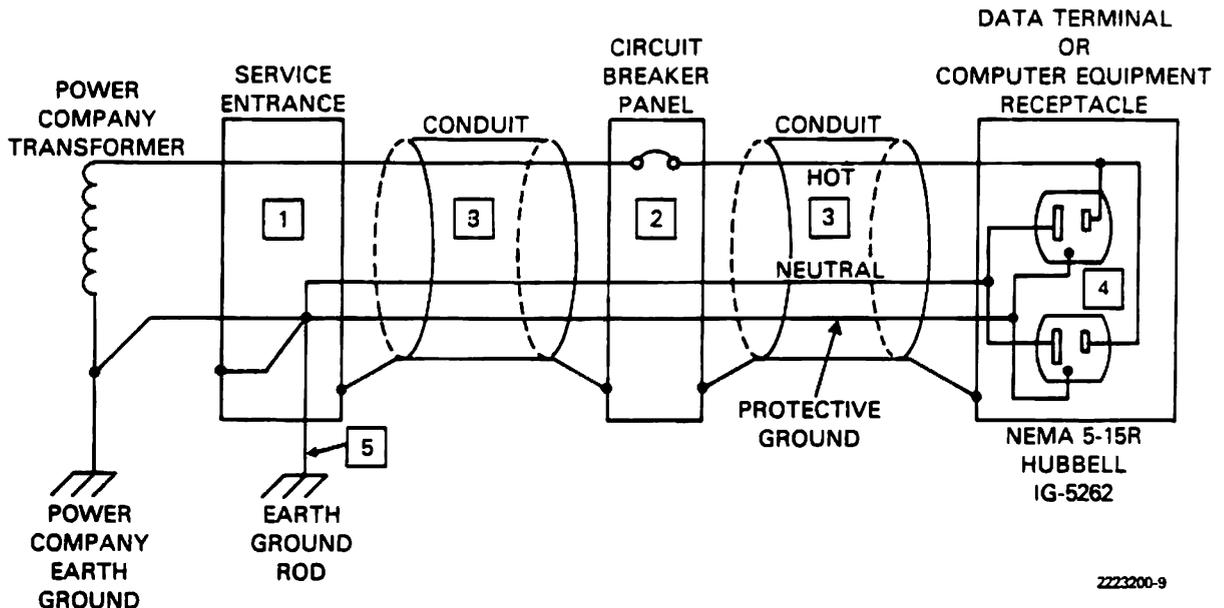
- Carpeting without antistatic properties or treatment
- Extremely low humidity
- Plastic or vinyl upholstery

Areas subject to lightning storms may require the installation of a lightning protector, particularly if the building is serviced by aerial power lines, or the power utility has installed lightning protectors on the primary power source.

### 2.2.3 Earth Ground

The ac power receptacle must be checked to make certain that it supplies the proper voltage and is properly grounded. In some installations, the earth ground of the power receptacle is supplied by a metal conduit that connects to the neutral phase at the circuit-breaker box. Depending on site conditions, this metal conduit may conduct current from other sources that can interfere

with the operation of a computer or printer plugged into the socket. To avoid this possibility, the earth ground and neutral should be isolated from the conduit (except at the circuit-breaker housing) for the computer system ac circuit (and any serial printers connected), as shown in Figure 2-1. This ensures that the protective ground carries only fault and leakage currents from the computer and printer.



#### Notes:

1. Neutral and protective ground are connected together at a single point at the service entrance.
2. Neutral and protective ground are isolated from each other where connected at the service entrance.
3. Neutral and protective ground are isolated from the conduit except where connected at the service entrance. This is accomplished with a HUBBLE IG-5262 receptacle wired in accordance with the National Electrical Manufacturers Association specification NEMA 5-15R.
4. The protective ground wire should have a resistance of less than 1 ohm.
5. Earth ground should have a resistance of 1 ohm or less.

Figure 2-1. AC Power Distribution and Grounding

### 2.2.4 Grounding Rule for EIA RS-232-C Interface

In a system using the optional synchronous-asynchronous communication board with a serial printer (such as the Texas Instruments Model 810), protective ground is electrically connected to the computer chassis (chassis ground). Chassis ground is in turn connected to earth ground via the ac power cord. Signal ground is the common reference potential for all the interface circuits except protective ground. Signal ground and protective ground should be connected on the system unit by a jumper between E19 and E20. This

connection should be made at only one point in a directly connected system to avoid forming a "ground loop." A ground loop allows unpredictable current flow in the equipment.

The printing of extraneous characters, parity errors, missing characters, and even component damage can be symptoms of multiple, common, system grounds. If these problems appear, the signal ground and protective ground situation should be investigated and the configuration should be corrected.

In general, the protective ground to signal ground connection should be made in the equipment with the largest ac power (current) requirement. When the printer is connected directly to a Texas Instruments Professional Computer through the serial printer port, the single grounding point is made at the computer (a factory-installed jumper is installed between E19 and E20 on the system unit board). Many Texas Instruments printers are assembled with the protective ground and signal grounds joined by a jumper, or by a wire and capacitor combination. Refer to the manual for the particular printer used to determine grounding configuration, and ensure that jumpers on external printers or other devices are removed.

In cases where equipment manuals are not available, the device grounding status may be determined by using an ohmmeter to measure between pins 1 (chassis ground) and 7 (signal ground) of the printer or device. A shorted reading on the meter indicates that signal ground is tied to chassis ground. An open reading on the ohmmeter (or very high resistance reading) means that signal ground is NOT tied to chassis ground.

### 2.3 UNPACKING AND SETUP

Four shipping cartons contain the basic Texas Instruments Professional Computer system.

- System unit carton
- Keyboard carton
- Display unit carton
- Manuals and diskettes carton

Perform the following steps to remove the Texas Instruments Professional Computer from its shipping cartons.

1. Examine the cartons for signs of damage. If any damage is indicated, note its nature and follow the local procedure for handling damaged shipments.
2. Open all cartons from the top. Pull out the fitted foam packs and set them aside. Carefully remove the equipment and set it on a table or work surface. Retain the

shipping cartons and foam packs for future moves or returns for service.

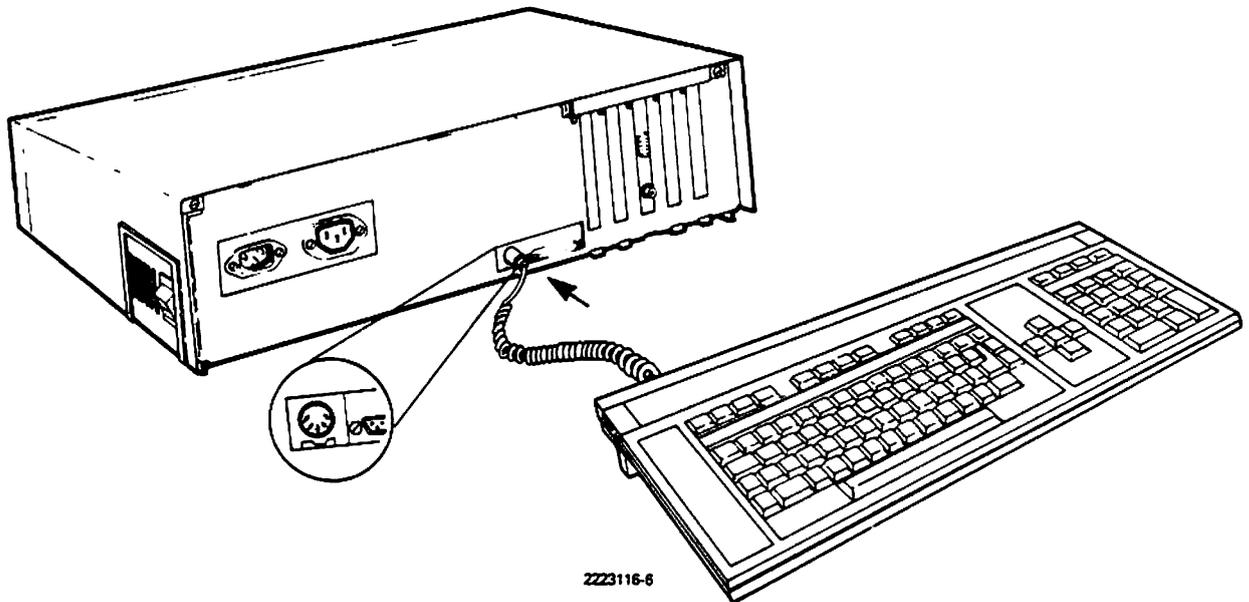
3. Inspect the system unit, keyboard unit, display unit, and documentation. Check for incomplete assembly and hidden damage. Hidden damage is damage to a unit discovered after unpacking, usually when there is no apparent damage to the shipping carton. Follow the local procedures for reporting and filing claims with the transportation carrier.
4. Store the cartons with all packing material in a clean, dry storage area. They should be retained for shipping returned equipment under the product warranty.

### 2.4 CABLE CONNECTIONS

1. Place the system unit on a working surface, preferably the table or workstation where it will be used. Place the system unit ON/OFF switch in the OFF position.
2. Place the display unit on top of the system unit. Insert the free (male) end of the power cable from the display unit into the left-hand (female) receptacle on the back panel of the system unit.
3. Install the display unit signal cable. The monochrome display has a cable with an audio-type pin plug on each end. One end connects to the CRT controller board on the system unit, the other end connects to the back of the monochrome display. The color display unit has a cable with a 9-pin D-type connector on one end and an 8-pin connector on the other end. The 9-pin D-type connector end connects to the CRT controller board on the system unit, the other end connects to the back of the color display unit.
4. Pull out the ON-OFF/BRIGHTNESS control on the front panel of the display unit. The display unit will only come on when the system unit ON/OFF switch is in the ON position.

5. Place the keyboard unit in front of the system unit or in a convenient location where it will be used. Route the telephone-type coiled cord on the left side of

the system unit and to the rear of the system unit. Plug the 5-pin DIN connector to the back panel as shown in Figure 2-2.



**Figure 2-2. Connecting the Keyboard**

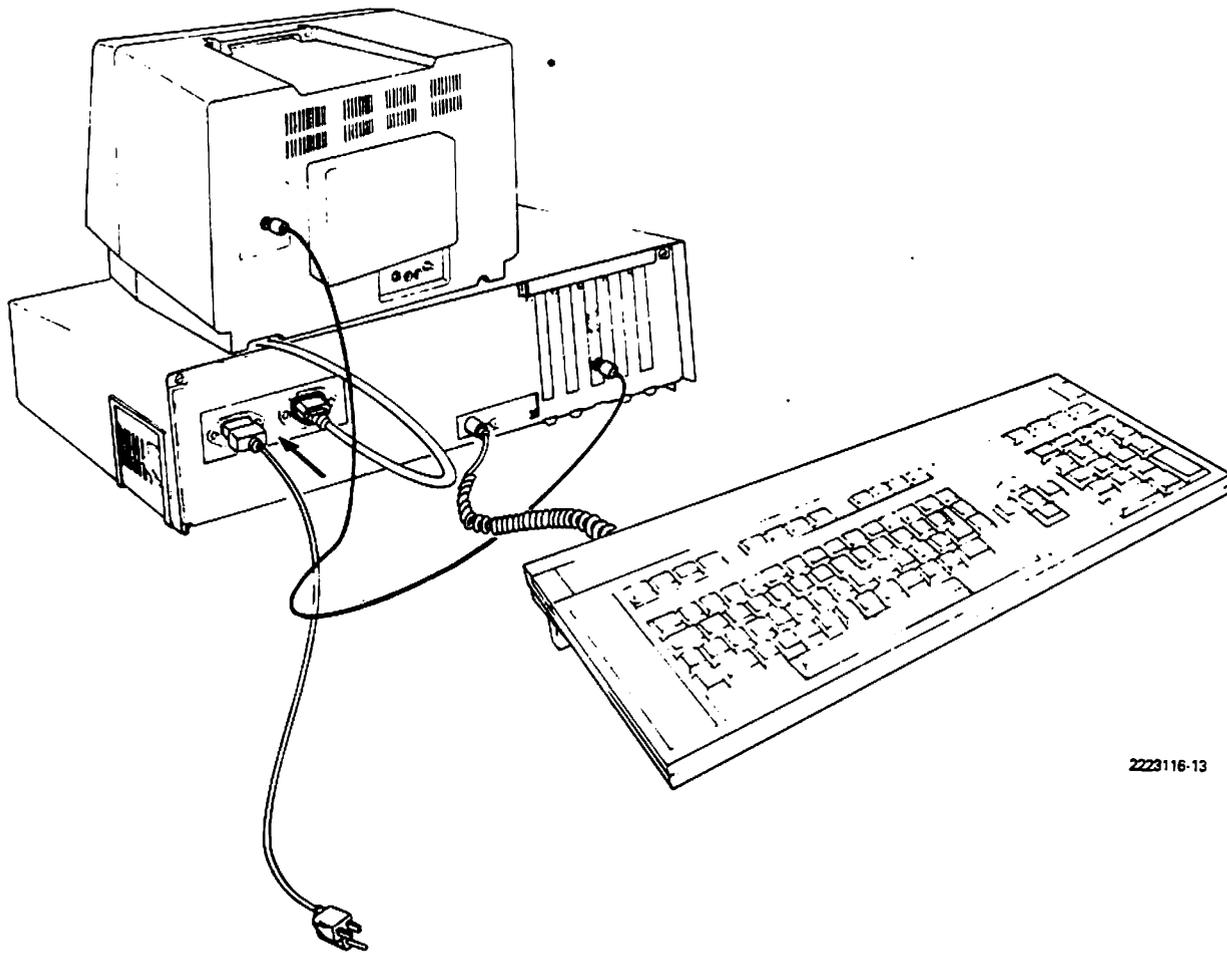
6. Locate the interconnecting cable packed with the display unit. If a monochrome display unit is used, a 1.0-m (3.28-ft) coaxial cable with a pin-type connector on each end is furnished. If a color display is used, a 1.0-m (3.28-ft) cable is furnished with a 9-pin D-type connector on one end and an 8-pin rectangular connector on the other end. Plug the cable into the matching connector located on the back of the system unit and the other end of the cable into the back of the display unit, as shown in Figure 2-3.
7. Locate the 6-foot power cord for the system unit. Plug the female end of the cord into the rear of the system unit. If an extension cord is required, ensure that it is a three-wire type with the proper current rating.

8. Before you insert the power cord plug into a wall receptacle, make certain that the system unit ON/OFF switch is in the OFF position.

#### **WARNING**

**Do not attempt to use a receptacle that does not accommodate a three conductor plug. See Figure 2-4. Do not cut the grounding prong off of the plug. Any attempt to operate the computer without an adequate ground may result in dangerous electrical shock to you, as well as damage to the computer and data.**

9. Insert the ac power plug into a grounded ac wall outlet of the proper voltage and load capacity.



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**Figure 2-3. Connecting the Cables**

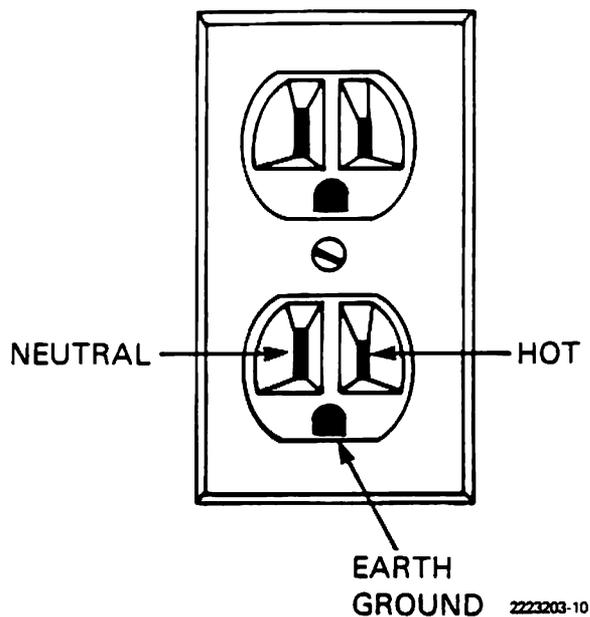
## 2.5 SELF-TEST DIAGNOSTICS

Every time the computer is powered up, it executes a self-test procedure that runs automatically and tests the functional elements of the system. When an error is detected during the test, the failing element is indicated by an error message on the first line of the display, as well as through three light-emitting diodes (LEDs) located on the left side of the system unit chassis. In the event of a failure which prevents the display unit from displaying anything, or in the event the display unit is not connected to the system unit, the LEDs identify the suspect assembly. This feature greatly simplifies bench checkout, particularly if a display unit is not readily available for the system unit.

If an error message is encountered during the power-up self-test, refer to Section 4, "Fault Identification." After the defective field-replaceable assembly is identified, replace it using the removal and replacement procedures outlined in Section 5.

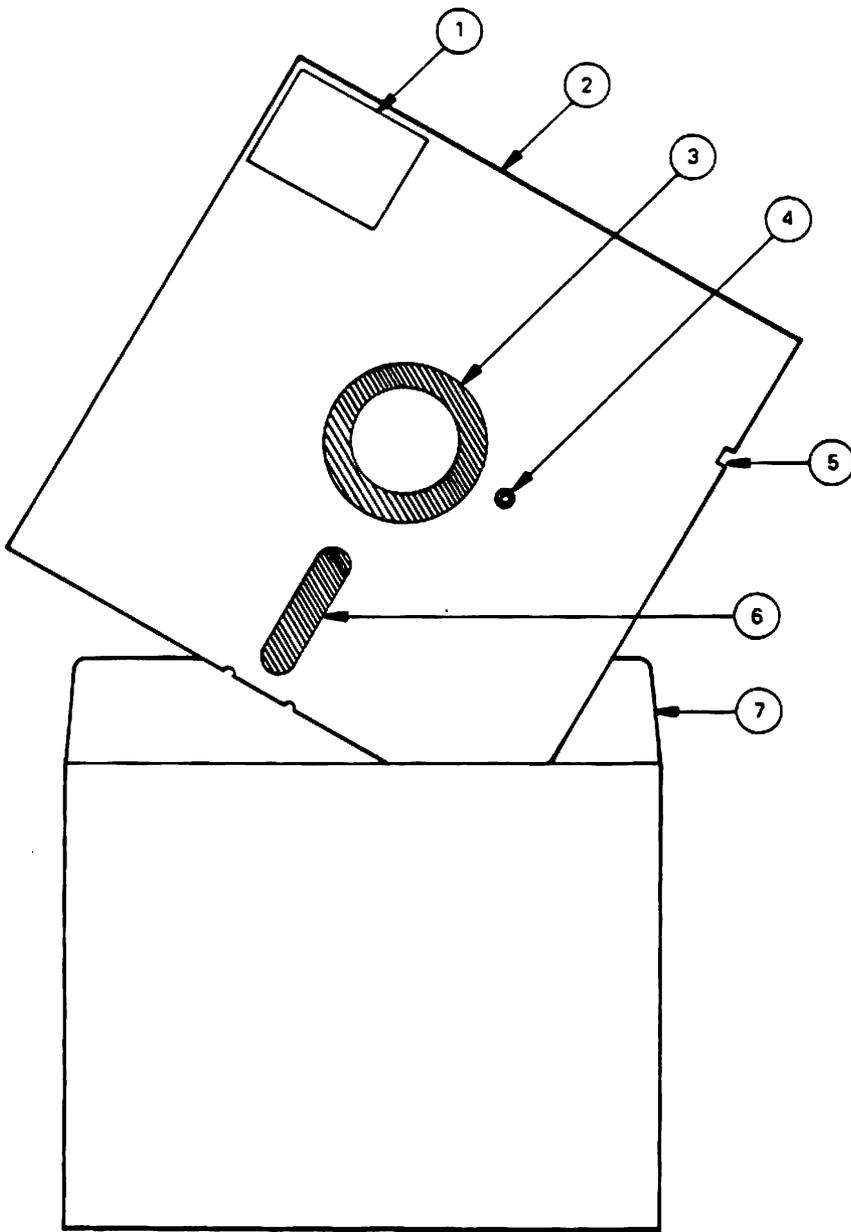
## 2.6 HANDLING STORAGE MEDIA

Figure 2-5 shows the various elements of the diskette used with the Texas Instruments Professional Computer. An understanding of diskettes is important. If you attempt to operate the computer without some background information, you could damage a diskette.



**Figure 2-4. Grounded ac Outlet**

1. **Label.** The manufacturer's label identifies the top and front of the diskette, and is used to select the correct orientation for inserting the diskette in the drive. The recording surface of a single-sided diskette, surface zero, is the bottom surface of the rotating diskette (the side OPPOSITE the label). On a double-sided, dual-density diskette, the lower surface is side zero (to be consistent with the single-sided diskette), and the upper surface is side one.
2. **Diskette Jacket.** The diskette is encased in a permanently sealed, protective jacket which is lined with special material for lubrication and cleaning of the diskette surface. Never attempt to open the jacket for any reason.
3. **Spindle Mounting Hole.** This large central cutout allows the drive spindle cone to align and clamp the diskette to the spindle for rotation.
4. **Index/Sector Hole.** A round cutout in the diskette jacket allows an optical transducer in the drive to generate a pulse when a smaller hole in the diskette rotates past the cutout. This index pulse occurs once per revolution. It is used to verify that the diskette is rotating, and it serves as a reference for formatting soft sectors on the diskette.



2223200-1

**Legend:**

- 1 Label
- 2 Diskette jacket
- 3 Spindle mounting hole
- 4 Index/sector hole
- 5 Write-protect notch
- 6 Head access slot
- 7 Storage envelope

**Figure 2-5. A Diskette**

5. **Write-Protect Notch.** With this notch open, as shown, data may be written to, or recorded on, the diskette. Leave this notch open if you wish to change information on the diskette. Cover this notch with a self-adhesive write-protect label (supplied with each pack of diskettes) if you wish to **WRITE PROTECT** the disk-

ette and prevent any changes to its contents.

6. **Head Access Slot.** This long opening allows the read/write head to access all of the tracks. Do not touch the diskette surface which is accessible through this slot, or any of the other exposed areas of the diskette.

7. **Storage Envelope.** Diskettes that are not in use should always be returned to their storage envelopes.

For maximum reliability of the computer, we recommend that only double-sided, dual-density diskettes be used. The diskettes used with the Texas Instruments Professional Computer store digital information in a thin layer of ferric oxide deposited on the diskette media surface. Data is recorded in concentric, circular tracks on one or both sides of the diskette surface — much like a phonograph record. The read/write heads are positioned near the spinning diskette and actually touch the diskette surface when data is being recorded or read.

Each operation subjects the diskette to a minute amount of wear, and after extended usage, or use in a dusty or dirty environment, the worn tracks can be seen on the diskette surface. Maintenance is largely a matter of common sense. Contaminants, mechanical damage, and exposure to strong magnetic fields are the three primary concerns. Diskettes should be kept away from dirt or moisture. The surface of the diskette visible through the carrier jacket should not be touched.

Diskettes require careful handling. The slightest bit of dust or oil between the recording head and the diskette surface can cause improper contact. This can prevent data from being read from, or written to, the diskette. The following rules for diskette care are standard throughout the industry and should be followed for more reliable operation and longer diskette life.

- Keep the diskette in its envelope when not actually in the drive mechanism. Store the diskette upright, protected from foreign objects, bending, and excess heat.
- Do not touch the head access slot or permit it to come in contact with desk tops, pencils, or other objects. Do not lay a diskette down on a piece of paper or an open book. Paper dust is abrasive. If you smoke, try to avoid blowing smoke on the diskette.
- Keep diskettes away from strong magnetic fields, such as those found in television sets, loudspeakers, transformers, and large electric motors. It is best not to

lay diskettes on top of the display unit or against a telephone.

- Do not bend, fold, or wrinkle the vinyl jacket. Do not use paper clips or staples on any part of the diskette.
- **Never** write on a diskette label with a pencil, ball-point pen, or other hard-pointed instrument. If you must write on the label, use a soft felt-tipped pen. Whenever possible, write on the labels before applying them to the jacket.
- Avoid placing the diskette near any source of heat. Do not leave diskettes in parked cars on warm days. The sun may cause their vinyl jackets to warp so severely they will no longer fit into the drive slot. Keep all diskettes stored at 10°C (50°F) to 52°C (125°F), and 8 to 80 percent relative humidity. Diskettes taken from storage locations with a temperature difference of more than 6.7°C (20°F) from the temperature at which they will be operated should be allowed to stabilize for at least one hour prior to use. Those diskettes required for immediate use should be stored for one hour in the operating environment of the computer.

## 2.7 BACKUP DISKETTES

Part or all of the information on a diskette may be lost when the diskette is mishandled, wears out, or a power outage occurs while it is in the drive. To avoid problems, always have at least one backup copy of all important diskettes. A systematic backup procedure may be a minor inconvenience, but the loss of the only copy of an important data file can be a major disaster.

Whenever files are manipulated on a daily basis, and data is entered or changed, backup diskettes must be made the same day the changes are entered. If a backup diskette is not available and data is destroyed, it might be extremely difficult, if not impossible, to reconstruct data files containing business records or programs. Even a relatively minor loss of data which requires time-consuming reentry will illustrate the need for backing up data files and program diskettes.

The procedure for making a backup of a diskette is described in detail in Appendix D. Also included are instructions in various operating system (MS-DOS) and printer commands.

## 2.8 OPTION INSTALLATION CHECKOUT

Options in a Texas Instruments Professional Computer may have been installed by any one of the following.

- Texas Instruments factory
- Texas Instruments Authorized Dealer
- Field service engineer
- Customer

If a unit fails to operate properly, and the power-up self-test or the diskette diagnostics point to an option as a source of the fault, first check to see that the option has been properly installed. In the event any option boards manufactured by sources other than Texas Instruments are found installed, they should be removed until the cause of the failure is determined, and necessary repairs are made.

Appendix C provides installation, removal, and checkout information on all options manufactured by Texas Instruments. Use these instructions as guides in the checkout of the options. An improperly installed option may cause the option to fail, or, worse yet, may cause a failure on the board in the system unit, or to the power supply, or both.

### NOTE

To prevent unnecessary equipment failure and damage, all options should be both installed and serviced by Texas Instruments Authorized Dealers or service personnel.

### 2.8.1 Monochrome Display Alignment

The alignment and adjustment of the monochrome display unit was set to precise factory specifications prior to shipment and should rarely

require field alignment, unless the display is distorted or out of focus. Prior to any alignment, allow at least five minutes warmup before adjusting.

**2.8.1.1 Tool Requirements.** The following tools are required for proper alignment.

- Medium-tipped Phillips screwdriver
- Small-size, flat-bladed screwdriver for adjustment of potentiometers
- Medium-size, flat-bladed screwdriver
- Hexagonal plastic alignment tool

### WARNING

**Hazardous voltages exist inside the monochrome display unit. Adjustments should only be accomplished by qualified personnel.**

### 2.8.1.2 Preliminary Steps

1. Place the system unit ON/OFF switch in the OFF position. Remove the display unit power cord from the back of the system unit.
2. Remove the display unit signal cable from the back of the display unit. Set the monochrome display to the side and make certain you have adequate room to turn the display around with the display connected to the system unit.
3. Remove the back of the cabinet, using a Phillips screwdriver. Six screws must be removed. Two short self-threading screws secure the bottom, two long self-threading screws secure the top (on each side of the built-in handle), and two plated screws secure the rectangular video input jack to the back of the case. All six screws must be removed before the back can be removed.

4. Remove the back of the cabinet and set it to the side, out of the way. Reconnect the monochrome display unit power cord to the back of the system unit.
5. Reconnect the signal cable to the display unit.
6. Insert a diagnostics diskette into the left drive and place the system unit ON/OFF switch in the ON position. After a self-test, the diagnostics menu is displayed.
7. Press the **CTRL** and **A** keys at the same time to enter the Advanced Diagnostics menu.
8. Press the **RETURN** key to select the Keyboard Entry of diagnostics.

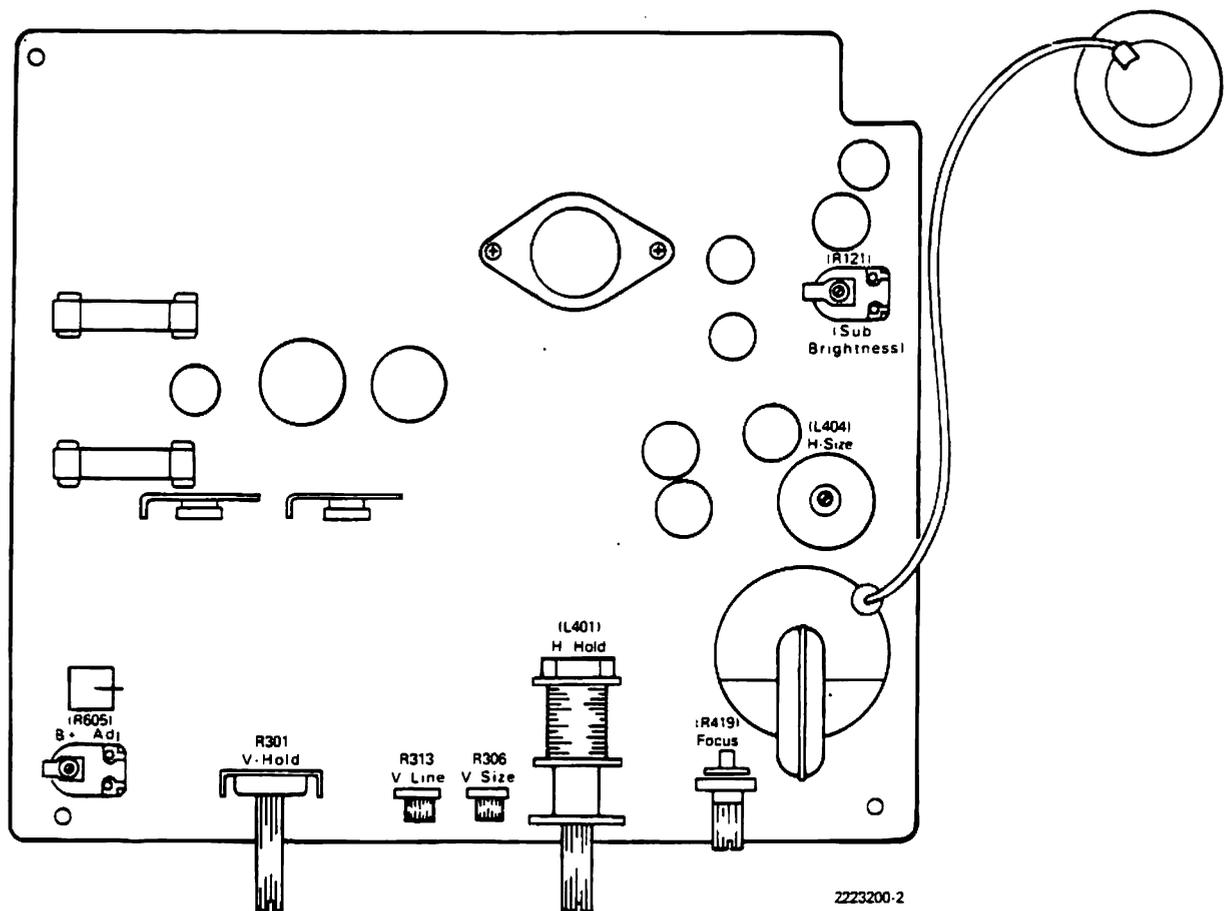
9. Type:

**CRTTST TEST = ALIGN**

and press the **RETURN** key. The alignment pattern is a rectangle with horizontal and vertical lines intersecting in the middle. The rectangle shows the outline of the displayed area. The crossed lines provide a pattern for determining if the display is properly adjusted for image centering, linearity, and focus.

### 2.8.1.3 Brightness/Contrast Adjustment.

1. Adjust the **BRIGHTNESS** and **CONTRAST** controls on the front panel to the midpoint of rotation.
2. Study Figure 2-6 to familiarize yourself with the control locations.



**Figure 2-6. Control Locations – Monochrome**

#### 2.8.1.4 Alignment Procedure.

1. Using a flat-bladed screwdriver, adjust control R121 (SUB-BRIGHTNESS) until brightness increases to the point that the raster scan lines start to appear. See Figure 2-6 for the control locations.
2. Using a plastic alignment tool, adjust the HORIZONTAL SIZE coil (L404) until the width of the rectangle displayed is 210.82 mm (8.3 in). Use a ruler to verify the size is correct.
3. Using a small flat-bladed screwdriver, adjust the FOCUS control (R419) until you obtain the best overall picture focus. The sharpest focus point for the center of the display may not be the sharpest point for viewing the corners. Adjust for the best overall viewing. It is usually a compromise adjustment.
4. Place the system unit ON/OFF switch in the OFF position. Remove the display unit power cord from the back of the system unit.
5. Replace the cabinet back. Two long self-threading screws secure the top, two short self-threading screws secure the bottom, and two plated screws secure the video connector jack panel.
6. With the alignment pattern displayed, adjust the rear controls as follows.
  - Adjust the HORIZONTAL HOLD control (L401) with a flat-bladed screwdriver until the picture is stabilized, and the image is positioned in the center of the raster area. The front panel BRIGHTNESS and CONTRAST controls must be turned clockwise in order to see the scan lines of the raster which are outside the image area. The alignment pattern must be centered in the raster area with right and left raster edges an equal distance from the image.
  - Adjust the VERTICAL HOLD control (R301) with the alignment pattern displayed to the right point of a stable image display, then with the alignment pattern displayed to the left point of a stable image display. Now position the control midway between these points of travel. Push in (OFF) the ON/OFF switch on the display unit, then pull it out (ON). Observe the display. There should be no vertical roll on the display when you power up the unit. Readjust until there is no vertical roll at power-up.
  - Adjust the VERTICAL SIZE control (R306) with a flat-bladed screwdriver until the height of the alignment pattern is 157.48 mm (6.2 in). Use a ruler to verify the correct image size.
  - Adjust the VERTICAL LINEARITY control (R313) until the extreme top and bottom characters are equal in height to the center characters. It may be necessary to readjust the VERTICAL SIZE control after this adjustment.

#### 2.8.2 Color Display Alignment

The red-green-blue (RGB) color display unit has been factory adjusted to extremely close tolerances to ensure the convergence, color purity, and raster alignment. Due to the complexity of the purity and convergence alignment, and the specialized equipment required, Texas Instruments recommends that this alignment be performed by experienced personnel. The information on purity and convergence provided within the following paragraphs is for reference only.

The only field alignment recommended is the following.

- White balance alignment
- Horizontal hold alignment

- Vertical hold alignment
- Vertical linearity alignment
- Vertical size alignment
- Vertical position alignment
- Horizontal width alignment

**2.8.2.1 Tool Requirements.** The following tools are required for proper alignment.

- An oscilloscope is necessary, with 100:1 probe, if screen grid adjustments are made.
- A digital volt-ohm-milliammeter with an input impedance of at least 5 megohms is necessary if making voltage measurements or adjustments.
- A character display generator or specialized RGB signal generator.
- Medium-tipped Phillips screwdriver (for removing the case back)
- Small-size, flat-bladed screwdriver with insulated handle
- Medium-size, flat-bladed screwdriver with insulated handle
- Hexagonal plastic alignment tool

**WARNING**

**Hazardous voltages exist inside the color display unit. Adjustment should only be performed by qualified personnel.**

**2.8.2.2 Preliminary Steps.**

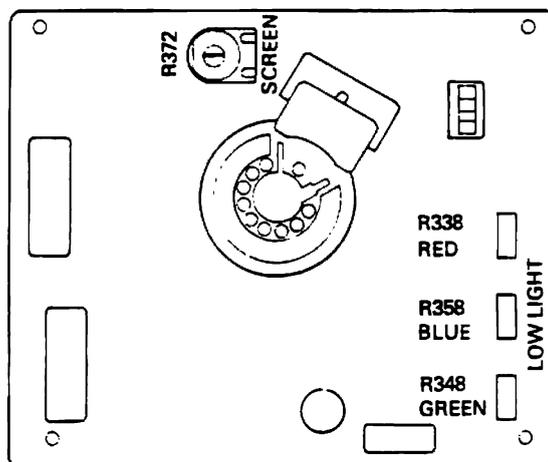
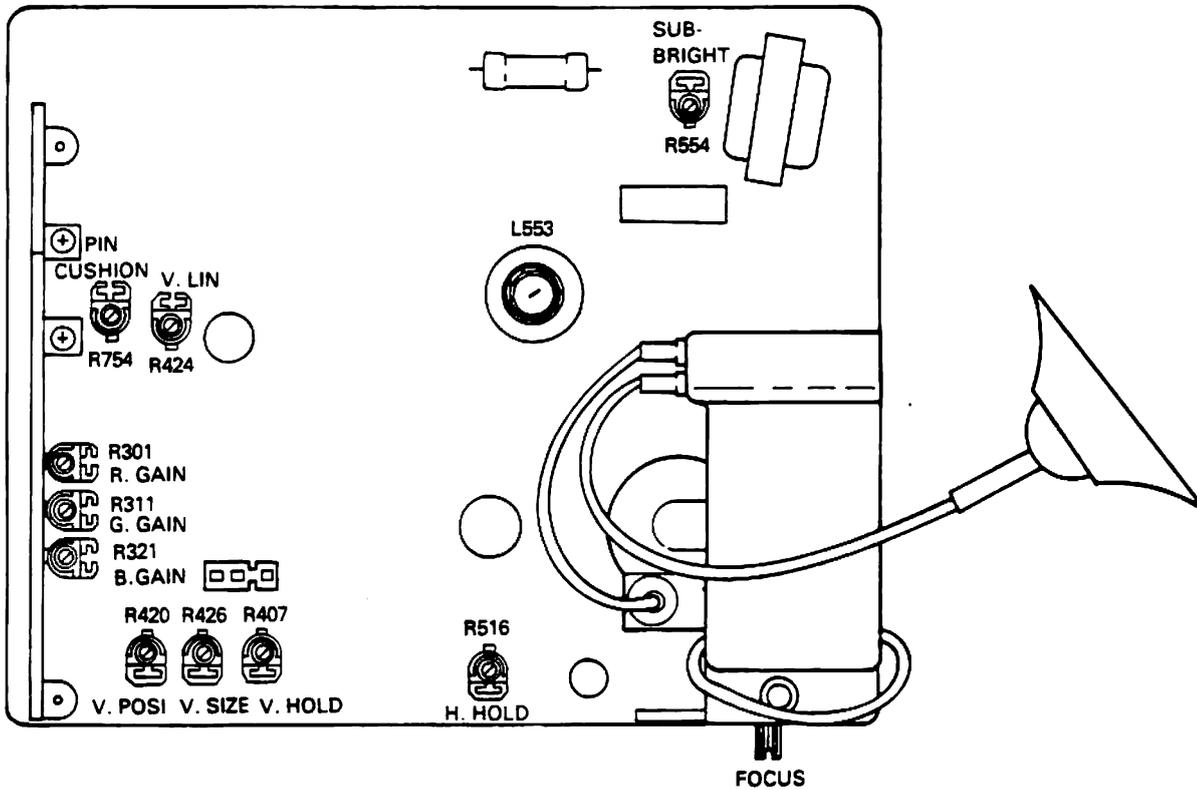
1. Place the system unit ON/OFF switch in the OFF position. Remove the display unit power cord from the back of the system unit.

2. Remove the display unit signal cable from the back of the display unit. Set the color display to the side and make certain you have adequate room to turn the display around to access controls on the logic board with the display connected to the system unit.
3. Remove the back of the cabinet, using a Phillips screwdriver. Five screws must be removed. Two self-threading screws secure the bottom, two plated self-threading screws secure the cabinet sides (on the left and right side of the cabinet), and one plated screw secures the rectangular video input jack to the back of the case. All five screws must be removed before the back can be removed.
4. Remove the back of the cabinet and set it to the side, out of the way. Reconnect the monochrome display unit power cord to the back of the system unit.
5. Reconnect the signal unit to both the display unit and the system unit.
6. Insert a diagnostics diskette into the left drive and place the system unit ON/OFF switch in the ON position. After a self-test, the diagnostics menu is displayed.
7. Press the **CTRL** and **A** keys at the same time to enter the Advanced Diagnostics menu.
8. Press the **RETURN** key to select the Keyboard Entry of diagnostics.
9. Type:

**CRTTST TEST = ALIGN**  
and press the **RETURN** key. The alignment pattern is a rectangle with horizontal and vertical lines intersecting in the middle. The rectangle shows the outline of the displayed area. The crossed lines provide a pattern for determining if the display is properly adjusted for image centering, linearity, and focus. This display image is the only image necessary for all of the adjustments in the following procedure.

**2.8.2.3 Alignment Procedure.**

1. Adjust the front panel BRIGHTNESS control to the midpoint of rotation.
2. Study Figure 2-7 to familiarize yourself with the control locations.



2223200-3

**Figure 2-7. Control Locations – Color**

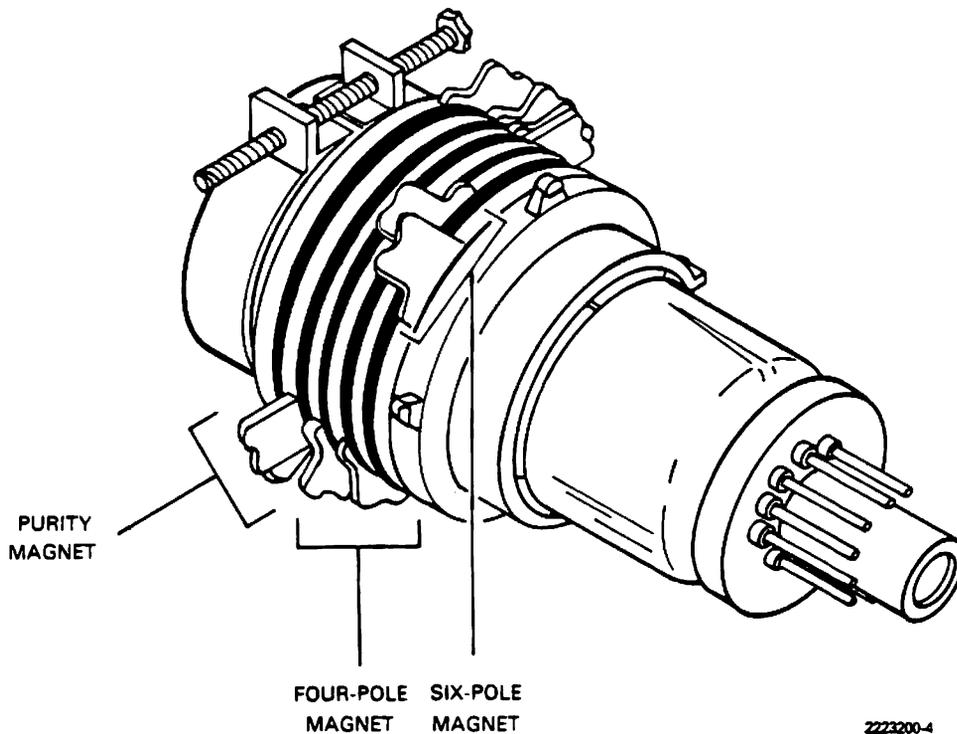
3. Using a flat-bladed screwdriver, adjust the SUB-BRIGHTNESS control (R554) until brightness increases to the point that the raster scan lines start to appear.
  4. Using a plastic alignment tool, or a small flat-bladed screwdriver (depending upon the type of coil installed), adjust the HORIZONTAL WIDTH control (L553) until the width of the rectangle displayed is 240 mm (9.4 in)  $\pm$  2 mm (0.78 in). Use a ruler to verify the size is correct.
  5. Using a small flat-bladed screwdriver, adjust the FOCUS control (located on the right rear corner of the logic board) until you obtain the best overall picture focus. The sharpest focus point for the center of the display may not be the sharpest point for viewing the corners. Adjust for the best overall viewing. It usually is a compromise adjustment.
  6. The white balance is adjusted as follows.
    - Adjust the respective red, green, and blue video gain controls so that the display image is white. They are controls R301, R311, and R321.
    - Next, adjust the front panel BRIGHTNESS control from maximum to minimum brightness, and watch the display for any change in color balance.
    - If low-light adjustment is necessary, the three controls are located on a small square printed wiring board fastened to the CRT socket. The controls are on the right side of the board (as viewed from the rear). Adjust the red, green, or blue control (R338, R348, and R358, respectively) which corresponds to the color which appears when the BRIGHTNESS control is rotated throughout its travel limits.
    - Adjust the front panel BRIGHTNESS control throughout its travel limits to ensure there is no change in the displayed white image.
  7. Adjust the HORIZONTAL HOLD control (R516) with a flat-bladed screwdriver until the picture is stabilized, and the image is positioned in the center of the raster area. The front panel BRIGHTNESS and CONTRAST controls must be turned clockwise in order to see the scan lines of the raster which are outside the image area. The alignment pattern must be centered in the raster area with right and left raster edges an equal distance from the image.
  8. Adjust the VERTICAL HOLD control (R407) with the alignment pattern displayed to the right point of a stable image display, then with the alignment pattern displayed to the left point of a stable image display. Now position the control midway between these points of travel. Turn the unit OFF, then turn it ON again. Observe the display. There should be no vertical roll on the display when you power up the unit. Readjust until there is no vertical roll at power-up.
  9. Adjust the VERTICAL SIZE control (R426) with a flat-bladed screwdriver until the height of the alignment pattern is 180 mm (7 in)  $\pm$  2 mm (0.8 in). Use a ruler to verify the correct image size.
  10. Adjust the VERTICAL LINEARITY control (R424) until the extreme top and bottom characters are equal in height to the center characters. It may be necessary to readjust the VERTICAL SIZE control after this adjustment.
  11. Adjust the VERTICAL POSITION (R420) until the crossed horizontal and vertical lines intersect at the precise center of the display. A simple way of checking this is to position a long ruler from the top left corner of the screen to the bottom right corner of the screen. The ruler edge forms a diagonal line which must intersect the crossing point of the horizontal and vertical image on the display.
- No further adjustment of the color display should be attempted. If the display still has problems, it must be returned for factory repair.

12. Place the system unit ON/OFF switch in the OFF position. Remove the display unit power cord from the back of the system unit.
13. Replace the cabinet back. Two long self-threading screws secure the top, two short self-threading screws secure the bottom, and two plated screws secure the video connector jack panel.

**2.8.2.4 Convergence and Purity Adjustment.** The following information is presented for

reference only. These adjustments require precision test equipment and personnel who are experienced in servicing RGB-type color display units. All adjustments should be made only after the display unit has been allowed to warm up for at least 20 minutes.

For the convergence and purity adjustments, study Figure 2-8 to familiarize yourself with the locations of the convergence and purity magnets.



**Figure 2-8. Convergence and Purity Magnets**

**2.8.2.5 Voltage Adjustments.**

1. Using a digital volt-ohm-milliammeter with an input impedance of at least 5 megohms, measure the power supply input voltage at Test Point (TP)1 on subassembly TNP82840 (the main analog printed wiring board). It must be a minimum of 115 V.
2. Verify the voltage at TP3 on subassembly TNP82840 is  $58\text{ V} \pm 2\text{ V}$ .
3. Verify the voltage at TP4 on subassembly TNP82840 is  $-20\text{ V} \pm 2\text{ V}$ .
4. Verify the voltage at TP5 on subassembly TNP82840 is  $+20\text{ V} \pm 2\text{ V}$ .

5. Verify the voltage at TP6 on subassembly TNP81121 is  $+ 8.5 \text{ V} \pm 0.5 \text{ V}$ .
6. Verify the voltage at pin 7 on CRT socket board is  $+ 6.2 \text{ V} + 0.2 \text{ Vrms}$ .

#### 2.8.2.6 CRT Screen Voltage Adjustment.

1. Adjust the R, G, and B attenuators on the signal generator so that the video signal is just at the cutoff point (no signal on the display).
2. Turn the SUB-BRIGHTNESS control (R554) to the minimum point.
3. Turn the SCREEN control (R372) on the CRT socket board to the minimum point.
4. Turn the following LOW LIGHT controls counterclockwise as far as they will go.
  - R338 Red
  - R358 Green
  - R348 Blue
5. Place the service switch in the "S" position.
6. Adjust the SUB-BRIGHTNESS control (R554) while monitoring the voltage on grid 1 of the CRT (pin 8 on the CRT socket board). Adjust for a reading of  $- 17 \text{ V}$  on grid 1. A 100:1 test probe and an oscilloscope are recommended for this adjustment.
7. Rotate the SCREEN control (R372 on the CRT socket board) while viewing the display. See what color was displayed at the moment the CRT cutoff occurred.
8. Rotate to the maximum (clockwise) the controls for the two colors you DID NOT SEE at the moment of cutoff in the last step.
9. Rotate the SCREEN control just to the point at which the color appears (the color you saw at the moment of cutoff).

10. Rotate the two LOW LIGHT controls (corresponding to the colors you DID NOT SEE at the moment of cutoff) clockwise just to the point that these two colors can be seen at the same degree as the color displayed in the last step.

11. Place the service switch in the "N" position.

12. Adjust the SUB-BRIGHTNESS control (R554) until the raster is just cut off.

13. While monitoring the grid 1 voltage with an oscilloscope, reduce grid 1 voltage in the negative direction by 5 volts. Grid 1 now should read  $- 22 \text{ V}$ .

#### 2.8.2.7 Purity Adjustment. All purity adjustments must be made only after at least a 30 minute warmup.

1. In the absence of an artificial horizontal or vertical magnetic field, erase the magnetism built up in the chassis and CRT with the degaussing coil. Confirm that the static convergence is roughly matched.
2. Adjust the signal generator for a RED signal input only.
3. Loosen the deflection yoke mount and slide the yoke/magnet assembly to the rear until the image is a round circle at the center of the display.
4. Adjust the purity magnets until you obtain a red circle in the center of the display.
5. Slide the deflection yoke/magnet assembly forward so that the red image fills the entire image area of the display.
6. With the display unit on, test the purity and the degaussing circuit by picking up the color display unit and rotating it 360 degrees. While rotating the display unit, watch for changes of convergence on the display caused by the terrestrial magnetic field. Confirm that the degaussing circuit can erase the magnetism buildup developed by the rotation.

7. Check the purity of the display with a video signal alternately applied to RED, BLUE, and GREEN. If necessary, repeat this step until the optimum display is obtained.

#### 2.8.2.8 Convergence Adjustment.

1. Adjust the signal generator for a mixed red-blue dot pattern.
2. Match the red and blue dots at the center of the display with the four-pole magnets. Rotate the two ring magnets to match up the red and blue dots.
3. Adjust the signal generator for a mixed red-blue-green dot pattern.
4. Match the red, blue, and green dots in the center of the display with the six-pole magnets.
5. If the overall pattern does not match, use individual magnets around the yoke if necessary to "fine tune" the convergence. If you add magnets, keep in mind the following precautions.
  - Place them at least 20 mm (0.78 in) from the anode cap.
  - Do not stack them.
  - Do not place them on top of labels.
6. After adjusting the convergence, recheck the purity. Readjust the purity magnets if necessary.
7. Repeat the above procedure several times if necessary to obtain the optimum purity and convergence.

#### 2.8.3 Diskette Drive Motor Speed Adjustment

The diskette diagnostics provides excellent tests for diskette drives. Most of the diskette drive tests will display the four-digit error code 0604, together with the statement "Motor speed incorrect" on detection of a diskette drive which is adjusted to be too fast or too slow. The computer measures the diskette drive capstan speed by

sensing the index/sector photocell pulses (which are interrupted once each rotation of the diskette) and displays an error message if the speed is out of tolerance.

**2.8.3.1 Tool Requirements.** The following tools are required for adjusting the motor speed control.

- A medium-size, flat-bladed screwdriver for removing the system unit cover.
- A small-size, flat-bladed screwdriver for adjusting the motor speed potentiometer.

#### 2.8.3.2 Preliminary Steps.

1. Be sure there is sufficient working space available. You will be turning the system unit to gain access to the back panel, and you will need space beside the system unit (with the cover removed) to place the display unit in order to observe the test program.
2. Place the system unit ON/OFF switch in the OFF position.
3. Remove the display unit from the top of the system unit and set it to the side.
4. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner using a flat-bladed screwdriver.
5. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit. Set the cover aside, out of the way.

#### CAUTION

With the system unit cover open and power applied, the system unit board and diskette drive logic boards are exposed. Make certain that no tools, test probes, or other metallic items come in contact with any exposed components. Damage to the unit may result.

6. Place a diagnostics diskette in the left diskette drive. Close the drive door.
7. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the user diagnostics menu is displayed.
8. Enter the advanced diagnostics menu by pressing the CTRL and A keys at the same time. The advanced diagnostics menu is displayed.
9. Select the Keyboard entry of diagnostics by pressing the RETURN key. You will see displayed the single word "Command:" and a line, with the cursor at the head of the line.
10. Type:  
  
FLOTST TES = ALI DRIVE = (enter a 1,2,3 or 4)  
  
and press the RETURN key. The test displays a menu of commands and status information as shown in Figure 2-9.
11. Make certain a scratch diskette is inserted into the diskette drive being tested. Press the O key, and then the I key, pausing after pressing each key to see if there is a change in motor speed.
12. Leave the controls as they are for five minutes to permit the diskette drive to stabilize under operating conditions.
13. If the diskette drive is out of tolerance, use a small flat-bladed screwdriver to adjust the motor speed potentiometer. The specification is 300 rpm  $\pm$  1%, or 297 to 303 rpm. The "\*" indicates the moving indicator. To increase the motor speed, turn the motor speed control potentiometer (pot) clockwise. To decrease the motor speed, turn the control counter-clockwise.
14. Open the diskette drive door and remove the diskette. Insert another diskette to check for variations in motor speed between diskettes.

This concludes the motor speed control adjustment procedure.

```

Diskette Drive Alignment Test

Enter one of the following command characters:

O      - Seek Outermost Track (Track 00)
I      - Seek Innermost Track (Track 39)
nn     - Seek Track number nn
S      - Switch heads.
W      - Write pattern on current track (destroys data)
P      - Turn Write Precompt ON
R      - Read Data
<esc> - Exit from test

                                     Motor Speed (RPM)
Drive  Track  Side  Mode          279  286  293  300  308  315  324
  1     16    0    READ          :.....[:.....:].....:
                                     *
```

Figure 2-9. Diskette Drive Alignment Menu

# Section 3

## System Descriptions

---

### 3.1 INTRODUCTION

This section describes the components of the Texas Instruments Professional Computer. The computer system consists of three basic units.

- System unit
- Keyboard
- Display unit

The system unit board contains the central processor unit (CPU), socket for an optional numeric coprocessor, floppy disk controller (FDC), parallel-printer port, keyboard interface, 64 kbytes of on-board dynamic RAM, expansion RAM interface, system ROM, socket for additional 8 kbytes of ROM, expansion interface bus, fault-indicator LEDs, system timers, and connectors for the power supply and speaker.

### 3.2 SYSTEM UNIT BOARD

The system unit board contains the central processor unit (CPU) socket for an optional numeric coprocessor, floppy disk controller (FDC), parallel-printer port, keyboard interface, 64 kbytes of on-board dynamic RAM, expansion RAM interface, system ROM, socket for additional 8 kbytes of ROM, expansion interface bus, fault-indicator LEDs, system timers, and connectors for the power supply and speaker.

#### 3.2.1 Central Processor Unit (CPU) (U1)

The main processor consists of an Intel-designed 16-bit, 8088 central processor. The system CPU contains processor clock circuits, bus buffers, bus latches, and CPU status decoding and control line generation.

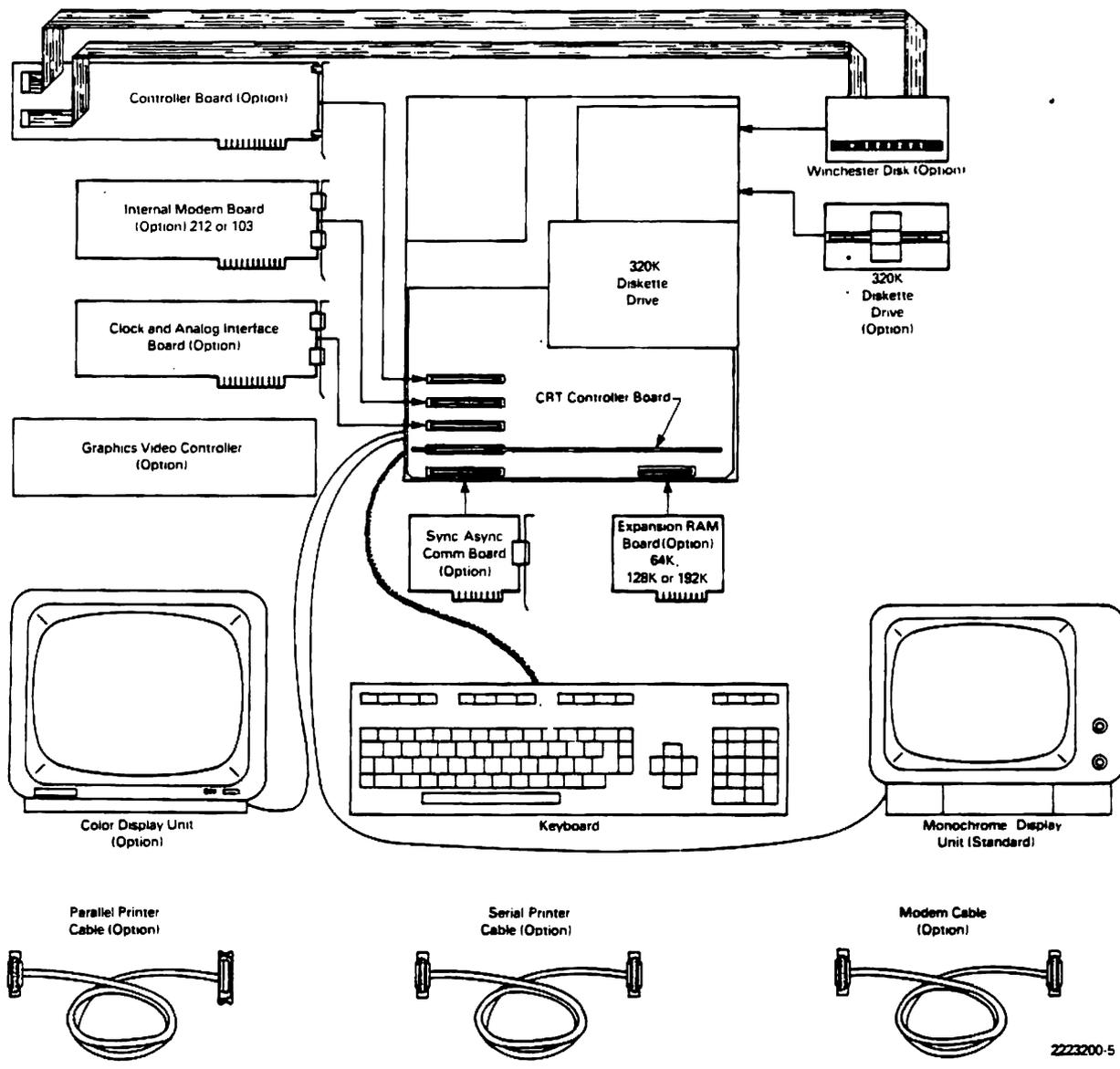
#### 3.2.2 Floppy Disk Controller (FDC) (J9, J13) (U13)

The diskette subsystem is centered on a Western Digital FD1793-02 floppy disk controller integrated circuit (IC). The floppy disk controller logic provides controls for diskette drive selection, seek control, and read and write commands. The FDC can control up to four 5 1/4-inch diskette drives. Two drives are mounted inside the system unit, and connected by a daisy-chain cable to connector J9 on the main board. Two drives are external.

If external drives are used, a control/data ribbon cable is required to provide a 37-pin D-type connector on the back panel of the system unit. The other end of this cable must be plugged into the system unit board at J13. Texas Instruments does not manufacture either the external diskette drives, or the required cable assembly. User-furnished external drives which are compatible with the type installed in the system unit may be connected to this 37-pin connector. Specifications for the diskette drives used in the Texas Instruments Professional Computer are found in the diskette drive option manual included in Appendix C.

When using two or more diskette drives, be certain they are all of the same type and capacity. The absence of a jumper between E1 and E2 on the system unit board means that 160-kbyte capacity drives are selected. A jumper installed between E1 and E2 selects 320-kbyte capacity drives.

Jumper location E3 to E4 is left open on the system unit board. It is reserved for future use.



**Figure 3-1. System Block Diagram**

If the Texas Instruments Professional Computer is to be relocated to a foreign country using 50-Hz power, a jumper must be installed on the system unit board between E5 and E6. This jumper changes the video refresh rate for 50-Hz operation. (The power supply must also be changed by a jumper, and the monochrome display unit must be reconfigured by positioning an internal switch. Although a color monitor cannot be converted for 50-Hz power, an international-version color display unit is available.)

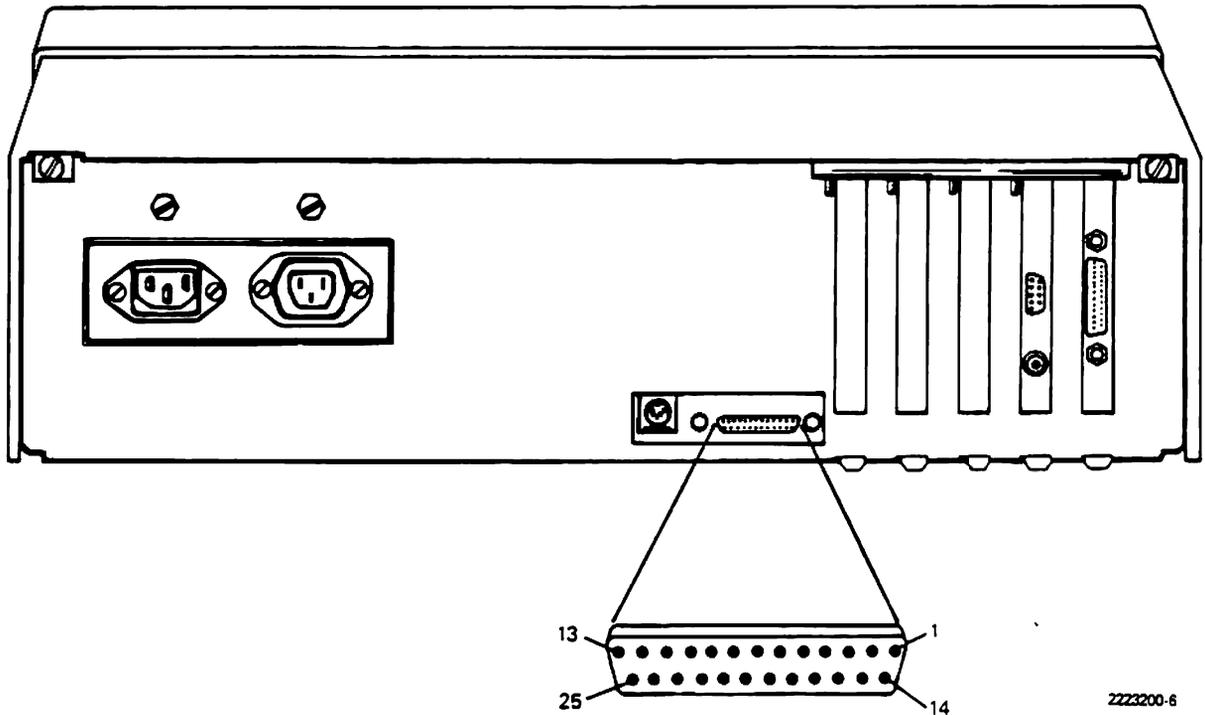
The Texas Instruments Professional Computer is configured with the system ground tied to chassis ground by means of a jumper on the system unit board between E19 and E20. Before using a serial printer, make certain the printer signal ground (sometimes referred to as logic ground) is NOT connected to chassis ground (sometimes referred to as earth ground or protective ground). Refer to paragraph 2.2.4 for more information on grounding of equipment.

2223200-5

### 3.2.3 Parallel-Printer Port (J7)

The system unit printer port is designed for use with parallel-interfaced printers utilizing a Centronics-compatible interface. An optional printer cable is available with a 25-pin D-type connector on one end and a 36-pin D-type connector (of the type used with Centronics-compatible printers) on

the opposite end. The location of the parallel-printer port is shown in Figure 3-2. The parallel port is also used to monitor the power-up self-tests, and provide more detailed information than provided by the three fault-indicator LEDs on the left side of the system unit.



2223200-6

**Figure 3-2. Parallel-Printer Port**

The connector is the familiar 25-pin D-type connector, which is used in most communications

and printer port applications. Table 3-1 lists the pin-out of the parallel-printer port.

**Table 3-1. Parallel-Printer Port Signals**

Signal	Signal Name	Source	Function
1	DATA STROBE –	System	Data to be sampled when signal is LOW.
2	DATA 1	System	Data output bits.
3	DATA 2	System	
4	DATA 3	System	
5	DATA 4	System	
6	DATA 5	System	
7	DATA 6	System	
8	DATA 7	System	
9	DATA 8	System	
10	ACKNOWLEDGE –	Printer	Indicates that another character can be received.
11	BUSY	Printer	Indicates no data can be sent when HIGH.
12	PAGE END	Printer	Indicates paper is out when HIGH.
13	SLCT	Printer	Indicates printer is ONLINE when HIGH.
14	AUTO FEED –	System	Indicates printer is to line feed when LOW.
15	FAULT	Printer	Indicates fault when LOW.
16	INIT –	System	Resets printer when LOW.
17	SELECTION –	System	Always LOW.
18-25	GROUND		SYSTEM GROUND.

### 3.2.4 Keyboard Interface (J8)

The keyboard regulates +12 V down to +5 V through an on-board regulator circuit. The telephone-type coiled cord linking the keyboard to the system unit has the following six conductors.

- +12 Vdc
- Common ground
- Test request
- Serial data to keyboard
- Serial data to system unit
- Shield (chassis/earth ground)

Both serial data lines are UART-type interfaces, running at TTL levels. Transmission from the keyboard is at 2440 baud. Keyboard reception is 300

baud. The keyboard does not transmit ASCII codes, but sends a code indicating which key position was pressed along with the status of the ALT, SHIFT, CTRL, and CAPS LOCK keys.

### 3.2.5 Dynamic RAM Interface and 64K RAM (J10) (U35 to U43)

The memory system in the Texas Instruments Professional Computer consists of 64 kbytes of dynamic random-access memory (RAM) on the main board, up to 16 kbytes of read-only memory (ROM), and connectors for an expansion memory board with up to 192 kbytes of RAM. The 8088 CPU can directly address up to 1 megabyte of memory.

Table 3-2 is a memory map of the Texas Instruments Professional Computer.

**Table 3-2. Memory Map**

Decimal	Contents	Hexadecimal Address
0 – 65535	64 Kbytes System Board RAM	00000 – 0FFFF
65536 – 131071	64 Kbytes Expansion Board Bank 1	10000 – 1FFFF
131072 – 196607	64 Kbytes Expansion Board Bank 2	20000 – 2FFFF
196608 – 262143	64 Kbytes Expansion Board Bank 3	30000 – 3FFFF
62144 – 1032191	Expansion Memory Bus	40000 – FBFFF
1032192 – 1040383	8 Kbytes Expansion ROM Slot	FC000 – FDFFF
1040384 – 1048575	8 Kbytes Main System ROM	FE000 – FFFFF

### 3.2.6 Expansion RAM Interface (J10)

The expansion RAM interface consists of a 44-pin card-edge connector which is used to connect the expansion RAM board. In order to provide more efficient utilization of the expansion bus, the expansion RAM is not added to the five connectors of the expansion bus.

The expansion RAM board is an option board, with 64 kbytes of soldered-in RAM plus two additional banks of sockets. It is available as a 64-kbytes, a 128-kbyte, or a 192-kbyte option board. Separate 64-kbyte upgrade option kits consist of

nine RAM devices that can be installed on an existing expansion RAM option board. The RAM devices are inserted into the two banks of empty sockets.

### 3.2.7 Boot System ROMs (U62, U63)

The system ROM is located in memory hexadecimal address FE000 and is supplied with each system containing the software necessary to power up and boot the system from the diskette. It also contains the kernel of the system device service routines (DSR) for the keyboard, display, diskette

drives, Winchester disk drive, serial printer support, and power-up self-test to check out the system and report errors.

A second ROM, located at hexadecimal address FC000, is reserved for future expansion.

### 3.2.8 Expansion Bus (J1 to J5)

The expansion interface bus allows standard and option devices that are not part of the main processor board to be added to the system. There are five expansion interface bus connectors.

The expansion interface bus allows memory-mapped or I/O-mapped devices to be added to the system in a straightforward manner. This bus supports devices requiring interrupts for efficient operation. Devices which require direct memory access (DMA) will be able to do so with their own special hardware. The system unit expansion memory is separated from the main system data bus by a bidirectional buffer to provide sufficient drive and margin for the data transfers. Table 3-3 lists the connector pin-outs for the expansion bus.

**Table 3-3. Expansion Bus Signals**

Pin	Signal	Pin	Signal
A01	NMI -	B01	GROUND
A02	DATA 7	B02	RESET
A03	DATA 6	B03	+ 5 VOLTS POWER
A04	DATA 5	B04	INTERRUPT 0
A05	DATA 4	B05	N/C*
A06	DATA 3	B06	N/C
A07	DATA 2	B07	- 12 VOLTS POWER
A08	DATA 1	B08	CPU ENABLE
A09	DATA 0	B09	+ 12 VOLTS POWER
A10	Wait	B10	GROUND
A11	GROUND	B11	MEMWRITE
A12	ADDR 19	B12	MEMREAD
A13	ADDR 18	B13	I/OWRITE
A14	ADDR 17	B14	I/OREAD
A15	ADDR 16	B15	N/C
A16	ADDR 15	B16	N/C
A17	ADDR 14	B17	N/C
A18	ADDR 13	B18	N/C -
A19	ADDR 12	B19	N/C
A20	ADDR 11	B20	PROCESSOR CLOCK (5MHZ)
A21	ADDR 10	B21	INTERRUPT 6
A22	ADDR 9	B22	INTERRUPT 5
A23	ADDR 8	B23	INTERRUPT 4
A24	ADDR 7	B24	INTERRUPT 2
A25	ADDR 6	B25	INTERRUPT 1
A26	ADDR 5	B26	N/C
A27	ADDR 4	B27	REFRESH
A28	ADDR 3	B28	ADDRESS LATCH
A29	ADDR 2	B29	+ 5 VOLT POWER
A30	ADDR 1	B30	OSC CLOCK (15MHZ)
A31	ADDR 0	B31	GROUND

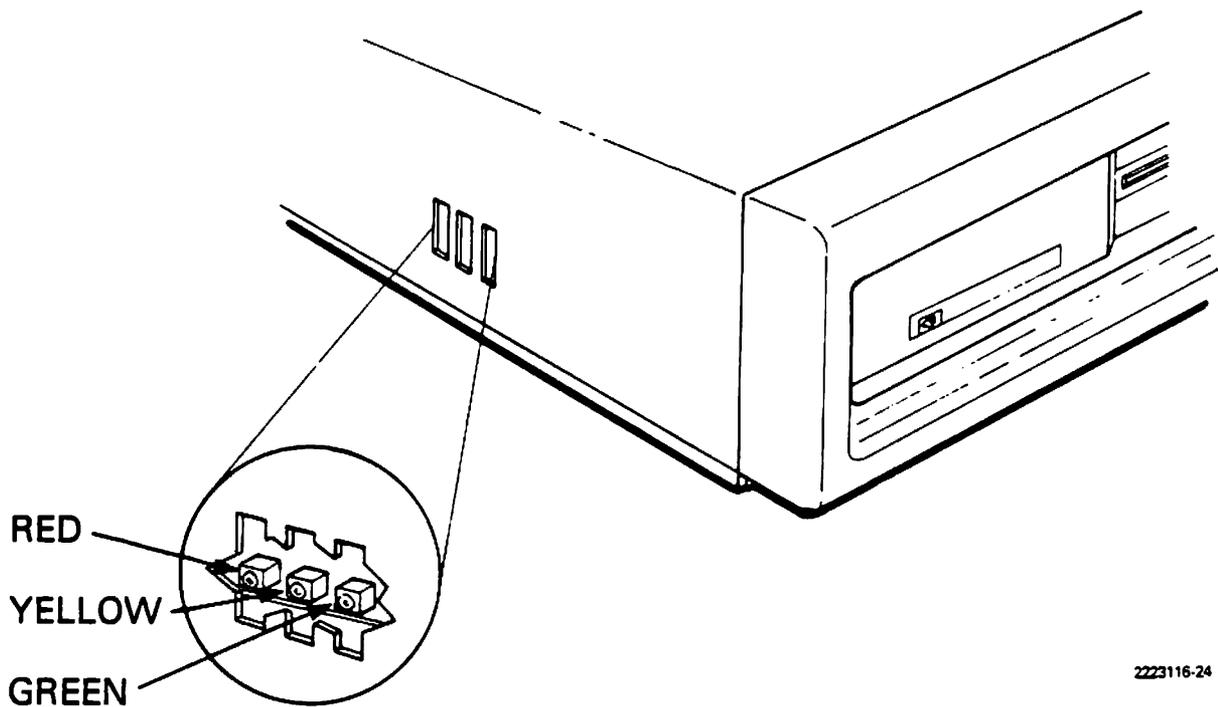
\* N/C = Not connected

### 3.2.9 Fault-Indicator LEDs

Three fault-indicator LEDs are mounted on the side of the system unit board, as shown in Figure 3-3. They are (from left to right) red, yellow, and green. These provide a visually coded indication of a fault during the power-up self-test sequence, along with any message shown on the display.

During every power-up, the self-test routine is

executed, with every step of the self-test displaying a different binary number pattern on the LEDs. If a fault occurs during the self-test, the test will halt; and the LEDs will remain on. The LEDs will display the binary pattern of the test during which the fault occurred. In the event of a failure during power-up, the LEDs will always display a binary number pattern, whether or not a message appears on the display.



2223116-24

Figure 3-3. Fault-Indicator LEDs

### 3.2.10 System Timers and Speaker

The system unit contains an internal loudspeaker which is used during the self-test for error notification and for signaling under program control. The speaker is mounted beneath the diskette drive mounting shelf and connects to the system unit board at J11.

### 3.2.11 CRT Controller Board

The CRT controller board is used to drive either a monochrome display unit with a composite video interface, or a color display unit with red-green-blue (RGB) transistor-transistor logic (TTL) interfacing. This board provides two connectors (J41 and J42) for attaching an optional graphics video controller to the board. The addition of the graphics board makes the computer a complete alpha-

numerics and raster graphics system. The color signals are completely compatible with monochrome displays. Either eight colors or eight shades of gray are displayed.

The CRT controller board contains a character-generator ROM with 256 characters. These are defined as follows.

- 128 USASCII characters (uppercase, lowercase, and control characters)
- 24 International (European) characters
- Line-drawing characters
- Special-purpose characters

The CRT controller board has been designed with a position for an additional 2- or 4-kbyte EPROM/ROM, which could be used to expand the character set to a total of 512 characters. Two attribute bits are used to select character sets in separate 128-character blocks.

A jack at E1 on the CRT controller board provides an interface for the clock and analog interface option board. This option board allows the operation of a user-furnished light pen.

### 3.3 OPTION BOARDS

#### 3.3.1 Synchronous-Asynchronous Communications Board

The synchronous-asynchronous communications board provides an RS-232-C interface. In asynchronous mode, it is capable of operation from 50 to 19 200 baud. In external synchronous mode, any baud rate up to 50 000 is allowed by the hardware, with software throughput determining the actual maximum baud rate supported. Up to four communication option boards can be installed. Each must be assigned a separate port address by selecting a jumper for the interrupt and a jumper for the address. Refer to the *Synchronous-Asynchronous Communications Board* option manual in Appendix C for details on jumper selection.

The option board uses the Zilog Z8530 serial communications controller. This integrated circuit controller automatically handles asynchronous protocols as well as most synchronous protocols, such as synchronous data-link control (SDLC) and high-level data-link control (HDLC). Cyclic redundancy checking (CRC) is automatic and can be included in any transmission.

**3.3.1.1 Interface Signal Functions.** The RS-232-C interface signals and their functions are described below.

- **PROTECTIVE GROUND (AA)** - This signal is connected to the computer chassis and the earth-ground connector of the power cord. The signal is jumpered to signal ground on the system unit board when a jumper is installed between E19 and E20. (Refer to paragraph 2.2.4 for more information on system grounding.)
- **SIGNAL GROUND (AB)** - This signal is connected to dc ground on the computer power supply. It establishes the common ground reference for all interface signals. (Refer to paragraph 2.2.4 for more information on system grounding.)
- **TRANSMITTED DATA (BA)** - This line conveys signals from the data transmitter output to the data-set transmitter circuits. It is held to a mark (binary logic one) condition when no data signals are being transmitted.
- **RECEIVED DATA (BB)** - This line conveys signals from the external data-set receiver to the computer data receiver input.
- **REQUEST TO SEND (CA)** - This signal is used to control the transmitted carrier of the data set (or modem) and is functional only with half-duplex data sets such as the Bell 202 series. REQUEST TO SEND is held on at all times when the computer is configured for full-duplex operation. This signal is controlled by line turnaround (LTA) character(s) and the communications software protocol.
- **CLEAR TO SEND (CB)** - This signal is turned on by the data set to indicate to the computer that the data set is ready to transmit. The computer does not attempt to transfer data across the interface when CLEAR TO SEND is off.
- **DATA SET READY (CC)** - This signal is turned on by the data set to indicate to the computer that the data set is ready to transmit. The computer does not attempt to receive or transmit across the interface when DATA SET READY is off.
- **DATA TERMINAL READY (CD)** - This signal is turned on by the computer to indicate that it is ready to establish or interconnect to a connected device, that is, to receive a call. Operation depends on the software protocol selected.
- **RING INDICATOR (CE)** - This signal is turned on by the data set to indicate that a ringing signal is being received on the

communications line. This signal is used to determine if the computer originated or answered the connection.

- **RECEIVED LINE SIGNAL DETECTOR (CF)** - This line is turned on by the modem to indicate that it is receiving a valid carrier signal from the connected data set. The computer does not accept data from the interface if this signal is turned off.

This line is regarded as on when open (floating) to permit operation with data sets, such as the Bell 113, that do not provide circuit CF.

- **DATA SIGNAL RATE SELECTOR (CH)** - This signal is used by the computer to select, transmit, and receive data rates when used with the Bell 212, or an equivalent set equipped with the rate-select option. The computer holds this signal on when configured for data rates of 1200 baud or higher, and off for all other data rates.
- **SECONDARY REQUEST TO SEND (SCA)** - This signal is equivalent to signal CA (Request to Send) except that it requests the establishment of the secondary data channel instead of the establishment of the primary data channel. The operation of this signal is governed by the software communications protocol selected.
- **SECONDARY RECEIVED LINE SIGNAL DETECTOR (SCF)** - This signal is equivalent to signal CF (Received Line Signal Detector) except that it indicates the proper reception of the secondary channel line signal instead of indicating the proper reception of a primary channel received line signal. The Bell 212 and equivalent data sets use this signal as a baud rate indicator, holding the signal on for 1200-baud operation and off for 300-baud operation. The computer may be configured to automatically adjust transmit and receive data rates in response to this signal.

**3.3.1.2 Interface Signal Pin Outs.** The identification of the 25-pin communications connector

on the synchronous-asynchronous communications board may be found in the *Synchronous-Asynchronous Communications Board* option manual located in Appendix C.

### **3.3.2 Internal Modems**

Two separate internal modems are available. A 300-baud Bell 103 compatible modem, and a Bell 212A compatible modem. Both provide communications with autodial and autoanswer in a fully programmable manner. Two modular telephone jacks are provided on the back plate.

### **3.3.3 Clock and Analog Interface**

The clock and analog interface option consists of three separate and distinct sections: real-time clock-calender, analog input, and lightpen. The clock is a battery-powered CMOS clock which displays time in hours, minutes, and seconds. A.M. and P.M. indicators, or a 24-hour format are selectable. Two connectors are located on the rear panel. A 9-pin D-type connector is provided for a light pen, and a 15-pin D-type connector is provided for analog input.

### **3.3.4 Graphics Video Controller Board**

The graphics video controller option board mounts piggy-back on the CRT controller board. It implements the same number of pixels (720 x 300 at 60 Hz) as the CRT controller board, 720 x 300 at 60 Hz. When the computer is operated at 50 Hz power, the number of pixels is 720 x 350. Each pixel can contain a maximum of three attribute bits labeled A, B, and C. These bits are converted by a palette look-up table to red, blue, or green; to combinations of red, blue or green; or to one of eight shades of gray (if a monochrome display is used).

**3.3.4.1 Graphics Palette.** The palette used on the graphics board is designed to map the pixel attribute bits to the three color outputs.

**3.3.4.2 Pixel Addressing.** The pixels are placed in the processor's memory space so that a group of 16 adjacent pixels of a single attribute bit are contained within a single 16-bit word. The words containing pixels are mapped into a continuous string, 45 words for every row. This provides 720 (16 x 45) pixels per horizontal row. There is one unused word at the end of each row. The entire display occupies a block of 32 768 memory locations. Only 27 600 (corresponding to 736 x 300/8) of these memory locations are actually used. The three attribute sections are located in three adjacent 32-kbyte blocks of memory.

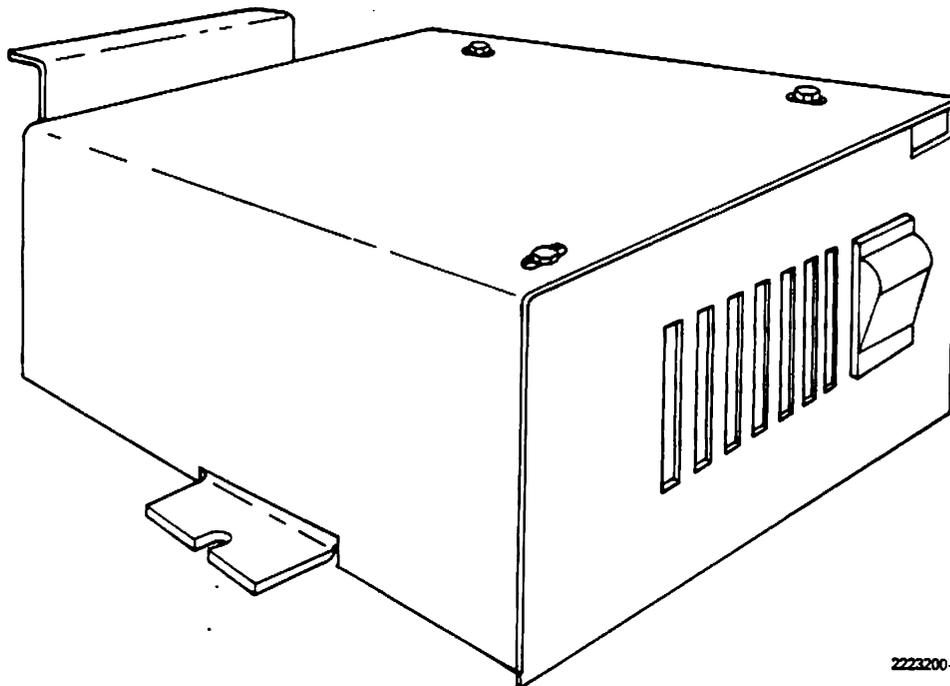
**3.3.4.3 Graphics Display Memory.** Dynamic memory is used on the graphics controller board because of the large amounts of memory required. The memory is organized as 16 kbytes x 4 bits and is packaged in an 18-pin dual in-line (DIP) package. Each plane of memory consists of four Texas Instruments TMS4416 Dynamic RAMs.

### 3.4 POWER SUPPLY

The power supply used in the computer is a switching type that is capable of converting the ac line voltage from 90 to 130 V (or from 180 to 265 V for international versions) to three regulated dc voltages listed in Table 3-4. A jumper on the printed wiring board selects between 120 or 230 Vac input, 47 to 63 Hz. See Figure 3-4 for an illustration of the power supply assembly.

**Table 3-4. Power Supply Output Ratings**

DC Output (Volts)	Current (Amperes)	Regulation (Percent)
+ 5	10.0	5
+ 12	4.5	5
- 12	0.6	5

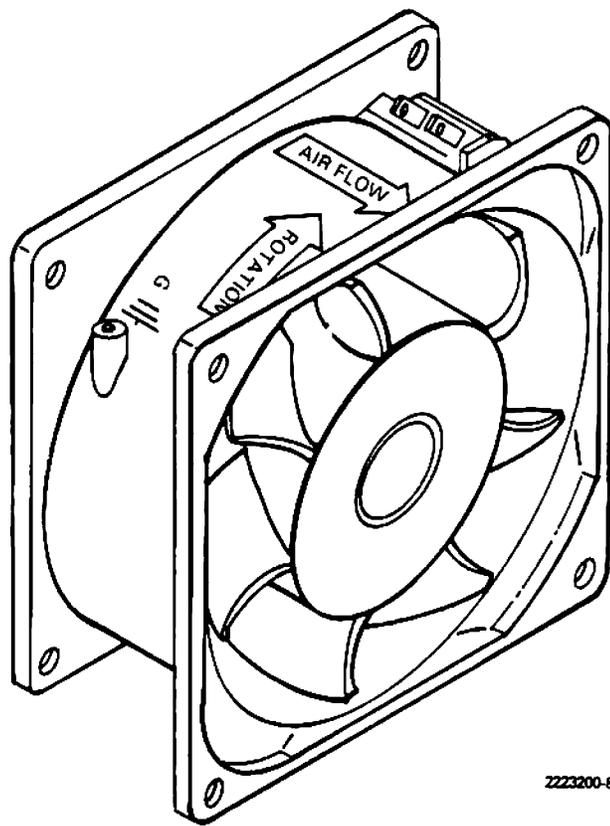


**Figure 3-4. Power Supply Assembly**

### 3.5 FAN

The fan assembly is a tubeaxial-type fan that is 82.55 mm (3.25 in) in diameter. It is rated at 29 cfm, continuous duty. The fan is switched ON

whenever the computer is turned ON. The system unit components have been designed to take optimum advantage of forced-air cooling. Figure 3-5 shows the fan assembly.



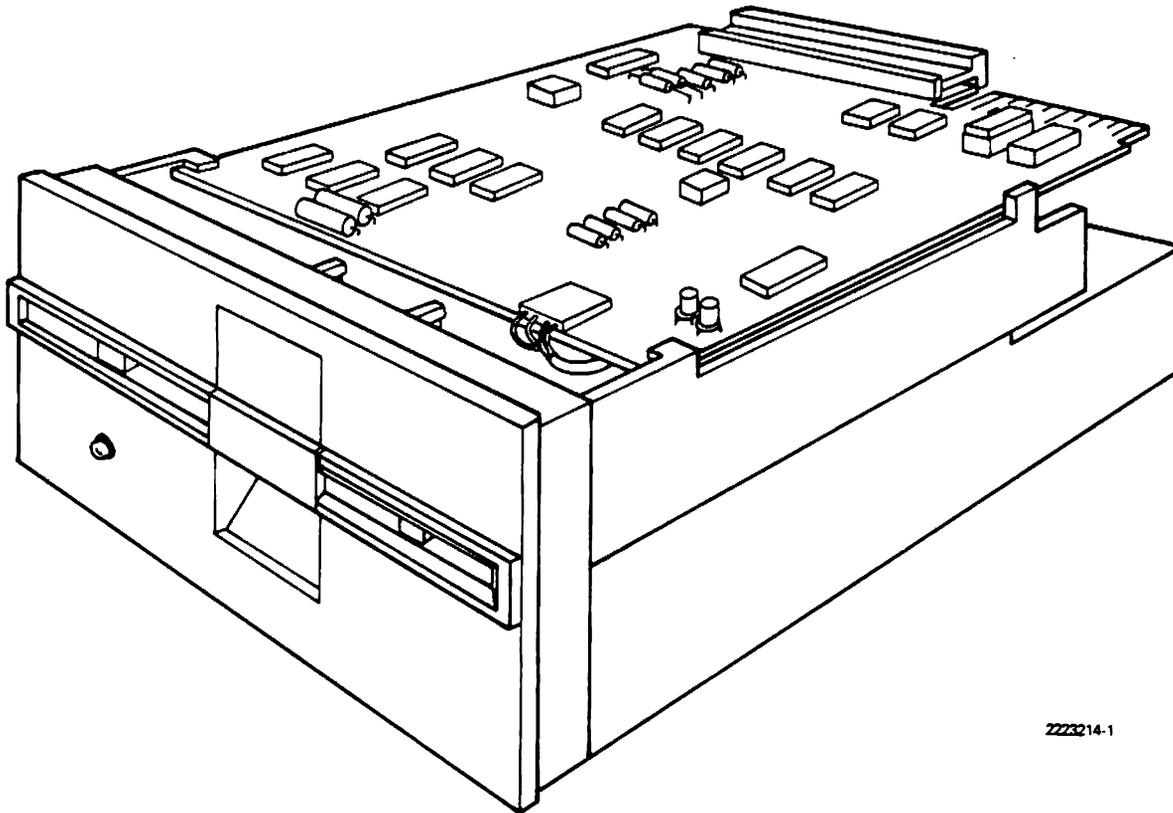
2223200-8

Figure 3-5. Fan

### 3.6 DISKETTE DRIVE

The diskette drive assembly shown in Figure 3-6 consists of the mechanical and electrical components necessary to record and read digital data on a diskette. DC power at +12 V and +5 V (provided by the power supply assembly in the

system unit) is required for operation. The main logic board contains circuits for index detection, head-positioning driver, read/write amplifier and transition detector, step control, track 00 sense, write-protect sense, motor speed control, and drive motor regulation and control.



773214-1

Figure 3-6. Diskette Drive

#### 3.6.1 Functional Description

The diskette drive assembly is self-contained. It consists of a spindle drive system, a head-positioning system, and a read/write/erase system.

When the front latch is opened, access is provided for the insertion of a 130-mm (5 1/4-in) double-sided, dual-density, soft-sectored diskette. The diskette is held in place by plastic guides, the front latch, and a backstop.

Closing the front latch activates the cone/clamp system that both centers and clamps the diskette to the drive hub. A servo-controlled dc motor rotates the hub at a constant speed of 300 rpm. The magnetic read/write/erase head is "loaded"

when a felt pad presses against the spinning flexible diskette and causes the diskette to press against the head.

A four-phase stepper motor and a highly accurate head-carriage drive assembly, together with the stepper-motor electronics, position the magnetic head over the desired track. This positioner uses a one-step rotation to cause a one-track linear movement. When a write-protected diskette is inserted into the drive, the write-protect sensor disables the write electronics of the drive and an appropriate signal is sent to the interface. When performing a write operation, a 0.33-mm (0.013-in nominal) data track is recorded.

Data-recovery electronics include a low-level-read amplifier, zero-crossing detector, differentiator, and digitizing circuits. No data-decoding facilities are provided in the basic drive assembly.

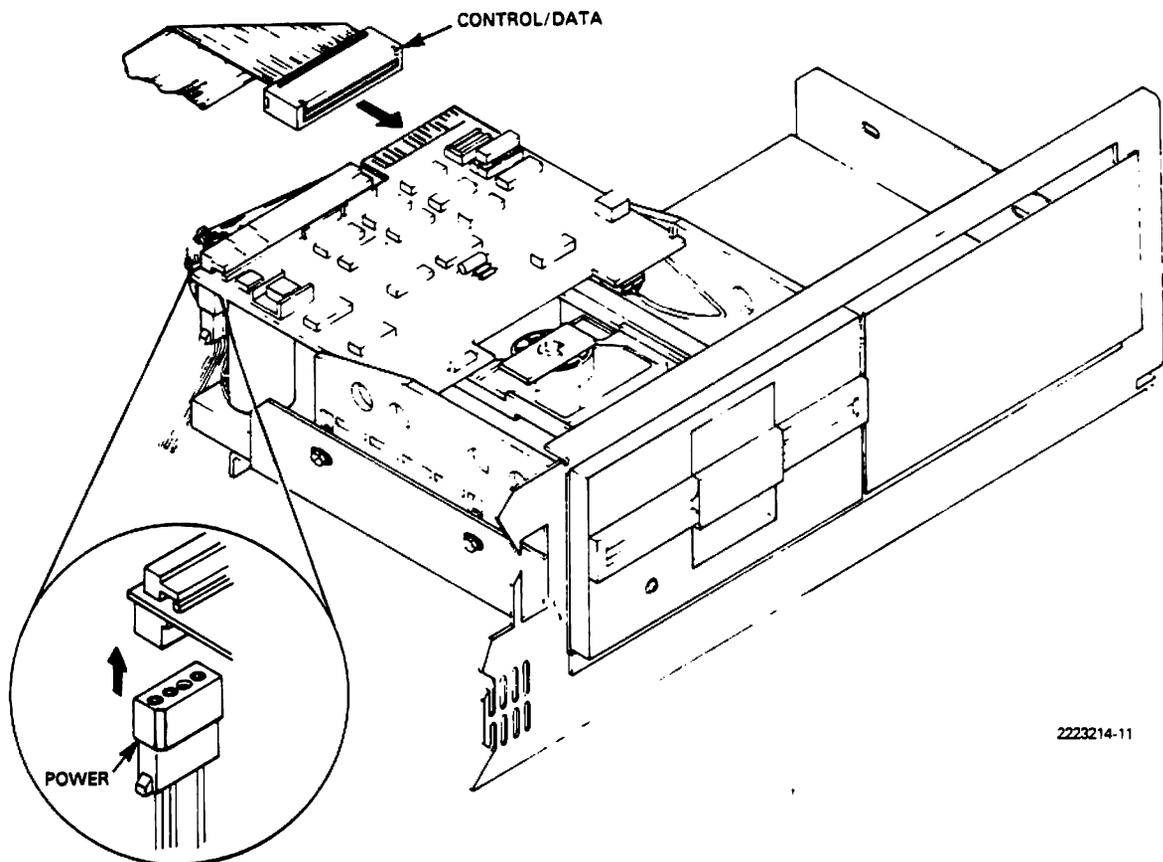
The diskette drive assembly is also equipped with the following sensor systems.

- A track 00 switch that senses when the head/carriage assembly is positioned at the track 00 position.
- The index sensor (an LED light source and a phototransistor) is positioned so that when an index hole is detected, a digital signal is generated.

- The write-protect sensor disables the disk drive electronics whenever a write-protect tab is applied to the diskette or whenever a diskette without a write-enable notch is inserted.

### 3.6.2 System and Power Interface

System interfacing is via a 34-pin card-edge connector on the rear of the diskette drive logic board. The data/control cable linking the system unit board to the diskette drive assembly contains three connectors, as shown in Figure 3-7. One connector to P9 on the system unit main board, Two connectors are in series, one for each of the two internal diskette drive assemblies. The signal pin-outs for all three connectors are identical. Table 3-5 shows the connector pinouts for the diskette drive bus.



2223214-11

Figure 3-7. Diskette Drive Cable Connectors

PROTECT

**Table 3-5. Diskette Drive Bus Signals**

Pin	Signal	Pin	Signal
1	Ground	18	DIRECTION
2	N/C*	19	Ground
3	Ground	20	STEP
4	N/C	21	Ground
5	Ground	22	WRITE DATA
6	N/C	23	Ground
7	Ground	24	WRITE GATE
8	Index	25	Ground
9	Ground	26	TRACK 00
10	SELECT 1	27	Ground
11	Ground	28	WRITE PROTECT
12	SELECT 2	29	Ground
13	Ground	30	READ DATA
14	N/C	31	Ground
15	Ground	32	SIDE 1
16	MOTOR ON	33	Ground
17	Ground	34	N/C

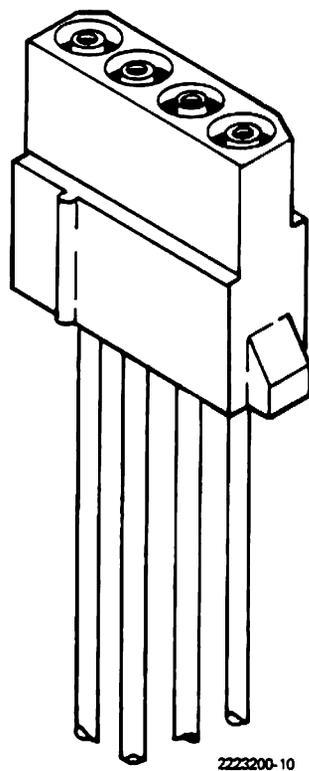
\* N/C = Not connected

The Texas Instruments Professional Computer supports up to four diskette drives. An optional second drive can be installed in the system unit, and one or two user-furnished external drives can be connected to the system unit. The user-furnished external drive assemblies must include a power supply and a user-furnished data/control ribbon cable. All diskette drives must be of the same type. They must all be single-sided 160-

kbyte capacity drives, or they must all be double-sided 320-kbyte capacity drives. The standard is a 48-tpi drive, single-sided, 160-kbyte capacity. A jumper installed on the system unit board between E1 and E2 selects 320-kbyte capacity (double-sided) drives. If a jumper is not installed between E1 and E2, 160-kbyte capacity (single-sided) drives are selected. The 160-kbyte capacity drive is standard in the basic system configuration.

Power connections for the diskette drive assembly are made through a four-conductor connector on the circuit etch (lower) side of the drive assembly logic board. This connector is shown in Figure 3-

8. The system unit's power supply dc harness provides cables for two drives. If only one drive is installed, the second connector is secured to the system unit chassis.

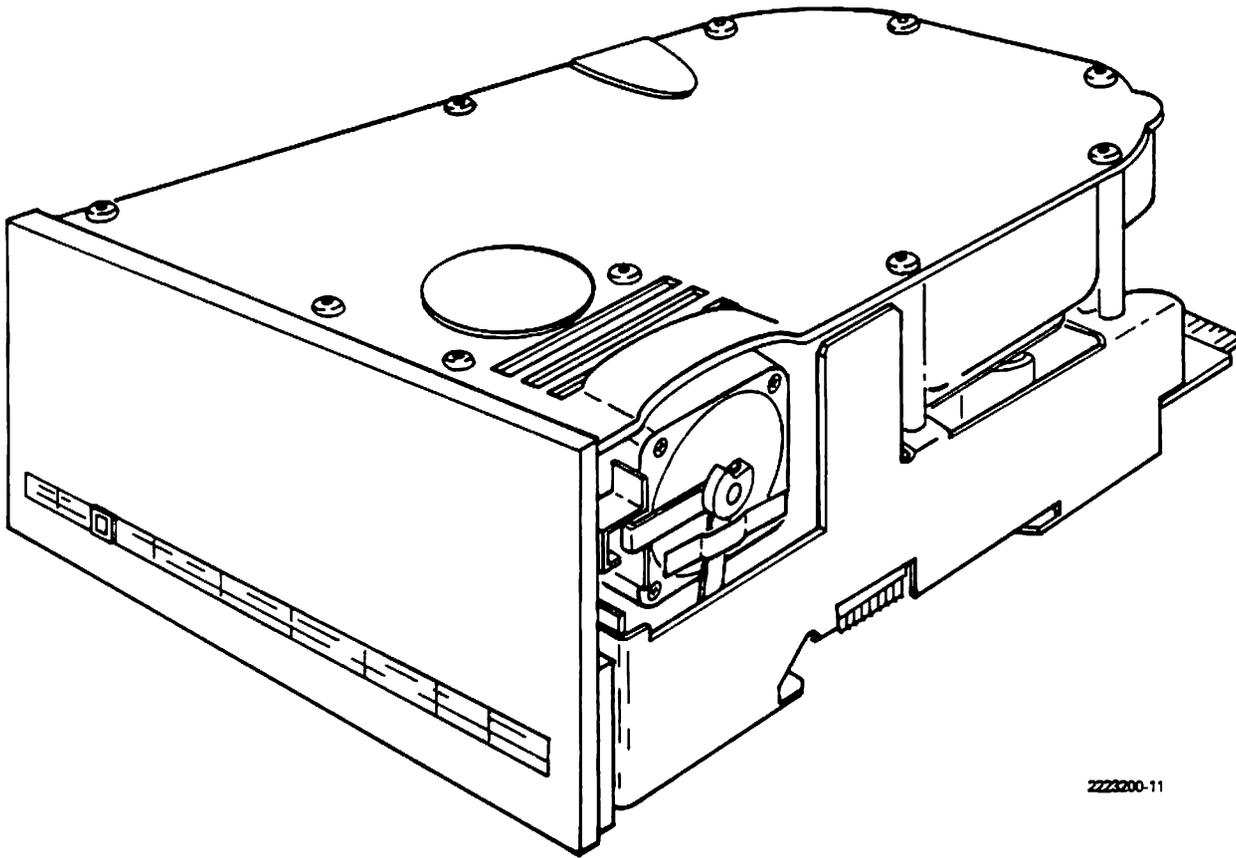


**Figure 3-8. Diskette Drive Power Connector**

### 3.7 WINCHESTER DISK DRIVE OPTION

The optional 5 1/4-inch Winchester disk drive and controller (TI Part No. 2223239) provide 5, 10, or 15 megabytes of formatted data storage. The

controller transfers data at the rate of 5 megabits per second. The Winchester disk drive furnishes online mass storage for the Texas Instruments Professional Computer. See Figure 3-9 for an illustration of the Winchester disk drive.

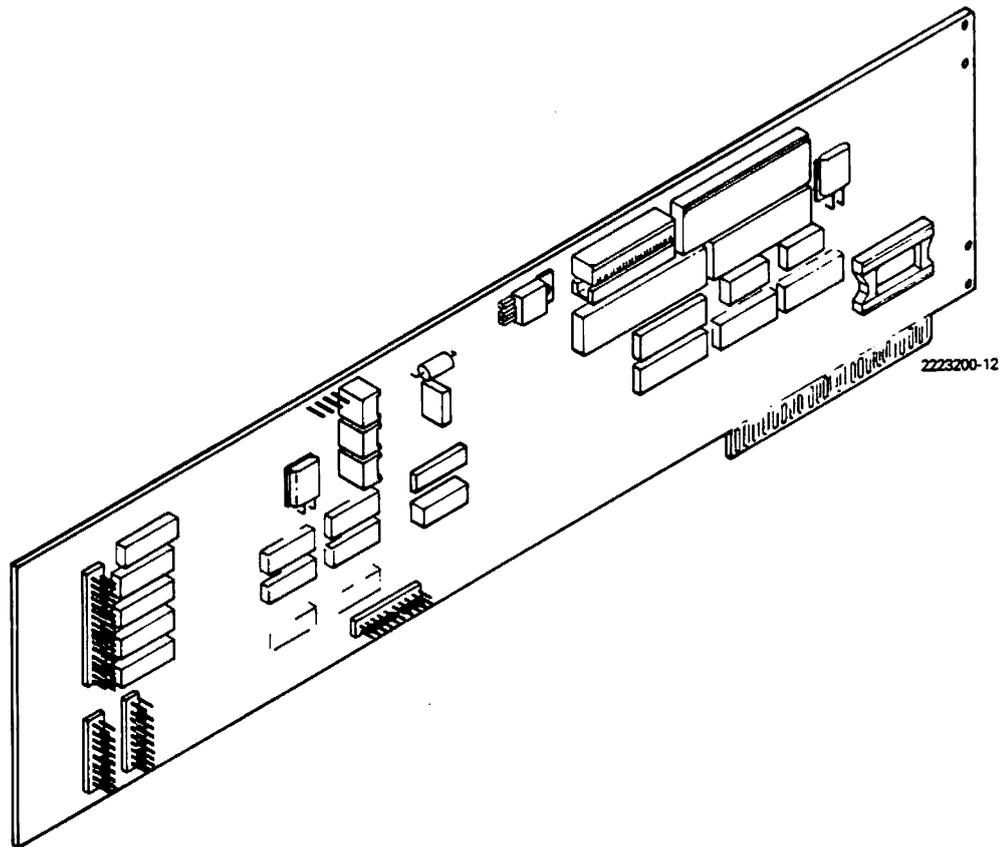


2223200-11

Figure 3-9. Winchester Disk Drive

This option consists of a controller board, a Winchester drive assembly, interconnecting cables, mounting screws, and software. The software is provided for initializing the Winchester disk sur-

face, transferring the system programs, and running diagnostics tests. See Figure 3-10 for an illustration of the Winchester disk controller board.



**Figure 3-10. Winchester Disk Controller Board**

### **3.8 KEYBOARD ASSEMBLY**

The keyboard consists of a microprocessor, TTL logic gates, board, and key-switches. The low-profile keyboard uses an on-board regulator to provide 5 volts needed for the microprocessor and

logic. The key-switches are at intersections of an X-Y matrix formed by the scan and return lines to the microprocessor. The keyboard does not transmit ASCII codes to the system unit. Instead, it sends a unique code which in turn is converted to ASCII characters by the computer.

At power-up, the system unit transmits a request for a keyboard test. The keyboard initiates the self-test and sends a status to the system unit of OK or Not OK. The system unit then sends a signal that it has completed the system unit power-

up self-test and is ready to receive data from the keyboard. The keyboard receives data from the system unit at 305 baud. See Figure 3-11 for a functional diagram of the keyboard.

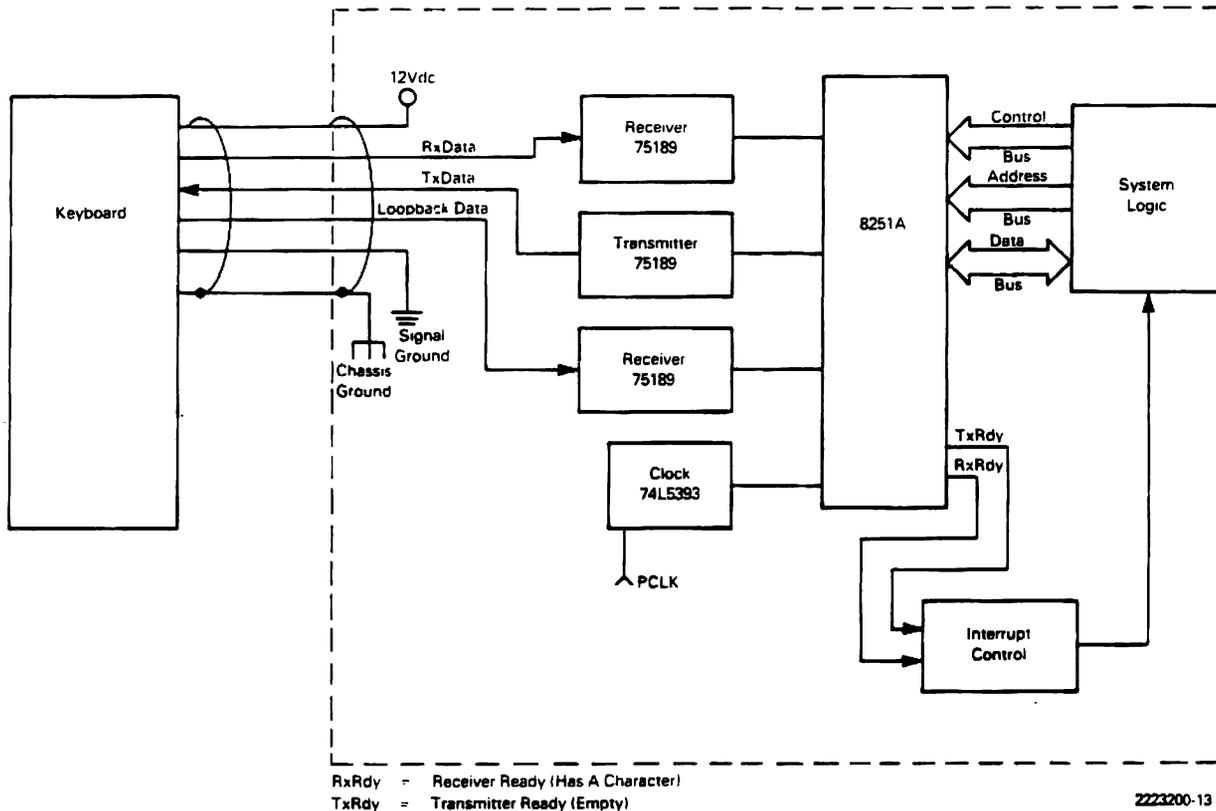


Figure 3-11. Keyboard Diagram

Each key will cause either one or two bytes to be transmitted, based on the status of the mode keys. The mode keys are defined as those keys which alter the meaning of the standard keys. The mode keys are **SHIFT**, **ALT**, **CAPS LOCK**, and **CTRL** keys.

The first byte (mode byte) is sent only if it has changed since the last transmission. It is never sent without being followed by the second byte. Since the mode is not permitted to change when the repeat-action key function is on, the mode byte is never sent during a typamatic re-

peat-action key transmission. The nine bits of the first byte consist of 4 bits indicating the first byte identifier, 4 bits indicating the mode Keys, and a parity bit. Transmission from the keyboard is at 2440 baud.

The second byte of nine bits, consist of seven bits for the scan code, a repeat-action mode status bit, and a parity bit.

### 3.9 MONOCHROME DISPLAY UNIT

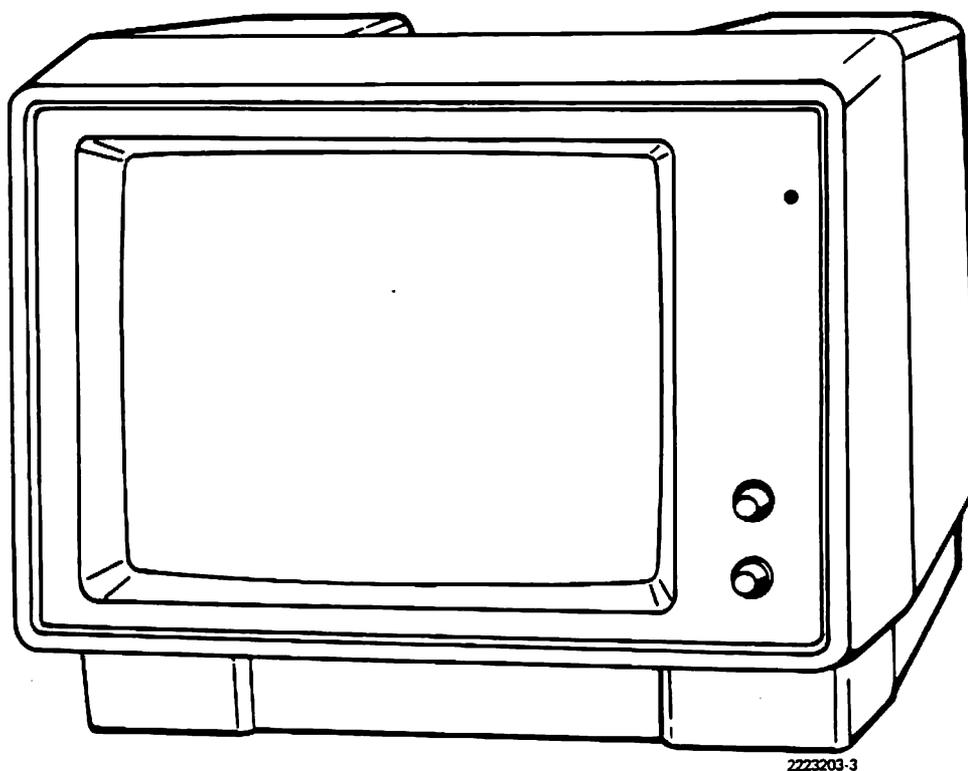
The monochrome display unit used with the Texas Instruments Professional Computer utilizes a 305-

mm (12-in) P31 green phosphor screen. The size of the display is 80 x 25 characters. The display unit has a standard composite video input and two front-panel controls.

- **BRIGHTNESS** (with a pull-push ON/OFF switch)

- **CONTRAST**

Horizontal and vertical hold, vertical size, and vertical linearity controls are located on the back of the case. A switch inside the cabinet selects 120 or 230-Vac input, at 50 or 60 Hz. Figure 3-12 shows the monochrome display unit.



**Figure 3-12. Monochrome Display Unit**

Composite video is routed via a 1.0-m (39.4-in) coaxial cable from the back-panel connector on the CRT controller board (inserted into the system unit main board) to the back of the display unit. The display unit ac power cord plugs into the back of the system unit. At power-up, the display unit and the system unit are turned on at the same time. The power-on indicator is located on the front panel of the display unit.

The monitor is capable of operating from 0 V to 1.2 V peak-to-peak composite signal (as measured across 75 ohms with the sync being 30 percent of the total signal). Input signal polarity is standard black negative and sync negative.

The monochrome display unit is controlled by the CRT controller board. The CRT controller board is installed in the system unit. The computer may be

used with an optional color display unit without any modification to the CRT controller board. The CRT controller board also provides the required signals which allow the addition of an optional graphics controller piggyback board. With the optional graphics controller board, the Texas Instruments Professional Computer is a complete alphanumeric and raster-scan graphics system. The CRT controller board provides both eight-level gray scale and eight-color red-green-blue (RGB) outputs.

### 3.10 COLOR DISPLAY UNIT OPTION

The optional color display unit (TI Part No. 2223041-0001) features a 13-inch (diagonal measurement) high-resolution screen, RGB TTL input, and a 25-line by 80-column display. The color display signal cable interfaces with the system unit by a 9-pin D-type connector. This cable interfaces with the back of the color display unit on an 8-pin rectangular connector. Figure 3-14 shows the location of the color display unit connector. Figure 3-13 shows the color display unit.

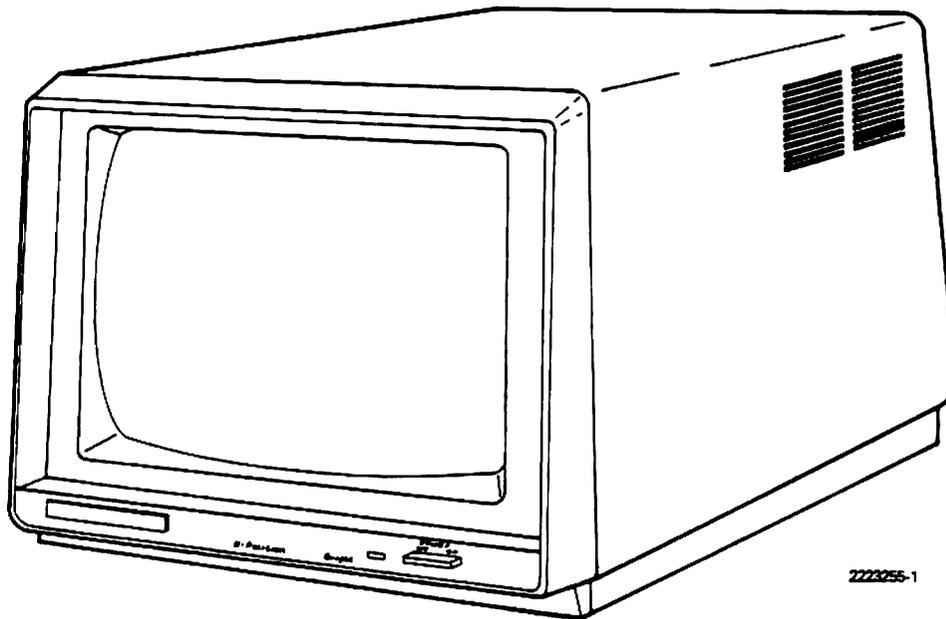
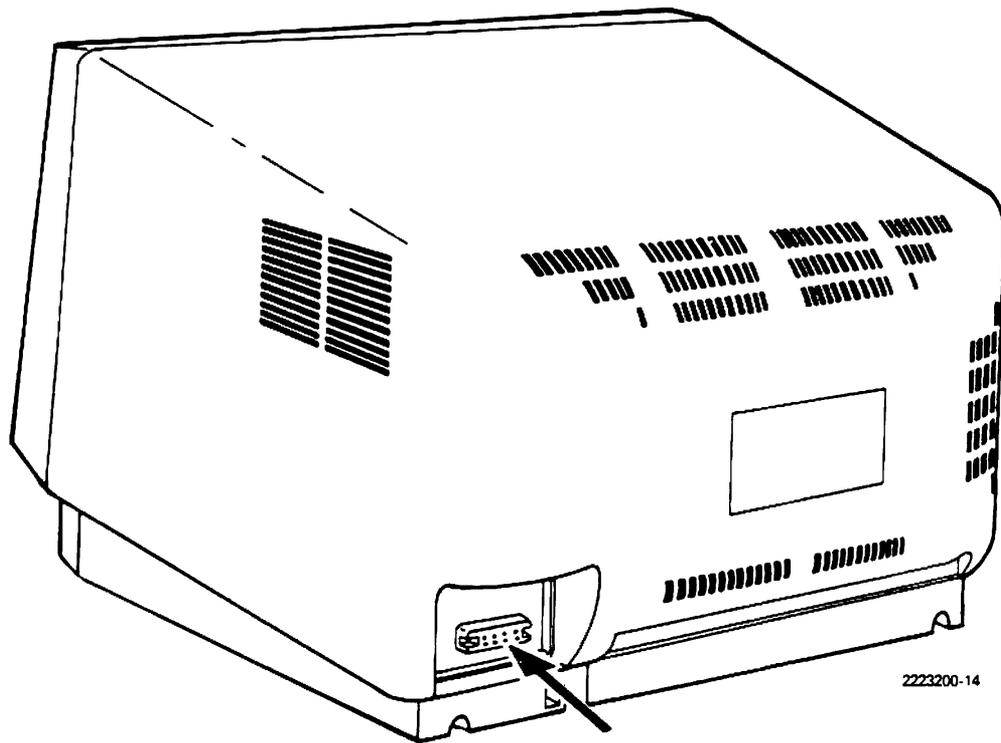


Figure 3-13. Color Display Unit

Two versions of the color display unit are available. The domestic (US) unit operates at 120 Vac at 60 Hz. The international version operates at 230 Vac at 50 Hz. Figure 3-14 shows the location

of the color display unit connector.

The pin-out of the 9-pin D-type connector on the CRT controller board is listed in Table 3-6.



**Figure 3-14. Location of Color Display Connector**

**Table 3-6. Color Display Connector Signals**

<b>Pin</b>	<b>Signal</b>
1	Ground
2	No Connection
3	RED Video
4	GREEN Video
5	BLUE Video
6	No Connection
7	No Connection
8	Horizontal Drive
9	Vertical Drive

# Section 4

## Fault Identification

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### 4.1 INTRODUCTION

This section describes the error messages, power-up self-test, diagnostics, and advanced diagnostics.

The purpose of the diagnostics tests is to determine the condition of the Texas Instruments Professional Computer and to identify any defective subassemblies.

Three distinct types of diagnostics are provided.

- A power-up self-test sequence which is automatically activated on every power-up or reset.
- A diagnostics diskette which contains a variety of tests the user may select from a menu.
- Advanced diagnostics which are intended for the maintenance person, who is using the same standard diagnostics diskette and instructions in this section.

#### 4.1.1 Indication of Failures

The user may encounter the following problems while using the computer or when running diagnostics tests.

- A failure message may be displayed on the display unit, or the LEDs may light on the left side of the system unit.
- A failure may occasionally occur which causes neither an error message to be displayed nor the LEDs to light.

#### 4.1.2 Failure Indication by LEDs

LEDs (light-emitting diodes) are used to display failures of computer system components which are essential for operation. The power-up self-test sequence is halted whenever one of these failures is detected. The LEDs are red, yellow, and green. By matching the LED pattern displayed against a table in Appendix B, the probable cause and corrective action can be determined.

#### 4.1.3 Displayed Error Messages

An error message shown on the display does not always indicate a failure of the computer. Many error messages the user sees will be caused by the following external faults.

- Operator error such as an attempt to write to a write-protected diskette, failure to connect a keyboard, or failure to properly configure options or peripherals.
- Diskettes that are blank, or do not have an operating system, or that have somehow been "zapped" (only one changed bit can make a diskette useless). See Section 2, "Handling Storage Media," for more information.

- Software that has recently developed a flaw or has not been thoroughly debugged.

**4.1.3.1 Format for Power-Up Self-Test Messages.** Error messages that are displayed during the power-up self-test provide the name of the

main assembly (system unit or keyboard) in which the fault has occurred. Examples of these messages are as follows.

**\*\* System Error - 0031 \*\***  
or  
**\*\* Keyboard Error - 0010 \*\***

Notice that the first two digits of the message number are always zeros.

When an error message occurs during a power-up self-test, you should first check for obvious things. If you see the message refers to the keyboard, check for a disconnected or loose keyboard cable. If a disconnected or loosened keyboard cable is not found, place the system unit ON/OFF switch in the OFF position and wait at least 15 seconds. Next, place the ON/OFF switch in the ON position. If the keyboard error recurs, refer to Appendix B for the exact meaning and recommended action.

**4.1.3.2 Format for Diagnostics Messages.** Messages displayed during the execution of diskette diagnostics are numbered in a similar manner as those occurring during a power-up self-test. Some of the messages are not error messages, but status messages concerning the test completed.

The structure for the 4 digits in the error messages for the diskette-based diagnostics may be given as follows.

\_\_\_\_\_ Test: XXYY

Where XX is the device under test, and YY is the status code.

The device codes used are:

- 00 Power-up self-tests
- 01 CRT controller board and graphics video controller board
- 02 Keyboard
- 03 Communications board
- 04 ROM
- 05 RAM
- 06 Diskette drive
- 07 Reserved
- 08 Printer
- 09 Reserved
- 10 Reserved
- 11 Winchester disk

The status code information, its meaning, and the recommended corrective action is found in Appendix B.

Examples of these messages are as follows.

**\*\* System Error - 0033 \*\***

Diskette Test: Loop xxxx, D = x, Controller hardware failed - 0606

CRT Alignment Test: Test complete - 0100

The first example listed above is of a failure encountered during the bootup of the system diskette. The major component which failed is listed (system or keyboard is always indicated), followed by the four-digit code.

The next example is a message displayed when running the advanced diagnostics tests. Notice the test is listed along with test parameters to indicate the point during the test when the error occurred. The four digits of the device under test and status message (XXYY) complete the message.

The other form of displayed error message involves the LEDs on the left side of the system unit. These LEDs display information when a failure occurs during the power-up self-test. The LEDs are red, yellow, and green. By matching the LED pattern displayed against a table, the probable cause and recommended corrective action can be determined. The LEDs are particularly useful when no display is available, or when trying to isolate a failure in the system unit or display unit.

#### 4.1.4 Errors Without Messages

You may have a failure and not receive any error message or indication. The symptoms in Table 4-1 describe most problems of this type and give recommended action to be taken. Typical situations where error indications are not received are the following.

- Power supply failures
- Fan failures

- Display unit failures
- Power cord failures
- Video signal cable failures
- Speaker failures

**WARNING**

High voltage is present inside the monochrome and color display units. Servicing (including alignment and internal adjustments) of the display unit must only be performed by qualified personnel.

**Table 4-1. Errors Without Messages**

Symptom	Probable Cause	Recommended Action
Blank display, no sound of fan, no display power indicator, no LEDs on system unit.	<ol style="list-style-type: none"> <li>1. Not plugged in.</li> <li>2. Dead ac outlet.</li> <li>3. Bad power supply.</li> <li>4. Bad power cord.</li> </ol>	<ol style="list-style-type: none"> <li>1. Make sure power cord is plugged in securely.</li> <li>2. Check ac outlet with lamp or appliance. Check the circuit breaker.</li> <li>3. Check for proper voltages at system unit dc power connector. Replace if bad power supply.</li> <li>4. Replace power cord.</li> </ol>
Blank display, no display power indicator, fan on, LEDs come on, then go out.	Bad display unit.	Replace display unit.
Blank display, display power LED indicator is on, system unit LEDs come on, go out.	<ol style="list-style-type: none"> <li>1. Bad video signal cable.</li> <li>2. Bad display unit.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check cable, replace if needed.</li> <li>2. Replace display unit.</li> </ol>
No fan sound, display ok, system unit LEDs come on then go out.	<ol style="list-style-type: none"> <li>1. Disconnected fan.</li> <li>2. Bad fan.</li> </ol>	<ol style="list-style-type: none"> <li>1. Connect fan cable.</li> <li>2. Replace fan.</li> </ol>
Keyboard locked up.	<ol style="list-style-type: none"> <li>1. Bad system unit board.</li> <li>2. Line transient or static charge.</li> <li>3. Bad keyboard.</li> <li>4. Lockup is caused by software.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace system unit board.</li> <li>2. Place system unit ON/OFF switch in the OFF position, wait 15 seconds, place in ON position.</li> <li>3. Replace keyboard board.</li> <li>4. Wait for software to send keyboard an unlock command.</li> </ol> <p>Refer to specific program documentation.</p>

**Table 4-1. Errors Without Messages (Continued)**

Symptom	Probable Cause	Recommended Action
Image on display unit is bad. The front and rear panel controls do not help (monochrome display only).	<ol style="list-style-type: none"> <li>1. Fuzzy image is due to out-of-tolerance focus control.</li> <li>2. Dim image is due to either poor CRT or out-of-tolerance pot.</li> <li>3. Character fold-over on edge of display may be caused by out-of-tolerance pot.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust R419 (Focus) control on monochrome board. This is an internal adjustment.</li> <li>2. Adjust R121 (Sub-brightness) control on the monochrome board. This is an internal adjustment. If not improved, replace the display unit.</li> <li>3. Adjust horizontal size coil L404 on monochrome display board. This is an internal adjustment.</li> </ol>
No sound from speaker at any time.	<ol style="list-style-type: none"> <li>1. Speaker cable not attached.</li> <li>2. Speaker bad.</li> <li>3. Bad system unit board.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace cable from speaker to system unit board at J11.</li> <li>2. Replace speaker. See "Assembly Removal and Replacement" section.</li> <li>3. Replace system unit board.</li> </ol>

**4.2 RECOMMENDED TROUBLESHOOTING PROCEDURE**

The following procedure will serve as a guide for troubleshooting the Texas Instruments Professional Computer. These procedures are applicable for bench repair, user carry-in, or on-site work.

**4.2.1 Before Touching the Equipment**

If the user of the equipment is available, obtain as much information as possible to learn the nature of the problem.

1. Which item failed?
2. Was the failure an intermittent or a repeating failure?

3. Were there any error message numbers? Which ones?
4. What was the computer doing when the failure occurred?
  - Did failure occur during power-up? (Was there a message or LED code?)
  - Did failure occur while performing an MS-DOS command? (If so, which?)
  - Did failure occur during start-up of an applicable program? (If so, which?)

- Did failure occur while in BASIC or another language program? (If so, which?)
  - Did failure occur during a diskette operation? (If so, which?)
5. Did this failure occur previously? How many times? (What was done previously when this occurred?)
  6. What is the configuration of the system unit?
  7. What peripherals (such as modems or printers) were connected when the failure occurred?
  8. Were other diskettes tried (if the problem was diskette related)?
  9. What is the environment of the computer work area? (If the problem is intermittent, determine if a line voltage surge/sag/transient exists, or if the computer is on a branch circuit with other equipment.)
5. If there is an error without an error message, review paragraph 4.1.2.
  6. If an option fails to operate, review the installation and checkout procedure outlined in the option manual in Appendix C. Also, select the Display System Configuration to verify that the computer properly recognizes the installed options.
  7. When the failure has been identified to a field-replaceable assembly (FRA), replace the FRA, using the removal and replacement instructions in Section 5. A listing of field-replaceable assemblies is provided in Section 6.
  8. After the repairs have been completed, the Overall Unit Test should be conducted from the user-diagnostics menu. If time permits, longer testing of the computer, particularly in the tests applicable to the newly replaced FRA, should be performed. This will provide a good system burn in of the problem area.
  9. With experience, all technicians will develop a series of favorite tests to respond to typical problems. These tests may be developed into batch streams on the diagnostics diskette. You could add batch streams of tests to the diagnostics menu listing. See Appendix A for more details on running the advanced diagnostics.

#### **4.2.2 Set Up System and Run User Diagnostics**

At this point, you should have information which should make the actual troubleshooting simple.

1. Set up the system, using instructions in Section 2.
2. Observe the diagnostic power-up self-test results as outlined in paragraph 4.3.1.
3. Run the diskette-based diagnostics as outlined in paragraph 4.4.2. See Appendix B for meanings of any error messages and corrective actions.
4. If there is an intermittent problem, run the advanced diagnostics tests repeatedly. If intermittent failures occur, or if user diagnostics did not detect a failure, set up tests using repetitions appropriate to the suspected failure. If a parallel or serial printer or other peripheral is connected, and intermittent failures occur, check for a peripheral device with the logic ground tied to chassis or protective ground that may be causing the ground loops.

### **4.3 DIAGNOSTICS**

Two types of diagnostics are provided with the Texas Instruments Professional Computer.

- Power-up diagnostics
- Diskette-based diagnostics

The diagnostics which occur during power-up reside in the main system ROM located on the system unit board at U62. At power-up, the LEDs are turned on by the hardware. The pattern of the LEDs represents a binary count which is decremented as tests are successfully completed. If all tests are successfully completed, the LEDs are turned OFF.

A single diagnostics diskette provides the user with comprehensive menu-driven diagnostics. These tests, when properly executed according to these instructions, either reassure the user his computer is operating satisfactorily or identify which component the user must return for service.

The same diagnostics diskette is used by both the field and shop technician to identify the faulty field-replaceable assembly.

**4.3.1 Power-Up Self-Test Error Messages**

Every time the computer is turned on, it performs a self-test. This self-test occurs automatically. If a fault is encountered, the test halts at the point the fault was encountered, and a message on the display identifies the assembly that failed. In cases where the display is inoperative, there is still a

means of identifying the fault. Three LEDs (red, yellow, and green) are visible through slots on the left side of the system unit.

These LEDs permit error codes to be displayed when the display unit is not connected, or when it is faulty. They remain lit if a fault is encountered. The LED pattern displayed represents the point in the self-test at which the failure occurred. On power-up, all of the LEDs come on, then sequentially go off. In the event of a power supply failure, the LEDs will not light at all. An error message on the display means that the system unit board is operational enough to conduct the test, isolate the fault, and display the results.

Table 4-2 defines the LED error messages and gives the necessary corrective action required.

**Table 4-2. Self-Test LED Error Indicators**

LED 1 Red	LED 2 Yellow	LED 3 Green	Binary Value	Probable Cause of Failure	Corrective Action
ON	ON	ON	7	Digital system	Possible bad system unit board. Replace system unit board.
ON	ON	OFF	6	ROM	Possible bad ROM in system unit. Replace system unit board.
ON	OFF	ON	5	RAM	Possible bad RAM in system unit. Replace system unit board.
ON	OFF	OFF	4	Interrupt controller	Possible bad IC in system unit. Replace system unit board.
OFF	ON	ON	3	Floppy disk controller	Replace system unit board.
OFF	ON	OFF	2	CRT controller	Replace bad CRT controller board, or replace system unit board.

Table 4-2. Self-Test LED Error Indicators (Continued)

OFF	OFF	ON	1	Winchester controller	Replace bad Winchester drive controller board.
OFF	OFF	OFF	0	Normal or no power	No action if normal. If no display or diskette activity, bad power supply or ac power source (fan is heard even if power supply is bad). Recycle power and observe LEDs. System unit is good if they sequence, and then go out. Display may be bad, or cables loose.

Supplementing the code displayed by the LEDs on the system unit is additional failure information which can be obtained by service personnel using a special 25-pin test plug. Figure 4-1 shows the schematic of the parallel test plug.

**4.3.1.1 Using the Parallel Test Plug.** Messages which are shown on the display are limited in length by the amount of ROM available on the system unit board. As a result, the messages indicate which major component has failed, such as the system unit or keyboard. Additional information is available to service personnel through the use of the parallel test plug. This test plug can help identify the faulty subassembly and, in some cases, the faulty component.

**NOTE**

The parallel test plug is not necessary for the identification of a faulty field-replaceable assembly. Most service personnel will not require it for servicing at the field-replaceable assembly level. This test plug is useful only when component level repair is accomplished.

The parallel test plug operates in two modes. Mode 1 is used to test the parallel printer port. Parallel control signals are looped back to test inputs and outputs. The eight data lines are connected to eight LEDs. You can monitor the LEDs to see that all data lines are functioning.

*Mode 1 Testing.* Mode 1 testing is used to check the parallel printer interface. The test is entered in the following manner from the Advanced Diagnostics menu (see paragraph 4.3.3).

PRTTST TEST = LOO

and press the RETURN key

This test requires that you monitor the eight LEDs on the test plug during testing to ensure that each LED lights twice during the test. The test starts by lighting all LEDs at once. Then each LED is lighted individually. If any LED does not light during either part of the test, failure of the parallel printer interface has occurred.

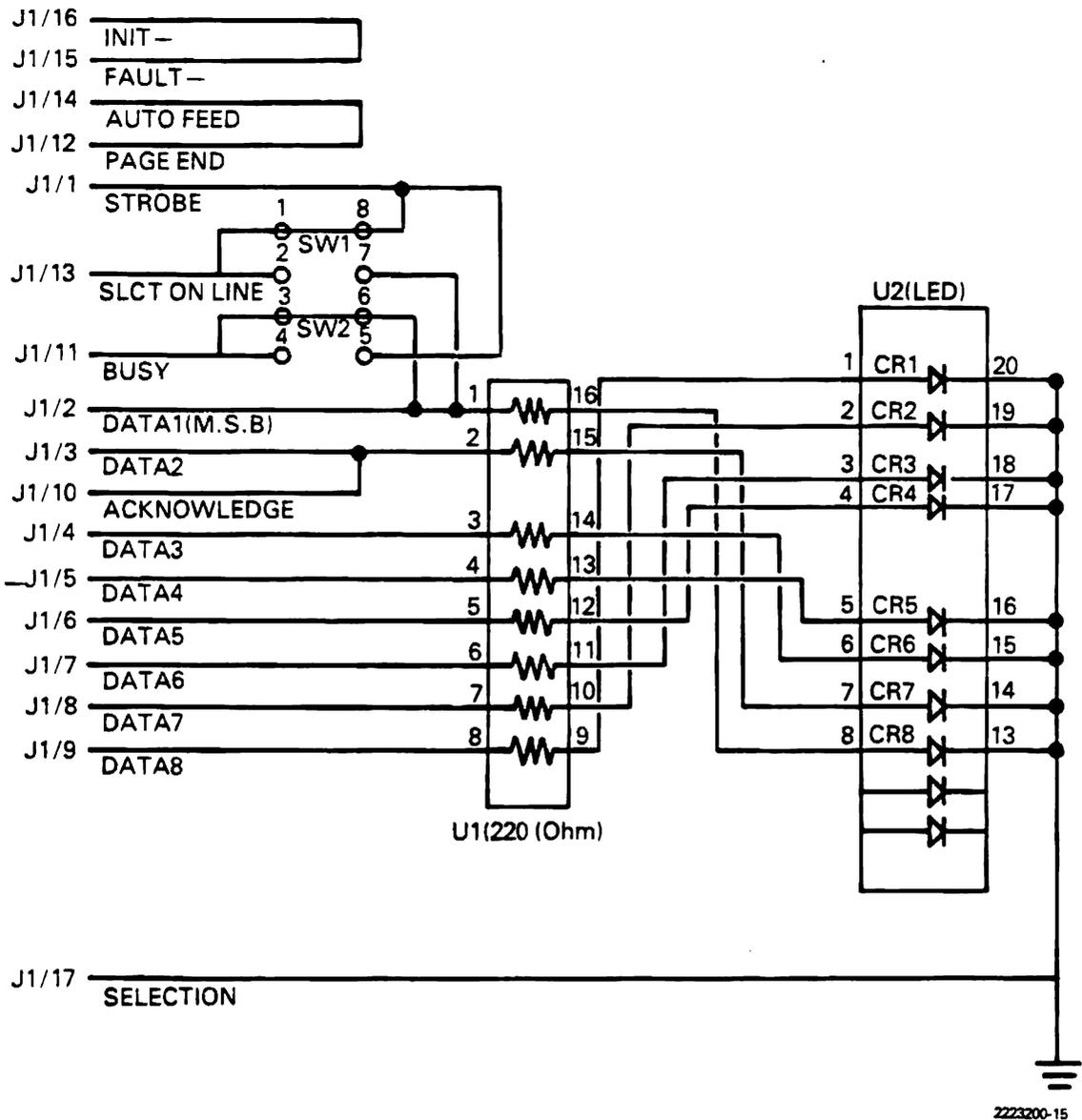


Figure 4-1. Parallel Test Plug Schematic

**Mode 2 Testing.** Mode 2 testing uses the eight LEDs to display additional failure information AFTER a power-up self-test failure has occurred. In order for this mode to function properly, the parallel test plug must only be inserted AFTER a power-up self-test failure has occurred. If you insert the parallel test plug prior to turning on the power, incorrect information will be displayed on

the eight LEDs. The additional LEDs should be read and compared with the information in Table 4-3.

The failure codes shown in Table 4-3 are available only when using the parallel test plug and correspond to LEDs lit on the test plug.

**Table 4-3. Test Plug LED Error Indicators**

<b>Red LED</b>	<b>Yellow LED</b>	<b>Green LED</b>	<b>Test Plug Display</b>	<b>Additional Failure Information</b>
ON	ON	ON	00000000	Bad processor on main board
ON	ON	OFF	00000000	Bad ROM — replace
ON	OFF	ON	00000000	RAM — Parity bit failure
			XXXXXXXX1	RAM — LSB failure
			1XXXXXXXX	RAM — MSB failure
			11111111	RAM — All bits failed
ON	OFF	OFF	00000000	Interrupt controller failure
ON	OFF	ON	00000001	Invalid interrupt
			00000010	NMI interrupt failure
			00000100	Timer interrupt failure
			00001000	FDC interrupt failure
			00010000	Keyboard interrupt failure
			00100000	Timer 0 failure
			01000000	Timer 1 failure
			10000000	Timer 2 failure
OFF	ON	ON	XXXXXXXX1	FDC logic: even bit, sector buffer fails
			XXXXX1X1	FDC logic: odd bit, sector buffer fails
			XXXX1XX1	Controller failed (registers)
			XXX1XXXX	Controller failed (restore)

Table 4-3. Test Plug LED Error Indicators (Continued)

Red LED	Yellow LED	Green LED	Test Plug Display	Additional Failure Information
OFF	ON	OFF	00000000	Not used
			XXXXXXXX1	CRT Attribute memory failure
			XXXXXXXX1X	CRT Attribute latch failure
			XXXXX1XX	CRT Controller fails (registers)
			XXXX1XXX	CRT Character memory failure
			XXX1XXXX	CRT Video output failure
			XX1XXXXX	Reserved for future option
			X1XXXXXX	Reserved for future option
			1XXXXXXX	Reserved for future option
OFF	OFF	ON		Reserved for future option

**4.3.1.2 Power-Up Sequence.** The power-up self-tests take place in the following order.

1. **Hardware Reset.** All LEDs are lighted at the start of the test (a binary seven is displayed). A check is made for the existence of a valid factory-interface ROM. If the ROM is not present, normal power-up testing continues. Hardware that must be reset to permit testing is reset at this point. At the completion of this test, a binary six is displayed on the LEDs.
2. **ROM Test.** A cyclic redundancy check (CRC) of the boot ROM (U63) is executed. At the completion of this test, a binary five is displayed on the LEDs.
3. **RAM Test.** The 64-kbyte dynamic RAM on the system unit board is tested. A failure here will halt the test. If the parallel test plug is installed on the parallel port, the failing bit(s) will be indicated by a lighted LED. At the completion of this test, a binary four is displayed on the LEDs.
4. **Interrupt Controller Test.** The interrupt controller and interrupts that are generated by the basic system unit hardware (such as non-maskable interrupt [NMI], diskette drive interrupt, and keyboard interrupt) are tested. The CRT controller interrupt is not included, since it is tested in the CRT test. At the completion of this test, a binary three is displayed on the LEDs.
5. **Timers Test.** The two timers used in the CPU subsystem are tested. The timer used to generate the audible tones to the speaker is also tested.
6. **Speaker Test.** The speaker is tested with a short, polite tone.
7. **FDC Test.** The floppy disk controller and related registers and buffers are tested. At the completion of this test, a binary two is displayed on the LEDs.

8. **CRT Test.** The attribute and character display memory is tested. The CRT controller board is tested, the CRT interrupt is verified, and a brief video signal is displayed on line one of the display to test the video signal output. At the completion of this test, a binary one is displayed on the LEDs.
9. **Keyboard Test.** The system unit CPU

transmits a request to the keyboard CPU for a CRC check of the contents of the keyboard ROM. An incorrect CRC checksum causes an error message to be displayed. If the keyboard fails to respond to the request, a similar error message is displayed. No LED pattern is displayed by this test. Table 4-4 shows error messages that may be displayed as a result of this test.

**Table 4-4. Keyboard Test Error Messages**

Display	Meaning
** Keyboard Error - 0010 **	Keyboard not installed.
** Keyboard Error - 0011 **	Keyboard installed but no response.
** Keyboard Error - 0012 **	Keyboard RAM failure.
** Keyboard Error - 0013 **	Keyboard ROM failure.
** Keyboard Error - 0014 **	Keyboard unexpected response.
** Keyboard Error - 0015 **	Keyboard ACK character receive error.

10. **Option RAM Test.** Any option RAM installed is tested. A pattern of walking ones and zeros is used. No LED pattern is

displayed by this test. Table 4-5 shows error messages that may be displayed as a result of this test.

**Table 4-5. Option RAM Test Error Messages**

Display	Meaning
** System Error - 0020 **	Option RAM bank 1 fails.
** System Error - 0021 **	Option RAM bank 2 fails.
** System Error - 0022 **	Option RAM bank 3 fails.

11. **Optional ROMs Test.** Any ROMs installed on the main board or on option boards are checked for a valid CRC checksum. As each CRC test completes, it conducts any self-tests for the option or circuits associated with the option. The ROM on a Winchester controller board causes the Winchester disk drive to be booted. The

operating system on that drive is loaded into memory. If a hardware fault locks up the system, the LEDs remain lit in the pattern of OFF-OFF-ON (only the green LED is lit). At the completion of this test, a binary zero is displayed on the LEDs. Table 4-6 shows error messages that may be displayed as a result of this test.

**Table 4-6. Option ROM Test Error Messages**

Display	Meaning
** System Error - 0028 **	Option ROM at hexadecimal address 0F4000 failed.
** System Error - 0029 **	Option ROM at hexadecimal address 0F6000 failed.
** System Error - 002A **	Winchester Option ROM at hexadecimal address 0F8000 failed.
** System Error - 002B **	Option ROM at hexadecimal address 0FA000 failed.
** System Error - 002C **	System ROM (U62) at hexadecimal address 0FC000 failed.

12. **Diskette Drive Test.** The software attempts to read sector one of track zero from each drive in sequence, starting with drive A (logical drive zero). The first drive from which a valid boot sector can be loaded is used as the boot drive. The boot sector is loaded into RAM and executed. This information provides instructions to read the remainder of the operating system from the same diskette and load it

into memory. If a failure occurs anywhere in this sequence, the boot program returns to the ROM boot, and an error message is displayed. Another drive is then tried. If none of the four can be booted successfully, error 0031 is displayed. Table 4-7 shows error messages that may be displayed as a result of this test.

**Table 4-7. Diskette Drive Test Error Messages**

Display	Meaning
** System Error - 0030 **	No diskette drives installed.
** System Error - 0031 **	System could not boot from any drive.
** System Error - 0032 **	CRC diskette read error.
** System Error - 0033 **	Diskette seek error.
** System Error - 0034 **	Sector not found.
** System Error - 0035 **	FDC interface failure.
** System Error - 0036 **	Not a system diskette.
** System Error - 0037 **	Diskette format error or no data received.
** System Error - 0038 **	Boot sector CRC error or bad sector buffer.
** System Error - 0039 **	DRQ error from controller.

13. **Winchester Interface Test.** The Winchester disk controller interface circuits are checked by testing the sector buffer on the controller board and the disk controller itself. If the Winchester disk drive and controller board option is not

installed, the test is skipped and the power-up self-test is concluded.

Table 4-8 lists system error messages that may occur during a power-up self-test or at any other time the computer is operating.

**Table 4-8. Other Error Messages**

Display	Meaning
** System Error - 0008 **	Unexpected NMI during power-up.
** System Error - 0009 **	RAM parity error detected during power-up.
** System Error - 1040 **	Unexpected NMI.
** System Error - 1041 **	RAM parity error detected during operation.
** System Error - 1042 **	Unexpected software or hardware interrupt.
** System Error - 1050 **	Fatal software condition encountered.

#### 4.4 USING THE DISKETTE DIAGNOSTICS

The diskette-based diagnostics are contained on a single diskette shipped as part of the Software Package, Diagnostics Maintenance (TI Part No. 2223199-0001). This package contains the Maintenance Handbook and a diagnostics diskette.

The diskette-based diagnostics are intended for two types of users.

The first type is the Texas Instruments Professional Computer user, who needs to ensure that the hardware is installed and is operating properly. If it is not operating properly, the user needs to know which major unit requires service (system unit, display unit, or keyboard).

The second user is the customer representative or technician who uses the advanced diagnostics to isolate a failure to the field-replaceable assembly (FRA).

The diagnostics diskette contains programs which are designed to check out thoroughly the different parts of the system. These programs perform tests that are more extensive than those of the power-up self-test. The information obtained from them accomplishes several things. After running these tests, you will be able to answer the following questions.

- Is the system functioning properly?
- Which part of the system is faulty?

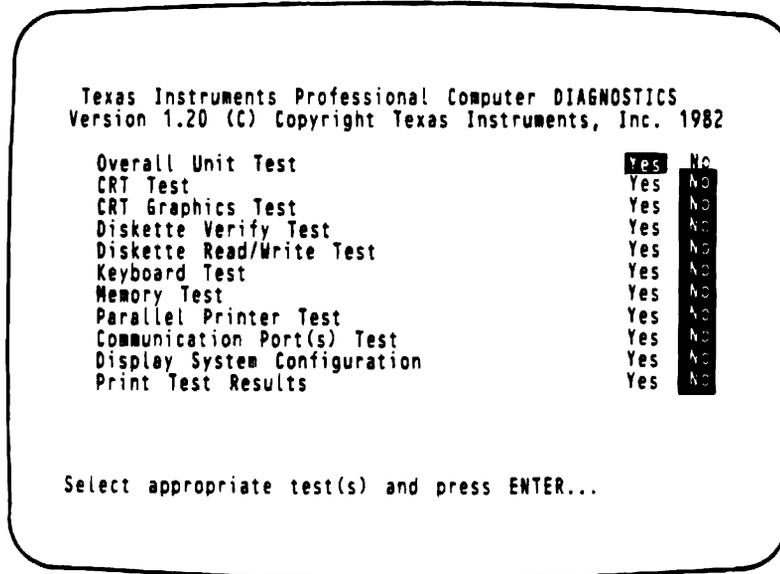
We ask that you write down pertinent information while testing (or, if you have a printer, print the results). Some of the tests will require that you participate. Also, you need to have a spare ("scratch") diskette for one of the tests. We provide the details below.

##### 4.4.1 Starting the Diagnostics

Follow these steps.

1. Place the system unit ON/OFF switch in the OFF position.
2. Remove the male end of the system unit ac power cord from the three-prong ac power receptacle.
3. Recheck the installation of all cables and cords. (This information is located in subsection 2.4, "Cable Connections.")
4. Remove the diagnostics diskette from the plastic holder in the back of this handbook.
5. Make certain the door of the diskette drive is open. To open it, gently lift the front latch.
6. Insert the diskette, with the label side up and towards you, into the left-hand diskette drive. Remember to treat the diskette carefully.

7. Close the door of the diskette drive by gently pushing down the front latch.
8. Ensure that the display unit is turned on. To do this, pull the upper control on the display outward.
9. Recheck that the ON/OFF switch on the system unit is in the OFF position.
10. Insert the male end of the ac power cord attached to the system unit into a three-prong receptacle.
11. Place the system unit ON/OFF switch in the ON position.
12. After about 30 seconds, the display should appear as shown in Figure 4-2.



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**Figure 4-2. Diagnostics Menu 1**

13. Look at your display and match your response with one listed below.

**RESPONSE:** It is similar to Figure 4-2.

**ACTION:** Go to the next section, "Using the Diagnostics."

**RESPONSE:** Nothing is visible.

**ACTION:** Recheck that the two controls on the front of the display unit are turned fully clockwise. Recheck that the video cable from the display unit to the system unit is firmly attached.

**RESPONSE:** One or more system messages appear on the display.

**ACTION:** Write down this information. If any of these messages are of the type:

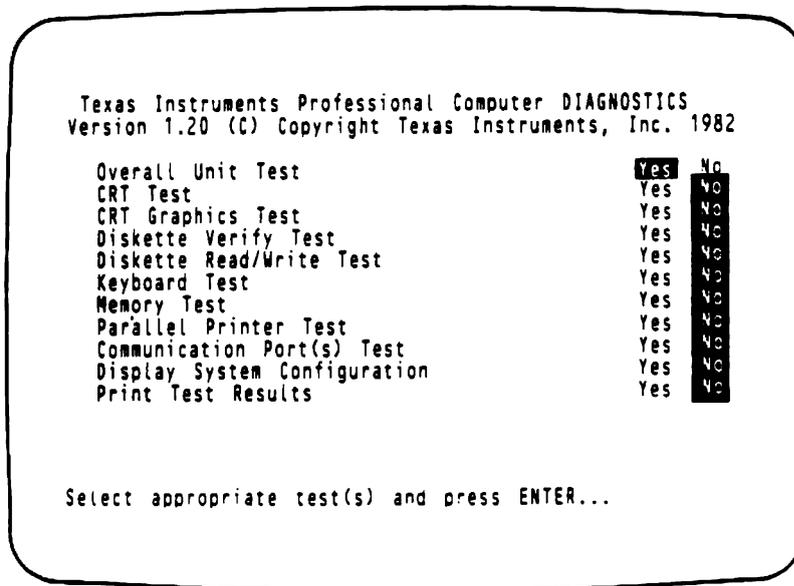
**\*\*Keyboard error\*\* 001x**

recheck that the cable from the keyboard is properly attached to the back of the system unit.

If a keyboard message still appears when you restart the system, replace the keyboard. For other system messages, proceed to the next section.

#### 4.4.2 Using the Diagnostics

Your display currently shows a menu of the different choices you have, as shown in Figure 4-3.



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**Figure 4-3. Diagnostics Menu 2**

To test the entire system, we use the Overall Unit Test entry of the test menu. This test is actually a collection of all the other tests displayed. When you select the last entry, Print Test Results, you receive a printed record of all test results.

If you have a parallel printer connected to your system, press the **DOWN ARROW** key until the

cursor is on the Print Test Results line. Then press the **LEFT ARROW** key once to select this option. (Ensure that your printer is ready.)

Don't press the **ENTER** key yet.

You need to do three things while the Overall Unit Test is being performed.

1. During the Display System Configuration Test, inspect the amount of memory (RAM) and the list of options to see if everything that you think is installed shows up. Also write down the System Configuration Code.

A sample configuration display is shown in Figure 4-4.

2. Watch the display for messages and write down the associated number for any which indicate a failure or an option not installed. For example, for the following failure message you would write down "0510".

System RAM failure in IC Uxx - 0510

```
                Texas Instruments Professional Computer
                  System Configuration

ROMs installed:

V1.20 SYSROM (c) Copyright Texas Instruments Inc. 1982

RAM installed: 123 K bytes

OPTIONS installed:
Diskette drive 1, 1 side(s), 40 tracks
Diskette drive 2, 1 side(s), 40 tracks
3 Graphics planes

System Configuration Code - 7073200000
```

Figure 4-4. Configuration Display

In general, write down the number of any message that is *not* of the type xx00, where xx can be anything. These messages indicate a test has been completed. Here's an example:

RAM test: Test complete - 0500

3. During the execution of the diagnostic tests, you may be asked to press certain keys and verify some information on the display.

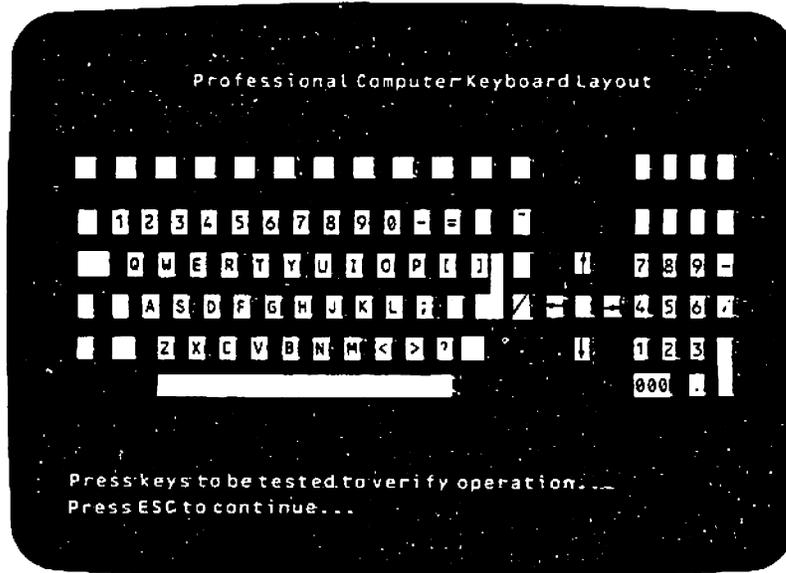
Let's run the diagnostics:

1. Press the ENTER key.
2. The first test displays the configuration of your system. Normally, before you have a chance to read this information, the display is used for the next test. After that test is completed, you will have a chance to see the configuration information.

Record the System Configuration Code. Verify if all your options and amount of

memory (RAM) are listed correctly. If there are any differences, check the option installation procedure in Appendix C.

3. Look at the messages being displayed and note errors or options not installed until your display appears as shown in Figure 4-5.



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Figure 4-5. Keyboard Display

This part of the test helps you determine if all the keys are functioning.

When you press a key, the corresponding location on the display will flash, and the system unit will beep. Test all the keys except the *ESC* key.

To test the **SHIFT** key, press and hold the **SHIFT** key and then press another key. Then release both of them. The **SHIFT** key symbol on the display should flash along with the symbol for the other key you pressed. Use the same method to test the **CTRL** and **ALT** keys.

Activate the **CAPS LOCK** by pressing it once. Press another key and check to see that both key symbols flash.

If any of the keys didn't work, replace the keyboard board.

After you have tested all the keys, press the **ESC** key.

#### NOTE

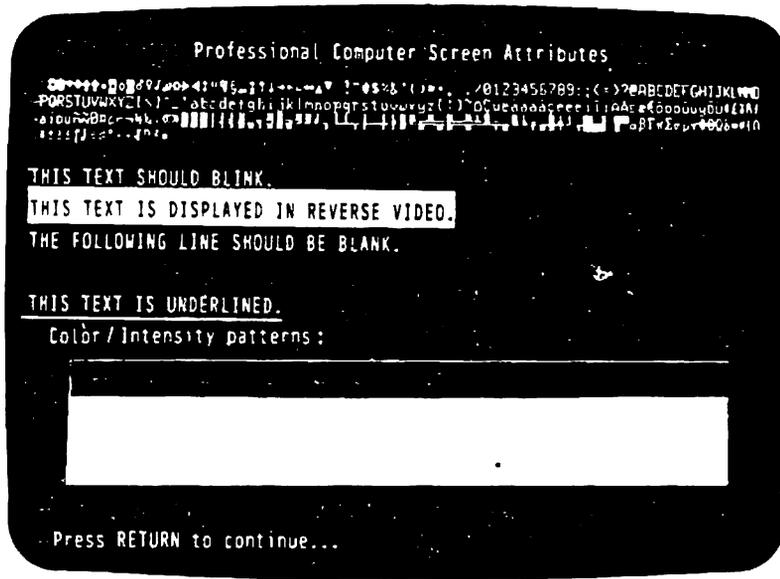
If you accidentally hit the **ESC** key twice and have a blank display, except for the single letter "A:" it means you have exited the diagnostics program. To reenter the diagnostics, simply type:

#### DIAGS

and press the **RETURN** key. This will take you back to the diagnostics menu.

- If any of the keyboard messages had numbers from 0203 to 0207, replace the keyboard board. Look at the messages

being displayed, and note errors or options not installed until your display appears as shown in Figure 4-6.



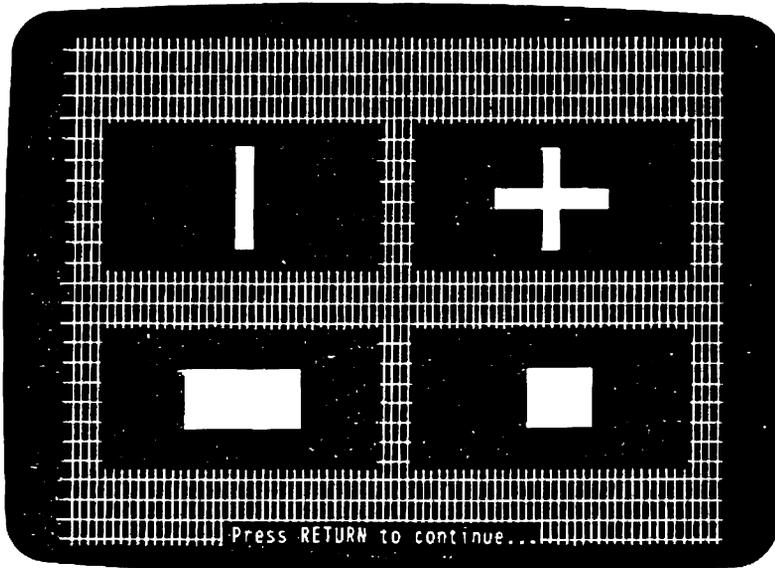
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**Figure 4-6. Attributes Display**

Verify whether or not your display matches the illustration. If not, have your system unit serviced.

Now press the RETURN key.

- Look at the messages being displayed and note errors or options not installed until your display appears as shown in Figure 4-7.



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**Figure 4-7. Alignment Display**

Verify whether or not your display matches Figure 4-7. If not, check the monochrome display alignment, using the procedure at paragraph 2.8.1. If a color display unit displays a shift of the bright background from the large graphic figures, run the advanced diagnostics test: Display Graphics Alignment Test as indicated in Appendix A. Now press the **RETURN** key.

6. Look at the messages being displayed and note errors or options not installed until your display shows the following message:

Insert a **SCRATCH** diskette and enter a drive to test (1-4).[ ]

The first part of this test checks if information can be both read and written to a diskette. It requires a scratch diskette. The drive numbers requested (1-4) are analogous to the designations A, B, C, and D.

Remove the diagnostics diskette and insert a spare diskette. Make sure you use one that has no important information and is not write-protected.

Enter a drive number 1. (The number which you enter must equal the number for an installed drive, or you will have an error message indicating the drive is not installed. For this explanation we have selected drive 1.)

7. Look at the messages being displayed and note errors until your display shows this message:

Press **SPACE** bar to test another drive, or, Insert diagnostic disk in drive 1 and press **RETURN** to continue test.[ ]

If you don't have another drive, replace the scratch diskette with the diagnostics diskette and press the **RETURN** key. Skip to step 11.

If you have a second drive, press the space bar. You get this message:

Insert a **SCRATCH** diskette and enter a drive to test (1-4).[ ]

8. Remove the scratch diskette from drive A and place it in drive B. Enter a drive number 2.
9. Look at the messages being displayed and note errors until your display shows this message:

Press **SPACE** bar to test another drive, or, Insert diagnostic disk in drive 1 and press **RETURN** to continue test.[ ]

10. Remove the scratch diskette from drive B, insert the diagnostics diskette into drive A, and press the **RETURN** key.
11. Look at the messages being displayed and note errors until your display shows this message:

Diskette Test: Enter a drive to test (1-4).[ ]

The next portion of this test checks if information can be read from a diskette.

12. Replace the diagnostics diskette in drive A with the scratch diskette and enter the drive number 1.
13. Look at the messages being displayed and note errors until your display shows this message:

Press **SPACE** bar to test another drive, or, Insert diagnostic disk in drive 1 and press **RETURN** to continue test.[ ]

14. If you don't have a second drive, replace the scratch diskette in drive A with the diagnostics diskette, press the **RETURN** key, and skip to step 18.
15. To test the second drive, press the space bar. You see this message:

Diskette Test: Enter a drive to test (1-4).[ ]

Remove the scratch diskette from drive A and place it in drive B. Enter a drive number 2.

- 16. Look at the messages being displayed and note errors until your display shows this message:

Press SPACE bar to test another drive, or, Insert diagnostic disk in drive 1 and press RETURN to continue test.[ ]

- 17. Insert the diagnostics diskette in drive A, and then press the RETURN key.
18. When you have finished checking all the drives, inspect the messages and take the

appropriate action as described below. If errors recur when you are asked to test again, record the number(s) and refer to Appendix B for the meanings and recommended actions.

If you don't have a parallel printer attached, skip the next step.

- 19. Look at the messages being displayed and note errors or options not installed. Inspect the printer messages shown in Figure 4-8 and take the appropriate action as described below. If errors recur when you are asked to test again, record the number(s) and check the meaning in Appendix B. Your printer should then print the information shown on the display.

1234567890ABCDEFGHIJKLMNOPQRSTUVWXYZ !@#\$%^\*()\_+~;:><abcdefghijklmnopqrstuvwxy

Figure 4-8. Printer Display

If your printed output doesn't match the illustration, check the parallel-printer port interface by performing a Parallel Printer Loopback Test, as outlined in the advanced diagnostics (Appendix A). If the system passes the Parallel Printer Loopback test, the problem lies with the printer or the printer cable. Replace the cable assembly to check for a bad cable.

- 20. Look at the messages being displayed and note errors or options not installed until the testing completes. (Ignore printer

messages if you don't have a printer attached.)

At this point, pressing any key brings you back to the main menu.

If you wish to run a specific test from the User Diagnostics menu, and not the Overall Unit Test, use the cursor-control arrows to select tests and press the ENTER key when all desired tests are selected, or use the RETURN key if your cursor is positioned on the last test.

#### 4.4.3 Interpreting the Messages

Typically, you received several messages during the diagnostics indicating that a particular option was not installed. If any of these conflict with what you thought was installed, check the option installation using the option manuals in Appendix C. For the meaning of error messages and the recommended action, see Appendix B.

#### 4.5 ADVANCED DIAGNOSTICS

The advanced diagnostics are accessible to service personnel who are using the standard diagnostics diskette. When the main menu is displayed (which occurs immediately after the diskette is booted), press and hold the CTRL key, and then press the A key. The advanced diagnostics menu is then displayed, as shown in Figure 4-9.

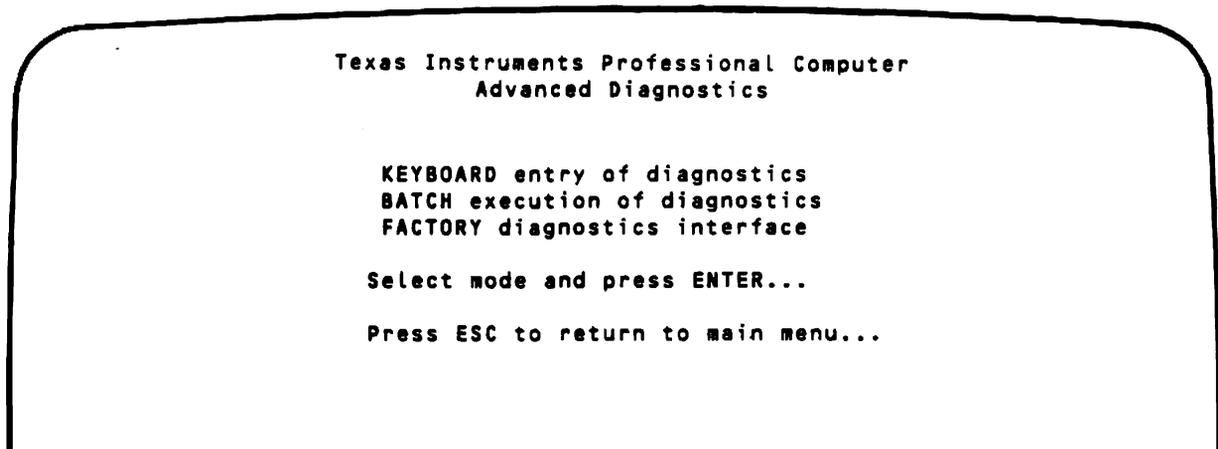


Figure 4-9. Advanced Diagnostics Menu

The advanced diagnostics provide two basic functions.

- Specify individual parameters for each of the diagnostic test programs in the system.
- Execute these tests from an asynchronous communications link (factory use only), a batch file, or directly from the keyboard.

Individual parameters can be specified using the diagnostic commands of string format, where a typical command syntax is as follows.

```
COMMAND PARM = VALue PARM = VALue..... PARM = VALue PARM = VALue
```

Everything in uppercase characters is mandatory. All information in lower case is optional. In other words, typing either LOC or LOCAL will be accepted by the program. This enables short commands and parameters to be entered to initiate advanced diagnostics tests. The word PARM is shorthand for "test parameter." COMMAND is

the filename assigned to the test, and VALUE is the figure or word you have selected which will indicate the subtest to run, which device to test, or other information about the test you have selected. All of the details on running these tests are provided in Appendix A, "Advanced Diagnostics Tests."

For example:

```
COM TST TEST = LOCAL PORT = 1
FORMat = ASYnc SPEed = 300 MODE = INTERnal, ERRor = 5
LOOPs = 2 LOG = ON
```

In this example, the following was selected.

- Communications Local Loopback Test
- Port 1 (the port number assigned the sync-async board by jumpers)
- Asynchronous mode
- 300-baud rate

- Internal loopback test mode
- Maximum of five errors recorded
- Test conducted twice
- Test results printed on attached parallel printer

COMTST TES = LOC POR = 1 FOR = ASY  
 SPE = 300 MOD = INT ERR = 5 LOO = 2  
 LOG = ON

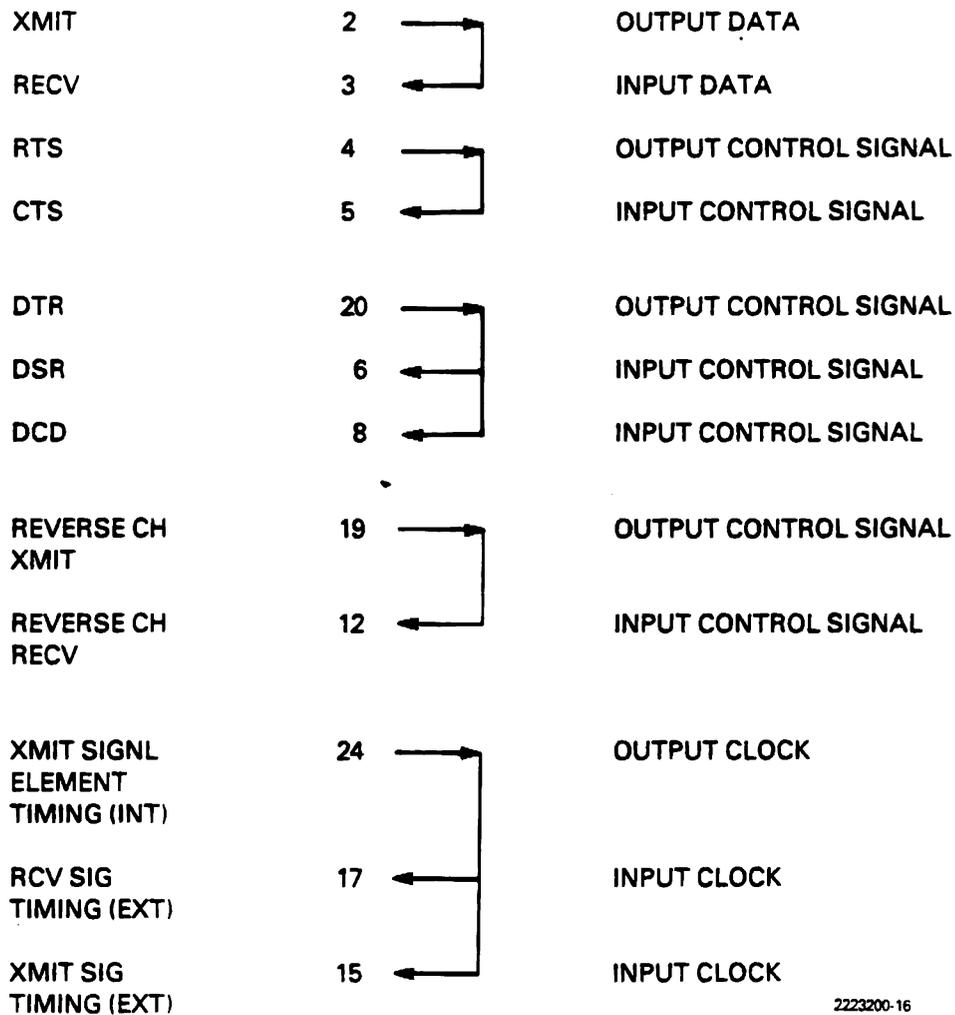
**4.5.1 Test Plugs**

The two test plugs that may be used with the advanced diagnostics are a communications loopback plug and a parallel port test plug.

**4.5.1.1 Communications Loopback Plug.**

The communications loopback plug is used with the Communications Local Loopback Test. A schematic of the comm loopback plug is shown in Figure 4-10.

This example could also have been entered, using the absolute minimum of keystrokes, as follows.



2223200-16

**Figure 4-10. Comm Loopback Plug Schematic**

Details on running the communications Local Loopback Test are given in Appendix A. The communications loopback plug is installed prior to running the test, and provides a return, or looping back of the transmitted signal, to the receive line. Additional signal lines are looped back for control purposes. This enables the originating unit to have its transmitted data "echoed back" for comparison and verification of the complete link.

**4.5.1.2 Parallel Test Plug.** Operation of the parallel test plug is covered in paragraph 4.3.1. Figure 4-1 shows the schematic diagram for the parallel test plug.

#### **4.5.2 Keyboard Entry of Diagnostics**

Keyboard entry of diagnostics prompts the user or customer representative to enter explicit commands in a string format from the keyboard. After the test name and parameter information are entered, the ENTER key must be pressed to begin the test. On completion, the display prompts for pressing the RETURN key so that test results may be examined before restoring the advanced diagnostics menu. As in the user diagnostics, pressing the ESC key at any time will abort the test and return to the advanced diagnostics menu. If the advanced diagnostics menu is displayed, and the ESC key is pressed, the user diagnostics menu is then displayed. Pressing the ESC key one more time exits the user diagnostics menu and displays:

A:

If you wish to return to the diagnostics menu, simply type:

DIAGS

and press the RETURN key. After a few seconds, the user diagnostics menu is displayed.

For details on specific tests which may be entered, see Appendix A.

#### **4.5.3 Batch Execution of Diagnostics**

Batch execution of diagnostics permits execution of diagnostics commands stored in a MS-DOS diskette file. When batch execution is activated, the operator is prompted for the name of the file containing the commands. The commands are then read from the diskette and executed one at a time.

The file containing the commands must be a text file. Only one command is permitted per record. Command files can be created using the MS-DOS utility program EDLIN. The name of the file should not have the same spelling as that of the system batch files. System batch files can be checked by typing DIR and pressing the RETURN key. The directory of the diskette in the default drive will be displayed. Check all of the filenames listed with an extension (three letters in the second column) of BCH. DO NOT duplicate any of these filenames, or you will be erasing the original file with the same name.

Detailed information on the MS-DOS EDLIN utility program may be found in the *Texas Instruments Professional Computer MS-DOS Operating System* manual.

Comments may be included in the batch file by preceding each comment with an exclamation mark (!). The first record is always ignored, so it may be used for comments or documentation purposes (see the following example). The LOOP command provides a feature that enables the constant repeating of the tests in a batch file. To use this feature, add the word LOOP after all tests which are to be repeated.

Any commands following the LOOP command are ignored. A sample command file is shown below.

```
Record 0 Example Batch file (record 0 is ignored)
Record 1 COMTST SPEed = 300 LOOPs = 1
ERRORs = 20
Record 2 ROMTST LOG = ON !comment
Record 3 !comment
.
.
Record N-1 FLOTST TEST = VERify LOOPs = 30
Record N LOOP
```

The ESC key can be pressed to terminate the batch execution of tests and return to the advanced diagnostics menu. After running a batch file program with no LOOP command, the display shows a prompt to press the RETURN key. Test results can then be examined before returning to the advanced diagnostics menu.

For details on batch tests that may be executed from your own batch files, see Appendix A.

#### 4.5.4 Customizing the User Menu

The diagnostics have been designed to allow you to customize the user menu. You can easily change the tests performed by each menu entry, delete menu entries, or add your own tests to fit your needs.

Each entry shown in the user menu has an associated batch file that contains the commands which will be executed when that menu is selected. When the diagnostics are activated, the menu is built by searching the diagnostics diskette for batch files following a certain naming convention. This operation occurs when you see the "Building Menu..." message on the display.

Batch files that are part of the user menu must be named so that the first character in the filename is a dollar sign \$ and has the BCH file extension. As you may have noticed in previous sections, the first line in a batch file is reserved. This line is used to place the text that you would like to appear on the menu to describe the contents of that particular batch file. For example, if you wanted to create a batch file containing a combination of various diskette tests that you have selected, you would create a batch file as follows (using the MS-DOS EDLIN utility).

File name: \$DSKTST.BCH

File Contents:

```
Line 1: MY OWN DISKETTE TESTS
Line 2: FLOTST TEST = VERIFY DRIVE = 3
        LOOP = 60 ERRORS = 30
Line 3: FLOTST TEST = WRITE DRIVE = 3
        LOOP = 700 LOG = ON
```

.  
. .  
. .  
. .  
AND SO ON

The same rules applicable to any other batch file apply to those appearing on the menu. The LOOP command can be used to repeat the tests in the batch file indefinitely each time the corresponding menu entry is selected. Before you create any menu entries of your own, it is recommended that you list the directory contents of the batch files in

your diagnostics diskette that make up the standard user menu. By listing the directory contents, you can avoid conflicts with the existing batch files while naming your own files.

If you want to remove an item from the menu, simply delete the corresponding batch file from the diskette using the MS-DOS ERASE command.

#### 4.5.5 Factory Diagnostics Interface

The factory diagnostics interface allows diagnostic programs to be executed in the unit under test. This interface is solely for use by the factory and cannot be used in the field.

### 4.6 EXTERNAL FAULT IDENTIFICATION

The Texas Instruments Professional Computer has been designed to meet the highest standards of performance and reliability. Like any electronic data equipment, performance and reliability are directly related to the environment. Faults are often traced to extremes (or failures) of magnetic media, ambient temperature, humidity, dust, ac power source, interconnecting cables, systems grounding, communications circuits, and equipment. Proper site preparation during the initial installation of the computer can reduce the need for corrective measures at a later date, often after important data is lost.

#### 4.6.1 Magnetic Media

Diskettes, which have been "zapped" by a magnetic field, damaged by dust or foreign particles, or have simply worn out through constant and prolonged use, are the major cause of faults in any diskette-based computer system. These problems can be dramatically reduced through both the training of operators and the systematic backup of important diskettes. The common complaint that "it worked yesterday; why won't it work today?" is often accompanied by a needless and time-consuming service call...often when there is no hardware fault.

All too frequently the problem is with the diskette itself. Use only top-quality, fully tested and certified double-sided, dual-density diskettes. However, even the use of the best diskettes cannot guarantee trouble-free performance.

#### **4.6.2 Software**

Software that has not been thoroughly debugged, or a flawed diskette that causes alterations of software may produce random errors or errors which appear to indicate a possible hardware fault. If such a fault is encountered, try another copy of the software diskette. If the fault recurs, run both the user and advanced diagnostics. If the system checks out, the software should be suspect. If possible, run the software in another Texas Instruments Professional Computer. If the problem recurs with the other computer, the software is suspect.

#### **4.6.3 Temperature**

The computer should only be operated between + 10 and + 40 °C ( + 50 and + 104 °F).

Some types of diskette media are more sensitive to temperature changes than others. Physical changes in the recorded data may result in read errors unless the computer is operated in a stabilized environment.

Never cover or obstruct the exhaust fan at the rear of the system unit while power is on, or overheating may occur. The clearance between the system unit rear panel and a wall must be at least four inches to ensure adequate air circulation.

#### **4.6.4 Humidity**

Extremely high humidity or extremely low humidity can cause problems to computer equipment.

When high humidity is coupled with rapid temperature change, condensation takes place. This can lead to dust buildup, shorting of electronic components and circuits, and damage to diskettes.

Low humidity allows electrical charges which normally would be discharged into the atmosphere to accumulate. This electrical charge is referred to as static electricity. Static electricity can cause computer equipment to reset or lock up. When this happens, data which was in RAM storage is often lost, because recovery may require resetting the system.

With extremely low humidity, high levels of static electricity can build up in carpeting which has not been treated with an antistatic compound. Unfortunately, static electricity is often discharged through computer equipment, to a diskette, or to

other magnetic media with damaging results. The use of antistatic mats, carpets, and carpet sprays can alleviate this problem.

The Texas Instruments Professional Computer performs to specifications in an environment with a relative humidity from 20 to 80 percent with no condensation.

#### **NOTE**

Any time the computer is brought into an office environment from an extremely hot, cold, wet, or humid environment, permit it to stabilize at least two hours before operating. Diskettes also require stabilization to reduce data losses due to expansion or contraction of media.

#### **4.6.5 Dust**

If it is necessary to install the Texas Instruments Professional Computer in an environment with a high level of dust, the equipment must be dusted and vacuumed more frequently than normal so that dust buildup will not be excessive. Any visible dust buildup on a work surface is excessive.

The Texas Instruments Professional Computer has been designed for reliable operation in a wide range of environmental extremes, but dust and smoke should be avoided as much as possible, because they are very destructive to diskettes.

#### **4.6.6 AC Input Voltage**

The Texas Instruments Professional Computer operates with an ac input voltage range from 90 to 130 V (or from 180 to 264 V for the international model). Input frequency can range from 47 to 63 Hz.

The computer is equipped with a switching-type power supply. The power supply is capable of sustaining full dc output voltage for a minimum of 5 ms from loss of ac line voltage. It will withstand a 2.5-kV line transient of 1- $\mu$ s duration in the form of a damped sinusoid, and a 200-V line voltage surge of 8-ms duration, differential mode from the line. In other words, the computer will operate satisfactorily with all but the most severe fluctuations of line voltage. Industrial, medical, or office

equipment, such as copying machines, have motors that may produce transients, surges, or sags during start-up or shutdown. These power fluctuations may cause disruptions to the computer.

If serious line voltage problems exist, or are suspected, review the "Site Preparation" steps in Section 2.

#### **4.6.7 Interconnecting Cables**

A defect in an interconnecting cable is often overlooked and sometimes difficult to isolate. In most cases, excessive strain, crushing, or binding is the cause, and a shorted or open conductor is the result.

#### **4.6.8 System Grounds**

A qualified electrician may be needed to determine whether the outlet used is adequately grounded, and wired as an independent or isolated branch circuit. The branch circuit must be properly grounded to a buried building ground electrode at the service entrance of the power line.

Proper grounding of the computer ac receptacles, signal ground, equipment ground, and earth ground are covered in "Site Preparation" steps in Section 2.

### **4.7 IT PASSES ALL TESTS BUT STILL HAS PROBLEMS**

On rare occasions, a system passes all diagnostics, yet still has problems at the customer's loca-

tion. In such cases the following steps are recommended.

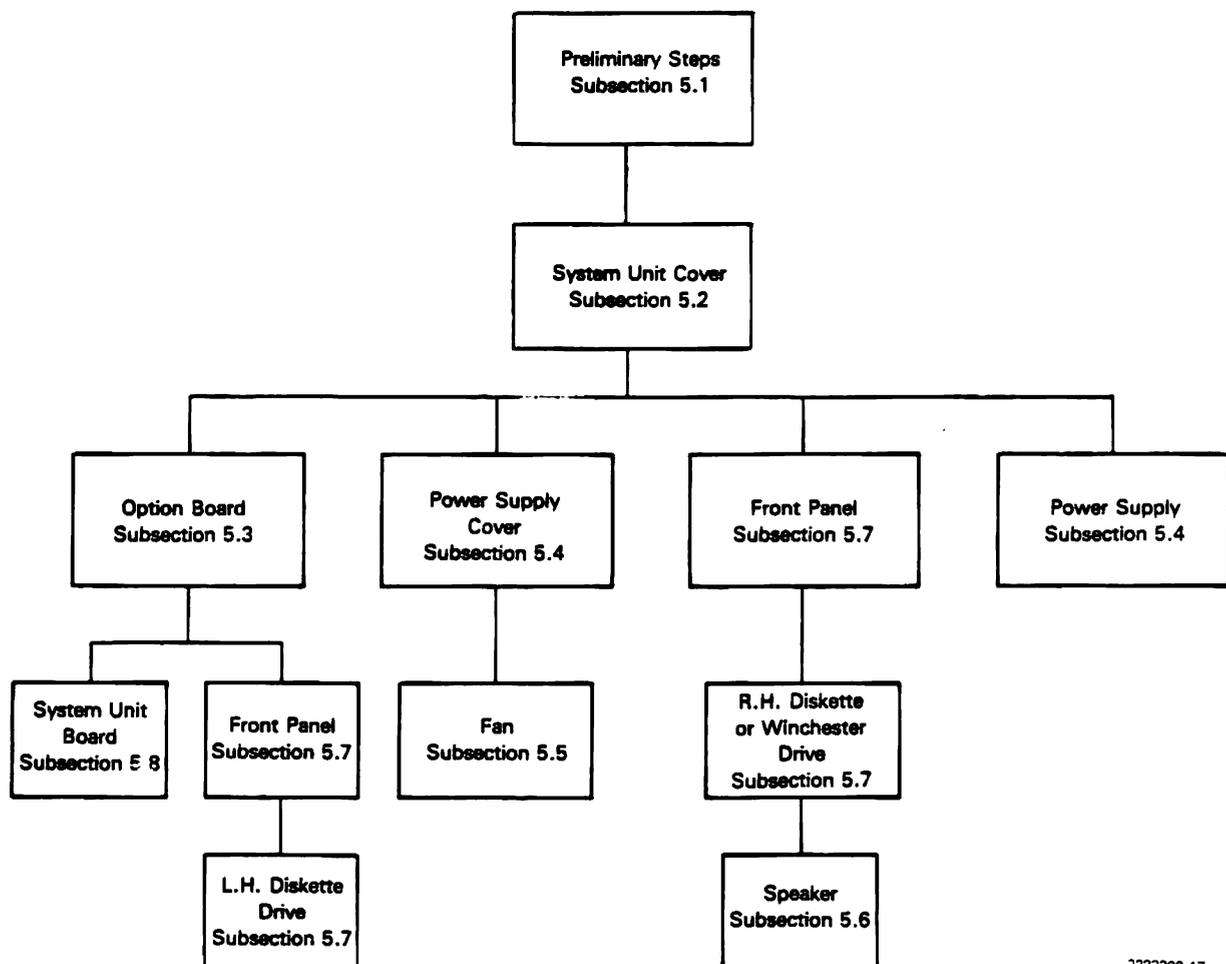
1. Determine whether the fault occurs when running one diskette or one type of software program. If a backup copy of the program is available, see if a fault occurs when running the backup. If another Texas Instruments Professional Computer system is available, see if the fault is repeatable on another system. If it is, the fault lies with the software. It may be a glitch that a software patch will cure. Refer the customer to the software source for another copy of the software and see if the problem still exists. In many cases, this is the cure.
2. Go over the site preparation precautions outlined in Section 2 again. It may be a faulty ground or power-line interference. Move the unit to another location. If that does not help, move it to the repair shop. If checking it at the repair shop causes the problem to cease, have the customer check his power, grounds, and sources of electrical interference.
3. If the problem is intermittent, it can still be caused by software, static electricity, radio frequency, or power-line interference. If exchanging field-replaceable units does not solve the problem, technical assistance may be required.

# Section 5

## Assembly Removal and Replacement

This section provides step-by-step procedures for the disassembly, removal, and reassembly of field-replaceable assemblies.

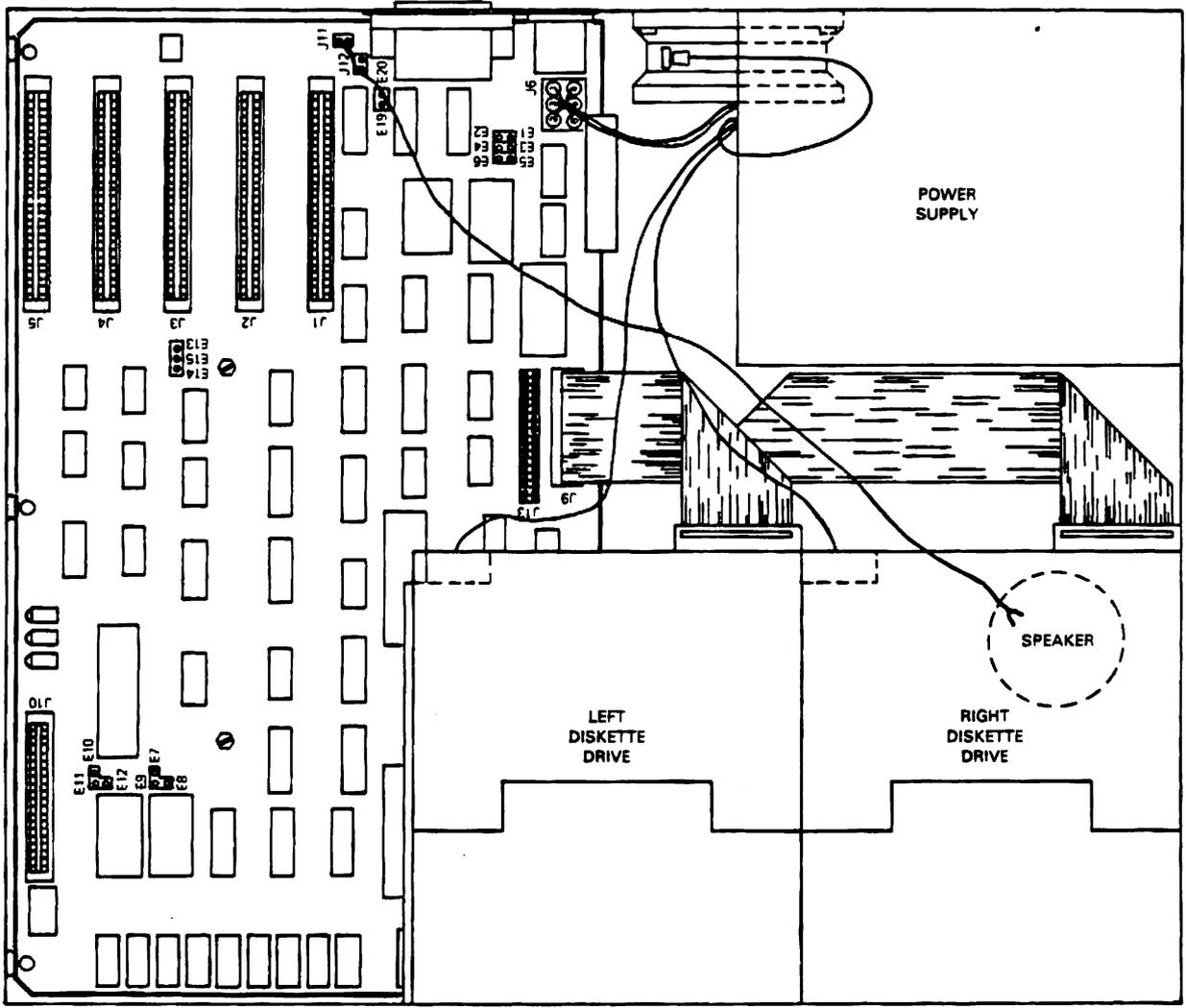
Figure 5-1 illustrates the order in which assemblies and options are to be removed from the system unit. In most cases, reassembly is simply in the reverse order.



2223200-17

Figure 5-1. Removal and Replacement Sequence

Figure 5-2 illustrates the interconnecting cables in the system unit.



2223200-18

**Figure 5-2. Cable Interconnection Diagram**

**5.1 PRELIMINARY STEPS**

Before attempting to remove any components, complete the following steps.

1. If you wish to check the computer or any component prior to removal, refer to subsection 2.8 of this manual for check-out procedures using a diagnostics diskette.
2. Place the system unit ON/OFF switch in the OFF position, and remove the power cord from the ac receptacle.

3. Disconnect the following cords and cables.

- System unit power cord
- Display unit power cord
- Display unit signal cable
- Keyboard cable
- Any other peripheral cables connected to the system unit

4. Remove the display unit from the top of the system unit and set it to the side. Set

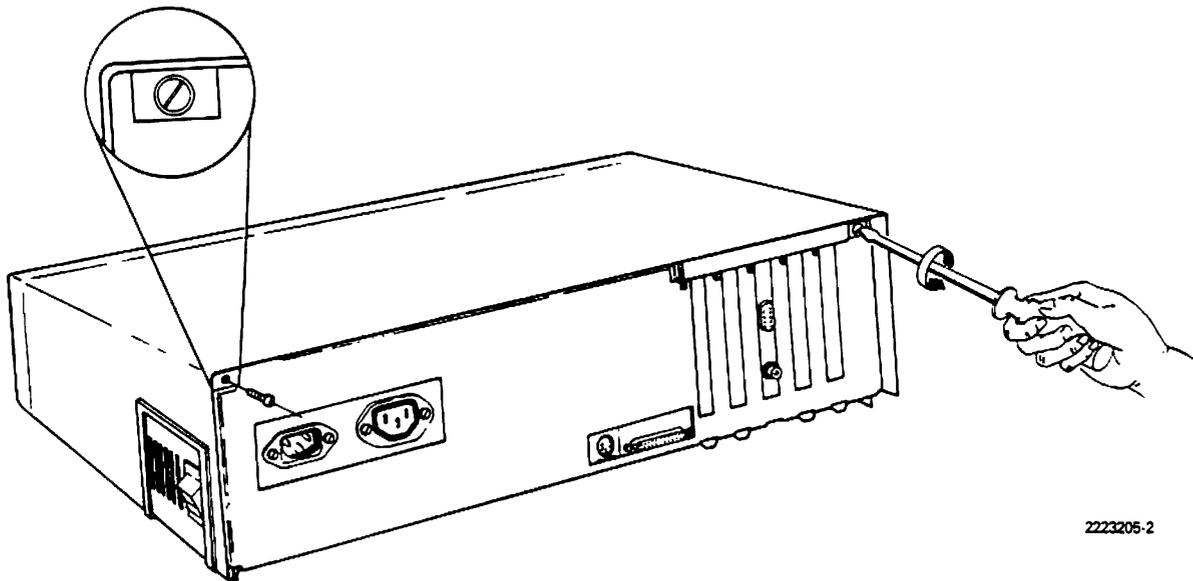
the keyboard and any other peripherals to the side, away from the system unit.

## 5.2 SYSTEM UNIT COVER

Use the procedures in the following section to remove and replace the system unit cover.

### 5.2.1 Cover Removal

1. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner with a flat-bladed screwdriver. See Figure 5-3 for the locations of the screws.



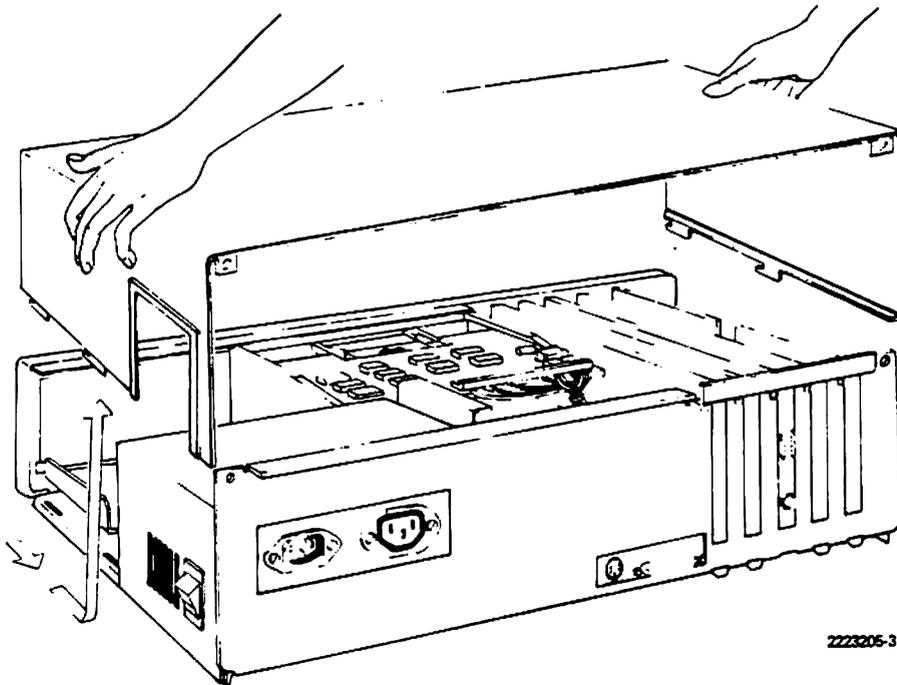
2223205-2

**Figure 5-3. Removing the Cover Screws**

2. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit. Set the cover aside and out of the way. See Figure 5-4.

### 5.2.2 Cover Replacement

1. Turn the system unit so that its rear panel is facing you. Replace the system unit cover by gently lowering it into place, and sliding it toward the front panel, as shown in Figure 5-5.



**Figure 5-4. Removing the Cover**

2. Replace the two cover screws securing the system unit cover and tighten as shown in Figure 5-6.

### 5.3 OPTION BOARD

Use the procedures in the following sections to remove and replace the option boards.

#### 5.3.1 Option Board Removal (for Options in Expansion Connectors J1-J5)

1. Place the system unit ON/OFF switch in the OFF position and remove the system unit power cord from the ac receptacle.
2. Disconnect the following cords and cables.
  - System unit power cord
  - Display unit power cord
  - Display unit signal cable
  - Keyboard cable
  - Any other peripheral cables connected to the system unit.
3. Remove the system unit cover as shown in paragraph 5.2.1, "Cover Removal."

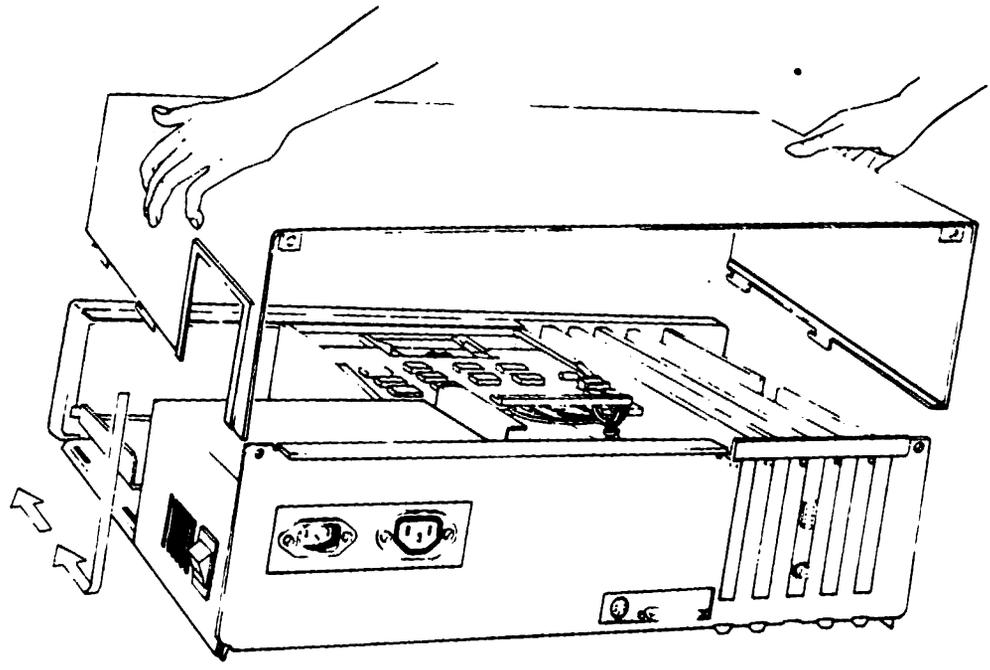


Figure 5-5. Replacing the Cover

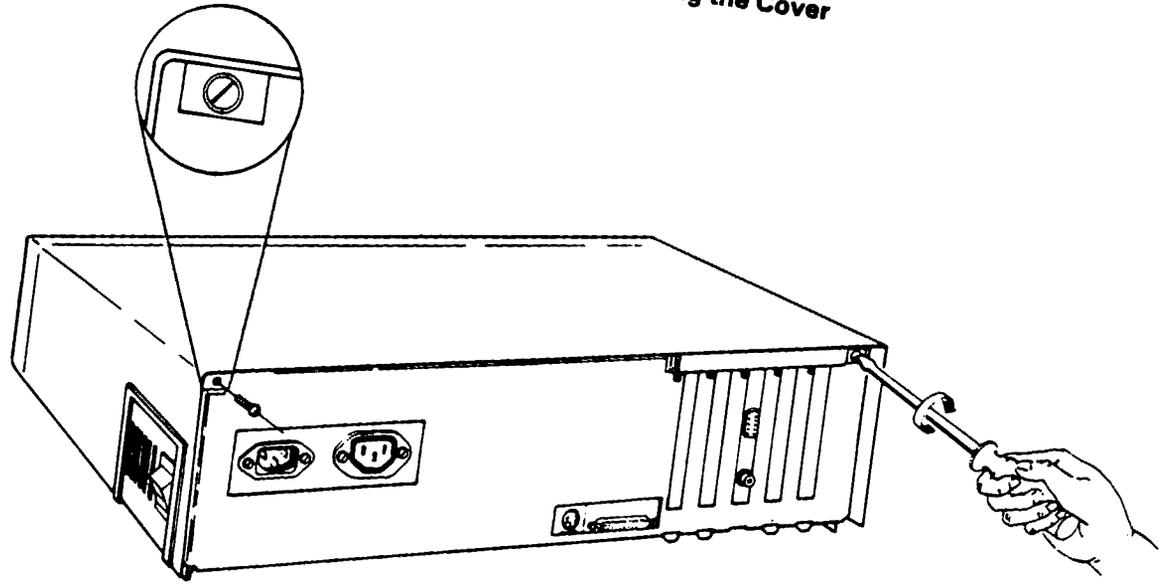


Figure 5-6. Tightening the Cover Screws

## CAUTION

Static electricity can be destructive to static-sensitive components mounted on the option board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.

4. Using a flat-bladed screwdriver or 1/4-in nutdriver, remove the screw securing the option plate assembly to the rear panel of the system unit. The screw must be retained for use in step 8.
5. If you are removing a Winchester controller board, clock and analog interface board, or other board which has cables attached to the side of the option board, gently remove these cable connectors attached to the board.
6. Hold the option board firmly and lift it straight up and out of the socket as shown in Figure 5-7.
7. Place the board in an antistatic bag. If no antistatic bag is available, a sheet of aluminum foil may be wrapped around the board.

## NOTE

If the option board is being removed due to a fault, and a replacement board is being inserted, follow the installation instructions below, or refer to Chapter 2 of the appropriate option manual. Use the antistatic bag from the replacement board to store the board being removed.

8. If you are not replacing the option board, you should place a blank plate (TI Part No. 2223033-0001) in the slot in the back of the system unit, and secure it with the screw removed in step 4, as shown in Figure 5-8.

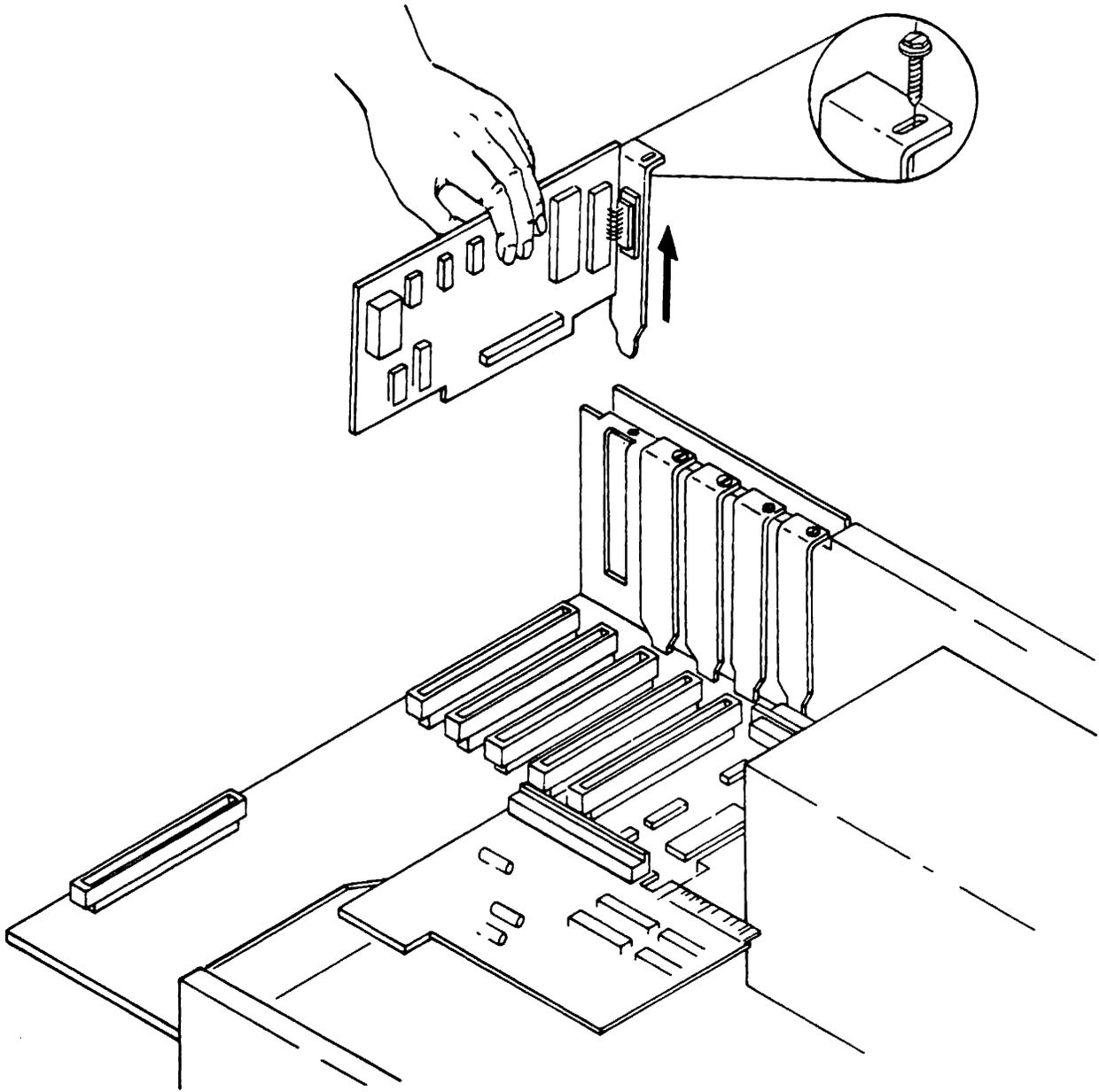
## 5.3.2 Option Board Replacement

1. Remove the option board from its antistatic bag. Place the board on a smooth work surface, component side up. Refer to Chapter 2 of the appropriate option manual for any pre-installation work, such as jumper configuration or other work necessary prior to installation.

## NOTE

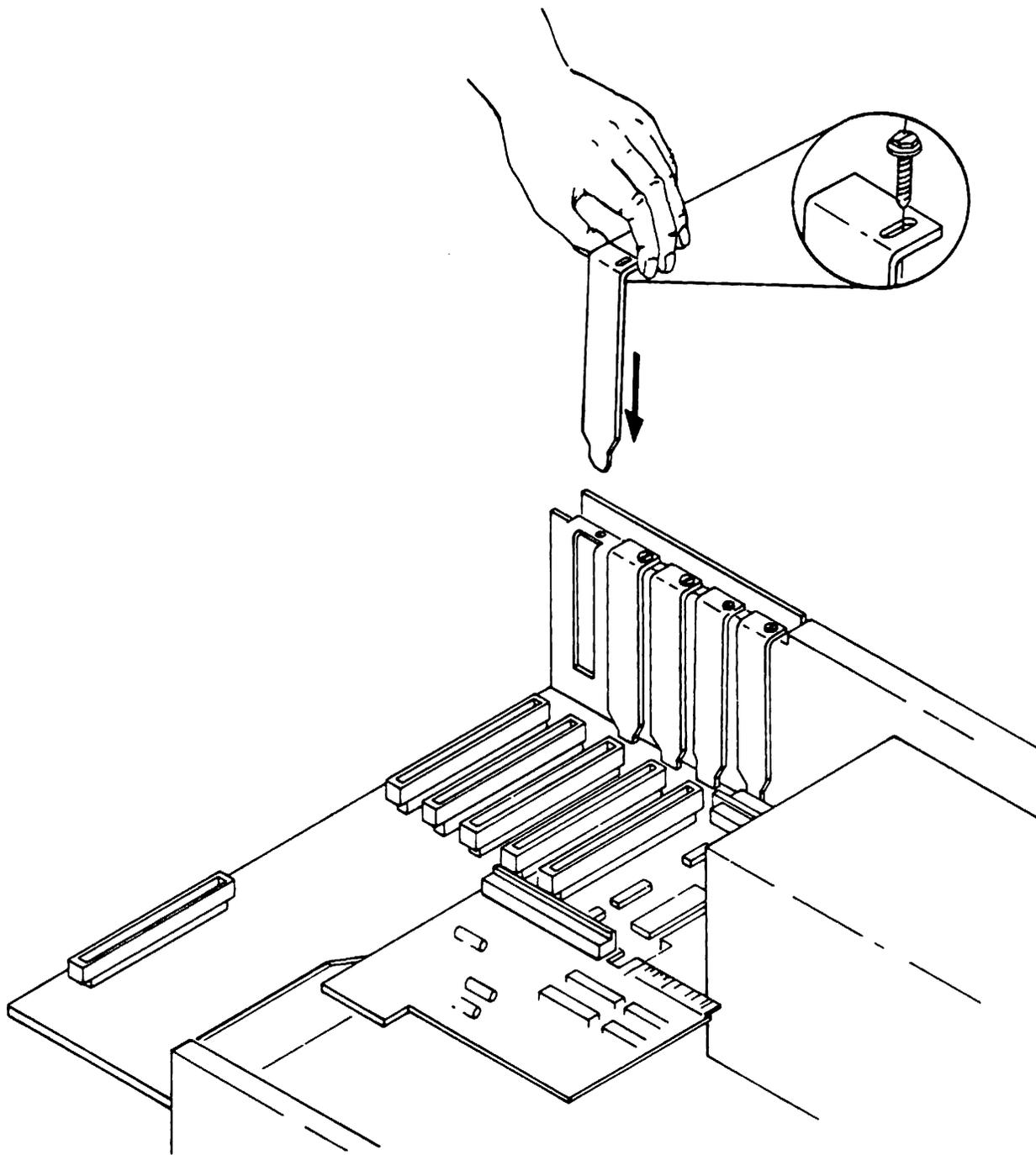
Although the card-edge connectors J1 to J5 are all logically and electrically identical, there are physical size and cabling limitations which require that some boards occupy certain positions, and avoid other locations. The following boards must be installed in the positions indicated.

- The Winchester controller board must always be installed in position J1 because ribbon cables are attached to the side of the board facing the Winchester drive assembly.
  - The synchronous-asynchronous communications board may be installed in any position. However if an expansion RAM board is installed, it is strongly recommended that the comm board be installed in position J5, because the comm board is physically shorter than most option boards. This would leave the remaining positions available for the future installation of full-size option boards.
2. Locate the card-edge connector where you wish to install the option. Use any of the positions J1 through J5.
  3. Gently insert the option board into the selected card-edge connector on the system unit board. See Figure 5-9. Use the guide on the front panel and the slot on the rear of the system unit chassis to align the board during insertion.



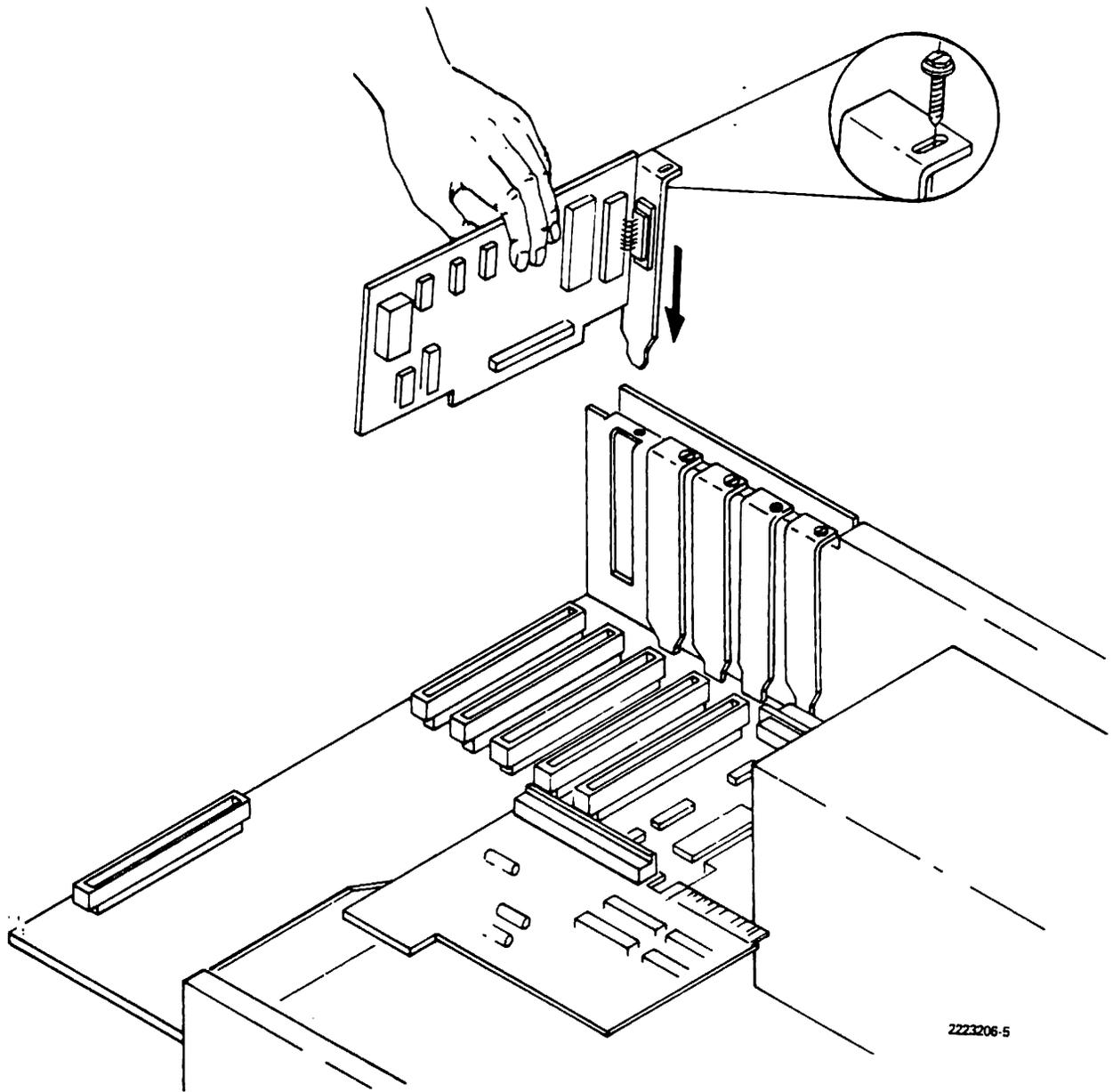
2223206-7

**Figure 5-7. Removing the Option Board**



223206-8

**Figure 5-8. Installing the Blank Plate**



2223206-5

**Figure 5-9. Inserting the Option Board**

4. Align the hole on the back plate of the option board with the corresponding hole on the back panel of the system unit. Install the screw removed in step 4 of the "Option Board Removal" procedure, and tighten it, using a flat-bladed screwdriver or a 1/4-in nutdriver.
5. Replace the system unit cover as shown in paragraph 5.2.2, "Cover Replacement."

#### 5.4 POWER SUPPLY

Use the procedures outlined in the following paragraphs to remove and replace the power supply. Use the procedures outlined in paragraph 5.8.2 to measure the power supply voltages at the system unit board.

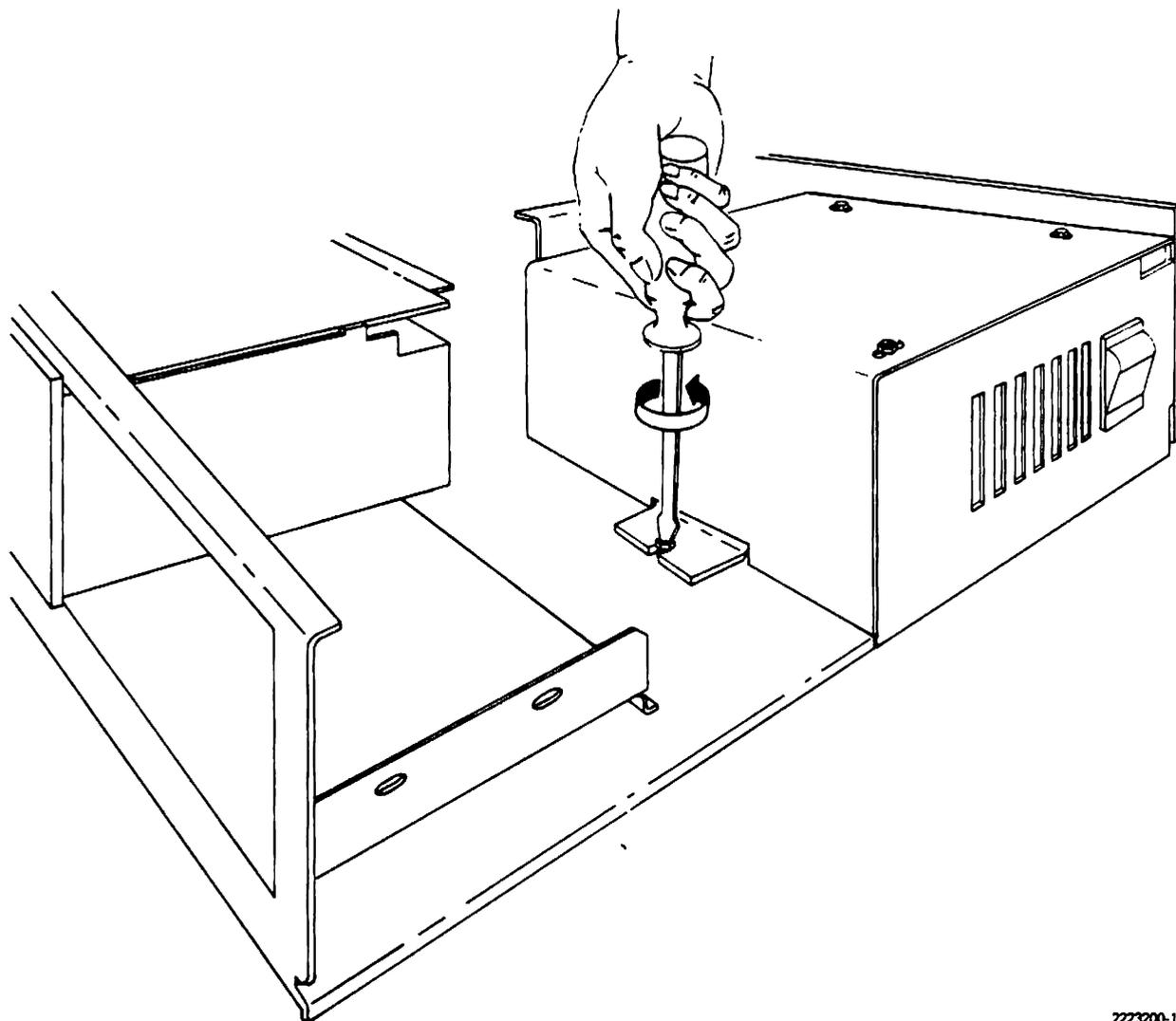
##### 5.4.1 Power Supply Removal

1. Place the system unit ON/OFF switch in the OFF position and remove the power cord from the ac receptacle.
2. Disconnect the following cords and cables.
  - System unit power cord
  - Display unit power cord
  - Display unit signal cable
  - Keyboard cable
  - Any peripheral cables connected to the system unit.
3. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any peripheral equipment to the side, away from the system unit.

#### CAUTION

**Static electricity can be destructive to static-sensitive components mounted on the option board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.**

4. Remove the system unit cover as shown in paragraph 5.2.1, "Cover Removal."
5. Remove two screws from the back panel of the system unit using a 1/4-in hex nutdriver.
6. Remove one screw from front of the power supply, securing it to the chassis bottom panel. See Figure 5-10 for the location of this screw.
7. Remove the power cable from the fan assembly.
8. Slide the power supply out the side of the cabinet for 13 mm (0.5 in). This will provide more space for removing the left diskette drive power cable connector.
9. Remove the power cable from the system unit board, and from the diskette drive logic board(s). Use two hands to remove the diskette drive (or diskette drive and Winchester disk drive) connectors. Use one to hold the printed wiring board, and the other to remove the connector. Use a rocking motion to remove the connectors. Be careful not to stress the printed wiring boards.



223200-19

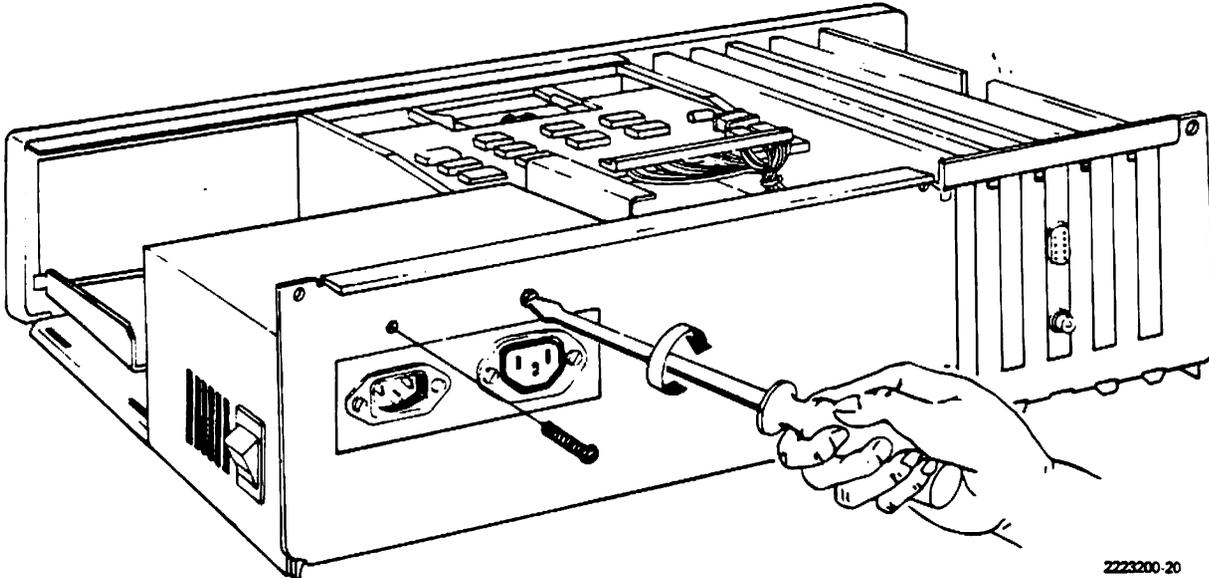
**Figure 5-10. Power Supply Removal**

- Carefully slide the power supply assembly out of the chassis, to the side and away from the fan assembly.

#### 5.4.2 Power Supply Replacement

- Gently lower the power supply assembly into place. Keep about 13-mm (0.50-in) clearance from the back panel of the system unit.

- Align the power supply with the mounting holes on the chassis bottom and back panel.
- Install and tighten two screws in the back panel, as shown in Figure 5-11.
- Install and tighten one screw in the bottom front of the supply.



**Figure 5-11. Power Supply Replacement**

- Reinstall the power connector(s) to the diskette drive logic board(s). Be careful not to stress the printed wiring boards.
- Reinstall the power connector to the main board.
- Reinstall the fan power connector.
- Replace the system unit cover as shown in paragraph 5.2.2, "Cover Replacement."
- Reconnect the following cables and cords.
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
  - Any peripheral cables which you have removed

## 5.5 FAN

### 5.5.1 Fan Removal

1. Place the system unit ON/OFF switch in the OFF position and remove the power cord from the ac receptacle.
2. Disconnect the following cords and cables.
  - System unit power cord
  - Display unit power cord
  - Display unit signal cable
  - Keyboard cable
  - Any peripheral cables connected to the system unit.
3. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any peripheral equipment to the side, and away from the system unit.

#### CAUTION

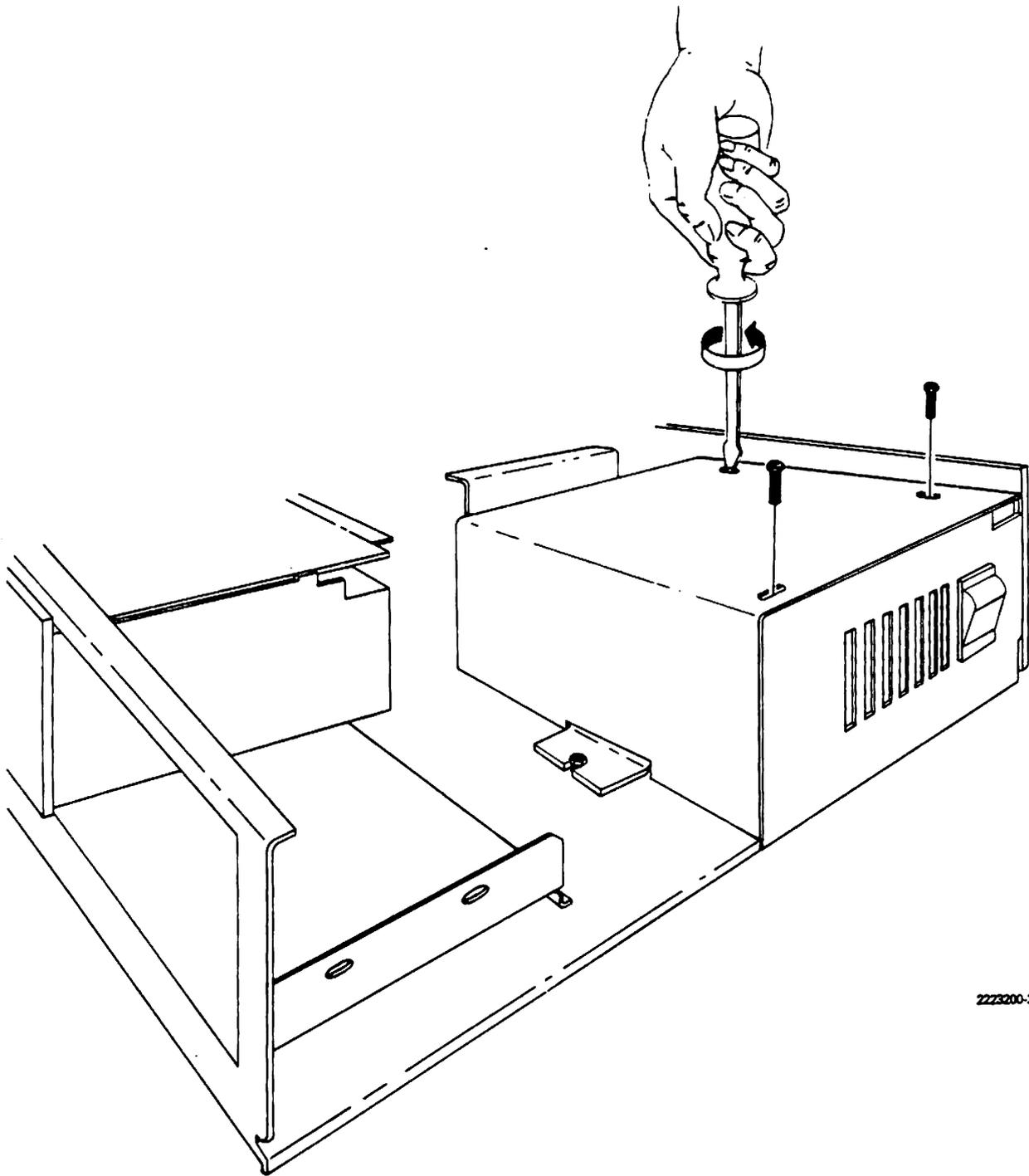
**Static electricity can be destructive to static-sensitive components mounted on the option board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.**

4. Remove the system unit cover as shown in paragraph 5.2.1, "Cover Removal."
5. Remove four 8-32 x 3/8-in screws from back panel of the system unit. Remove the fan guard and set it aside.

6. Remove the three screws securing the power supply cover.
7. Lift the power supply cover up and away from the system unit chassis, as shown in Figure 5-12. Set it to the side, out of the way.
8. Remove the power cable from the fan assembly. Notice the markings on the fan housing. An arrow shows that the direction of airflow is to the OUTSIDE of the system unit. Also note that the connector is on the top left of the fan.
9. Lift the fan assembly up and out of the chassis. Set the fan to the side. Remove the clip-on nutplates. They will be used on the replacement fan. Note the orientation of the nutplates on the fan. See Figure 5-13.

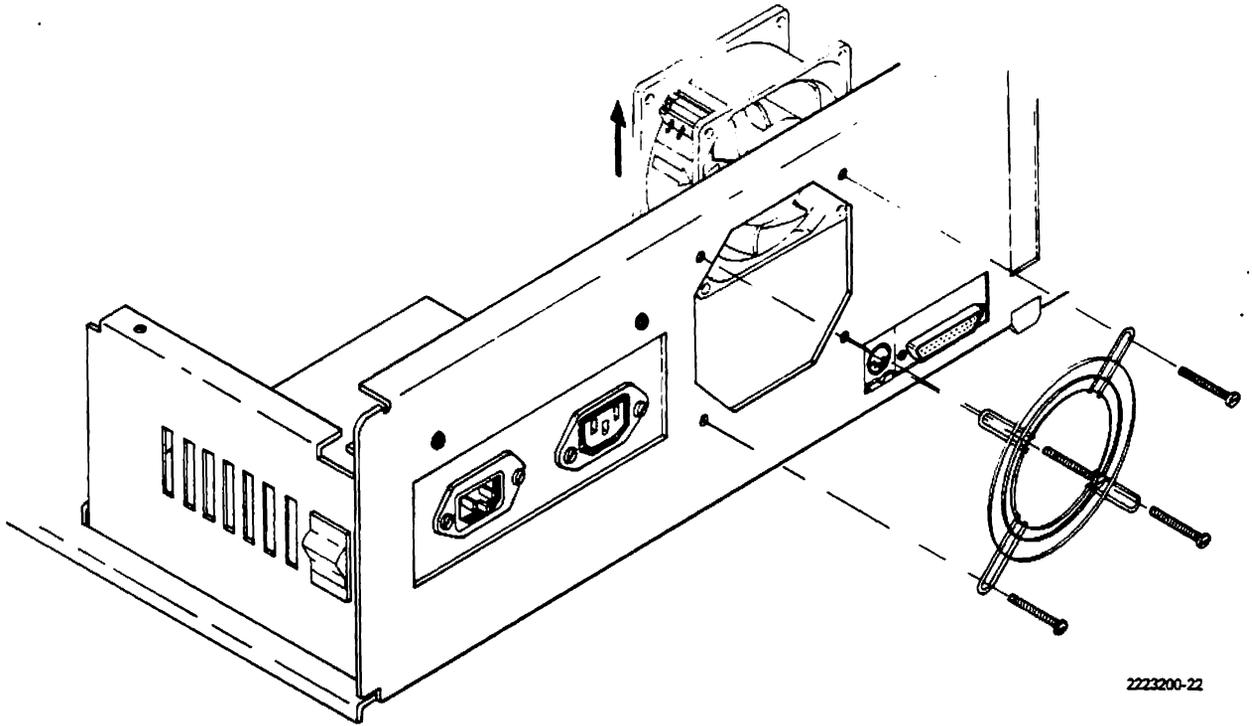
### 5.5.2 Fan Replacement

1. Install the nutplates on the replacement fan. Make certain they are properly installed, and that the direction of airflow (as indicated by the arrow marked on the fan) is toward the side of the fan on which the nutplates are installed.
2. Gently lower the fan into place. Align the fan assembly with the mounting holes in the back panel of the system unit. Make sure the airflow arrows are pointing toward the outside of the system unit, and that the fan connector contacts are on top.
3. Insert four 8-32 x 3/8-in screws through the fan guard, into the fan assembly, and tighten. See Figure 5-14.
4. Reinstall the power cable on the fan assembly.
5. Replace the system unit cover as shown in paragraph 5.2.2, "Cover Replacement."

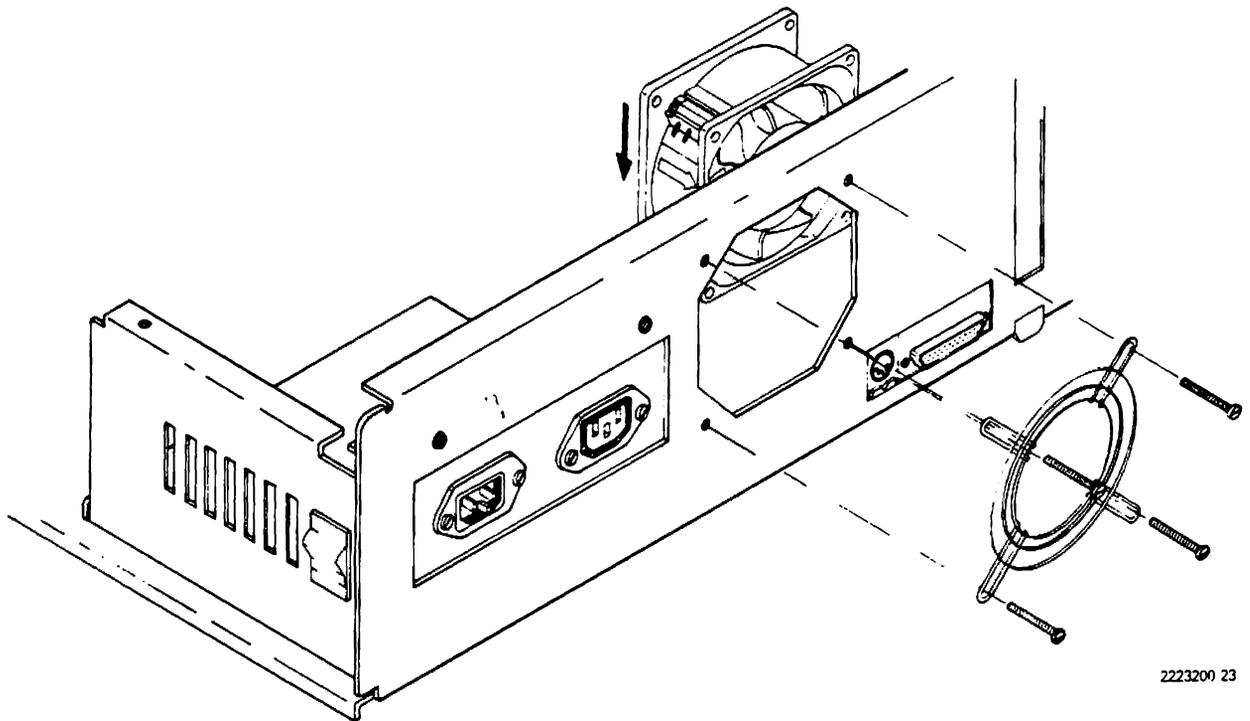


223200-21

**Figure 5-12. Removing the Power Supply Cover**



**Figure 5-13. Removing the Fan**



**Figure 5-14. Installing the Fan**

6. Reconnect the following cables and cords.
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
  - Any peripheral cables which you have removed

## 5.6 SPEAKER

### 5.6.1 Speaker Removal

1. Place the system unit ON/OFF switch in the OFF position and remove the power cord from the ac receptacle.
2. Disconnect the following cords and cables.
  - System unit power cord
  - Display unit power cord
  - Display unit signal cable
  - Keyboard cable
  - Any peripheral cables connected to the system unit.
3. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any peripheral equipment to the side and away from the system unit.

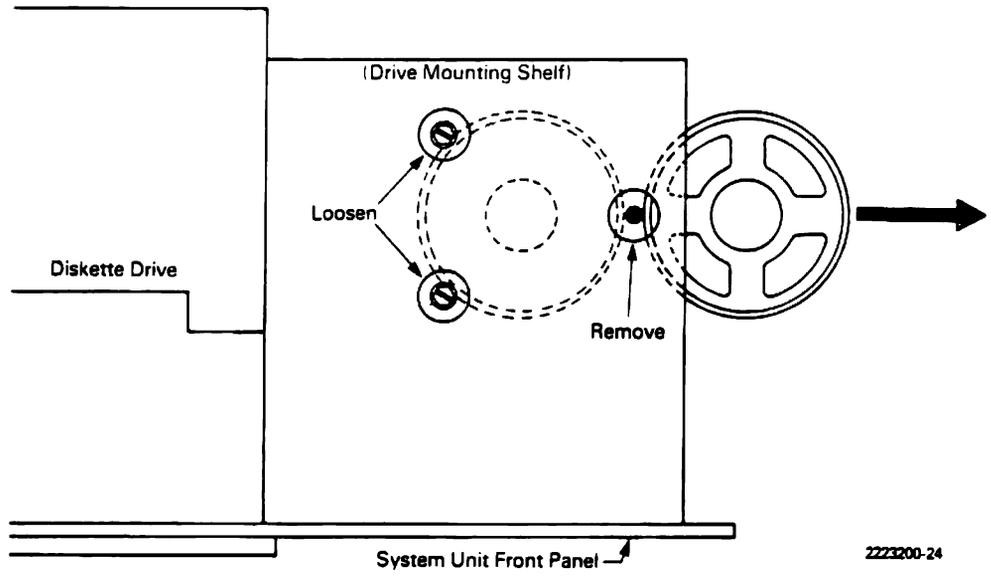
### CAUTION

Static electricity can be destructive to static-sensitive components mounted on the option board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.

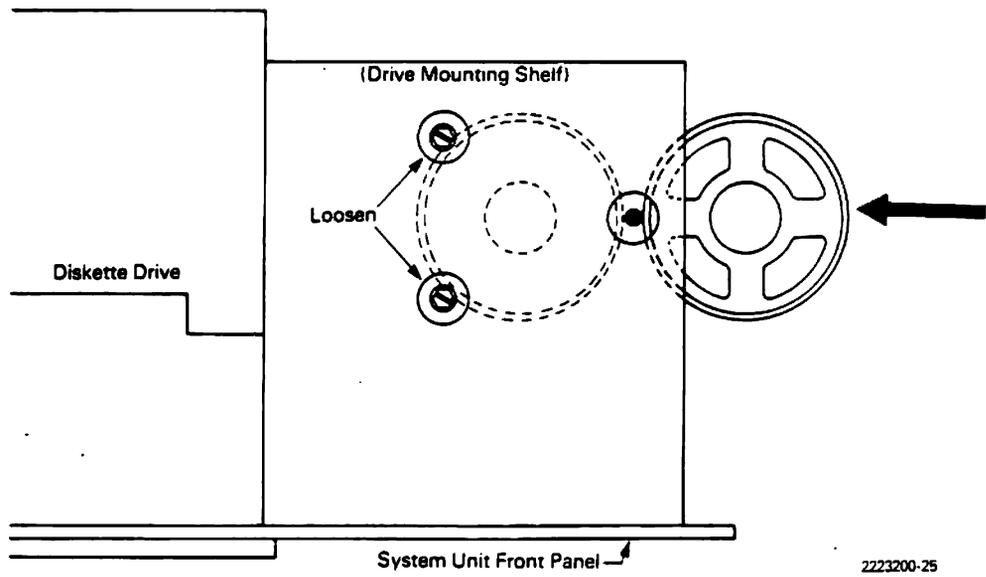
4. Remove the system unit cover as shown in paragraph 5.2.1, "Cover Removal."
5. Disconnect the speaker cable from the system unit board at J11.
6. Remove the diskette drive or Winchester disk drive assembly located in the right side of the system unit, if installed. See subsection 5.7 for the removal procedure. Locate three 8-32 x 3/8-in thread-forming screws, accessible through three holes in the diskette drive mounting-shelf bracket.
7. Using a 1/4-in nutdriver, loosen two of these screws, and remove the right-hand screw.
8. Slide the speaker out the side of the system unit chassis. Do not permit the speaker cable to become caught on the system unit board during removal. Refer to Figure 5-15 for speaker removal locations.

### 5.6.2 Speaker Replacement

1. Thread the cable assembly under the diskette drive mounting-shelf bracket to the system unit board.
2. Slide the speaker into place under the right diskette drive mounting-shelf bracket until it seats against the remaining two screws. See Figure 5-16. Tighten these screws.
3. Using a screw-starting screwdriver, or a pair of long-nose pliers, start the remaining self-threading screw into its hole.
4. Tighten all three screws with a nutdriver or flat-tipped screwdriver.
5. Reconnect the speaker cable at J11 on the system unit board.
6. Replace any diskette drive or Winchester disk drive removed earlier (see subsection 5.7).
7. Replace the system unit cover as shown in paragraph 5.2.2, "Cover Replacement."



**Figure 5-15. Removing the Speaker**



**Figure 5-16. Installing the Speaker**

8. Reconnect the following cables and cords.

- Keyboard cable
- Display unit signal cable
- Display unit power cord
- System unit power cord
- Any peripheral cables which you have removed

## 5.7 DISKETTE DRIVE AND WINCHESTER ASSEMBLY

Use the procedures outlined in the following paragraphs to remove and replace the left or right diskette drive assembly, and the Winchester disk drive assembly.

### 5.7.1 Diskette Drive/Winchester Removal

1. Place the system unit ON/OFF switch in the OFF position and remove the power cord from the ac receptacle.
2. Disconnect the following cords and cables.
  - System unit power cord
  - Display unit power cord
  - Display unit signal cable
  - Keyboard cable
  - Any peripheral cables connected to the system unit.
3. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any peripheral equipment to the side and away from the system unit.

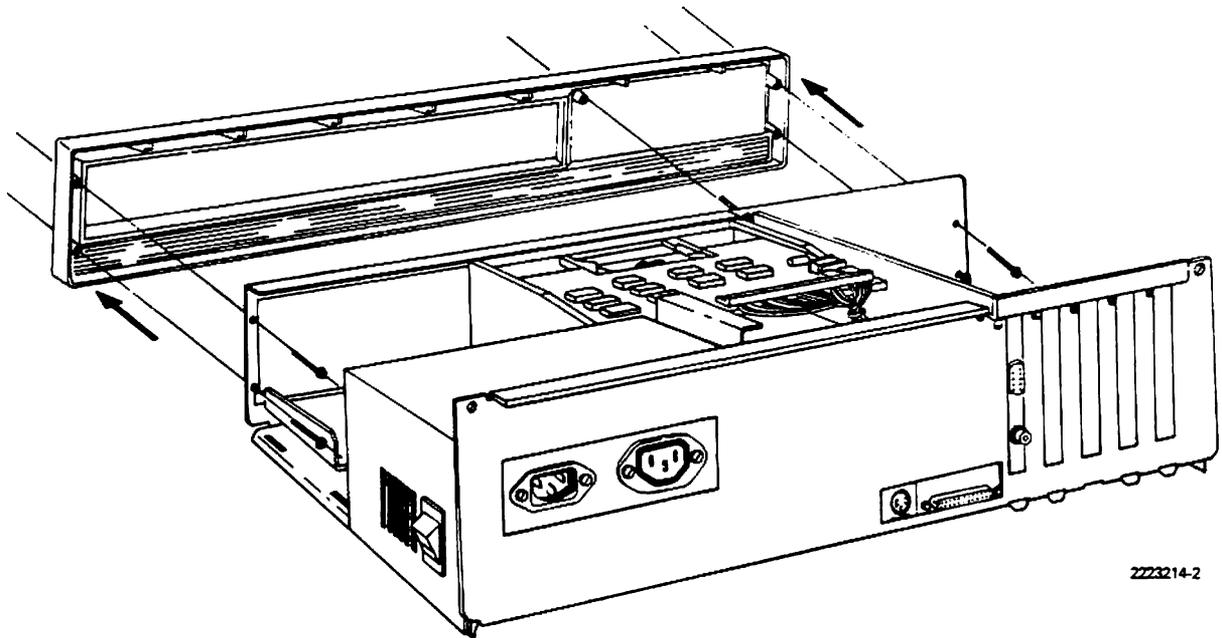
## CAUTION

Static electricity can be destructive to static-sensitive components mounted on the option board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.

4. Remove the system unit cover as shown in paragraph 5.2.1, "Cover Removal."
5. Remove the five screws securing the front panel to the system unit. Note that one screw is shorter than the others. It must be installed in the same place it was removed — the top center position. Remove the front panel and set it aside, out of the way. See Figure 5-17.
6. Tilt the system unit up so that the ON/OFF switch is facing up. The system unit is supported by the left side of the chassis. Remove the circular metal dust cover from the large hole on the bottom of the chassis. Two screws are accessible. The left screw as viewed from the front of the system unit, secures the left drive. The right screw secures the right drive.
7. Remove the 6-32 x 3/8-in screw securing the drive assembly that you wish to remove. See Figure 5-18 for location of the screws.
8. Carefully lower the system unit to the work surface. DO NOT DROP!

## NOTE

Step 9 is necessary only if you are removing the left diskette drive. Skip step 9 if you are removing the right diskette drive or a Winchester disk drive.



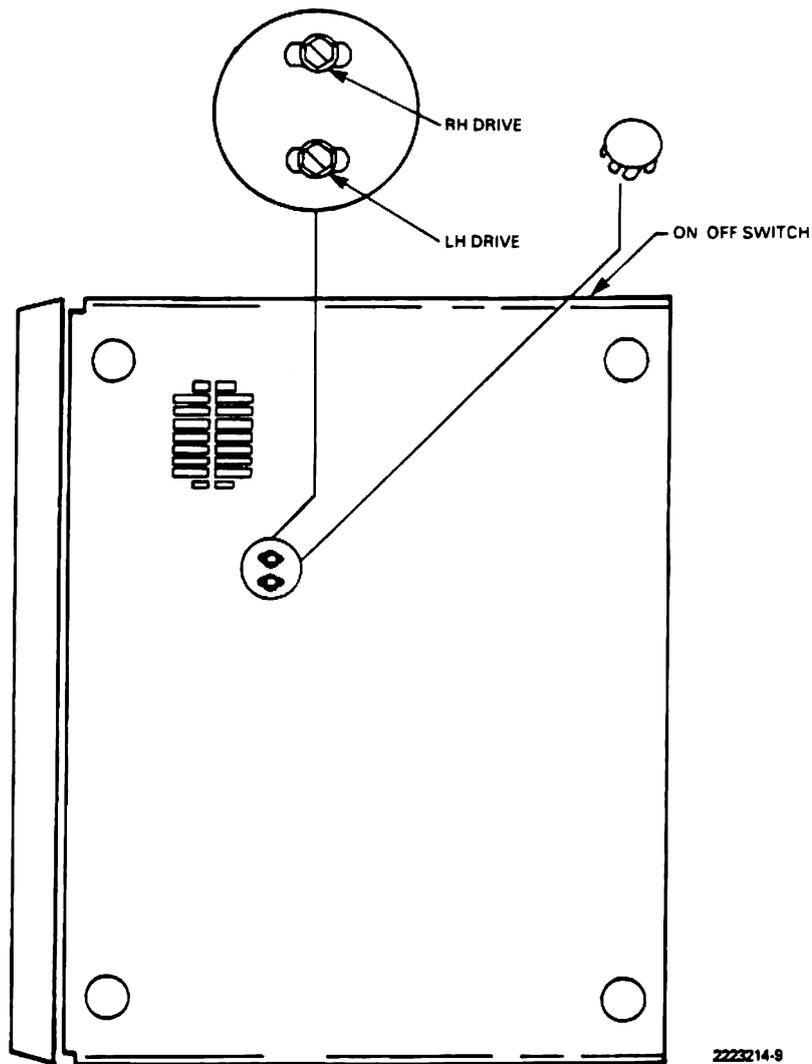
**Figure 5-17. Removing the Front Panel**

9. Remove all option boards using the procedures outlined in subsection 5.3.
10. Remove two 6-32 x 3/8-in screws from the side of the diskette drive. See Figure 5-19 for locations of these screws.
11. Remove the power connector from the diskette drive logic board. The right drive should be pulled away from the power supply to provide enough clearance to remove the power connector. Use both hands. Use one to remove the power connector with a rocking motion, and the other to hold the corner of the printed wiring board.
12. Remove the flat control/data cable connector from the diskette drive logic board. If you are removing a Winchester, two flat cables must be removed. See Figure 5-20.
13. Carefully remove the diskette drive assembly by sliding it out the front of the system unit as shown in Figure 5-21. If you are removing a Winchester disk drive assembly, make certain the printed wiring board, located on the bottom of the assembly, does not scrape against the mounting shelf.

#### 5.7.2 Diskette Drive/Winchester Replacement

##### NOTE

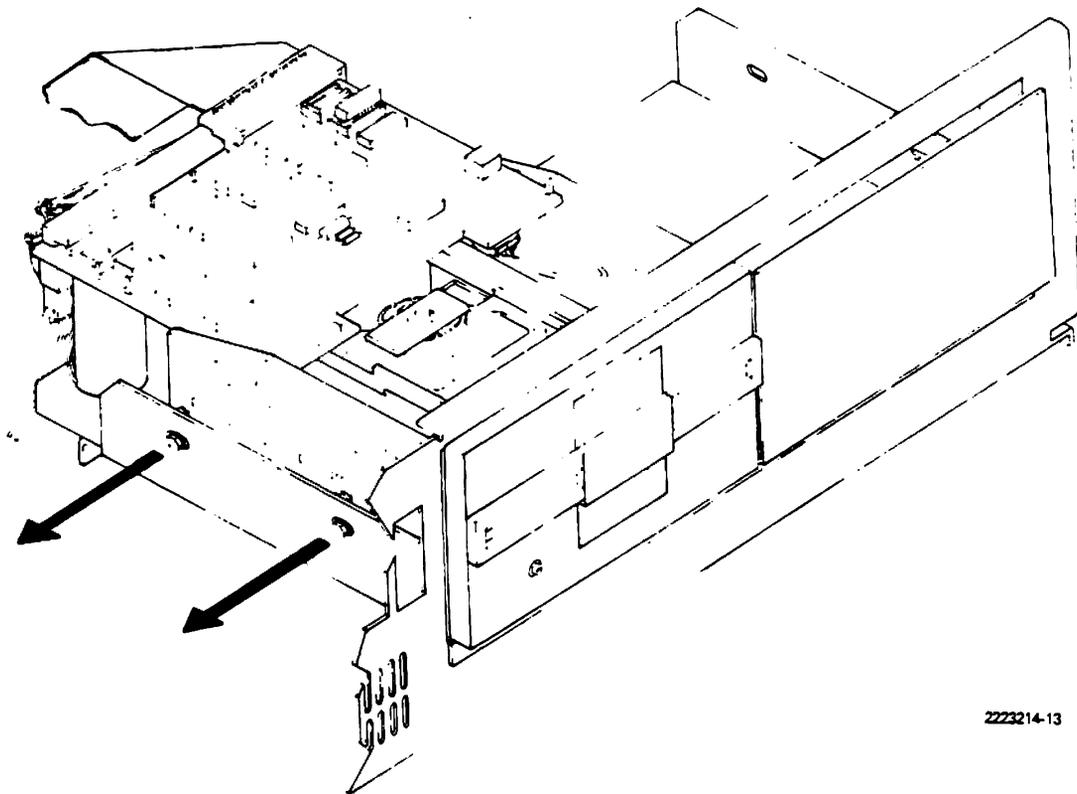
The following steps apply to the diskette drive assemblies only. If you are replacing a Winchester disk drive assembly, follow the DIP shunt configuration instructions provided with the Winchester disk drive option kit.



**Figure 5-18 Bottom Mounting Screw Removal**

1. Configure the DIP shunts for selecting the correct drive. The left-hand drive assembly, as viewed from the front of the system unit, is considered to be drive zero by the drive logic. The proper shunt configuration for drive zero is shown in Figure 5-22. The right-hand drive assembly is considered to be drive one by the drive logic. Shunt configuration for drive one is shown in Figure 5-23.

When replacing an existing drive of the same type and capacity, unplug the shunt from the logic board of the unit that you removed and install it on the replacement drive. If the replacement drive is being installed as a new option, use an AMP cutting tool (AMP part number 435862-1) or similar cutting device to program the shunts.



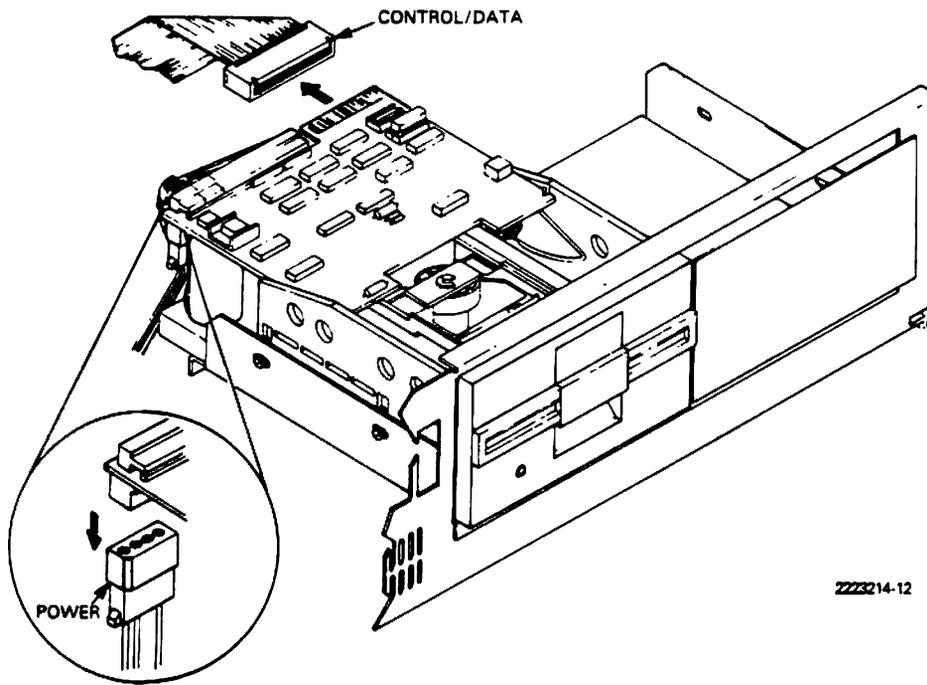
2223214-13

**Figure 5-19. Mounting Screw Removal**

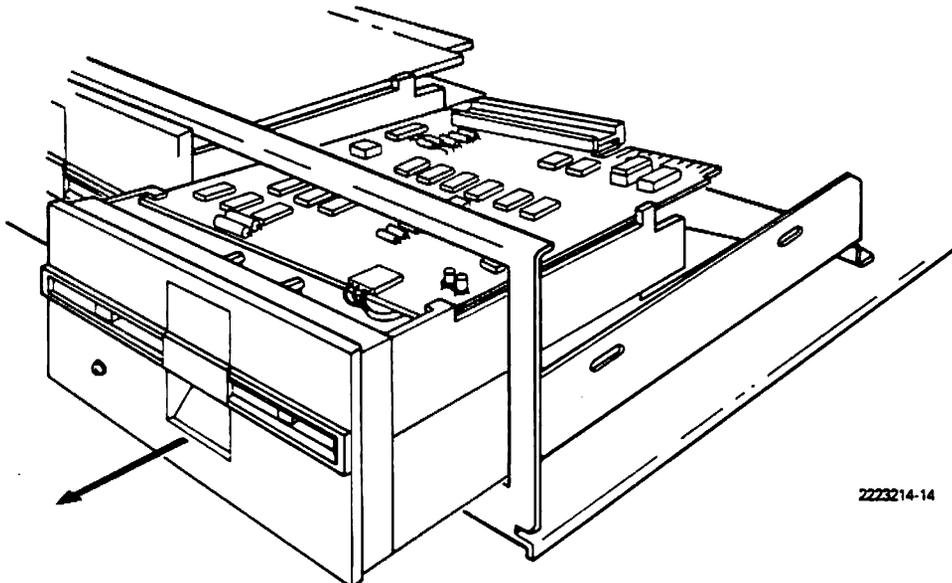
If your drive assembly differs from the illustration, use the instructions packed with the drive. Note that the 12-pin DIP shunt is in a 14-pin socket. The two vacant socket positions must be on the end of the socket which is close to the outside edge of the printed wiring board. Refer to the following figure and make certain the unused sockets are exactly as illustrated.

2. If your unit has only one diskette drive, make certain the terminating resistor is in place on the diskette drive logic board. If your unit has two diskette drives, make certain that the terminating resistor pack is installed in the right-hand drive only.

Remove the terminating resistor pack from the left-hand drive using an IC removal tool or a small flat-bladed screwdriver. Note that the terminating resistor pack is a 14-pin DIP device seated in a 16-pin socket. The two vacant socket positions must be on the end of the socket facing the center of the printed wiring board. Refer to Figure 5-24 and make certain the unused sockets are exactly as illustrated. If you are installing a Winchester disk drive, BOTH the left diskette drive logic board AND the Winchester disk drive logic board must have terminating resistors installed.



**Figure 5-20. Cable Connector Removal**



**Figure 5-21. Diskette Drive Removal**

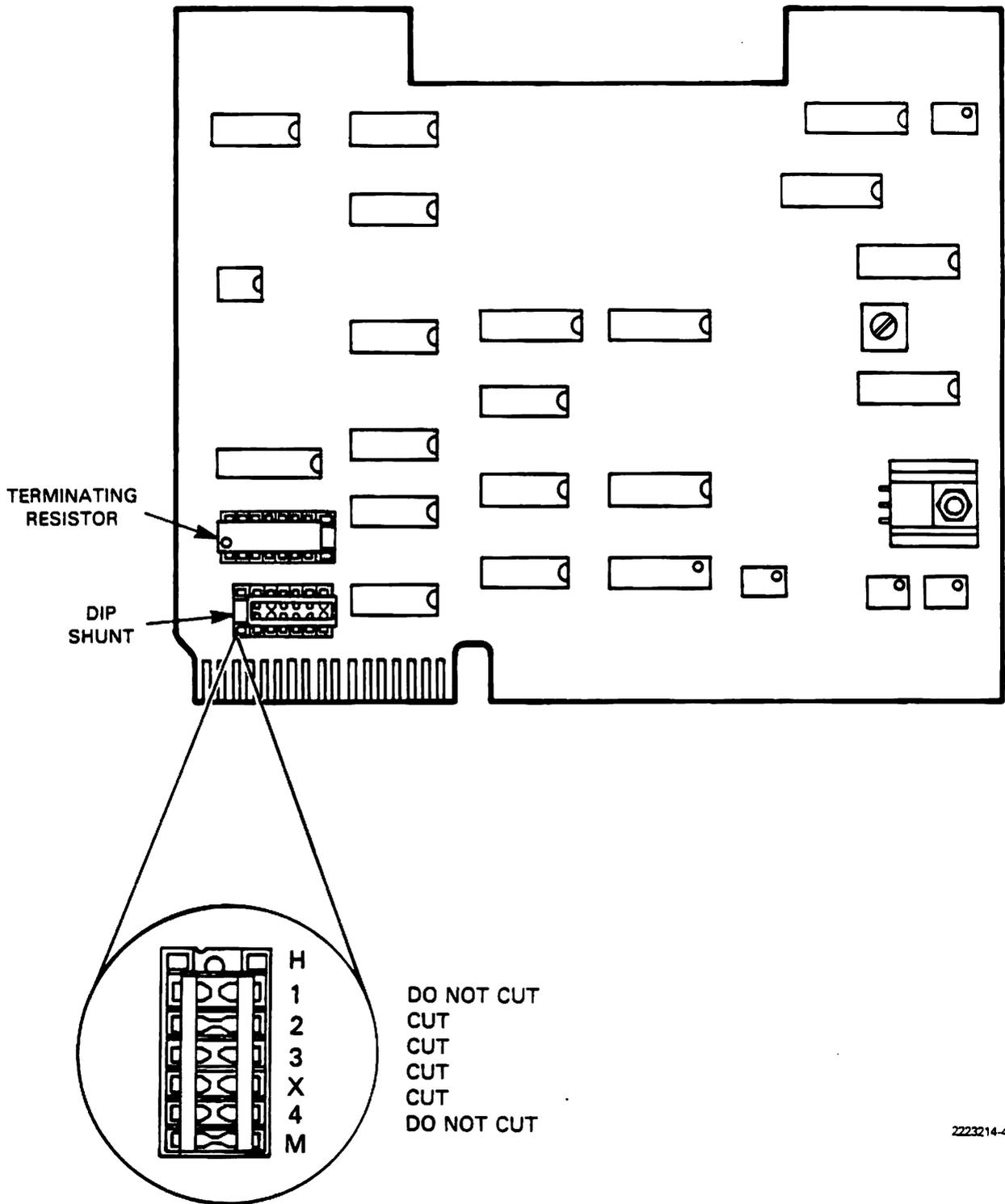


Figure 5-22. Shunt Configuration for Drive Select Zero

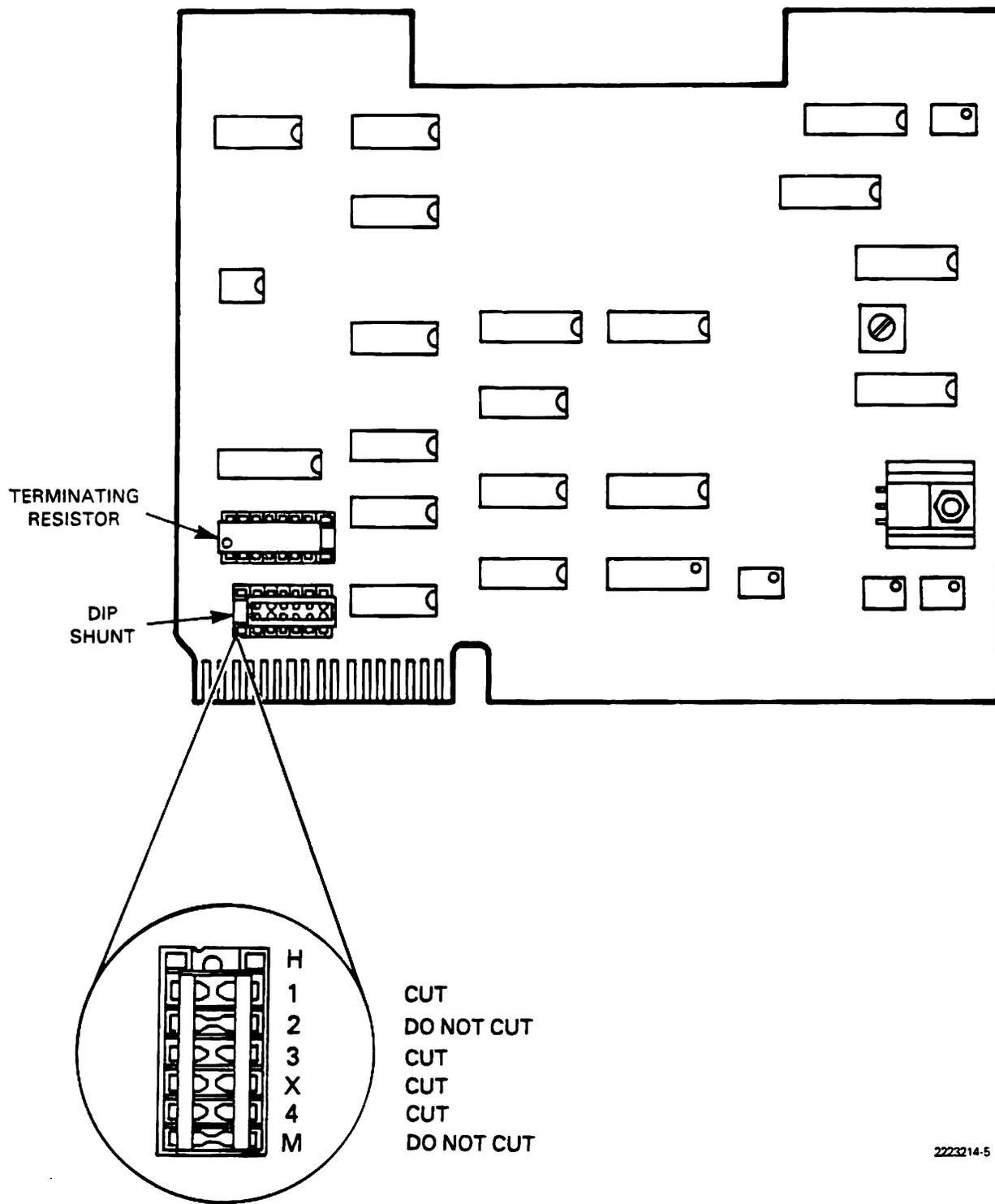
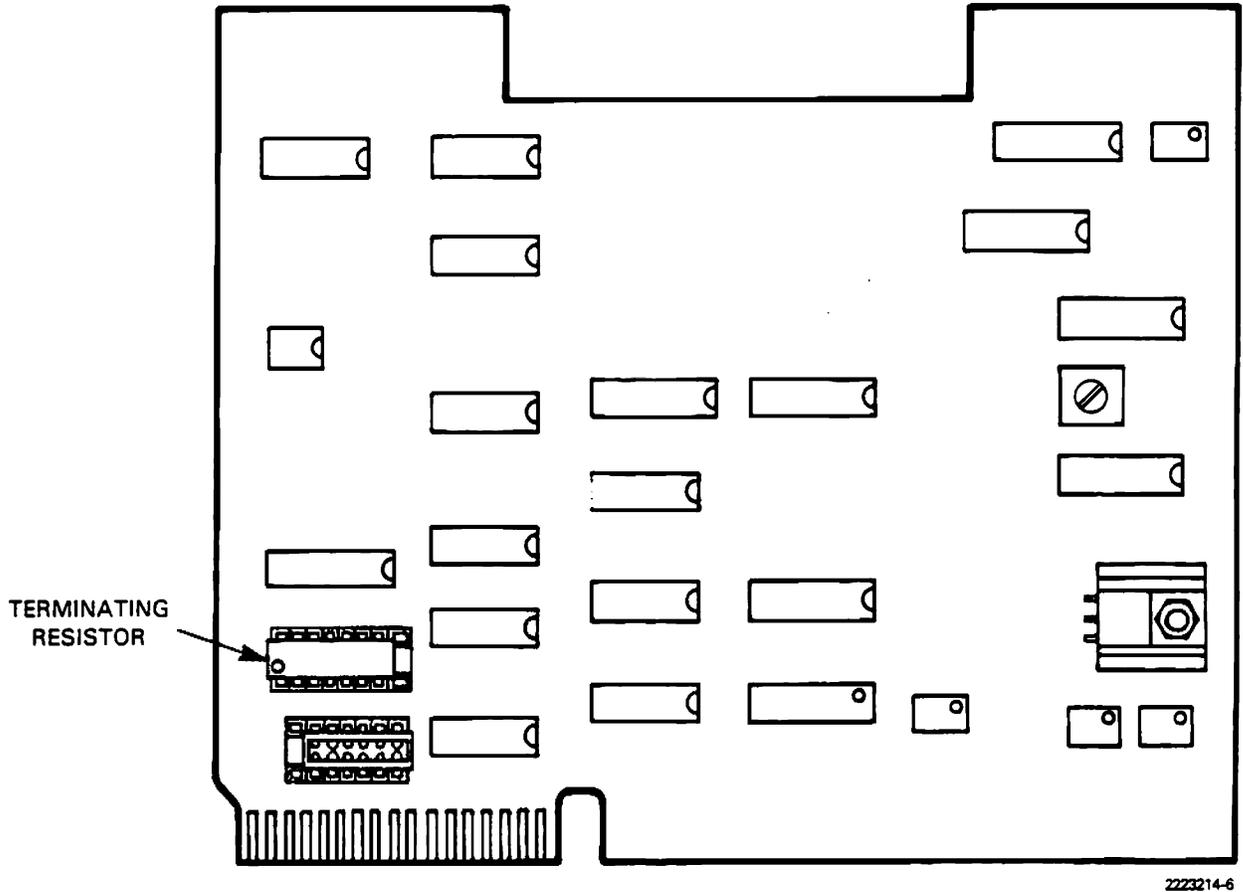


Figure 5-23. Shunt Configuration for Drive Select One

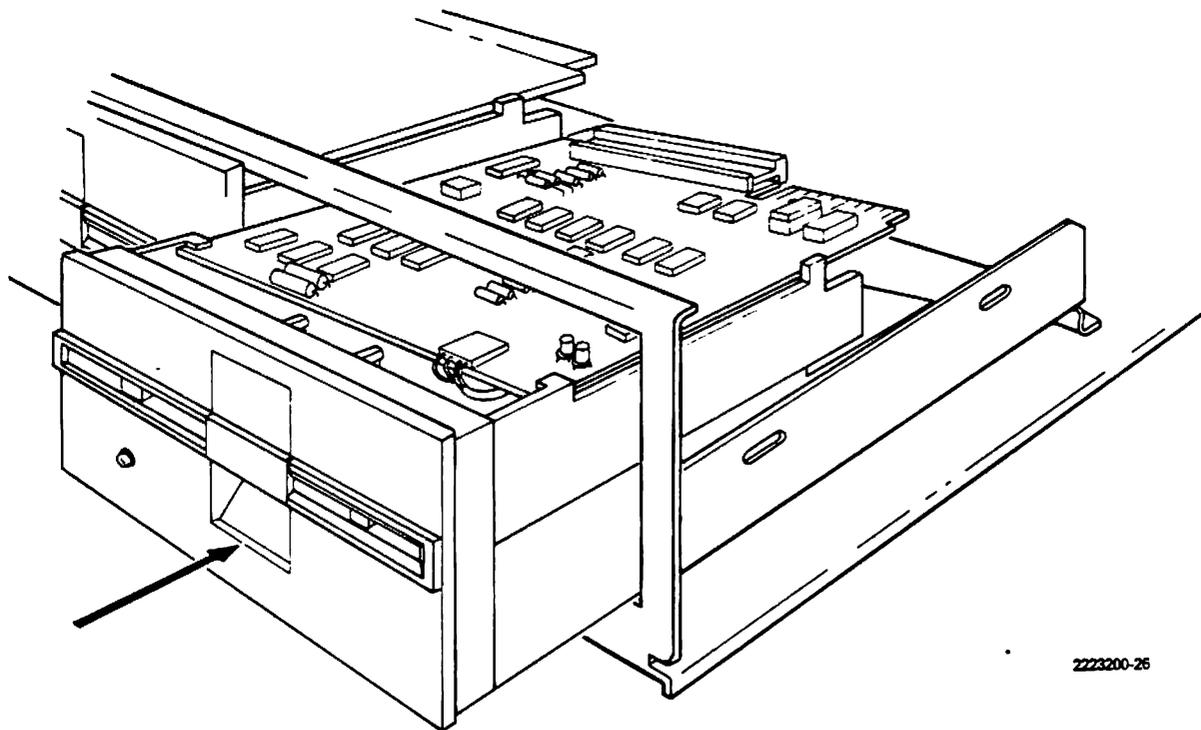


2223214-6

**Figure 5-24. Terminating Resistor Location**

3. Gently slide the diskette drive assembly into the system unit from the front as shown in Figure 5-25. If you are installing a Winchester disk drive assembly, use care in handling the drive. Do not permit the components mounted on the logic board, located on the bottom of the Winchester drive, to scrape against the mounting shelf during installation.
4. Reinstall the diskette drive power connector and data/control ribbon cable connector, as shown in Figure 5-26. The right

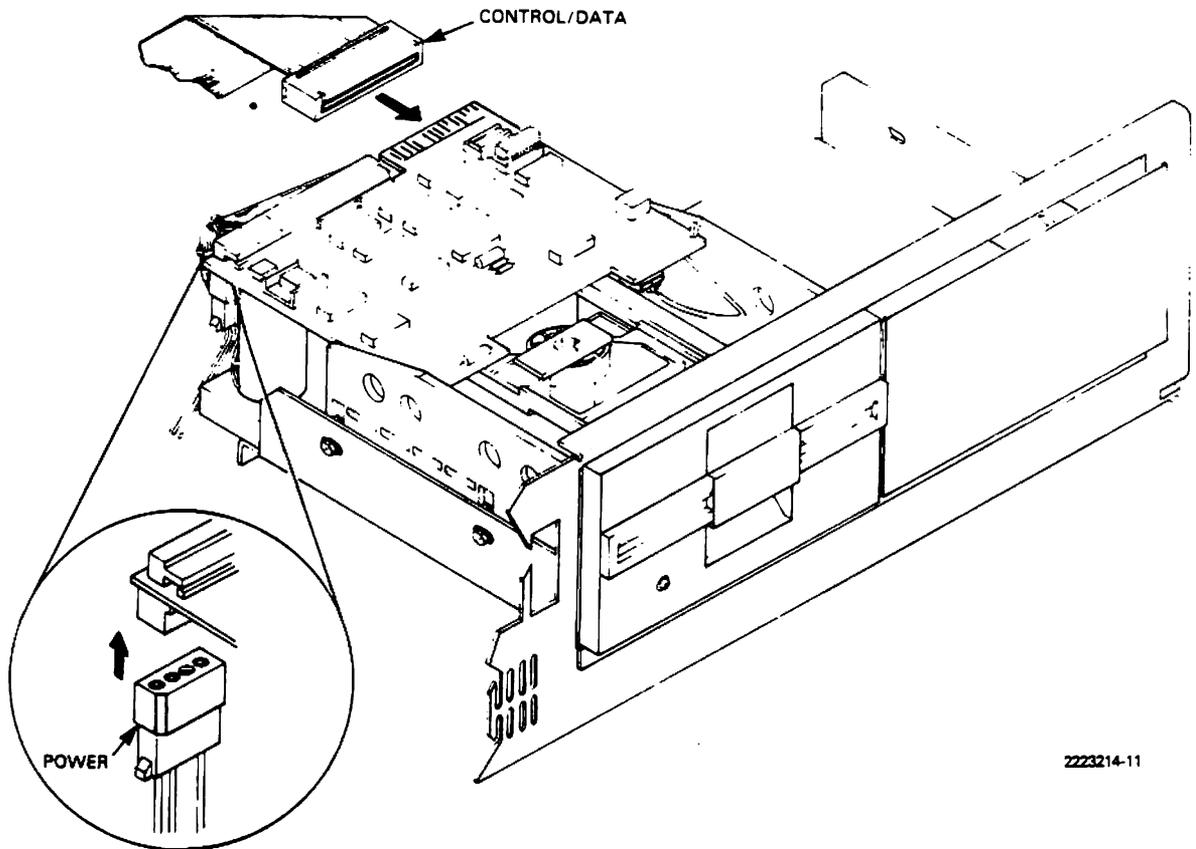
drive power connector is more easily installed with the diskette drive pulled away from the power supply to provide clearance. Use two hands. Use one to hold the corner of the printed wiring board, and use the other to seat the connector. If a Winchester drive is being replaced, two ribbon cable connectors must be installed. Refer to Figure 5-27 for typical connection locations (the Winchester disk drive you are replacing may vary slightly from the illustration).



2223200-26

**Figure 5-25. Diskette Drive Replacement**

5. Reinstall the front panel, securing it with five 6-20 x 7/8-in thread-forming screws. Note that the shorter screw goes in the top center location. Refer to Figure 5-28 for locations.
6. Align the drive assembly with the mounting holes on the side of the diskette mounting shelf, making certain the drive's front panel is flush against the front panel. Install the two mounting screws, but tighten only finger tight. See Figure 5-29.
7. Tilt the system unit up so that the ON/OFF switch faces up. The system unit is supported by the left side of the chassis. Install a 6-32 x 3/8-in mounting screw in the position corresponding to the drive you are installing. See Figure 5-30. The right screw position is for the right drive, the left screw position is for the left drive. Tighten the screw. Replace the round metal dust cover.
8. Carefully lower the system unit to the work surface. **DO NOT DROP!**
9. Tighten the two mounting screws on the side of the drive assembly which were installed only finger-tight.
10. Reinstall any option boards which you removed, using the procedure in subsection 5.3.
11. Replace the system unit cover as shown in paragraph 5.2.2, "Cover Replacement."
12. Reconnect the following cables and cords.
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord



2223214-11

**Figure 5-26. Replacing the Connectors**

- System unit power cord
- Any peripheral cables which you have removed

2. Disconnect the following cords and cables.

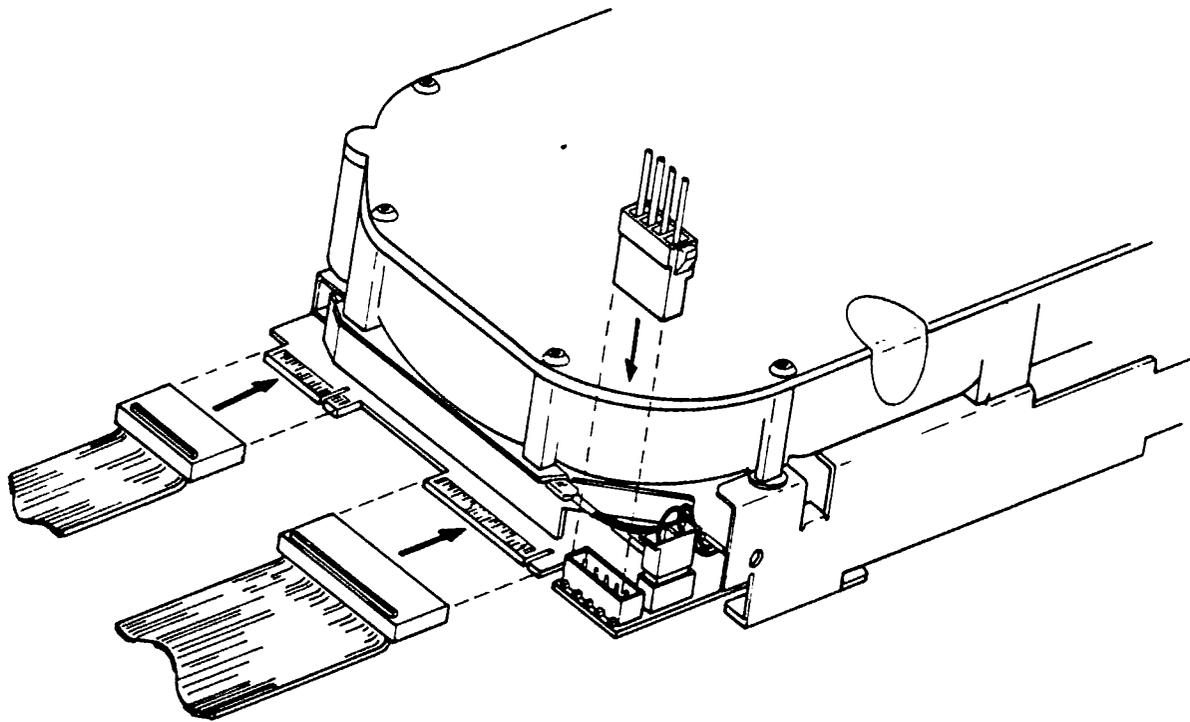
- System unit power cord
- Display unit power cord
- Display unit signal cable
- Keyboard cable
- Any peripheral cables connected to the system unit.

## 5.8 SYSTEM UNIT BOARD

Use the procedures outlined in the following paragraphs to remove and replace the system unit board.

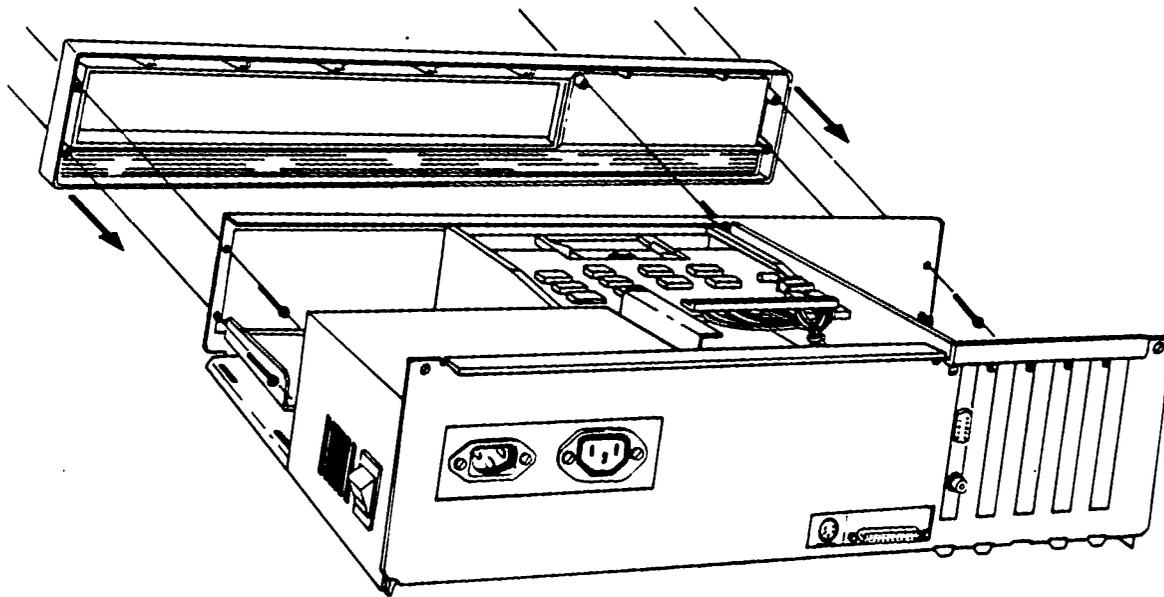
### 5.8.1 System Unit Board Removal

1. Place the system unit ON/OFF switch in the OFF position and remove the power cord from the ac receptacle.



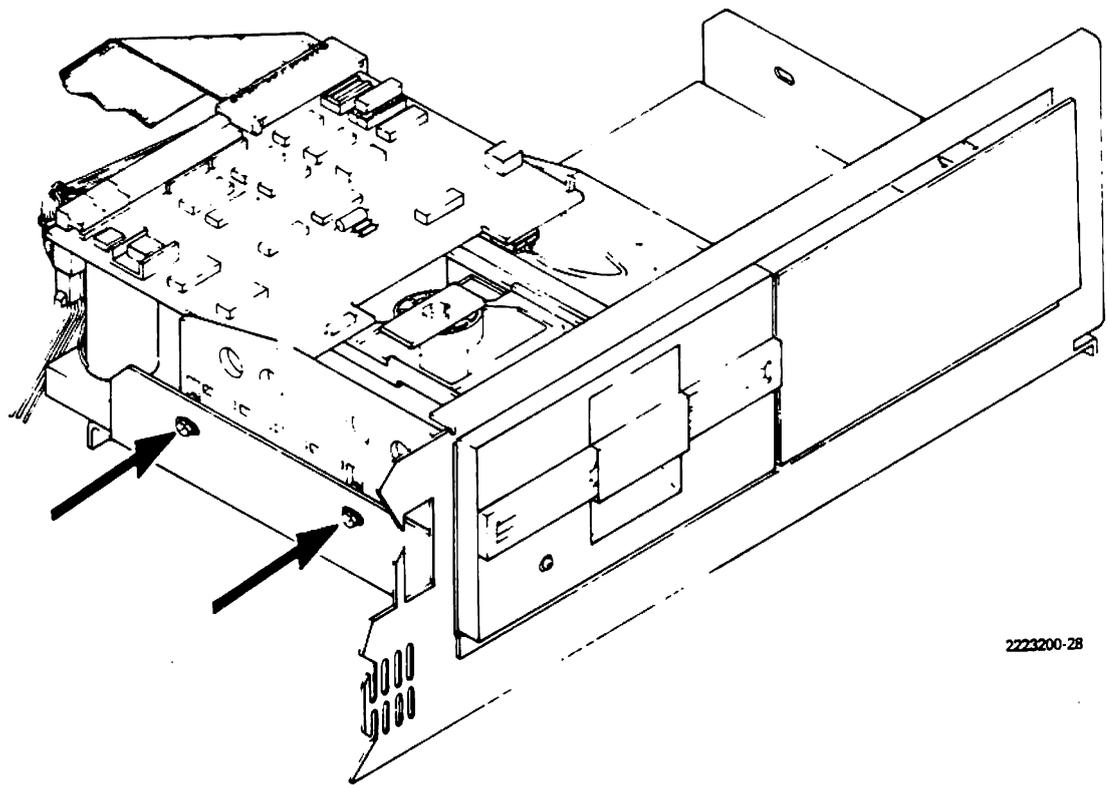
2223200-27

Figure 5-27. Replacing Winchester Connectors



2223214 10

Figure 5-28. Front Panel Replacement



2223200-28

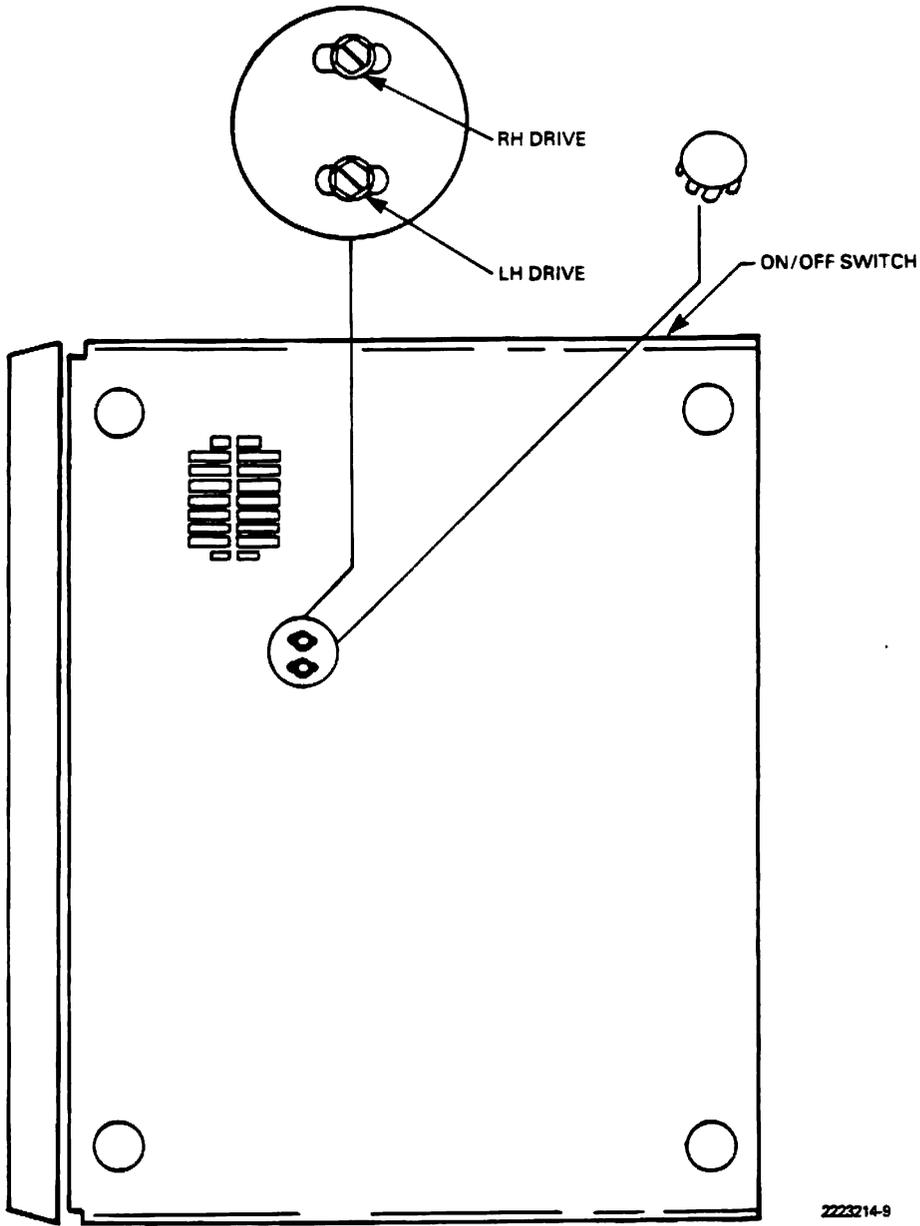
**Figure 5-29. Mounting Screw Replacement**

3. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any peripheral equipment to the side and away from the system unit.

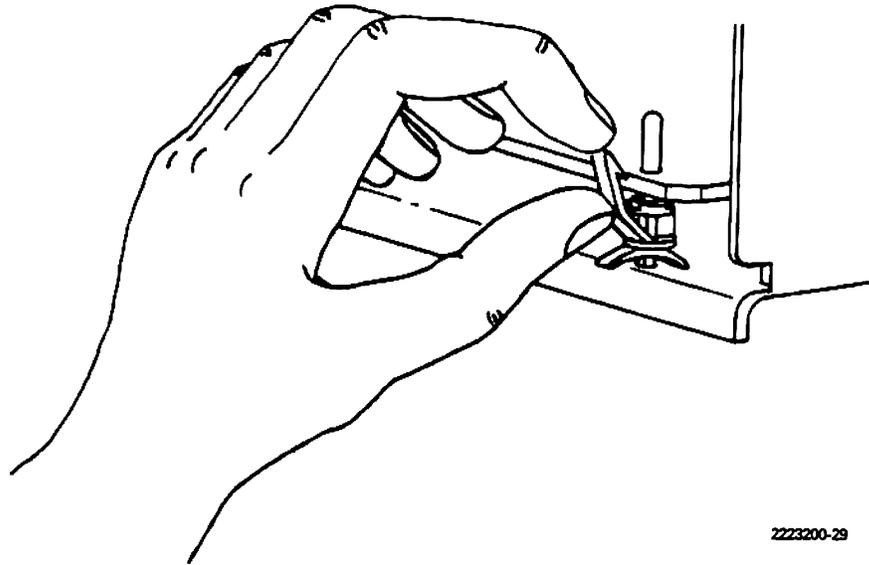
**CAUTION**

**Static electricity can be destructive to static-sensitive components mounted on the option board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.**

4. Remove the system unit cover as shown in paragraph 5.2.1, "Cover Removal".
5. Remove all option boards from the system unit board, as detailed in paragraph 5.3.1, "Option Board Removal."
6. Remove the diskette drive control/data cable connector.
7. Remove the external diskette drive cable, if installed.
8. Remove the power connector from the system unit board.
9. Remove the speaker connector from J11.
10. Remove the two center 8-32 x 1/4-in sheet-metal screws securing the board.
11. Remove the grounding cable from the J7 printer connector.
12. Release the three plastic retainer clips from the side of board. See Figure 5-31.



**Figure 5-30. Install Mounting Screw Through Access Hole**



2223200-29

**Figure 5-31. Connector and Retainer Removal**

13. Carefully lift the board up and out the side of the system unit, as shown in Figure 5-32.

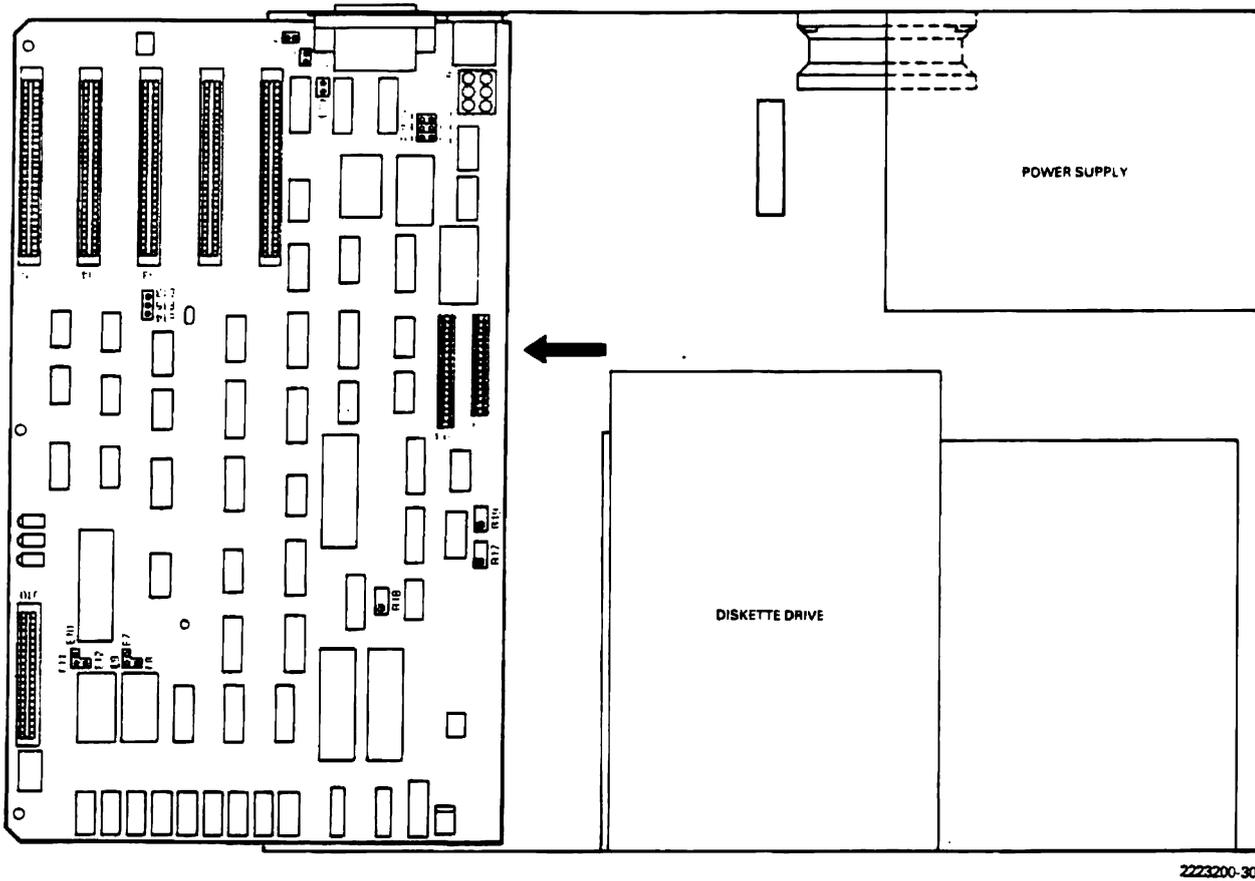
#### 5.8.2 System Unit Board Replacement

1. Make certain the system unit board is complete. Ensure that all ICs are plugged into the board including the ROM and microprocessor. Make certain all jumpers are properly installed. See Figure 5-33.

#### CAUTION

**Do not attempt to measure the output of the power supply unless it is connected to the system unit board. Damage to the power supply could result. Measure the output by placing the test probes on the conductors that are accessible from the top of P6.**

2. Gently slide the board into the slots in the two locator blocks. See Figure 5-34.
3. Press down on the board to secure it in the three retainer clips, as shown in Figure 5-35.
4. Install two 8-32 x 1/4-in sheet metal screws through the holes in the board and into the chassis bottom.
5. Reinstall the speaker cable connector to J11.
6. Reinstall the power supply connector to J6.
7. Reinstall the diskette drive ribbon cable connector to J9.
8. Replace the external diskette drive cable (if installed) to J13.



2223200-30

**Figure 5-32. System Unit Board Removal**

9. Reinstall the grounding cable to the J7 printer connector.
10. Reinstall all option boards as described in subsection 5.3, "Option Board Replacement."
11. Replace the system unit cover as shown in paragraph 5.2.2, "Cover Replacement."
12. Reconnect the following cables and cords.

- Keyboard cable
- Display unit signal cable
- Display unit power cord

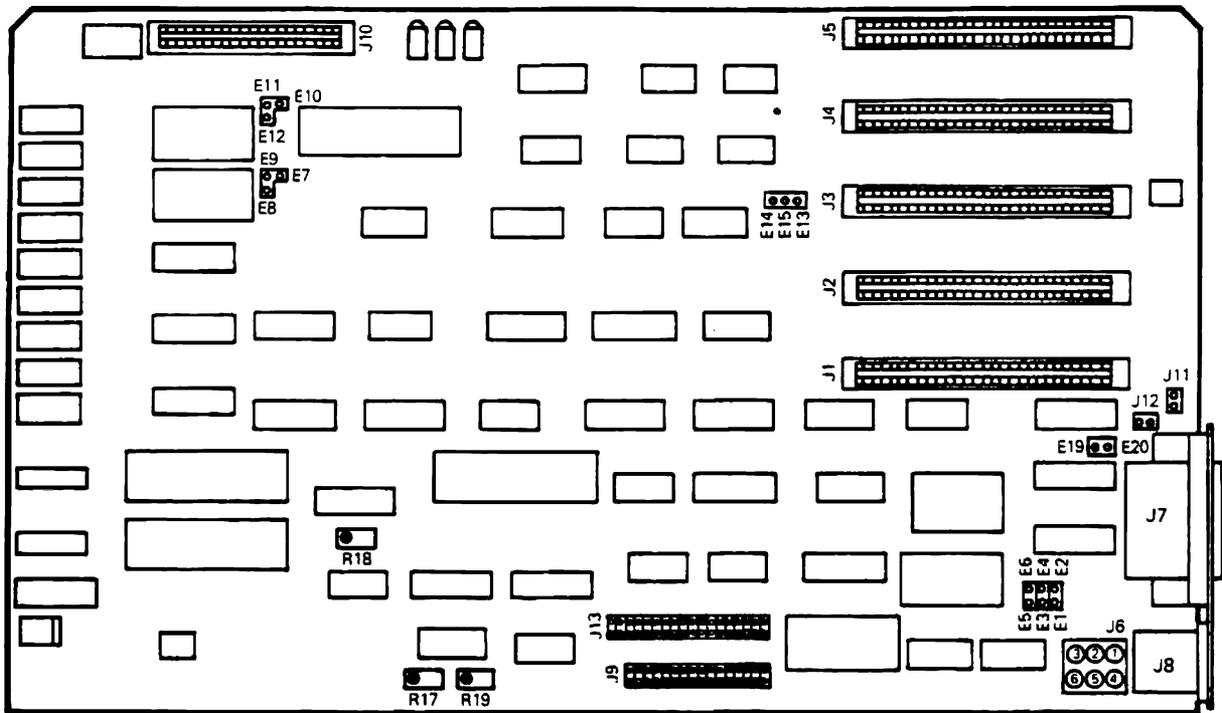
- System unit power cord
- Any peripheral cables which you have removed.

## 5.9 KEYBOARD BOARD

Use the procedures outlined in the following sections to remove and replace the keyboard board and cable assemblies.

### 5.9.1 Keyboard Board Removal

1. Place the system unit ON/OFF switch in the OFF position and remove the power cord from the ac receptacle.
2. Disconnect the keyboard cable from the back of the system unit.



**JUMPER OPTIONS**

- E1-E2 = Double-sided 320K bytes (Jumpered)  
Single-sided 160K bytes (No Jumper)
- E3-E4 = Reserved but currently open
- E5-E6 = 50 Hz (Jumpered)  
60 Hz (No Jumper)
- E7-E9 = ROM U62
- E8-E9 = 4K EPROM U62
- E10-E11 = ROM U63
- E12-E11 = 4K EPROM U63
- E14-E15 = 4K ROMs Decode
- E13-E15 = 8K ROMs Decode
- E19 = Signal Ground
- E20 = Chassis Ground
- No Jumper = Signal-Chassis Ground Isolated
- Jumpered = Signal-Chassis Ground Shorted

POWER CONN (J6)		
PIN NO.	SIGNAL	COLOR
1	+ 12V	Yellow
2	+ 5V	Red
3	GND	Black
4	- 12V	Green
5	+ 5V	Red
6	GND	Black

Speaker Output (J10)

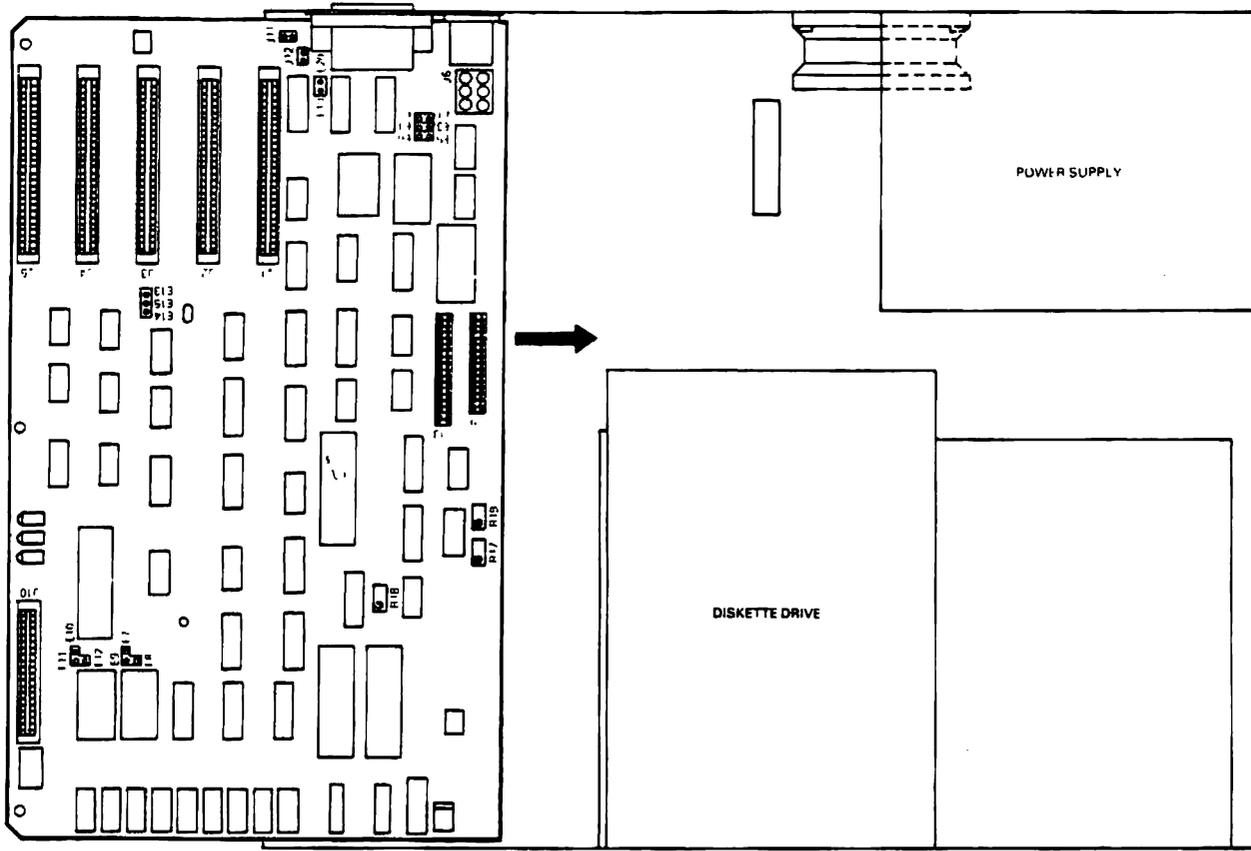
- 1 = Speaker
- 2 = Ground

Potentiometers (FDC Alignment)

- R17 = Pump Line Voltage (1.4 Vdc)
- R18 = Vco frequency (2.0 mHz)
- R19 = Write Pulse Width (750ns)

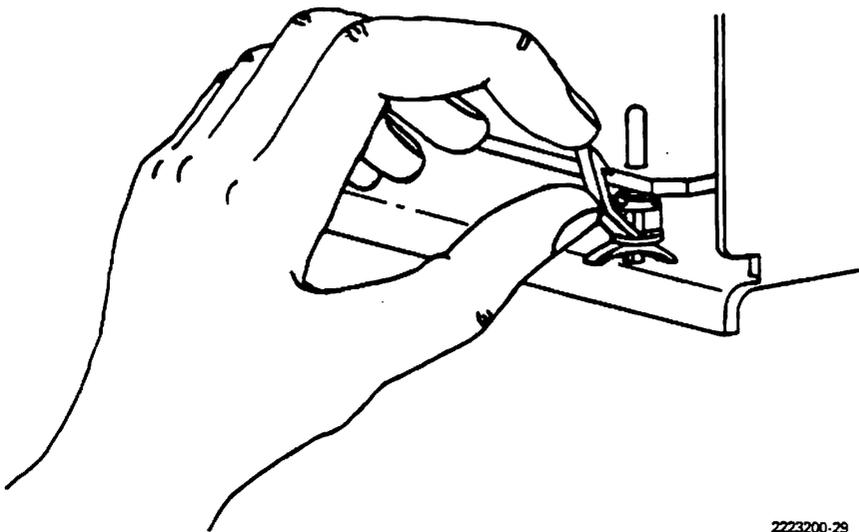
2223200-31

**Figure 5-33. System Unit Jumpers**



2223200-32

Figure 5-34. System Unit Board Replacement



2223200-29

Figure 5-35. Connector and Retainer Replacement

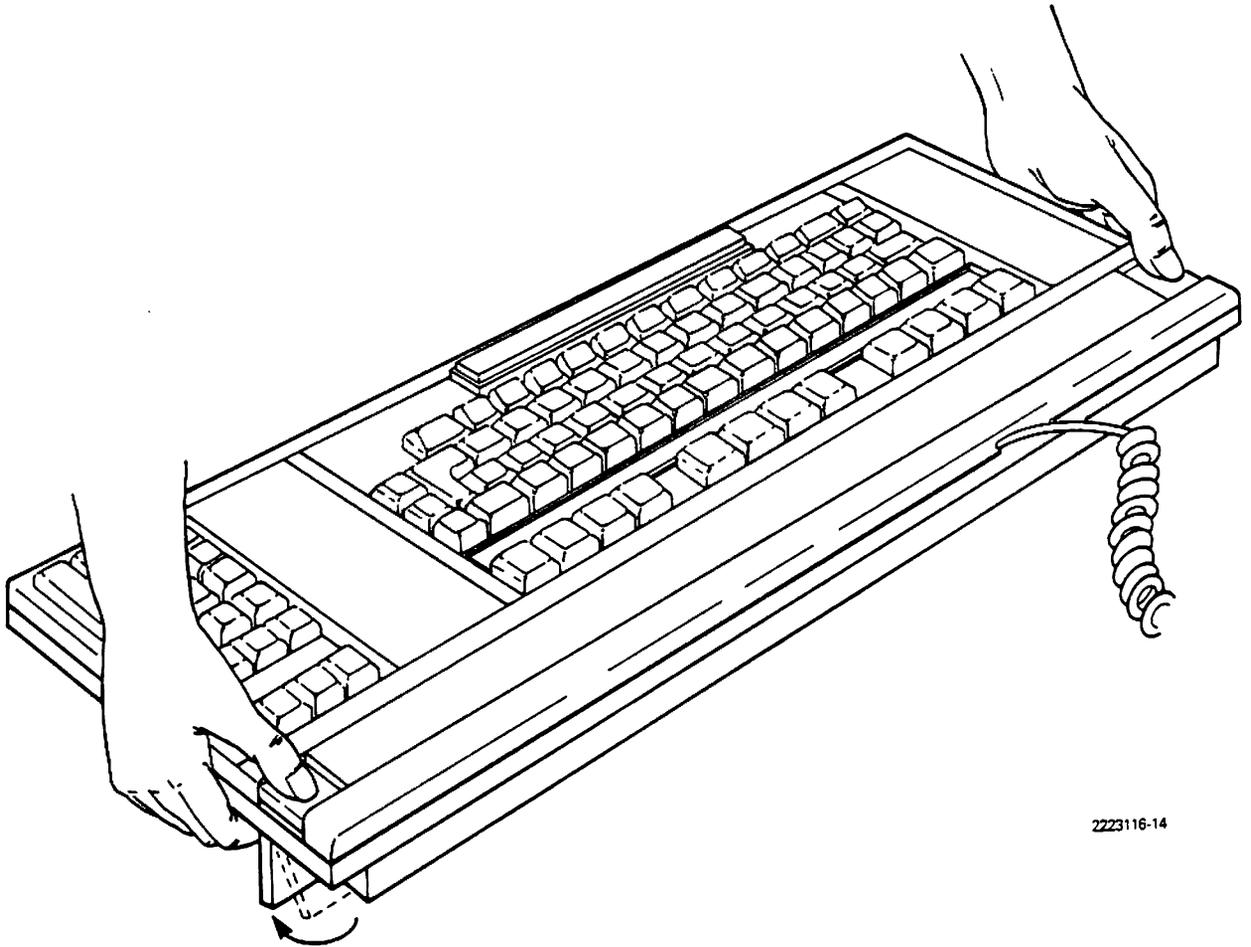
### CAUTION

Static electricity can be destructive to static-sensitive components mounted on the option board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.

### NOTE

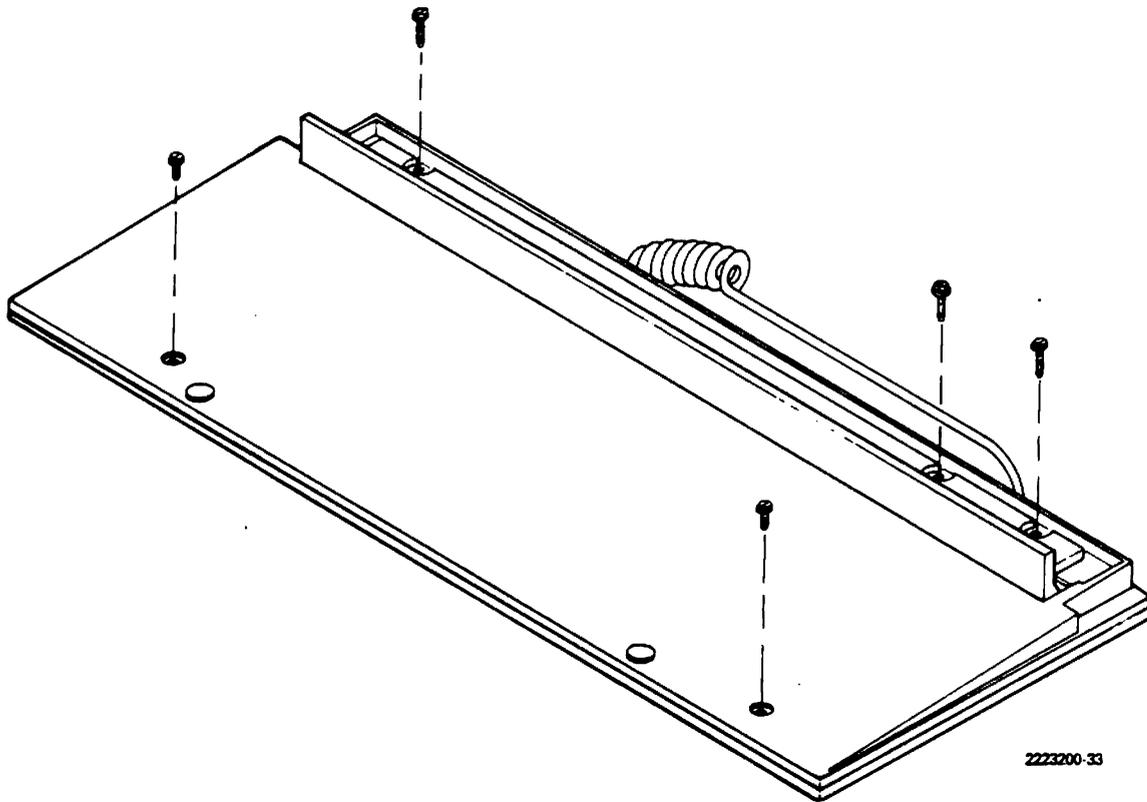
To perform the following steps, place the keyboard on a padded or cushioned work surface to protect the keycaps.

3. Extend the keyboard tilt bar by holding the keyboard on each side and pressing down on the release buttons, as indicated in Figure 5-36.
4. Turn the keyboard upside down. Remove the five screws using a 1/4-in nutdriver. Three of the screws are longer than the other two. The longer screws are located in the tilt bar well. See Figure 5-37 for the locations of these screws.
5. Holding the keyboard cover and base, turn the keyboard rightside up on the work surface. Lift the cover up and away from the keyboard base and board assembly as shown in Figure 5-38. Set the cover aside and out of the way.



2223116-14

Figure 5-36. Lowering the Tilt Bar



**Figure 5-37. Removing the Case Screws**

6. Unplug the cable from the printed wiring board. If only the keyboard cable is being replaced, skip step 7.
7. Remove the five screws securing the keyboard board assembly to the bottom case. Notice that the three screws at the top are longer than the two at the bottom. The keyboard is now free to lift up and out of the bottom case. See Figure 5-39.

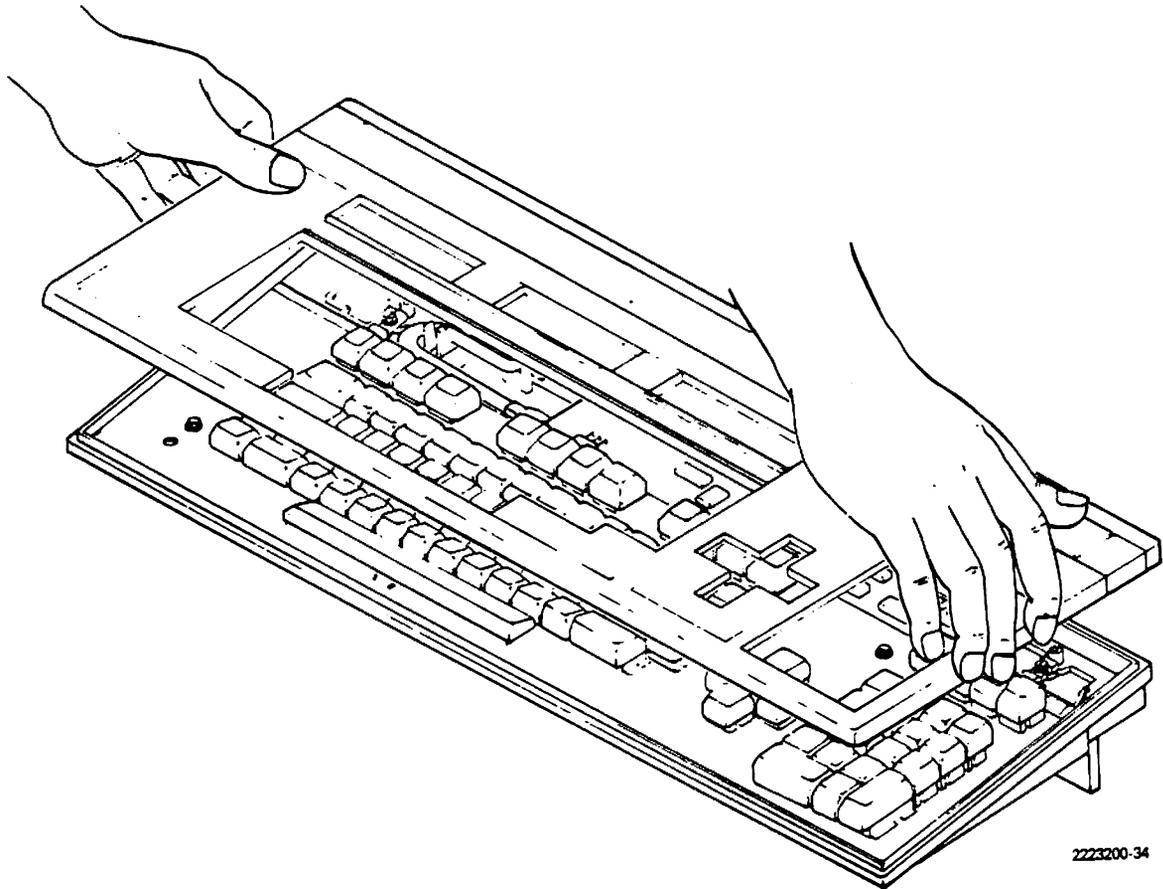
**NOTE**

Before performing the following steps, place the keyboard on a padded or cushioned work surface to protect the keycaps.

1. Gently lower the board into the bottom case. Make certain it is properly positioned in the bottom case. See Figure 5-40.
2. Replace the five screws securing the keyboard board to the bottom case. Make certain the longer screws are installed in the top three holes.

**5.9.2 Keyboard Board Replacement**

If only the keyboard cable is being replaced, perform steps 3 through 7. If the keyboard board assembly is also being replaced, perform all steps.



**Figure 5-38. Removing the Cover**

3. Thread the keyboard cable through the restraining molding on the inside bottom of the case. Connect the keyboard connector to the keyboard board assembly. See Figure 5-41.
4. Replace the top cover on the keyboard assembly. Make certain the top cover fits flush against the case bottom.
5. Carefully place the halves of the case together and gently turn the keyboard upside down. Set the keyboard down, and rest it on its keycaps.
6. Reinstall the four screws which secure the top and bottom case halves, as shown in Figure 5-42. **USE CAUTION!** The longest screws must only be used on the thick side (top) of the keyboard. Make certain that the keyboard case fits snugly on all sides. Do not use excessive force when tightening the screws.
7. Reconnect the keyboard cable to the back of the system unit.

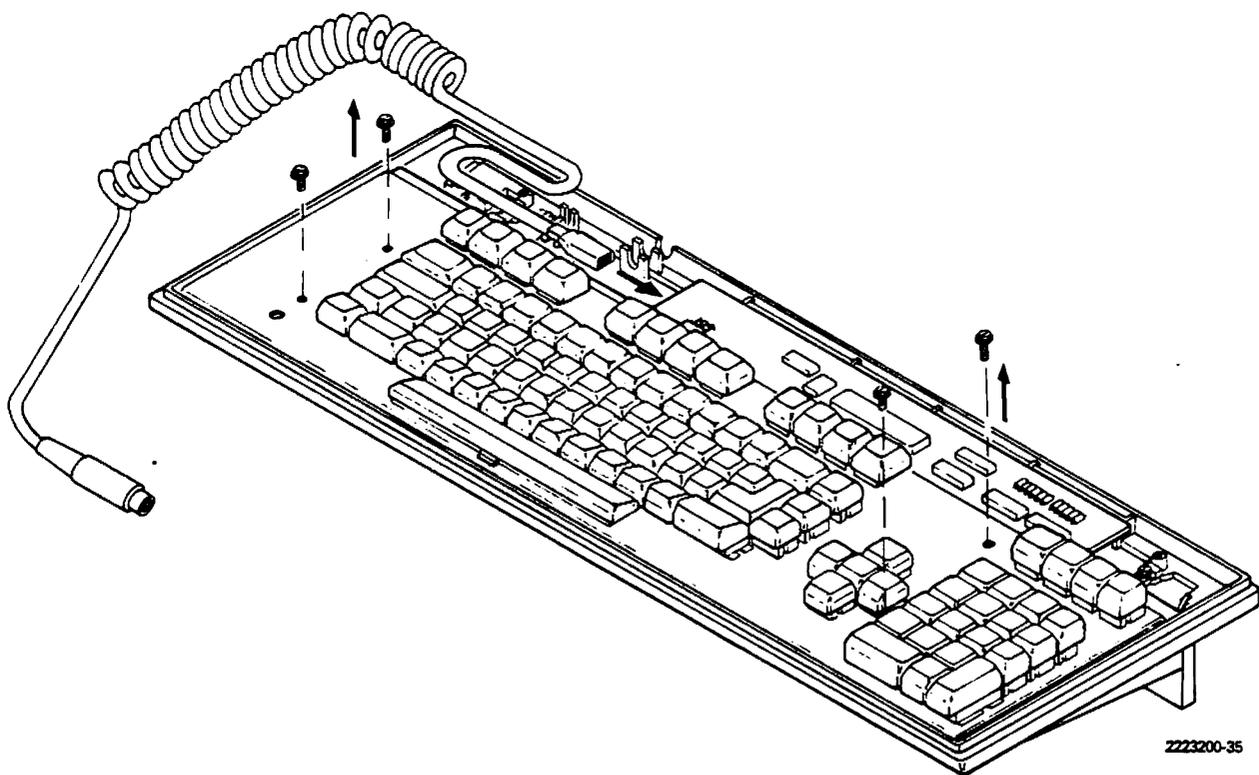


Figure 5-39. Keyboard Board Removal

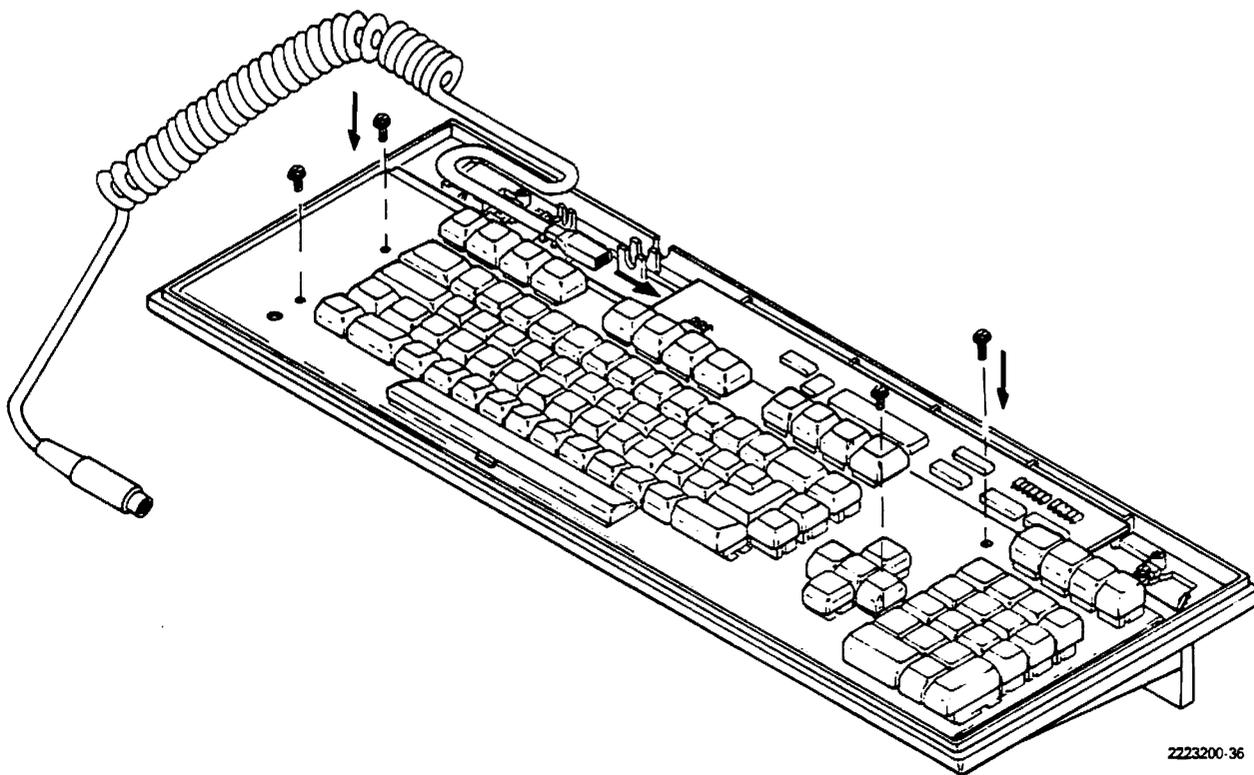
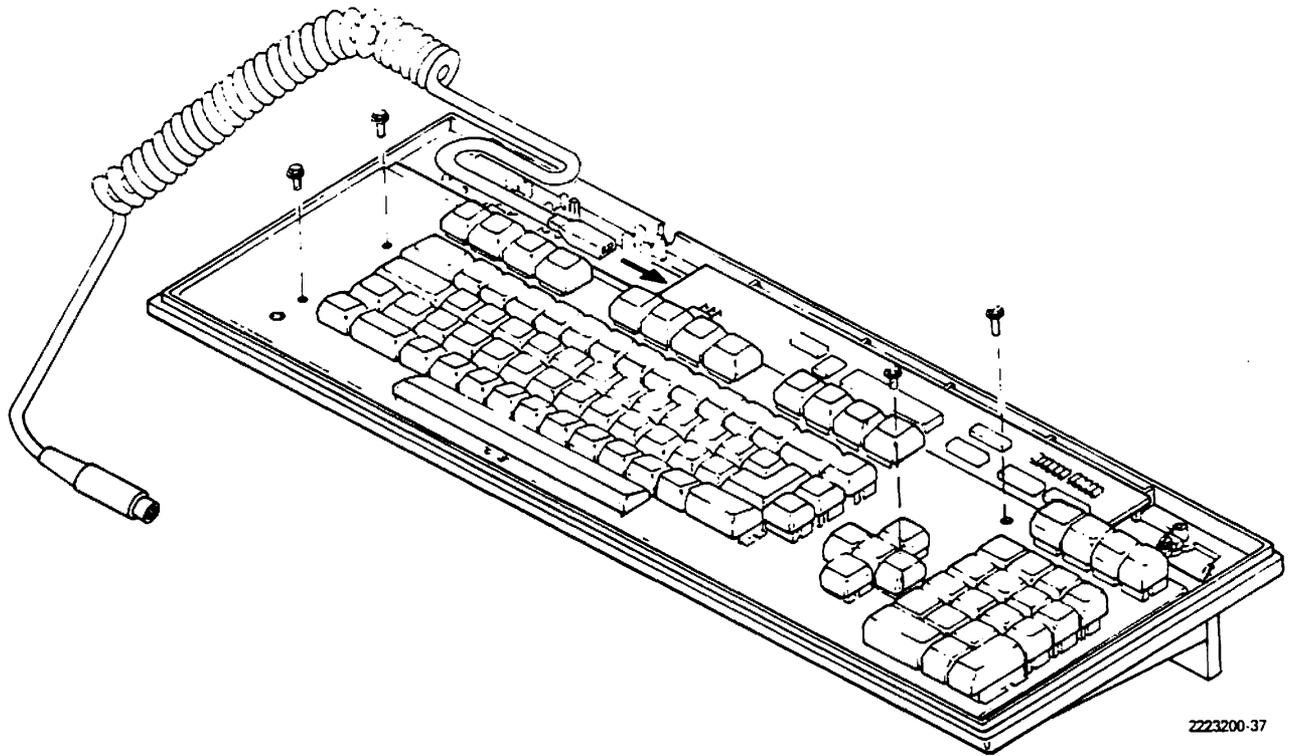
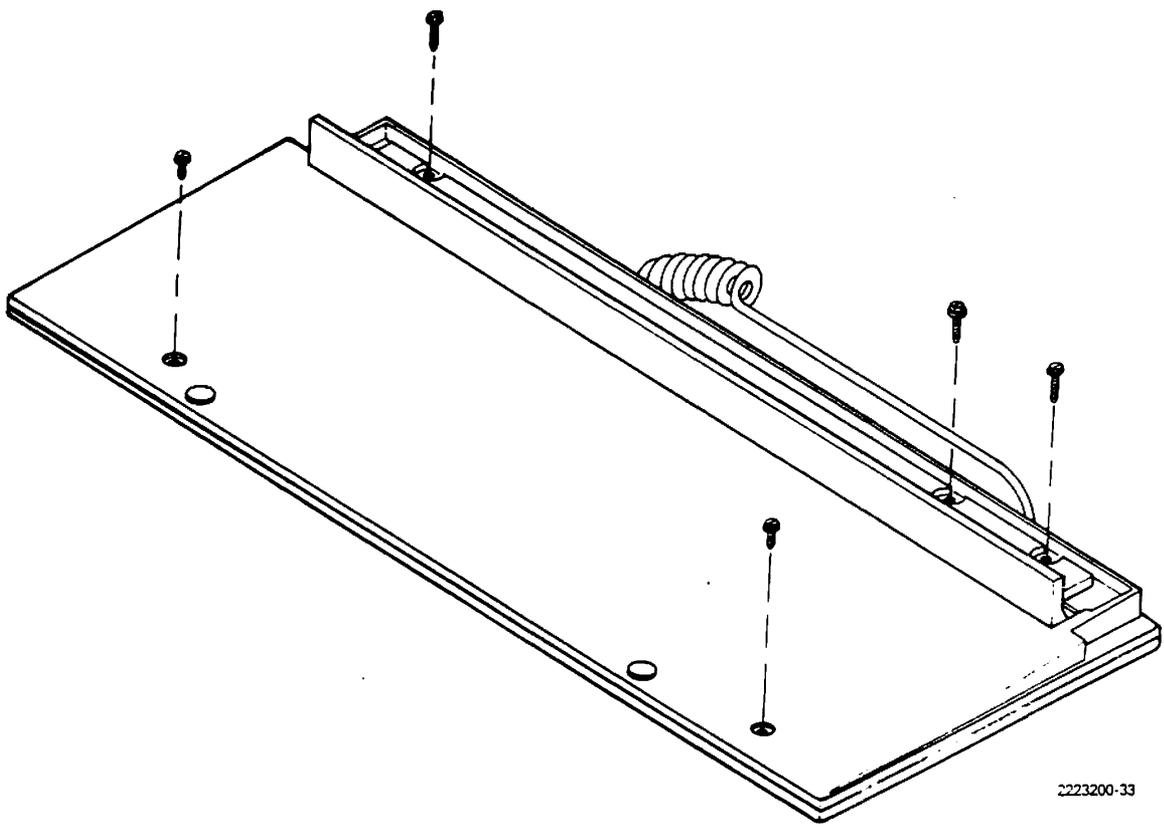


Figure 5-40. Keyboard Board Replacement



2223200-37

**Figure 5-41. Installing the Cable**



2223200-33

**Figure 5-42. Replacing the Case Screws**

# Section 6

## Parts

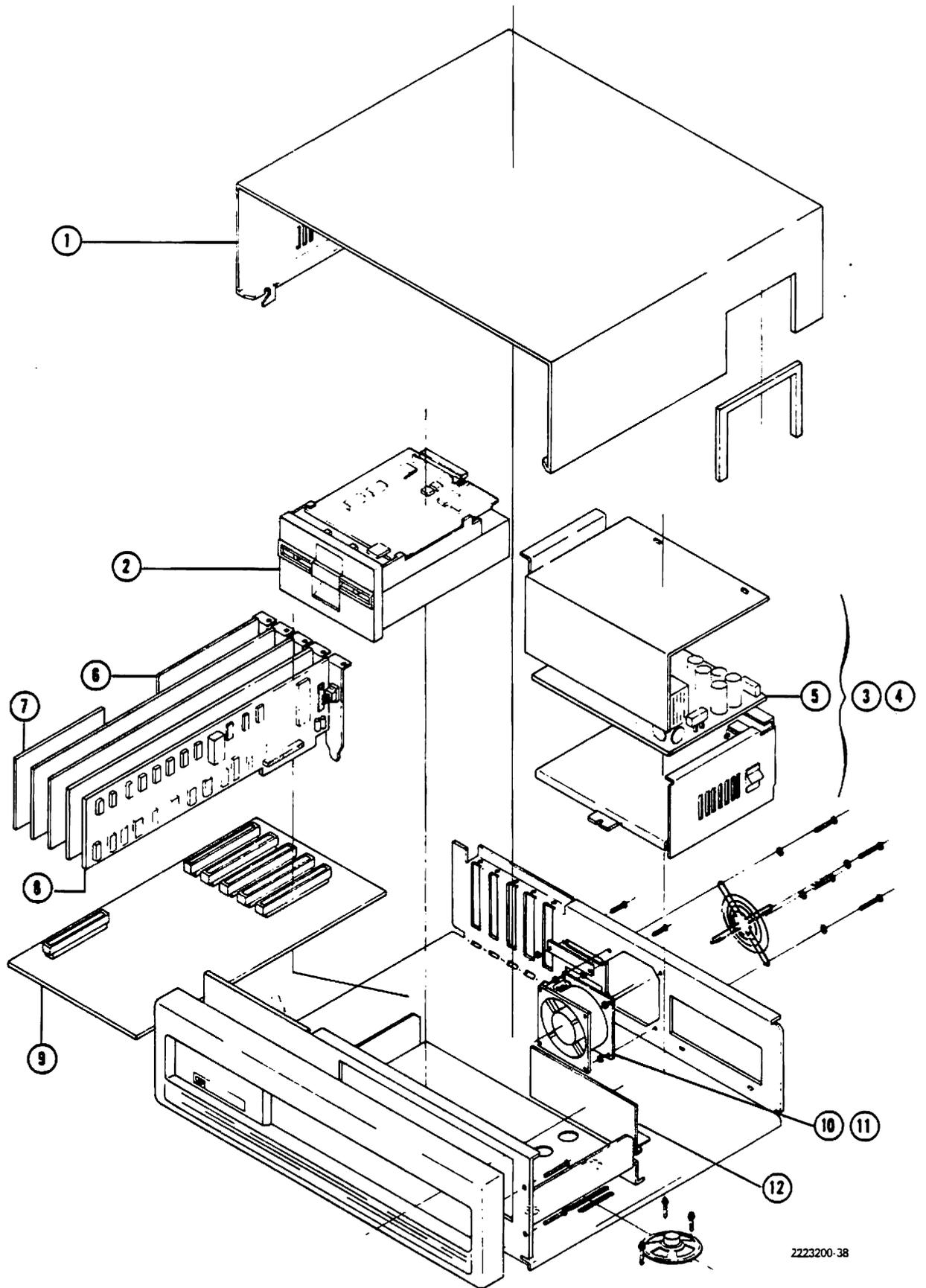
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This section identifies all field-replaceable assemblies used in the Texas Instruments Professional Computer. See Figure 6-1 for an exploded view of the system unit. See Figure 6-2 for an exploded

view of the keyboard. Following the listing of all field-replaceable assemblies and their part numbers are figures of the system unit and keyboard.

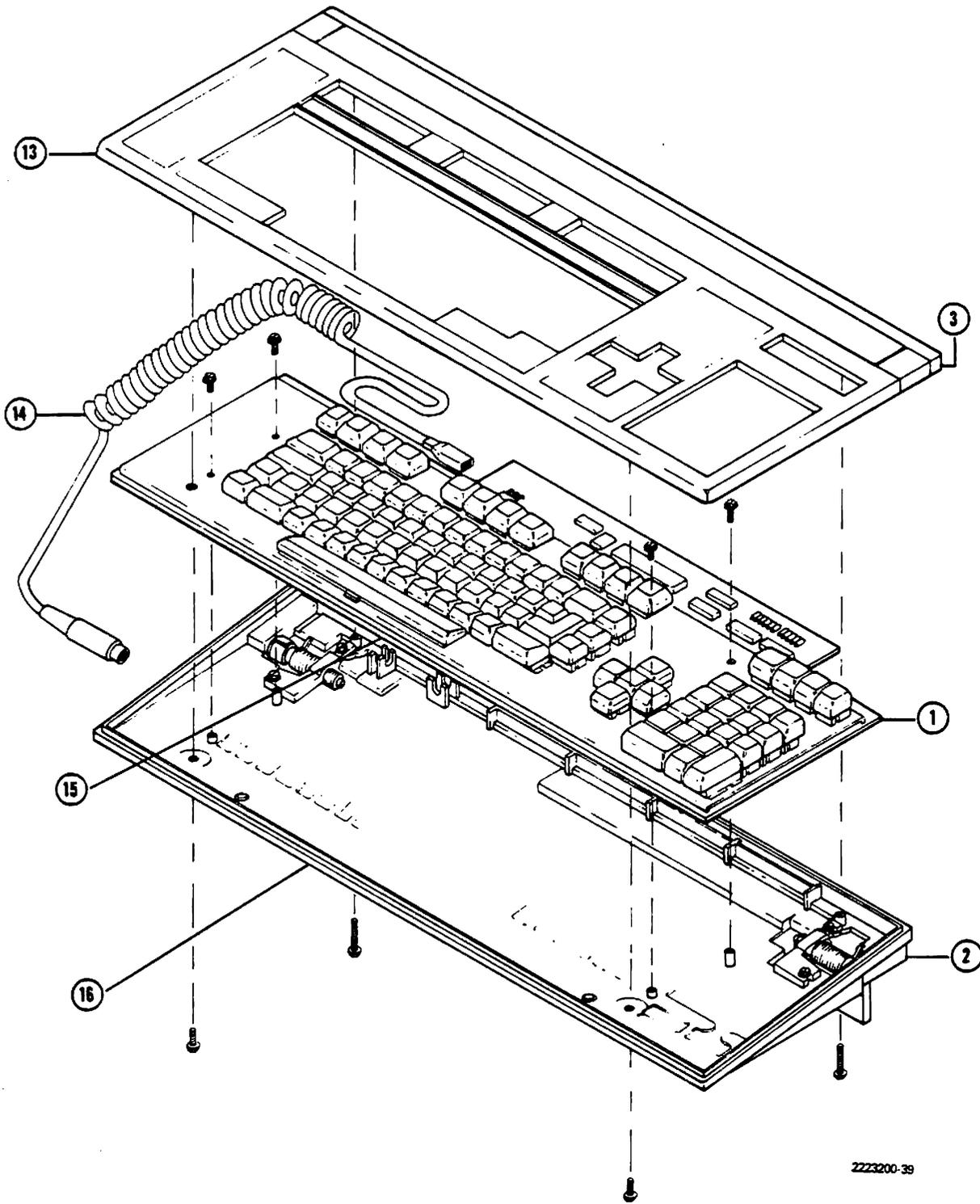
TI Part Number	Description	Figure Reference Number
2223029-0001	Cover, System Unit	1
2220446-0002	Diskette Drive 320-kbyte	2
2223037-0001	Power Supply Assy, 120 Vac	3
2223037-0002	Power Supply Assy, 250 Vac	4
2223091-0001	Board, Power Supply 120/250 Vac	5
2223094-0001	Sync/Async Comm Board (Option)	6
2223015-0001	Expansion RAM Board 64-kbyte (Option)	7
2223015-0002	Expansion RAM Board — 128-kbyte (Option)	7
2223015-0003	Expansion RAM Board — 192-kbyte (Option)	7
2223099-0001	RAM Upgrade Kit — Nine 64-kbyte chips (Option)	7
2223100-0001	CRT Controller Board (2-layer)	8
2223003-0001	System Unit Board (Motherboard)	9
2220632-0001	Fan Assembly, 125 Vac	10
2232328-0001	Fan Assembly, 250 Vac	11
2223220-0001	Winchester Drive Controller Board (Option) (NOTE: Comes with 2 cables)	
2217210-0001	Winchester Disk Drive (5-Mbyte)	
2223061-0001	Graphics Controller Board 1 plane (Option)	

<b>TI Part Number</b>	<b>Description</b>	<b>Figure Reference Number</b>
2223061-0002	Graphics Controller Board 3 planes (Option)	
2223049-0001	300/1200 Baud Internal Modem Board (Option)	
2223260-0001	300 Baud Internal Modem Board (Option)	
2223043-0001	Clock and Analog Interface (Option)	
2223046-0001	Monochrome Display	
2223219-0001	Color Display Unit	
2223033-0001	Blank Plate, Option Board	
2223034-0001	Blank Plate, Diskette Drive	12
2207634-0001	Cable, Serial Port/Modem	
993239-0001	Cable, Serial Printer	
2223106-0001	Cable, Parallel Printer	
22232326-0001	Cable, Daisy Chain (Winchester)	
22232327-0001	Cable, Radial (Winchester)	
2223105-0001	Cable, Monochrome Signal	
2223097-0001	Cable, Diskette Drive Daisy Chain	
2211801-0001	Cordset, Flat, modem 2.13 m (84 in)	
2223108-0001	Cable Assy, Speaker	
2220556-0001	Speaker	
2211919-0002	Plug, Hole 32 mm (1.563 in)	
2207985-0001	Test Plug EIA, Mdl 767	
2223276-0001	Parallel Loopback Plug	
2230530-0002	Keyboard Cover	13
2230549-0001	Cable, Keyboard	14
2230527-0001	Keyboard PWB, Complete	15
2230529-0002	Keyboard Base	16



2223200-38

Figure 6-1. Exploded View — System Unit



2223200-39

Figure 6-2. Exploded View – Keyboard Assembly

# Appendix A

## Advanced Diagnostics Tests

---

### A.1 INTRODUCTION

This appendix contains a comprehensive description of each test that can be executed using the advanced diagnostics menu as described in Section 4. Each test description includes the following information.

- Problems the test can identify and typical situations in which the test should be executed.
- Operations the test performs.
- Syntax, and acceptable and default values for the various test parameters.
- Any special instructions required for the execution of the test.

All the tests can be activated by accessing the advanced diagnostics menu. This is accessed by pressing **CTRL** and **A** when at the user diagnostics menu. All the tests can be executed by entering the command via the keyboard or by including the command in a batch file. All tests can be aborted at any time by pressing the **ESC** key. The only exception to this is a brief period of time during the keyboard test when the keyboard is locked out. Pressing the **ESC** key also aborts tests being run from a batch file.

Pressing the **ESC** key one time aborts and returns to the advanced diagnostics menu. Pressing **ESC** a second time exits the advanced diagnostics menu, and returns to the user diagnostics menu. Pressing **ESC** a third time exits to **MS-DOS**, and you will see the prompt:

**A:**

If you inadvertently **ESC**aped to **MS-DOS** and wish to return to the diagnostics without rebooting the computer, simply type:

**DIAGS**

and press the **RETURN** key.

**DIAGS** is the filename for the diagnostics program on the diskette.

### A.2 DISPLAY DIAGNOSTICS

The display diagnostics tests are described in the following paragraphs.

### A.2.1 CRT Alignment Test

The CRT Alignment Test displays a pattern to aid the shop technician in adjusting the video controls. This test should be executed when adjustment of the display is necessary to correct any of the following symptoms.

- Raster size out of tolerance
- Linearity out of tolerance
- Rolling or tearing of the display
- Out of focus
- Foldover on the end of a line
- Tilted image

Syntax :

Command	Parameter	Description	Acceptable Value
CRTTST	TEST	Test to execute	ALIGN

Example:

```
CRTTST TEST = ALIGN
```

Display Messages:

```
CRT Alignment Test: Test complete - 0100  
CRT Alignment Test: Test aborted - 0101
```

### A.2.2 CRT Controller Video Test

The CRT Controller Video Test provides a comprehensive check of the CRT controller board. It isolates any remaining problems with the display image after proper adjustments have been made using the CRT Alignment Test.

The CRT Controller Video Test performs a complete test of the controller registers and character and attribute video memories. The test checks for the presence of an output video signal to the display unit. It also tests for an interrupt generated by the CRT controller during the vertical synchronization signal. This interrupt synchronizes certain display operations with the vertical blanking signal to avoid flashing of retrace or other signals on the display.

During execution of the CRT Controller Video Test, the display will blink ON and OFF repeatedly as the video is turned OFF while testing the character and attribute memories. A line of solid block characters (briefly visible as a solid white bar) is flashed on the top (first) line of the display. The amplitude of this signal is verified to test the output signal of the CRT controller board.

Syntax:

Command	Parameter	Description	Acceptable Value	Default Value
CRTTST	TESt	Test to execute.	VIDeo	-----
	ERRors	Number of errors reported.	1 to 255	10
	LOG	Enables logging of messages to printer.	ON or OFF	OFF
	LOOp	Number of repetitions.	1 to 9999	10

Example:

```
CRTTST TES = VID ERR = 20 LOG = ON LOO = 200
```

Display Messages:

```
CRT Video test: Test complete - 0100
CRT Video test: Test aborted - 0101
```

```
CRT test: Loop xxxxx: CRT controller failure - 0102
CRT test: Loop xxxxx: CRT memory failure - 0103
CRT test: Loop xxxxx: CRT attribute memory failure - 0104
CRT test: Loop xxxxx: CRT attribute latch failure - 0105
CRT test: Loop xxxxx: CRT video failure - 0106
CRT test: Loop xxxxx: CRT interrupt failure - 0107
```

### A.2.3 Display Attributes Test

The Display Attributes Test is the only means of testing the operation of the character generator ROM on the CRT controller board. You should execute the test any time the integrity of the character generator circuitry is in question. The test displays every character (codes 00 through FF) in the character generator ROM so that the viewer can determine whether each character is properly displayed. The Display Attributes Test also displays typical character sequences using the reverse video, blink, blank, and underline attributes.

Horizontal bars are also displayed in various colors/intensities. In a monochrome display, the bars appear in only one color, but in varying intensities. In a color display, the bars appear in different colors. The low-intensity bars may not be visible if the brightness adjustment is set for normal viewing of text. To view the low-intensity bars, turn the brightness control on the display unit clockwise. Restore the brightness control to a normal setting after viewing the intensity/color bars.

Syntax:

Command	Parameter	Description	Acceptable Value
CRTTST	TEST	Test to be executed.	ATTRIBUTES

Example:

CRTTST TEST = ATTRIBUTES

Display Messages:

CRT Attributes Test: Test complete – 0100  
 CRT Attributes Test: Test aborted – 0101

### A.3 DISPLAY GRAPHICS DIAGNOSTICS

#### A.3.1 Display Graphics Memory Test

The Display Graphics Memory Test performs a memory test of the three possible RAM banks, each corresponding to a single graphics plane. The test also checks for the presence of the graphics video signal. You should execute this test whenever the graphics circuitry is suspect.

During this test, "RAM bank (A, B, or C) not installed" messages appear when a graphics video controller board that has less than three banks of memory is installed.

The palette hardware is also tested, along with the presence of the video signal, when a line of dots with different palette settings are on the top line of dots on the display. A check is made for the presence of a video output signal with each palette setting.

Syntax:

Command	Parameter	Description	Acceptable Value	Default Value
CRTTST	TEST	Test to execute.	VIDEO	---
	ERRORS	Number of errors reported.	1 to 255	10
	LOG	Enables logging of messages to printer.	ON or OFF	OFF
	LOOP	Number of repetitions.	1 to 9999	10

**Example:**

**GRATST TES = VIDEO LOO = 600**

**Display Messages:**

**CRT GRAPHICS test: Test complete – 0100**

**CRT GRAPHICS test: Test aborted – 0101**

**CRT GRAPHICS test: Loop xxxxx: Graphics video failure – 0108**

**CRT GRAPHICS test: loop xxxxx: RAM failure in IC Uxx – 0109**

**CRT GRAPHICS test: loop xxxxx: RAM Bank A not installed – 0110**

**CRT GRAPHICS test: loop xxxxx: RAM Bank B not installed – 0111**

**CRT GRAPHICS test: loop xxxxx: RAM Bank C not installed – 0112**

### **A.3.2 Display Graphics Alignment Test**

The Display Graphics Alignment Test checks the relative alignment of the alphanumeric and graphics display planes. You should execute this test when the alignment of either the alphanumeric or graphics data is suspect.

The Display Graphics Alignment Test displays a high-intensity pattern on the graphics plane overlaid by an identical pattern on the alphanumeric plane. The pattern on the alphanumeric plane is displayed using low intensity. The pattern on the graphics is displayed with high intensity. If the alphanumerics and graphic planes are properly aligned, the high-intensity pattern displayed on the graphics plane is not visible to the operator. If any portion of the high-intensity pattern is visible, the graphics and alphanumeric planes are not properly aligned. If the high-intensity pattern is shifted, replace the graphics video controller board. If the low-intensity pattern is shifted, replace the CRT controller board.

**Syntax:**

<b>Command</b>	<b>Parameter</b>	<b>Description</b>	<b>Acceptable Value</b>
<b>GRATST</b>	<b>TES</b>	<b>Test to be executed.</b>	<b>alignment</b>

**Example:**

**GRATST TES = ALIGNMENT**

**Display Messages:**

**CRT GRAPHICS test: Test complete – 0100**

**CRT GRAPHICS test: Test aborted – 0101**

## A.4 KEYBOARD DIAGNOSTICS

### A.4.1 Keyboard Interface Test

You should execute the Keyboard Interface Test whenever the keyboard is partially inoperative or intermittent keyboard failures occur. The system unit microprocessor tests the interface by sending diagnostic commands to the keyboard. The diagnostic commands request the keyboard to perform a ROM and RAM test of the keyboard memory. Once the test is completed, the keyboard responds to the system unit with one of eight codes that indicate the test status.

Syntax:

Command	Parameter	Description	Acceptable Value	Default Value
KEYTST	TES	Test to execute.	INTERface	----
	ERRors	Number of errors reported.	1 to 255	10
	LOG	Enables logging of messages to printer.	ON or OFF	OFF
	LOOp	Number of repetitions.	1 to 9999	10

Example:

```
KEYTST TES = INT ERR = 1 LOO = 1000
```

Display Messages:

```
KEYBOARD Interface test: Test complete - 0200
KEYBOARD Interface test: Test aborted - 0201
KEYBOARD test: Loop xxxxx: Keyboard not installed - 0202
KEYBOARD test: Loop xxxxx: No keyboard response - 0203
KEYBOARD test: Loop xxxxx: Keyboard receiver error - 0204
KEYBOARD test: Loop xxxxx: Keyboard RAM failure - 0205
KEYBOARD test: Loop xxxxx: Keyboard ROM failure - 0206
KEYBOARD test: Loop xxxxx: Unexpected keyboard response - 0207
```

### A.4.2 Keyboard Keys Test

Use the Keyboard Keys Test to verify the proper operation of any one of the key-switches on the keyboard. This test requires you to participate in testing any or all of the keys on the keyboard.

This test displays an image of the keyboard on the display. As you press each key on the keyboard, the corresponding displayed key (and qualifiers, for example, SHIFT, ALT, CTRL, and CAPS LOCK) blinks to indicate that the key is operating. The displayed key continues to blink until you press another key. As you press each key, the system bell produces a short "beep." You can observe the repeat action function of the keyboard by pressing and holding down any repeat action key. The repeat action key produces a sequence of audible beeps.

Syntax:

Command	Parameter	Description	Acceptable Value
KEYTST	TES	Test to be executed.	KEYS

Example:

KEYTST TES = KEYS

Display Messages:

KEYBOARD Keys test: Test complete – 0200  
 KEYBOARD Keys test: Test aborted – 0201

## A.5 COMMUNICATIONS PORT DIAGNOSTICS

The communications diagnostics tests are described in the following paragraphs.

### A.5.1 Communications Local Loopback Test

Use the Communications Local Loopback Test to test the synchronous-asynchronous communications board or interface to any serial external device including external modems, serial printers, or any other RS-232-C device.

You can execute the Communications Local Loopback Test either internally to the communications board or via an external loopback device. The external loopback mode is particularly useful when testing the operation of an external modem. The external modem should be set in the analog loopback mode. You should execute the external loopback test at an appropriate speed and format to suit the type of external modem used.

Refer to the modem manual when performing analog loopback. Some modems require that request to send (RTS) be active prior to switching to the analog loopback mode.

The communications loopback plug, provided with the Maintenance Option Kit (TI Part No 2223282-0001) can be used for performing the external loopback operation. No modem is necessary. The transmitted data is looped back to the receive channel, and data from the two channels are compared. The external loopback test verifies that the computer and communications port are operating. If communications problems persist, consider the following.

- Bad cabling to external equipment
- Bad local modem
- Poor quality communications lines linking the two points of communication

- Bad modem on the far end of the link
- Bad terminal, host computer, or other device with which you are attempting to communicate
- Improper configuration of one or more devices on the link

The internal mode of the Communications Local Loopback Test allows you to perform an extensive checkout of the communications board. When using the internal mode however, the EIA input/output drivers (which convert internal TTL signal levels to the EIA signal levels available at the external connector) are not tested.

Supplementing the ability of the synchronous-asynchronous communications board to transmit and receive, the internal baud rate generator is also tested to ensure that the rate is within allowable limits. When testing in the synchronous format and external mode, the receive and transmit input EIA clock signals are also tested. In the asynchronous format, the transmit and receive clocks are derived from the internal baud rate generator according to the Speed parameter selection.

The Communications Local Loopback Test is able to detect invalid jumper configurations of the communications board. That is, if a communications board is configured in a manner so that the selected port address does not match the assigned interrupt level, the error message "Invalid Port Configuration" appears on the display. The test is not able to detect problems when two communications boards are installed and configured for the same port address and interrupt. Make sure that the port numbers shown on the System Configuration Display correspond to the boards that are actually installed.

After you execute the Communications Local Loopback Test on a communications board that is used to interface to the serial printer, the printer interface must be reinitialized before normal printing operations can resume. You can reinitialize the serial printer interface by booting the unit with the operating system diskette that is configured to use the serial printer.

**Syntax:**

<b>Command</b>	<b>Parameter</b>	<b>Description</b>	<b>Acceptable Value</b>	<b>Default Value</b>
<b>COMTST</b>	<b>TES</b> t	Test to execute.	<b>LOC</b> al	---
	<b>POR</b> t	Port(s) to test.	<b>1,2,3,4</b>	<b>All</b>
	<b>FOR</b> mat	<b>SYN</b> chronous or <b>ASY</b> nchronous loopback.	<b>SYN</b> c, <b>ASY</b> nc	<b>ASY</b> nc
	<b>SPE</b> ed	Speed of loopback.	<b>110 to 9600</b>	<b>9600</b>
	<b>MODe</b>	Internal or external loopback of data.	<b>INT</b> ernal, <b>EXT</b> ernal	<b>INT</b> ernal

### Syntax (Continued)

Command	Parameter	Description	Acceptable Value	Default Value
	ERRor	Maximum number of errors reported.	1 to 255	1
	LOG	Enables logging of messages to printer.	ON, OFF	OFF
	LOOP	Number of test repetitions.	1 to 9999	1

#### Examples:

```
COMTST TES = LOC PORT = 2 FORMAT = SYN MODE = EXT LOG = ON
```

```
COMTST TEST = LOCAL FORMAT = ASYNC SPEED = 1200 MODE = INTERNAL LOOP = 250
```

#### Display Messages:

```
COMM local loopback test: Test complete - 0300  
COMM test: Test aborted - 0301
```

```
COMM test: Loop xxxxx: Port not installed - 0302  
COMM test: Loop xxxxx: Transmit interrupt failure - 0303  
COMM test: Loop xxxxx: Receive interrupt failure - 0304  
COMM test: Loop xxxxx: Receive data failure - 0305  
COMM test: Loop xxxxx: Invalid port configuration - 0306  
COMM test: Loop xxxxx: Invalid interrupt - 0307  
COMM test: Loop xxxxx: Erratic input clock - 0308
```

### A.5.2 Communications Remote Loopback Test

The Communications Remote Loopback Test allows you to test communications between two Texas Instruments Professional Computers, or between a Texas Instruments Professional Computer and another computer or device capable of conducting an external loopback test. When the Communications Remote Loopback Test is activated, any data received by the computer is echoed or transmitted back to the source of the data. The device which originated the data compares the data received with the data originally transmitted. Any difference in the data causes an error message to be sent to the display of the computer originating the Communications Local Loopback Test.

A local computer (designated computer A) has selected the Communications Local Loopback Test using the EXTERNAL mode. The remote computer (designated computer B) has selected the Communications Remote Loopback Test. Each computer is selected by the port assignment for which its respective synchronous-asynchronous communications board is jumpered.

Computer A executes the Communications Local Loopback Test. Computer B echoes back any character sent to it until the operator at Computer B presses either the ESC or RETURN key. This test can be used to test the entire communications link from one station to another.

Syntax:

Command	Parameter	Description	Acceptable Value	Default Value
COMTST	TEST	Test to execute.	REMOTE	----
	PORT	Port(s) to test.	1,2,3,4	All

Example:

COMTST TEST = REMOTE PORT = 1

Display Messages:

COMM Remote loopback test: Test complete – 0300  
COMM test: Test aborted – 0301

## A.6 ROM DIAGNOSTICS

### A.6.1 CRC test

Because the proper operation of the ROMs is essential to the operation of the entire computer, the Cyclic Redundancy Test (CRC Test) reports a pass/fail status on each ROM installed. The size of the ROM, along with its CRC checksum, is displayed with the completion or error message. This test should be run whenever any system malfunction occurs.

If a ROM failure occurs, you should run the Display System Configuration test to determine which ROMs are installed. Most of the option ROMs are located on option boards such as the Winchester controller board. In addition, there is a socket on the main board that may contain an optional ROM (XU63).

Syntax:

Command	Parameter	Description	Acceptable Value	Default Value
ROMTST	ERRors	Number of errors reported.	1 to 255	1
	LOG	Enables logging of messages to printer.	ON, OFF	OFF
	LOOps	Number of test repetitions.	1 to 9999	1

Example:

ROMTST LOG = ON LOO = 9999

## Display Messages:

ROM test: Loop xxxx. Testing xxxx byte ROM at address XXXXXX. CRC = xxxx.

ROM test: Test complete – 0400

ROM test: Test aborted – 0401

ROM test: Loop xxxx: CRC error - 0402 (ROM at hexadecimal address 0F4000 failure)

ROM test: Loop xxxx: CRC error - 0403 (ROM at hexadecimal address 0F6000 failure)

ROM test: Loop xxxx: CRC error - 0404 (ROM at hexadecimal address 0F8000 failure)  
(Winchester board ROM)

ROM test: Loop xxxx: CRC error - 0405 (ROM at hexadecimal address 0FA000 failure)

ROM test: Loop xxxx: CRC error - 0406 (ROM at hexadecimal address 0FC000 failure [U62])

ROM test: Loop xxxx: CRC error - 0407 (ROM at hexadecimal address 0FE000 failure)

## A.7 RAM DIAGNOSTICS

You should execute RAM tests when any system malfunction occurs.

### A.7.1 RAM Test

The RAM Test selectively tests various RAM blocks with a walking ones and zeros test pattern. For test purposes, the RAM area is subdivided into banks of 64 kbytes. Four banks (0 through 3) are tested, yielding a maximum tested RAM area of 256 kbytes. "RAM Bank (1,2,or 3) Not Installed" messages are to be expected for systems having less than the maximum number of banks installed. Proper operation of the RAM is essential to the operation of the entire system.

#### Syntax:

Command	Parameter	Description	Acceptable Value	Default Value
RAMTST	TEST	Test to execute.	RAM	---
	BEGIN	First RAM Bank to be tested.	0,1,2, or 3	0
	END	Last RAM Bank to be tested.	0,1,2, or 3	3
	ERRor	Maximum number of errors reported.	1 to 255	10
	LOG	Enables logging of messages to printer.	ON, OFF	OFF
	LOOp	Number of test repetitions.	1 to 9999	30

#### Example:

RAMTST TES = RAM BEGIN = 1 END = 2 LOO = 200

**Display Messages:**

RAM test: Test complete – 0500  
RAM test: Test aborted – 0501

RAM test: 64-kbyte RAM Bank number 1 is not installed – 0503  
RAM test: 64-kbyte RAM Bank number 2 is not installed – 0504  
RAM test: 64-kbyte RAM Bank number 3 is not installed – 0505  
RAM test: System RAM failure in IC UXX – 0510  
RAM test: Option RAM failure in IC UXX – 0511  
RAM test: Main board NMI failure – 0512

**A.7.2 RAM Refresh Test**

The RAM Refresh Test verifies dynamic RAM that has retained its data for a period of time when read and write activity is inhibited. A refresh operation is performed every four milliseconds to retain the data. This test checks the validity of the RAM refresh operation.

The RAM Refresh Test stops all read and write activity in the dynamic RAM for the period of time (in seconds) specified by the loop count. At the completion of this period, the dynamic RAM is checked to ensure that it has retained its data.

During execution of the refresh test, most of the display is blank since the static RAM normally used for the display memory is used to execute the software performing the refresh test.

**Syntax:**

<b>Command</b>	<b>Parameter</b>	<b>Description</b>	<b>Acceptable Value</b>	<b>Default Value</b>
RAMTST	TESt	Test to execute.	REFresh	---
	ERRors	Number of errors reported.	1 to 255	10
	LOG	Enables logging of messages to printer	ON or OFF	OFF
	LOOP	Number of seconds to delay.	1 to 9999	30

**Example:**

RAMTST TES = REFRESH LOO = 30

**Display Messages:**

RAM test: Test complete – 0500  
RAM test: Test aborted – 0501  
RAM Refresh Test: RAM subsystem failure – 0513

## A.8 DISKETTE DIAGNOSTICS

### A.8.1 Format Diskette Test

The Format Diskette Test provides a comprehensive test of the diskette media as well as the read/write hardware. This test can also be used to test media compatibility between diskette drives. You should run this test whenever the integrity of the media or a diskette drive is in question.

You can format a diskette in one drive and verify it in another using the Diskette Verify Test. Use an unprotected scratch diskette with this test.

During the Format Diskette Test, the entire diskette is formatted with a hexadecimal 6DB6 pattern in the data fields of each sector. After the entire diskette is formatted, the contents of each track are verified. The test then writes all data fields with a specified pattern and verifies each track once again. Any errors found are reported and read three times. If the error is not corrected by the third read, the error is reported as a hard error. If the error disappears by the third read, the error is reported as a soft error.

Syntax:

Command	Parameter	Description	Acceptable Value	Default Value
FLOTST	TEST	Test to execute.	FORmat	-----
	DRive	Drive to test	1,2,3,or 4	Explicitly Defined
	ERRor	Maximum number of errors reported.	1 to 255	1
	LOG	Enables logging of messages to printer.	ON, OFF	OFF
	LOOpS	Number of test repetitions.	1 to 9999	1
	PATtern	Test pattern for writes.	4 digit hexadecimal	6DB6
	OPTion	Drive type. (See list of options in Table A-1)	0 to 9	8

The option parameter indicates which type of drive is to be tested and the setting for the write precompensation. Selecting write precompensation ON causes dual-density formatting or writing on the inner tracks.

Selecting write precompensation OFF causes single-density formatting or writing on the inner tracks. Table A-1 lists the acceptable option values and corresponding drive types.

**Table A-1. Format Diskette Test Option Values and Drive Types**

Option	Drive Type	Write Precompensation Setting
0	40 track, single-sided	OFF
1	40 track, single-sided	ON
2	40 track, double-sided	OFF
3	40 track, double-sided	ON
4	80 track, single-sided	OFF
5	80 track, single-sided	ON
6	80 track, double-sided	OFF
7	80 track, double-sided	ON
8	track and side as installed	OFF
9	track and side as installed	ON

When using options 8 and 9, the drive type is determined by the selection jumpers on the system unit board. Use the System Configuration Display to verify the type of drives installed.

Example:

FLOTST TEST = FOR DRI = 1 OPT = 8

Display Messages:

Diskette Format Test: Test complete-0600  
 Diskette Test: Test aborted - 0601  
 Diskette Test: Loop xxxx. D = x, Motor speed incorrect - 0602  
 Diskette Test: Loop xxxx. D = x, Motor control bad - 0603  
 Diskette Test: Loop xxxx. D = x, Not Ready or bad Index sensor - 0604  
 Diskette Test: Loop xxxx. D = x, Not installed - 0605  
 Diskette Test: Loop xxxx. D = x, Controller hardware failed - 0606  
 Diskette Test: Loop xxxx. D = x, T = xx S = xx Seek error - 0607  
 Diskette Test: Loop xxxx. D = x, T = xx S = xx Soft Data CRC error - 0608  
 Diskette Test: Loop xxxx. D = x, T = xx S = xx Hard Data CRC error - 0609  
 Diskette Test: Loop xxxx. D = x, T = xx S = xx Write protect error - 0610  
 Diskette Test: Loop xxxx. D = x, T = xx S = xx DRQ error, controller failure - 0611  
 Diskette Test: Loop xxxx. D = x, Track 00 sensor misadjusted - 0612  
 Diskette Test: Loop xxxx. D = x, Bad track value entered - 0613  
 Diskette Test: Loop xxxx. D = x, T = xx, S = xx Soft seek error - 0614  
 Diskette Test: Loop xxxx. D = x, T = xx, S = xx No information read - 0615  
 Diskette Test: Loop xxxx. D = x, T = xx, S = xx Data does Not equal memory - 0616  
 Diskette Test: loop xxxx. D = x, T = xx, S = xx Soft sector not found error - 0617  
 Diskette Test: loop xxxx. D = x, T = xx, S = xx Hard sector not found error - 0618

### A.8.2 Diskette Verify Test

The Diskette Verify Test performs a comprehensive seek test on the diskette drive, as well as a complete verification of the data on the diskette. This test is not destructive to the diskette data and can be used on any formatted diskette.

The test includes checks for motor on/off, motor speed, and track 00 sensor failure. When the drive test has been completed, the entire diskette is read sequentially (starting with track zero) and its contents are verified. A crescendo and random seek/read test is then performed reading one sector per track. The crescendo and random tests provide the fastest possible seeks between diskette tracks. Any errors detected are reported and retried three times. If the error is not corrected by the third try, the error is reported as a hard error. Otherwise, it is reported as a soft error.

On double-sided drives, both sides of the diskette are read unless the drive type is explicitly set for a single-sided drive using the Option parameter. Care should be taken on units with double-sided drives to ensure that the diskette to be verified is formatted on both sides. Normally, it is recommended that you run the Diskette Format Test on a scratch diskette, and use the formatted diskette for execution of the Diskette Verify Test. This will insure that the diskette is formatted on both sides on systems where double-sided drives are installed.

Syntax:

Command	Parameter	Description	Acceptable Value	Default Value
FLOTST	TEST	Test to execute.	VERIFY	-----
	DRive	Drive to test.	1,2,3,or 4	Explicitly defined
	ERRors	Maximum number of errors reported.	1 to 255	1
	LOG	Enables logging of messages to printer.	ON, OFF	OFF
	LOOP	Number of test repetitions.	1 to 9999	1
	OPTion	Drive type. (See list of options in Table A-2.)	0 to 9	8

The option parameter indicates which type of drive is to be tested and the setting for the write precompensation. Selecting write precompensation ON causes dual-density formatting or writing on the inner tracks.

Selecting write precompensation OFF causes single-density formatting or writing on the inner tracks. Table A-2 lists the acceptable option values and corresponding drive types.

**Table A-2. Diskette Verify Test Option Values and Drive Types**

Option	Drive Type	Write Precompensation Setting
0	40 track, single-sided	OFF
1	40 track, single-sided	ON
2	40 track, double-sided	OFF
3	40 track, double-sided	ON
4	80 track, single-sided	OFF
5	80 track, single-sided	ON
6	80 track, double-sided	OFF
7	80 track, double-sided	ON
8	track and side as installed	OFF
9	track and side as installed	ON

When selecting options 8 and 9, the drive type is determined by the selection of jumpers on the system unit board. Use the System Configuration Display to verify the type of drives installed.

Example:

FLOTST TES = VERIFY DRI = 1 OPT = 8

Display Messages:

- Diskette Verify Test: Test complete - 0600
- Diskette Test: Test aborted - 0601
- Diskette Test: Loop xxxx. D = x, Motor speed incorrect - 0602
- Diskette Test: Loop xxxx. D = x, Motor control bad - 0603
- Diskette Test: Loop xxxx. D = x, Not Ready or bad Index sensor - 0604
- Diskette Test: Loop xxxx. D = x, Not installed - 0605
- Diskette Test: Loop xxxx. D = x, Controller hardware failed - 0606
- Diskette Test: Loop xxxx. D = x, T = xx S = xx Seek error - 0607
- Diskette Test: Loop xxxx. D = x, T = xx S = xx Soft Data CRC error - 0608
- Diskette Test: Loop xxxx. D = x, T = xx S = xx Hard Data CRC error - 0609
- Diskette Test: Loop xxxx. D = x, T = xx S = xx DRQ error, controller failure - 0611
- Diskette Test: Loop xxxx. D = x, Track 00 sensor misadjusted - 0612
- Diskette Test: Loop xxxx. D = x, T = xx, S = xx Soft seek error - 0614
- Diskette Test: Loop xxxx. D = x, T = xx, S = xx No information read - 0615
- Diskette Test: Loop xxxx. D = x, T = xx, S = xx Soft sector not found error - 0617
- Diskette Test: Loop xxxx. D = x, T = xx, S = xx Hard sector not found error - 0618

### A.8.3 Diskette Write Test

The Diskette Write Test is used as a quick check of the writing ability of the hardware and diskettes. Use an unprotected scratch diskette with this test. The Diskette Write Test writes a specified pattern to all the data fields on a specified track and verifies that they can be read. Any errors detected are reported and retried three times. If the error is not corrected by the third time, the error is reported as a hard error. Otherwise, it is reported as a soft error.

Syntax:

Command	Parameter	Description	Acceptable Value	Default Value
FLOTST	TEST	Test to perform.	WRITE	-----
	DRIVE	Drive to test.	1,2,3, or 4	Explicitly defined
	ERRORS	Maximum number of errors reported.	1 to 255	1
	LOG	Enables logging of messages to printer.	ON, OFF	OFF
	LOOPS	Number of test repetitions.	1 to 9999	1
	TRACK	Track to use for write test.	0 - max track	MAX
	PATTERN	Test pattern for writes.	4 digit hexadecimal	6DB6
	OPTION	Drive type. (See list of options in Table A-3.)	0 to 9	8

The Option parameter indicates which type of drive is to be tested and the setting for the write precompensation. Selecting write precompensation ON causes dual-density formatting or writing on the inner tracks. Selecting write precompensation OFF causes single-density formatting or writing on the inner tracks. Table A-3 lists the acceptable option values and corresponding drive types.

**Table A-3. Diskette Write Test Option Values and Drive Types**

Option	Drive Type	Write Precompensation Setting
0	40 track, single-sided	OFF
1	40 track, single-sided	ON
2	40 track, double-sided	OFF
3	40 track, double-sided	ON
4	80 track, single-sided	OFF
5	80 track, single-sided	ON
6	80 track, double-sided	OFF
7	80 track, double-sided	ON
8	track and side as installed	OFF
9	track and side as installed	ON

When selecting options 8 and 9, the drive type is determined by the selection of jumpers on the system unit board. Use the System Configuration Display to verify the type of drives installed.

Example:

FLOTST TES = WRITE DRI = 1 TRA = 1 OPT = 8

Display Messages:

Diskette Write Test: Test complete - 0600

Diskette Test: Test aborted - 0601

Diskette Test: Loop xxxx. D = x, Motor speed incorrect - 0602

Diskette Test: Loop xxxx. D = x, Motor control bad - 0603

Diskette Test: Loop xxxx. D = x, Not Ready or bad Index sensor - 0604

Diskette Test: Loop xxxx. D = x, Not installed - 0605

Diskette Test: Loop xxxx. D = x, Controller hardware failed - 0606

Diskette Test: Loop xxxx. D = x, T = xx S = xx Seek error - 0607

Diskette Test: Loop xxxx. D = x, T = xx S = xx Soft Data CRC error - 0608

Diskette Test: Loop xxxx. D = x, T = xx S = xx Hard Data CRC error - 0609

Diskette Test: Loop xxxx. D = x, T = xx S = xx Write protect error - 0610

Diskette Test: Loop xxxx. D = x, T = xx S = xx DRQ error, controller failure - 0611

Diskette Test: Loop xxxx. D = x, Track 00 sensor misadjusted - 0612

Diskette Test: Loop xxxx. D = x, Bad track value entered - 0613

Diskette Test: Loop xxxx. D = x, T = xx, S = xx Soft seek error - 0614

Diskette Test: Loop xxxx. D = x, T = xx, S = xx No information read - 0615

Diskette Test: Loop xxxx. D = x, T = xx, S = xx Data does Not equal memory - 0616

Diskette Test: Loop xxxx. D = x, T = xx, S = xx Soft sector not found error - 0617

Diskette Test: Loop xxxx. D = x, T = xx, S = xx Hard sector not found error - 0618

#### A.8.4 Diskette Drive Alignment Test

The Diskette Drive Alignment Test provides the experienced technician with an efficient method of controlling the diskette drives through all phases of servicing. Using this program diskette, drives may be thoroughly serviced and aligned for dual-density, 40 or 80 track operation. The Diskette Drive Alignment Test also includes the subtests Turn Write Precomp ON, and Write Pattern on Current Track. These two subtests are useful in alignment of the floppy disk controller components on the system unit board.

The following equipment is required for diskette drive alignment:

- Dual-trace 35 mHz oscilloscope with triggered sweep.
- Alignment diskette. This is a specially manufactured diskette with analog and digital signals recorded at calibrated positions on the diskette. This diskette cannot be backed up, and should be handled with care.
- Unprotected scratch diskette is required for various write operations, as well as testing after alignment. (The term "scratch" diskette simply means a blank diskette, new or used, which can be recorded on for tests.)

The following equipment is required for floppy disk controller alignment. (For information on alignment of the floppy disk controller, refer to the *Texas Instruments Professional Computer Technical Reference Manual*.)

- Dual-trace 35 mHz oscilloscope with triggered sweep (or better)
- Digital voltmeter
- Digital frequency meter

This test should be used only by experienced technicians with the proper training and equipment. The test displays a menu of commands and status information as shown in Figure A-1.

```

          Diskette Drive Alignment Test.

          Enter one of the following command characters:

          O   - Seek Outermost Track (Track 00).
          I   - Seek Innermost Track (Track 39).
          nn  - Seek Track Number nn.
          S   - Switch Heads.
          W   - Write Pattern On Current Track (Destroys Data)
          P   - Turn Write Precomp ON.
          R   - Read Data.
          <esc> - Exit From Test.

          Drive  Track  Side  Mode  Motor Speed (RPM)
          1      16     0     WRITE 279 286 293 300 308 315 324
          :.....[:.....:.....:].....:
                                     *

Write protect error - 0610
    
```

Figure A-1. Diskette Drive Alignment Test Display

Syntax:

Command	Parameter	Description	Acceptable Values	Default Values
FLOTST	TEST	Test to perform.	ALIGN	-----
	DRive	Drive to test.	1,2,3,or 4	Explicitly Defined
	PATtern	Test pattern for write operation.	4 digit hexadecimal	6DB6
	OPTion	Drive type. (See list of options in Table A-4.)	0 - 9	8

The option parameter indicates which type of drive is to be tested and the setting for the precompensation.

Disk write precompensation is required when writing dual-density data (modified frequency – modulation mode) in order to reduce the “bit-shift” phenomenon which occurs with magnetic flux reversals in head and media. Without precompensation, the data stored on the innermost tracks appears to be shifted so far it is unreadable. Precompensation corrects for this shift, and is generally used on the inner half of the tracks on the diskette surface.

Table A-4 lists the acceptable option values and corresponding drive types.

**Table A-4. Alignment Test Option Values and Drive Types**

Option	Drive Type	Write Precompensation Setting
0	40 track, single-sided	OFF
1	40 track, single-sided	ON
2	40 track, double-sided	OFF
3	40 track, double-sided	ON
4	80 track, single-sided	OFF
5	80 track, single-sided	ON
6	80 track, double-sided	OFF
7	80 track, double-sided	ON
8	track and side as installed	OFF
9	track and side as installed	ON

When selecting options 8 and 9, the drive type is determined by the selection of jumpers on the system unit board. Use the System Configuration Display to verify the type of drives installed.

Example:

FLOTST TEST = ALI DRI = 1 OPT = 8 PAT = 0000

Display Messages:

Diskette Align Test: Test complete - 0600  
 Diskette Test: Test aborted - 0601

Not Ready or bad Index sensor - 0604  
 Not installed - 0605  
 Controller hardware failed - 0606  
 Write protect error - 0610  
 Track 00 sensor misadjusted - 0612  
 Bad track value entered - 0613

**A.8.5 Diskette Random Write Test**

Use the Diskette Random Write Test to check media (diskettes) as well as hardware (the diskette drive assembly and the floppy disk controller circuitry). Use an unprotected scratch diskette for performing this test. The Diskette Random Write Test performs random writes to tracks and sectors on the diskette in rapid succession until 100 sectors have been written. The motor is occasionally turned off during this operation in order to check speedup effects on the drive. The test then reads the entire diskette to check the data written. Any errors found are reported and retried three times. If the error is not corrected by the third time, the error is reported as hard. Otherwise, it is reported as soft.

Syntax:

Command	Parameter	Description	Acceptable Values	Default Value
FLOTST	TESt	Test to perform.	RANdom	-----
	DRive	Drive to test	1,2,3,4	Explicitly Defined
	ERRor	Maximum number of errors reported.	1 to 255	1
	LOG	Enables logging of messages to printer.	ON, OFF	OFF
	LOOps	Number of test repetitions.	1 to 9999	1
	PATtern	Test pattern for writes.	4 digit hexadecimal	6DB6
	OPTion	Drive type. (See list of options in Table A-5.)	0 to 9	8

The option parameter indicates which type of drive is to be tested and the setting for the precompensation. Table A-5 lists the acceptable option values and corresponding drive types.

**Table A-5. Diskette Random Write Test Option Values and Drive Types**

Option	Drive Type	Write Precompensation Setting
0	40 track, single-sided	OFF
1	40 track, single-sided	ON
2	40 track, double-sided	OFF
3	40 track, double-sided	ON
4	80 track, single-sided	OFF
5	80 track, single-sided	ON
6	80 track, double-sided	OFF
7	80 track, double-sided	ON
8	track and side as installed	OFF
9	track and side as installed	ON

When selecting options 8 and 9, the drive type is determined by the select of jumpers on the system unit board. Use the System Configuration Display to verify the type of drives installed.

Example:

FLOTST TES = RANDOM DRI = 1 PAT = 0000 OPT = 8

Display Messages:

- Diskette Random Test: Test complete - 0600
- Diskette Test: Test aborted - 0601
- Diskette Test: Loop xxxx. D = x, Motor speed incorrect - 0602
- Diskette Test: Loop xxxx. D = x, Motor control bad - 0603
- Diskette Test: Loop xxxx. D = x, Not Ready or bad Index sensor - 0604
- Diskette Test: Loop xxxx. D = x, Not installed - 0605
- Diskette Test: Loop xxxx. D = x, Controller hardware failed - 0606
- Diskette Test: Loop xxxx. D = x, T = xx S = xx Seek error - 0607
- Diskette Test: Loop xxxx. D = x, T = xx S = xx Soft Data CRC error - 0608
- Diskette Test: Loop xxxx. D = x, T = xx S = xx Hard Data CRC error - 0609
- Diskette Test: Loop xxxx. D = x, T = xx S = xx Write protect error - 0610
- Diskette Test: Loop xxxx. D = x, T = xx S = xx DRQ error, controller failure - 0611
- Diskette Test: Loop xxxx. D = x, Track 00 sensor misadjusted - 0612
- Diskette Test: Loop xxxx. D = x, Bad track value entered - 0613
- Diskette Test: Loop xxxx. D = x, T = xx, S = xx Soft seek error - 0614
- Diskette Test: Loop xxxx. D = x, T = xx, S = xx No information read - 0615
- Diskette Test: Loop xxxx. D = x, T = xx, S = xx Data does Not equal memory - 0616
- Diskette Test: Loop xxxx. D = x, T = xx, S = xx Soft sector not found error - 0617
- Diskette Test: Loop xxxx. D = x, T = xx, S = xx Hard sector not found error - 0618

**A.9 PARALLEL PRINTER DIAGNOSTICS**

The parallel printer diagnostics tests are described in the following paragraphs.

**A.9.1 Parallel Printer Pattern Test**

The Parallel Printer Pattern Test verifies the operation of the printer port driver circuitry, printer cabling, and printer operation. The Parallel Printer Pattern Test transmits a pattern of characters to the parallel printer. The operator verifies that the data was printed correctly. The printed data for each loop selected should appear as shown in Figure A-2.

```

1234567890ABCDEF GHIJKLMNOPQRSTUVWXYZ !@#$%^&()_+~; :><abcdefghijklmnopqrstu vwx yz

```

**Figure A-2. Parallel Printer Pattern Test**

Syntax:

Command	Parameter	Description	Acceptable Values	Default Values
PRTTST	TEST	Test to execute.	PATtern	-----
	ERRors	Maximum number of errors reported.	1 to 255	1
	LOG	Enables logging of messages to printer.	ON, OFF	OFF
	LOOps	Number of test repetitions	1 to 9999	10

Example:

```
PRTTST TES = PATTERN LOO = 10
```

Display Messages:

```
PARALLEL PRINTER Pattern test: Test complete - 0800  
PARALLEL PRINTER test: Test aborted - 0801
```

```
PARALLEL PRINTER test: Loop xxxxx: Printer fault - 0804  
PARALLEL PRINTER test: Loop xxxxx: Printer paper out - 0805  
PARALLEL PRINTER test: Loop xxxxx: Printer offline - 0806  
PARALLEL PRINTER test: Loop xxxxx: Printer not installed or paper out -0807  
PARALLEL PRINTER test: Loop xxxxx: Printer time-out - 0809
```

### A.9.2 Parallel Printer Loopback Test

The Parallel Printer Loopback Test requires you to install the test plug containing eight LEDs. The test checks the signals at the parallel printer port. This test requires you to watch the plug to ensure that each LED lights at least twice during the test. The test starts by testing the input and output control signals which are looped inside the loopback plug. You do not have to watch the plug while the control signals are tested.

All the data signals are then set to an active level. The active level causes all the LEDs on the loopback plug to light. Each LED is then lighted individually to allow you to check each signal as it is tested. You should remove the loopback plug when the test has completed.

Syntax:

Command	Parameter	Description	Acceptable Values	Default Value
PRTTST	TEST	Test to execute.	LOOPBACK	----
	ERRors	Maximum number of errors reported.	1 to 255	1
	LOG	Enables logging of messages to printer.	ON, OFF	OFF
	LOOps	Number of test repetitions	1 to 9999	10

Example:

```
PRTTST TES = LOOPBACK LOO = 10
```

Display Messages:

```
PARALLEL PRINTER Pattern test: Test complete - 0800  
PARALLEL PRINTER test: Test aborted - 0801  
PARALLEL PRINTER test: Printer interface failure - 0803
```

## A.10 DISPLAY OF SYSTEM CONFIGURATION

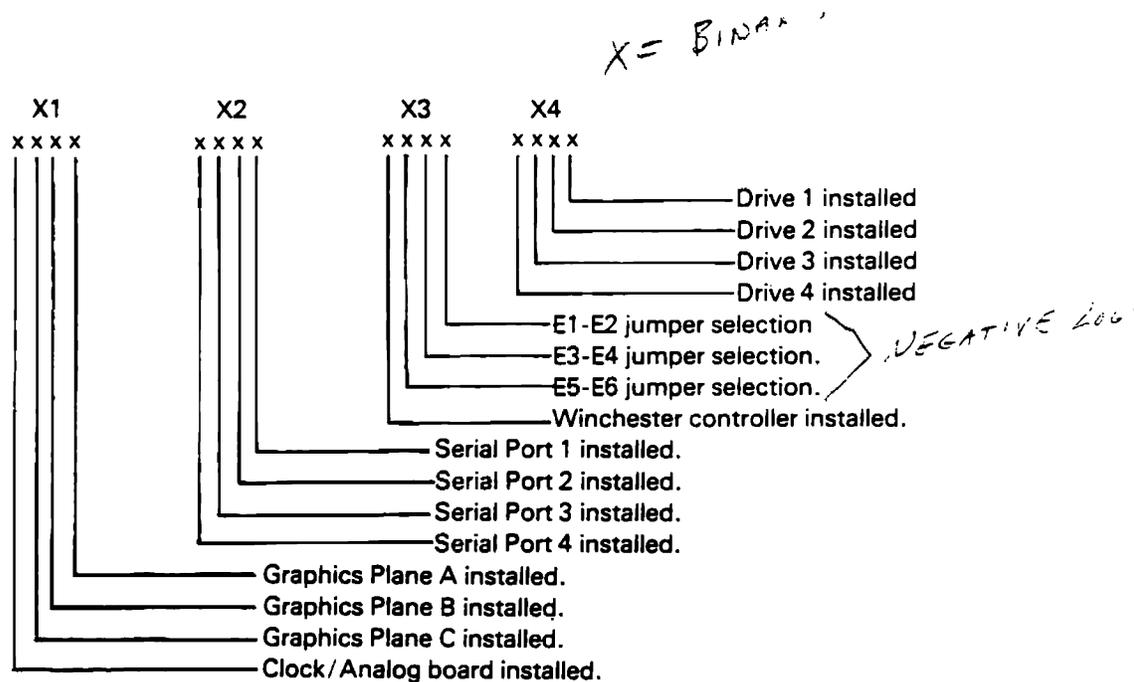
When the Display System Configuration is selected, the system configuration at the time power is applied to the unit is displayed. This should be the first test executed when diagnosing a system failure. Using this test, discrepancies between what the user believes to be installed and what is actually installed can be resolved. Also, this test can identify some special problems that other tests cannot detect. For example, reconciliation of the system configuration display with the options actually installed is the only way to detect the improper installation of two communication boards using the same port address.

The display of system configuration provides a very useful tool for service personnel in obtaining a list of the options a user has installed before the service is actually performed. You can print test results by selecting "Print Test Results" from the user diagnostics menu. To print a copy of the system configuration, select "Print Test Results" while executing the Display System Configuration.

For ease of communication, a system configuration code has been developed to summarize the configuration of the system textually displayed in this test. The system configuration code is composed of 10 digits labeled XXXX, YYYY and ZZ below. Each digit represents a hexadecimal ASCII value from 0 to F. Each binary element (bit) in each digit represents the state of an option in the unit (for example, installed or not installed). The meaning of each element is described below using binary representation for each digit.

System Configuration Code - XXXXYYYYZZ

The X digits are identified in Figure A-3.



**Figure A-3. System Configuration Code X Digits**

It should be noted that a 0 value for the jumper selection indicates that a jumper is installed.

The Y digits are identified as follows.

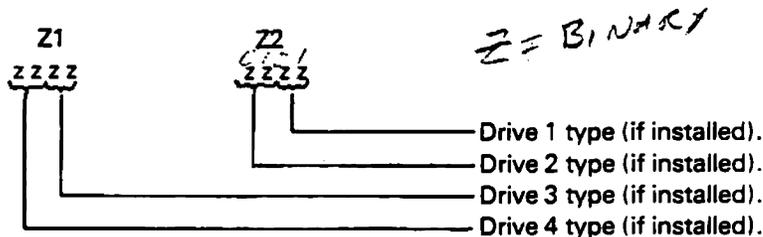
The Y digits indicate the amount of RAM installed in the system in multiples of paragraphs (16 bytes). The following are typical values for the Y digits.

- 1000 = 64 kbytes
- 2000 = 128 kbytes
- 3000 = 192 kbytes
- 4000 = 256 kbytes

*Y = DECIMAL*

The Z digits are identified as follows.

The Z digits indicate the type of drives installed. Since all drives are of the same type, these two digits are normally equal. Digit X4 should be used to determine what drives are actually installed. Figure A-4 identifies the Z digits.



The drive types are as follows.

- 00 - 1-sided, 40 tracks/side
- 01 - 2-sided, 40 tracks/side
- 10 - 1-sided, 80 tracks/side
- 11 - 2-sided, 80 tracks/side

**Figure A-4. System Configuration Code Z Digits**

# Appendix B

## Error Messages

---

### B.1 INTRODUCTION

This appendix explains error messages displayed by the computer during the power-up self-test, during the running of diagnostics tests, as well as operating system messages.

Error information displayed in the form of three LED codes is also included.

Error messages are organized into four categories.

- Power-up display messages
- Power-up LED codes
- Diagnostics messages
- Operating system messages

Not all messages displayed are error messages. Many are statements of test completion or conditions causing a routine or program to halt.

The message on the display identifies the major component involved, and which subassembly is defective or may require further testing. Examples and their meanings are as follows.

```
** System Error -  
0033 ** Diskette drive  
seek error  
or  
** Keyboard Error -  
0010 ** Keyboard is  
not installed
```

Table B-1 lists the power-up display messages.

**Table B-1 Power-Up Self-Test Fatal Hardware Error Messages**

<b>Display Message</b>	<b>Meaning/Cause</b>	<b>Recommended Action</b>
<b>SYSTEM ERRORS</b>		
0001	Reserved.	
0002	CRT controller.	Replace CRT controller board
0003	Floppy disk controller.	Replace system unit board.
0004	Interrupt controller.	Replace system unit board.
0005	RAM failure.	Replace system unit board.
0006	ROM failure.	Replace system unit board.
0007	Digital system failure.	Replace system unit board.
0008	NMI error during powerup. CRT controller, RAM on system unit board, or option RAM board.	Remove options generating NMI (CRT Controller). Remove other options, and retest.
0009	RAM parity error during power-up, bad system unit.	Replace system unit board.

Table B-2 lists the power-up self-test display messages.

**Table B-2. Power-Up Self-Test Display Messages**

<b>Display Message</b>	<b>Meaning/Cause</b>	<b>Recommended Action</b>
<b>KEYBOARD ERRORS</b>		
0010	Keyboard not installed. Bad keyboard or connector.	Install or replace keyboard; check cable or connector; replace keyboard or system unit board. If keyboard intermittently fails, run keyboard tests on Advanced Diagnostics Menu.

**Table B-2. Power-Up Self-Test Display Messages (continued)**

<b>Display Message</b>	<b>Meaning/Cause</b>	<b>Recommended Action</b>
<b>KEYBOARD ERRORS</b>		
0011	No keyboard response, but keyboard installed. Bad keyboard, connector, cable, or system unit.	Replace keyboard; check cable, connectors, or system unit board.
0012	Keyboard RAM failure. Bad keyboard, connector, cable, or system unit.	Replace keyboard; or check cable, connectors, or system unit board.
0013	Keyboard ROM failure. Bad keyboard, connector, cable, or system unit.	Replace keyboard or check cable, connectors, or system unit board.
0014	Unexpected keyboard response. Bad keyboard, connector, cable, or system unit.	Replace keyboard; check cable, connectors, or system unit board.
0015	Keyboard ACK character receive error.	Replace keyboard; or check cable, connectors, or system unit board.
<b>SYSTEM UNIT ERRORS</b>		
0020	Option RAM bank 1. Bad RAM.	Run disk diagnostics Memory Tests. If failure recurs, replace RAM expansion board.
0021	Option RAM bank 2. Bad RAM device or bad board.	Run disk diagnostics Memory Tests. If failure recurs, replace bad RAM device or board.
0022	Option RAM bank 3. Bad RAM device or bad board.	Run disk diagnostics Memory Tests. If failure recurs, replace bad RAM device or board.
0023	Reserved.	_____
0024	Reserved.	_____

**Table B-2. Power-Up Self-Test Error Messages (continued)**

<b>Display Message</b>	<b>Meaning/Cause</b>	<b>Recommended Action</b>
<b>SYSTEM UNIT ERRORS</b>		
0025	Reserved.	_____
0026	Reserved.	_____
0028	Reserved.	Remove any option with ROM, rerun test. If failure recurs, replace system unit board
0029	Reserved.	Remove any option with ROM, rerun test. If failure recurs, replace system unit board.
002A	Winchester disk controller bad.	Run disk diagnostics. Winchester Controller may be bad. Remove any option with ROM, rerun test. If failure recurs, replace system unit board.
002B	ROM at U63 fails.	Remove any option with ROM, rerun test. If failure recurs, replace system unit board.
002C	ROM at U62 fails.	Remove any option with ROM, rerun test. If failure recurs, replace system unit board.
0030	No drives installed.	Check drive connectors. Replace drive, replace system unit board.
0031	Cannot boot from any drive, all have problems.	No system diskette in drive, replace drive, replace system unit board.
0032	CRC read error, bad diskette or drive.	Try another diskette, or try diskette diagnostics on a formatted diskette.

**Table B-2. Power-Up Self-Test Display Messages (concluded)**

<b>Display Message</b>	<b>Meaning/Cause</b>	<b>Recommended Action</b>
<b>SYSTEM UNIT ERRORS</b>		
0033	Seek error, bad diskette or drive.	Try another diskette, or try diskette diagnostics on a formatted diskette.
0034	Sector not found, bad diskette or drive.	Try another diskette, or try diskette diagnostics on a formatted diskette.
0035	FDC failure.	Try another diskette, try disk diagnostics. If failure recurs, replace system unit board.
0036	Not a system diskette.	Use a system diskette.
0037	No data found.	Bad diskette, unformatted disk, bad drive or system unit board.
0038	Boot sector CRC error.	Wrong diskette, bad system wrong diskette.
1040	Unexpected NMI.	Check CRT controller, RAM option board, or system unit board.
1041	RAM parity error during operation.	Run diskette RAM tests. Replace system unit board if U35 to U43 identified. Replace option RAM board if U1 to U9 identified. Replace RAM IC if U10 to U27 bad.
1042	Unexpected interrupt.	Run diskette diagnostics - Overall Test, RAM Test. Possible software problem change diskettes, retry.
1050	Fatal software condition encountered.	NOT a hardware fault. Check software or change diskettes.

Table B-3 defines the LED error message and gives the necessary corrective action required.

**Table B-3 Self-Test LED Error Indicators**

LED 1 Red	LED 2 Yellow	LED 3 Green	Binary Value Failure	Probable Cause of	Corrective Action
ON	ON	ON	7	Digital system	Possible bad system unit board. Replace system unit board.
ON	ON	OFF	6	ROM	Possible bad ROM in system unit. Replace system unit board.
ON	OFF	ON	5	RAM	Possible bad RAM in system unit. Replace system unit board.
ON	OFF	OFF	4	Interrupt controller	Possible bad IC in system unit. Replace system unit board.
OFF	ON	ON	3	Floppy disk controller	Replace system unit board.
OFF	ON	OFF	2	CRT controller	Replace bad CRT controller board, or replace system unit board.
OFF	OFF	ON	1	Winchester controller	Replace bad Winchester drive controller board.
OFF	OFF	OFF	0	Normal or no power	No action if normal. If no display or diskette activity, bad power supply or ac power source (fan is heard even if power supply is bad). Recycle power and observe LEDs. System unit is good if they sequence, then go out. Display may be bad, or cables loose.

Supplementing the code displayed by the LEDs on the system unit, additional failure information can be obtained by service personnel using a special 25-pin test plug, TI Part No. 2223276-0001,

which contains eight LEDs for the display of specific information on failures. Table B-4 lists the failure codes that are available only when using this test plug.

**Table B-4. Test Plug LED Error Indicators**

<b>LED 1</b>	<b>LED 2</b>	<b>LED 3</b>	<b>Test Plug Display</b>	<b>Additional Failure Information</b>
ON	ON	ON	00000000	Bad processor on main board
ON	ON	OFF	00000000	Bad ROM-replace
ON	OFF	ON	00000000	RAM - parity bit failure
ON	OFF	ON	XXXXXXXX1	RAM - LSB failure
ON	OFF	ON	XXXXXXXXX	RAM - MSB failure
ON	OFF	ON	11111111	RAM - All bit failure
ON	OFF	ON	00000000	Controller failure
ON	OFF	ON	00000001	Invalid interrupt
ON	OFF	ON	00000010	NMI interrupt failure
ON	OFF	ON	00000100	Timer interrupt failure
ON	OFF	ON	00001000	FDC interrupt failure
ON	OFF	ON	00010000	Keyboard interrupt failure
ON	OFF	ON	00100000	Timer 0 failure
ON	OFF	ON	01000000	Timer 1 failure
ON	OFF	ON	10000000	Timer 2 failure
OFF	ON	ON	XXXXXXXX1	Floppy disk: even bit, sector buffer failure
OFF	ON	ON	XXXXX1X1	Floppy disk: odd bit, sector buffer failure

**Table B-4. Test Plug LED Error Indicators (continued)**

<b>LED 1</b>	<b>LED 2</b>	<b>LED 3</b>	<b>Test Plug Display</b>	<b>Additional Failure Information</b>
OFF	ON	ON	XXXX1XX1	Floppy Disk Controller failure (registers)
OFF	ON	ON	XXX1XXXX	Floppy Disk Controller failure (restore)
OFF	ON	OFF	00000000	Not Used
OFF	ON	OFF	XXXXXXX1	CRT Attribute memory failure
OFF	ON	OFF	XXXXXX1X	CRT Attribute latch failure
OFF	ON	OFF	XXXXX1XX	CRT Controller failure (registers)
OFF	ON	OFF	XXXX1XXX	CRT Character memory failure
OFF	ON	OFF	XXX1XXXX	CRT Video output failure
OFF	ON	OFF	XX1XXXXX	Not Used
OFF	ON	OFF	X1XXXXXX	Not Used
OFF	ON	OFF	1XXXXXXX	Not Used
OFF	OFF	ON		Winchester drive

Table B-5 shows all disk diagnostic messages. Some are not failures at all...merely an indication that a test has successfully completed or was

aborted by operator action. Additional testing is required in many cases to identify the defect.

**Table B-5. Disk Diagnostics Messages**

<b>Message Code</b>	<b>Meaning</b>	<b>Corrective Action</b>
<b>CRT TEST</b>		
0100	CRT test complete CRT	None required.
0101	Test aborted	None required.
0102	CRT controller failure	Replace CRT controller board, or system unit board.
0103	CRT controller memory bad	Replace CRT controller board, or system unit board.
0104	CRT attribute memory bad	Replace CRT controller board, or system unit board.
0105	CRT attribute latch bad	Replace CRT controller board, or system unit board.
0106	Video failure	Replace CRT controller board, or system unit board.
0107	CRT interrupt bad	Replace CRT controller board, or system unit board.
0108	Graphics video failure	Bad or no graphics board.
0109	RAM failure at Uxx	Bad or no graphics board.
0110	RAM bank A not installed	Bad or no graphics board.
0111	RAM bank B not installed	Bad or no graphics board.
0112	RAM bank C not installed	Bad or no graphics board.
<b>KEYBOARD TEST</b>		
0200	Keyboard test complete	None required.
0201	Keyboard test aborted	None required.
0202	Keyboard not installed	Install keyboard, bad keyboard, bad cord.
0203	No keyboard response	Bad keyboard. Run keyswitch test and look for sticking key-switches.

**Table B-5. Disk Diagnostic Messages (continued)**

Message Code	Meaning	Corrective Action
<b>KEYBOARD TEST</b>		
0204	Receiver error	Replace keyboard.
0205	Keyboard RAM failure	Replace keyboard.
0206	Keyboard ROM failure	Replace keyboard.
0207	Unexpected response	Replace keyboard.
<b>COMM TEST</b>		
0300	Comm test completed	None required.
0301	Comm test aborted	None required.
0302	Port not installed	None required.
0303	Transmit interrupt	Run advanced diagnostics— COMTST with loopback plug. If test fails, replace comm board.
0304	Receive interrupt	Same as above.
0305	Receive data failure	Same as above.
0306	Wrong port configuration	Rejumper comm board.
0307	Invalid interrupt	Run advanced diagnostics. If diagnostics fails, replace comm board.
0308	Erratic input clock	Bad external modem, cabling or replace comm board.

**Table B-5. Disk Diagnostic Messages (continued)**

<b>Message Code</b>	<b>Meaning</b>	<b>Corrective Action</b>
<b>ROM TEST</b>		
0400	ROM test complete	None required.
0401	ROM test aborted	None required.
0402	CRC failure at 0F4000	Future option use.
0403	CRC failure at 0F6000	Future option use.
0404	CRC failure at 0F8000	Replace Winchester controller board.
0405	CRC failure at 0FA000	Future option use.
0406	CRC failure at 0FC000	Replace system unit board.
0407	CRC failure at 0FE000	Replace system unit board.
<b>RAM TEST</b>		
0500	RAM test complete	None required.
0501	RAM test aborted	None required.
0502	RAM bank 0 not installed	Replace system unit board.
0503	RAM bank 1 not installed	If option RAM is installed, run advanced diagnostics RAM test.
0504	RAM bank 2 not installed	Same as above.
0505	RAM bank 3 not installed	Same as above.
0506	RAM bank 4 not installed	Reserved for future. If occurs, replace system unit board.

**Table B-5. Disk Diagnostic Messages (continued)**

<b>Message Code</b>	<b>Meaning</b>	<b>Corrective Action</b>
<b>RAM TEST</b>		
0507	RAM bank 5 not installed	Same as above.
0508	RAM bank 6 not installed	Same as above.
0509	RAM bank 7 not installed	Same as above.
0510	System RAM bad at Uxx	Replace system unit board.
0511	Option RAM bad at Uxx	Replace option RAM IC or board.
0512	NMI failure	Replace system unit board.
<b>DISKETTE TESTS</b>		
0600	Test complete	None required.
0601	Test aborted	None required.
0602	Motor speed incorrect	Adjust speed pot or replace drive.
0603	Motor control bad	Run advanced diagnostics. Check if DIP shunts on drive are correct; replace diskette drive.
0604	Drive not ready Bad index sensor	Run advanced diagnostics. Door open; diskette not in drive; loose connector, bad drive.
0605	Drive not installed Bad track 00 sensor	Run advanced diagnostics. Loose connector on drive; track 00 sensor misaligned.
0606	FDC bad	Run advanced diagnostics. Replace system unit board.
0607	Seek error Sector ID error	Reformat; bad diskette. Run advanced diagnostics. Replace drive.

**Table B-5. Disk Diagnostic Messages (continued)**

<b>Message Code</b>	<b>Meaning</b>	<b>Corrective Action</b>
<b>DISKETTE TESTS</b>		
0608	Soft error on read	Bad diskette: Run advanced diagnostics. If advanced diagnostics fails, bad drive or bad system unit board.
0609	Hard CRC error	Bad diskette, bad drive, or bad system unit board. Verify by running advanced diagnostics.
0610	Write protect error	Diskette is write protected. Remove write protect tab. If failure recurs, drive is bad.
0611	DRQ error Drive controller bad	Run advanced diagnostics. Replace drive or replace system unit board.
0612	Track 00 sensor bad	Run advanced diagnostics. If advanced diagnostics fails, replace drive.
0613	Bad track value entered	Operator error - write track number is too large.
0614	Soft seek error	Diskette needs formatting; bad diskette or bad drive. Run advanced diagnostics.
0615	Cannot read disk	Unformatted diskette or bad drive. Run advanced diagnostics.
0616	Data does not equal memory.	Bad system unit board.
0617	Soft sector not found	Bad diskette, replace and retest. If replacement diskette fails, run advanced diagnostics.
0618	Hard sector not found	Bad diskette drive. Run advanced diagnostics.

**Table B-5. Disk Diagnostic Messages (concluded)**

<b>Message Code</b>	<b>Meaning</b>	<b>Corrective Action</b>
<b>PRINTER TEST</b>		
0800	Test complete	None required.
0801	Test aborted	None required.
0802	Printer not ready	No cable or bad cable; no printer or bad printer; printer not ON or ON LINE; or printer out of paper.
0803	Interface failure	(Normal message if the LED loopback plug is installed.)
0804	Printer fault	Run advanced diagnostics - PRTTST. If advanced diagnostics fails, check printer, cabling, or printer grounds.
0805	Paper out	Check paper, paper-out switch, printer, or cables.
0806	Printer off-line	Place printer on line. Run advanced diagnostics. Check cable and printer.
0807	Paper not installed	Check paper. Run advanced diagnostics.
0809	Printer timeout	Reset printer. Retest.

# Appendix C

## Options

---

This appendix provides information on the following items for the Texas Instruments Professional Computer.

- Documentation
- Minimum system configurations
- Hardware option manuals

### C.1 DOCUMENTATION

Documentation available for the Texas Instruments Professional Computer is listed in Tables C-1, C-2, and C-3. Copies of the hardware option manuals are located at the end of this section.

**Table C-1 List of Software Packages**

Manual Title	TI Part No.
Operating Instructions	2223110-0001
MS™-DOS Operating System	2223129-0001
EasyWriter™	2223141-0001
EasyWriter II™	2223147-0001
EasySpeller™	2223193-0001
EasySpeller II™	2223293-0001
Multiplan™	2223187-0001
MS™-BASIC	2223153-0001
MS™-FORTRAN	2223159-0001
MS™-Pascal	2223171-0001
MS™-COBOL	2223165-0001
TTY Communications	2223119-0001
3780 Communications	2223124-0001

**Table C-2. Hardware Option Manuals**

Manual Title	TI Part No.
Expansion RAM	2223205-0001
Diskette Drives	2223214-0001
Graphics Video Controller Board	2223207-0001
Color Display Unit	2223255-0001
Synchronous-Asynchronous Communications Board	2223206-0001
Winchester Disk Drive and Controller	2223212-0001
Internal Modems	2223256-0001
Clock and Analog Interface	2223215-0001
Local Area Network Interface	2223213-0001

**Table C-3. Maintenance Documentation**

Manual Title	TI Part No.
Maintenance Handbook	2223199-0001
Technical Reference Manual	2223216-0001

**C.2 MINIMUM CONFIGURATIONS**

Tables C-4, C-5, and C-6 list the Texas Instruments Professional Computer software

packages, hardware options, and maintenance documentation. These tables show the options required for using the items listed in the tables.

**Table C-4. Software Packages**

Software Package	Options Required for Use		
	MS-DOS Operating System	Expansion RAM (Note 1)	Other Hardware Options (Note 2)
Operating Instructions	Recommended	No	None
MS-DOS Operating System	---	No	None
EasyWriter	Yes	No	Printer
EasyWriter II	Yes	Yes	Printer
EasySpeller (Note 3)	Yes	Yes	None
EasySpeller II (Note 3)	Yes	No	None

**Table C-4. Software Packages**

Software Package	Options Required for Use		
Package Title	MS-DOS Operating System	Expansion RAM (Note 1)	Other Hardware Options (Note 2)
Multiplan	Yes	Yes	None
MS-BASIC	Yes	Yes	None
MS-FORTRAN	Yes	Yes	None
MS-Pascal	Yes	Yes	None
MS-COBOL	Yes	Yes	A Second Diskette Drive Option
TTY Communications	Yes	Yes	Synchronous-Asynchronous Communications Board Option
3780 Communications	Yes	Yes	Synchronous-Asynchronous Communications Board Option

**NOTES**

1. The basic system has 64 kbytes (kilobytes) of random-access memory (RAM). The expansion RAM adds 64, 128, or 192 kbytes.

2. The hardware options are described in the next table.

3. EasySpeller is used with EasyWriter and EasySpeller II is used with EasyWriter II.

**Table C-5. Hardware Options**

Hardware Option	Options Required for Use		
Option Title	MS-DOS Operating System	Expansion RAM	Other Options
Expansion RAM	Recommended	--	None
Diskette Drives	Recommended	No	None
Graphics Video Controller Board	Yes	Yes	MS-BASIC
Color Display Unit	Recommended	No	None
Synchronous-Asynchronous Communications Board	Yes	Yes	TTY Communications or 3780 Communications
Winchester Disk Drive and Controller	Yes	No	None
Internal Modems	Yes	No	TTY Communications or 3780 Communications
Clock and Analog Interface	Yes	No	MS-BASIC
Local Area Network Interface	Yes	No	None

**Table C-6. Maintenance Documentation**

Documentation Title	Options Required for Use
Maintenance Handbook	None
Technical Reference Manual	None

## **C.3 EXPANSION RAM BOARD OPTION MANUAL (TI PART NO. 2223205-0001)**

### **Preface**

This manual provides the user or technician with information necessary for installing and using the Expansion Random-Access Memory (RAM) Option. After the option has been installed, you should file this manual in Chapter 5 of your *Texas Instruments Professional Computer Operating Instructions* (TI Part No. 2223116-0001). You can also find a copy of this and all other option manuals in Appendix C of the *Texas Instruments Professional Computer Maintenance Handbook* (TI Part No. 2223200-0001).

This manual is divided into three chapters.

Chapter 1 describes the option, lists the tools required for installation and removal, and provides a checklist in case of difficulties.

Chapter 2 contains step-by-step instructions for installing the option and describes the checkout procedure.

Chapter 3 discusses the procedures for removing the option.

#### **C.3.1 Chapter 1 - Introduction**

This chapter describes the expansion RAM board (shown in Figure C-1), provides part number infor-

mation for the option kits and kit components, and lists the tools required for installing the option.

**C.3.1.1 Purpose.** The expansion RAM board enables you to more than double the memory capacity of your computer. Operation of this option is totally transparent. No specific commands are necessary to activate it. You will find this additional memory makes possible the execution of longer and more complex programs, and speeds up many operations, including sort routines and diskette backup.

**C.3.1.2 Description.** Three expansion RAM board option kits are available with capacities of:

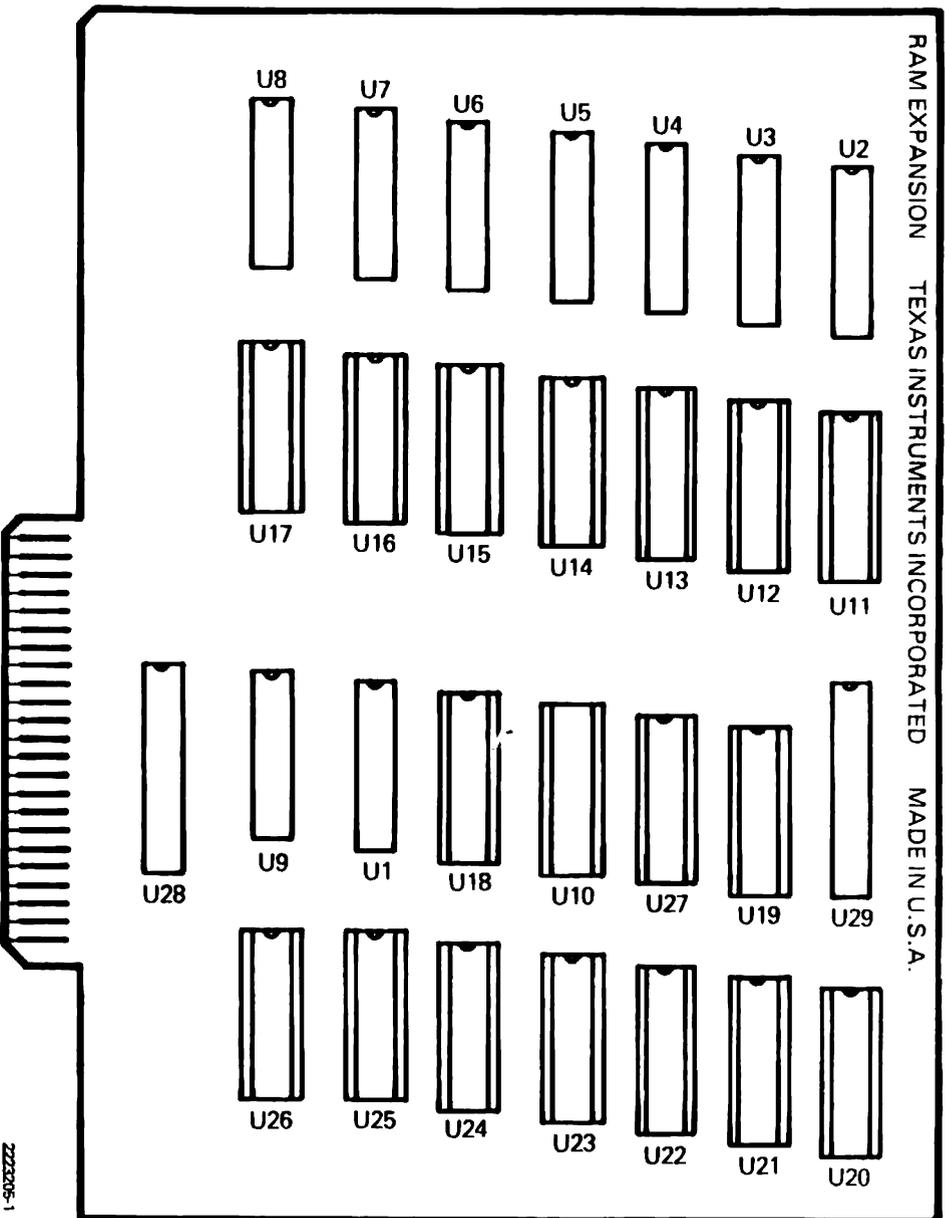
- 64 kbytes
- 128 kbytes
- 192 kbytes

Each option kit consists of a printed wiring board and an option manual.

An option kit is also available for increasing a 64-kbyte or 128-kbyte option by 64 kbytes. This kit consists of nine dynamic RAM devices, which plug into sockets on the option board.

TI Part Numbers for the expansion RAM board kits are listed in Table C-7.

RAM EXPANSION TEXAS INSTRUMENTS INCORPORATED MADE IN U.S.A.



222205-1

Figure C-1. Expansion RAM Board

**Table C-7. Expansion RAM Board Kit Part Numbers**

TI Part No.	Description
2223237-0001	Option Kit, Expansion RAM Board (64 kbytes)
consisting of: 2223015-0001 2223205-0001  or	Expansion RAM Board, 64-kbyte Capacity Option Manual, Expansion RAM Board
2223237-0002	Option Kit, Expansion RAM Board (128 kbytes)
consisting of: 2223015-0002 2223205-0001  or	Expansion RAM Board, 128-kbyte Capacity Option Manual, Expansion RAM Board
2223237-0003	Option Kit, Expansion RAM Board (192 kbytes)
consisting of: 2223015-0003 2223205-0001  or	Expansion RAM Board, 192-kbyte Capacity Option Manual, Expansion RAM Board
2223099-0001	Option Kit, Dynamic RAM Devices
consisting of: 2211118-0004 ( 9 each) 2211752-0001 2223269-0001 0970950-0001	Integrated Circuit (IC) 64K bit Dynamic RAM 150 ns Maximum Access Time Plastic Bag, Antistatic Caution Sheet RAM Chip Kit Urethane Sheet

**C.3.1.3 Tool Requirements.**

- Medium-size flat-bladed screwdriver
- 1/4-in nutdriver (optional tool for installing option board retaining screw)
- An integrated circuit (IC) removal tool or a small flat-bladed screwdriver is useful in removing individual RAM devices from the option board.

**C.3.1.4 In Case You Have Problems....** If you have any operating difficulty after installing the option, you should check for the following conditions.

- Improper seating of the option board in its socket
- Loose connectors, or improper cable hookup
- Another option which you may have loosened from its socket

## C.3.2 Chapter 2 - Installation

**C.3.2.1 Preliminary Steps.** Before attempting to install this option, complete the following steps:

1. Be sure there is sufficient working space available. You will be turning the system unit to gain access to the back panel, and you will need space beside the system unit (with the cover removed) to place the display unit temporarily for installation checkout.
2. Make certain your Texas Instruments Professional Computer is operational. This may be done in the following manner.
  - Insert a diagnostics diskette in the left drive and close the door.
  - Place the system unit ON/OFF switch in the ON position (the self-test will be executed and the diagnostics menu will be displayed).
  - Select the Overall Unit Test and follow the procedures outlined in the *Texas Instruments Professional Computer Operating Instructions*.

Do not attempt to install this option unless this test is successfully completed.

3. Place the system unit ON/OFF switch in the OFF position, and remove the system unit power cord from the ac receptacle.
4. Disconnect the following:
  - System unit power cord
  - Display unit power cord
  - Display unit signal cable
  - Keyboard cable
  - Any peripheral cables connected to the system unit

5. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any additional equipment to the side, away from the system unit.

### CAUTION

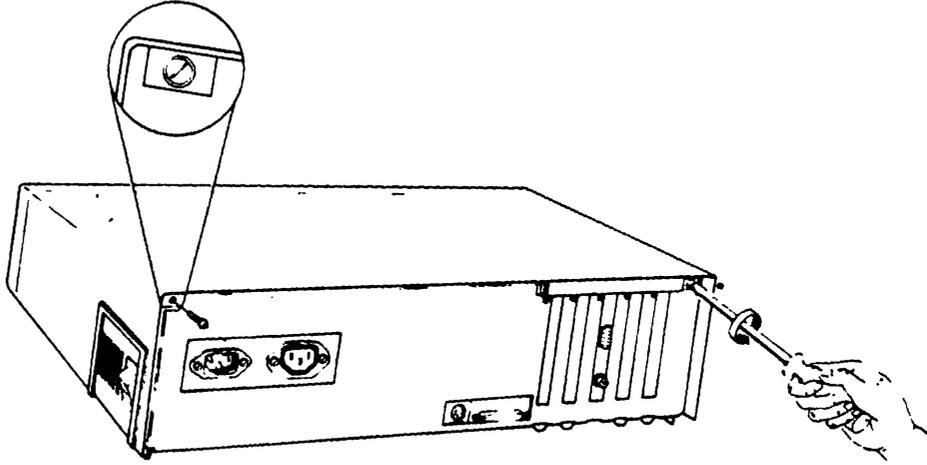
**Static electricity can be destructive to static-sensitive components, mounted on the expansion RAM board. Before touching any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table. Care must be used in handling the expansion RAM board. We recommend that the board assembly be left IN THE ANTISTATIC PACKING BAG until you are ready to install it.**

6. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner using a flat-bladed screwdriver. See Figure C-2 for the locations of these screws.
7. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit. See Figure C-3. Set the cover aside, out of the way.

### C.3.2.2 Installation Procedure. Installing the Individual RAM Devices.

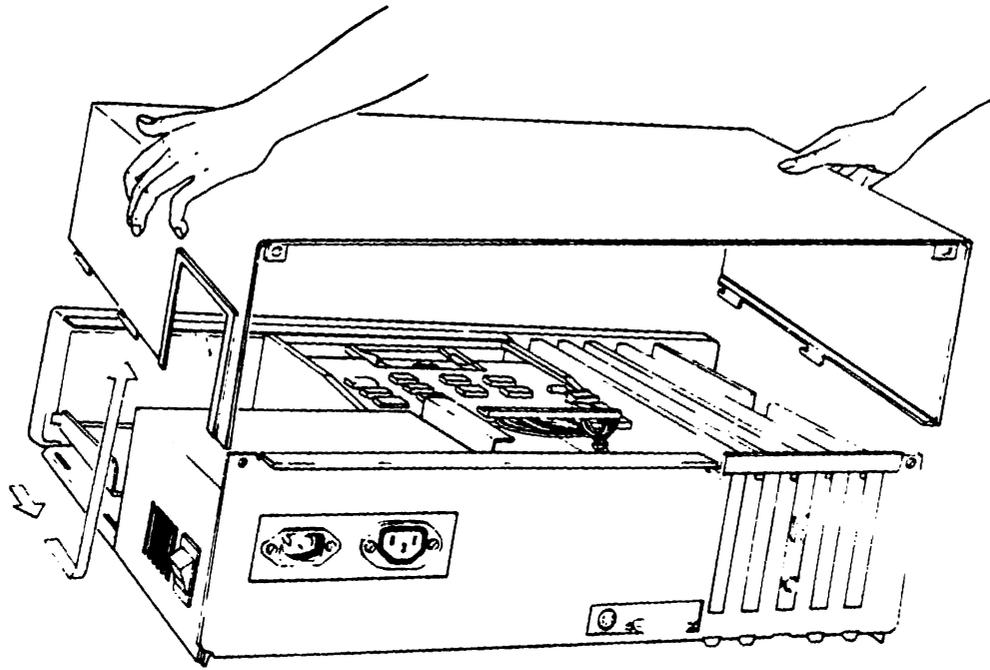
#### NOTE

If you are installing an option board only, skip ahead to the next section, "Installing the Option Board."



2223205-2

**Figure C-2. Removing the Cover Screws**



2223205-3

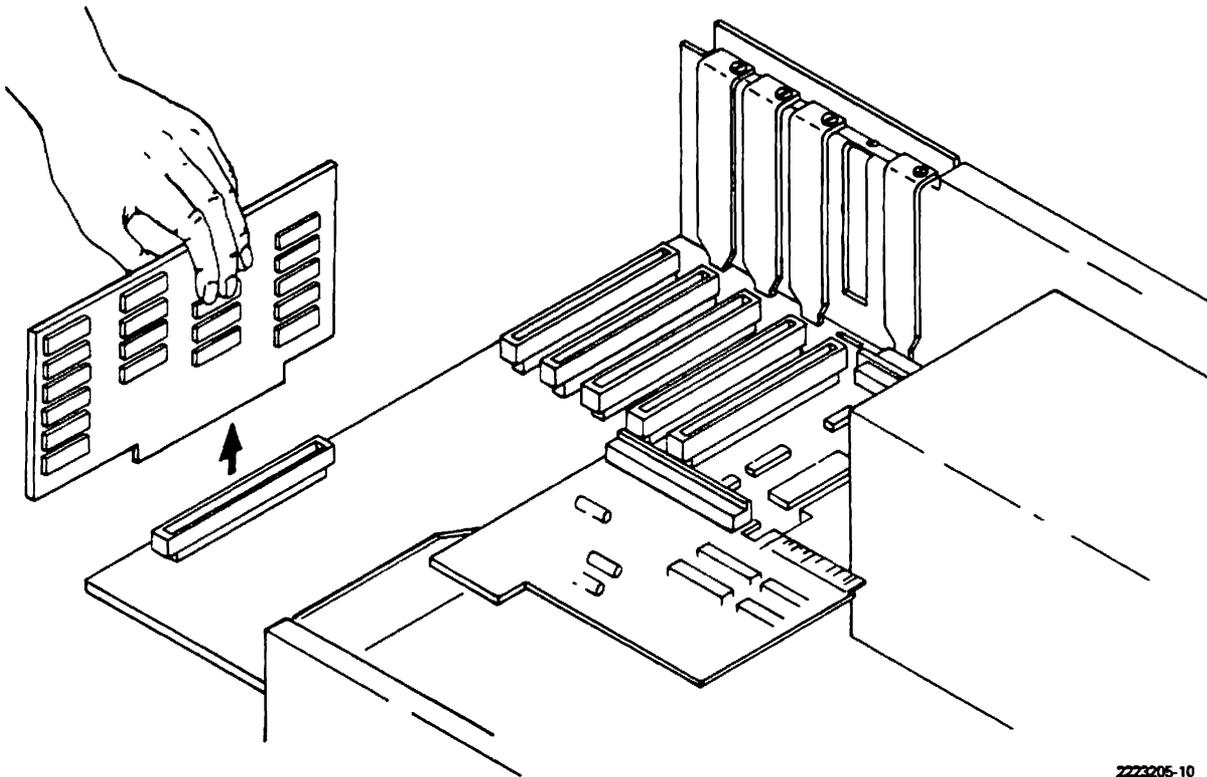
**Figure C-3. Removing the Cover**

This section describes the installation of nine 64-kbyte x 1-bit dynamic RAM devices on an installed expansion RAM board.

1. Locate the expansion RAM option board in card-edge connector J10, and gently lift it straight up, out of the socket. Set it down, component side up, on the smooth surface of a grounded work table. See Figure C-4.

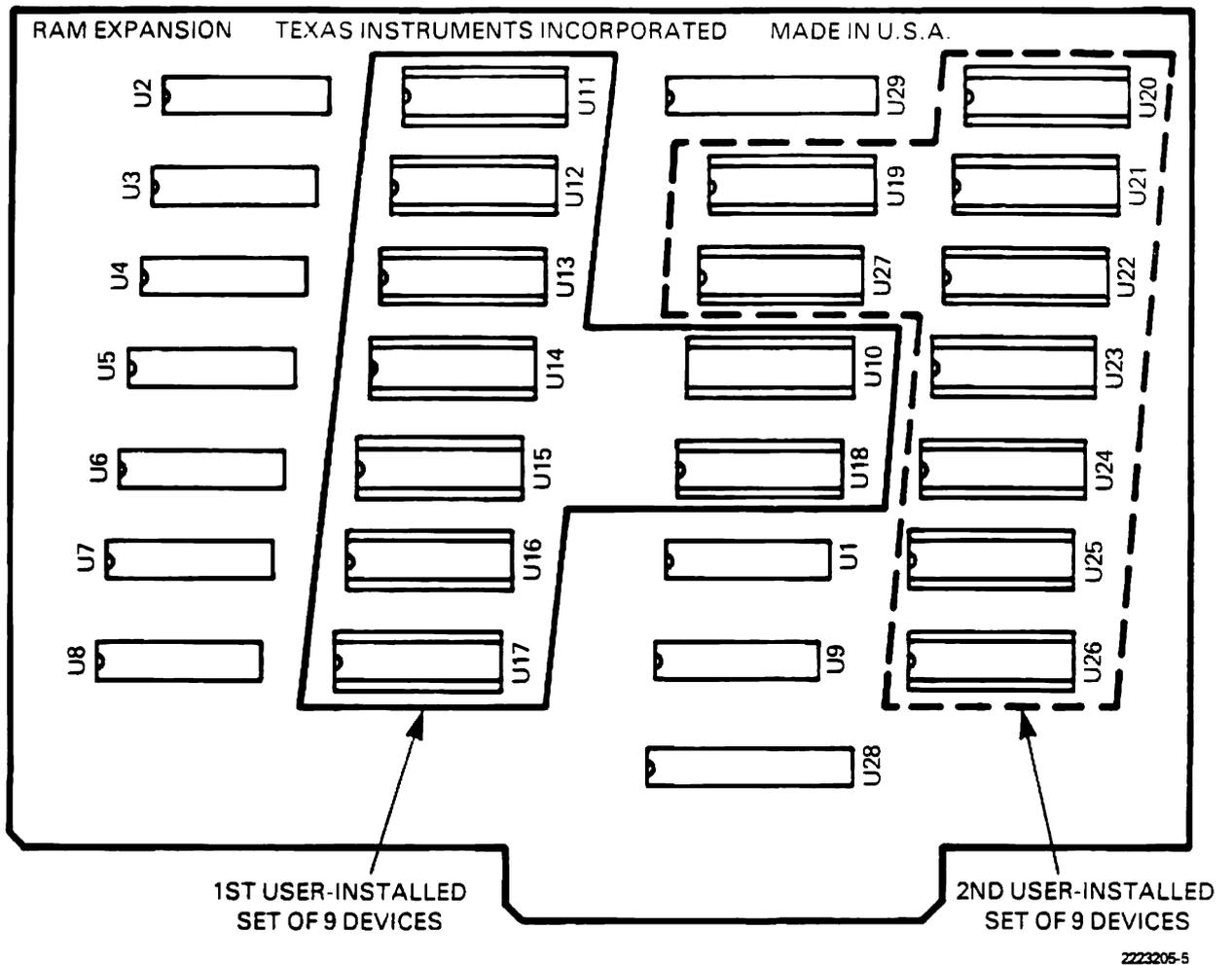
2. Study Figure C-5 on the following page to familiarize yourself with the expansion RAM board.

Location	Description
U1 to U9	Factory-installed memory
U10 to U18	First option kit of nine devices here
U18 to U27	Second option kit of nine devices here



2223205-10

**Figure C-4. Removing the Option Board**



**Figure C-5. Expansion RAM Board**

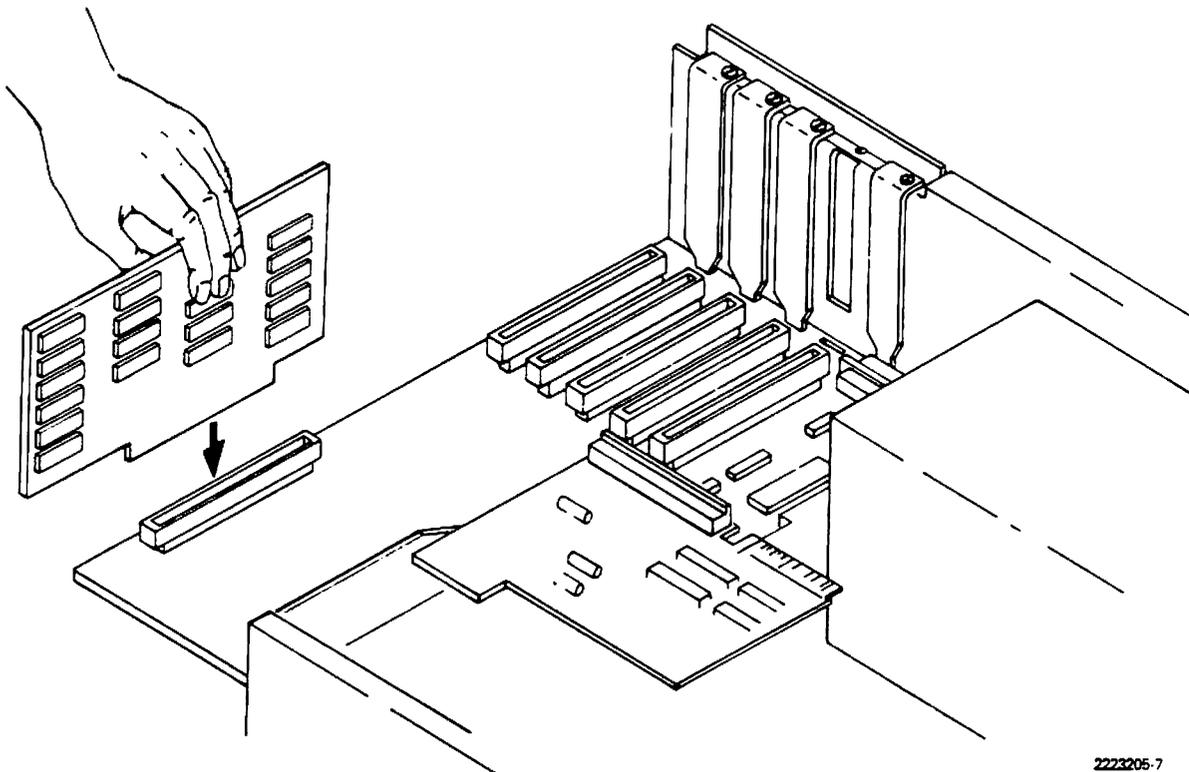
3. The dynamic RAM devices are shipped in a special antistatic container. Remove them one at a time, inspecting the pins to make certain they are all aligned properly. These pins are easily bent, and must be aligned with the socket connectors before pressing them into place. Remember to align each device so that the notch on the end of the RAM device matches the notch on the socket.
4. Align the pins with the socket connector and firmly press each RAM device into place. Make certain that all nine devices are installed in their proper sockets, and that each is facing the left, as viewed with the board connector at the bottom, in the same manner in which the factory-

installed memory devices are installed on the board.

**NOTE**

Be very careful of bent pins! Pins are easily bent under the device and are very difficult to see.

5. Gently insert the expansion RAM board into card-edge connector J10 on the system unit board. Use the notch on the front panel as a guide in installing the option board. Figure C-6 shows the correct method of inserting the option board into the connector. Note that the component side of the expansion RAM board faces the inside of the system unit.



2223205-7

**Figure C-6. Inserting the Option Board**

6. This completes the installation. Skip ahead to "Installation Checkout," located later in this chapter.

#### **Installing the Option Board.**

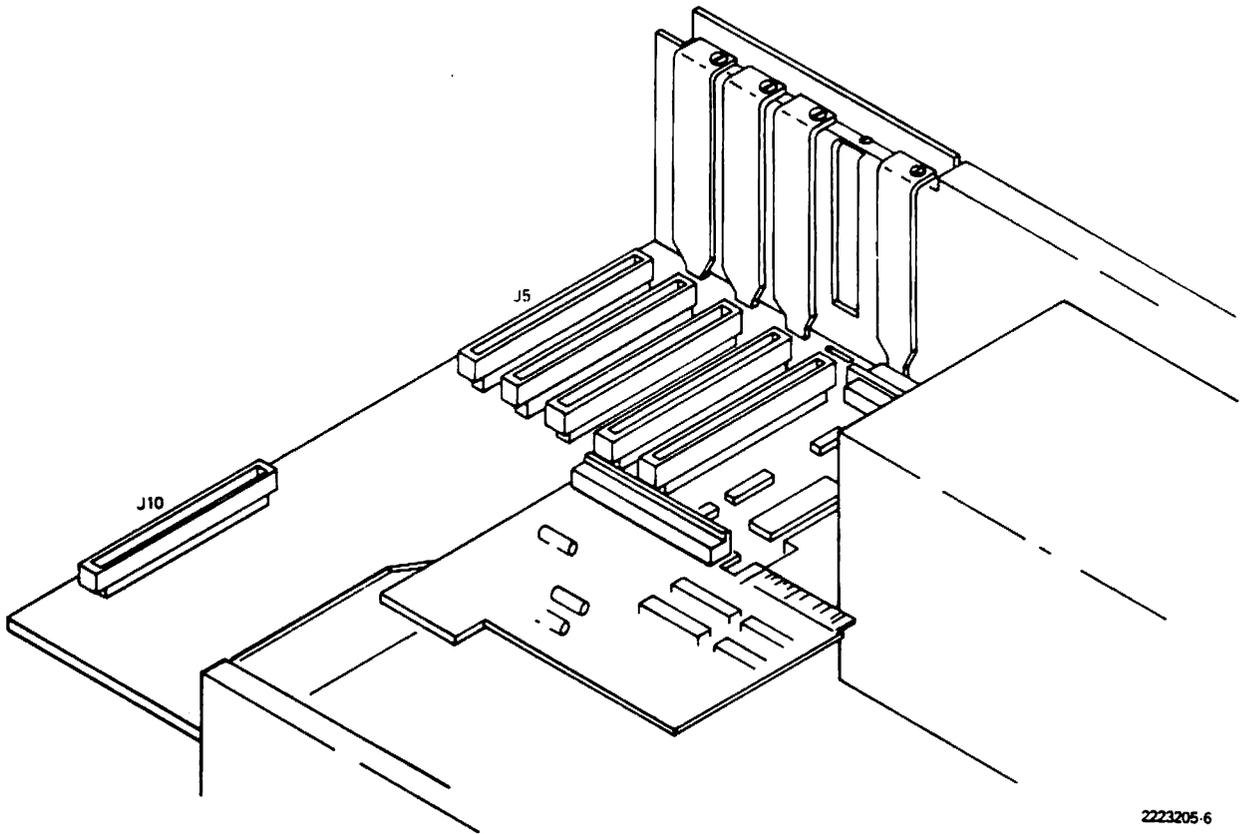
1. Locate card-edge connector J10 on the system unit board. See Figure C-7. This connector is an empty socket next to the three light-emitting diodes (LEDs), near the edge of the system unit board.

The J10 connector is reserved exclusively for the expansion RAM board. No other board is to be installed in this card-edge connector.

Make certain that any option board installed in the J5 card-edge connector location (the leftmost, as viewed from the

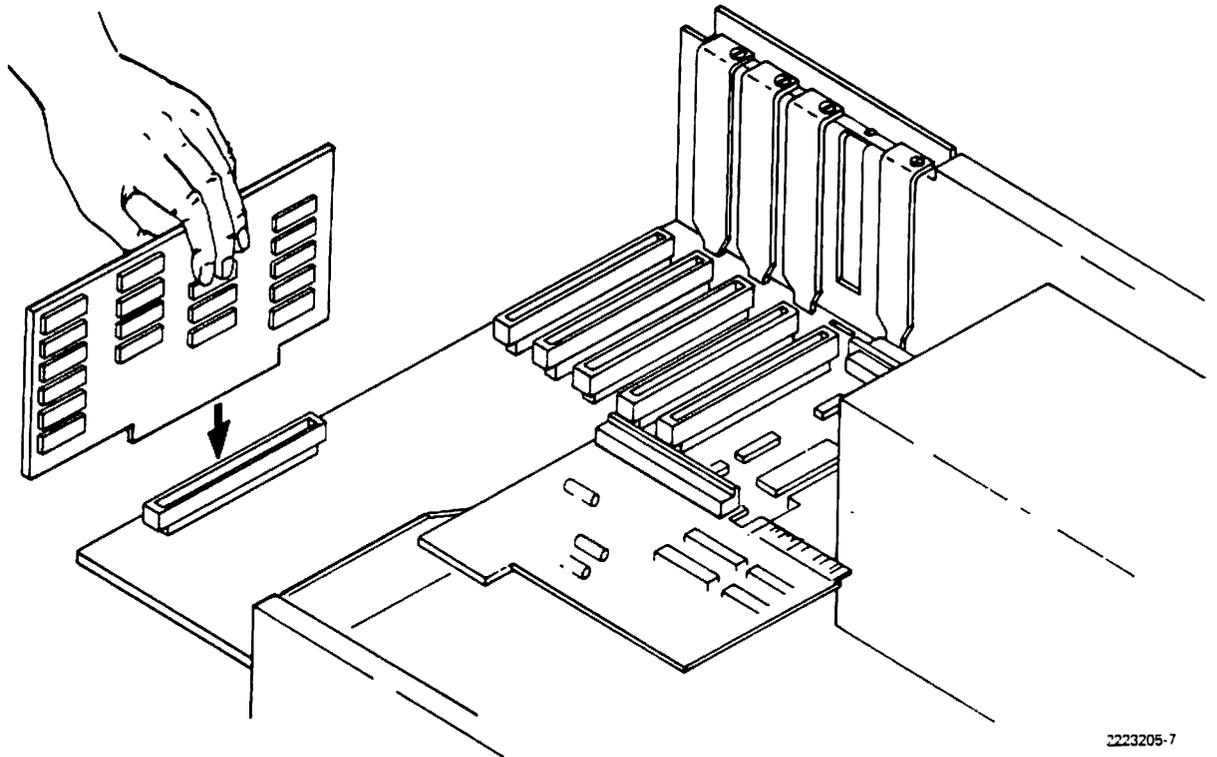
front, of the five expansion-bus card-edge connectors) does not extend over the top of the J10 connector. Only Texas Instruments Professional Computer half-size option boards may be inserted into card-edge connector J5 if the expansion RAM board is to be installed. Any other options installed in card-edge connector J5 must be relocated to a vacant option card-edge connector (J1 through J4).

2. Gently insert the expansion RAM board into card-edge connector J10 on the system unit board. Use the notch on the front panel as a guide in installing the option board. Figure C-8 shows the correct method of inserting the option board into the connector. Note that the component side of the expansion RAM board faces the inside of the system unit.



2223205-6

**Figure C-7. Location of J10 Connector**



2223205-7

**Figure C-8. Inserting the Option Board**

**C.3.2.3 Installation Checkout.** Before replacing the system unit cover, check the installation one more time, and plug everything in for an operational check. Inspect the seating of the expansion RAM board in its socket. Make certain that the components on the board are facing toward the interior of the system unit.

**CAUTION**

**With the system unit cover open and power applied, the system unit board and diskette drive logic boards are exposed. Make certain that no tools, test probes, or other metallic items come in contact with any exposed components. Damage to the unit may result.**

1. Reconnect the following:
  - Keyboard cable
  - Display unit signal cable
2. With the system unit ON/OFF switch in the OFF position, plug the system unit power cord into an ac receptacle.
  - Display unit power cord
  - System unit power cord
3. Place a diagnostics diskette in the left drive. Close the drive door.
4. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the diagnostics menu is displayed.
5. Select the Overall Unit Test. Following the test, the system configuration table is displayed. Figure C-9 shows the display.

```

Texas Instruments Professional Computer
System Configuration

ROMs installed:
V1.20 SYSROM (c) Copyright Texas Instruments Inc. 1982

RAM INSTALLED: 128 K bytes

OPTIONS installed:
Diskette drive 1, 2 side(s), 40 tracks
Diskette drive 2, 2 side(s), 40 tracks
Serial Communications port 1
3 Graphics planes

System Configuration Code - 7173200000

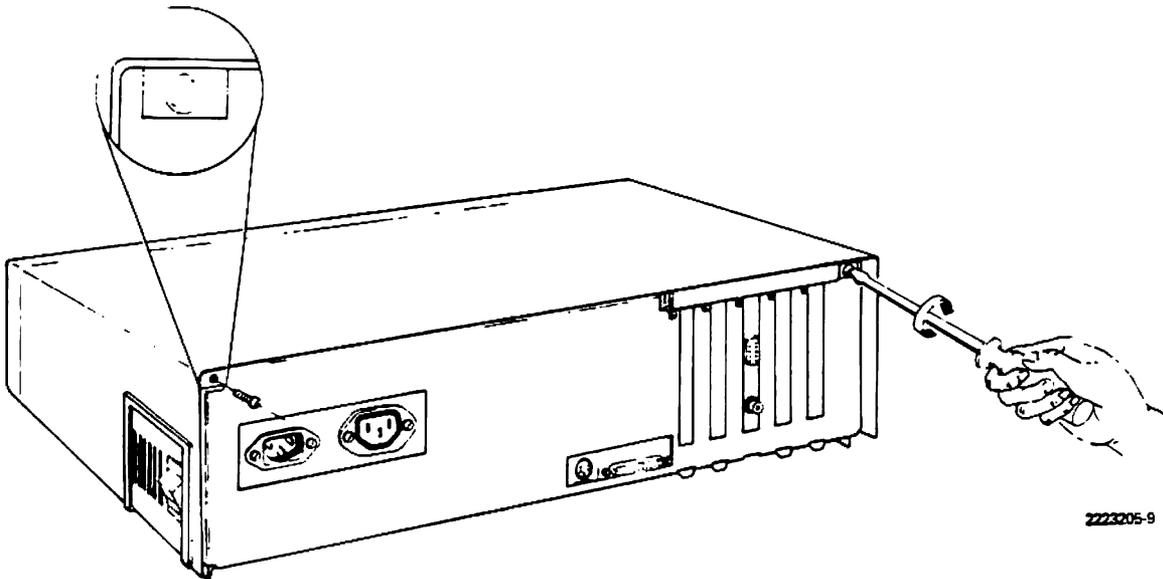
Press any key to return . . .
```

**Figure C-9. Overall Unit Test Menu**



8. Replace the two screws which secure the system unit cover and tighten them as

shown in Figure C-11.



**Figure C-11. Tightening the Cover Screws**

9. Reconnect the following:

- Keyboard cable
- Display unit signal cable
- Display unit power cord
- System unit power cord
- Any peripheral cables which you removed

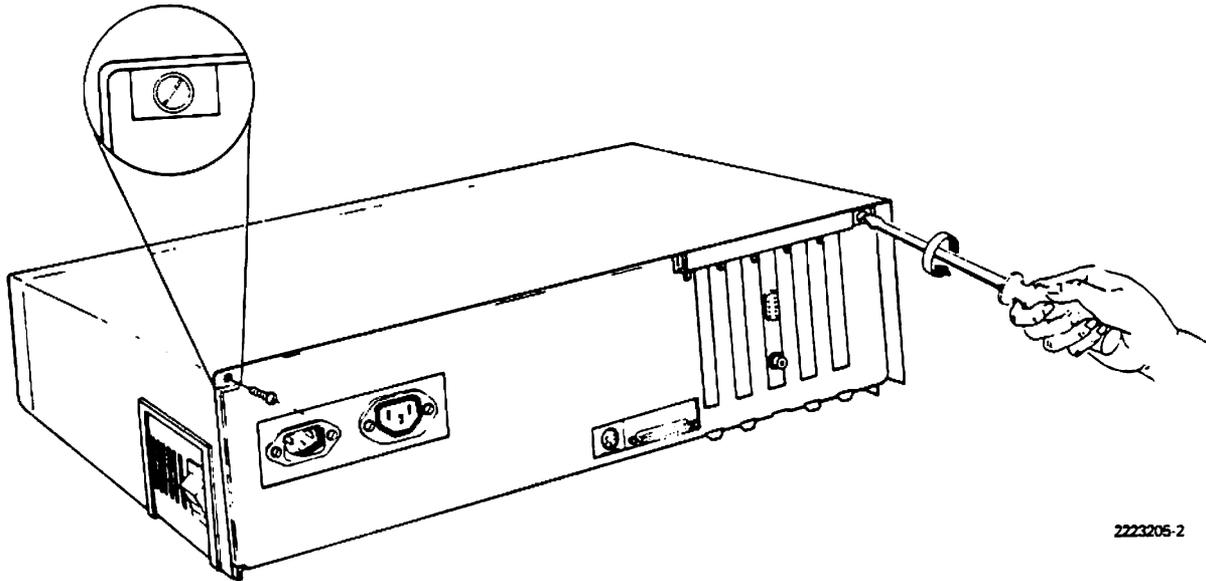
This concludes the installation and check-out of the expansion RAM board.

### C.3.3 Chapter 3 - Option Removal

**C.3.3.1 Preliminary Steps.** Before attempting to remove the option, complete the following steps.

1. If you wish to check the computer or option prior to removal, refer to the *Texas Instruments Professional Computer Operating Instructions* for checkout procedures using a diagnostics diskette.
2. Place the system unit ON/OFF switch in the OFF position and remove the system unit power cord from the ac receptacle.
3. Disconnect the following:
  - System unit power cord
  - Display unit signal cable
  - Display unit power cord
  - Keyboard cable
  - Any other peripheral cables connected to the system unit

4. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any other peripherals to the side, away from the system unit.
5. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner using a flat-bladed screwdriver. See Figure C-12 for the locations of the screws.



2223206-2

**Figure C-12. Removing the Cover Screws**

6. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit. Set the cover aside, out of the way. See Figure C-13.

#### C.3.3.2 Removal Procedure.

1. Locate the expansion RAM option board in card-edge connector J10, and gently lift it straight up, out of the socket. See Figure C-14.
2. Place the board in an antistatic bag. If no antistatic bag is available, a sheet of aluminum foil may be wrapped around the board.

#### CAUTION

Static electricity can be destructive to static-sensitive components mounted on the expansion RAM board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.

#### NOTE

If the expansion RAM board is being removed due to a fault, and a replacement board is being inserted, follow the installation instructions in Chapter 2. Use the antistatic bag from the replacement board to store the board being removed.

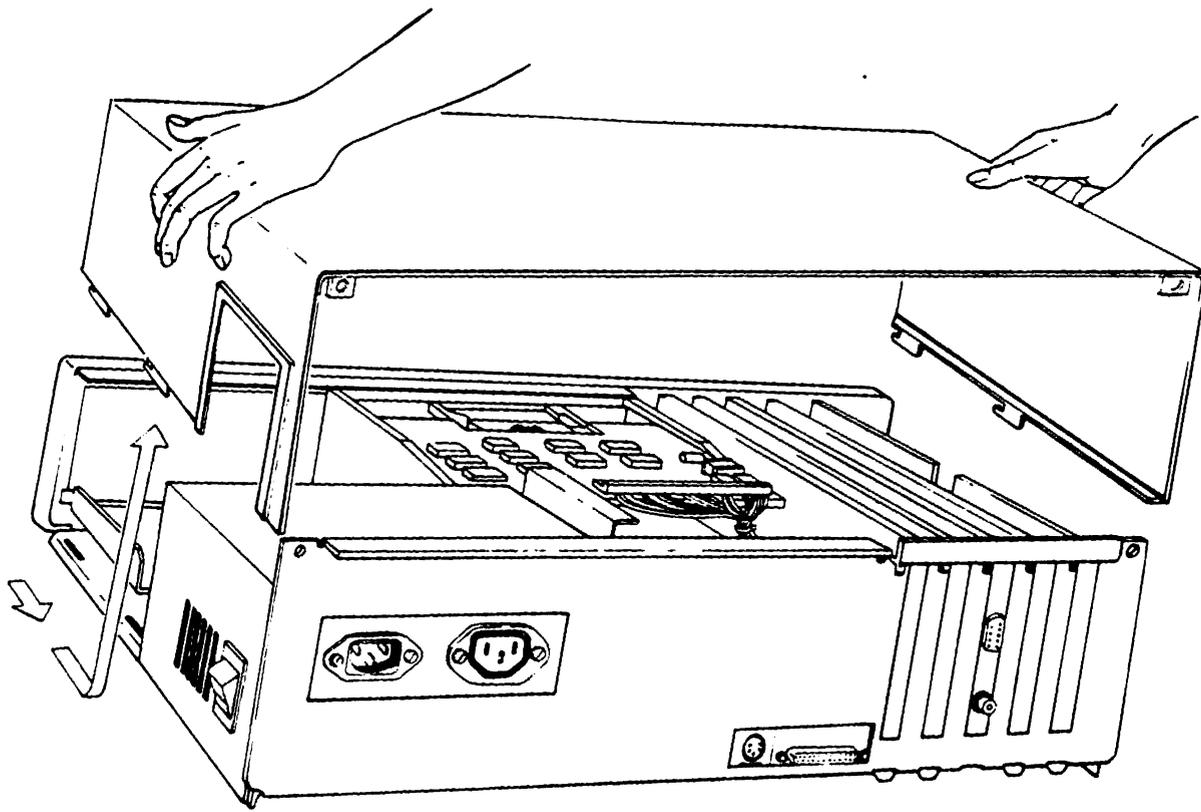


Figure C-13. Removing the Cover

223205-3

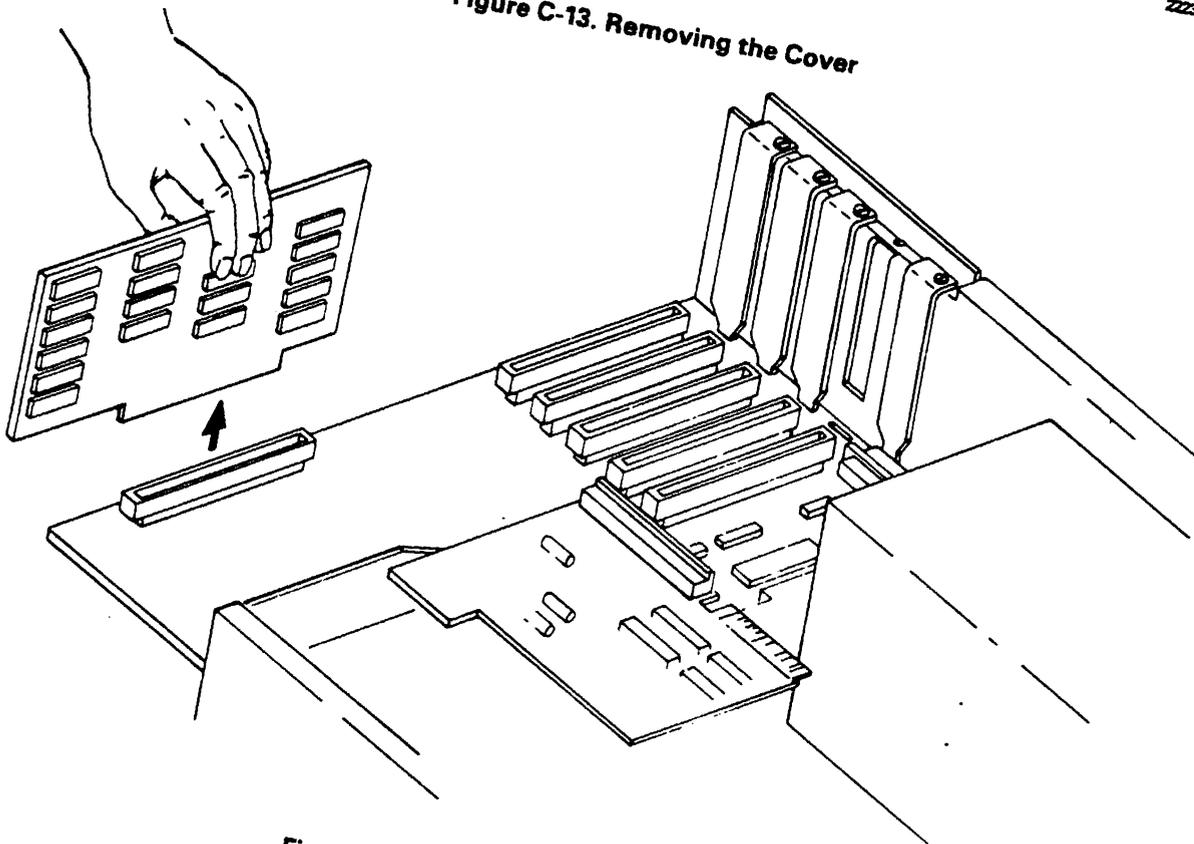


Figure C-14. Removing the Option Board

223205-10

3. If an individual dynamic RAM device is being replaced, and the identification of the socket number is known, remove the device by using an integrated circuit

removal tool. To remove the device, pull with a rocking motion while lifting the device out of the socket. See Figure C-15.

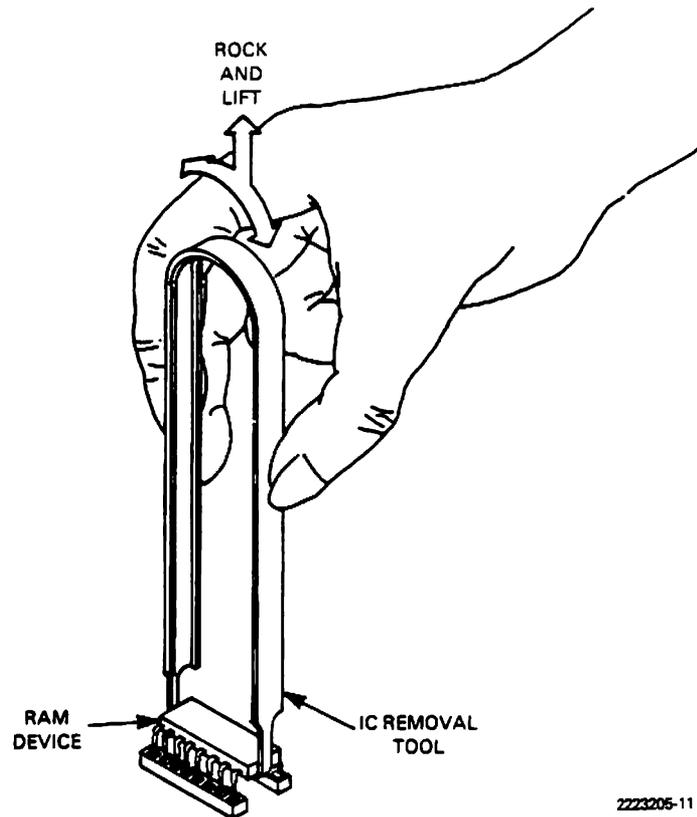


Figure C-15. Removing a RAM Device

#### CAUTION

With the system unit cover open and the power applied, the system unit board and diskette drive logic boards are exposed. Make certain that no tools, test probes, or other metallic items come in contact with any exposed components. Damage to the unit may result.

4. Reconnect the following:

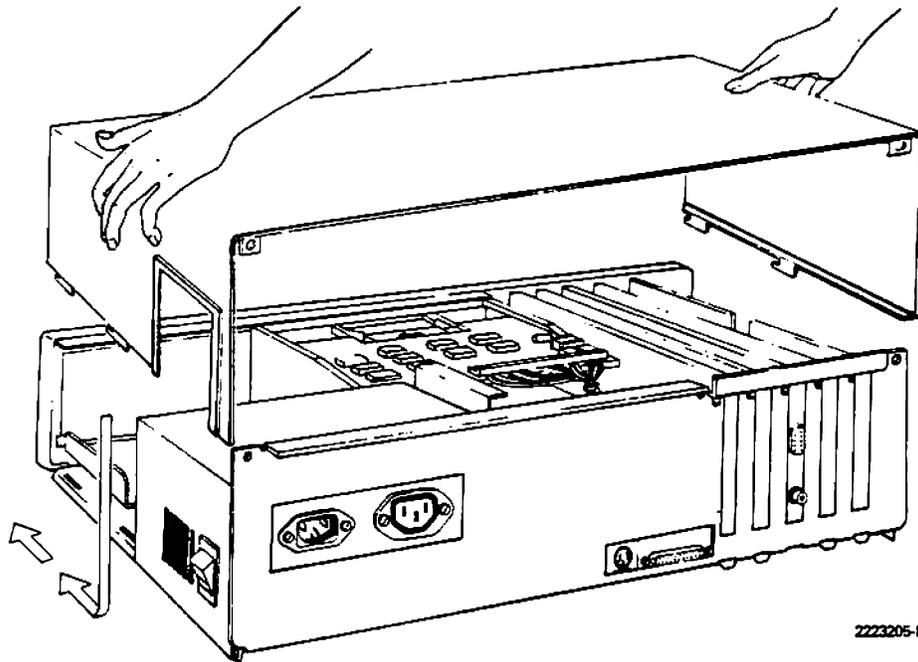
- Keyboard cable
- Display unit signal cable

- Display unit power cord
- System unit power cord

Do not plug the power cord into an ac receptacle yet.

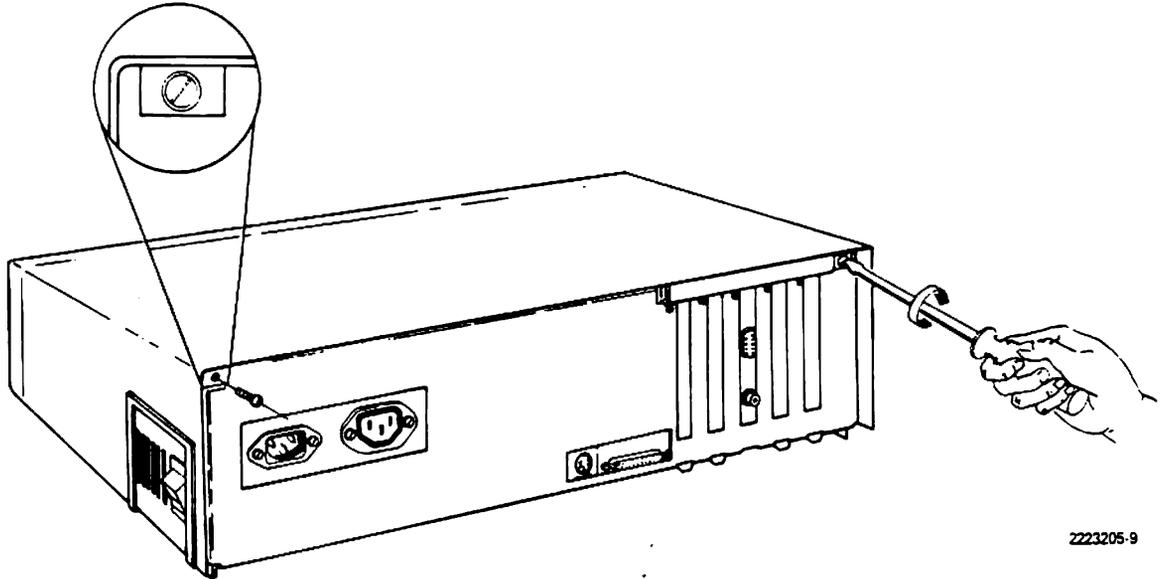
5. With the system unit ON/OFF switch in the OFF position, plug the system unit power cord into an ac receptacle.
6. Place a diagnostics diskette in the left drive. Close the drive door.

7. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the diagnostics menu is displayed. Select the Overall Unit Test. At the beginning of the test, the system configuration is displayed.
8. You may check out the installation more intensively by selecting the Memory Test from the diagnostics menu.
9. Place the system unit ON/OFF switch in the OFF position. Remove all cords and cables from the back of the system unit.
10. Turn the system unit so that its rear panel is facing you. Replace the system unit cover by gently lowering it into place and sliding it toward the front panel, as shown in Figure C-16.



**Figure C-16. Replacing the Cover**

11. Replace the two screws which secure the system unit cover and tighten, as shown in Figure C-17.



**Figure C-17. Tightening the Cover Screws**

12. Reconnect the following:

- Keyboard cable
- Display unit signal cable
- Display unit power cord
- System unit power cord
- Any peripheral cables which you removed

#### **C.4 DISKETTE DRIVES OPTION MANUAL (TI PART NO. 2223214-0001)**

##### **Preface**

This manual provides the user or technician with information necessary for installing and using the Diskette Drive Option. After the option has been

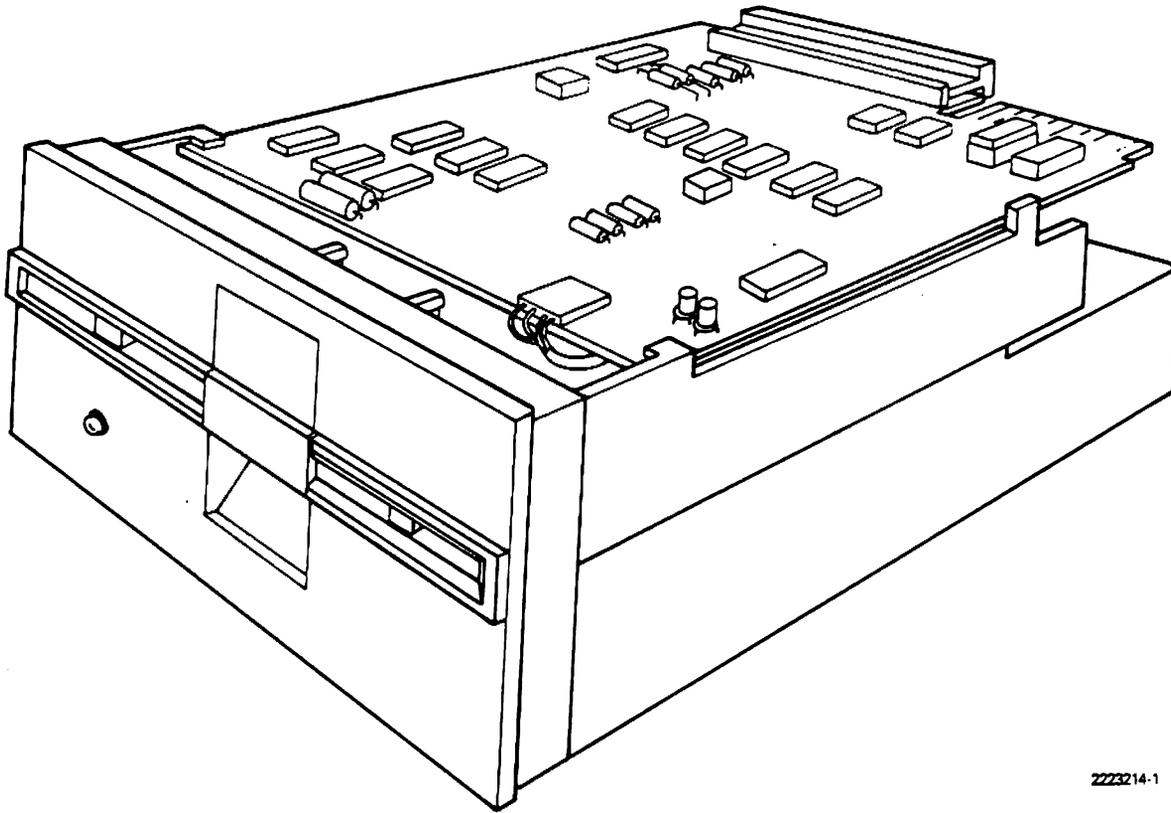
installed, you should file this manual in Chapter 5 of your *Texas Instruments Professional Computer Operating Instructions* (TI Part No. 2223116-0001). You can also find a copy of this and all other option manuals in Appendix C of the *Texas Instruments Professional Computer Maintenance Handbook* (TI Part No. 2223200-0001).

This manual is divided into three chapters.

Chapter 1 describes the option, lists the specifications, lists the tools required for installation and removal, and provides a checklist in case of difficulties.

Chapter 2 contains step-by-step instructions for installing the option and describes the checkout procedure.

Chapter 3 discusses the procedures for removing the option.



2223214-1

**Figure C-18. Diskette Drive Option**

#### **C.4.1 Chapter 1 - Introduction**

This chapter describes the diskette drive option, lists specifications, provides part number information for the option kit and kit components, and lists the tools required for installing the option. The option may be used as a second drive or as a replacement drive. See Figure C-18.

**C.4.1.1 Purpose.** When installed as the second drive in your Texas Instruments Professional

Computer the diskette drive option enables you to more than double your program and data storage capacity. You will also find that a second diskette drive makes preparing backup diskettes much simpler and faster.

**C.4.1.2 Specifications.** Specifications are listed in Table C-8.

**Table C-8. Diskette Drive Specifications**

	<b>160-kbyte Drive TI Part No. 2220446-0001</b>	<b>320-kbyte Drive TI Part No. 2220446-0002</b>
<b>Capacity</b>		
<b>Unformatted</b>		
Per diskette	250 kbytes	500 kbytes
Per track	6.250 kbytes	6.250 kbytes
<b>Formatted</b>		
Per diskette	163.84 kbytes	327.68 kbytes
Per surface	163.84 kbytes	163.84 kbytes
Per track	4096 bytes	4096 bytes
Per sector	512 bytes	512 bytes
<b>Transfer Rate</b>	250 kbits/s	250 kbits/s
Average latency	100 ms	100 ms
Seek time,		
Track-to-track	6 ms	6 ms
Settling time	15 ms	15 ms
Head-load time	35ms	35ms
Write precom- pensation	200 ns	200 ns
Media	single-sided, dual-density, soft-sectored	double-sided, dual-density, soft-sectored

**Table C-8. Diskette Drive Specifications (continued)**

	<b>160-kbyte Drive TI Part No. 2220446-0001</b>	<b>320-kbyte Drive TI Part No. 2220446-0002</b>
Rotational speed	300 rpm	300 rpm
Track density	48 tpi	48 tpi
Number of tracks	40	80 (40 each side)
Number of sides	1	2
Operating temperature	50° to 104°F (10° to 40°C)	50° to 104°F (10° to 40°C)
Nonoperating temperature	-40° to 160°F (-40° to 71°C)	-40° to 160°F (-40° to 71°C)
Operating humidity (relative)	20% to 80%	20% to 80%

**C.4.1.3 Description.** The diskette drive option kit consists of either a 160-kbyte or 320-kbyte capacity 5 1/4-in diskette drive assembly, three mounting screws, and an option manual. Power and data cabling are provided in the system unit chassis.

desire to install two drives of the highest mass storage capacity, both must be 320-kbyte capacity units. The system unit jumpers E1 and E2 must be shorted with a jumper plug (provided at the E1 position).

**NOTE**

Both of the installed drives must be of the same type and capacity. If you

The TI Part Numbers for the diskette drive option kit are listed in Table C-9.

Table C-9. Diskette Drive Option Kit Part Numbers

TI Part No.	Description
2223042-0001	Option Kit, Diskette Drive (160 kbyte)
consisting of: 2220446-0001	Diskette Drive Assembly, 160-kbyte Capacity
2210071-0009	Screw, 6-32 x 3/8-in, Hex-Head (3 each)
2223214-0001	Option Manual, Diskette Drive
or	
2223042-0002	Option Kit, Diskette Drive (320 kbyte)
consisting of: 2220446-0002	Diskette Drive Assembly, 320-kbyte Capacity
2210071-0009	Screw, 6-32 x 3/8-in, Hex-Head (3 each)
2223214-0001	Option Manual, Diskette Drive

#### C.4.1.4 Tool Requirements.

- Medium-size flat-bladed screwdriver
- A 1/4-in nutdriver may be useful in removing and replacing the front panel and in installing the mounting screws.
- A programmable dual-inline-package (DIP) shunt cutting tool, AMP part number 1-435830-1 or other suitable tool (such as a pair of small diagonal cutting pliers) is required to program the DIP shunts, as outlined in the installation procedures in Chapter 2 of this manual.
- DIP removal tool, or other suitable device or tool (such as a small flat-bladed screwdriver) is required for removing the terminating DIP resistor when installing a second drive assembly.
- Integrated circuit removal tool.

#### CAUTION

Care must be used in handling the diskette drive. It is strongly recommended that the drive assembly be left in the original container until you are ready to install it. This diskette drive mounts internally in the system unit. Do not attempt to use

it as an external drive. External diskette drives require a separate power supply, case, and separate data/control cable assembly.

**C.4.1.5 In Case You Have Problems....** If you have any operating difficulty after installing the option, you should check for the following conditions.

- Improper orientation or seating of the power or control cables in their sockets
- Another option which you may have loosened in its socket
- Improper DIP shunt configuration
- Improper terminating resistor configuration
- Blank or bad diskette in the drive

#### C.4.2 Chapter 2 - Installation

**C.4.2.1 Preliminary Steps.** Before attempting to install this option, complete the following steps.

1. Be sure there is sufficient working space available. You will be turning the system unit to gain access to the back panel, and you will need space beside the system

unit (with the cover removed) to place the display unit temporarily for installation checkout.

2. Make certain your Texas Instruments Professional Computer is operational. This may be done in the following manner.
  - Insert a diagnostics diskette into the left diskette drive and close the door.
  - Place the system unit ON/OFF switch in the ON position (the self-test will be executed and the diagnostics menu will be displayed)
  - Select the Overall Unit Test and follow the procedures outlined in the *Texas Instruments Professional Computer Operating Instructions*.

Do not attempt to install this option unless this test is successfully completed.

3. Place the system unit ON/OFF switch in the OFF position and remove the system unit power cord from the ac receptacle.
4. Disconnect the following:
  - System Unit power cord
  - Display unit power cord
  - Display unit signal cable
  - Keyboard cable
  - Any peripheral cables connected to the system unit
5. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any additional equipment to the side, away from the system unit.

## CAUTION

Static electricity can be destructive to static-sensitive components mounted on the diskette drive logic boards. Before touching any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.

6. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner using a flat-bladed screwdriver. See Figure C-19 for the location of these screws.
7. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit. Set the cover aside, out of the way. See Figure C-20.
8. Remove the five screws which secure the front panel to the system unit using a 1/4-in nutdriver. Note that one of the screws (the top center screw) is shorter than the other four. Save these screws, they will be used again in step 5 of the installation procedures. Set the front panel to the side, out of the way. See Figure C-21.

Perform the next step only if you are installing a drive in the right-hand drive position.
9. Remove the two screws which secure the blank panel to the right-hand drive support bracket. Remove and retain the blank panel and screws for possible future use. See Figure C-22 for location.

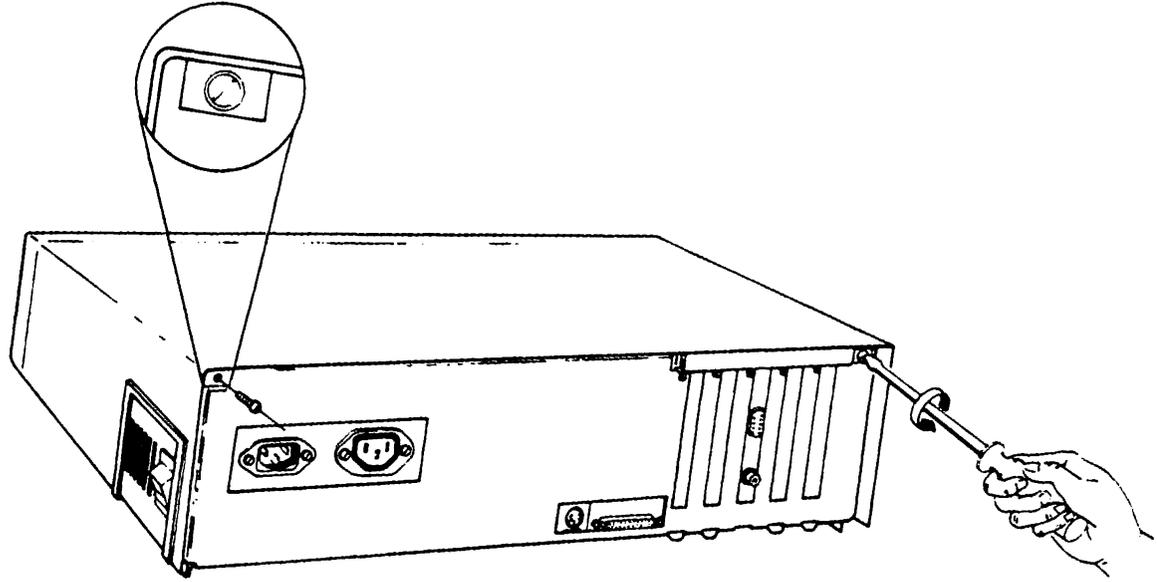


Figure C-19. Removing the Cover Screws

223205-2

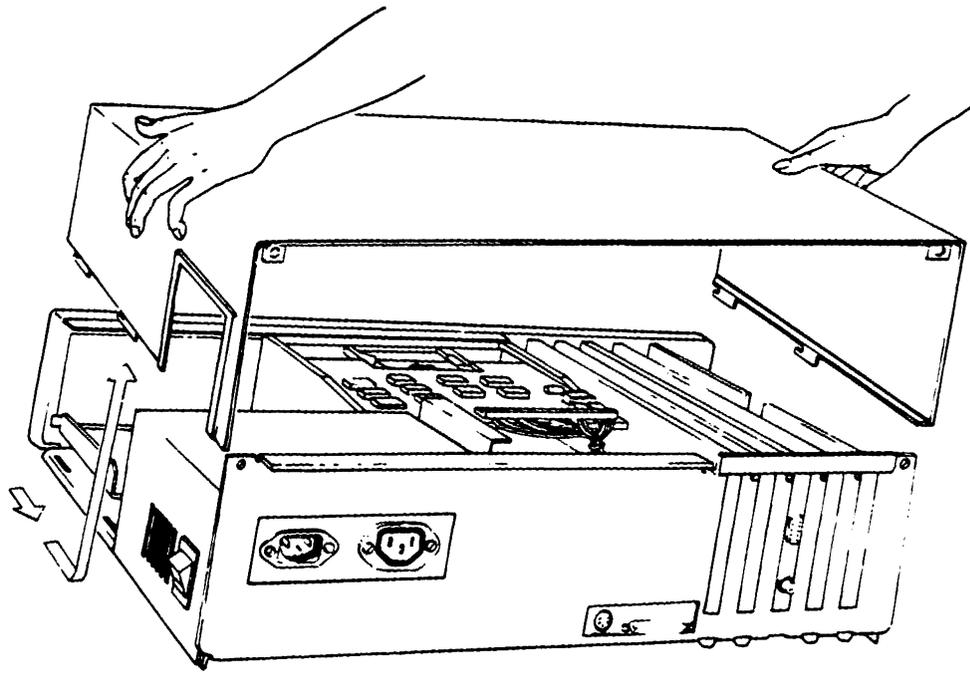


Figure C-20. Removing the Cover

223205-3

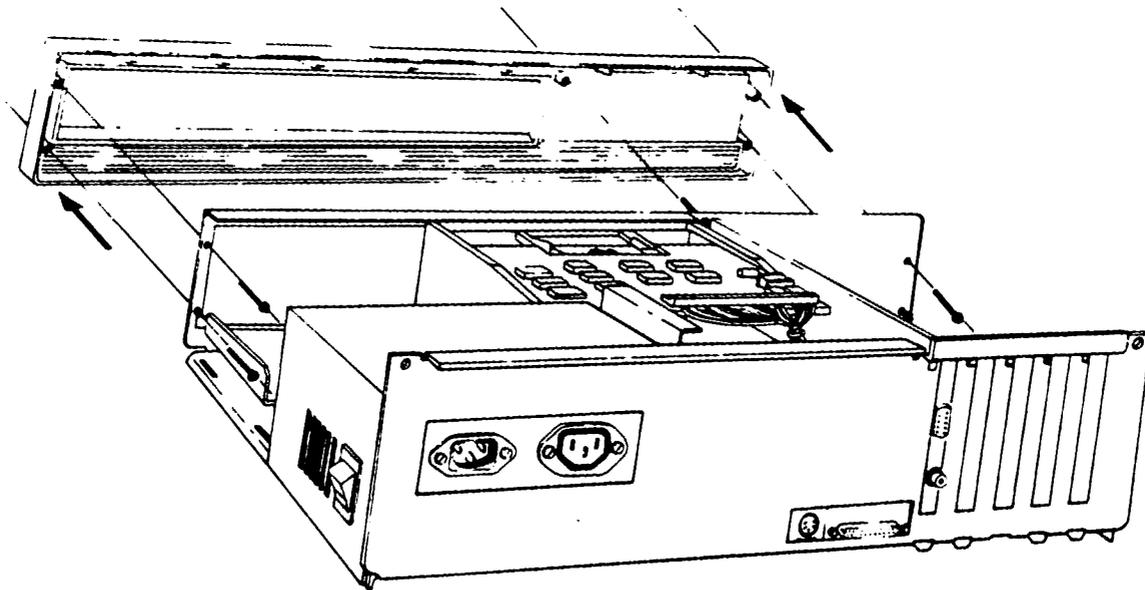


Figure C-21. Removing the Front Panel

2223214-2

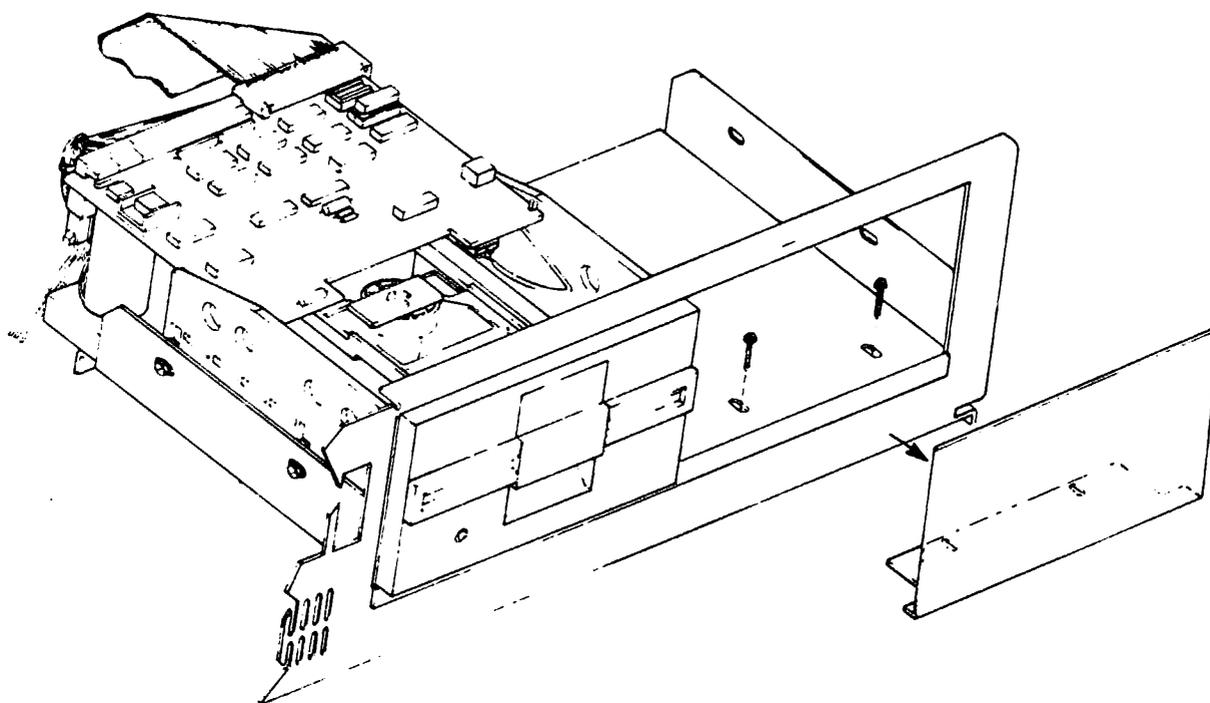


Figure C-22. Removing the Blank Panel

2223214-3

#### C.4.2.2 Preparing the Drive Assembly.

##### NOTE

MSTM-DOS and other disk operating systems use the convention of designating diskette drive names as: Drive A, Drive B, Drive C, and Drive D, or Drive 1, Drive 2, Drive 3, and Drive 4; even though the mnemonics, or names of logic signals assigned these drives are often: DRIVE ZERO, DRIVE ONE, DRIVE TWO, and DRIVE THREE (for a four-drive system). So remember, the left diskette drive can be referred to as DRIVE A when discussing operating system functions, and also referred to as DRIVE ZERO in discussing technical control terms and logic signals.

Remove the diskette drive assembly from the packing container. Retain the packing container for future storage or transport of a diskette drive assembly.

Prior to the installation of the drive, certain shunts on the drive assembly logic board must be cut, or "programmed," to allow the computer to select the correct drive, using a common data and control bus. The left drive (standard with the basic

model Texas Instruments Professional Computer) is considered by the drive logic to be DRIVE ZERO.

The drive to be installed in the right-hand drive position is considered by the drive logic to be DRIVE ONE.

If you are replacing an existing drive assembly with an identical assembly, use the DIP shunt from the drive you are removing and install it on the replacement drive. If the drive is a new option (either a second 160-kbyte drive, or a first or second 320-kbyte drive) and is to be placed in either the right-hand or left-hand drive position. Make certain that the DIP shunts are correctly programmed for the desired drive position. To program the DIP shunts, cut them completely through with a DIP shunt cutting tool, a short-bladed knife, or a pair of diagonal-cutting pliers. Refer to Figures C-23 and C-24 for proper shunt configuration of both the left and right diskette drives.

If you are installing a second diskette drive assembly, make certain that the terminating resistor located on the drive assembly logic board is in place for the right drive only. Remove the terminating resistor on the left drive assembly, using an integrated circuit removal tool or a small flat-bladed screwdriver. The terminating resistor location is shown in Figure C-25.

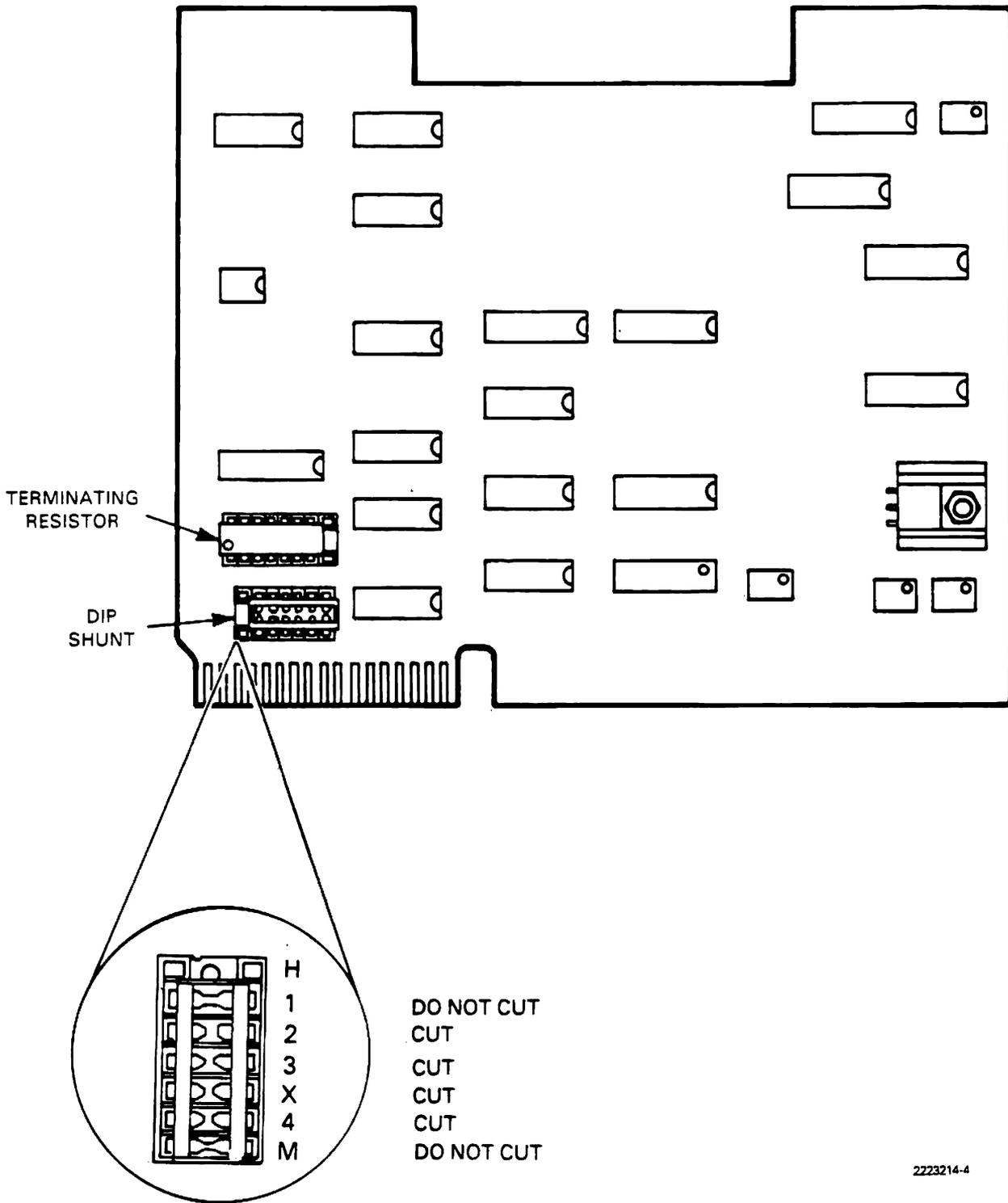


Figure C-23. Shunt Configuration Drive Zero (Left Drive)

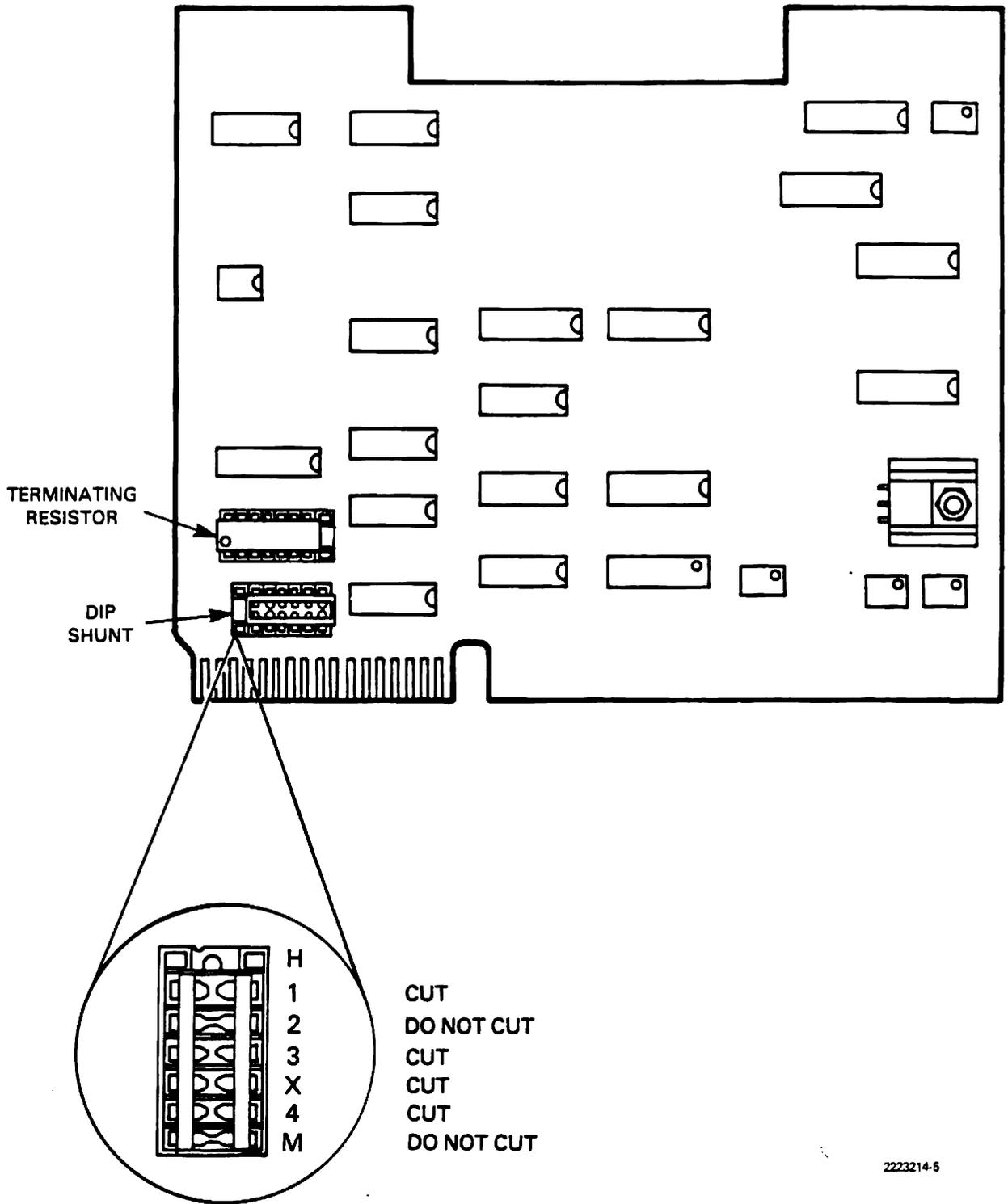
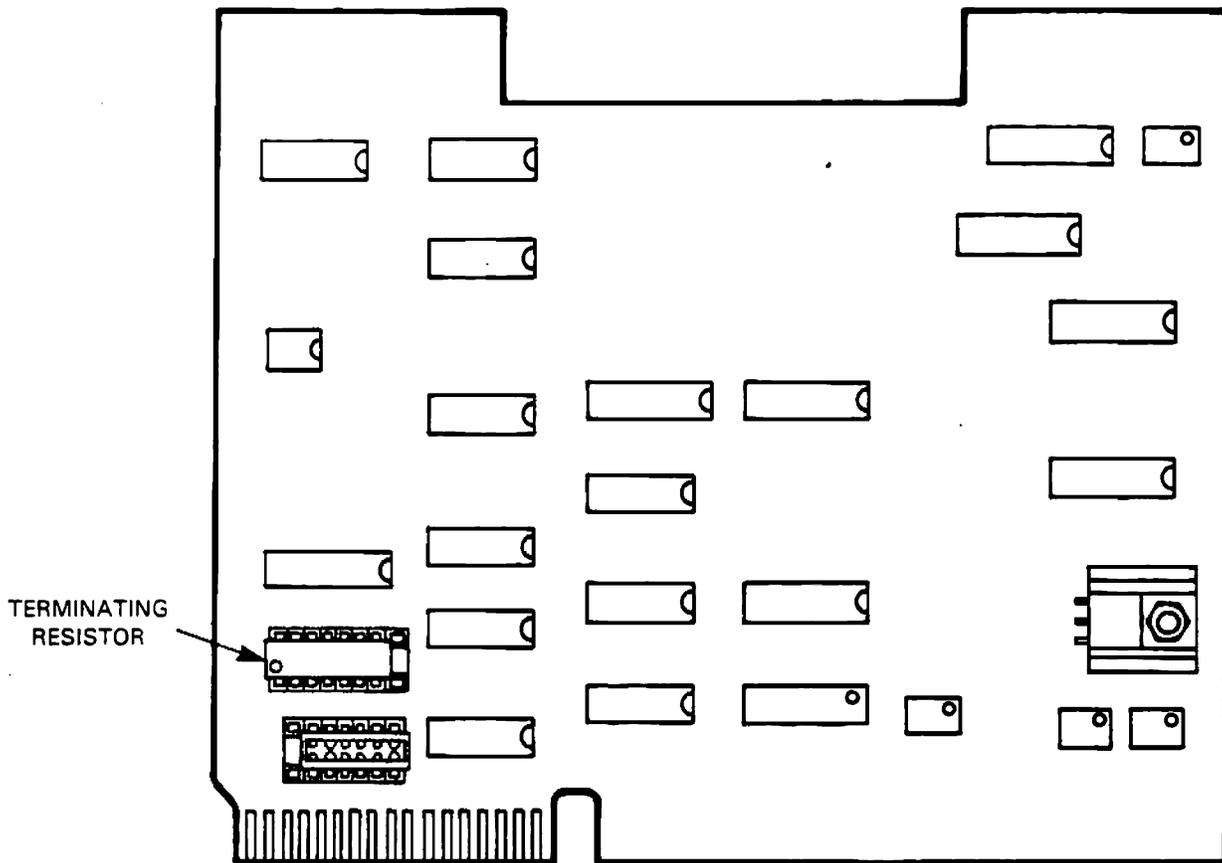


Figure C-24. Shunt Configuration Drive One (Right Drive)

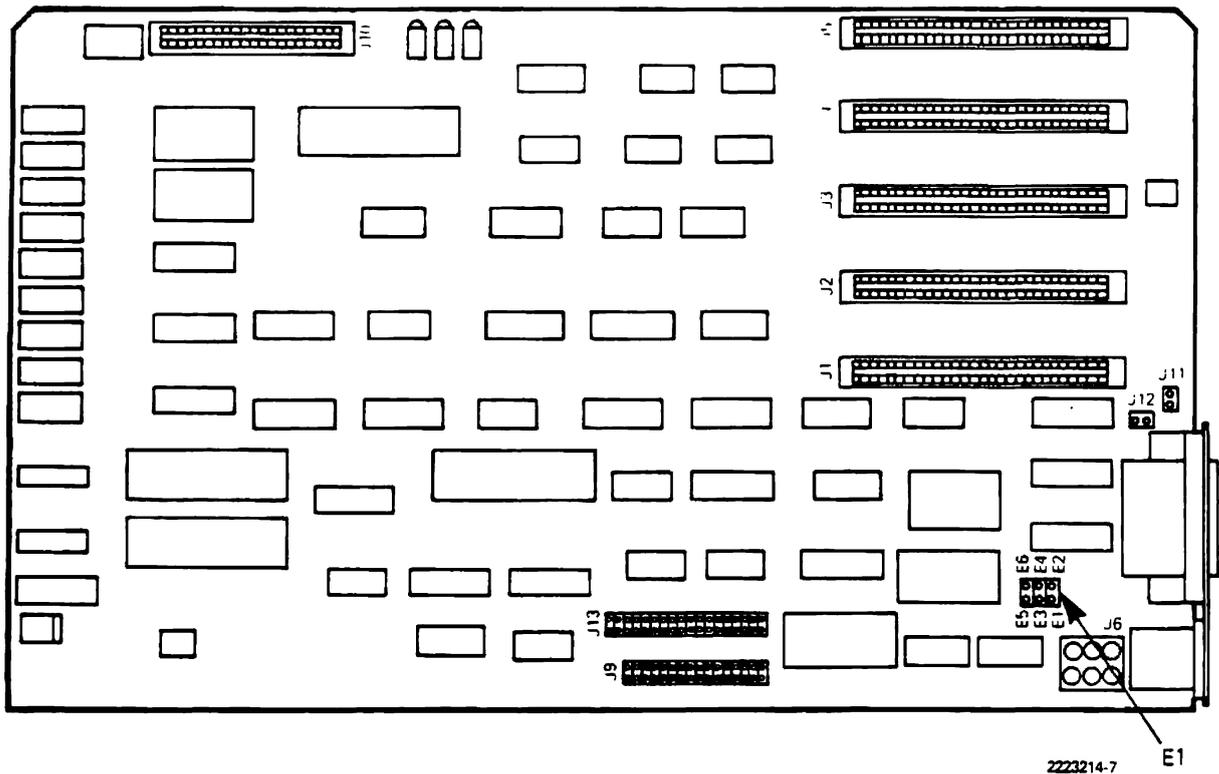


**Figure C-25. Terminating Resistor Location**

**Preparing the System Unit Board Jumper.**

If you are installing a 160-kbyte drive, it is not necessary to change any jumpers on the system unit board.

If you are installing one or more 320-kbyte capacity double-sided drives, you must install a jumper between E1 and E2 on the system unit board. A jumper plug is provided at the E1 position. See Figure C-26 for the jumper location.



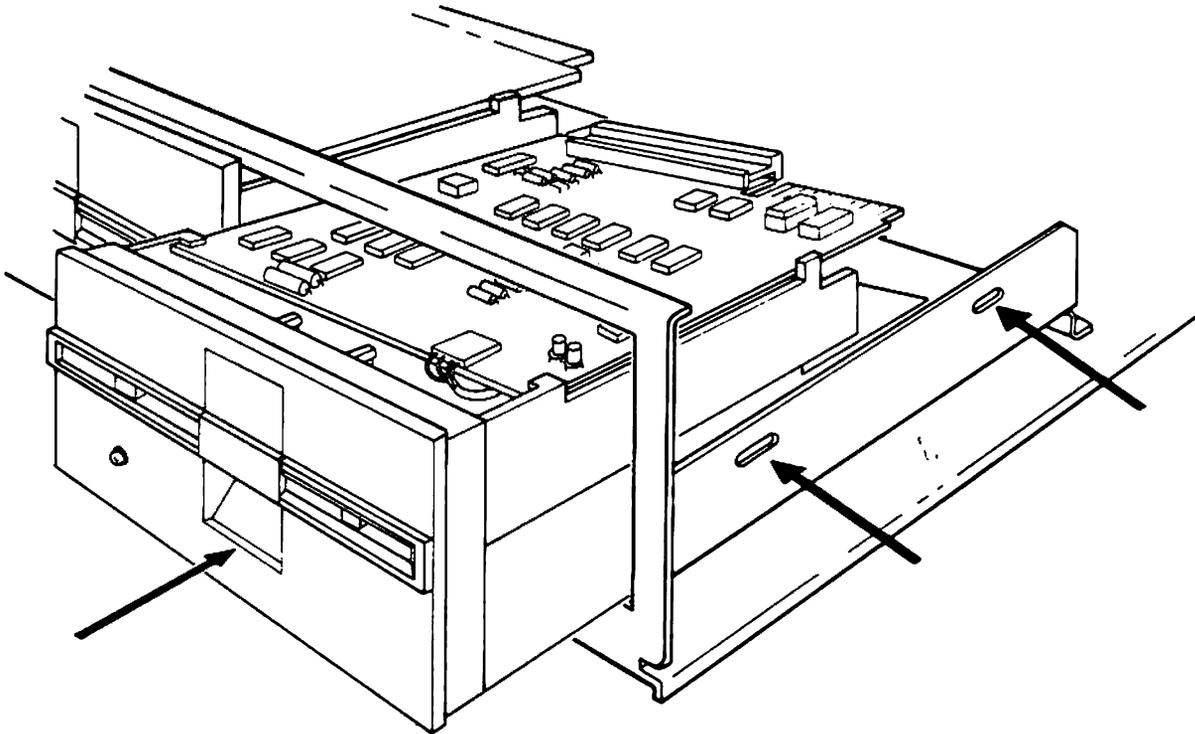
**Figure C-26. Location of Jumper E1**

All drives installed must be of the same type, that is, both must be 160-kbyte single-sided diskette drives, or both must be 320-kbyte double-sided diskette drives.

#### **C.4.2.3 Installation Procedure.**

1. Gently slide the diskette drive assembly into the system unit from the front.
2. Align the drive assembly on the mounting

shelf so that the two holes on the side of the diskette drive assembly align with the two matching holes on the side of the mounting shelf, making certain that the front panel of the new diskette drive is even with the front of the existing drive. Install two 6-32 x 3/8-in mounting screws through the mounting shelf holes into the side of the drive assembly frame, and finger tighten them. Refer to Figure C-27 for screw locations.

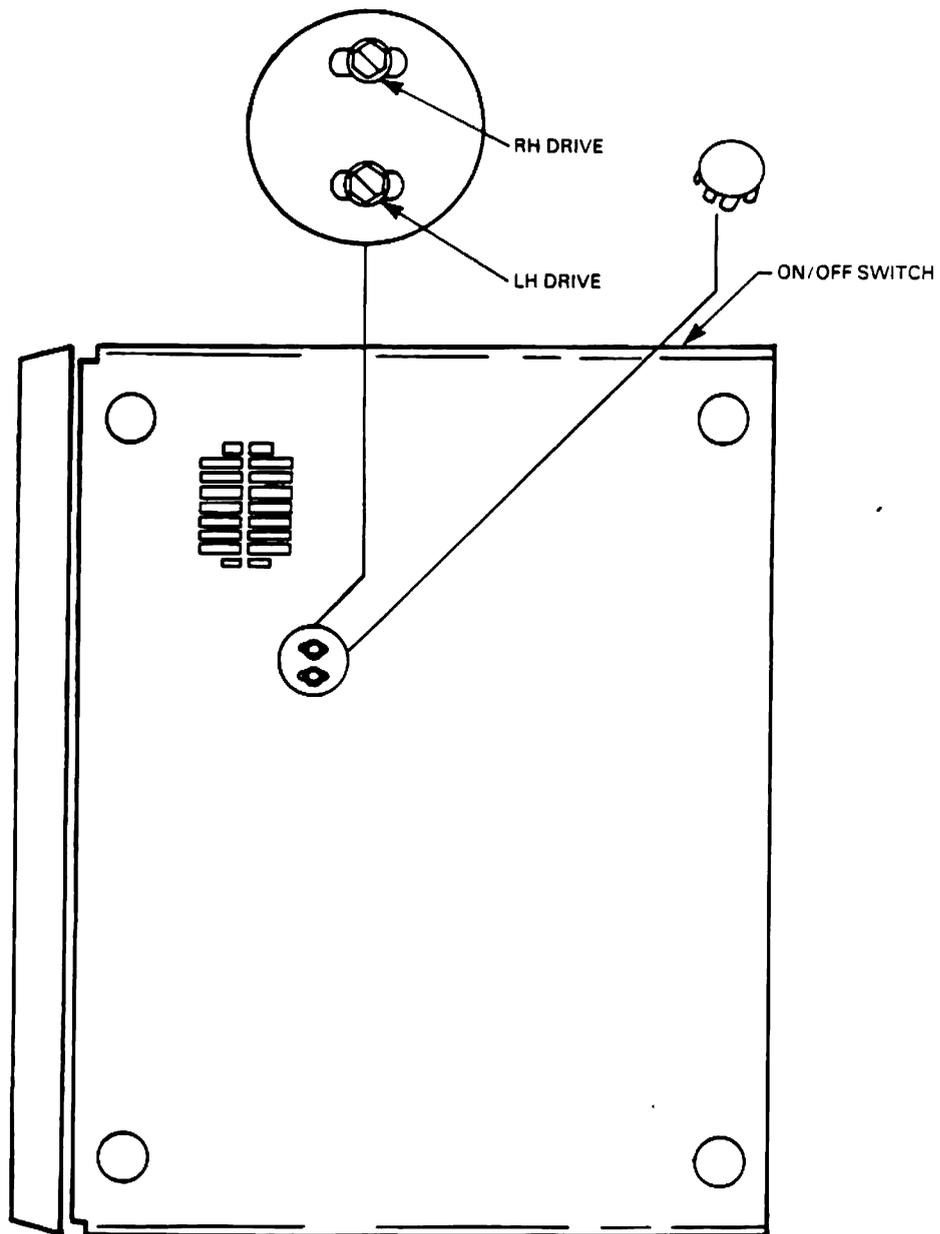


223214-8

**Figure C-27. Installing the Mounting Screws**

3. Gently tilt the system unit up with the system unit ON/OFF switch facing up. The system unit should rest on the left side of the chassis. With a flat-bladed screwdriver, remove the circular metal dust cover from the bottom of the chassis. Using a screw-starting screwdriver or a pair of long-nose pliers, install a 6-32 x 3/8-in screw through the hole, into the

diskette drive assembly frame. Prior to tightening the screw, make certain that the front panel of the diskette drive is properly aligned with the front panel of the existing drive. Tighten the mounting screw. Replace the circular metal dust cover. See Figure C-28. Carefully lower the system unit to the work surface. DO NOT DROP!



2223214-9

**Figure C-28. Installing the Bottom Mounting Screw**

4. Tighten the two screws you installed in step 2 on the side of the mounting shelf bracket to secure the diskette drive in place.
5. Using a 1/4-in nutdriver, reinstall the front panel, securing it with the five screws you removed in preliminary step 8. Remember to install the shortest screw in the top center position. See Figure C-29.
6. Install the diskette drive power connector and the control/data ribbon-cable connector. See Figure C-30.

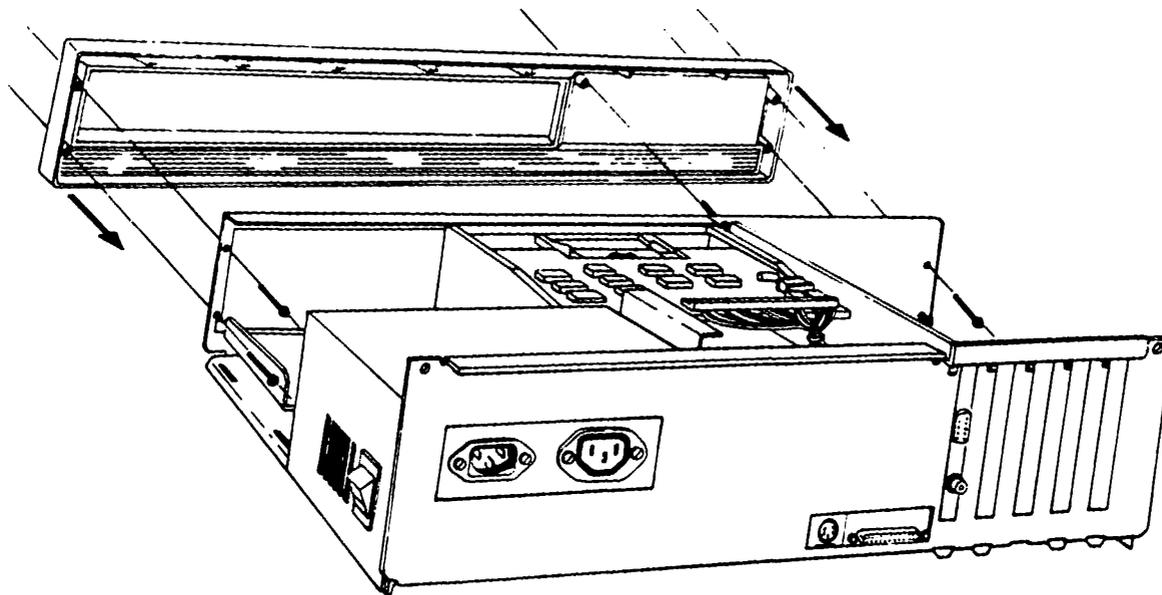


Figure C-29. Front Panel Replacement

2223214-10

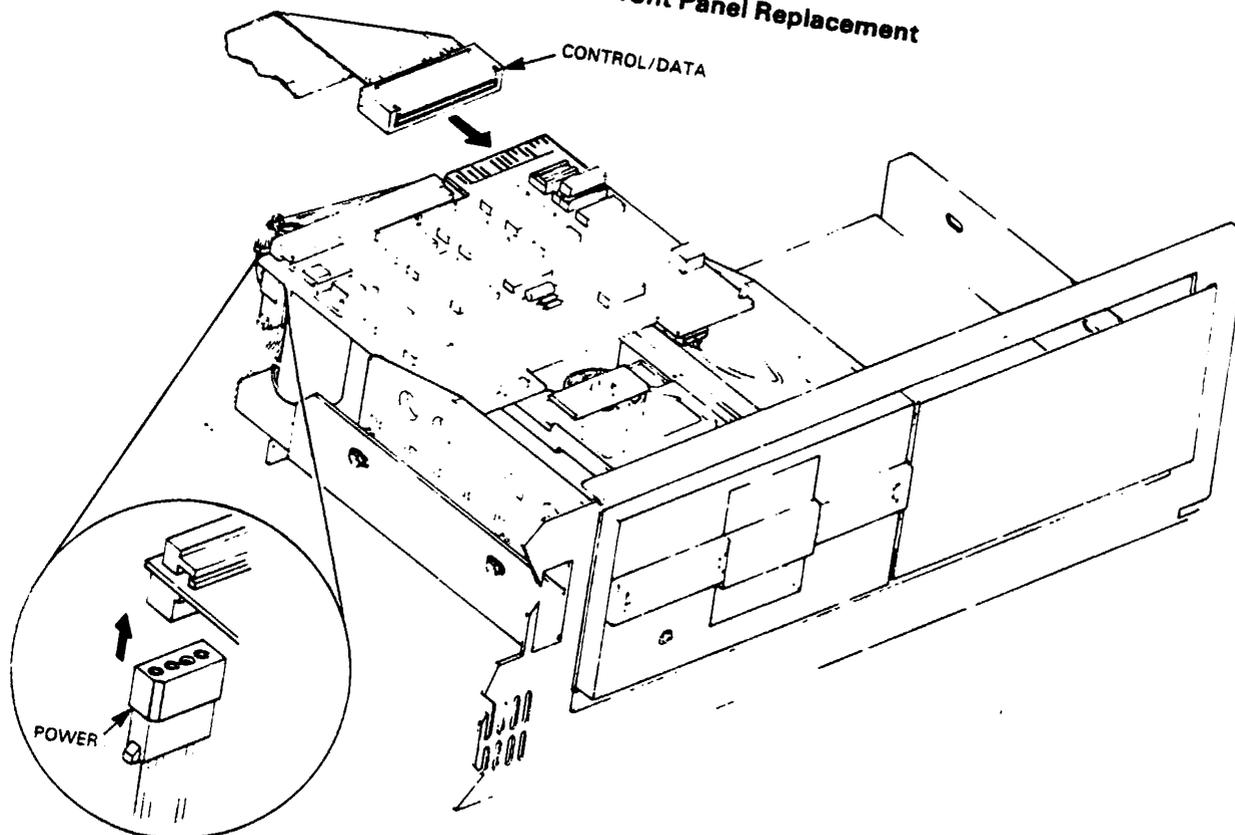


Figure C-30. Installing Power and Control/Data Connectors

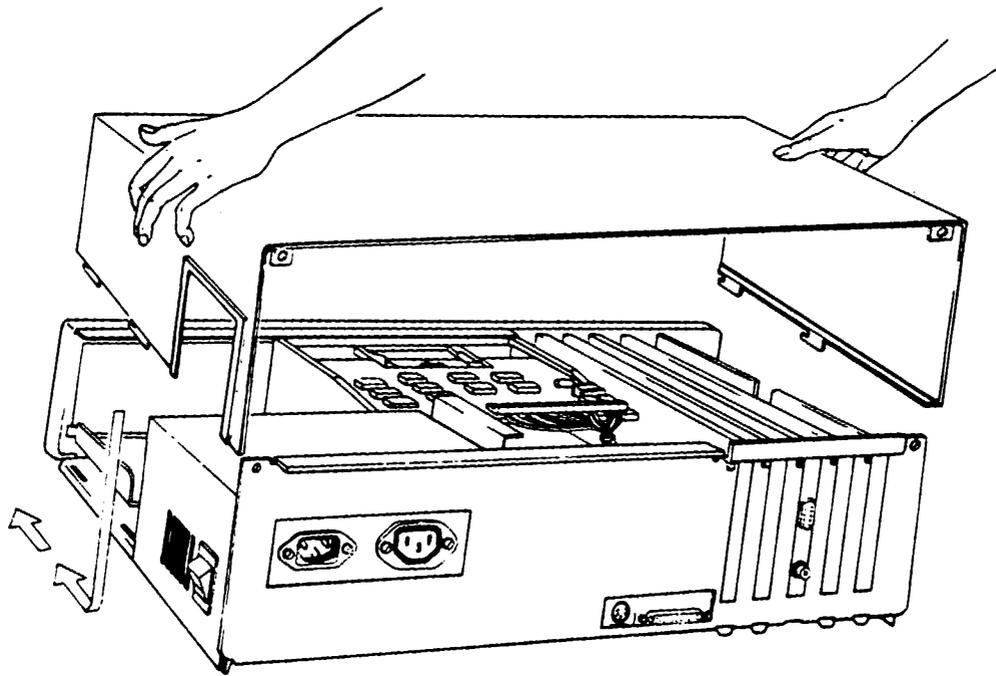
2223214-11

**C.4.2.4 Installation Checkout.** Before replacing the system unit cover, check the installation one more time, and plug everything in for an operational check.

### **CAUTION**

**With the system unit cover open and power applied, the system unit board and diskette drive logic boards are exposed. Make certain that no tools, test probes, or other metallic items come in contact with any exposed components. Damage to the unit may result.**

1. Compare the DIP shunt configuration of the newly installed diskette drive with the DIP shunt illustrations in the paragraph entitled, "Preliminary Steps" in this chapter. Correct if necessary.
2. Check the power connector to see if is firmly seated in the socket, which is just under the edge of the drive assembly logic board. Refer to the previous illustration for the socket location. Correct if necessary.
3. Check to see that the control/data ribbon-cable connector is connected.
4. Reconnect the following:
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
5. With the system unit ON/OFF switch in the OFF position, plug the system unit power cord into an ac receptacle.
6. Place a diagnostics diskette in the left drive. Close the drive door.
7. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the diagnostics menu is displayed.
8. Select the Diskette Read/Write Test. Follow the instructions displayed, inserting a scratch diskette into the diskette drive you just installed. A scratch diskette is a blank diskette or a diskette on which test data may be written. Enter the drive number for the drive you just installed (1 through 4). If you just installed a new drive in the right-hand position, enter a 2. The diskette will be formatted, then data will be written to and read from the diskette. If the test is successfully completed you will be prompted to press the **RETURN** key to return to the main menu. (If you have a single drive system, you will be prompted to insert the diagnostics diskette prior to the next step).
9. Select the Diskette Verify Test. The scratch diskette must be in the drive you just installed. After successfully completing this test, remove the diskette, and place it in the other drive. Repeat the test, specifying the drive number for the other (ordinarily, the left) drive. The purpose of this test is to ensure that data created in one drive is readable when the diskette is inserted into another drive and read back. After this test is completed, you will be prompted to return to the main menu by pressing the **RETURN** key.
10. Select the Configuration Test. Verify the drive numbers and types.
11. Place the system unit ON/OFF switch in the OFF position. Unplug the system unit power cord from the ac receptacle. Disconnect all cords and cables from the rear of the system unit.
12. Turn the system unit so that the rear panel is facing you. Replace the system unit cover by gently lowering it into place, and sliding it toward the front panel, as shown in Figure C-31.
13. Replace the two screws which secure the system unit cover and tighten, as shown in Figure C-32.



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Figure C-31. Replacing the Cover

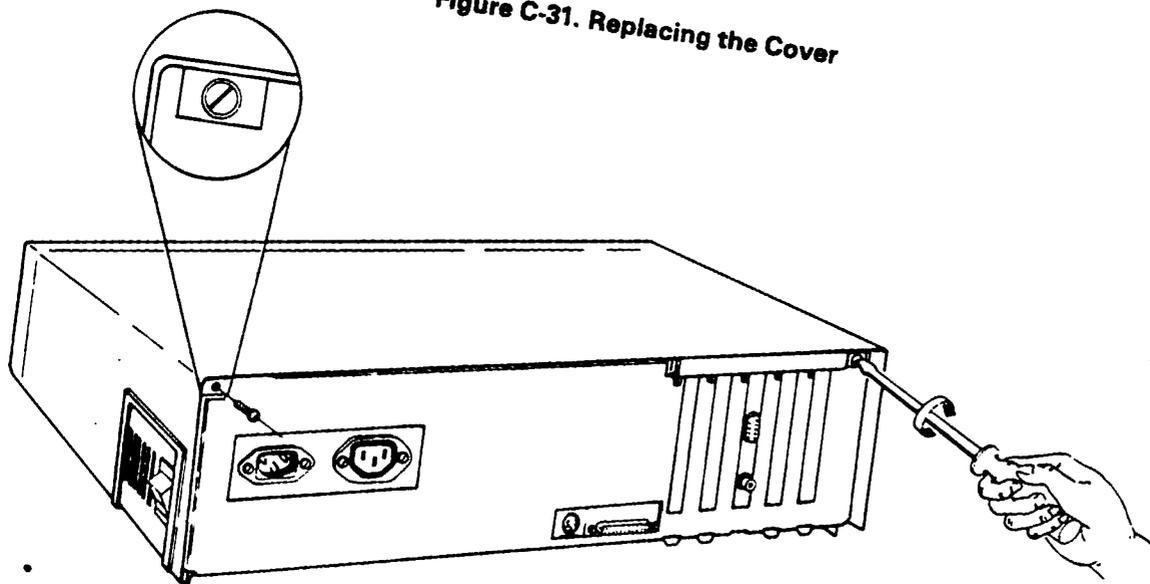


Figure C-32. Tightening the Cover Screws

ZZZ3205-9

14. Reconnect the following:
- Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
  - Any peripheral cables which you removed

This concludes installation and checkout of the diskette drive option.

### C.4.3 Chapter 3 - Option Removal

**C.4.3.1 Preliminary Steps.** Before attempting to remove the option, complete the following steps.

1. If you wish to check the computer or option prior to removal, refer to the *Texas Instruments Professional Computer Operating Instructions* for checkout procedures using a diagnostics diskette.
2. Place the system unit ON/OFF switch in the OFF position and remove the system unit power cord from the ac receptacle.
3. Disconnect the following:
  - System unit power cord
  - Display unit power cord

- Display unit signal cable
  - Keyboard cable
  - Any other peripheral cables connected to the system unit
4. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any other peripherals to the side, away from the system unit.
  5. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner with a flat-bladed screwdriver. See Figure C-33 for the locations of the screws.
  6. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit. Set the cover aside, out of the way. See Figure C-34.
  7. Remove the five screws which secure the front panel to the system unit using a 1/4-in nutdriver. Note that one of the screws (the top center screw) is shorter than the other four. Save these screws, they will be used again in step 6 of the removal procedure. Set the front panel to the side out of the way. See Figure C-35.

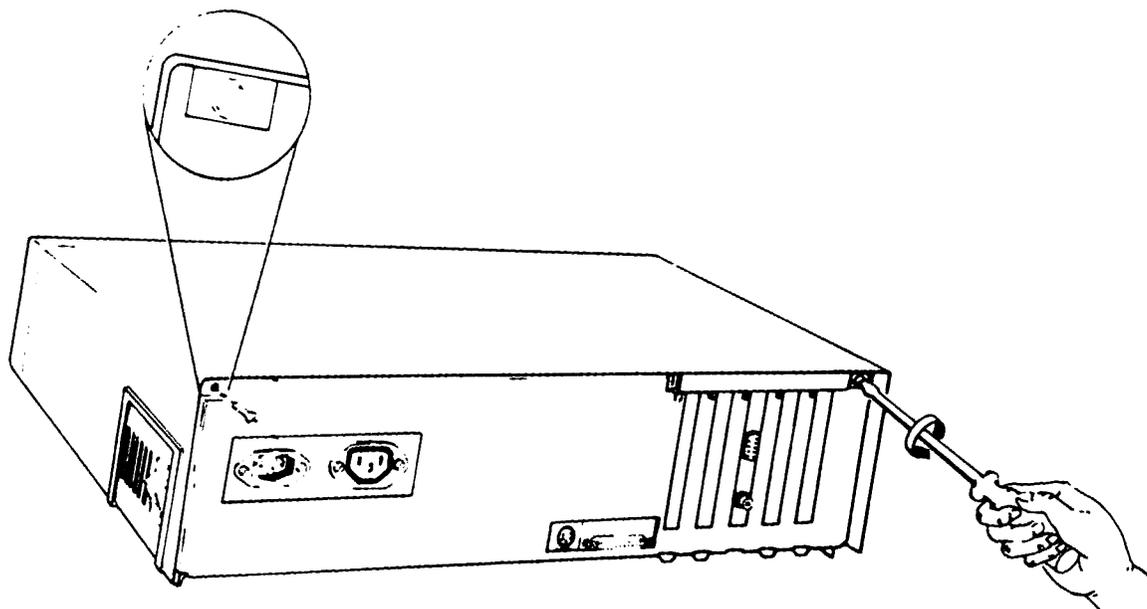


Figure C-33. Removing the Cover Screws

2223205-2

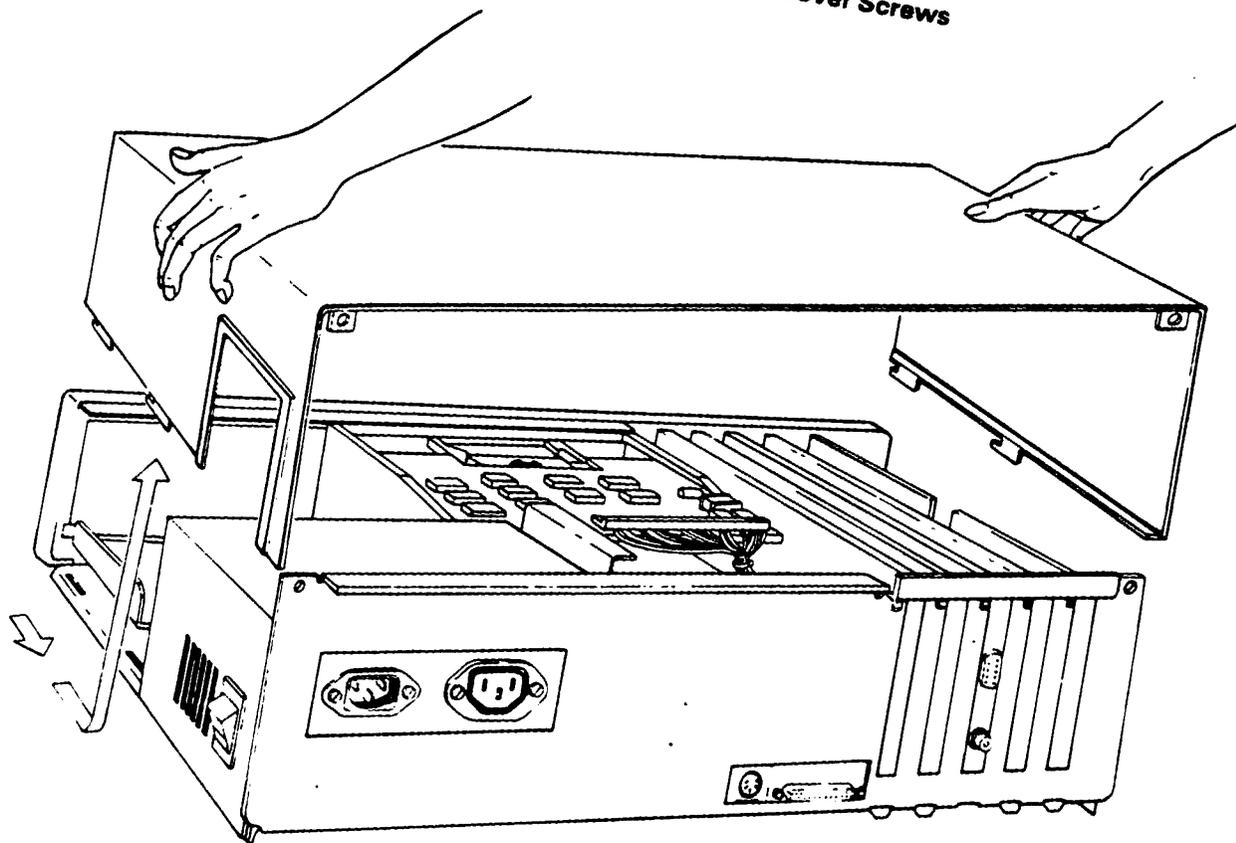
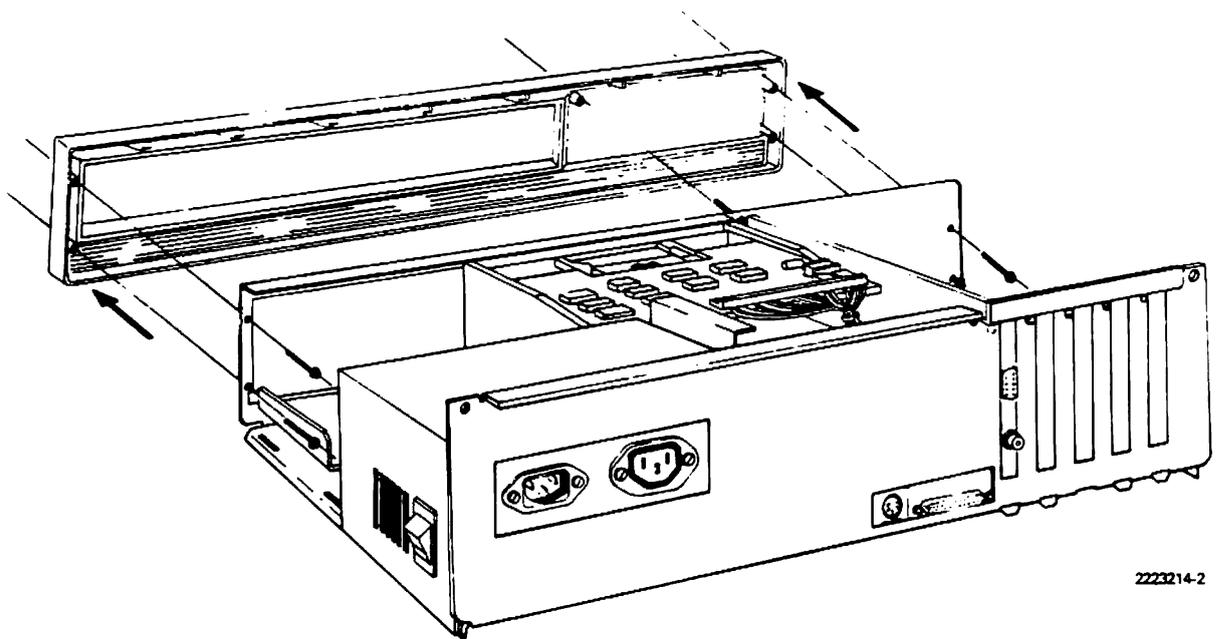


Figure C-34. Removing the Cover

2223205-3



**Figure C-35. Removing the Front Panel**

### **CAUTION**

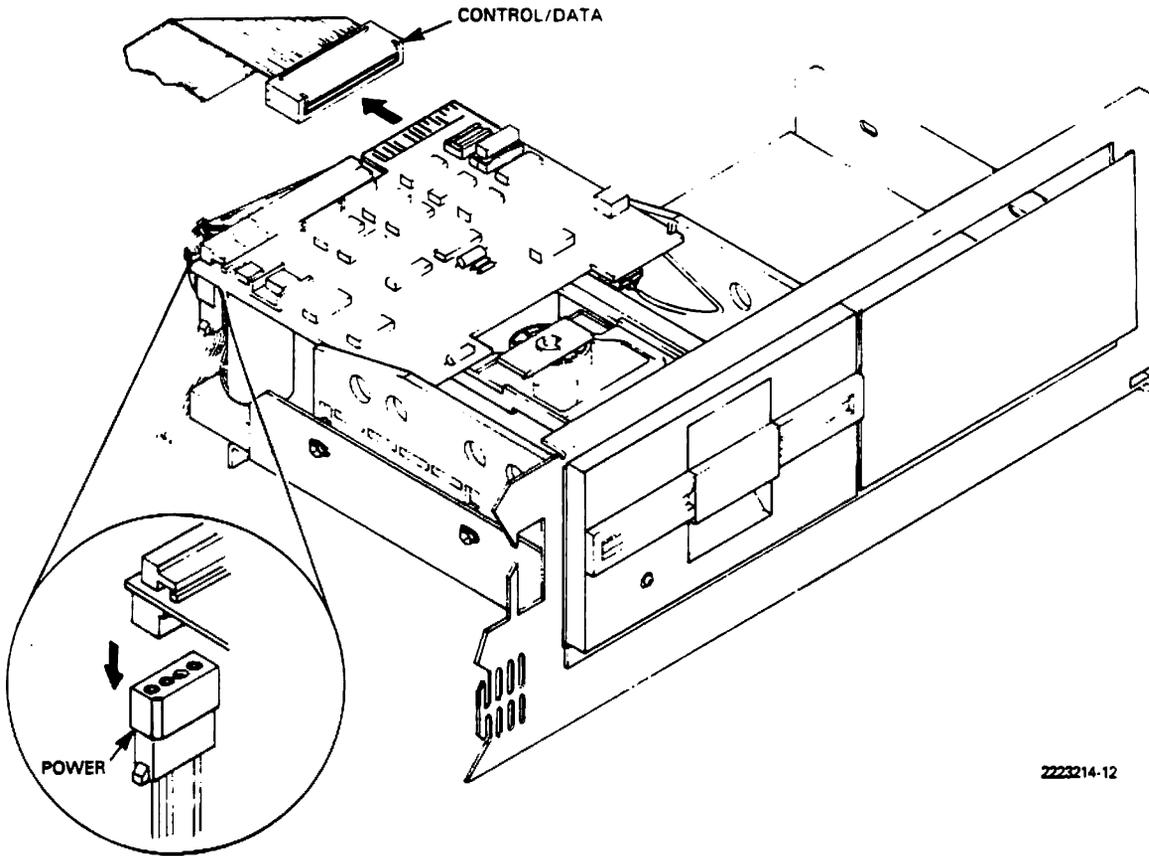
Static electricity can be destructive to static-sensitive components mounted on the diskette drive logic boards. Before touching or attempting to remove the diskette drive or any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.

**C.4.3.2 Preparing the Drive Assembly.** Before removing the drive assembly, notice the configuration of the shunts on the assembly logic

board. If the diskette drive is being replaced because of a fault, and the replacement drive is of the same type, the shunts may be interchanged. Place the old shunt from the drive you are removing into the replacement drive. If the diskette drive is being replaced with a drive assembly of a different type or capacity, then the shunt on the old drive should remain with that drive, and the new drive should be configured in accordance with Chapter 2, "Installation." The new drive's original packing carton should be retained to protect the drive which you removed.

### **C.4.3.3 Removal Procedure.**

1. Remove the diskette drive power connector and the control/data ribbon-cable connector, as shown in Figure C-36.

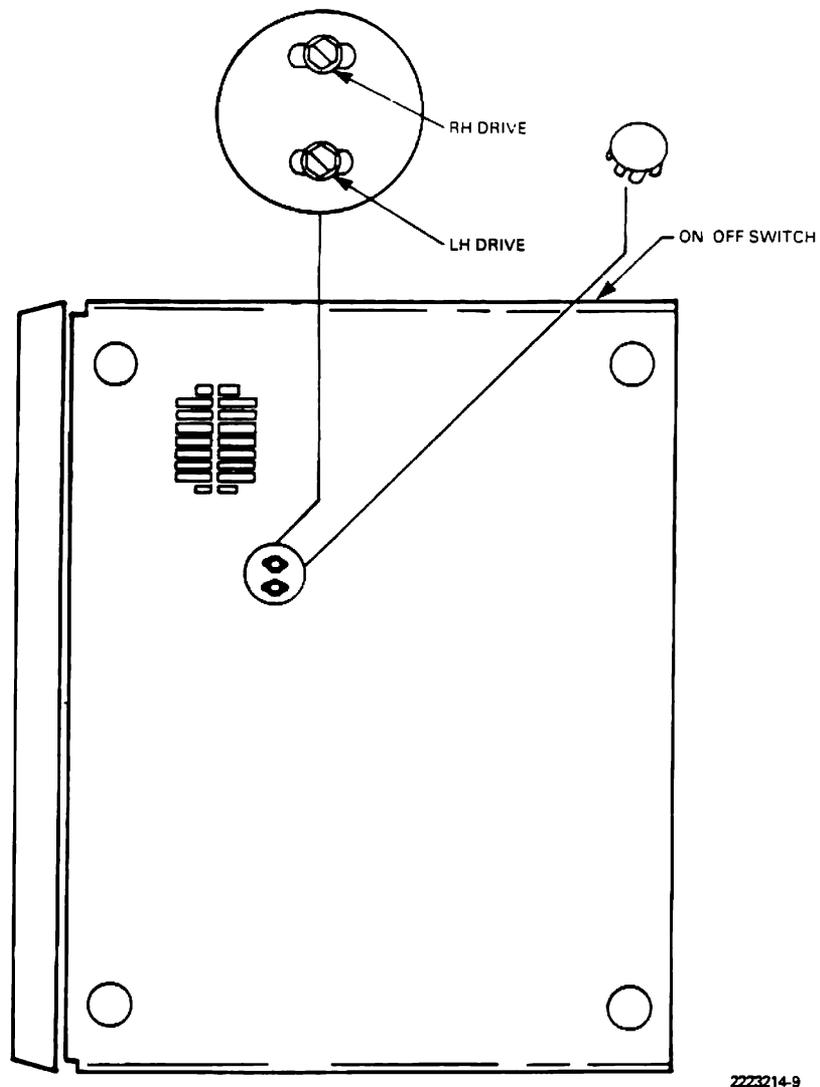


2223214-12

**Figure C-36. Removing Power and Control/Data Connectors**

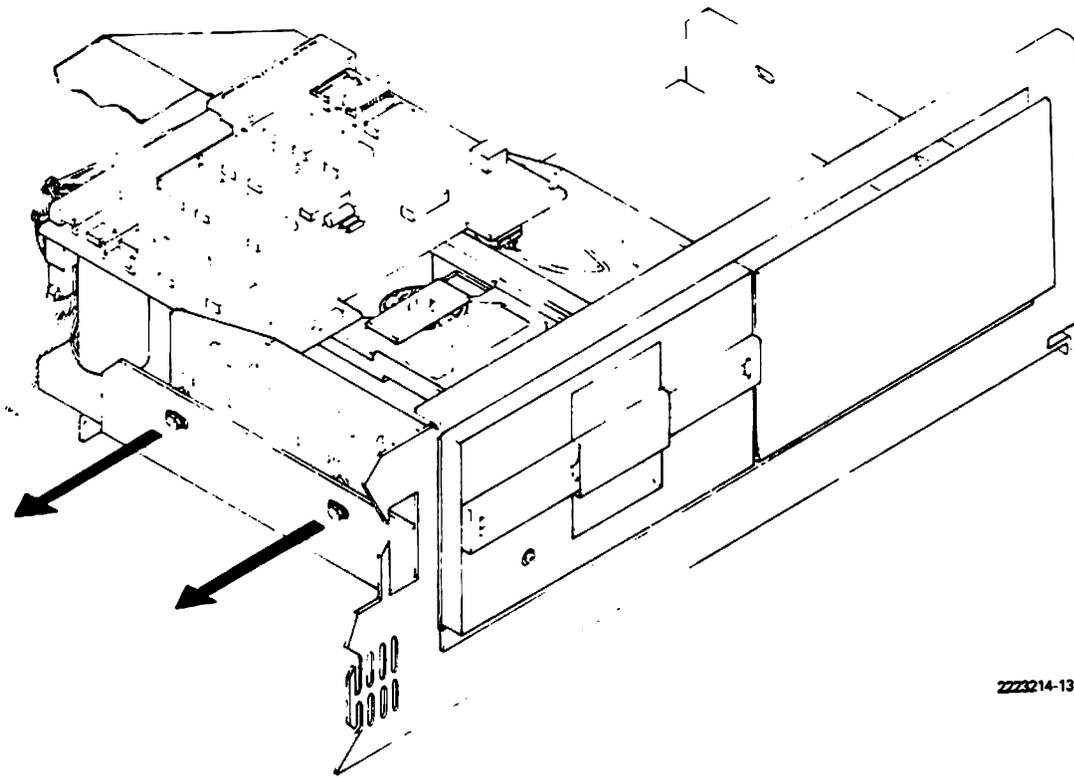
2. Tilt the system unit up so that the system unit ON/OFF switch is facing up. The system unit should rest on the left side of the chassis. Remove the circular metal dust cover from the large hole on the bottom of the chassis. Two screws are accessible through the hole. Remove the 6-32 x 3/8-inch screw for the drive being removed. The left screw (as viewed from the front) is for the left-hand drive. The

right screw is for the right-hand drive. These screws secure the drives to the mounting shelf in the system unit chassis. If a replacement drive is not to be installed in this location, you may replace the snap-in dust cover at this time and carefully lower the system unit to the work surface. **DO NOT DROP!** See Figure C-37 for the location of the dust cover.



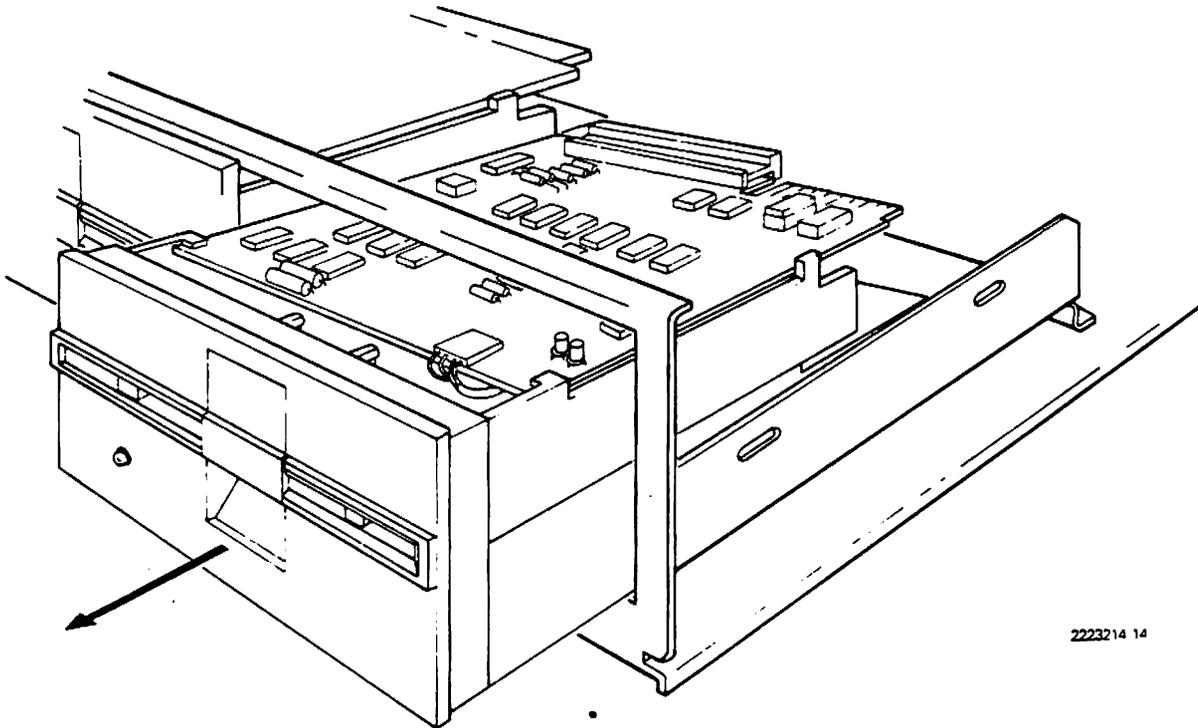
**Figure C-37. Removing the Bottom Mounting Screw**

3. Remove the two 6-32 x 3/8-in hex-head screws which secure the side of the diskette drive assembly to the mounting shelf. Refer to Figure C-38 for the location of the screws.
4. Carefully remove the diskette drive assembly by sliding it out the front of the system unit. See Figure C-39.



2223214-13

**Figure C-38. Removing the Mounting Screws**



2223214 14

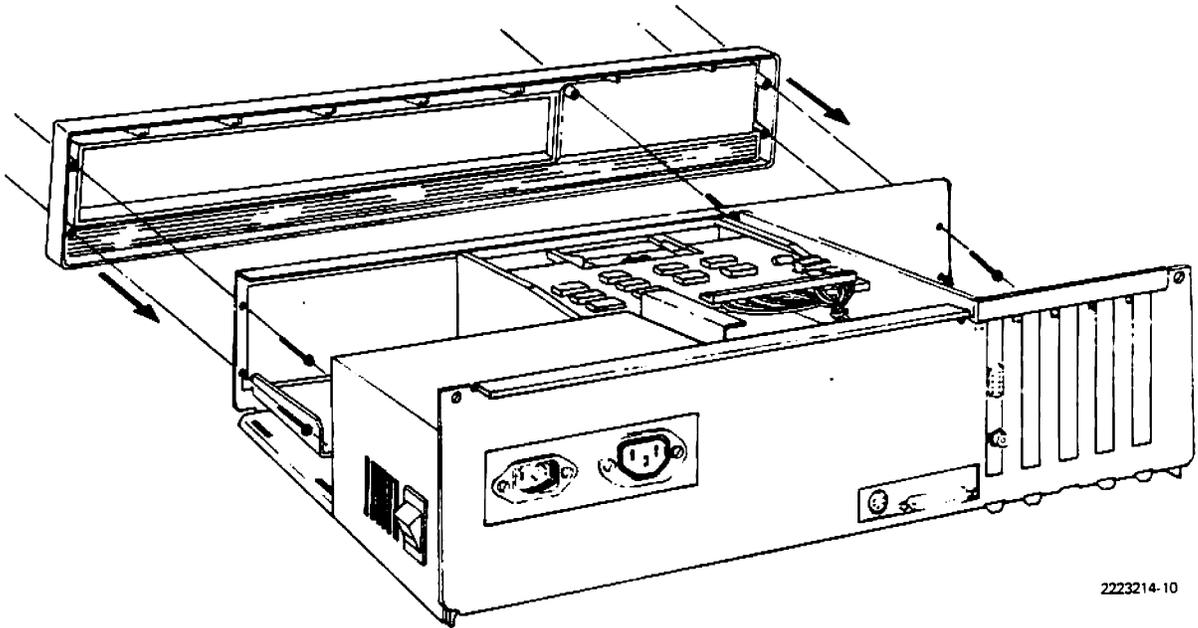
**Figure C-39. Diskette Drive Removal**

5. If the drive you are removing is a right-hand drive, install the blank plate in the location shown below (the blank plate was removed in preliminary step 9 of the "Installation Instructions" in Chapter 2).

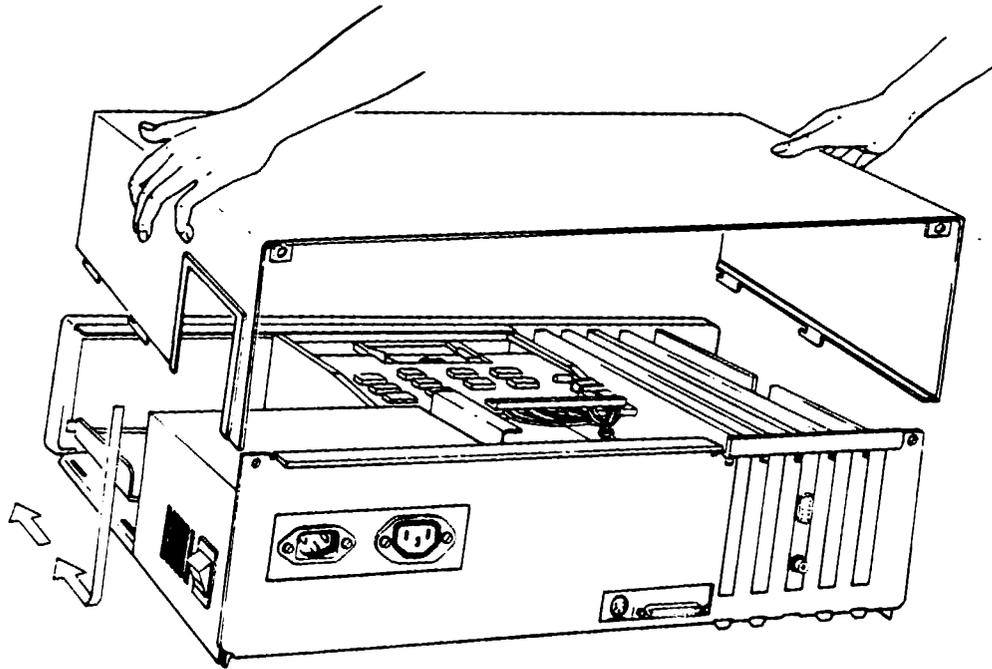
**NOTE**

If a replacement drive assembly is to be installed, follow the installation instructions in Chapter 2. If no replacement drive is to be installed, proceed to the next step.

6. Using a 1/4-in nutdriver, reinstall the front panel, securing it with the five screws which you removed in preliminary step 7. Install the shortest of the screws in the top center location. See Figure C-40.
7. Turn the system unit so that its rear panel is facing you. Replace the system unit cover by gently lowering it into place, and sliding it toward the front panel, as shown in Figure C-41.
8. Replace the two screws which secure the system unit cover and tighten. See Figure C-42.

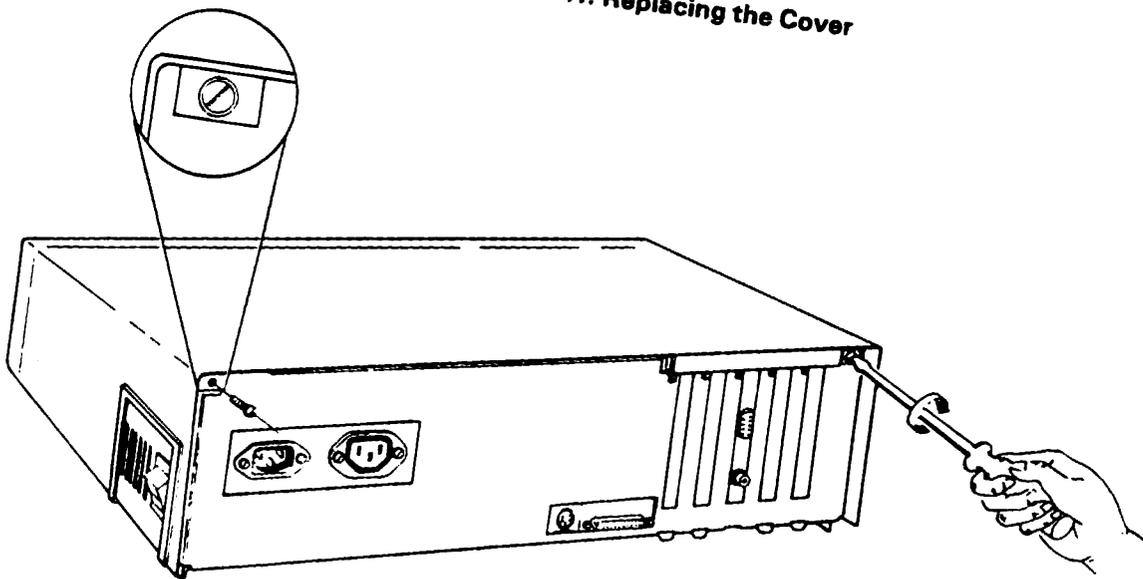


**Figure C-40. Replacing the Front Panel**



2223205-8

Figure C-41. Replacing the Cover



2223205-9

Figure C-42. Tightening the Cover Screws

9. Reconnect the following:
- Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
  - Any peripheral cables which you removed

The diskette drive which you removed should be placed in the original packing carton designed for this purpose. Retain the cartons from replacement drive assemblies for storage and shipment of removed drive assemblies. Defective drives should be returned to your Texas Instruments Authorized Dealer for repair or replacement. Drives returned for repair must be complete with all components, including the attached logic board. Drives returned with evidence of tampering or abuse will not be accepted as a warranty return.

**C.5 GRAPHICS VIDEO CONTROLLER  
OPTION MANUAL  
(TI PART NO. 2223207- 0001)**

**Preface**

This manual provides the user or technician with information necessary for installing and using the

Graphics Video Controller Option. After the option has been installed, you should file this manual in Chapter 5 of your *Texas Instruments Professional Computer Operating Instructions* (TI Part No. 2223116-0001). Specific instructions concerning the use of this option may be found in the *Texas Instruments Professional Computer MSTM-BASIC Manual* (TI Part No. 2223157-0001). You can also find a copy of this and all other option manuals in Appendix C of the *Texas Instruments Professional Computer Maintenance Handbook* (TI Part No. 2223200-0001).

This manual is divided into three chapters.

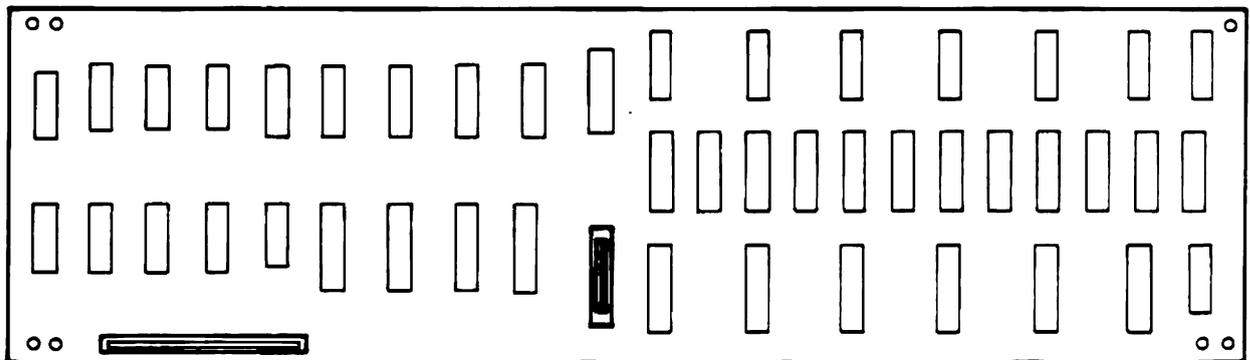
Chapter 1 describes the option, lists the tools required for installation and removal, and provides a checklist in case of difficulties.

Chapter 2 contains step-by-step instructions for installing the option and describes the checkout procedure.

Chapter 3 discusses the procedures for removing the option.

**C.5.1 Chapter 1 - Introduction**

This chapter describes the graphics video controller option, provides part number information for the option kit and kit components, and lists the tools required for installing the option.



2223236-1

**Figure C-43. Graphics Video Controller Board**

**C.5.1.1 Purpose.** The graphics video controller option provides a complete high density graphics capability. It provides a graphics resolution of 720 (horizontal) by 300 (vertical) picture elements (pixels) for 60 Hertz systems, and 720 by 350 pixels for 50 Hertz systems.

**C.5.1.2 Description.** Two option kits are available. One option kit provides two-color graphics

with a single plane of screen memory. The second provides a full eight-color graphics board with three planes of memory which may be mapped to any combination of red, blue, and green. Each graphics video controller option kit includes a printed wiring board and an option manual. Both option kits may be used with either a color or monochrome display. The TI Part Numbers for the graphics video controller option kits are listed in Table C-10.

**Table C-10. Graphics Video Controller Option Kit Part Numbers**

TI Part No.	Description
2223236-0001	Option Kit, Graphics Video Controller
consisting of: 2223061-0001 2223207-0001	Graphics Video Controller Board - 1 Plane Option Manual, Graphics Video Controller
2223236-0002	Option Kit, Graphics Video Controller
consisting of: 2223061-0002 2223207-0001	Graphics Video Controller Board - 3 Planes Option Manual, Graphics Video Controller

**C.5.1.3 Tool Requirements.**

- Medium-size flat-bladed screwdriver
- 1/4-in nutdriver (optional tool for installing the option board retaining screw)
- Small pair of needle-nose pliers

**C.5.1.4 In Case You Have Problems....** If you have any operating difficulty after installing the option, you should check for the following conditions.

- Improper seating of the option board in its socket
- Loose connectors, or improper cable hookup
- Another option which you may have loosened from its socket

**C.5.2 Chapter 2 - Installation**

**C.5.2.1 Preliminary Steps.** Before attempting to install this option, complete the following steps.

1. Be sure there is sufficient working space available. You will be turning the system unit to gain access to the back panel, and you will need space beside the system unit (with the cover removed) to place the display unit temporarily for installation checkout.
2. Make certain the Texas Instruments Professional Computer is operational. This may be done in the following manner.
  - Insert a diagnostics diskette in the left drive and close the door

- Place the system unit ON/OFF switch in the ON position (the self-test will be executed and the diagnostics menu will be displayed)
- Select the Overall Unit Test and follow the procedures outlined in the *Texas Instruments Professional Computer Operating Instructions*.

Do not attempt to install this option unless this test is successfully completed.

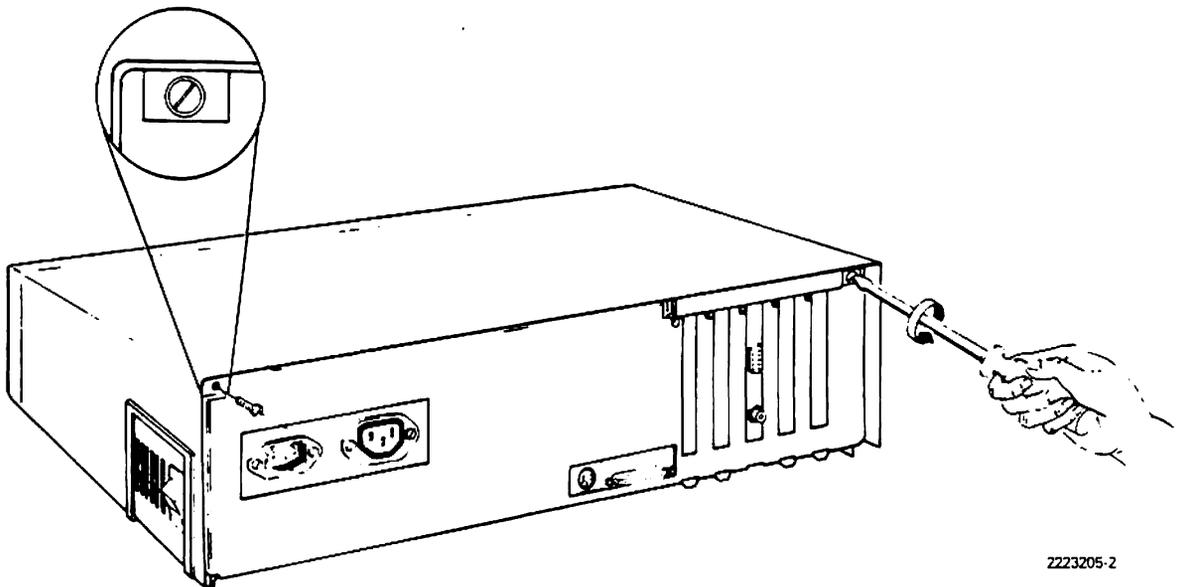
3. Place the system unit ON/OFF switch in the OFF position and remove the system unit power cord from the ac receptacle.
4. Disconnect the following:
  - System unit power cord
  - Display unit power cord
  - Display unit signal cable
  - Keyboard cable
  - Any peripheral cables connected to the system unit

5. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any additional equipment to the side, away from the system unit.

### CAUTION

**Static electricity can be destructive to static-sensitive components mounted on the graphics video controller board. Before touching any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table. Care must be used in handling the graphics video controller board. We recommend that the board assembly be left IN THE ANTISTATIC PACKING BAG until you are ready to install it.**

6. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner using a flat-bladed screwdriver. See Figure C-44 for the locations of these screws.

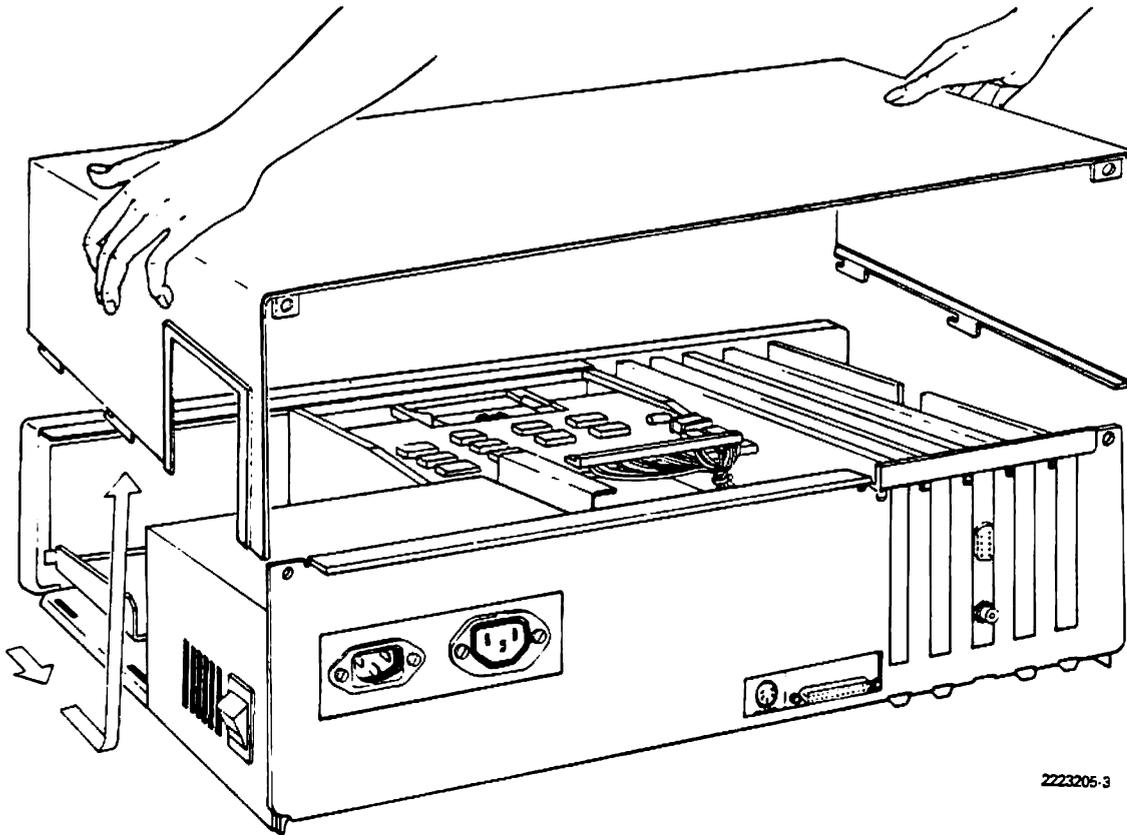


2223205-2

Figure C-44. Removing the Cover Screws

7. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit.

Set the cover aside, out of the way. See Figure C-45.

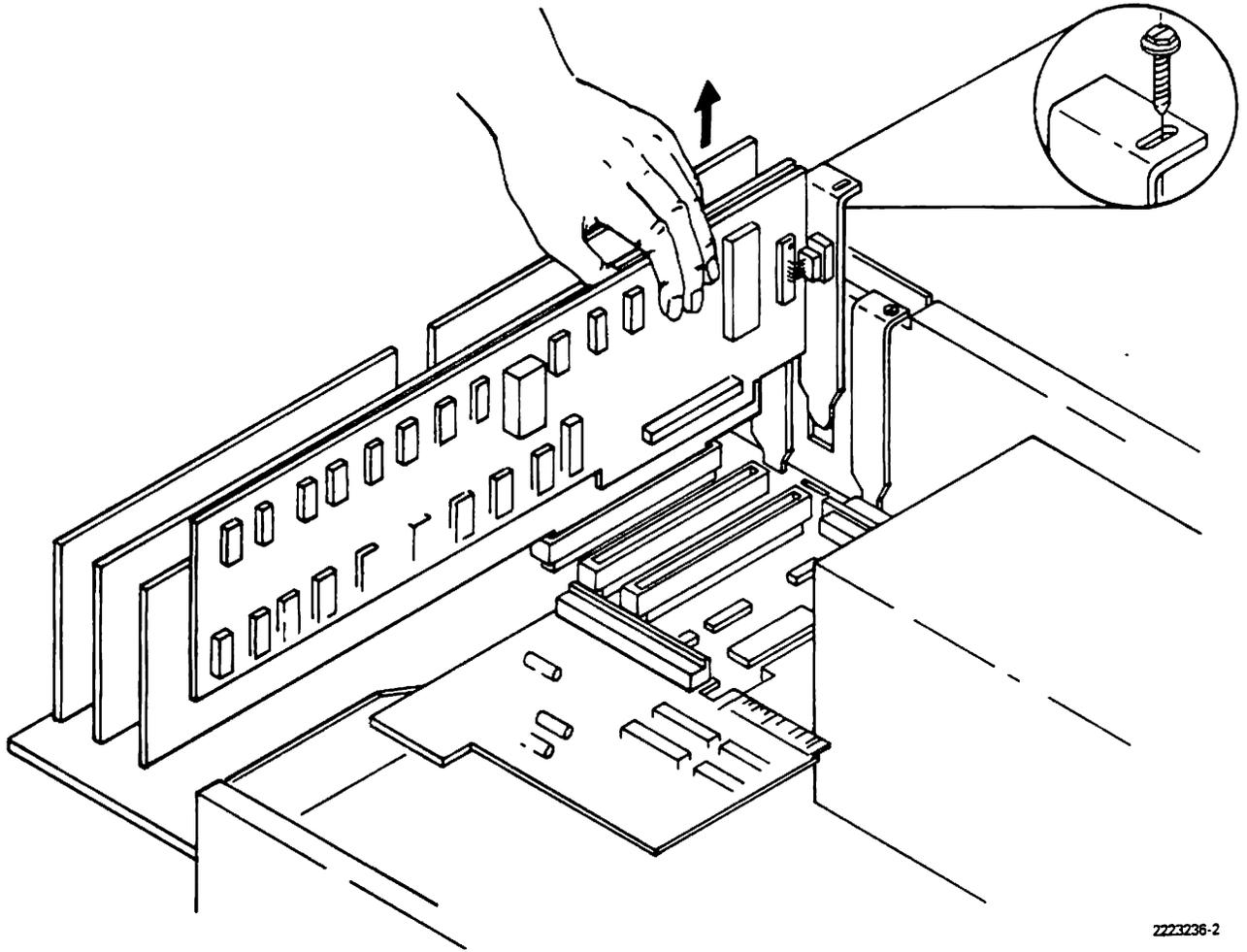


2223205-3

**Figure C-45. Removing the Cover**

**C.5.2.2 Installation Procedure.** The graphics video controller board must be installed in piggy-back fashion onto existing connectors on the CRT controller board. The CRT controller option board may be plugged into any of the five card-edge connector positions available, but Texas Instruments recommends using position J2, J3, or J4. Installation is simple and straightforward; just follow this step-by-step procedure.

1. Remove the CRT controller board from its socket by using a flat-bladed screwdriver or a 1/4-inch nutdriver to remove the screw which secures the CRT controller board rear panel. See Figure C-46. The screw must be saved for use in step 6. Place the CRT controller board on a smooth work surface, component side up.
2. Remove the graphics video controller board from its antistatic bag and inspect the pins on the component side of the board to ensure that none are bent or damaged.
3. Align the spacer "feet" so they are parallel with the longest dimension of the graphics video controller board.
4. Carefully mate the pins on the CRT controller board with the sockets on the graphics video controller board. Press the two boards together. Make certain that all pins are properly seated in their corresponding sockets, and all support spacers are properly seated in their matching holes on the graphics video controller board. Check to make certain that all four spacers lock on both boards, and that all connections are secure. See Figure C-47.



2223236-2

**Figure C-46. Removing the CRT Controller Board**

5. Gently insert the CRT controller board with the graphics video controller board attached, into the selected card-edge connector on the system unit board. Use the guide on the front panel of the system unit and the slot on the rear of the system unit chassis to align the board during insertion.

6. Align the hole on the back plate of the CRT controller board with the corresponding hole on the back panel of the system unit. Install the screw removed in step 1 in the location shown below and tighten, using a flat-bladed screwdriver or a 1/4-in nutdriver. See Figure C-48.

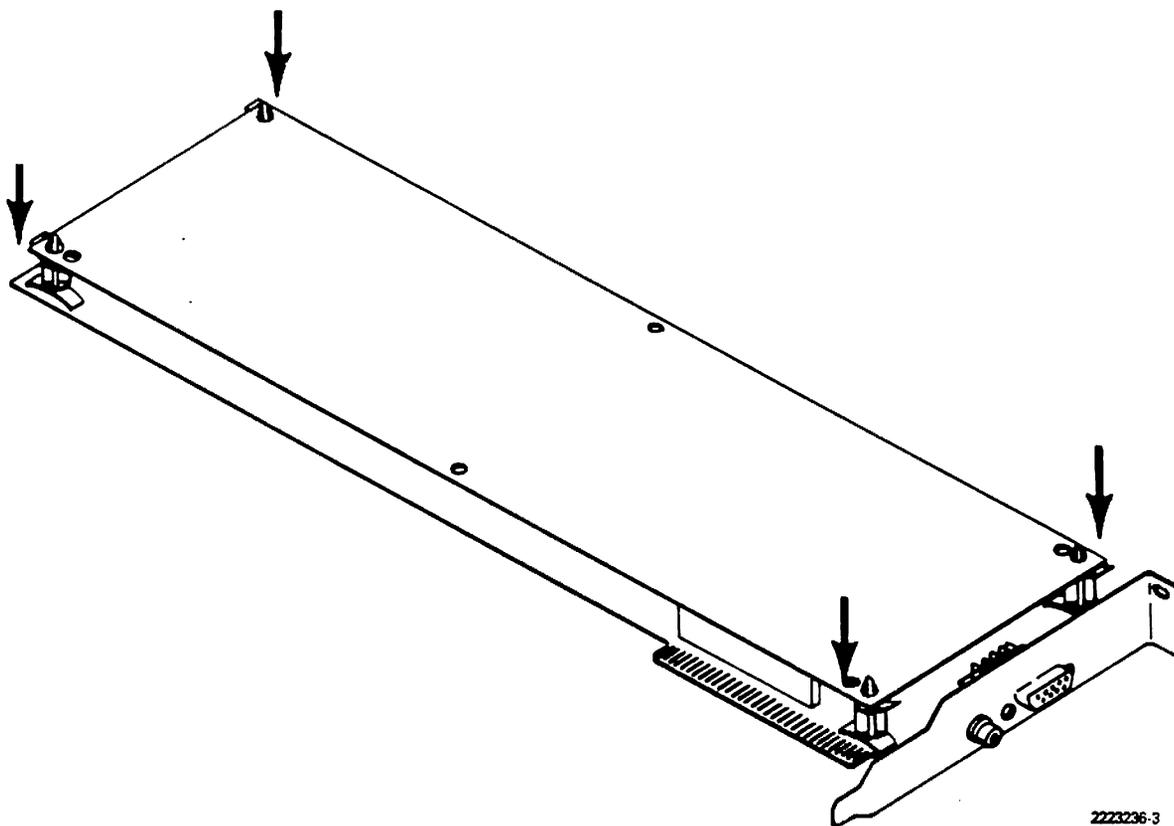
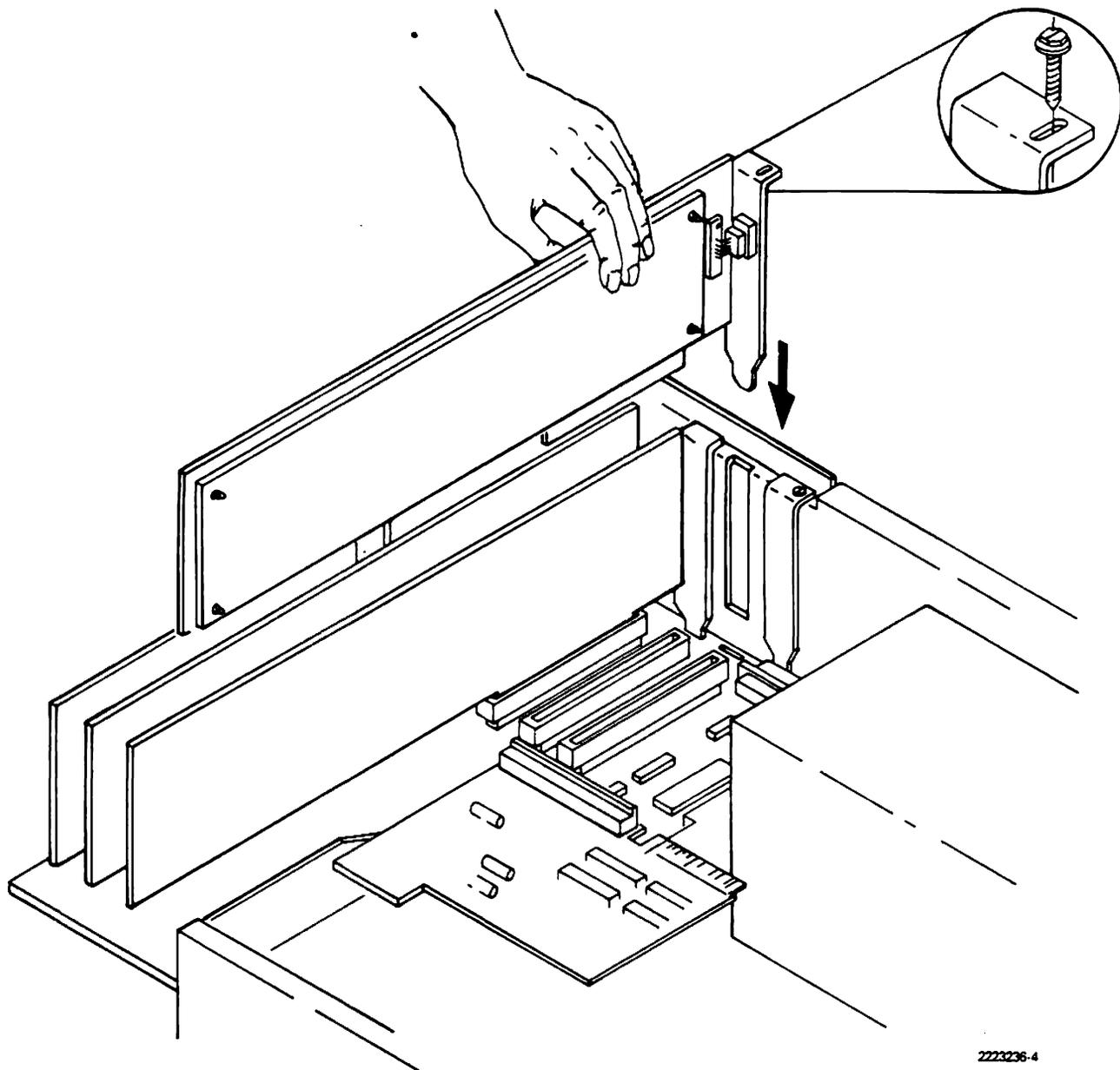


Figure C-47. Installing the Option Board



223236-4

**Figure C-48. Inserting Boards in the System Unit**

**C.5.2.3 Installation Checkout.** Before replacing the system unit cover, check the installation one more time, and plug everything in for an operational check.

### CAUTION

**With the system unit cover open and power applied, the system unit board and diskette drive logic boards are exposed. Make certain that no tools, test probes, or other metallic items come in contact with any exposed components. Damage to the unit may result.**

1. Reconnect the following:
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
2. With the system unit ON/OFF switch in the OFF position, plug the system unit power cord into an ac receptacle.
3. Place a diagnostics diskette in the left drive. Close the drive door.
4. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the diagnostics menu is displayed.
5. Select the Overall Unit Test. At the beginning of the test, the system configuration table is displayed. Check the display to ensure the display shows either "1 Graphics plane" or "3 Graphics Planes," indicating the correct option type is displayed. The memory of each of the installed graphics planes is tested. If a single plane board is installed, the following error messages are displayed:

CRT GRAPHICS test: loop xxxxx: RAM BANK B not installed - 0111  
CRT GRAPHICS test: loop xxxxx: RAM BANK C not installed - 0112

This is a normal response for a single-plane graphics video controller board.

6. Place the system unit ON/OFF switch in the OFF position and turn the system unit so that the rear panel is facing you. Remove all cables and cords from the back of the system unit.
7. Replace the system unit cover by gently lowering it into place, and sliding it toward the front panel, as shown in Figure C-49.
8. Replace the two screws which secure the system unit cover and tighten them. See Figure C-50.
9. Reconnect the following:
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
  - Any peripheral cables which you removed

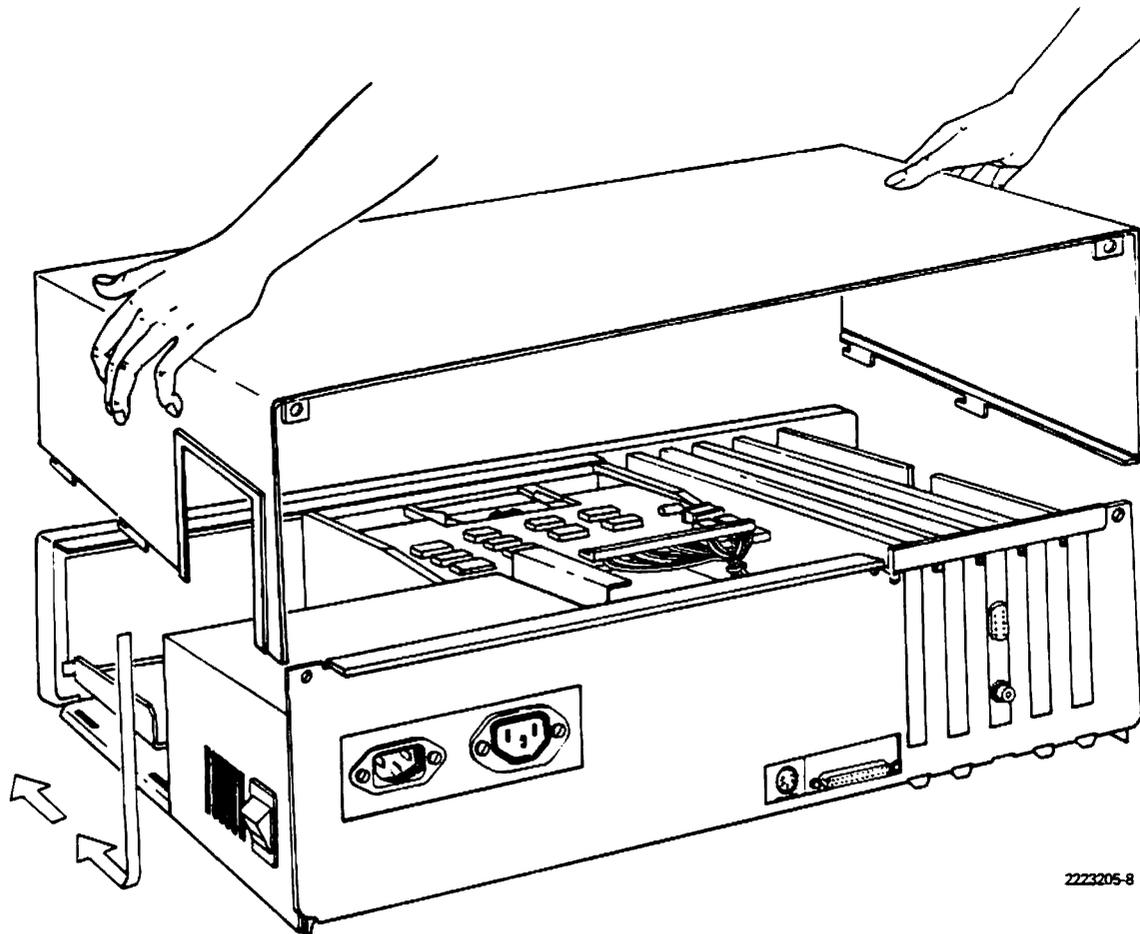
This concludes the installation and checkout of the graphics video controller board. Additional testing may be conducted, if desired, by performing the advanced diagnostics tests provided with the optional *Texas Instruments Professional Computer Maintenance Handbook*.

Instructions in the utilization of your graphics video controller board option are contained in the optional *Texas Instruments Professional Computer MSTM-BASIC Manual*.

### C.5.3 Chapter 3 - Option Removal

**C.5.3.1 Preliminary Steps.** Before attempting to remove the option, complete the following steps.

1. If you wish to check the computer or option prior to removal, refer to the *Texas Instruments Professional Computer Operating Instructions* for checkout procedures using a diagnostics diskette.



**Figure C-49. Replacing the Cover**

2. Place the system unit ON/OFF switch in the OFF position and remove the system unit power cord from the ac receptacle.
3. Disconnect the following:
  - System unit power cord
  - Display unit power cord
  - Display unit signal cable
  - Keyboard cable
  - Any other peripheral cables connected to the system unit
4. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any other peripherals to the side, away from the system unit.
5. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner with a flat-bladed screwdriver. See Figure C-51 for the locations of the screws.
6. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit. Set the cover aside, out of the way. See Figure C-52.

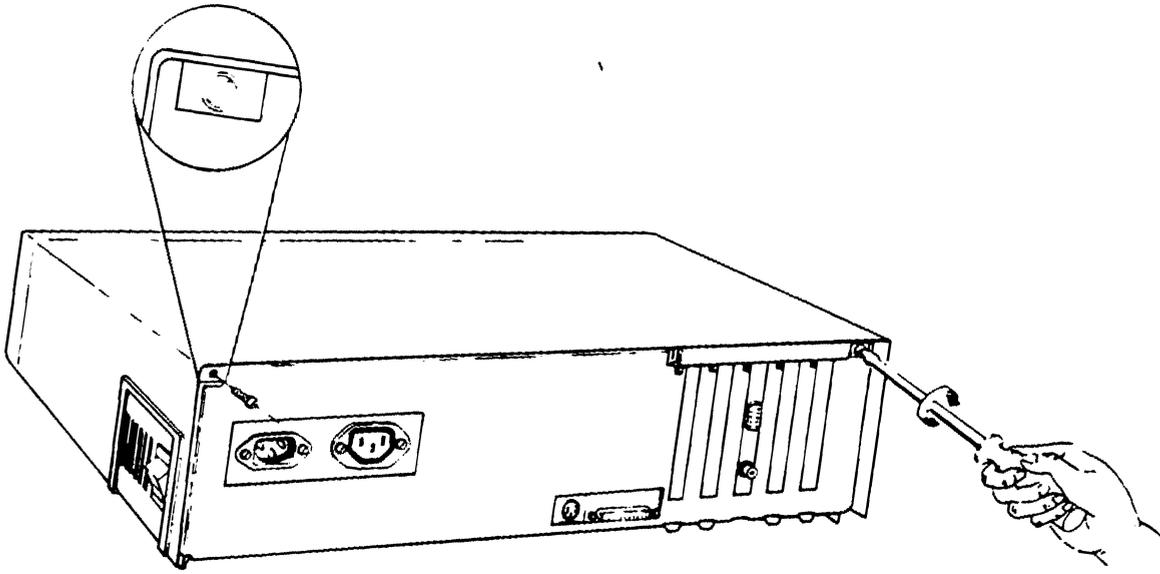


Figure C-50. Tightening the Cover Screws

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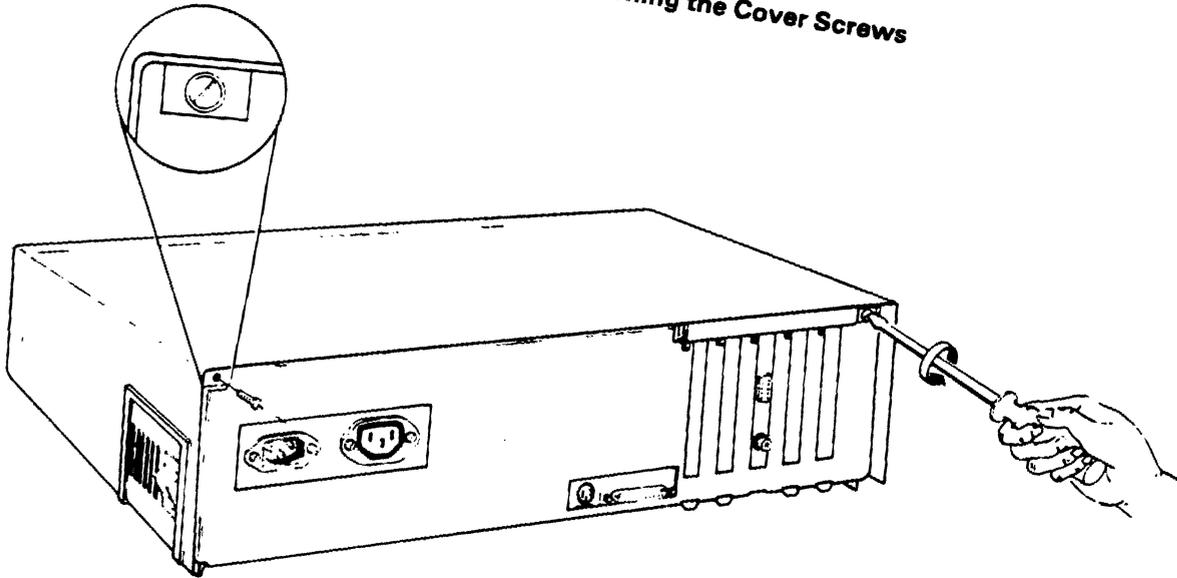


Figure C-51. Removing the Cover Screws

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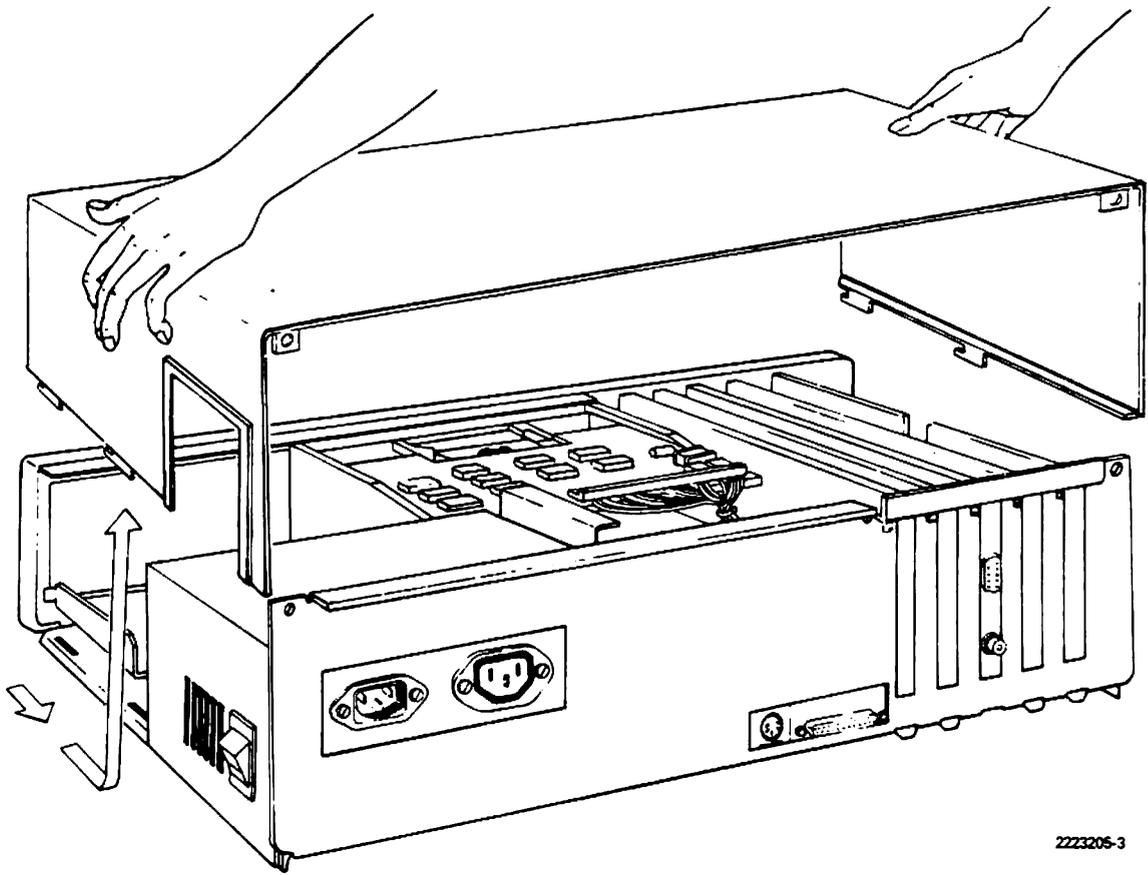


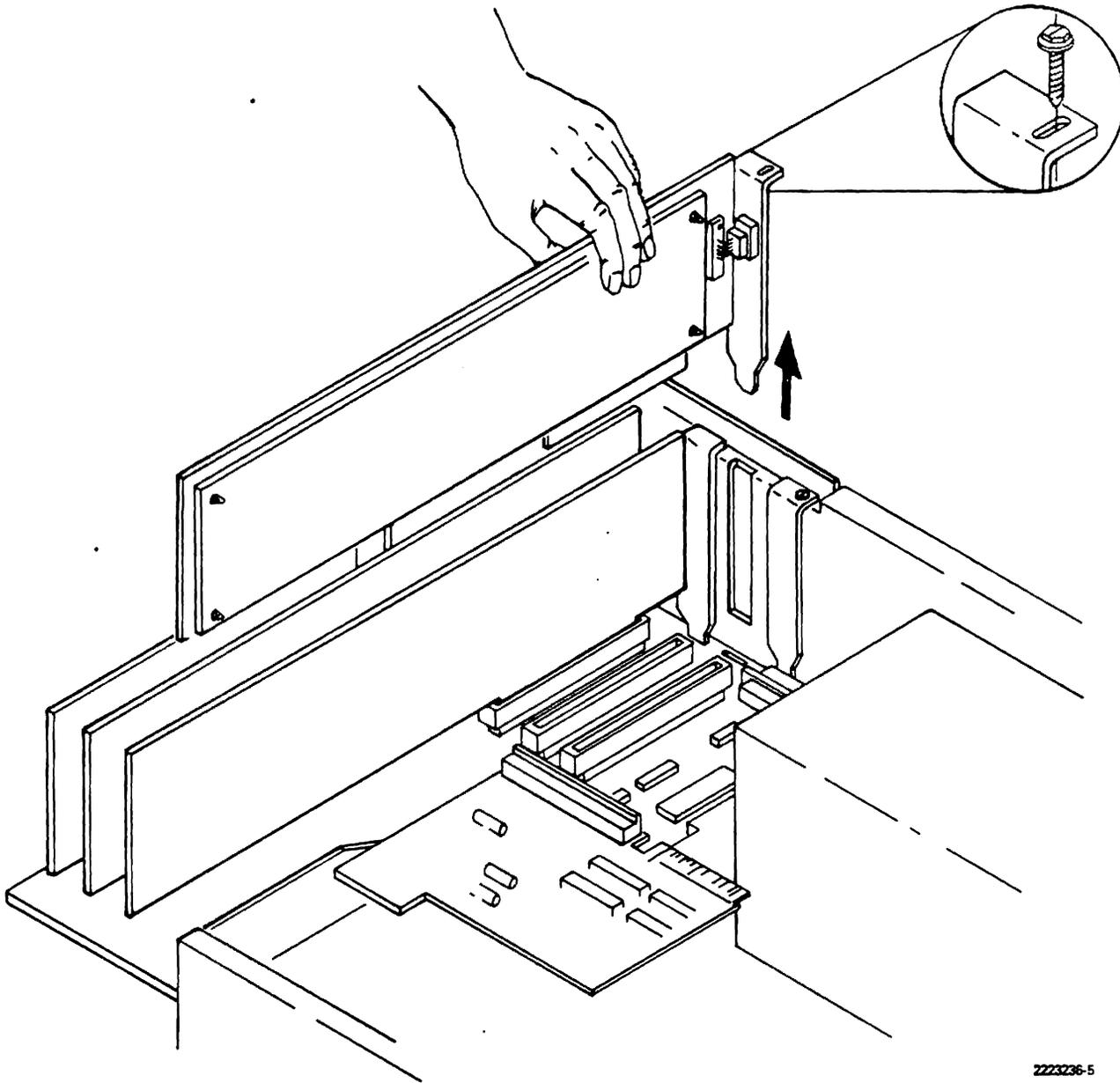
Figure C-52. Removing the Cover

### C.5.3.2 Removal Procedure.

#### CAUTION

Static electricity can be destructive to static-sensitive components mounted on the graphics video controller board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.

1. Using a flat-bladed screwdriver or 1/4-inch nutdriver, remove the screw securing the option plate assembly to the rear panel of the system unit. The screw must be retained for use in step 6.
2. Firmly hold the CRT controller board with the graphics video controller board mounted piggy-back, and gently lift them straight up, out of the socket. See Figure C-53.
3. Remove the graphics video controller board from the CRT controller board by squeezing the plastic support spacers located in each corner of the board, and at the same time pulling the option board away from the CRT controller board. A small pair of needle-nose pliers is useful for compressing the spacer locking tabs. Use care, the boards are joined by two multipin connectors. DO NOT BEND THE PINS. See Figure C-54.
4. Place the board in an antistatic bag. If no antistatic bag is available, a sheet of aluminum foil may be wrapped around the board.



2223236-5

**Figure C-53. Option Board Removal**

**NOTE**

If the graphics video controller board is being removed due to a fault, and a replacement board is being inserted, follow the installation instructions in Chapter 2. Use the antistatic bag from the replacement board to store the board being removed.

5. Gently reinstall the CRT controller board into the card-edge connector in the system unit. Use the guide on the front panel and the slot on the rear of the system unit chassis to align the board during insertion.

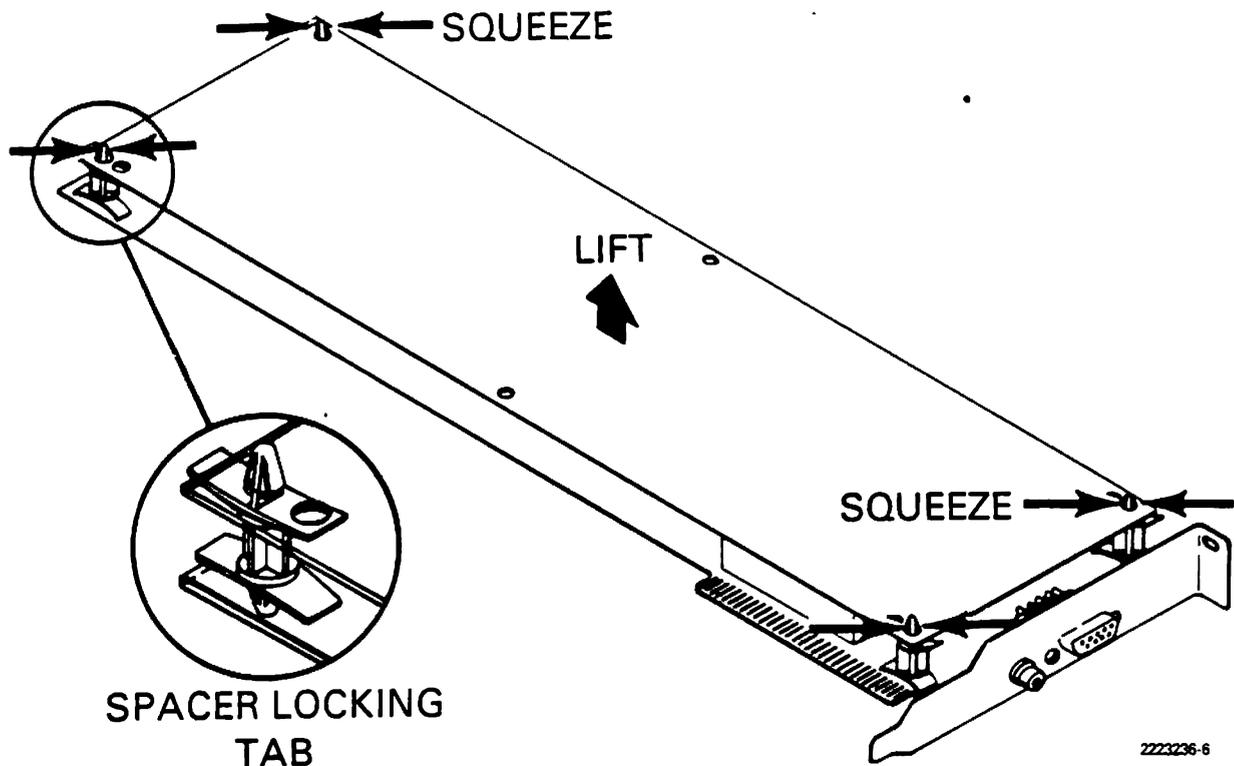


Figure C-54. Option Board Removal

6. Align the hole on the back plate of the CRT controller board with the corresponding hole on the back panel of the system unit. Install the screw removed in step 1 in the location shown below and tighten, using a flat-bladed screwdriver or a 1/4-in nutdriver. See Figure C-55.

**CAUTION**

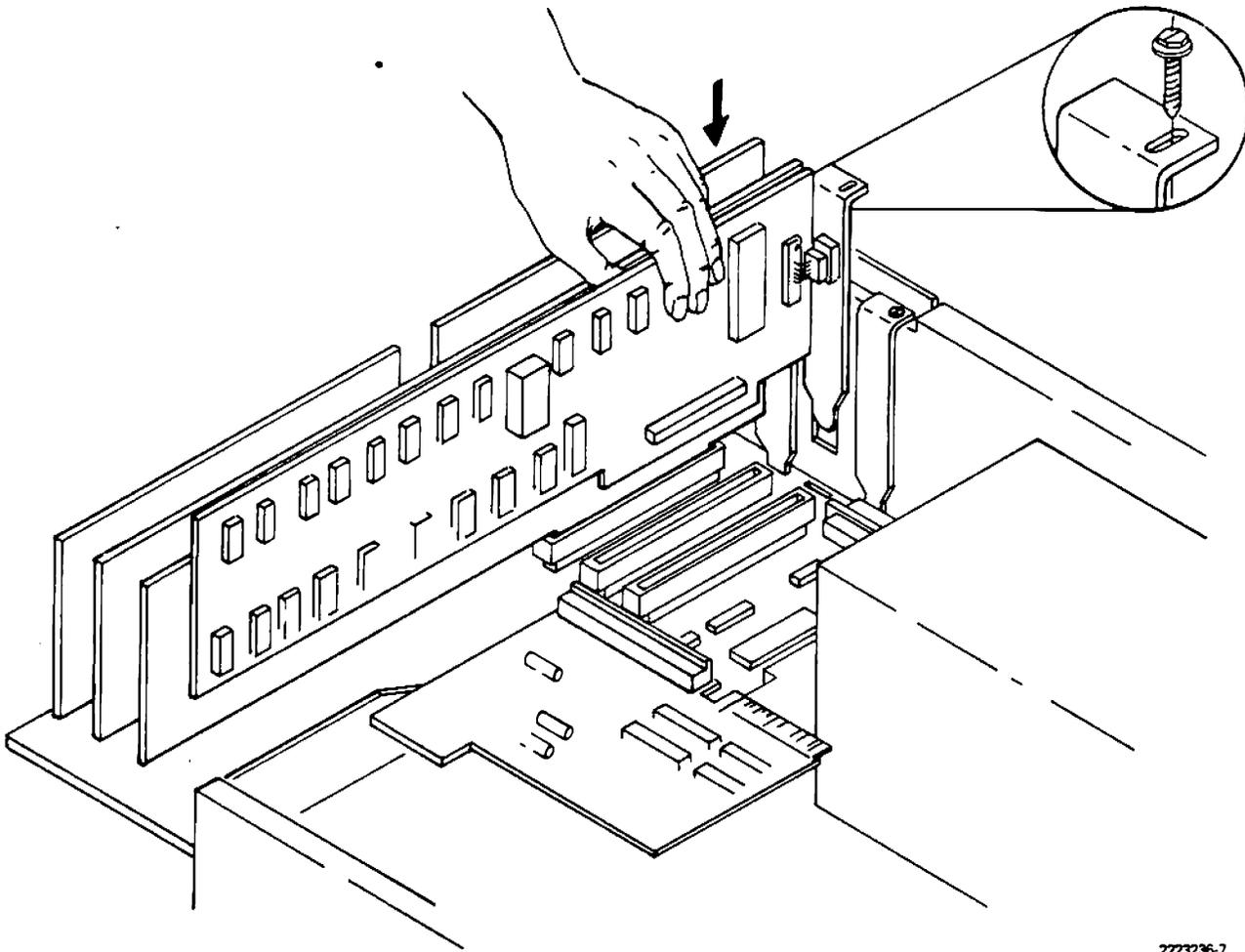
With the system unit cover open and power applied, the system unit board and diskette drive logic boards are exposed. Make certain that no tools, test probes, or other metallic items are permitted to come in contact with any exposed components. Damage to the unit may result.

7. Reconnect the following:

- Keyboard cable
- Display unit signal cable
- Display unit power cord
- System unit power cord

Do not plug the system unit power cord into an ac receptacle yet.

8. With the system unit ON/OFF switch in the OFF position, plug the system unit power cord into an ac receptacle.
9. Place a diagnostics diskette in the left drive. Close the drive door.



2773236-7

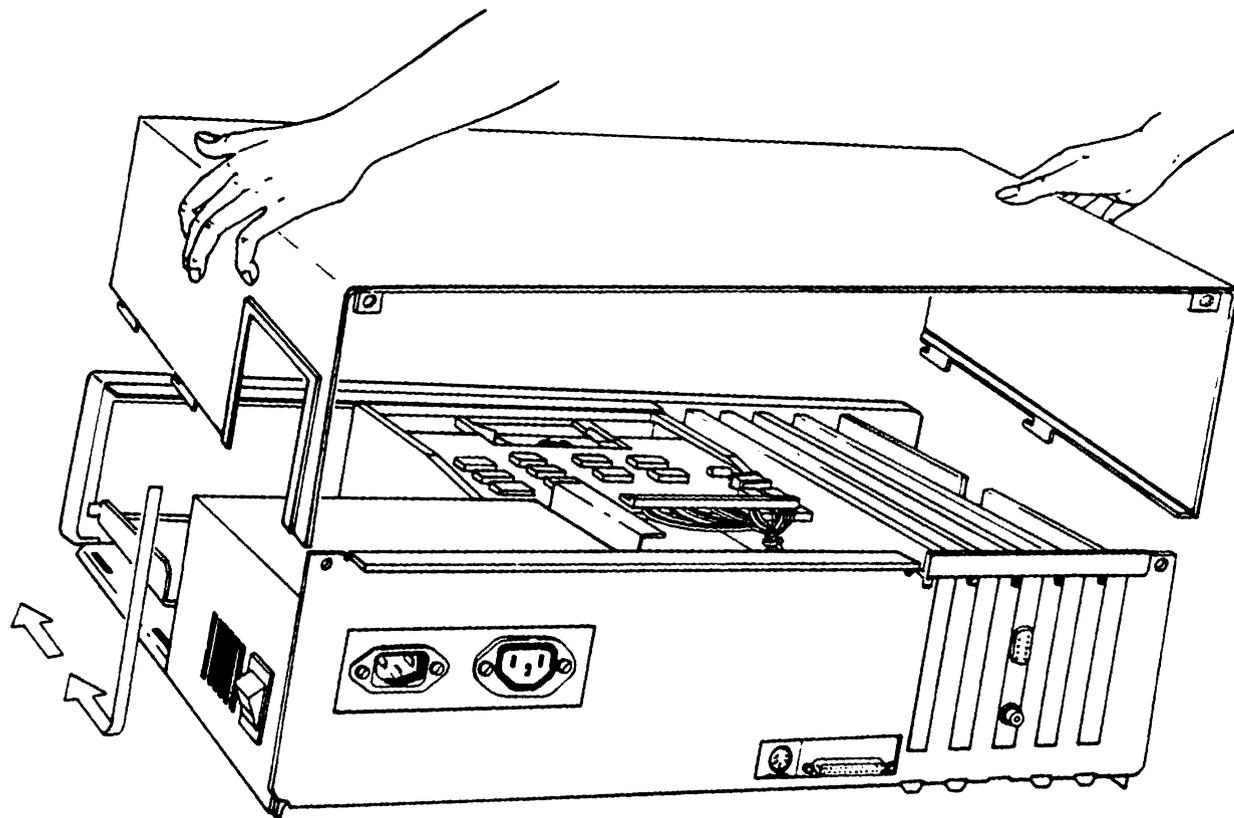
**Figure C-55. CRT Controller Board Installation**

10. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the diagnostics menu is displayed.

**NOTE**

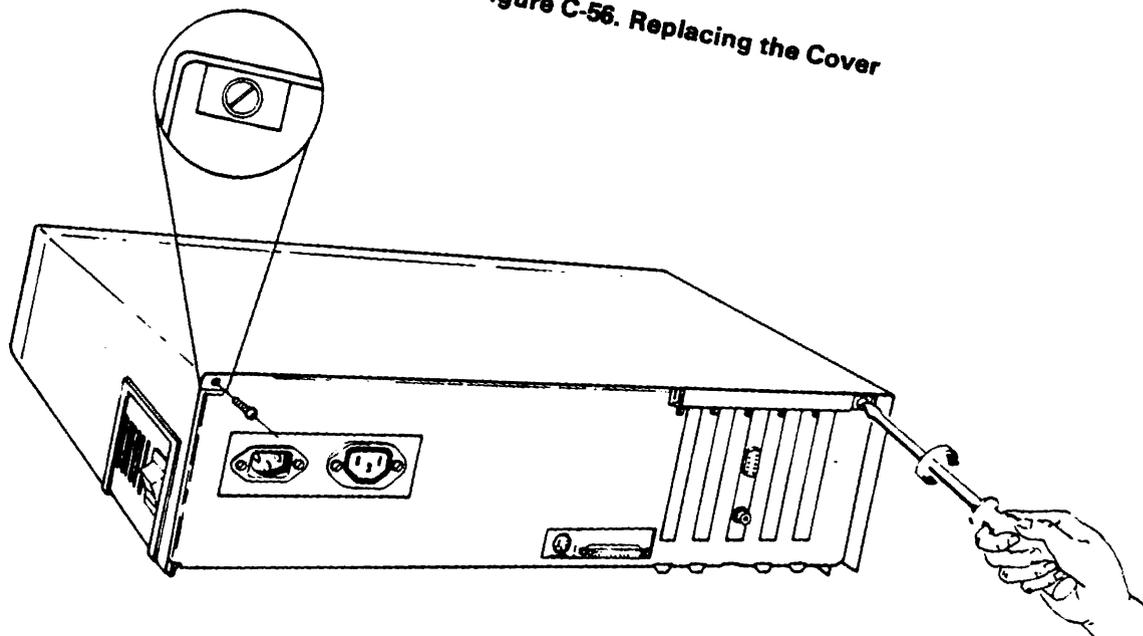
Failure to successfully complete the self-test indicates that the computer is not operating properly and may require additional service. Review the user diagnostics procedures outlined in the *Texas Instruments Professional Computer Operating Instructions* and run the diagnostics diskette. If the fault recurs, contact your local Texas Instruments Authorized Dealer for additional information.

11. Select the Overall Unit Test. At the beginning of the test, the system configuration is displayed.
12. Place the system unit ON/OFF switch in the OFF position. Remove all cords and cables from the back of the system unit.
13. Turn the system unit so that its rear panel is facing you. Replace the system unit cover by gently lowering it into place, and then sliding it toward the front panel, as shown in Figure C-56.
14. Replace the two screws which secure the system unit cover and tighten. See Figure C-57.



2223205-9

Figure C-56. Replacing the Cover



2223205-9

Figure C-57. Tightening the Cover Screws

15. Reconnect the following:

- Keyboard cable
- Display unit signal cable
- Display unit power cable
- System unit power cord
- Any peripheral cables which you removed

**C.6 COLOR DISPLAY UNIT**  
(TI PART NO. 2223255-0001)

**Preface**

This manual provides the user or technician with information necessary for installing and using the Color Display Unit option. After the option has been installed, you should file this manual in Chapter 5 of your *Texas Instruments Professional*

*Computer Operating Instructions* (TI Part No. 2223116-0001). You can also find a copy of this and all other option manuals in Appendix C of the *Texas Instruments Professional Computer Maintenance Handbook* (TI Part No. 2223200-0001).

This manual is divided into three chapters.

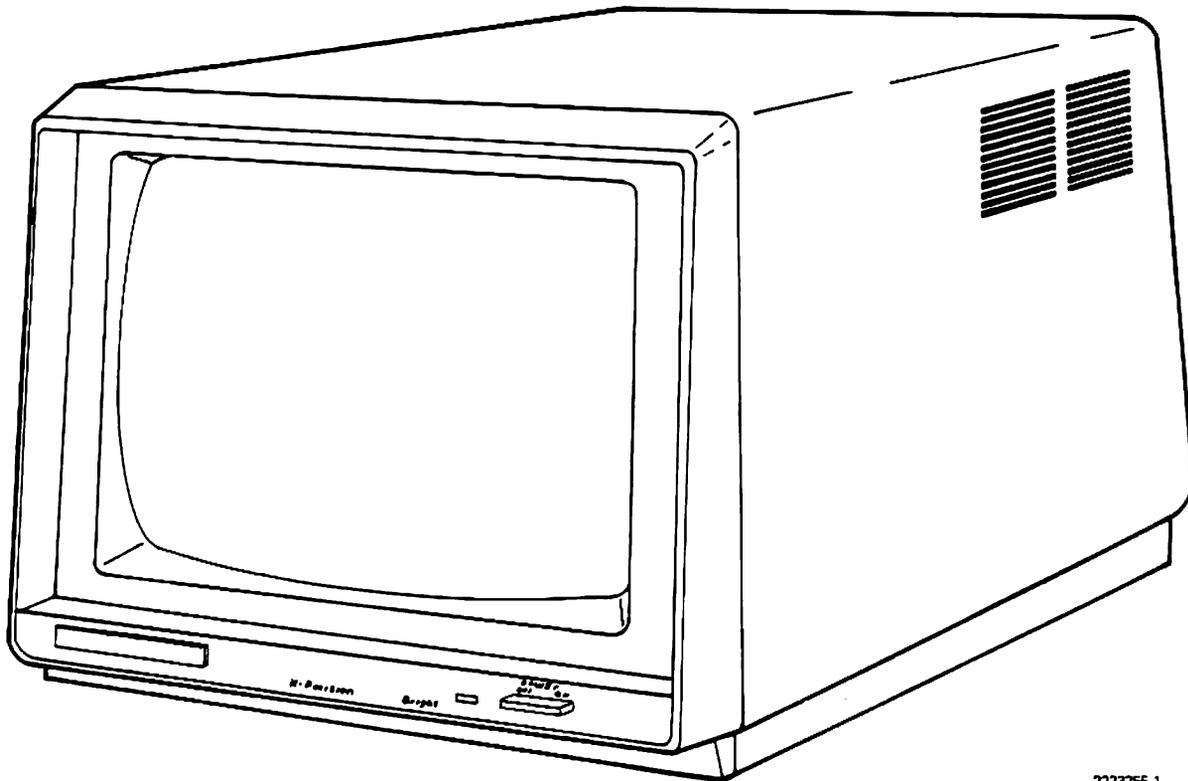
Chapter 1 describes the option and provides a checklist in case of difficulties.

Chapter 2 contains step-by-step instructions for installing the option and describes the checkout procedure.

Chapter 3 discusses the procedures for removing the option.

**C.6.1 Chapter 1 - Introduction**

This chapter describes the color display unit option and contains part number information for the option kit and kit components. The color display unit is shown in Figure C-58.



2223255-1

**Figure C-58. Color Display Unit**

**C.6.1.1 Purpose.** The color display unit option permits the display of high-resolution colors. When used with the graphics video controller option kit, the color display unit produces high-quality raster and character graphics.

**C.6.1.2 Description.** The color display unit option kit consists of a color display unit, a cable assembly, and an option manual.

The color display unit option provides the following features:

- a 14-inch diagonal measurement high-resolution screen
- a red-green-blue (RGB) transistor-transistor logic (TTL) input
- a 25 line by 80 column display
- a graphics resolution of 720 horizontal by 300 vertical pixels (60 Hz)
- a 9-pin D-type video interface connector

TI Part Numbers for the color display unit option kit are listed in Table C-11.

**Table C-11. Color Display Unit Option Kit Part Numbers**

TI Part No.	Description
2223041-0001	Option Kit, Color Display Unit
consisting of: 2223219-0001	Color Display Unit (includes signal and power cables)
2223255-0001	Option Manual, Color Display Unit

**C.6.1.3 In Case You Have Problems....** If you have any operating difficulty after installing the option, you should check for the following conditions.

- The system unit ON/OFF switch is not in the ON position, or the system unit power cord is not firmly seated in its connector on the back of the system unit.
- The color video signal cable is not seated properly. Both ends of the cable must be firmly seated in their connectors. One

connector is on the back of the color display unit, the other is located on the back of the system unit, on the CRT controller board.

- The brightness control on the front panel may need to be adjusted by turning it clockwise to a point where all colors are visible.

## C.6.2 Chapter 2 - Installation

**C.6.2.1 Preliminary Steps.** Before attempting to install this option, complete the following steps.

1. Be sure there is sufficient working space available. You will be turning the system unit to gain access to the back panel, and you will need space beside the system unit to place the display unit temporarily for installation checkout.
2. Make certain your Texas Instruments Professional Computer is operational. This may be done in the following manner.

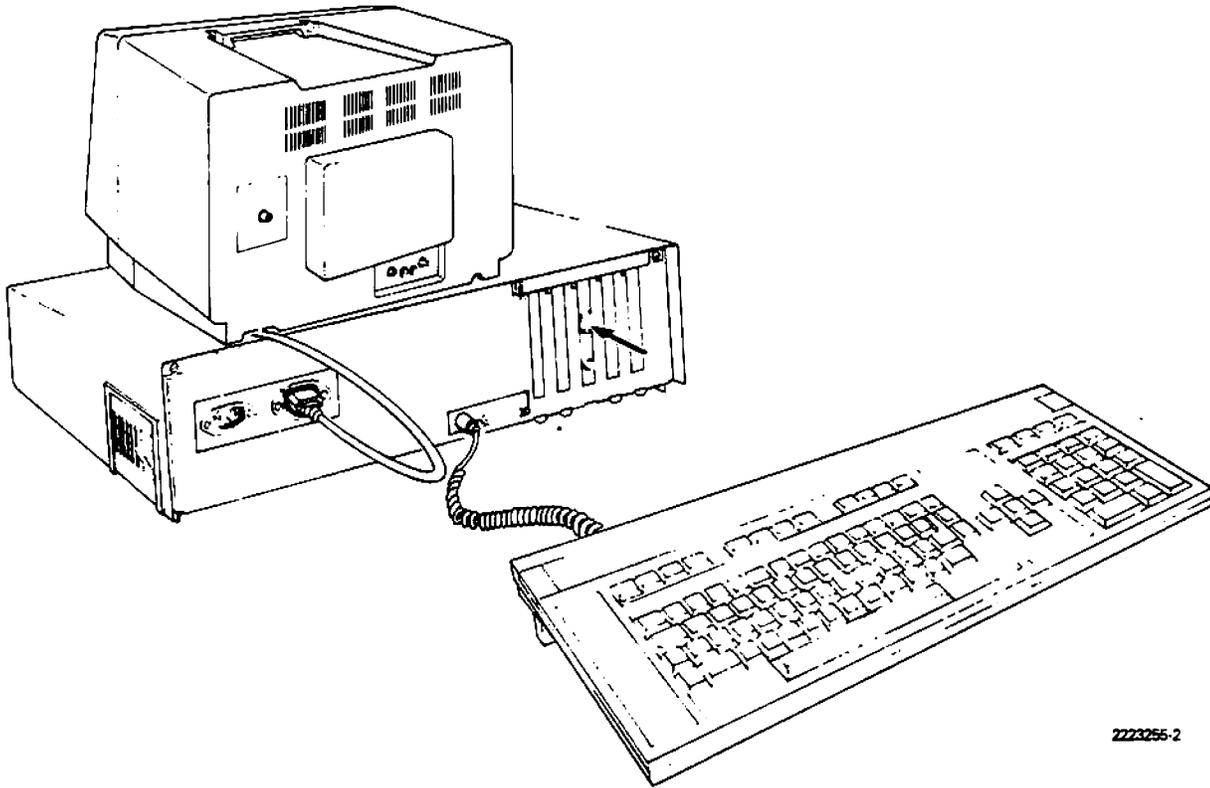
- Insert a diagnostics diskette in the left drive and close the door.
- Place the system unit ON/OFF switch in the ON position (the self-test will be executed and the diagnostics menu will be displayed.)
- Select the Overall Unit Test and follow the procedures outlined in the *Texas Instruments Professional Computer Operating Instructions*.

Do not attempt to install this option unless this test is successfully completed.

3. Place the system unit ON/OFF switch in the OFF position and remove the system unit power cord from the ac receptacle.

4. Disconnect the monochrome display unit signal cable from the back panel of the system unit. Study the panel from which you removed this cable. Notice the 9-pin D-type connector directly above the

connector for the monochrome display unit. This connector connects to the signal cable for the color display unit you will be installing. See Figure C-59.



223255-2

**Figure C-59. Connector Location for Color Display Unit**

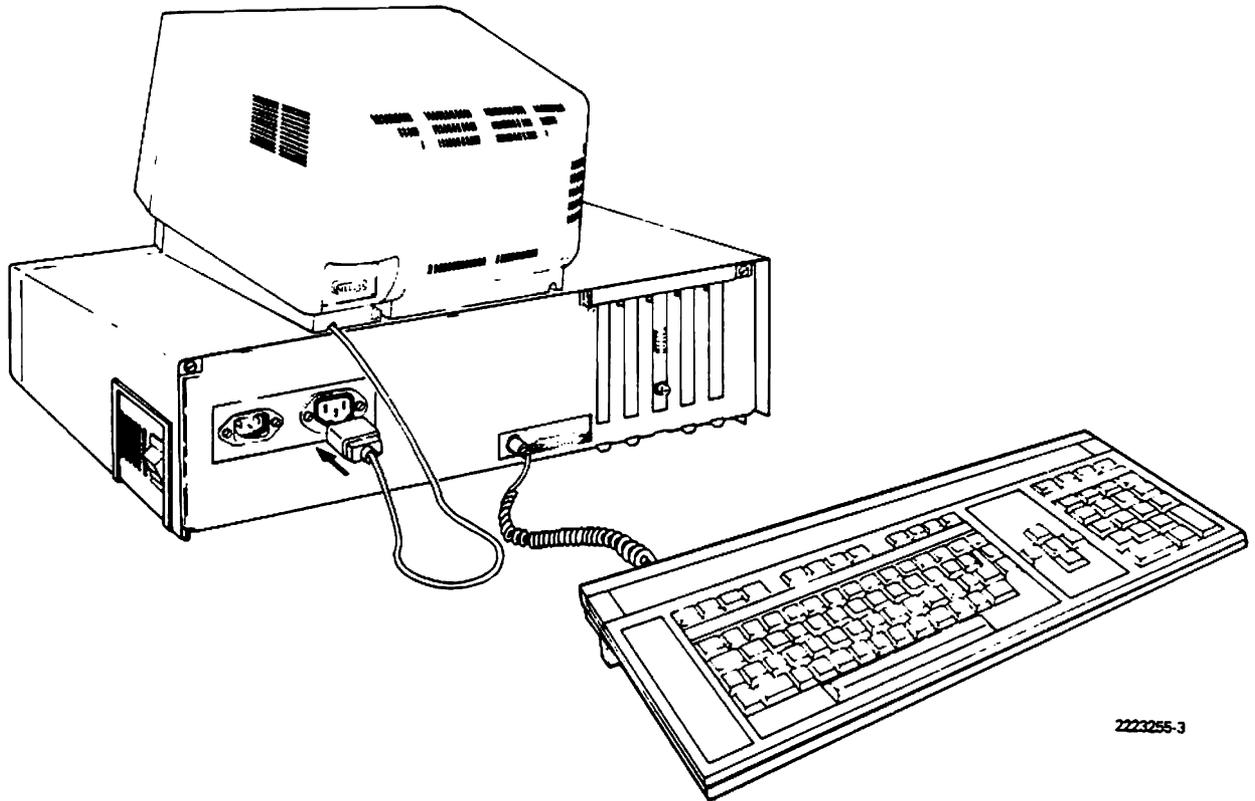
5. Remove the monochrome display unit from the top of the system unit and set it to the side, out of the way.

#### C.6.2.2 Installation Procedure.

##### **WARNING**

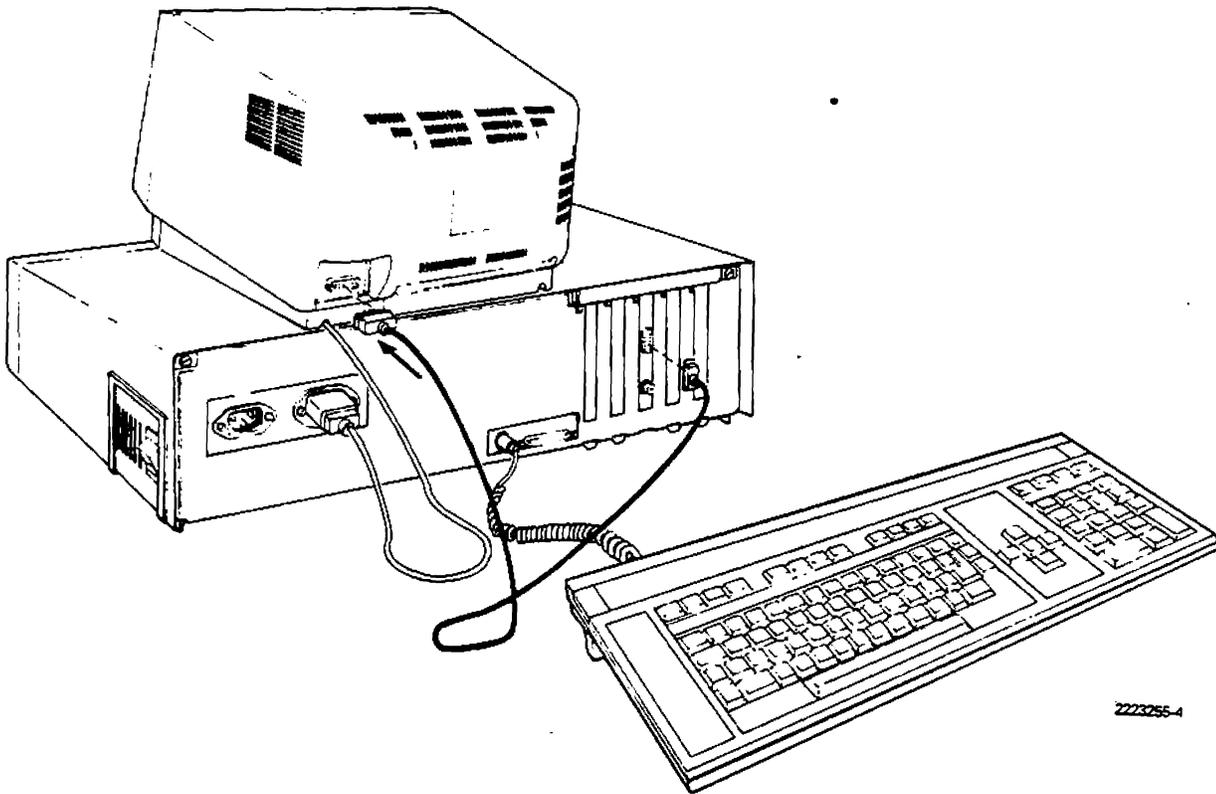
Use care when unpacking and handling the color display unit. The cathode ray tube (CRT) is under high vacuum. If the display unit is dropped or subjected to unusual abuse, the CRT can implode, causing personal injury and equipment damage.

1. Remove the color display unit from its shipping carton. We suggest you retain the carton and packing material for possible future use in transporting the display unit for relocation or service.
2. Locate the free end of the color display unit power cord and insert it into the ac receptacle on the back of the system unit. See Figure C-60.



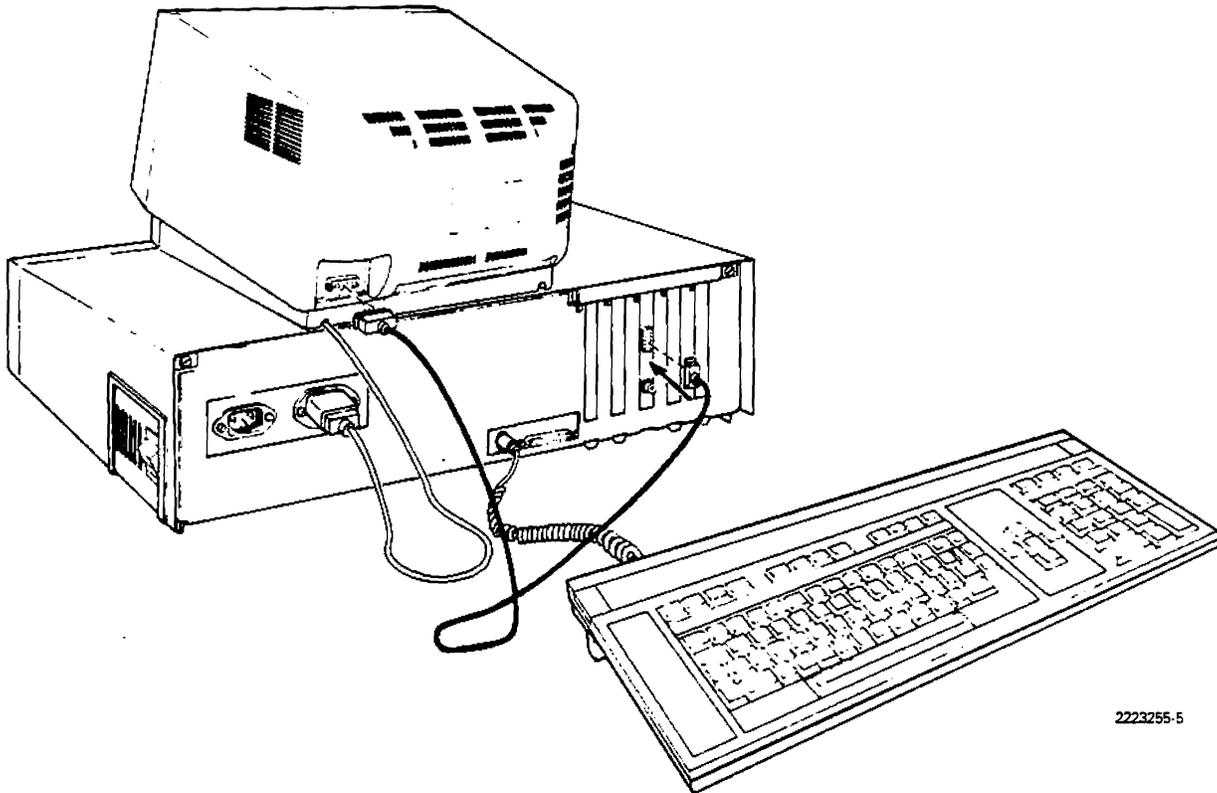
**Figure C-60. Plugging in the Power Cable**

3. Locate the color display unit signal and power cables. It has a 9-pin D-type connector which mates to a connector on the CRT controller board (located on the back panel of the system unit) and an 8-pin rectangular connector which mates to a connector on the back of the color display unit.
4. Connect the 8-pin rectangular connector to the back panel of the color display unit, as shown in Figure C-61.
5. Plug the free end of the signal cable to the 9-pin D-type connector on the CRT controller board (see preliminary step 3). The exact location which the CRT controller board occupies in your unit may differ somewhat from that shown in Figure C-62.



2223255-4

**Figure C-61. Connecting the Color Display Unit**

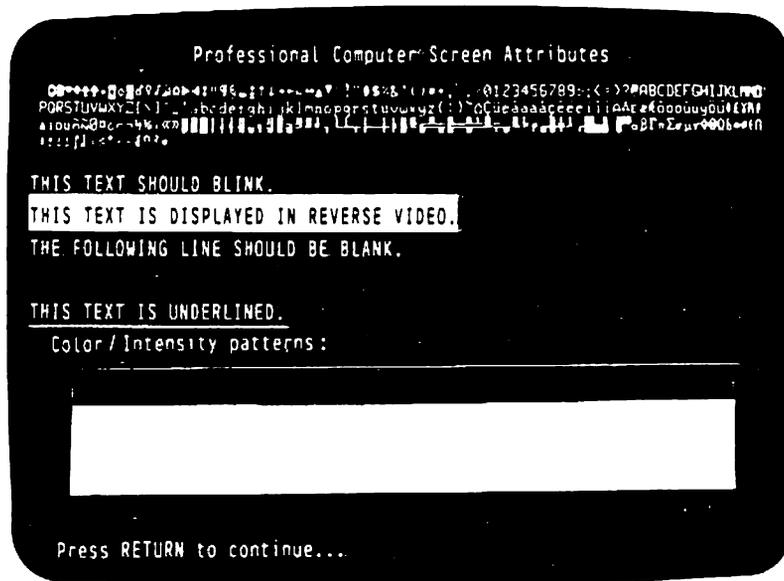


2223255-5

**Figure C-62. Inserting the Signal Cable Connector**

### C.6.2.3 Installation Checkout.

1. With the system unit ON/OFF switch in the OFF position, plug the system unit power cord into an ac receptacle.
2. Place the ON/OFF switch on the front of the color display unit in the ON position.
3. Place a diagnostics diskette in the left drive. Close the drive door.
4. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the diagnostics menu is displayed.
5. Select the Overall Unit Test. Proceed with the execution of the test until the CRT Attributes Test is displayed.
6. Observe the display on the CRT Attributes Test. Adjust the brightness control on the front panel if necessary. Your display should look like Figure C-63.



2223116-29

Figure C-63. CRT Attributes Test Display

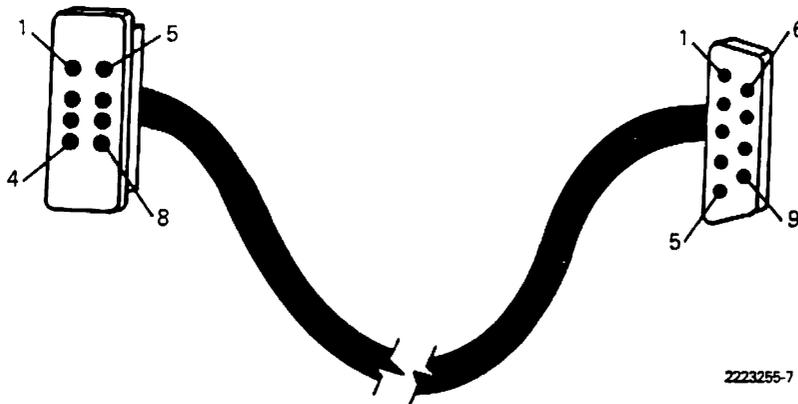
This concludes the installation and checkout of the color display unit. If you have any problems, review the installation steps again. If the problem persists, refer to the *Texas Instruments Professional Computer Operating Instructions* for problem resolution.

Figure C-64 identifies the signals and pin-outs of the color display unit signal cable.

### C.6.3 Chapter 3 - Option Removal

#### C.6.3.1 Preliminary Steps.

1. Place the system unit ON/OFF switch in the OFF position and remove the system unit power cord from the ac receptacle.



**Figure C-64. Signal Cable Signals**

2. Remove the color display unit from the top of the system unit and set it to the side.
3. Turn the system unit so that the back panel is facing you.
4. Remove the color display unit ac power cord from the back of the system unit. See Figure C-65.

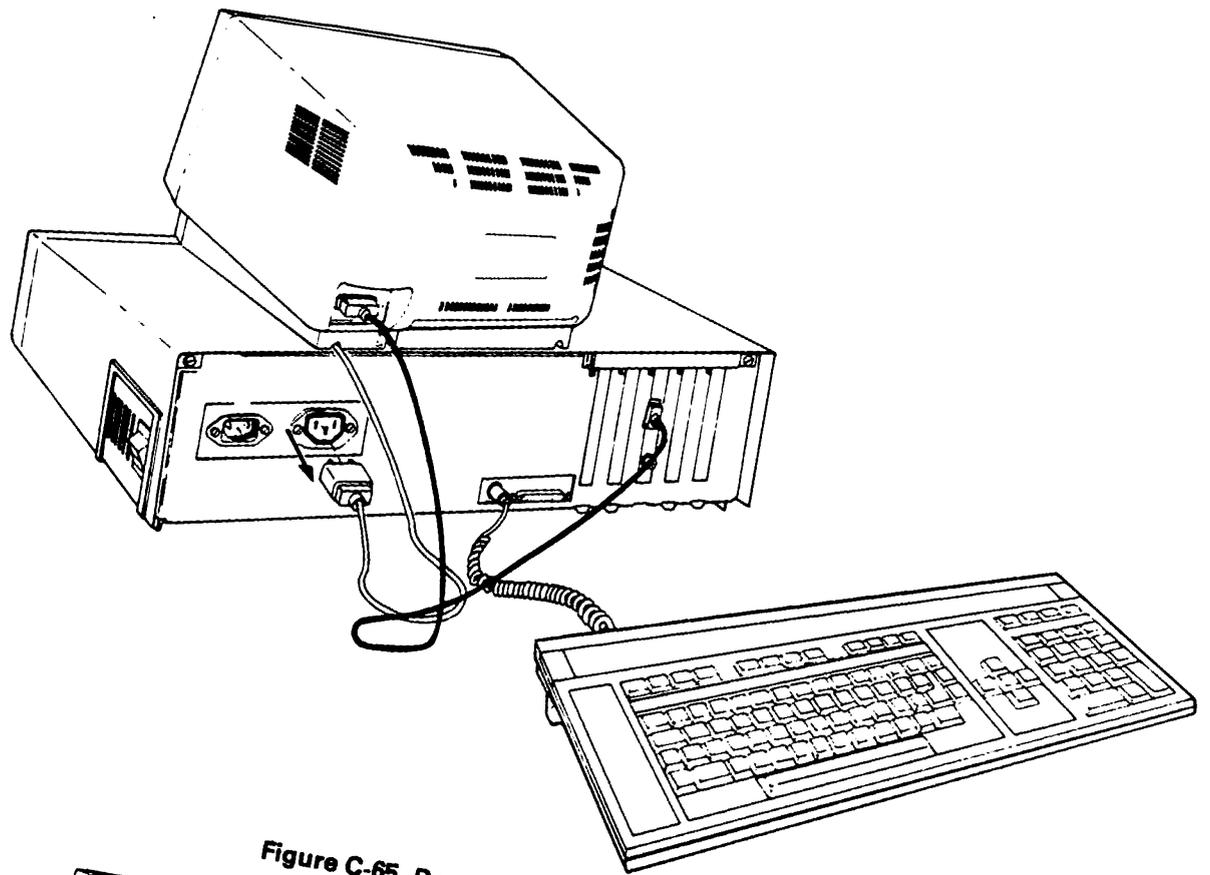
**C.6.3.2 Removal Procedure.**

1. Disconnect the color display unit signal cable from the CRT controller board, located on the back panel of the system unit. See Figure C-66.
2. Disconnect the color display unit signal cable from the back of the color display unit. Set it to the side, out of the way.
3. Pack the color display unit in its original packing carton, using the molded cushioning material for protection. If the original carton is not available, place adequate cushioning and packing material in the carton to protect the unit. Pack the color display unit signal cable in the carton with the display unit.
4. If a replacement color display unit is to be reinstalled, connect it, using the procedures in Chapter 2 of this manual. If a

monochrome display is replacing the color display unit, use the setup procedures in Chapter 2 of the *Texas Instruments Professional Computer Operating Instructions*.

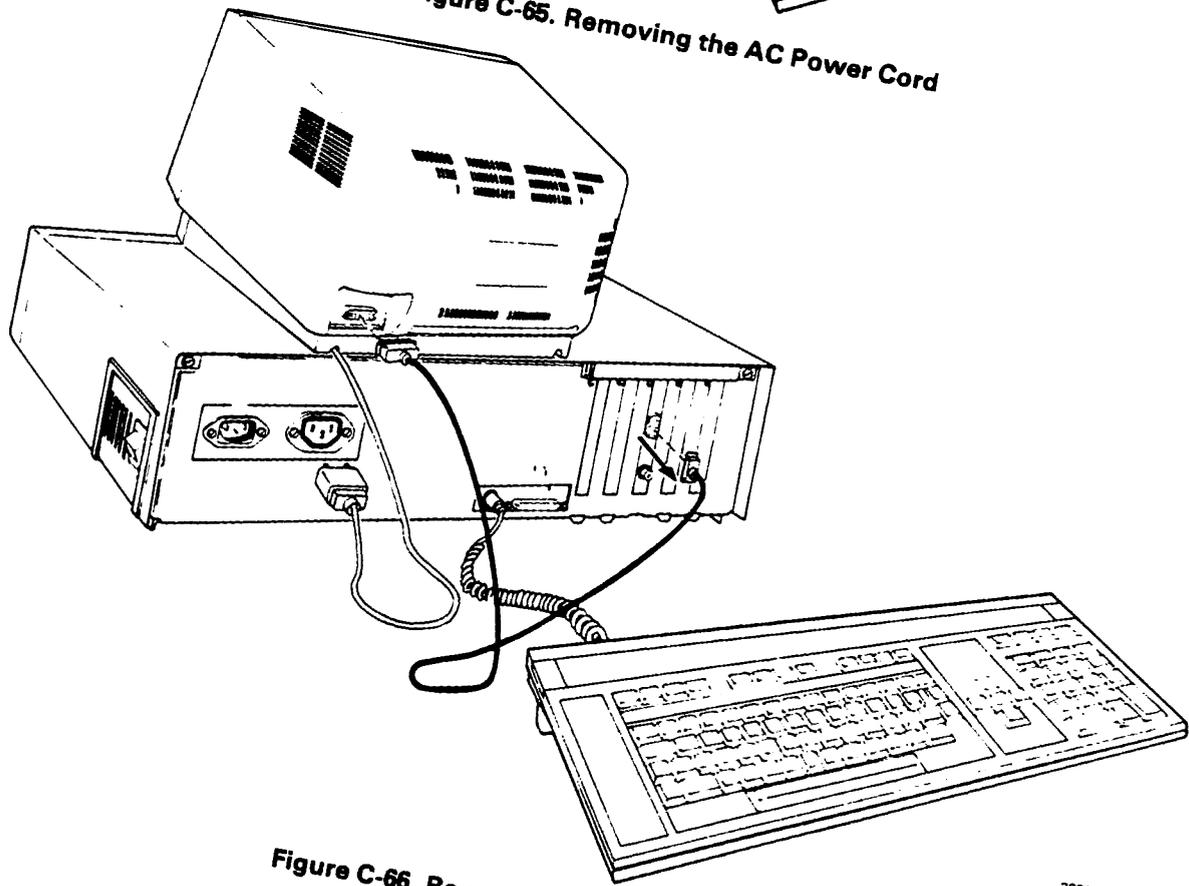
5. Plug the signal and power cables for the replacement display unit into its mating connector on the CRT controller board panel. The CRT controller board supports a monochrome or color display unit, or both.
6. Place a diagnostics diskette in the left drive. Close the drive door.
7. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the diagnostics menu is displayed. Select the Overall Unit Test.
8. Observe the CRT Attributes Test and adjust the controls on your replacement display unit for comfortable viewing.

Contact your local Texas Instruments Authorized Dealer for information concerning repairs. A variety of service programs are available, including on-site contract maintenance.



**Figure C-65. Removing the AC Power Cord**

2223255-8



**Figure C-66. Removing the Signal Cable**

2223255-9

**C.7 SYNCHRONOUS-ASYNCHRONOUS COMMUNICATIONS BOARD OPTION MANUAL (TI PART NO. 2223206-0001)**

**Preface**

This manual provides the user or technician with information necessary for installing and using the Synchronous-Asynchronous Communications (Sync-Async Comm) Board option. After the option has been installed, you should file this manual in Chapter 5 of your *Texas Instruments Professional Computer Operating Instructions* (TI Part No. 2223116-0001). You can also find a copy of this and all other option manuals in Appendix C of the *Texas Instruments Professional Computer Maintenance Handbook* (TI Part No. 2223200-0001).

This manual is divided into three chapters.

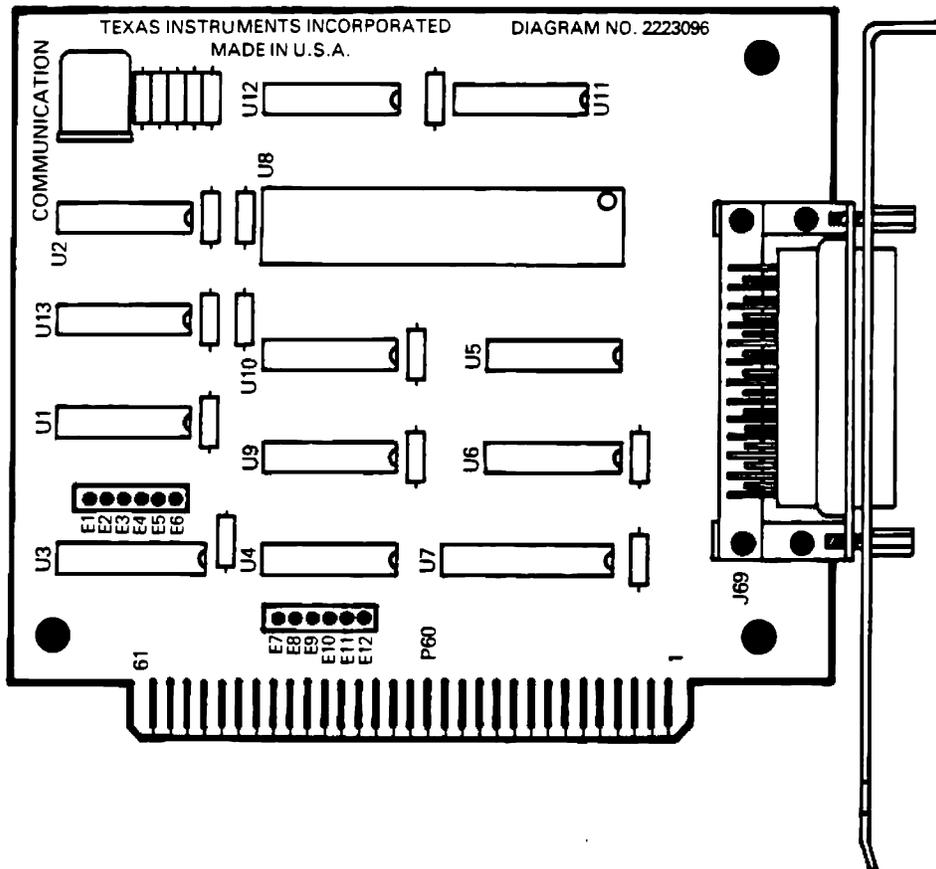
Chapter 1 describes the option, lists the tools required for installation and removal, and provides a checklist in case of difficulties.

Chapter 2 contains step-by-step instructions for installing the option and describes the checkout procedure.

Chapter 3 discusses the procedures for removing the option.

**C.7.1 Chapter 1 - Introduction**

This chapter describes the sync-async comm board option, provides part number information for the option kit and kit components, and lists the tools required for installing the option. The board is shown in Figure C-67.



2223206-2

**Figure C-67. Sync-Async Comm Board**

The sync-async comm board option supports several communications protocols, and is capable of operation over a wide range of baud rates. Each sync-async comm board may be set (using jumpers) to a different port address. This allows up to four option boards to be used on a single system.

The sync-async comm board provides a standard RS-232-C interface which allows your computer a generalized means of communication with some external device.

The term RS-232-C refers to a specific Electronic Industries Association (EIA) standard which defines the most widely accepted method for interfacing data terminal equipment with data communications equipment, by employing serial binary data interchange. This standard defines electrical signal characteristics, timing and control circuits, and the standard interfaces for selected communication system configurations. The RS-232-C interface is a universally used standard. Most video terminals, modems, line printers, card readers, and minicomputers utilize this standard for the interchange of data between devices.

This option provides the necessary conventions concerning data identification, transmission rates, send-receive sequences, error-checking methods, etc. It does not provide the special programming that is necessary to use a particular external device or system.

This means that simply having the installed sync-async comm board does not automatically enable you to send programs from one computer to another, or to output data to a serial printer via the interface. To perform these functions, you must acquire the special programs that are required. Communications applications programs (such as the optional *TTY Communications* package) are available from your Texas Instruments Authorized Dealer.

The installation of the sync-async comm board opens up a new world of communications compatibility. Your computer can now be programmed to communicate with a telephone modem, serial printer, a data terminal — almost any RS-232-C device.

The sync-async comm board option supports asynchronous speeds which are selectable from as slow as 50 bits per second to as fast as 19 200

bits per second. Most synchronous data communication protocols, including synchronous data link control (SDLC) and high-level data link control (HDLC), are supported by this option.

**C.7.1.1 Purpose.** The computer recognizes any one of four separate interrupts and addresses for use with the sync-async comm board. This allows up to four separately addressable comm boards to be installed in your system. No two sync-async comm boards may share the same interrupt or address.

**C.7.1.2 Description.** The sync-async comm board option kit consists of a printed wiring board and an option manual.

TI Part Numbers for the sync-async comm board option kit are listed in Table C-12.

**Table C-12. Sync-Async Comm Board Option Kit Part Numbers**

TI Part No.	Description
2223238-0001	Option Kit, Sync-Async Comm Board
consisting of: 2223094-0001 2223206-0001	Sync-Async Comm Board Option Manual, Sync-Async Comm Board

**C.7.1.3 Tool Requirements.**

- Medium-size flat-bladed screwdriver
- 1/4-in nutdriver (optional tool for installing the option board retaining screw)

**C.7.1.4 In Case You Have Problems....** If you have any operating difficulty after installing the option, you should check for the following conditions.

- Improper seating of the option board in its socket
- Loose connectors, or improper cable hookup

- Another option which you may have loosened from its socket
- Improper cable connecting an external device to the RS-232-C port
- Improperly configured, or faulty external device connected to RS-232-C port

## C.7.2 Chapter 2 - Installation

**C.7.2.1 Preliminary Steps.** Before attempting to install this option, complete the following steps.

1. Be sure there is sufficient working space available. You will be turning the system unit to gain access to the back panel, and you will need space beside the system unit (with the cover removed) to place the display unit temporarily for installation checkout.
2. Make certain your Texas Instruments Professional Computer is operational. This may be done in the following manner.
  - Insert a diagnostics diskette in the left drive and close the door.
  - Place the system unit ON/OFF switch in the ON position (the self-test will be executed and the diagnostics menu will be displayed).
  - Select the Overall Unit Test and follow the procedures outlined in the *Texas Instruments Professional Computer Operating Instructions*.

Do not attempt to install this option unless this test is successfully completed.

3. Place the system unit ON/OFF switch in the OFF position, and remove the system unit power cord from the ac receptacle.
4. Disconnect the following:
  - Keyboard cable
  - Display unit signal cable

- Display unit power cord
- System unit power cord
- Any peripheral cables connected to the system unit

5. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any additional equipment to the side, away from the system unit.

### CAUTION

**Static electricity can be destructive to static-sensitive components mounted on the sync-async comm board. Before touching any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table. Care must be used in handling the sync-async comm board. We recommended that the board assembly be left IN THE ANTISTATIC PACKING BAG until you are ready to install it.**

6. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner using a flat-bladed screwdriver. See Figure C-68 for the locations of these screws.
7. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit. Set the cover aside, out of the way. See Figure C-69.
8. Remove the sync-async comm board from its antistatic bag. Place the board on a smooth work surface, component side up. Study Figure C-70 and Table C-13 to familiarize yourself with the jumper locations for the various port assignments. The board is factory preset with jumpers E1 to E2 and E7 to E8, port 1 selected.

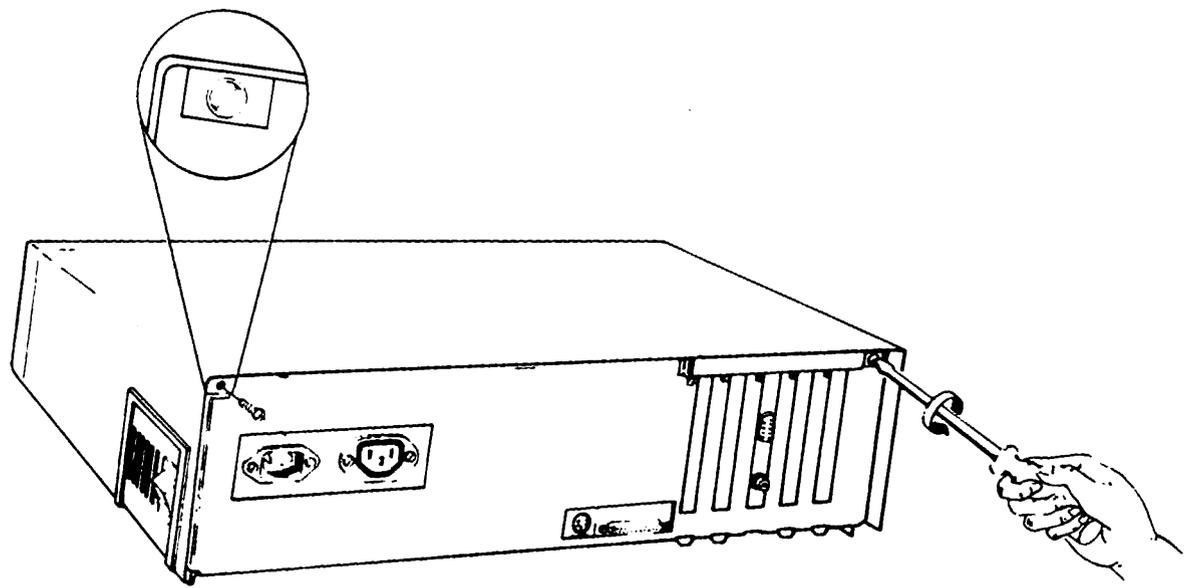


Figure C-68. Removing the Cover Screws

223205-2

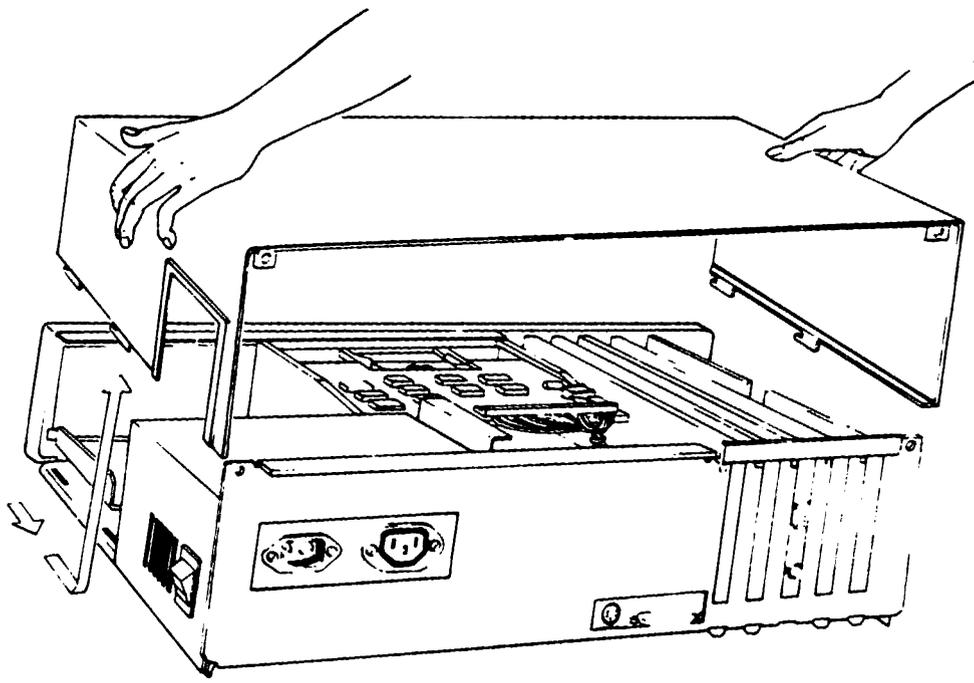
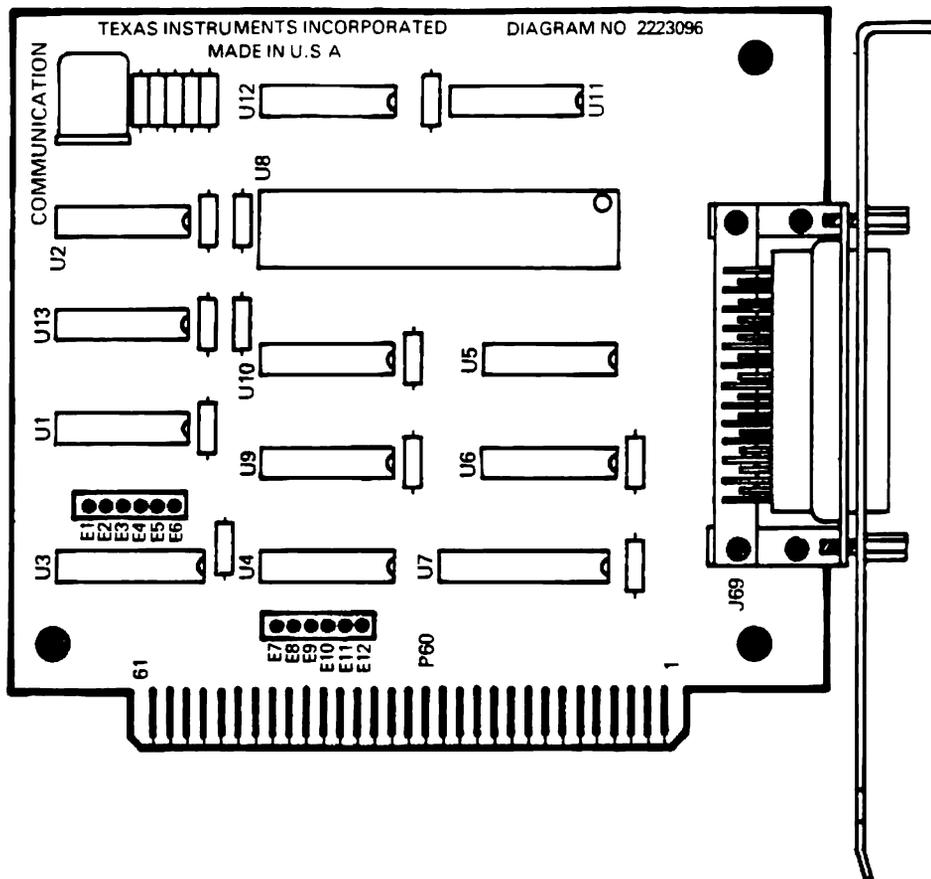


Figure C-69. Removing the Cover

223205-3



2223206-2

Figure C-70. Jumper Locations

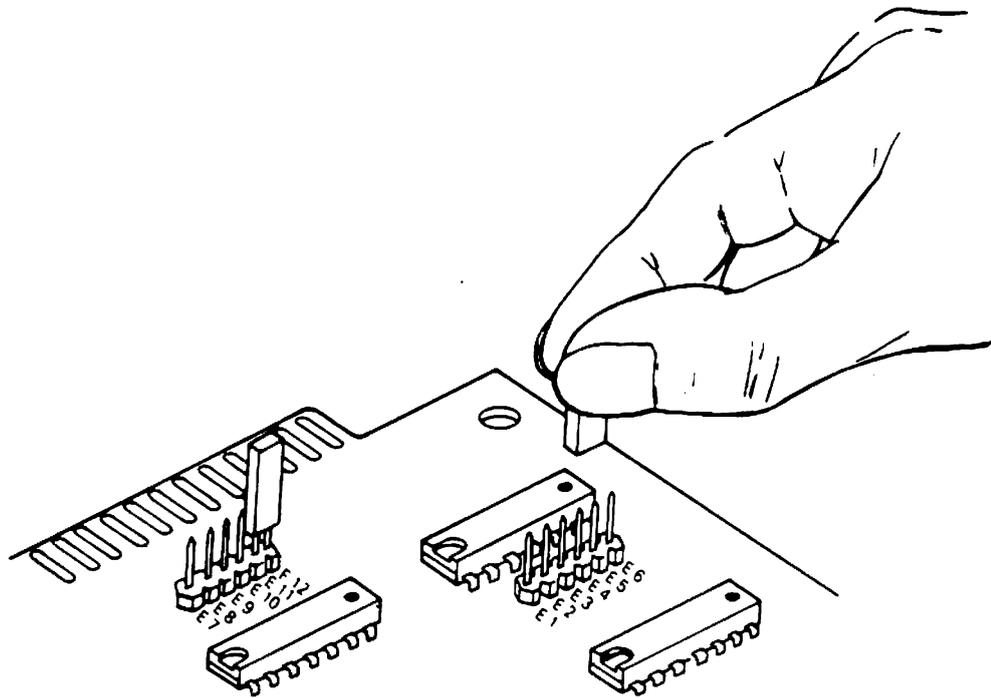
Table C-13. Jumper Assignments

Port No.	Address Jumpers	Interrupt Jumpers
1 *	E1 to E2	and E7 to E8
2	E4 to E5	and E10 to E11
3	E2 to E3	and E8 to E9
4	E5 to E6	and E11 to E12

\* Factory Setting

### C.7.2.2 Installation Procedure.

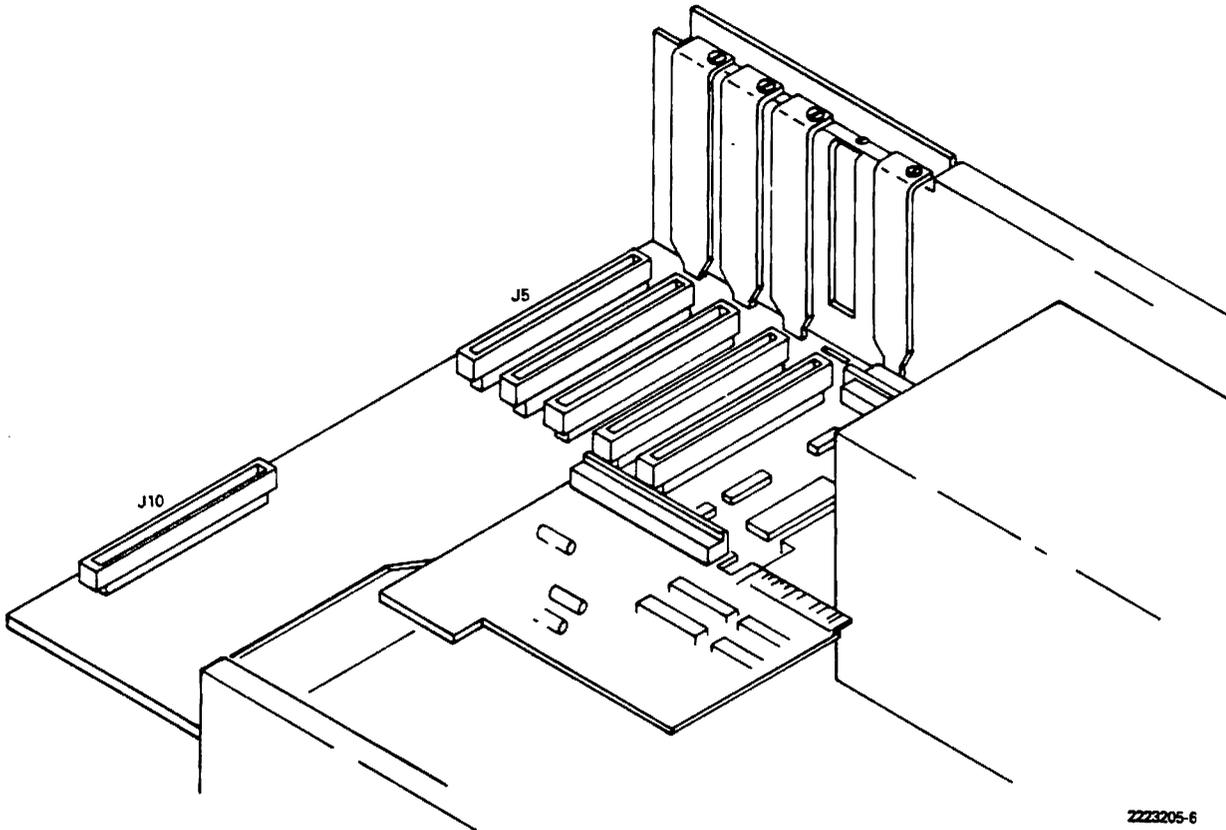
1. Due to the compact size of the option board, we recommended that position J5 be used for the first option board. This allows the clearance necessary for the future installation of an expansion RAM option board at J10 (directly to the front of J5), and avoids the need for relocating boards later. Additional boards may be installed in any option slot, J1 to J4. See Figure C-72.
  2. Using a flat-bladed screwdriver or 1/4-in nutdriver, remove the screw which secures the selected blank option plate to the back panel of the system unit. Remove the option plate and store it for possible future use. See Figure C-73. The screw must be saved for use in step 4.
9. Install the programming jumpers as shown in Figure C-71. This illustrates proper jumpering locations for port 4.



2223206-1

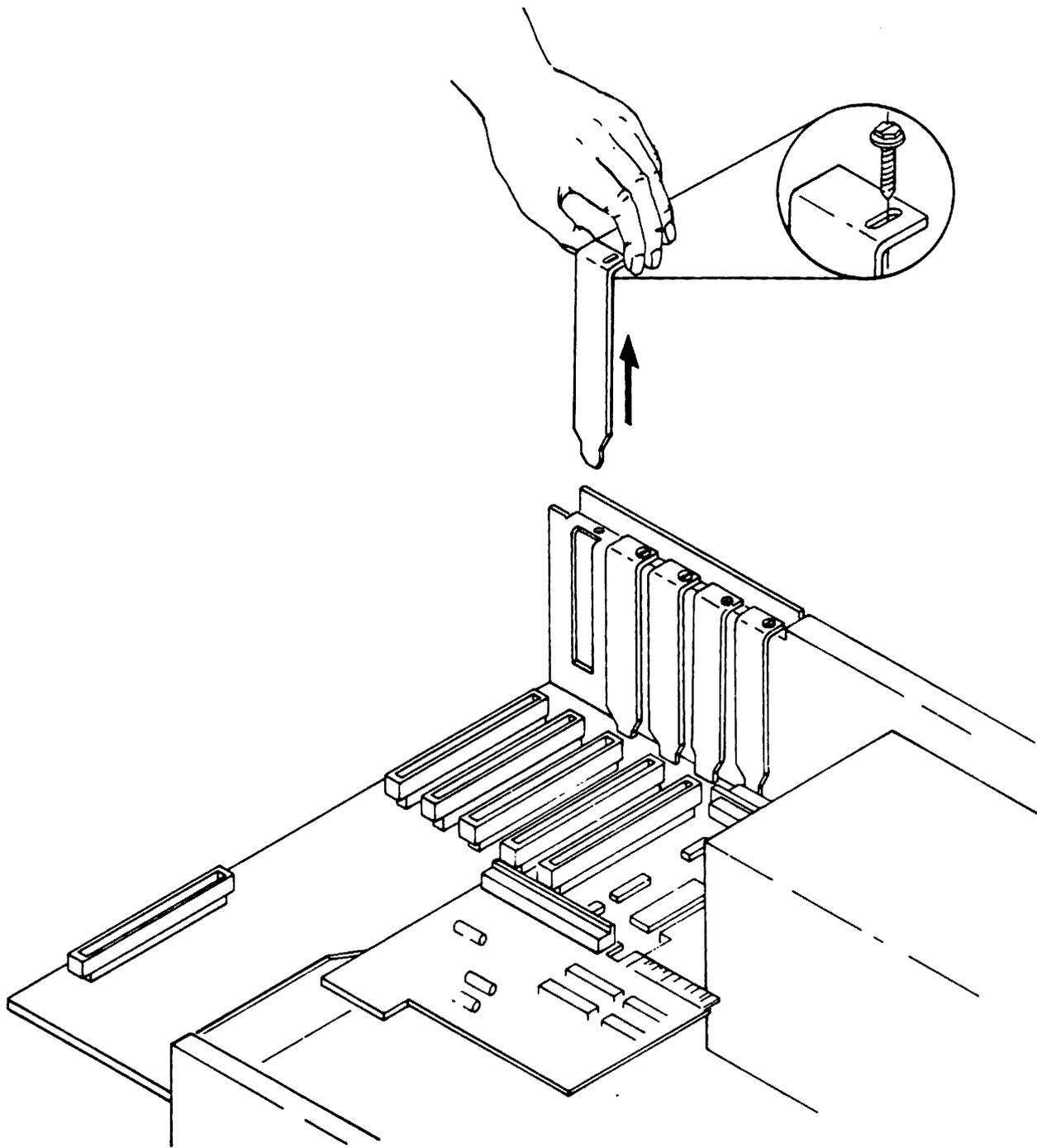
**Figure C-71. Installing Jumpers**

3. Gently insert the sync-async comm board into card-edge connector J5 on the system unit board. Use the slot on the rear of the system unit chassis to align the board during insertion. The locations of the connector and slot are shown in Figure C-74.
4. Align the hole on the back plate of the option board with the corresponding hole on the back panel of the system unit. Install the screw removed in step 2 and tighten, using a flat-bladed screwdriver or a 1/4-in nutdriver.



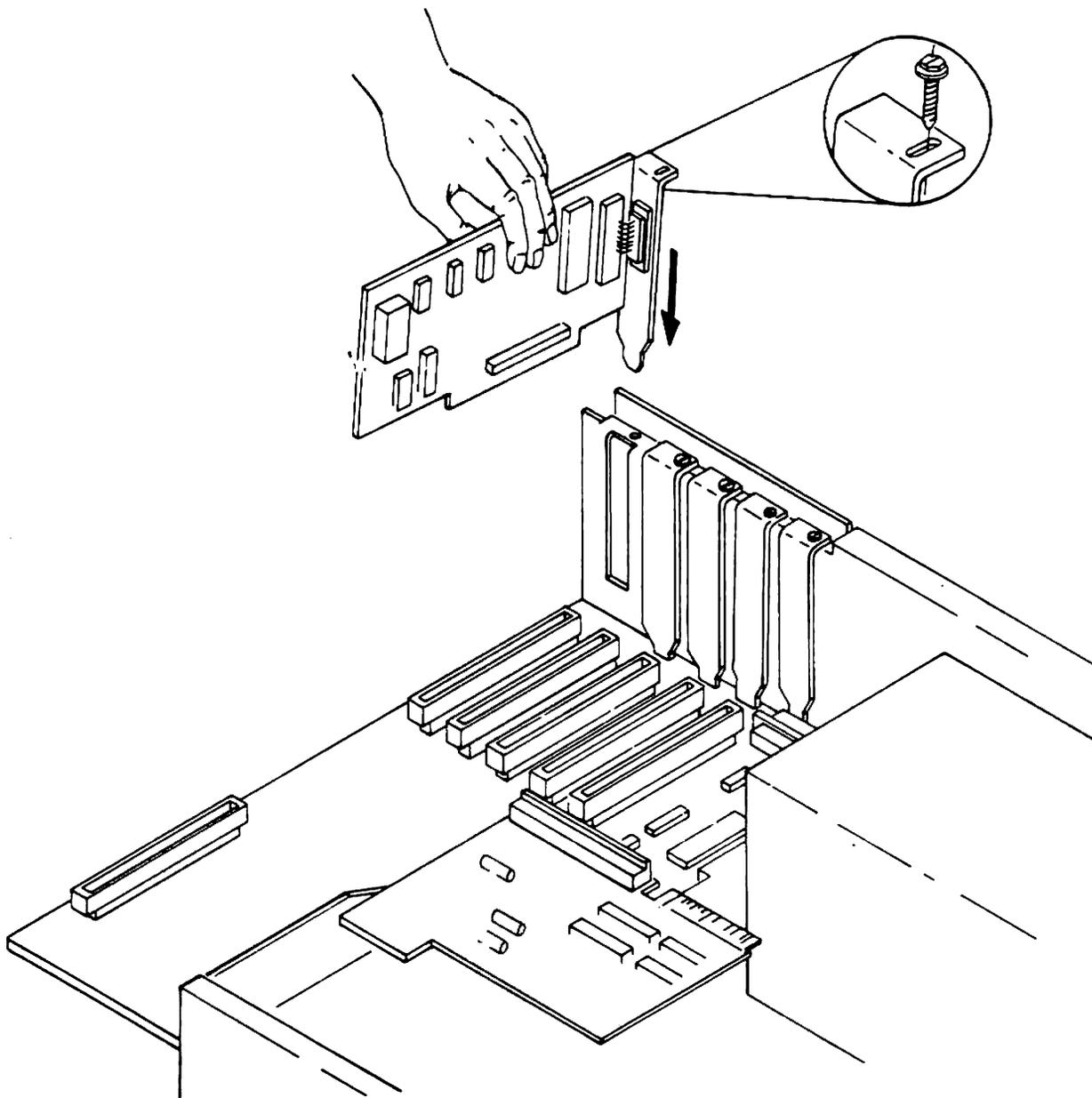
2223205-6

**Figure C-72. Card-Edge Connector Location**



2223206-4

**Figure C-73. Removing the Blank Plate**



2273206-5

**Figure C-74. Inserting the Option Board**

**C.7.2.3 Installation Checkout.** Before replacing the system unit cover, check the installation one more time, and plug everything in for an operational check.

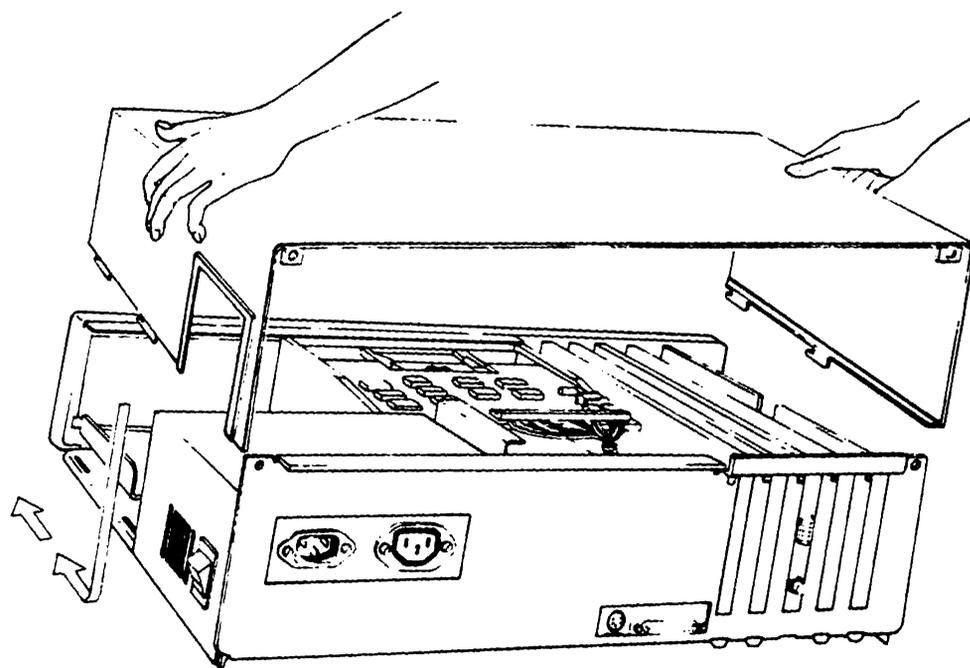
**CAUTION**

**With the system unit cover open and power applied, the system unit board and diskette drive logic boards are exposed. Make certain that no tools, test probes, or other metallic items come in contact with any exposed components. Damage to the unit may result.**

1. Reconnect the following:
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
2. With the system unit ON/OFF switch in the OFF position, plug the system unit power cord into an ac receptacle.
3. Place a diagnostics diskette in the left drive. Close the drive door.
4. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the diagnostics menu is displayed.
5. Select the Overall Unit Test. At the beginning of the test, the system configuration table is displayed. Check the display to ensure the port number displayed is the port number you programmed on the option board.
6. You may check out the installation more intensively by selecting the Communication Port(s) Test from the diagnostics menu.
7. Place the system unit ON/OFF switch in the OFF position and turn the system unit so that the rear panel is facing you.
8. Disconnect all cords and cables from the rear of the system unit.
9. Replace the system unit cover by gently lowering it into place, and sliding it toward the front panel, as shown in Figure C-75.
10. Replace the two screws which secure the system unit cover and tighten them. See Figure C-76.
11. Reconnect the following:
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
  - Any peripheral cables which you removed

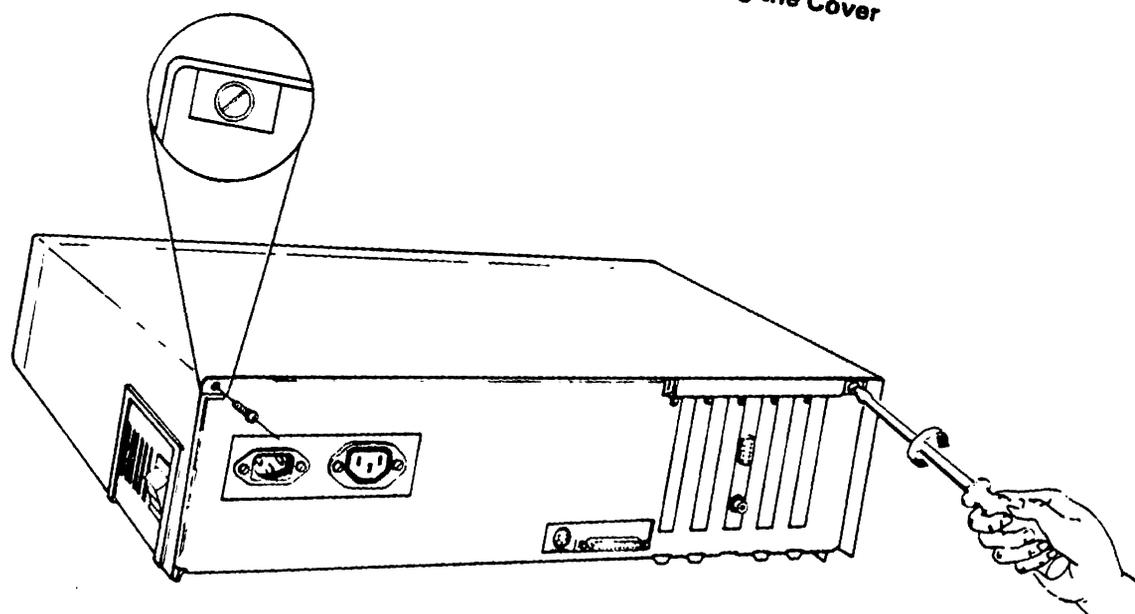
This concludes the installation and check-out of the sync-async comm board option. If more extensive testing is required, refer to the *Texas Instruments Professional Computer Maintenance Handbook*.

Table C-14 identifies the signals at the RS-232-C connector.



223205-8

Figure C-75. Replacing the Cover



223205-9

Figure C-76. Tightening the Cover Screws

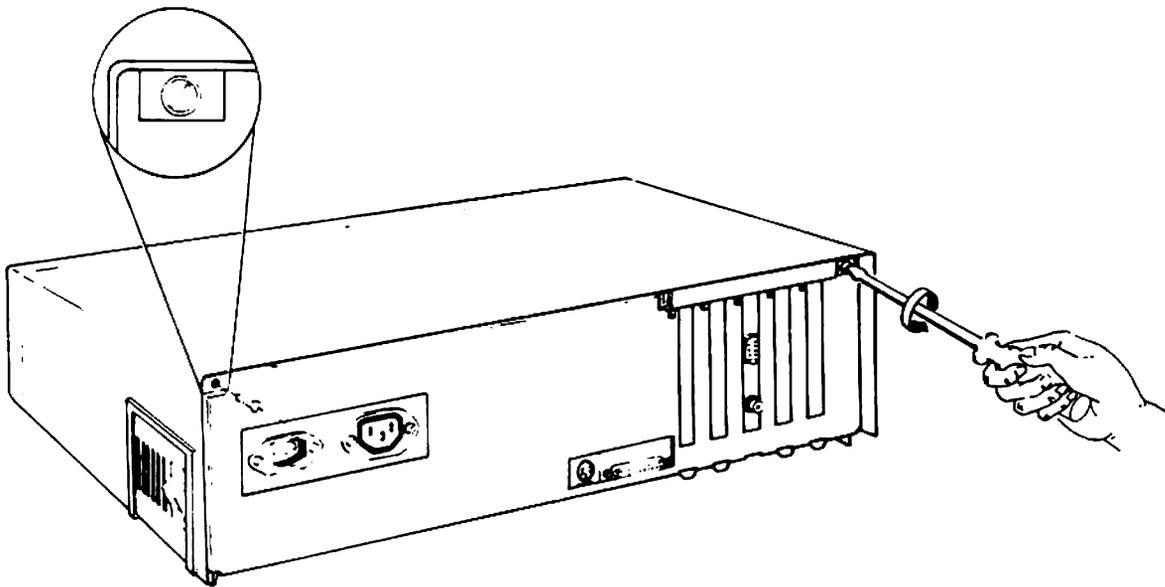
**Table C-14. RS-232-C Connector Signals**

<b>Pin</b>	<b>Signal Name</b>	<b>Signal</b>
1	Chassis Ground	AA
2	Transmitted Data	BA
3	Received Data	BB
4	Request to Send	RTS/CA
5	Clear to Send	CTS/CB
6	Data Set Ready	DSR/CC
7	Signal Ground	AB
8	Data Carrier Detect	DCD/CF
9	No Connection	
10	No Connection	
11	Secondary Request to send	SCA/CH
12	Secondary Clear to Send	SCF/CI
13	No Connection	
14	No Connection	
15	Transmitter Clock In	TXC/DB
16	No Connection	
17	Receiver Clock In	RSC/DD
18	No Connection	
19	No Connection	
20	Data Terminal Ready	DTR/CD
21	No Connection	
22	Ring Indicator	RI/CE
23	No Connection	
24	Ext Transmitter Clock	DA
25	No Connection	

### C.7.3 Chapter 3 - Option Removal

**C.7.3.1 Preliminary Steps.** Before attempting to remove the option, complete the following steps.

1. If you wish to check the computer or option prior to removal, refer to the *Texas Instruments Professional Computer Operating Instructions* for checkout procedures using a diagnostics diskette.
2. Place the system unit ON/OFF switch in the OFF position and remove the system unit power cord from the ac receptacle.
3. Disconnect the following:
  - System unit power cord
  - Display unit signal cable
  - Display unit power cord
4. Remove the display unit from the top of the system unit and set it to the side. Set the keyboard and any other peripherals to the side, away from the system unit.
5. Turn the system unit so that the back panel is facing you. Remove one screw from each top corner using a flat-bladed screwdriver. See Figure C-77 for the locations of the screws.
6. Remove the system unit cover by pulling it back approximately 13 mm (0.5 in), and then lifting it away from the system unit. Set the cover aside, out of the way. See Figure C-78.



2223205-2

**Figure C-77. Removing the Cover Screws**

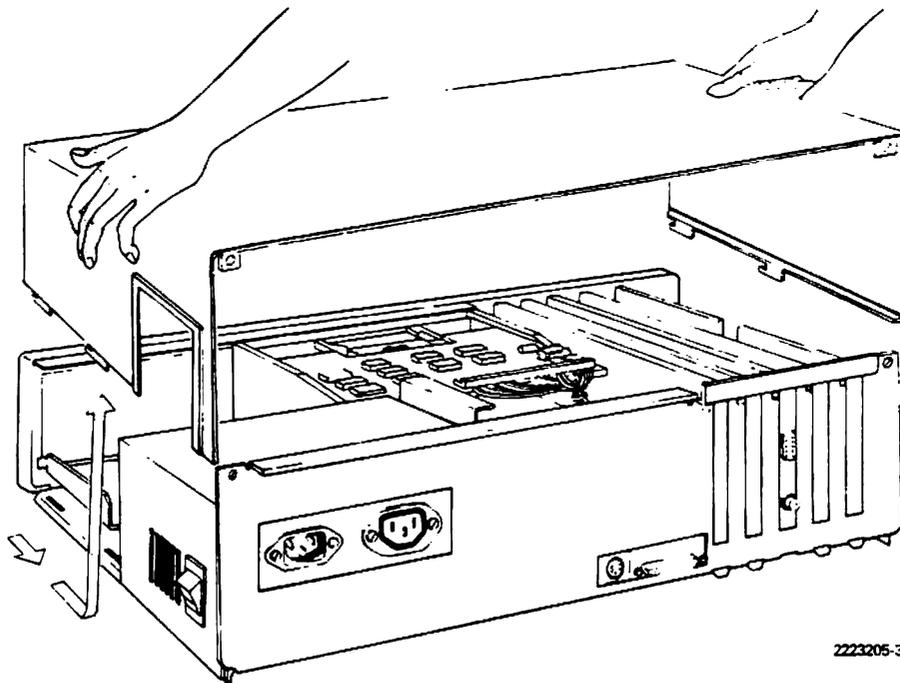


Figure C-78. Removing the Cover

### C.7.3.2 Removal Procedure.

#### CAUTION

Static electricity can be destructive to static-sensitive components mounted on the sync-async comm board. Before touching or attempting to remove any of the printed wiring boards, be sure you are discharged of static electricity. This can be accomplished by momentarily touching any grounded object, or a metal-framed desk or table.

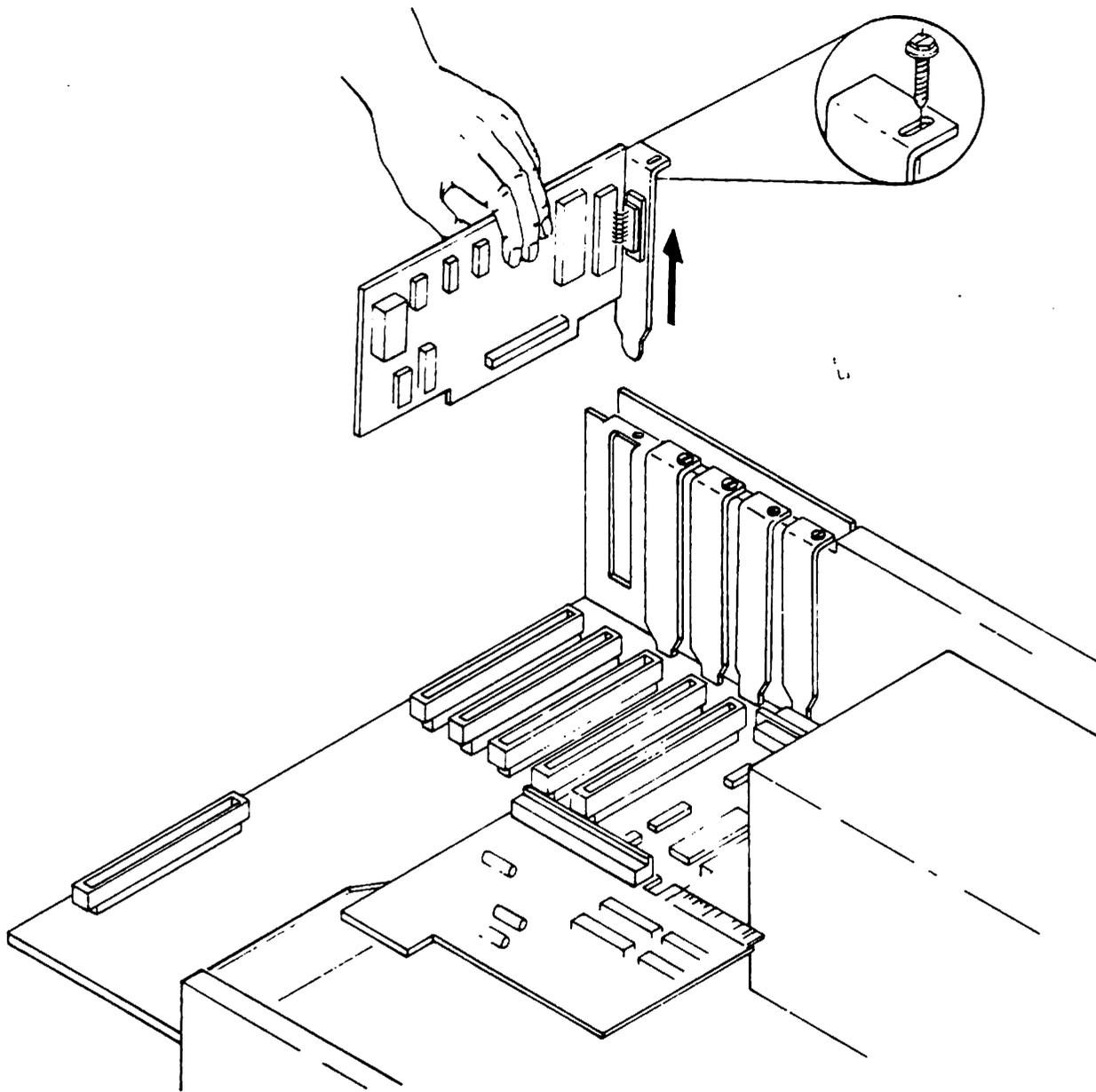
1. Using a flat-bladed screwdriver or 1/4-in nutdriver, remove the screw which secures the option plate assembly to the rear panel of the system unit. The screw must be retained for use in step 4.
2. Hold the sync-async comm board firmly and lift it straight up, out of the socket, as shown in Figure C-79. The board can be identified by the the word "COMMUNICATION" marked on the end opposite the 25-pin D-type connector.

3. Place the board in an antistatic bag. If no antistatic bag is available, a sheet of aluminum foil may be wrapped around the board.

#### NOTE

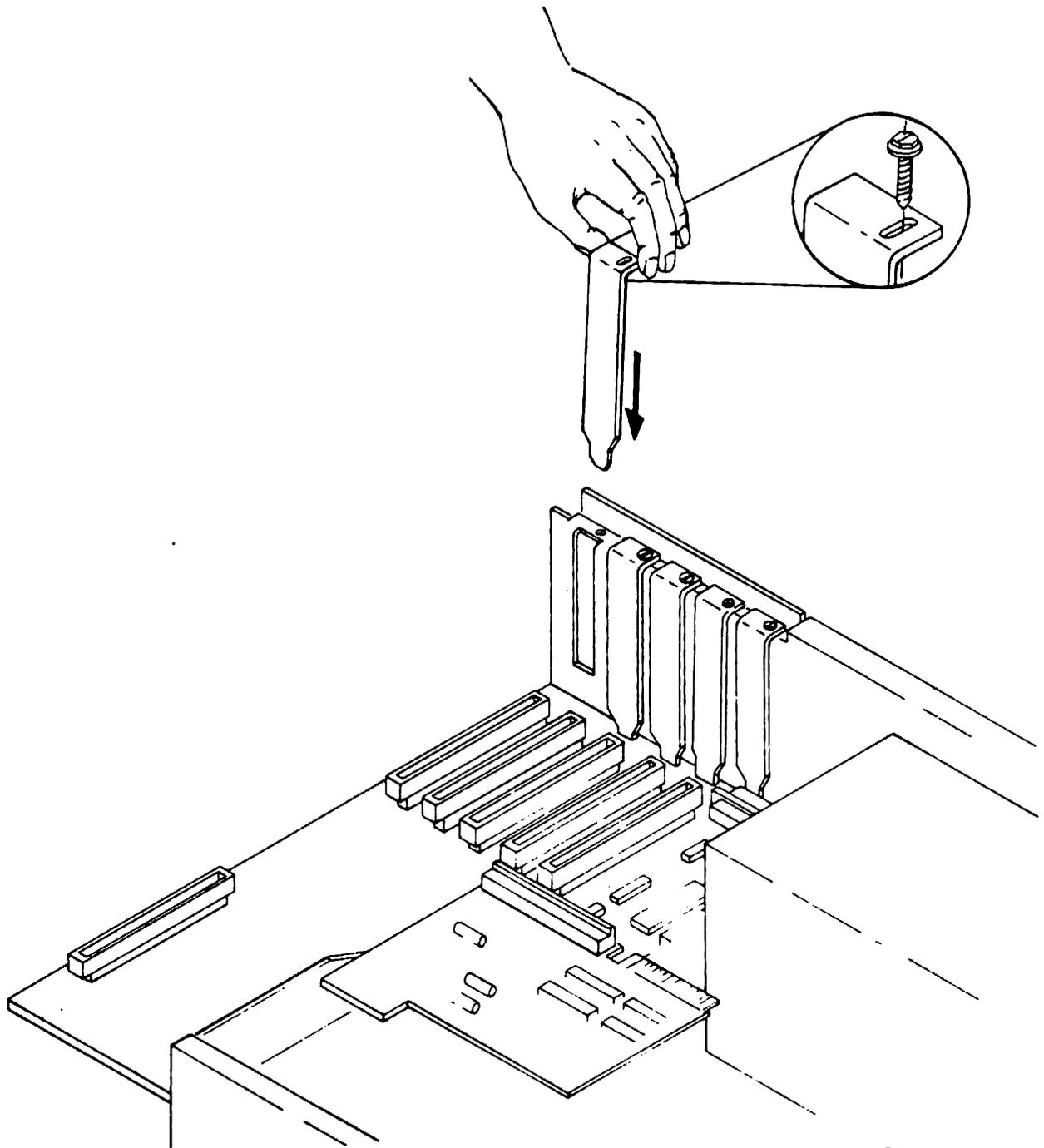
If the sync-async comm board is being removed due to a fault, and a replacement board is being inserted, follow the installation instructions in Chapter 2. The address and interrupt jumpers must be configured for the correct port. Use the antistatic bag from the replacement board to store the board being removed.

4. If you are *not* replacing the sync-async comm board, you should place a blank plate (TI Part No. 2223033-0001) in the slot in the back of the system unit, and secure it with the screw removed in step 1. See Figure C-80.



2223206-7

**Figure C-79. Removing the Option Board**



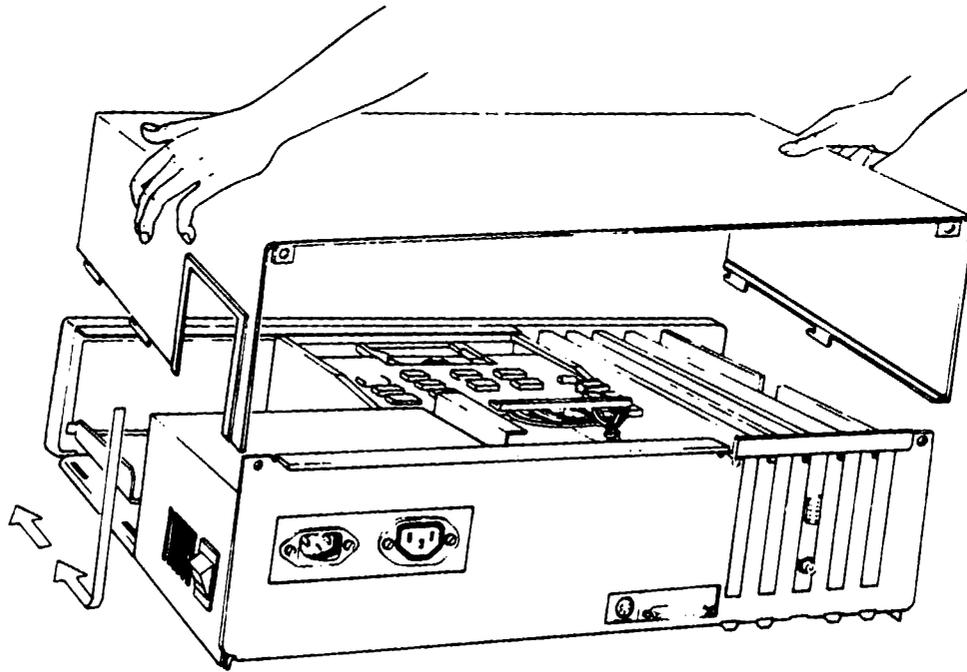
2223206-8

**Figure C-80. Installing the Blank Plate**

## CAUTION

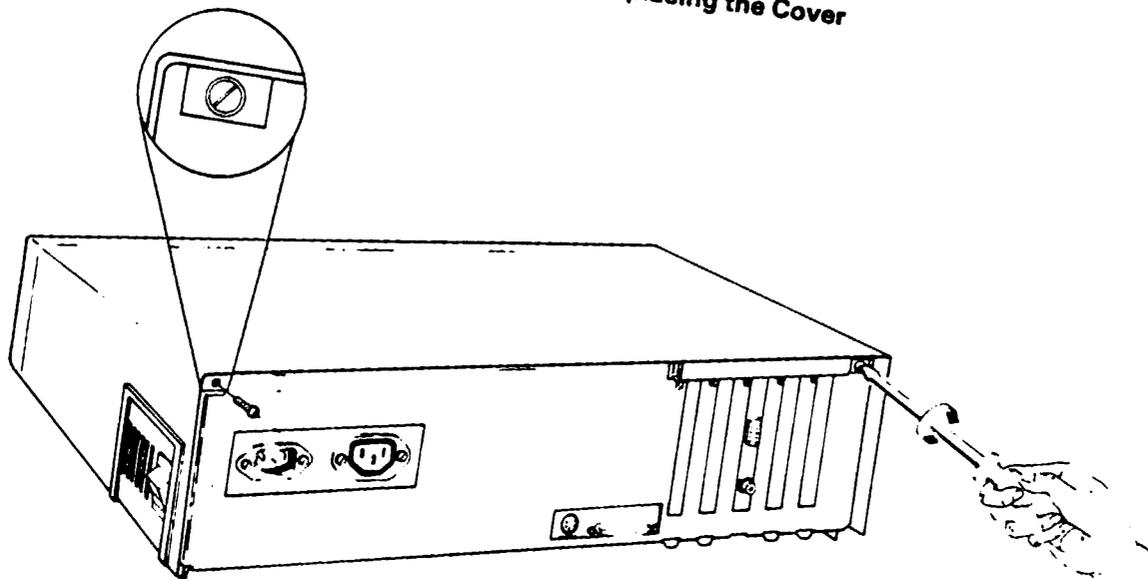
**With the system unit cover open and power applied, the system unit board and diskette drive logic boards are exposed. Make certain that no tools, test probes, or other metallic items are permitted to come in contact with any exposed components. Damage to the unit may result.**

5. Reconnect the following:
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cordDo not plug the system unit power cord into an ac receptacle yet.
6. With the system unit ON/OFF switch in the OFF position, plug the system unit power cord into an ac receptacle.
7. Place a diagnostics diskette in the left drive. Close the drive door.
8. Place the system unit ON/OFF switch in the ON position. Following the power-up self-test, the diagnostics menu is displayed. Select the Overall Unit Test. At the beginning of the test, the system configuration is displayed.
9. You may check out the installation more intensively by selecting the Communication Port(s) Test from the diagnostics menu.
10. Place the system unit ON/OFF switch in the OFF position. Remove all cords and cables from the back of the system unit.
11. Turn the system unit so that its rear panel is facing you. Replace the system unit cover by gently lowering it into place and sliding it toward the front panel, as shown in Figure C-81.
12. Replace the two screws which secure the system unit cover and tighten. See Figure C-82.
13. Reconnect the following:
  - Keyboard cable
  - Display unit signal cable
  - Display unit power cord
  - System unit power cord
  - Any peripheral cables which you removed



2223205-8

Figure C-81. Replacing the Cover



2223205-9

Figure C-82. Tightening the Cover Screws

# Appendix D

## Using Diskettes and MS-DOS

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This appendix contains instructions in the care and use of diskettes, and in using the MS-DOS operating system. Step-by-step procedures are provided for formatting a diskette, making backup copies, verifying copies, copying system bootup information for applications packages, copying files, and changing and erasing files. Frequently used keyboard commands for controlling MS-DOS and controlling a printer are also provided.

### D.1 BACKING UP IMPORTANT DISKETTES

Diskettes can be damaged, lost, or simply wear out. For these reasons it's important to make copies. These copies are called backups and the process of copying a diskette is referred to as backing it up. The need for making periodic backups can't be overemphasized. We strongly recommend that all diskettes be backed up. The time interval between backups should depend on the importance of the information on the diskette. Diskettes with data vital to the operation of your business might be backed up very often. Multiple backups are not uncommon.

Think about how you would reconstruct the information on a diskette if it was lost. If it would be easy to do, then the need for a backup is minimal. Most diskettes that are being used on a regular basis have information that is changing or increasing. Recreating such data is usually difficult, if not impossible.

In this section, we show you how to back up the MS-DOS diskette. *The instructions for backing up any other diskette are identical except where noted.* Three MS-DOS commands are used to backup a diskette.

- FORMAT
- DISKCOPY
- DISKCOMP

The **FORMAT** command is used to prepare a diskette to accept information. **DISKCOPY** copies the entire contents of one diskette onto another. **DISKCOMP** compares the contents of two diskettes.

These instructions are separated into two groups.

- Those for users with dual diskette drive systems
- Those for users with single diskette drive systems

One more point before you start. At times in this section we say "Press any key..." when instructing you to tell MS-DOS that you're ready to proceed. Strictly speaking, this is not true. Most keys will work. To be safe, press one of the alphanumeric keys or press the **RETURN** key.

### D.1.1 If You Have Dual Diskette Drives

Make sure that your system is ready for the backup procedure by following these steps.

1. Locate the original MS-DOS diskette. Make sure that it is write-protected with a piece of foil tape covering the write-protect notch.
2. Place it in drive A and close the latch of the diskette drive.
3. If your display currently shows the prompt A:, skip to paragraph D.1.1.1

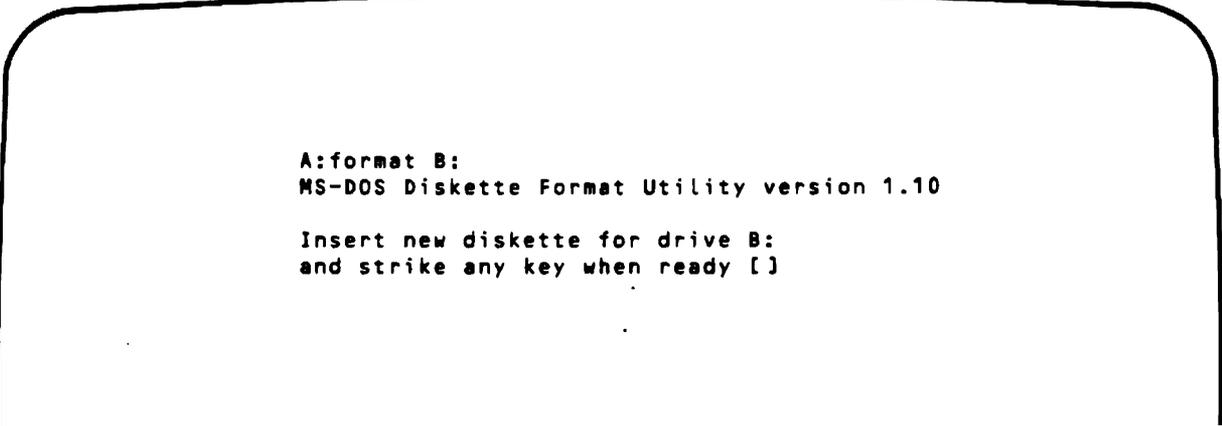
If your display shows something different or nothing at all, first make sure that your system is on. Next restart the system by following these steps.

- a. Press and hold both the **CTRL** and **ALT** keys.
- b. Press the **DEL** key.
- c. Release all the keys.
- d. Enter the current date and time. (If you need help doing this, refer to Chapter 3 of the *Texas Instruments Professional Computer Operating Instructions*.)

**D.1.1.1 Formatting a Diskette.** The **FORMAT** command is used to prepare a diskette to accept information. Formatting is required every time you use a new diskette. You can also use **FORMAT** when you want to use a diskette which contains information that you no longer need.

Select a diskette, preferably a new one. This diskette will become the backup. Remember, if the diskette you have chosen is not new, any information that was recorded on it will be lost. Ensure that the write-protect notch on the diskette is uncovered.

1. Insert the backup diskette into the right-hand drive, drive B, and close the diskette drive latch.
2. Type this:  
  
format B:  
  
and press the **RETURN** key. The drive designator, B:, lets MS-DOS know that you want to format the diskette in drive B.
3. The display is shown in Figure D-1.



```
A:format B:  
MS-DOS Diskette Format Utility version 1.10  
  
Insert new diskette for drive B:  
and strike any key when ready [ ]
```

Figure D-1. Sample Display 1

4. Press any key on the keyboard. Pressing a key lets MS-DOS know that the backup diskette is in drive B.
5. The diskette drive red in-use light comes on for drive B while the new diskette is being formatted. After about 30 seconds, the display will appear as shown in Figure D-2.
6. MS-DOS is asking if you want to format another diskette. Type n for no.

```
A:format B:
MS-DOS Diskette Format Utility version 1.10

Insert new diskette for drive B:
and strike any key when ready

    160256 bytes total disk space
    160256 bytes available on disk

Format another (Y/N)?[ ]
```

**Figure D-2. Sample Display 2**

At this point, the diskette has been formatted and is ready to have the files on the MS-DOS diskette copied to it.

**D.1.1.2 Copying a Diskette.** To copy diskettes, use the DISKCOPY command. This command copies the entire contents of one diskette onto another.

1. Type this:

diskcopy A: B:

and press the RETURN key.

The drive designators, A: and B:, let MS-DOS know that we are copying *from* the diskette in drive A *to* the diskette in drive B.

It's okay to put more than one space in between the command and the drive designators.

2. The display is shown in Figure D-3.

```
A: diskcopy A: B:
MS-DOS Diskette Copy Utility version 1.10
Insert source diskette in drive A:
Insert destination diskette in drive B:
Strike any key when ready
[]
```

**Figure D-3. Sample Display 3**

The source diskette mentioned above is the source of the information being copied. Likewise, the destination diskette is where the information is going. Make certain that drive A contains the MS-DOS diskette and drive B contains the backup diskette. (If you want to backup a source diskette other than MS-DOS, remove the MS-DOS diskette from drive A and insert the diskette to be backed up.)

The entire contents of the source diskette are now being copied to the backup diskette. The red in-use lights on both diskette drives repeatedly come on and then go out. What's happening is that the information is being read from the source diskette and then written to the backup diskette in small groups of characters.

3. Press any of the keys on the keyboard to let MS-DOS know you're ready.
4. After a short time, the display appears as shown in Figure D-4.

```
A: diskcopy A: B:
MS-DOS Diskette Copy Utility version 1.10
Insert source diskette in drive A:
Insert destination diskette in drive B:
Strike any key when ready
Copying 1 side(s)
Copy complete
Copy another? (Y/N) []
```

**Figure D-4. Sample Display 4**

The copy is now complete and MS-DOS wants to know if you want to copy another diskette. Type n for no.

**D.1.1.3 Verifying the Copy.** Although the backup is now complete, it is wise to verify the contents of the backup by comparing it against the original source diskette. The DISKCOMP command is used to accomplish this. (If you copied a source diskette other than MS-DOS, remove

the source diskette from drive A and insert the MS-DOS diskette.)

1. Type this:

diskcomp A: B:

and press the RETURN key. The display is shown in Figure D-5.

```
A: diskcomp A: B:
MS-DOS Diskette Compare Utility version 1.10
Insert first diskette in drive A:
Insert second diskette in drive B:
Strike any key when ready
[]
```

**Figure D-5. Sample Display 5**

(If you want to verify a source diskette other than MS-DOS, remove the MS-DOS diskette from drive A and insert the source diskette.)

2. Press any key.

The red in-use lights on both drives come on and go off several times while the information is being compared. After about a minute, the comparison is completed and the display appears as shown in Figure D-6.

```

A: diskcomp A: B:
MS-DOS Diskette Compare Utility version 1.10
Insert first diskette in drive A:
Insert second diskette in drive B:
Strike any key when ready
Comparing 1 side(s)
Diskettes compare OK
Compare more diskettes (Y/N)? []

```

Figure D-6. Sample Display 6

MS-DOS wants to know if you want to compare more diskettes. Type n for no.

**D.1.1.4 Labeling Your Backup.** The last step in backing up your MS-DOS diskette (or your source diskette) is to label it. *Use only a soft felt-tipped pen if you are writing on a label already on the diskette.* It's a good idea to put today's date on the label.

*We also recommend using the backup diskette in your daily operations and safely storing the original MS-DOS diskette (or your source diskette).*

This completes the backup for a system with two diskette drives. Go to subsection D.2.

**D.1.2 If You Have a Single Diskette Drive** Make sure your system is ready for the backup procedure by following these steps.

1. Locate the original MS-DOS diskette. Make sure that it is write-protected with a piece of foil tape covering the write-protect notch.

2. Place it in drive A and close the latch of the diskette drive.
3. If your display currently shows the prompt A:, skip to subsection D.2.

If your display shows something different or nothing at all, first make sure that your system is on. Next restart the system by following these steps.

- a. Press and hold both the **CTRL** and **ALT** keys.
- b. Press the **DEL** key.
- c. Release all keys.
- d. Enter the current date and time. (If you need help doing this, refer to the section "How to Tell MS-DOS the Date and Time," located in the *Texas Instruments Professional Computer Operating Instructions*.)

**D.1.2.1 Formatting a Diskette.** The **FORMAT** command is used to prepare a diskette to accept information. Formatting is required every time you use a new diskette. You can also use **FORMAT** when you want to use a diskette with information that you no longer need.

Select a diskette, preferably a new one. This diskette will become the backup. Remember, if the diskette you have chosen is not new, any information that was recorded on it will be lost. Ensure

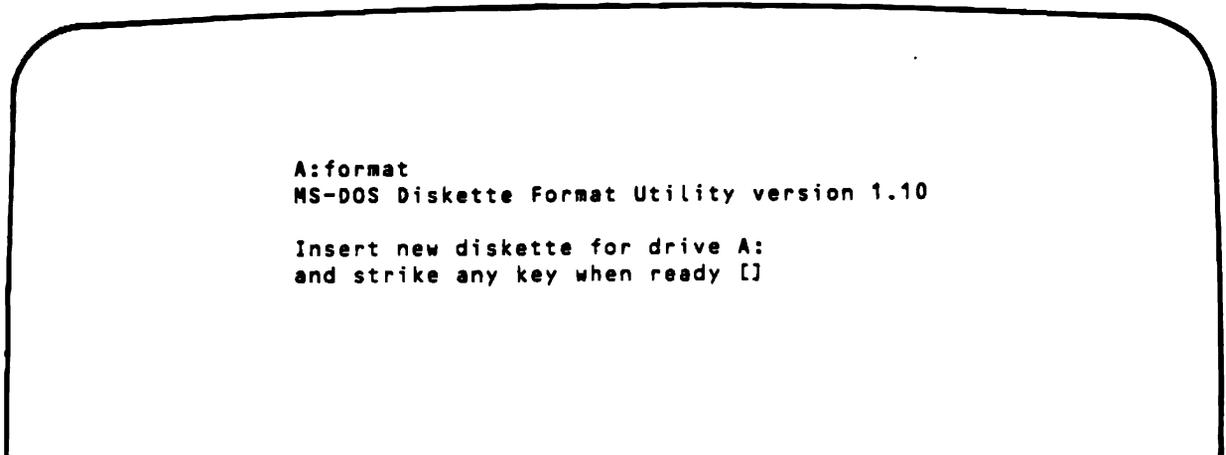
that the write-protect notch on the diskette is uncovered.

1. Type this:

`format`

and press the **RETURN** key.

2. The display appears as shown in Figure D-7.



**Figure D-7. Sample Display 7**

*Be careful not to press any key.*

3. Remove the MS-DOS diskette.

4. Insert the backup diskette in drive A and close the diskette latch.

5. Press any key on the keyboard. Pressing a key lets MS-DOS know that the backup diskette is in drive A.

6. The red in-use light comes on for drive A while the new diskette is being formatted. After about 30 seconds, the display will appear as shown in Figure D-8.

```
A:format
MS-DOS Diskette Format Utility version 1.10

Insert new diskette for drive A:
and strike any key when ready

160256 bytes total disk space
160256 bytes available on disk

Format another (Y/N)? []
```

**Figure D-8. Sample Display 8**

7. MS-DOS is asking if you want to format another diskette. Type n for no.

At this point, the diskette has been formatted and is ready to have the files on the MS-DOS diskette copied to it.

**D.1.2.2 Copying a Diskette.** To copy diskettes, use the DISKCOPY command. This command copies the entire contents of one diskette onto another. To do this MS-DOS first copies some information from the MS-DOS diskette into system memory. Then you switch diskettes, taking out the MS-DOS diskette and inserting the backup. At this point, MS-DOS copies from the

system memory to the backup. Because of the limitations of the system memory size, the copy procedure may take several iterations of removing and inserting the two diskettes.

1. Remove the backup diskette and insert the original MS-DOS diskette.
2. Type this:

```
diskcopy
```

and press the **RETURN** key. Your display will appear as shown in Figure D-9.

```
A:diskcopy
MS-DOS Diskette Copy Utility version 1.10

Insert source diskette in drive A:

Strike any key when ready
[]
```

**Figure D-9. Sample Display 9**

3. The *source* diskette mentioned above is the source of the information being copied. (If you want to backup a source diskette other than MS-DOS, remove the MS-DOS diskette from drive A and insert the diskette to be backed up.)

Press any of the keys to let MS-DOS know you're ready. The red in-use light on drive A comes on when data is being

read from the MS-DOS diskette into system memory.

4. After a short time your display appears as shown in Figure D-10.

*Be careful not to touch any key on the keyboard.*

The *destination* diskette, mentioned above, is where the information is going.

```
A: diskcopy
MS-DOS Diskette Copy Utility version 1.10
Insert source diskette in drive A:
Strike any key when ready
Copying 1 side(s)
Insert destination diskette in drive A:
Strike any key when ready
[]
```

Figure D-10. Sample Display 10

5. Remove the MS-DOS diskette (or your source diskette). Insert the backup.
6. Press any key to let MS-DOS know that the backup is in place. MS-DOS is now copying the information from system memory to the backup diskette.

After another short wait, the display appears as shown in Figure D-11.

*Again, be careful not to touch the keyboard.*

7. Remove the backup and insert the MS-DOS diskette (or your source diskette).
8. Press any key to let MS-DOS know the source diskette is present in drive A.
9. Repeat steps 4 through 8 until you see the message shown in Figure D-12.

```
Insert source diskette in drive A:  
Strike any key when ready  
[]
```

**Figure D-11. Sample Display 11**

```
Copy complete  
Copy another (Y/N)? []
```

**Figure D-12. Sample Display 12**

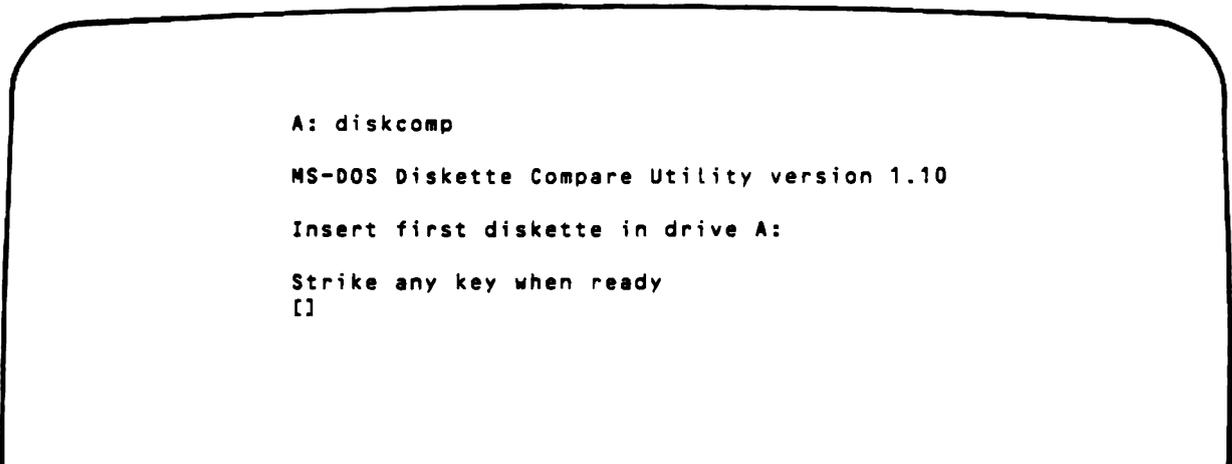
The copy is now complete and MS-DOS wants to know if you want to copy another diskette. Type n for no.

**D.1.2.3 Verifying the Copy.** Although the backup is now complete, it is wise to verify the contents of the backup by comparing it against the original source diskette. The DISKCOMP command is used to accomplish this.

1. Remove the backup diskette and insert the original MS-DOS diskette. Now type this:

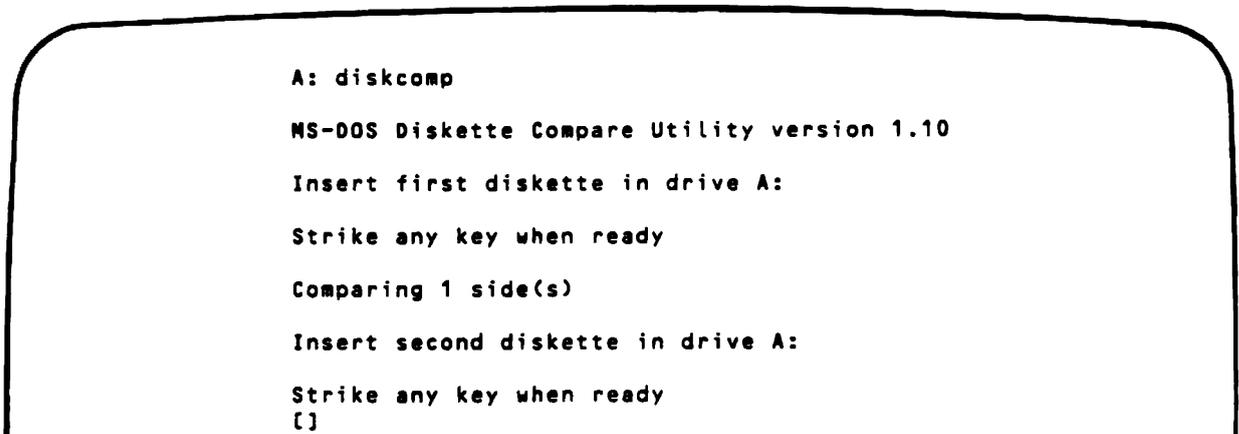
```
diskcomp
```

and press the **RETURN** key. The display will appear as shown in Figure D-13.



**Figure D-13. Sample Display 13**

2. Make sure the MS-DOS diskette is in drive A. (If you want to verify a source diskette other than MS-DOS, remove the MS-DOS diskette from drive A and insert the source diskette.)
3. Press any key.
4. After a short time your display will appear as shown in Figure D-14.



**Figure D-14. Sample Display 14**

5. Remove the MS-DOS diskette (or your source diskette) and insert the backup.
6. Press any key.
7. After a short time, your display is shown in Figure D-15.
8. Remove the backup and put the MS-DOS diskette (or your source diskette) back in drive A.
9. Press any key.
10. Repeat steps 4 through 9 until your display appears as is shown in Figure D-16.

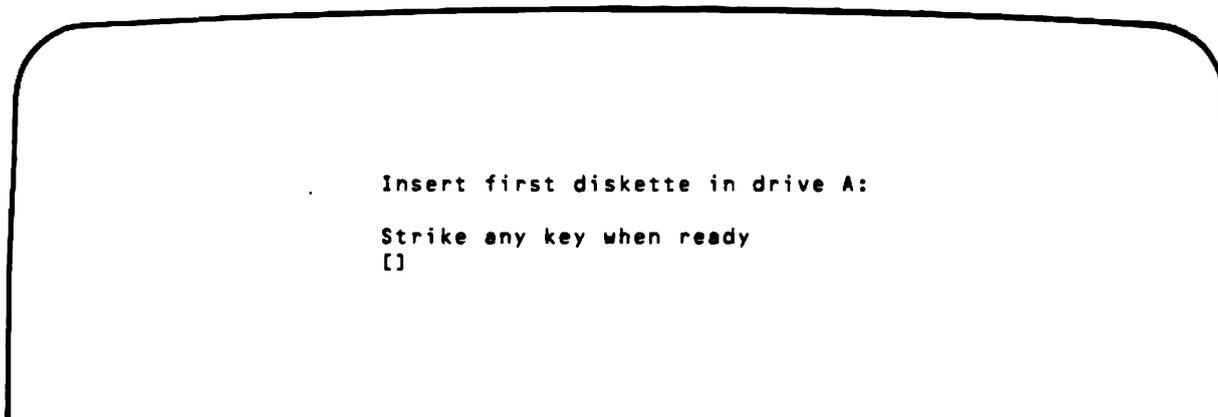


Figure D-15. Sample Display 15

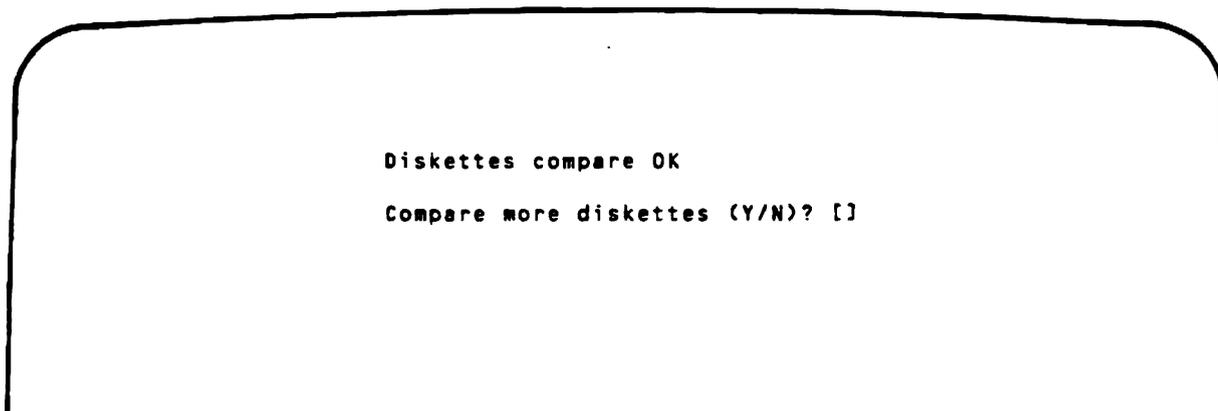


Figure D-16. Sample Display 16

11. The comparison is now complete and MS-DOS wants to know if you want to compare more diskettes. Type n for no.

**D.1.2.4 Labeling Your Backup.** The last step involved in backing up your MS-DOS diskette (or your source diskette) is to label it. First remove the backup diskette. *Only use a soft felt-tipped pen if you are writing on a label already on the diskette.* It's a good idea to put today's date on the label.

*We also recommend using the backup diskette in your daily operations and safely storing the original MS-DOS diskette (or source diskette).*

## D.2 HOW TO DO A QUICK BACKUP

There's a way to simplify backing up diskettes. What we did in the previous section is summarized in the following list.

1. Formatted a backup diskette (using FORMAT command)
2. Copied a diskette (using DISKCOPY command)
3. Compared backup to source (using DISKCOMP command)

The DISKCOPY command has two options which incorporate both the FORMAT and the DISKCOMP commands. Using these options you can reduce making a backup to a single command. It's important when you use the DISKCOPY command with these options that you remember all three operations are done in succession.

To use the DISKCOPY with the options, type the following for a dual diskette drive system.

```
diskcopy A: B: /F /V
```

The format option is signified by the /F. The /V denotes the disk compare option and stands for "verify."

To use the DISKCOPY with a single diskette drive system, type:

```
diskcopy /F /V
```

For more details on using these options with the DISKCOPY command, refer to the *MS-DOS Operating System* manual.

### D.3 HOW TO MAKE AN APPLICATION DISKETTE MORE CONVENIENT

Before you use an application program for the first time, follow the procedure in this section. This procedure describes how to backup your application diskette for daily use.

First, MS-DOS is copied onto the backup. Next, the programs on the application diskette are added to the backup. This backup can now be directly installed whenever you start your system.

These instructions are separated into two groups: those for users with dual diskette drive systems, and those for users with single diskette drive systems.

#### D.3.1 If You Have Dual Diskette Drives

Ensure your system is ready for this procedure by following these steps.

1. Locate the MS-DOS diskette.
2. Place it in drive A and close the latch of the diskette drive.
3. Ensure that the MS-DOS prompt A: appears on the display.
4. Select a diskette, preferably a new one. This diskette will become the backup.
5. Insert the backup diskette into drive B and close the latch of the diskette drive.
6. Type:  

```
format B: /S
```

and press the RETURN key.
7. Your display appears as shown in Figure D-17.

```
A:format B:/S
MS-DOS Diskette Format Utility version 1.10

Insert new diskette for drive B:
and strike any key when ready []
```

Figure D-17. Sample Display 17

8. Press any key. This FORMAT copies the system files from the MS-DOS diskette to your backup.

9. After about 30 seconds, the display appears as shown in Figure D-18.

```
A:format B:/S
MS-DOS Diskette Format Utility version 1.10

Insert new diskette for drive B:
and strike any key when ready

System transferred

160256 bytes total disk space
15872 bytes used by system
144384 bytes available on disk

Format another (Y/N)? []
```

Figure D-18. Sample Display 18

10. Type n for no.

11. Locate the application diskette to be backed up and ensure it is write-protected. Remove the MS-DOS diskette from drive A and insert the application diskette.

12. Type:

copy \*.\* B:

and press the RETURN key. The COPY command is used to copy all the files from the application diskette onto the backup.

13. After a short time you will see a display similar to the display shown in Figure D-19.

(The real names of the files on your application diskette appear instead of the ones shown in the preceding display.)

```
A:copy*.*B:
File1
File2
File3
3 file(s) copied
A:[]
```

Figure D-19. Sample Display 19

14. Remove the backup diskette in drive B and label it. Store the original application diskette and use the backup for daily operations.

Now, whenever you want to use this software application program, insert the backup just made and start your system.

### D.3.2 If You Have a Single Diskette Drive

Ensure that your system is ready for this procedure by following these steps:

1. Locate the MS-DOS diskette.

2. Place it in drive A and close the latch of the diskette drive.

3. Ensure that the MS-DOS prompt A: appears.

4. Select a diskette, preferably a new one. This diskette will become the backup.

5. Type:

`format /S`

and press the RETURN key.

6. Your display is shown in Figure D-20.

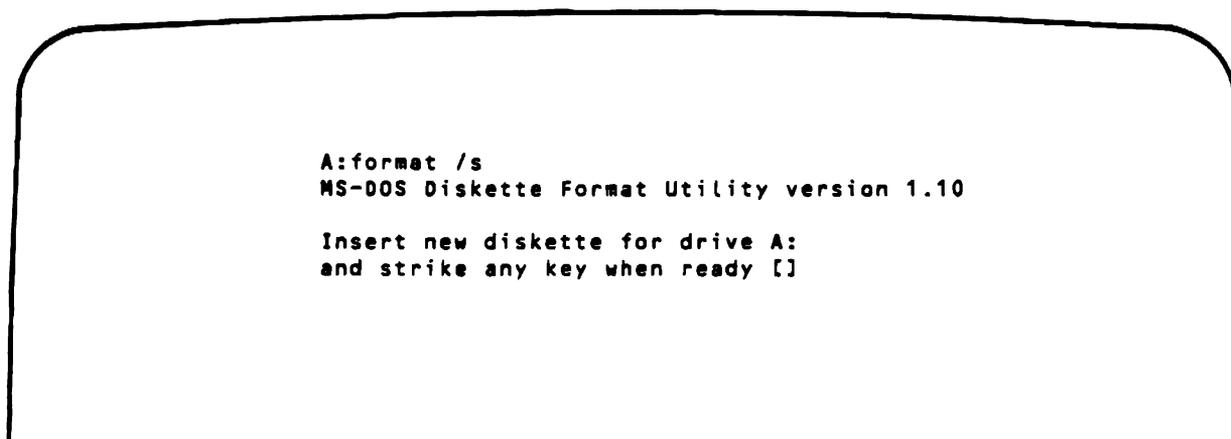


Figure D-20. Sample Display 20

7. Replace the MS-DOS diskette with the backup.
8. Press any key. This **FORMAT** copies the system files from the MS-DOS diskette to your backup.
9. After about 30 seconds, the display appears as shown in Figure D-21.

```
A:format /s
MS-DOS Diskette Format Utility version 1.10

Insert new diskette for drive A:
and strike any key when ready []

System transferred

160256 bytes total disk space
15872 bytes used by system
144384 bytes available on disk

Format another (Y/N)? []
```

**Figure D-21. Sample Display 21**

10. Type **n** for no.
11. Locate the application diskette to be backed up and ensure that it's write-protected. Remove the backup diskette from drive A and insert the application diskette.
12. Type:  
  
    copy \*.\* B:  
  
and press the **RETURN** key. The **COPY** command is used to copy all the files from the application diskette onto the backup. The files are copied one at a time.
13. After a short time you will see a display similar to the one shown in Figure D-22.  
  
(The real name of a file on your application diskette appears instead of File1.)
14. Replace the application diskette with the backup and press any key.
15. After a short time you will see a display similar to Figure D-23.

```
A:copy*,*B:  
File1  
Insert diskette for drive B:  
Strike any key when ready []
```

**Figure D-22. Sample Display 22**

```
A:copy*,*B:  
File1  
Insert diskette for drive B:  
and strike any key when ready []  
Insert diskette for drive A:  
and strike any key when ready []
```

**Figure D-23. Sample Display 23**

16. Replace the backup diskette with the application diskette and press any key.

17. Repeat steps 13 to 16 until your display appears similar to Figure D-24.

```
A:copy *.* B:
File1
Insert diskette for drive B:
and strike any key when ready []
Insert diskette for drive A:
and strike any key when ready []
File2
Insert diskette for drive B:
and strike any key when ready []
Insert diskette for drive A:
and strike any key when ready []
File 3
Insert diskette for drive B:
and strike any key when ready []
Insert diskette for drive A:
and strike any key when ready []
3 file(s) copied
A: []
```

Figure D-24. Sample Display 24

(The real names of the files on your application diskette appear instead of the ones shown in the preceding display.)

18. Remove the backup diskette in drive A and label it. Store the original application diskette and use the backup for daily operations.

Whenever you want to use this software application program, insert the backup you just made and start your system.

#### D.4 WAYS TO TAKE CONTROL OF YOUR SYSTEM

Now that you've had a little experience operating your system, here are some ways you can take more control.

##### D.4.1 How to Stop a Command After You've Pressed the RETURN Key

To stop MS-DOS at any time, press and hold **SHIFT** and then press the **BRK/PAUS** key. Now release both of them. MS-DOS stops doing every-

thing (terminates), and returns the prompt to let you know it's ready for your next command.

##### D.4.2 How to Temporarily Stop a Command

Sometimes your system shows information on the display faster than you can read it. For example, when you do a directory listing of a diskette that has more files than can be displayed, you may miss seeing the first few items. To stop the command temporarily, press the **BRK/PAUS** key once. This stops the display from scrolling.

*Whenever you decide to continue the command, press any key.*

#### NOTE

*The next two methods described assume you have a printer connected to your system. In order to take advantage of these methods with a serial printer, first use the CONFIG command as described in the manual entitled *MS-DOS Operating System*.*

#### D.4.3 How to Print What's on the Display

Sometimes you may want a record of what is on your display. This might include directory listings or the contents of a particular file. To do this, first make sure your printer is ready to receive information. (Refer to the manufacturer's manual if you have questions on how to do this.) Press and hold the **SHIFT** key, and then press the **PRNT** key. Then release both of the keys. Everything that's on the display will be printed.

#### D.4.4 How to Print Everything

If you want to print the information you enter and the MS-DOS responses, press the **PRNT** key once. Now whenever you finish entering a command (by pressing the **RETURN** key), or whenever MS-DOS sends you a line on the display, this information is recorded by the printer. The word used to describe this is "echoing".

To stop echoing, press the **PRNT** key once again.

Echoing is different from printing what's on the display (as described in the previous section). The latter method takes a "snapshot" of the information on the display, at one particular time, and prints it. Echoing is a *continuous* feature that operates similar to a light switch. Turn echoing on and it stays on, printing everything that transpires on the display. Like a light, echoing stays on until you turn it (or your computer) off.

#### D.4.5 Restarting MS-DOS

Although we've mentioned this previously, we repeat it here. To restart MS-DOS at any time after your system is on, press and hold both the **CTRL** and the **ALT** keys, and then press the **DEL** key. Then release all the keys. Any information in the system unit memory, that wasn't saved on a disk, is now lost.

Remember that you need the MS-DOS diskette in one of the diskette drives.

After the system does its power-up self-test, MS-DOS asks you for the date and time.

### D.5 SOME MS-DOS COMMANDS

This section is designed to give you a "hands-on" feel for using some of the MS-DOS commands.

Do the examples after reading the appropriate step. Your display should look very similar at each step to the ones we show here unless a mistake has been made.

Specifically, we first look at the contents of a certain file on the MS-DOS diskette. Then we make a copy of this file. After this step, we compare the files to see that they have the same information. Then the name of the copy file is changed. Finally, we erase the copy file from the diskette.

At each step we look at the copy file (and sometimes the disk directory) to see what each command accomplished.

*Be sure you use the backup of the MS-DOS diskette. Also, make sure that its write-protect notch is uncovered.*

*These instructions apply to both single- and dual-diskette drive systems.*

#### D.5.1 Looking at the Contents of a File

1. Place the backup MS-DOS diskette in the left-hand drive and close the latch. Make sure the MS-DOS prompt, **A:**, appears.
2. Type:

```
dir
```

and then press the **RETURN** key.

MS-DOS lists all the files on the diskette. One of these files has the name **LIBRARY.DOC**. (Remember the directory listing shows a file's name without the period separating the file name and the extension.)

Type:

```
type library.doc
```

and then press the **RETURN** key. We haven't used the drive designator, **a:**, because this file is on the default disk drive.

Your display is shown in Figure D-25.

LIBRARY OF COMMONLY USED MS-DOS COMMANDS

Command	What its used for	Internal(I) or External(E)
DIR	lists all the files on a disk	I
TYPE	shows the contents of a file	I
DATE	changes the current date	I
TIME	updates the current time	I
COPY	copies a file to any disk	I
RENAME	changes the name of a file	I
ERASE	removes a file from a disk	I
FORMAT	prepares a disk to accept information	E
DISKCOPY	makes a backup disk	E
DISKCOMP	determines if two disks have the same data	E
A:[]		

Figure D-25. Sample Display 25

The contents of \_\_LIBRARY.DOC are on the display. It has a list of commonly used MS-DOS commands. We want to make a copy of this file.

4. If you have a printer, make a copy of the information on the display. To do this, press and hold the **SHIFT** key and then press the **PRNT** key. Then release both keys.

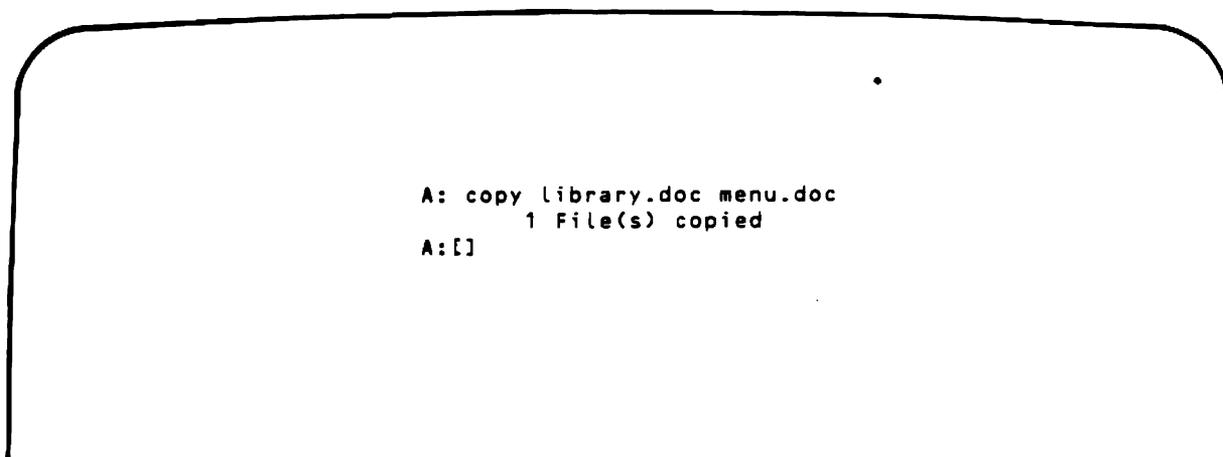
#### D.5.2 Copying LIBRARY.DOC

To copy a file, the COPY command is used. The copy is made to a file named MENU.DOC.

1. Type:

copy library.doc menu.doc

and then press the **RETURN** key. Your display should be similar to Figure D-26.



**Figure D-26. Sample Display 26**

MS-DOS has let you know that one file was copied. Now there should be a file on the diskette with the name MENU.DOC that is identical to LIBRARY.DOC. We chose the name, MENU.DOC, because this file has a "menu" of choices of MS-DOS commands.

#### **D.5.3 Comparing the Two Files**

To compare the two files, use the TYPE command.

1. Type:

```
type menu.doc
```

and then press the RETURN key.

Does MENU.DOC show the same information that LIBRARY.DOC did?

2. Now we use the DIR (for directory) command to further convince ourselves that both files exist on the diskette.

Type:

```
dir
```

and then press the RETURN key. Do you see these two files? Do they both have the same number of characters?

There is another MS-DOS command, FILCOM, that "looks" at the files for you and does the comparison. Its use is described in the *MS-DOS Operating System* manual.

#### **D.5.4 Changing the Name of MENU.DOC**

There's a command you'll use at times to change the filename or extension, or both. Nothing else related to the file is changed when this command is used. This command is RENAME.

1. Change the filename MENU.DOC to COMMANDS.DOC by typing:

```
rename menu.doc commands.doc
```

and then press the RETURN key.

The file MENU.DOC should have "disappeared" from the diskette and COMMANDS.DOC should now "appear."

To check this, first do a directory listing.

2. Type:

```
dir
```

and then press the RETURN key. Does COMMANDS.DOC show up? How about MENU.DOC?

3. Now, let's look at the contents of COMMANDS.DOC. Type:

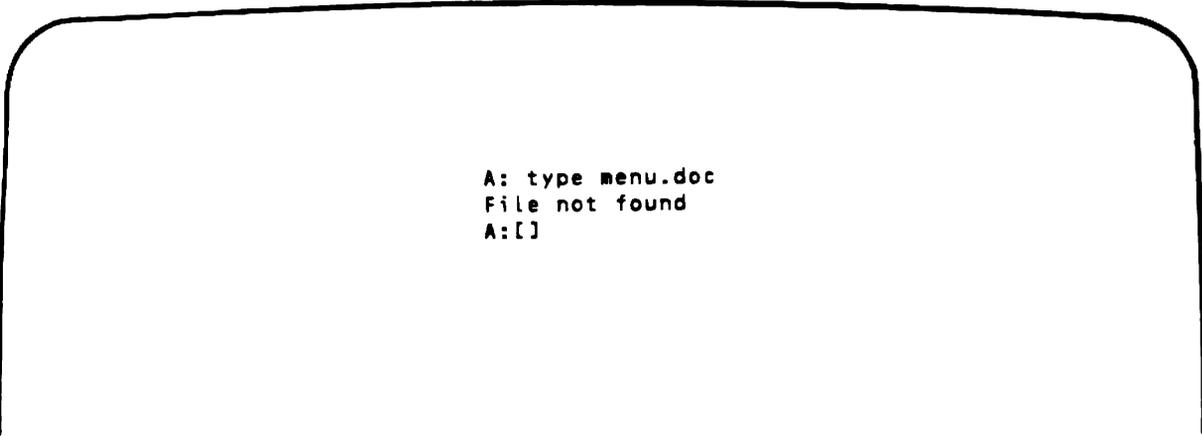
type commands.doc

and then press the **RETURN** key. Does it look the same as MENU.DOC ?

4. That happens if we look at the contents of MENU.DOC ? Type:

type menu.doc

and then press the **RETURN** key. Your display should look similar to the Figure D-27.



```
A: type menu.doc
File not found
A:[]
```

**Figure D-27. Sample Display 27**

MS-DOS is telling you that no file with the name MENU.DOC exists. This is what should happen when you rename a file.

#### **D.5.5 Erasing COMMANDS.DOC from the Diskette**

As the final step, we'll erase COMMANDS.DOC from the diskette by using the ERASE command.

It's common practice to remove files (using ERASE) from diskettes. Sometimes files have out-of-date information. You might copy some files to a different diskette and then want to erase them. Or you might just not want that information any-

more. Or you might want to free up diskette space for some other files. In any event, *use care with the ERASE command. Once the file is erased the information is gone.*

1. To erase COMMANDS.DOC, type:

erase commands.doc

and press the **RETURN** key. This file will no longer be on the diskette.

2. To verify that COMMANDS.DOC is not on your diskette, use the TYPE and DIR commands.

# Appendix E

## MS-DOS Messages

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### E.1 INTRODUCTION

This appendix is provided to assist you in responding to MS-DOS messages. Each message is described and the appropriate action(s) specified.

We use bold type to indicate the message you see on the display. Below each message is the command that caused the message. (If this word is MS-DOS and/or commands, the message could have occurred from several commands or programs.)

### E.2 MS-DOS MESSAGES

**Bad command or file name**

**MS-DOS.** The command and/or filename entered is not valid.

**Action:** Check that the command is a valid internal or external MS-DOS command; also check the diskette(s) to ensure the requested file exists.

**Bad or missing Command Interpreter**

**STARTUP.** The diskette in drive A does not contain the correct MS-DOS files.

**Action:** Try to restart the system. If this error persists make another backup from the MS-DOS diskette.

**Compare error(s) on Track xx, side xx**

**DISKCOMP.** The two diskettes contain different information.

**Action:** Make another backup if required.

**Compare more diskettes (Y/N)?**

**DISKCOMP.**

**Action:** Press Y if you want to compare more diskettes. Otherwise, press N.

**Copy another (Y/N)?**

**DISKCOPY.**

**Action:** Press Y if you want to copy another diskette. Otherwise, press N.

**Copy complete**

**DISKCOPY.** The destination diskette now has the same information as the source diskette.

**Action:** None.

**Copying n side(s)**

**DISKCOPY.** The number n is 1 for single-sided diskettes, and 2 for double-sided diskettes.

**Action:** None.

Could not read a copy of the boot sector

**FORMAT.** You do not have a valid MS-DOS diskette mounted in any disk drive in the system. Your system disk may have a bad boot sector.

**Action:** Insert an MS-DOS diskette in any drive and try again.

Could not write the boot sector, disk will not boot

**FORMAT.** An I/O error occurred while writing the boot sector.

**Action:** The disk may be useable as a data disk.

Data error reading drive x  
Abort, Retry, Ignore?

**MS-DOS.**

**Action:** Refer to the message Disk error reading drive x.

Data error reading drive x  
Abort, Retry, Ignore?

**MS-DOS.**

**Action:** Refer to the message Disk error reading drive x.

Destination disk is write protected  
Correct, then strike any key

**DISKCOPY.** The destination diskette is write protected.

**Action:** Remove the write-protect tape and reinsert this diskette.

Disk boot failure

**MS-DOS**

An error has occurred while attempting to start MS-DOS.

**Startup,**

**Action:** Try restarting. If the message repeats, use a backup MS-DOS diskette. Will usually be followed by a system error message.

Disk error reading drive x  
Abort, Retry, Ignore?

**MS-DOS.**

An error has occurred while reading from or writing to a diskette.

**Action:** Try the responses in this order to recover:

1. R for retry. The read or write will be tried again.

2. A for abort. This entry will abort the program.

3. I for ignore. The error is ignored and the program continues.

**CAUTION**

**Data can be lost when using the I response.**

Disk error writing drive x  
Abort, Retry, Ignore?

**MS-DOS.**

**Action:** Refer to the message *Disk error reading drive x.*

Disk format error, possible hardware failure

**FORMAT.** The disk does not appear to have been formatted even though **FORMAT** has just finished the format operation. Probable disk hardware failure.

**Action:** Report this problem to your dealer.

Disk format error reading drive x  
Abort, Retry, Ignore?

**MS-DOS.**

Diskette in question may not have been formatted prior to use.

**Action:** Refer to the message Disk error reading drive x.

Disk format error writing drive x  
Abort, Retry, Ignore?

**MS-DOS.** Diskette in question may not have been formatted prior to use.  
**Action:** Refer to the message Disk error reading drive x.

Disk unsuitable for system disk

**FORMAT.**  
**Action:** Use another diskette as a system diskette.

Divide overflow

**MS-DOS.** A mathematical or logical error was encountered by the system during its execution of a program.  
**Action:** Inspect your program for division by zero or logical error. If this error occurs during the execution of a standard MS-DOS program (in other words, not a user program) then report this problem to your dealer.

Drive is not a floppy disk,  
cannot format

**FORMAT.** You have attempted to format on a disk drive not in the range A: through D:.  
**Action:** Use only on disk drives A: through D:.

Drive is not ready

**FORMAT.** There is no diskette in the drive and/or the drive door is open.  
**Action:** Correct problem and retry.

Drive is missing or hardware failure occurred

**FORMAT** Cannot detect the presence of the specified drive.  
**Action:** If specified drive is not there, don't access that drive. If it is, report this problem to your dealer.

Duplicate filename or file not found

**RENAME.** One of two things has happened. Either you attempted to rename a file to one that already exists on the diskette, or the file that was to be renamed couldn't be found on the specified diskette.  
**Action:** Ensure that both file names are valid.

File allocation table bad, drive x  
Abort, Retry, Ignore

**MS-DOS.**  
**Action:** Refer to the message Disk error reading drive x. If you continue to get this message, use the **FORMAT** command to initialize this diskette again.

File cannot be copied onto itself

**COPY.**  
**Action:** Inspect the two names used and ensure that the copy file name is different or that it is to be copied to a different diskette.

File creation error

**MS-DOS and** You have attempted to add a new file to the directory. Either your diskette is full, or you have exceeded the maximum number of files allowed on the diskette.  
**commands.**  
**Action:** Use the **DIR** or **CHKDSK** command to determine the status of the diskette.

File not found

**MS-DOS and** A file that you have specified when using a command does not exist.  
**commands.**  
**Action:** Reenter a valid filename.

Format failure

**FORMAT.** A diskette error occurred while formatting.  
**Action:** Try formatting a different diskette. Do not use the diskette that caused the error.

Formatting while copying

**DISKCOPY.**  
**Action:** None.

Hardware failure occurred

**FORMAT.** A disk I/O operation failed to complete.  
**Action:** Report this problem to your dealer.

Incompatible diskette or drive types

**DISKCOMP.** The source diskette and diskette drive are double-sided, and either the destination diskette or the diskette drive is single-sided.  
**Action:** Ensure you are using a double sided diskette for the destination.

Incompatible drive types

**DISKCOPY.** The source diskette and diskette drive are double-sided, and the destination diskette drive is single-sided.  
**Action:** Ensure your diskette drives are the same.

Insert MS-DOS disk in xxxxx and strike any key when ready

**MS-DOS and FORMAT.** The MS-DOS diskette is not present in drive x.  
**Action:** Reinsert the MS-DOS diskette in drive x.

Insert first diskette in drive x  
Insert second diskette in drive y

**DISKCOMP.**  
**Action:** Insert the appropriate diskette into drive x or y.

Insert source diskette in drive x  
Insert destination diskette in drive y

**DISKCOPY.**  
**Action:** Insert the appropriate diskette into drive x or y.

Insufficient disk space

**MS-DOS and commands.** You have attempted to increase the size of a file or to add a new file to the directory. Either your diskette is full, or you have exceeded the maximum number of files allowed on the diskette.  
**Action:** Use the DIR or CHKDSK command to determine the status of the diskette.

Invalid COMMAND.COM in drive n

**MS-DOS.** There is a problem with a file on the MS-DOS diskette.  
**Action:** Use a backup MS-DOS diskette.

Invalid date

**DATE.**  
**Action:** Enter a new date. (See Chapter 2.)

Invalid drive specification

**MS-DOS and commands.** An invalid drive specification was entered.  
**Action:** Enter a valid drive specification (in other words, A:, B:, C:, and so on).

Invalid parameter

**DISKCOMP, DISKCOPY, and FORMAT.**  
**Action:** Enter a valid parameter.

Invalid time

**TIME.**  
**Action:** Enter a valid time. (See Chapter 2.)

Missing file name

**RENAME.** The new filename hasn't been specified.  
**Action:** Specify the old and new filenames when using this command.

Not ready error reading drive x  
Abort, Retry, Ignore?

**MS-DOS.**  
**Action:** Refer to the message *Disk error reading drive x.*

Not ready error reading drive x, or  
Not ready error writing drive x  
Correct, then strike any key

**DISKCOMP** The diskette is not inserted in the and indicated drive.  
**DISKCOPY.**  
**Action:** Insert the diskette in the designated drive.

Not ready error writing drive x  
Abort, Retry, Ignore?

**MS-DOS.**  
**Action:** Refer to the message *Disk error reading drive x.*

Out of paper  
Abort, Retry, Ignore?

**MS-DOS.**  
**Action:** Install additional paper in the printer.

Printer fault  
Abort, Retry, Ignore?

**MS-DOS.**  
**Action:** Ensure that the printer is ready.

Printer not installed  
Abort, Retry, Ignore?

**MS-DOS.**  
**Action:** Make sure the cables are connected.

Printer not ready  
Abort, Retry, Ignore?

**MS-DOS.**  
**Action:** Make sure the cables are connected and the printer is ONLINE.

Sector not found error reading drive x  
Abort, Retry, Ignore

**MS-DOS.**  
**Action:** Refer to the message *Disk error reading drive x.*

Sector not found error writing drive x  
Abort, Retry, Ignore

**MS-DOS.**  
**Action:** Refer to the message *Disk error reading drive x.*

Seek error reading drive x  
Abort, Retry, Ignore

**MS-DOS.**  
**Action:** Refer to the message *Disk error reading drive x.*

Seek error writing drive x  
Abort, Retry, Ignore

**MS-DOS.**  
**Action:** Refer to the message *Disk error reading drive x.*

Sector not found error ready drive x  
Abort, Retry, Ignore

**MS-DOS.**  
**Action:** Refer to the message *Disk error reading drive x.*

Track 0 bad-disk unusable

**FORMAT.**  
**Action:** Use another diskette.

Unexpected error, possible hardware failure

**FORMAT.** An error has occurred on a disk I/O which **FORMAT** never expects to happen. Probable disk hardware failure.

**Action:** Report this problem to your dealer.

Unrecoverable read error on drive x  
Track xx, side x

**DISKCOMP.** Data couldn't be read from the diskette in drive x.

**Action:** Copy as much information as possible onto a new diskette.

Unrecoverable format error on destination

**DISKCOPY** The diskette is not formattable. with the /f option.

**Action:** The destination diskette is unusable.

Unrecoverable verify error on destination Track xx, side x

**DISKCOPY.** Data is not the same on the diskettes being compared.

**Action:** Copy the diskette again and retry.

Unrecoverable read error on source  
Track xx, side x

**DISKCOPY.** Data couldn't be read from the source diskette.

**Action:** The backup may contain incomplete information. Copy as much information as possible from the source onto a new diskette.

Unrecoverable write error on destination Track xx, side x

**DISKCOPY.** Data could not be written on the destination diskette.

**Action:** The backup may contain incomplete information. Use another diskette as the backup.

Write protect error writing drive x  
Abort, Retry, Ignore

**MS-DOS.**

**Action:** Ensure the diskette in drive x has nothing covering its write-protect notch. Refer to the message *Disk error reading drive x.*

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