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DECstation/DECsystem 5000 Model 200 Series

Maintenance Guide

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This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such radio frequency interference. Operation of this equipment in a residential area may cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

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About This Guide

Intended Audience

This guide is for Digital customer service representatives who have completed training in DECstation 5000 Model 240 and 260 maintenance. This guide assumes that you are familiar with basic maintenance and troubleshooting operations and that you have experience with desktop computer systems.

How To Use This Guide

This guide explains how to identify and replace failed field-replaceable units (FRUs). Part I describes the FRUs and how to remove and install them. Part II describes the messages, tests, and procedures used when troubleshooting the system. Part III provides reference information.

For an overview of the system hardware and its configurations, see Chapter 1, “System Overview.”

For information about console mode, used for maintenance operations and operating mode, used for regular software operations, see Chapter 2, “Console Mode and Operating Mode.”

To install an alternate terminal as the console when the regular monitor is inoperative, see Chapter 3, “Alternate Terminal.”

Replacement procedures for non-electronic hardware, are contained in Chapter 4, "General Hardware Service Operations."

See Chapter 5, "Electronic Component Service Operations," for replacement procedures for electronic components.

For information about using small computer system interface (SCSI) storage drives, see Chapter 5, "Electronic Component Service Operations."

The keyboard and pointing devices, including the mouse and tablet, are in Chapter 7, "Keyboards and Pointing Devices."

For an overview of the tools that are used most often when troubleshooting the workstation, see Chapter 8, "Troubleshooting Overview."

For a description of the information available to help you identify failed FRUs, see Chapter 9, "Troubleshooting Information."

For a description of the tests and scripts used when troubleshooting, see Chapter 10, "Troubleshooting Tools."

For a set of specific troubleshooting procedures, see Chapter 11, "Troubleshooting Procedures."

For equipment specifications, see Appendix A, "Equipment Specifications."

For equipment part numbers, see Appendix B, "Part Numbers."

For an explanation of console commands, see Appendix C, "Console Commands."

For an explanation of individual system module and memory module tests, see Appendix D, "Base System Self-Test Commands and Error Messages."

For information about connector pin assignments, see Appendix E "CPU and System Registers."

For information about CPU and system registers, see Appendix F "Connector Pin Assignments."

Scope

This maintenance guide discusses current DECstation 5000 Model 240 and 260 hardware, and will be revised as additional options become available.

Table 1. Conventions

Convention	Use
`Monospace type`	`Anything that appears on your monitor screen is set in monospace type, like this.`
Boldface type	**Anything you are asked to type is set in boldface type, like this.**
Italic type	*Any part of a command that you replace with an actual value is set in italic type, like this.*

Part I

Hardware

1

System Overview

This chapter provides an overview of the DECstation 5000 Models 240 and 260 hardware, and discusses the following topics:

- Basic system hardware
- System hardware configurations
- Hardware options and peripherals

System Hardware Configurations

The DECstation 5000 Models 240 and 260 are reduced instruction set computer (RISC) desktop systems based on the MIPS Technologies, Inc. R3000 and R4000 processors. They are designed to support the ULTRIX operating system.

- The system can be configured as either a workstation or a server.
  - When the system is configured as a workstation, the user input and output devices are a graphics monitor connected to a TURBOchannel option graphics module, a keyboard, and a mouse or tablet.
  - When the system is configured as a server, the user input and output devices are a keyboard connected to a terminal which in turn is connected to serial communications port 3.
- The base system can be connected to the following devices:
  - One keyboard and mouse
  - Up to seven small computer system interface (SCSI) storage devices
  - One Ethernet network
  - Two modems, terminals, printers, or other serial devices
- Graphics monitors and additional storage devices, network connections, and serial devices can be supported by adding TURBOchannel option modules.

Figure 1-1 shows the layout of the functional areas of the DECstation 5000 Models 240 and 260.

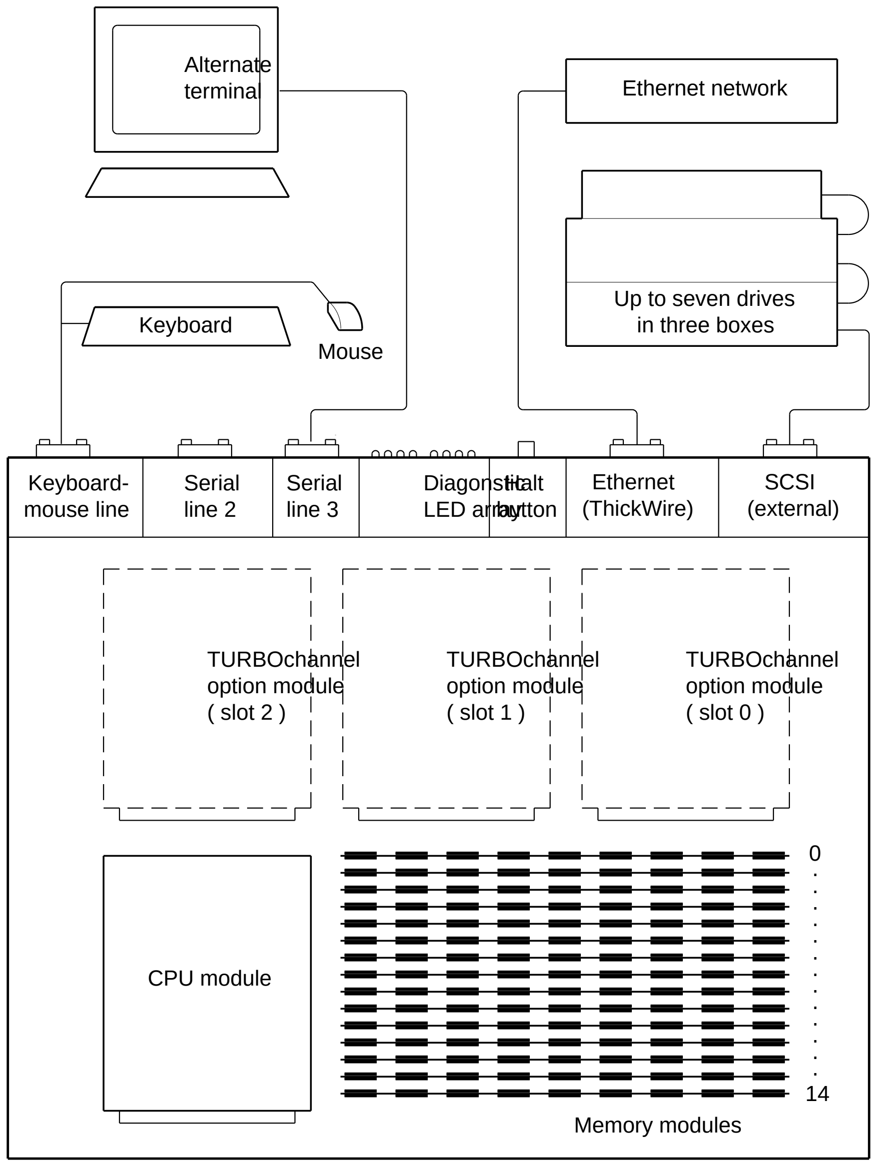


Figure 1-1. DECstation 5000 Model 240 & 260 functional areas

System Unit

The system unit is an assembly of modular components of the workstation, including the system unit chassis and cover, the modules, and the power supply. The modular components are called field replaceable units (FRUs). The components and features of the system unit are as follows:

- Base system module, which includes the following:
  - One double connector for the central processing unit (CPU) module
  - One keyboard/mouse interface for the keyboard and pointing device (mouse, tablet and stylus, or tablet and puck)
  - Fifteen memory module connectors for single in-line memory modules (SIMMs), providing up to 480 megabytes of random-access memory (RAM). A 1-megabyte nonvolatile RAM (NVRAM) module, which functions as a disk cache, can be installed in slot 14.
  - One SCSI controller for up to seven drives
  - Two synchronous/asynchronous RS232 serial communications ports with full modem control
  - One ThickWire Ethernet controller
  - Three connectors for TURBOchannel option modules
  - Diagnostic read-only memory (ROM)
- Replaceable/upgradeable CPU module with data and instruction cache memory
- Power supply assembly with three cooling fans
- One metal chassis that holds the system module and power supply
- Removable system unit cover and removable front cover plate

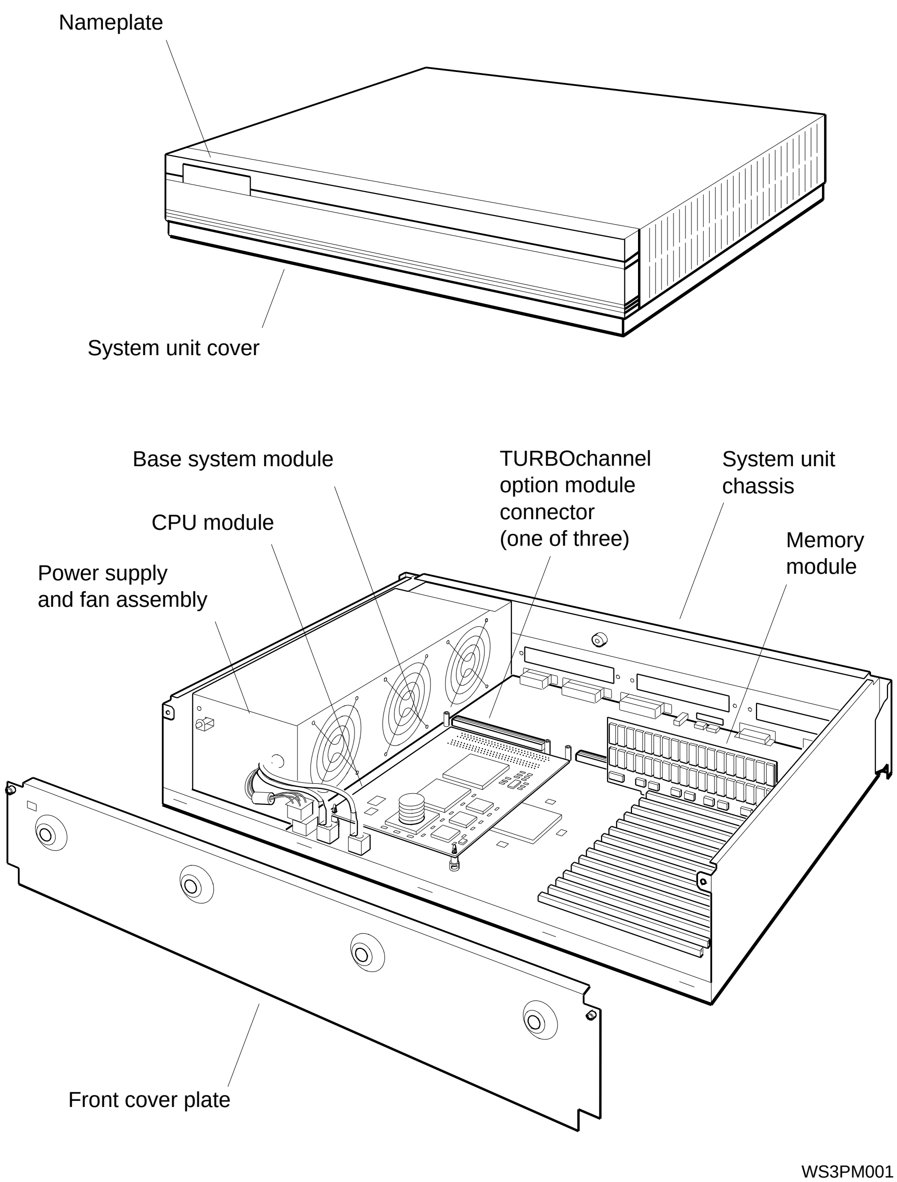


Figure 1-2. System unit

Controls and Indicators

The system unit controls and indicators are listed here and shown in Figure 1-3.

- The on/off switch controls the power to the system unit. Press down the 1 side of the switch to turn the power on. Press down the 0 side of the switch to turn the power off.
- The power indicator light-emitting diode (LED) glows green when the power supply is operating properly. This LED is also referred to as the DCOK LED.
- The diagnostic LED array contains two sets of four LEDs that display error codes that help you identify faulty components.
- The Halt button halts the operating system and puts the workstation into console mode.

On/off switch

Halt button

Back view

WS3PM003

icators on the system unit

External System Unit Connectors

The external system unit connectors on the back panel connect the workstation to external devices. The external system unit connectors are listed here and shown in Figure 1-4.

- The power connector provides alternating current (AC) power to the system unit from the system unit power cord.
- The system-unit-to-monitor power connector provides electric power to the monitor.
- The keyboard-mouse connector links the system unit to the keyboard-mouse cable.
- The base system ThickWire Ethernet connector links the base system Ethernet controller to an Ethernet network.
- The base system external SCSI connector connects the base system SCSI controller to a chain of external SCSI drives.
- The two RS-232 serial communication connectors link the base system to external devices such as printers, modems, or console terminals.
- Up to three option module connectors (in a row above the other connectors listed here) connect TURBOchannel option modules to external hardware. The number printed above each option module position is the logical slot number by which an option module mounted in that position is addressed in test commands and identified in error messages.

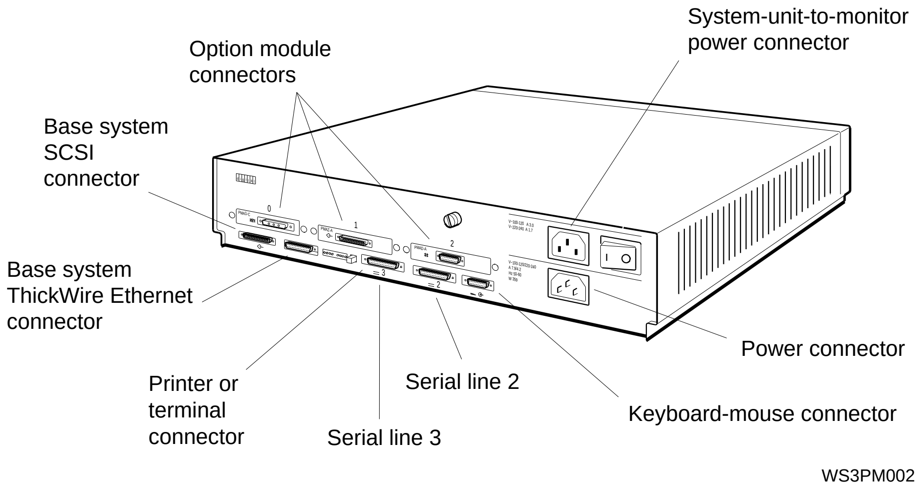


Figure 1-4. External system unit connectors

Internal Base System Module Connectors

The internal base system module connectors are the means by which the system's modular components, both standard and optional, are connected to the base system module and, through it, to each other. The internal base system module connectors are listed here and shown in Figure 1-5.

- The CPU module connector connects the CPU module to the base system module.
- Fifteen memory module connectors provide the means for installing SIMMs and one optional NVRAM module.
- Three internal TURBOchannel option module connectors connect TURBOchannel option modules to the base system module. The connector closest to the power supply is referred to as logical slot number 2 in test commands and error messages. The middle connector is logical slot 1, and the connector furthest away from the power supply is logical slot 0.
- The power input connectors receive direct current (DC) power from the power supply for all components in the system unit enclosure.

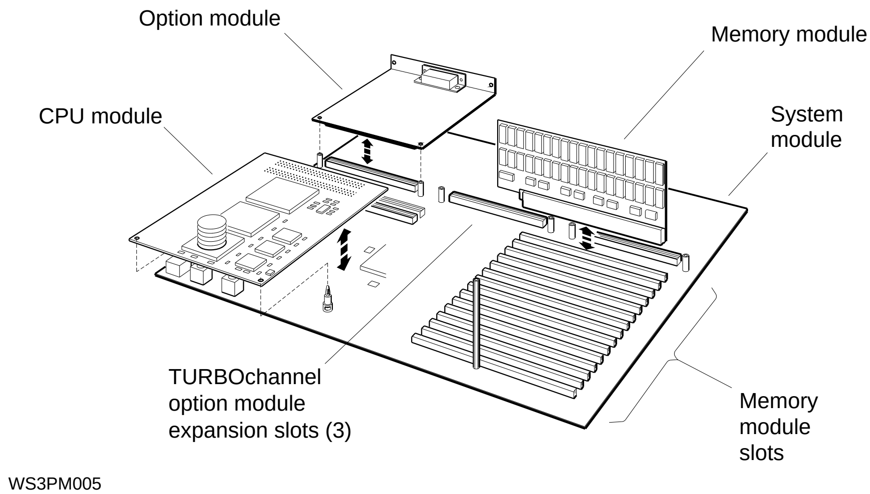


Figure 1-5. Internal base system module connectors

Hardware Options and Peripherals

The DECstation 5000 Models 240 and 260 support the following hardware options and peripherals:

- A CPU module that can be removed and replaced or upgraded
- SIMMs for up to 480 megabytes of RAM.
- One nonvolatile RAM (NVRAM) module
- Up to three TURBOchannel option modules
- Up to seven SCSI drives per SCSI controller
- Graphics monitors and terminals
- Keyboard and mouse or other pointing device
- RS-232 serial devices

Figure 1-4 and Figure 1-5 show the external and internal connectors that support the hardware options and peripherals.

CPU Module Description

The DECstation 5000 Model 240 contains the KN03-GA CPU module. The DECstation Model 260 contains the KN05-NB CPU module. The KN03-GA CPU module runs at 40 megahertz (MHz) and contains a total of 128 kilobytes of cache memory for instructions and data. The KN05-NB CPU module runs at 60 MHz and contains both a primary cache (internal to the CPU) and secondary cache (external to the CPU). Both CPU modules are replaceable. See the "CPU Module" section in Chapter 5 for information about the CPU module.

System Boot ROM

The system can boot from the system module or from the Boot ROM on the R4000 CPU. Two switches located on the CPU controls the access to the Boot ROM. See Figure 1-6 for the location of these switches. If these two switches are present on the R4000 they must always be in the *OFF* postion, the other postions are used by manufacturing only.

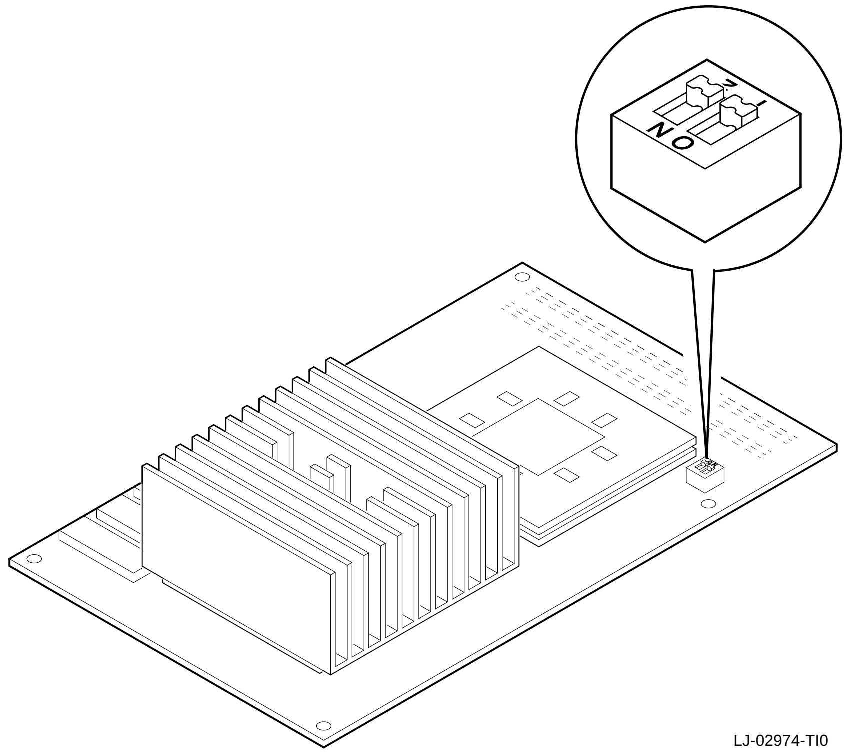


Figure 1-6. System Rom Switches

Note: *Note the orientation of the switches. Switches pointing to the ON postion are on, switches pointing towards the 1, 2 are off.*

Memory Modules

The base system module has 15 memory module connectors. The following memory module types are supported:

- 8-megabyte SIMM (MS02L-AB)
- 32-megabyte SIMM (MS02-CA)
- 1-megabyte NVRAM module (54-20948-01)

Note: *All SIMMs installed in a system must contain the same amount of memory. Do not mix 8-megabyte and 32-megabyte SIMMs in a single system. The NVRAM must be installed in slot 14.*

The SIMMs must be installed starting with memory slot 0, nearest the back of the system. Console mode requires one SIMM installed on the base system module. Operating mode requires greater amounts of RAM, depending on the operating system software installed. See the "Memory Modules" section in Chapter 5 for information about memory modules.

Monitors and Terminals

The monitors supported depend on the TURBOchannel graphics modules installed. Refer to the *TURBOchannel Maintenance Guide* for a list of monitors that each TURBOchannel graphics module supports.

The system can also display console text on and accept keyboard input from a terminal connected to serial port 3 on the back of the system unit. The monitor can be any RS-232 monitor of type VT52 or later. See Chapter 3 for information about installing an alternate terminal.

Keyboard, Mouse, and Other Pointing Devices

The system receives input from the user through a keyboard and a mouse or other pointing devices. The keyboard and mouse or tablet connect to the keyboard-mouse connector on the back of the system unit through the keyboard-mouse cable. See Chapter 7 for information about the keyboard and mouse.

The following keyboards are supported:

- LK401 keyboard
- LK421 keyboard

The following pointing devices are supported:

- VSXXX-GA mouse
- VSXXX-AB tablet

In addition, one or both of the following pointing devices can be connected through one of the serial ports:

- Lighted programmable function keyboard (LPFK)
- Programmable function dials (PFD)

SCSI Drives

The base system module comes with one onboard SCSI controller. In addition, up to three single width TURBOchannel SCSI controller option modules can be added to the system. Each SCSI controller can support up to seven drives. See Chapter 6 for more information about the SCSI drives.

TURBOchannel Option Modules

The TURBOchannel connectors on the base system module can support three TURBOchannel option modules. Any SCSI controller, Ethernet controller, or serial controller TURBOchannel option modules operate in addition to the equivalent functions on the base system module. See the "TURBOchannel Option Modules" section in Chapter 5 for information about removing and installing TURBOchannel option modules. See Chapter 11 for SCSI, Ethernet, and serial controller troubleshooting procedures.

For Further Information

For troubleshooting information, see Chapters 8, 9, 10, and 11.

For detailed information about the FRUs mentioned in this chapter, refer to the chapter later in this guide that discusses the FRU in which you are interested.

For further information about service for TURBOchannel option modules and connected drives and monitors, refer to the TURBOchannel Maintenance Guide.

2

Console Mode and Operating Mode

This chapter discusses the following topics:

- Console mode and operating mode
- Console prompts
- Password management
- System software startup and shutdown

Modes

The system operates in two modes: console mode and operating mode.

Console Mode

Most maintenance operations are conducted in console mode, including the following:

- Displaying hardware configurations (see Chapter 9 and Appendix C)
- Setting environment variables (see Chapters 8 and 10 and Appendix C)
- Running diagnostic tests and scripts (see Chapters 8 and 10 and Appendixes C and D)
- Booting the system software (see the"System Software Management" section in this chapter)

Note: *ULTRIX error logs cannot be accessed from console mode; they can be accessed only from operating mode.*

Console mode operations require that at least one RAM SIMM be installed in slot 0 on the base system module.

Console prompts

When the normal console prompt (>>) is displayed, full console functionality is available, and you can use all console commands.

When the restricted console prompt (R>) is displayed, you can enter only the boot or passwd command.

Console commands, including boot and passwd, are discussed in Chapters 8 and Chapter 10 and Appendix C.

To enter console mode

This section lists the methods of entering console mode in order of recommended preference. Enter console mode in one of the following ways, depending on circumstances:

- If system software is running, shut down the system software. The system enters console mode automatically when system software is shut down. This is the most orderly way to enter console mode as it prevents corruption of the data. See the "To Shut Down System Software" section in Chapter 2.

Note: *Turning off the power while ULTRIX is running can corrupt data.*

- If the system software will not accept the shutdown command, press the Halt button on the rear panel of the system unit. The system backs up what it can and shuts down the operating mode in the most orderly way possible.
- If autoboot is not enabled, turn the system power off, and then turn it on again. The system executes the power-up self-test sequence and then comes up in console mode, displaying one of the console prompts (>> or R>).
- If autoboot is enabled, you will need to defeat autoboot to enter console mode. Defeat autoboot in one of the following ways:
  - Turn the system power off, and then turn it on again.

    Watch the command line on the monitor. As each power-up self-test runs, the name of the test appears on the command line.

    When the screen does not display any test name and the cursor appears on a blank line, quickly press **Ctrl-C**.

    The system aborts the boot process and comes up in console mode, displaying one of the console prompts (>> or R>)
  - Use the clear-NVR jumper to return the environment variables to their default values where autoboot is disabled. See the "To Erase the Password" section in Chapter 2

If the R> prompt is displayed, you can use only the boot and passwd commands until you enter the password. See the "Password Management" section in Chapter 2.

Halt button

The Halt button on the rear panel interrupts the processor. The data in the memory and registers is preserved. An application can be halted to examine the state of memory and registers.

Halt button screen output The following screen output sample shows what would be seen when the halt button is pressed on a Model 260 system (R4000 CPU module installed).

```
>>
???
? PC:  0xa0010048 <vtr=NMI/SR>
? SR:  0x00510006 <BEV,SR,DE,IPL=8,MODE=KNL,ERL,EXL>
? CFG: 0x10410243 <SB=8W,SC=Y,IC=8K,DC=8K,IB=4W,DB=4W,K0=CNC>
?
? MB_CS:  0x00008000 <MSK=0,EE,ECC=0>
? MB_INT: 0x001f0000 <>
?
? at:00000070 a2:00000000 t3:00000002 s0:A00054F0 s5:0000000A k1:FFDFD7FF
? v0:00000067 a3:A0004C70 t4:00000000 s1:A00054F0 s6:0000000D gp:B2CE8E25
? v1:A000FEF0 t0:00000010 t5:00018F00 s2:FFFFFFFF s7:00000015 sp:A000FEBC
? a0:A0004C70 t1:00000010 t6:BFC0E3D4 s3:00000008 t8:BFC0E3D4 fp:0000007F
? a1:A000FEF0 t2:00000001 t7:00000001 s4:00000009 t9:A0010000 ra:A0010050

KN05-AA V1.0a    (PC: 0xa0010048, SP: 0xa000febc)
>>
```

Operating Mode

In operating mode, the system displays the ULTRIX prompt. Operating mode is used for regular software operation.

For maintenance purposes, operating mode is used to access ULTRIX error logs.

Operating mode requires at least 16 megabytes of RAM memory installed on the base system module. Some operating systems and versions require more than 16 megabytes of RAM. Refer to the operating system documentation for information about the amount of RAM required.

To enter operating mode

The system enters operating mode in one of two ways: automatically (autoboot) or manually from console mode.

If autoboot is enabled, the system executes the boot command immediately after the power-up self-test. The system goes directly to operating mode without displaying the console prompt. Autoboot is enabled when the haltaction environment variable has been set to b and the boot environment variable has been set to a meaningful bootpath. The boot and setenv commands and the environment variables are discussed in Appendix C.

Procedures for entering operating mode manually from either console prompt are described in the "To Boot System Software" section in this chapter.

Console Password Management

If a console password has been set, you must enter that password to access full console mode. After the power-up self-test sequence is completed, the screen displays the restricted console prompt (R>). You can use only the boot and passwd commands until you enter the correct password. The console password and the operating mode password are independent of each other. For information about the operating mode password, refer to the system software documentation.

To Enter the Password

1. At the R> prompt, type **passwd** and press Return. The system displays the pwd: prompt.
2. Type the password and press Return.

To Set or Change the Password

1. At the >> prompt, type **passwd- s** and press Return.
2. At the pwd: prompt, type the new password and press Return.
3. The system displays the pwd: prompt again. Enter the password again and press Return.

If the two password entries match exactly (including use of uppercase and lowercase letters), the entry becomes the new password. If the two entries do not match, the old password remains in effect.

- A password must have at least 6 and no more than 32 characters.
- A password must always use the same uppercase and lowercase letters. The system treats the uppercase version and the lowercase version of a letter as two different letters.

To Remove the Requirement for a Password

To remove the requirement for a password, at the >> prompt, type **passwd-c** and press Return.

To Erase the Password

If the password is unknown, you can use the clear-NVR jumper (12-14314-00) to erase the password. The clear-NVR jumper erases all password settings and any existing environment variable settings. You will need to reset the environment variables as well as the password. Use the clear-NVR jumper as follows:

1. Turn off the system power, remove the system unit cover, and locate the 2-pin clear-NVR connector on the system module. Figure 2-1 shows the location of the clear-NVR connector.
2. Slide the jumper entirely over the clear-NVR connector.
3. Turn on the system power and wait for the console prompt to appear.

4. When the console prompt appears, turn off the system power again.
5. Remove the clear-NVR jumper.
6. Turn on the system power.
7. Use the passwd and setenv commands to set the password and the environment variables. See Appendix C for instructions.

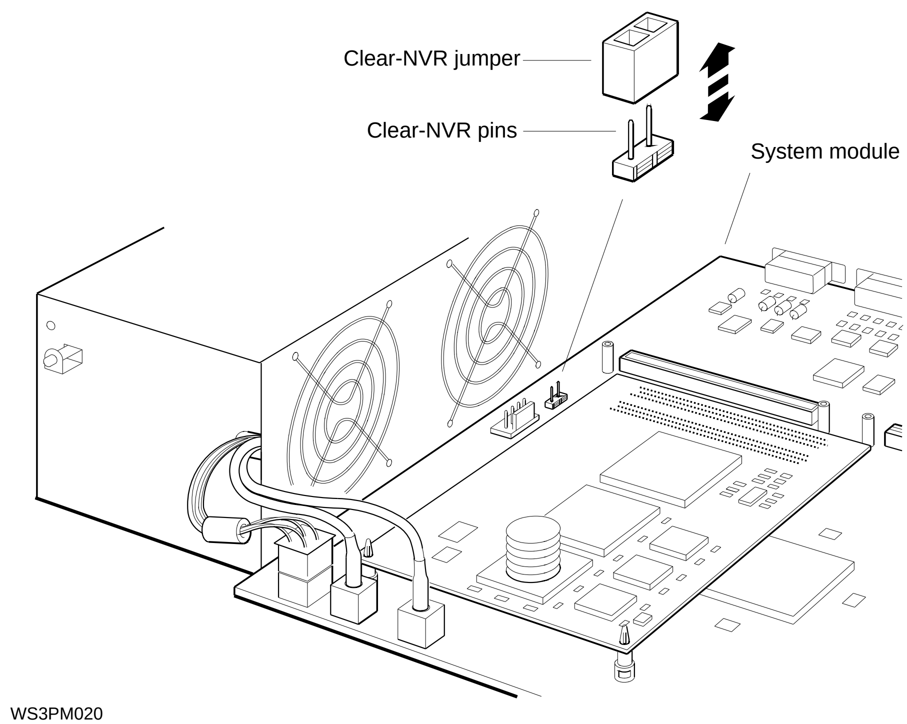


Figure 2-1. Clear-NVR jumper

System Software Management

The following system software (ULTRIX) operations are significant to the hardware maintenance process:

- Starting up (booting) system software
- Shutting down system software
- Accessing ULTRIX error logs

To Boot System Software

1. At either console prompt >> or R>, type **boot** and press Return. The boot process takes several minutes.
2. If the system displays the ULTRIX prompt (#) before the login: prompt appears, the system has stopped at single-user mode instead of multiuser mode. To move on to multiuser mode, press Ctrl-d to continue the boot operation. When the system displays the login: prompt, the system software has started successfully. The system stopped at single-user mode because the bootpath is set for single user mode or because of disk corruption. See the "setenv Command" section in Appendix C for information about how to set the bootpath for multiuser mode. If the problem persists, clean the disks using the fsck function.
3. If the system displays a console prompt (>> or R>), the boot failed. Proceed as follows:
   a. If the system displays an error message, see the "Console Command Error Messages" section in Appendix C .
   b. If the the system displays the restricted prompt (R>), type **passwd** and press Return. At the pwd: prompt, enter the password and press Return. The system displays the console prompt (>>). If you cannot enter the password, see the "Password Management" section in Chapter 2 .
   c. At the console prompt (>>), type **printenv** and press Return to display the environment variables table.
   d. Use the setenv command to set the boot environment variable to a device or to the network that contains the system software that you want to boot. See the "boot Command" section in Appendix C .
   e. Reenter the boot command to boot the system.

To Shut Down System Software

If the system is running ULTRIX software, shut down the software before you perform hardware maintenance.

At the ULTRIX prompt (#), type

/etc/shutdown -h (*now* | *hhmm* | +*n*)

and press Return.

You must include one of the parameters shown in parentheses to tell the system when to shut down.

- Specify the *now* parameter to shut down the software immediately.
- Specify *hhmm* to shut down the software at a specific hour and minute.
  - Replace *hh* with the hour to begin the shutdown.
  - Replace *mm* with the minute to begin the shutdown.
- Specify +*n* to shut down the software in a specified number of minutes. Replace *n* with the number of minutes until shutdown begins.

The system displays a console prompt (>>) or (R>) when shutdown is complete.

To Access ULTRIX Error Logs

At the ULTRIX prompt (#), type

/etc/uerf (-R | more)

and press Return. For information about interpreting the ULTRIX error logs, see the "ULTRIX Error Logs" section in Chapter 9.

3

Alternate Terminal

This chapter discusses the following topics:

- Alternate terminal settings
- Installing an alternate terminal
- Reactivating the regular system monitor and keyboard

If the regular system monitor is not working properly and you cannot access the workstation from another node on the network, you can install an alternate terminal to run tests and read error messages. Use any terminal from the VT100, VT200, or VT300 series or equivalent. When the alternate terminal has been activated, the following conditions apply:

- The regular system monitor is deactivated, and the alternate terminal displays the same text as the regular system monitor would.
- You can type commands only from the alternate keyboard.

Alternate Terminal Settings

The alternate terminal must be set as shown in Table 3-1. Refer to the terminal documentation if necessary.

Table 3-1. Alternate Terminal Settings

Setting	Value
Baud rate	9600
Bits	8
Parity	None
Stop bits	1
Handshake	Xon/Xoff
Mode	Full duplex

To Install the Alternate Terminal

1. Switch to console mode. See the "To Enter Console Mode" section in Chapter 2.
2. Turn off the system unit.
3. Connect the alternate keyboard to the keyboard port of the alternate terminal.
4. Install a serial line adapter on the left serial communications connector (line 3) of the system unit. See the "Serial Line Adapter" section in Chapter 4.
5. Connect one end of the communications cable to the I/O port of the alternate terminal. Connect the other end of the cable to the serial line adapter connected to the system unit.
6. Turn on the alternate terminal. Then turn on the system unit.

7. Wait for the console prompt (>>). If no prompt appears within 2 minutes, proceed without it. On the regular system keyboard, type:

   setenv console s

   and press Return. The alternate terminal is enabled as the console. Even if the graphics module doesn't work and the console prompt doesn't appear, the regular system keyboard should still work. See Appendix C for more information about the setenv command and the console environment variable.

8. If the regular system keyboard does not work or the system does not accept the setenv command, proceed as follows:

   a. Turn off the system unit.

   b. Disconnect the regular keyboard from the keyboard-mouse connector on the back of the system unit.

   c. Remove the TURBOchannel graphics module. See the "TURBOchannel Option Modules" section in Chapter 5.

   d. Connect the alternate terminal and keyboard.

   e. Turn on the system unit. The system starts up with the alternate terminal and keyboard enabled.

To Reactivate the Regular System Monitor and Keyboard

Type

setenv console *

and press Return. The system enables the monitor connected to the base system video controller or to the graphics module in the lowest-numbered TURBOchannel option slot as the console.

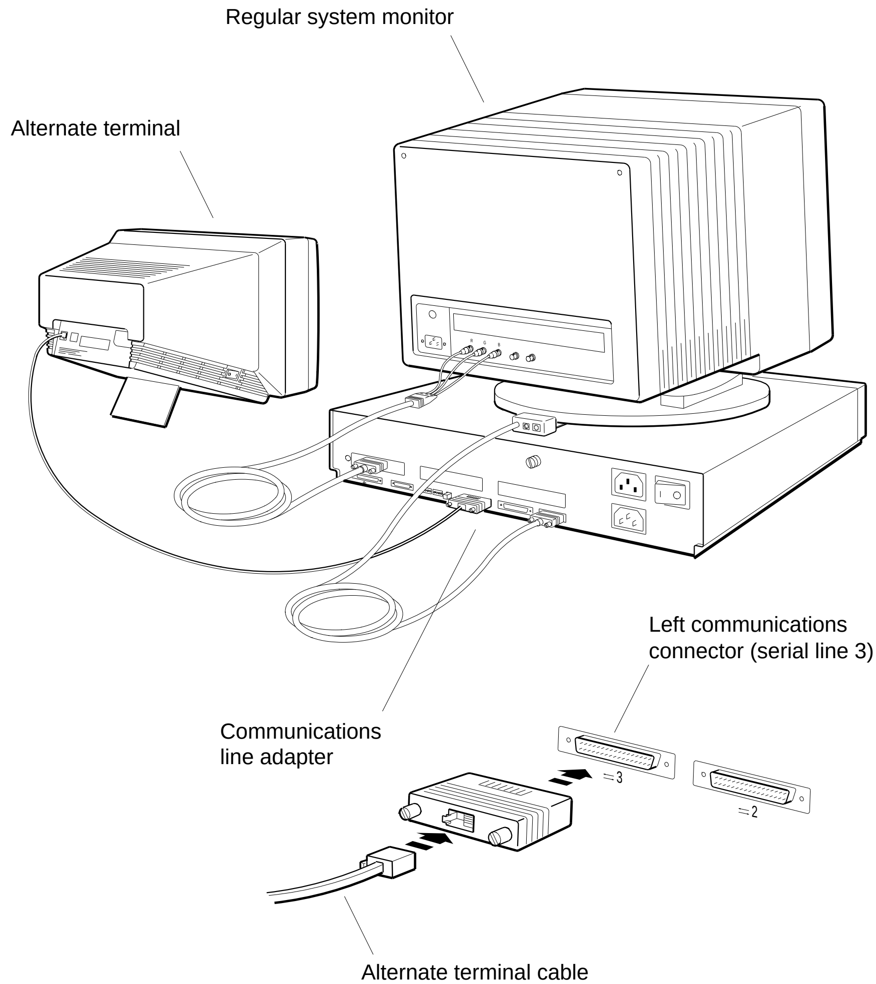


Figure 3-1. Alternate terminal

4

General Hardware Service Operations

The following general service operations are described in this chapter:

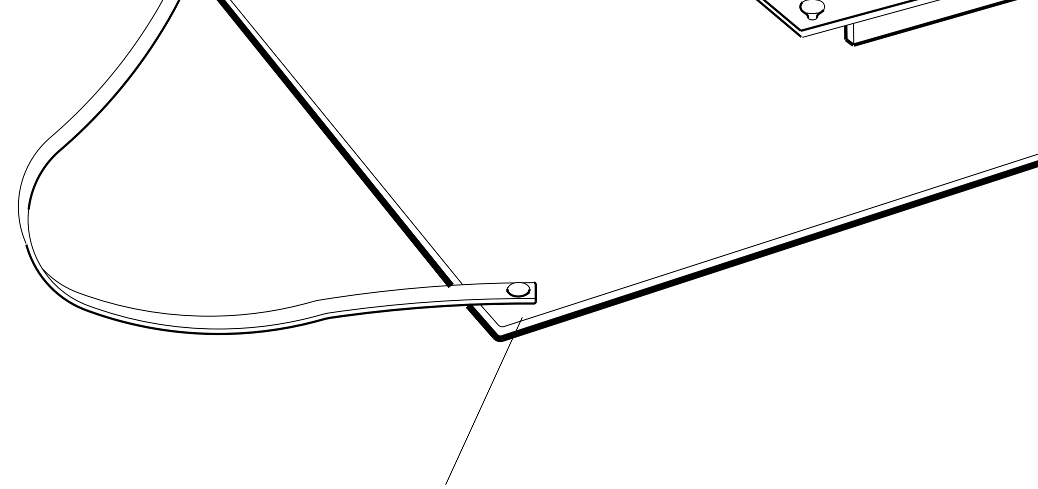
- Avoiding electrostatic damage when handling components
- Removing and installing the system unit cover
- Removing and installing the front cover plate
- Removing and installing the serial number plate
- Removing and installing the nameplate
- Removing and installing terminators and loopback connectors

Antistatic Kit

The Digital antistatic kit contains the equipment you need to handle static-sensitive electronic components safely Figure 4-1. Use the antistatic kit as follows:

1. Connect the antistatic mat to the system chassis.
2. Place the antistatic wrist strap around your wrist and attach the other end of the strap to the snap-on fastener on the antistatic mat. You are now ready to handle static-sensitive components safely.
3. Always place the static-sensitive components on the antistatic mat.

If no antistatic kit is available, wear the disposable grounding wrist strap (12-36175-01) on your wrist and attach the other end to the workstation chassis.



ntistatic Kit

System Unit Cover

Removing the System Unit Cover

1. Ensure power is turned off.
2. Loosen the captive screw that fastens the cover to the back panel of the system unit box.
3. Face the front of the system unit and grip both sides of the system unit cover.
4. Pull the cover toward you approximately 2 inches (5 cm). When the cover comes loose from the chassis, lift it up and away from the system unit.

Installing the System Unit Cover

1. Place the system unit cover on the system unit chassis. Leave at least 2 inches (5 cm) between the back of the cover and the back of the chassis.
2. Slide the cover toward the back of the chassis until it snaps into place.
3. Tighten the captive screw.

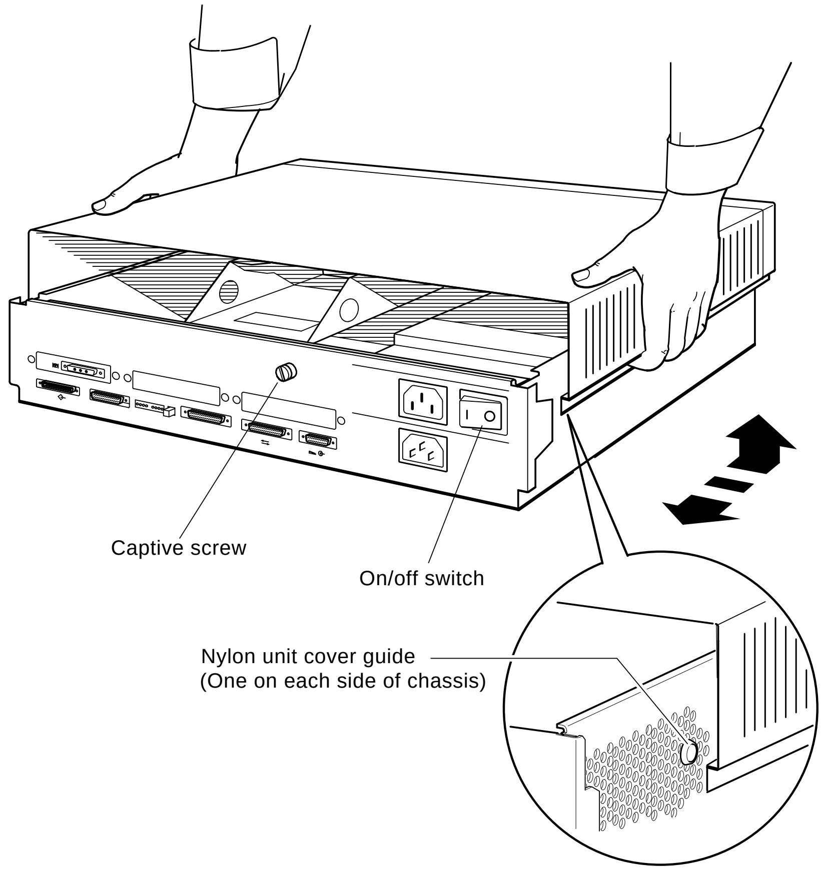


Figure 4-2. System unit cover

Front Cover Plate

Removing the Front Cover Plate

1. Make sure the power is off.
2. Remove the system unit cover. See the "System Unit Cover" section in this chapter.
3. Loosen the two captive screws that fasten the front cover plate to the system unit chassis.
4. Tilt the plate forward and lift it away from the chassis.

Installing the Front Cover Plate

1. Make sure the power is off.
2. Insert the tabs along the bottom of the front cover plate into the slots along the front of the system unit chassis.
3. Tilt the plate up against the front of the chassis.
4. Tighten the two captive screws.

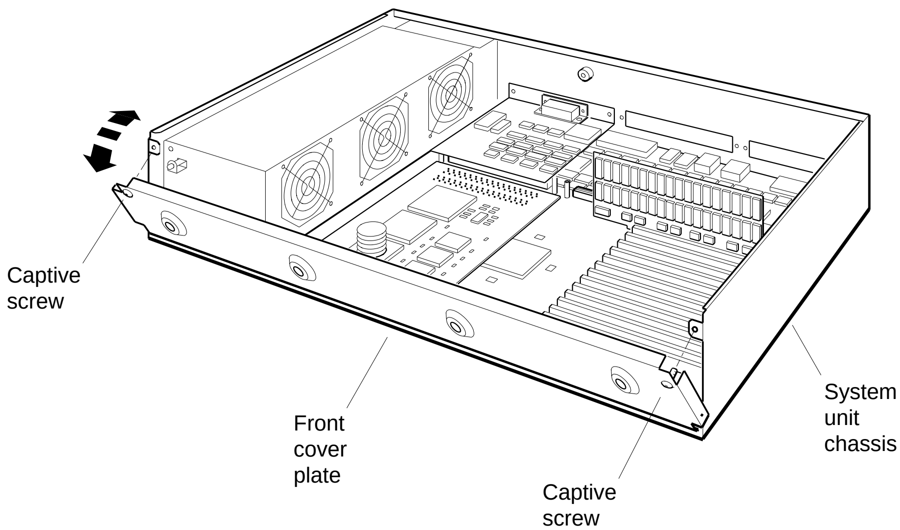


Figure 4-3. Front cover plate

Serial Number Plate

When the base system module and chassis has been changed, install the serial number plate from the original chassis on the new chassis.

Removing the Serial Number Plate

1. Make sure the power is off.
2. Remove the system unit cover. See the "System Unit Cover" section in this chapter.
3. Peel the tamper-proof tape off the two nuts that hold the serial number plate.
4. Remove the nuts. Use a crescent wrench to loosen the nuts.
5. Pull the serial number plate away from the system unit chassis.

Installing the Serial Number Plate

1. Pass the two mounting posts on the back of the serial number plate through the holes in the back panel of the system unit chassis.
2. Tighten the two nuts onto the posts.
3. Apply one piece of tamper-proof tape (36-33513-01) over each nut and post.

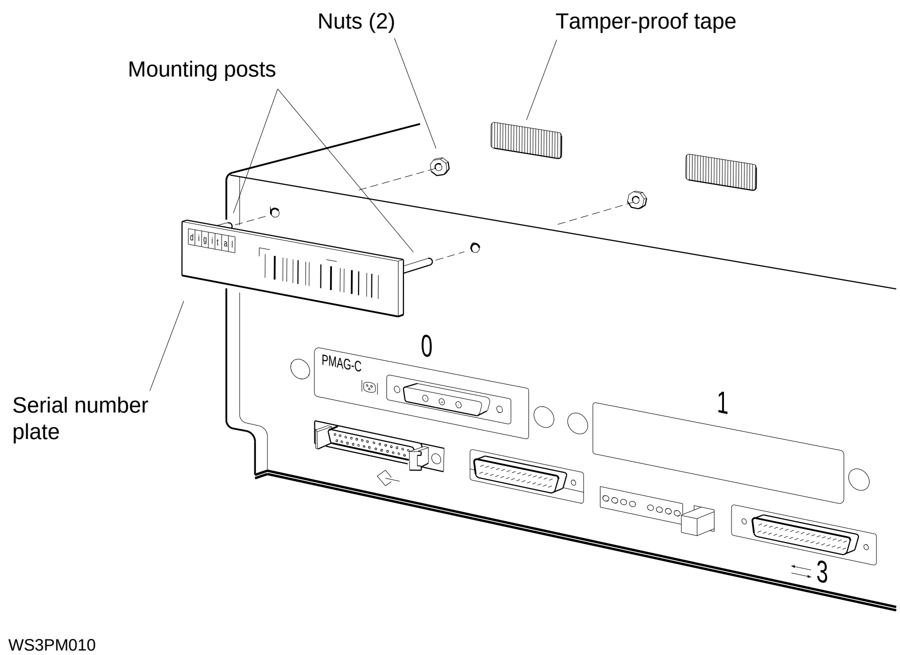


Figure 4-4. Serial number plate

Nameplate

Removing the Nameplate Medallion

1. Make sure the power is off.
2. Remove the system unit cover. See the "System Unit Cover" section in this chapter.
3. Place the cover upside down.
4. With your fingers or a small pair of pliers, pinch each nameplate medallion tab together and push the tabs through the holes in the front of the cover.
5. Pull the name plate away from the system unit cover.

Installing the Nameplate Medallion

1. Place the cover upside down.
2. Hold the nameplate medallion upside down and align the tabs with the holes in the front of the cover.
3. Push the tabs through the holes until they snap into place.

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Serial Line Adapter

Use the serial line adapter (12-33190-01) to connect a modular (telephone-jack-type) cable connector from a serial device to the D-connector of the system's RS-232 serial communications port. The serial line adapter is also called the comm-line-to-MMJ adapter. (MMJ stands for modified modular jack.)

Installing a serial line adapter

1. Press the serial line adapter onto the serial connector. The adapter fits only one way.
2. Tighten the two screws.

Removing a serial line adapter

1. Loosen the two screws that hold the adapter to the serial connector.
2. Pull the adapter off the connector.

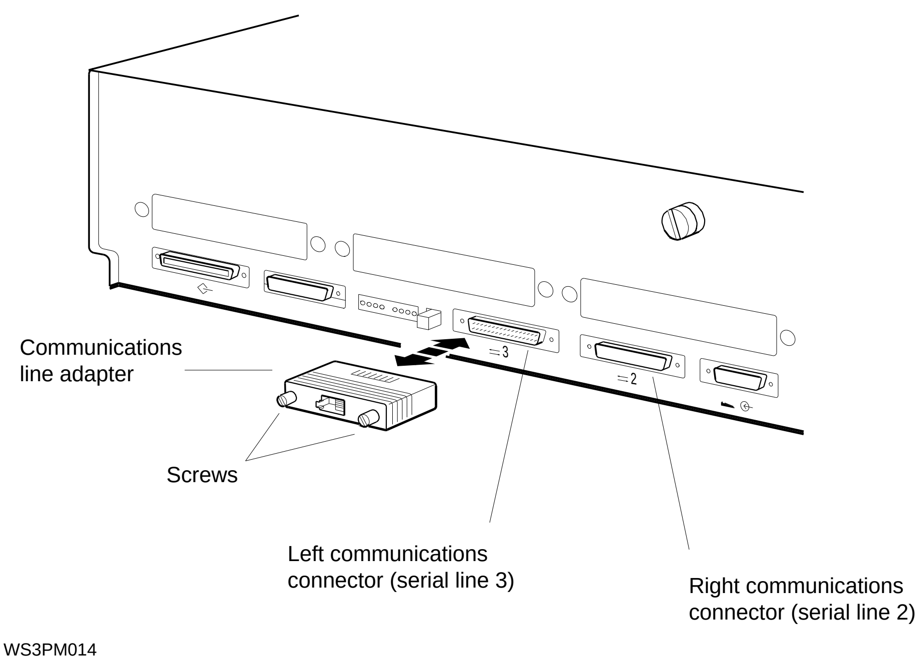


Figure 4-6. Serial line adapter

SCSI Controller Terminator

A SCSI controller terminator (12-33626-01) must be installed on the connector of any SCSI controller that has no external device connected to it.

Installing a SCSI controller terminator

1. Align the terminator over the SCSI connector. The terminator fits only one way.
2. Firmly press the terminator onto the SCSI connector.

Removing a SCSI controller terminator

1. Grip the loop on the SCSI controller terminator.
2. Pull the terminator off the connector.

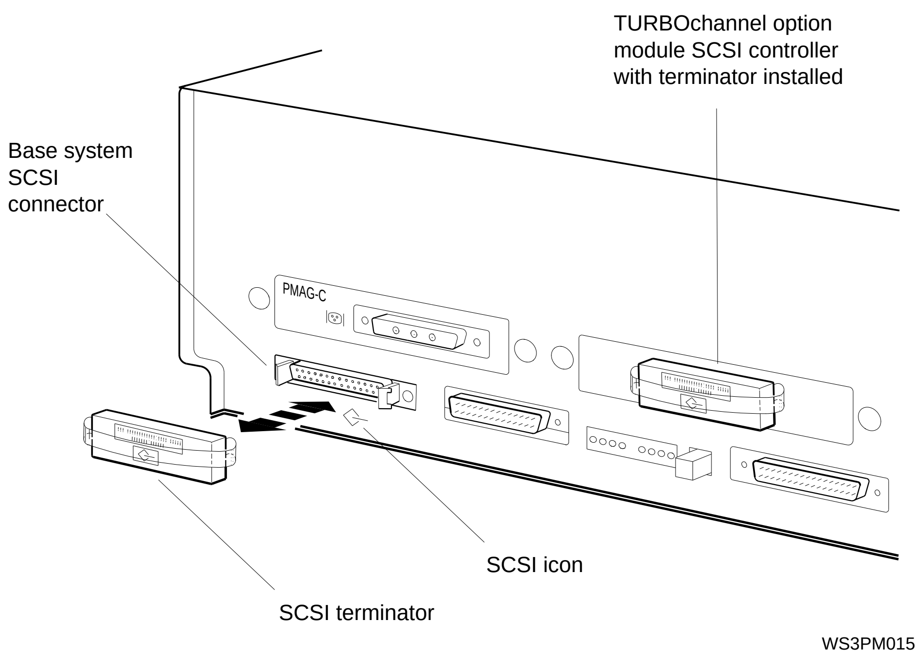


Figure 4-7. SCSI controller terminator

SCSI Chain Terminator

The last SCSI drive or expansion box in a chain requires a SCSI chain terminator (12-30552-01) on its unused connector. An exception to this requirement is the TURBOchannel Extender (TCE), which has only one SCSI connector and does not need an external terminator. When the TCE is used as a SCSI expansion box, it must be mounted last in the SCSI chain.

Installing a SCSI chain terminator

1. Firmly press the chain terminator onto the unused connector on the last drive in the chain. The terminator fits only one way.
2. Press the wire latches onto the SCSI terminator.

Removing a SCSI chain terminator

1. Push the wire latches away from the terminator.
2. Pull the terminator off the SCSI connector.

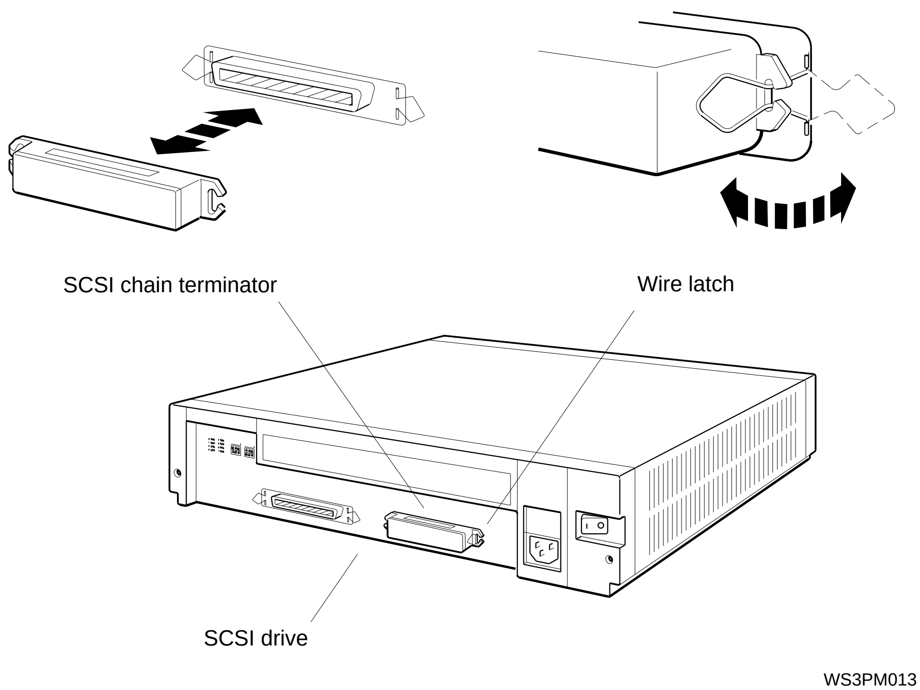


Figure 4-8. SCSI chain terminator

ThickWire Ethernet Loopback Connector

The ThickWire Ethernet loopback connector (12-22196-02) must be installed for certain Ethernet controller (base system or TURBOchannel option) tests.

Installing a ThickWire Ethernet loopback connector

1. Align the loopback connector with the ThickWire Ethernet connector. The loopback connector fits only one way.
2. Firmly press the loopback connector onto the ThickWire Ethernet connector.

Removing a ThickWire Ethernet loopback connector

1. Firmly grip the ThickWire loopback connector.
2. Pull the loopback connector away from the ThickWire connector.

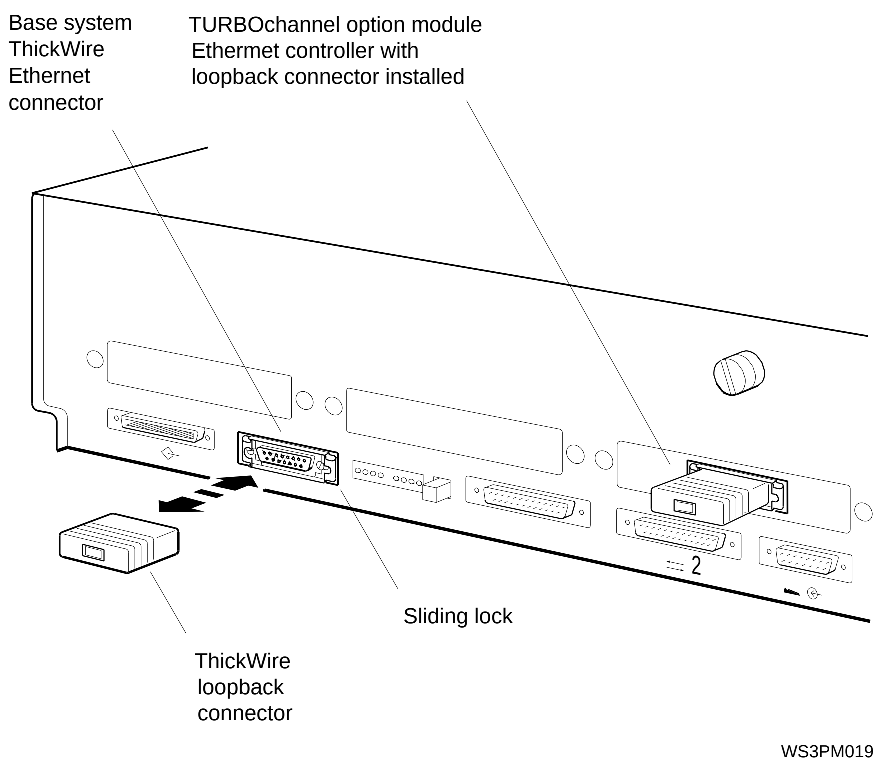


Figure 4-9. ThickWire Ethernet loopback connector

Serial Line Loopback Connector

The serial line loopback connector (12-25083-01) must be installed for certain serial controller tests.

Installing a serial line loopback connector

1. Align the loopback connector with the serial line connector. The loopback connector fits only one way.
2. Firmly press the connector onto the serial line connector.

Removing a serial line loopback connector

1. Firmly grip the serial line loopback connector.
2. Pull the connector away from the serial line connector.

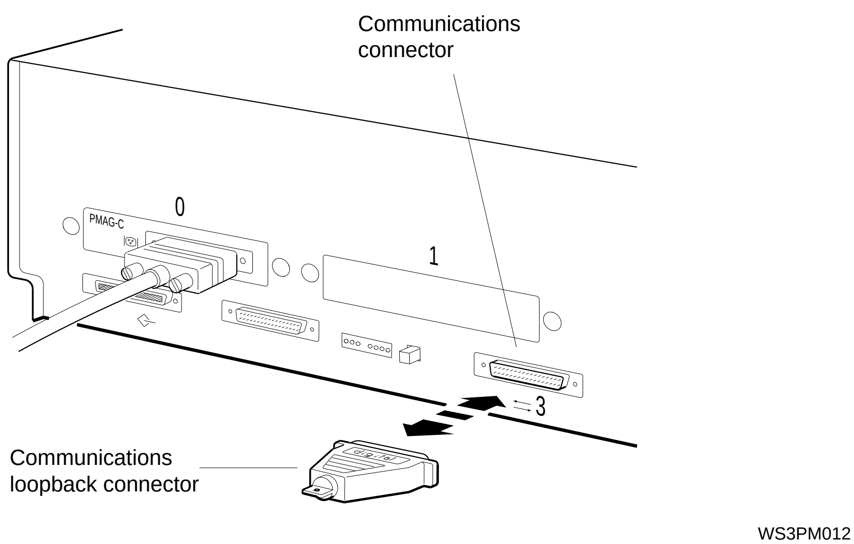


Figure 4-10. Serial line loopback connector

5

Electronic Component Service Operations

This chapter provides instructions for removing and installing the following field-replaceable units (FRUs):

- Base system module and chassis
- Ethernet station address register (ESAR) chips
- Central processing unit (CPU) module
- Single in-line memory modules (SIMMs)
- Nonvolatile random-access memory (NVRAM) module
- Power supply
- TURBOchannel option modules

Caution: *Always follow antistatic procedures when handling electronic components.*

Base System Module

The base system module provides basic system functions. The base system module features are significant to the field maintenance process listed here, and shown in Figure 5-1.

- One CPU module connector
- One keyboard-mouse interface for the keyboard and pointing device (mouse, tablet and stylus, or tablet and puck)
- Fifteen memory module connectors for SIMM and NVRAM memory modules.
- One small computer system interface (SCSI) controller
- Two synchronous/asynchronous RS-232 serial communications ports
- One ThickWire Ethernet controller with ESAR chip
- Three TURBOchannel option module connectors
- One clear-NVR connector
- Diagnostic read-only memory (ROM)

The base system module and chassis are one unit (70-28348-01). Never remove the base system module from the chassis.

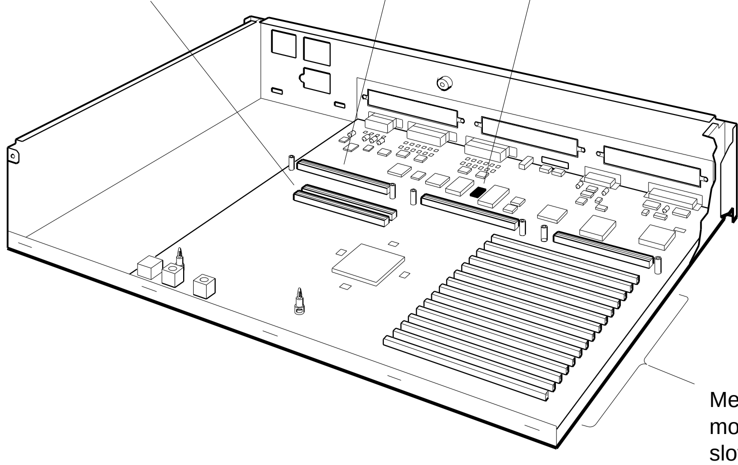


Figure 5-1. Base system module

To Install the Base System Module and Chassis

To install a system module and chassis, transfer the removable parts from the old system module onto the new system module.

Warning: *The system module and chassis are one unit. Never remove a system module from the chassis.*

To remove the components from the old base system module and chassis,

1. If possible, use the printenv command to display the environment variables. Record their values to be set on the new module.
2. Turn off the power. Disconnect all cables attached to the back of the system unit.
3. Remove the system unit cover and front cover plate. See the "System Unit Cover" and "Front Cover Plate" sections in Chapter 4.
4. Disconnect the system module power supply cords from the system module.
5. Remove all TURBOchannel option modules. See the "Option Modules" section in this chapter.
6. Remove the memory module retaining bar and all memory modules. See the "Memory Modules" section in this chapter.
7. Remove the CPU module. See the "CPU Module" section in this chapter.
8. Remove the power supply. See the "Power Supply" section in this chapter. If your system has the R4000 CPU Module upgrade installed, be sure to remove the two EMI grounding clips attached to the power supply.
9. Remove the ESAR chip from the base system module. See the "Base System ESAR Chip" section in this chapter.
10. Remove the serial number plate from the rear panel of the system unit chassis. See the "Serial Number Plate" section in Chapter 4.
11. If there are customer property identification labels on the old system unit chassis, have the customer transfer the labels to the new system unit chassis.

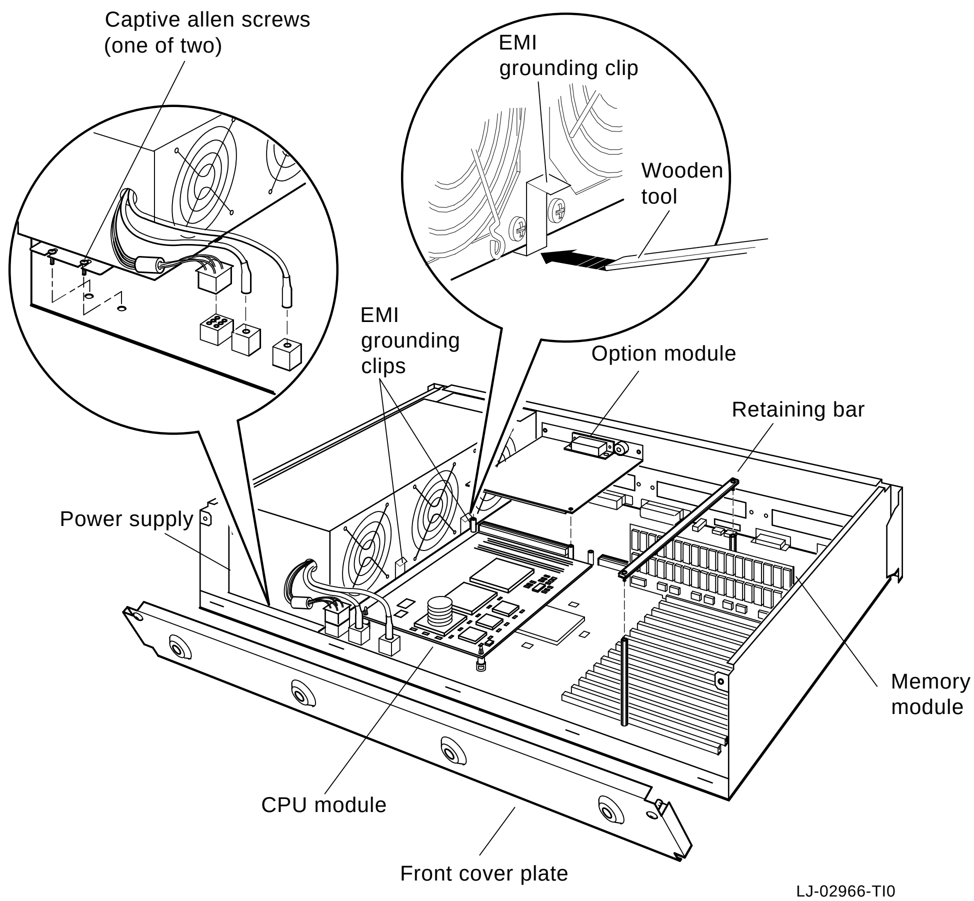


Figure 5-2. Removing and installing the base system module

To install components on the new base system module and chassis,

1. Install the ESAR chip from the old base system module. See the "Base System ESAR Chip" section in this chapter.
2. Install the serial number plate from the old chassis onto the new chassis. See the "Serial Number Plate" section in Chapter 4.
3. Install the power supply and connect the system module power supply cords to the system module. Be sure the two EMI ground clips from the R4000 CPU Module Upgrade Kit are reinstalled, if applicable. See the "Power Supply" section in this chapter.
4. Install the CPU module. See the "CPU Module" section in this chapter.
5. Install the memory modules and memory retaining bar. See the "Memory Modules" section in this chapter.
6. Install the TURBOchannel option modules. See the "TURBOchannel Option Modules" section in this chapter.
7. Install the front cover plate. See the "Front Cover Plate" section in Chapter 4.
8. Connect the cables to the back of the system unit.
9. Connect the system module power cord.
10. Turn on the system unit and check the power-up self-test results to make sure the system runs properly. If the power-up self-test does not complete successfully, see "When the Power-up Self-test Does Not Complete" section in Chapter 11.
11. Use the setenv command to set the environment variables on the new base system module, using the values recorded from the old base system module, if possible.
12. Install the system unit cover. See the "System Unit Cover" section in Chapter 4.

Base System ESAR Chip

The base system module contains an Ethernet station address register (ESAR) chip (23-365A1-00), which provides the Ethernet address of the base system Ethernet controller. When you install a new base system module, remove the ESAR chip from the old base system module and install it on the new one so the workstation will have the same address on the network. Every TURBOchannel Ethernet option module (PMAD-AB) also has an ESAR chip. See the "Ethernet Option Module ESAR Chip" section in this chapter.

Note: *If you use a new ESAR chip, inform the system manager.*

Caution: *Always follow antistatic procedures when handling electronic components.*

To remove the base system ESAR chip

1. Turn off the system unit power and remove the system unit cover. See the "System Unit Cover" section in Chapter 4.
2. If a TURBOchannel option module is installed in slot 1, remove it. See the "TURBOchannel Option Modules" section in this chapter.
3. Locate the ESAR chip. See Figure 5-3
4. Gently pry the ESAR chip up out of its socket.

To install the base system ESAR chip

1. Position the ESAR as shown in Figure 5-3. The notched end of the chip should be toward the rear of the system unit, and each pin should be over a hole in the ESAR chip socket.
2. Press the pins into the ESAR socket. Be careful not to bend the pins.

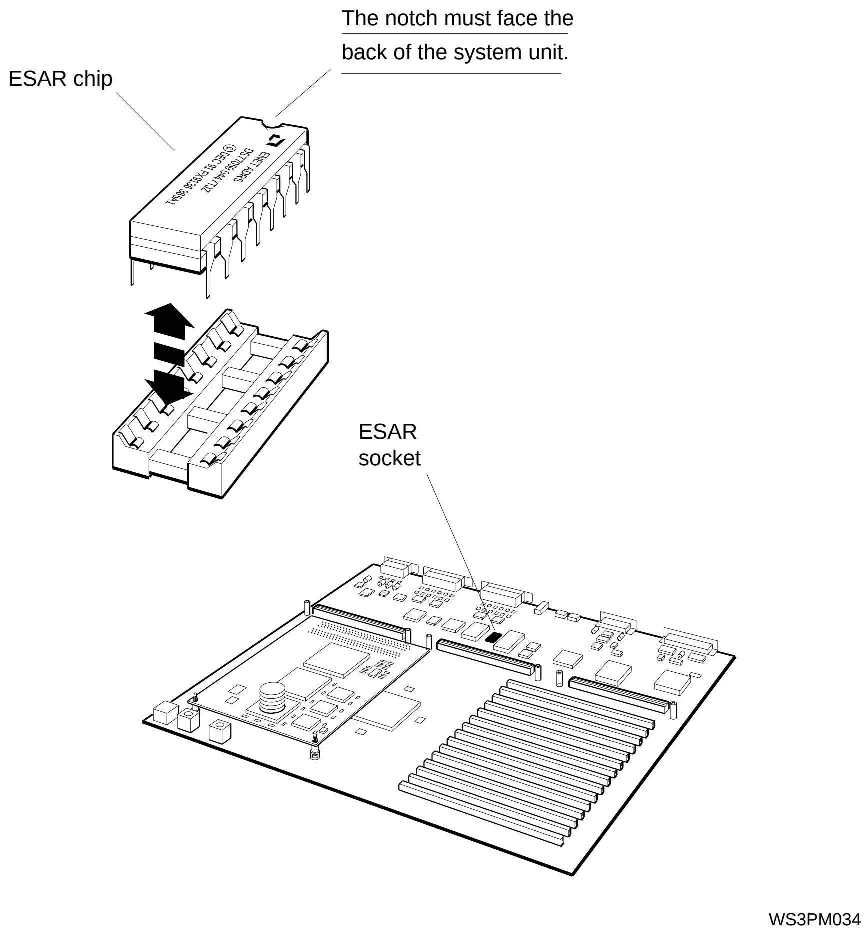


Figure 5-3. Base system ESAR Chip

CPU Module

The DECstation 5000 Model 240 supports the replaceable KN03-GA central processing unit (CPU) module Figure 5-4. The KN03-GA CPU module runs at 40 megahertz (MHz).

The CPU module uses the MIPS Technologies, Inc. R3000A CPU and R3010 Floating Point Unit (FPU), mounted on the same chip. The CPU uses a 64-kilobyte instruction cache and a 64-kilobyte write-through data cache.

The Decstation 5000 Model 260 supports the replaceable R4000 KN05 (54-21872-02) central processing unit (CPU) module Figure 5-5. The CPU module uses the MIPS Technologies, Inc. R4000 family CPU chip which has the floating point unit built into the R4000 chip. The R4000 CPU module runs at 60 megahertz (MHz).

The CPU modules have a pair of LEDs that indicate when certain power-up milestones occur. See the "Troubleshooting with LED Codes" section in Chapter 11.

CPU Module Upgrade

If you are upgrading your cpu module from the KN03 (R3000) to the KN05 (R4000) type, you should have an upgrade kit which includes the following components:

Table 5-1. CPU Module Upgrade Kit Components

Quantity	Description	Part Number
1	R4000 CPU Module	54-21872-02
1	PC Removal Tool	74-46254-01
1	Product Conversion Label	36-15946-11
2	EMI Grounding Clips	74-46746-01
1	Medllion	74-43093-11 (workstation)
1	Medllion	74-43093-15 (server)
1	Disposable Ground Strap	12-36175-01
1	Warning Label	36-19551-01

(continued on next page)

Table 5-1 (Cont.). CPU Module Upgrade Kit Components

Quantity	Description	Part Number
1	Return Label	36-26123-07
2	Push Rivets	90-11357-01

See the "Installing a CPU Module" section of this chapter for detailed instructions on installing the upgrade kit components.

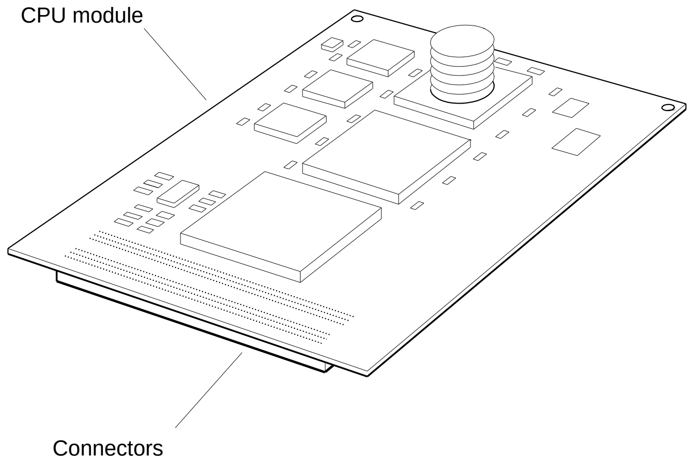


Figure 5-4. R3000 CPU module

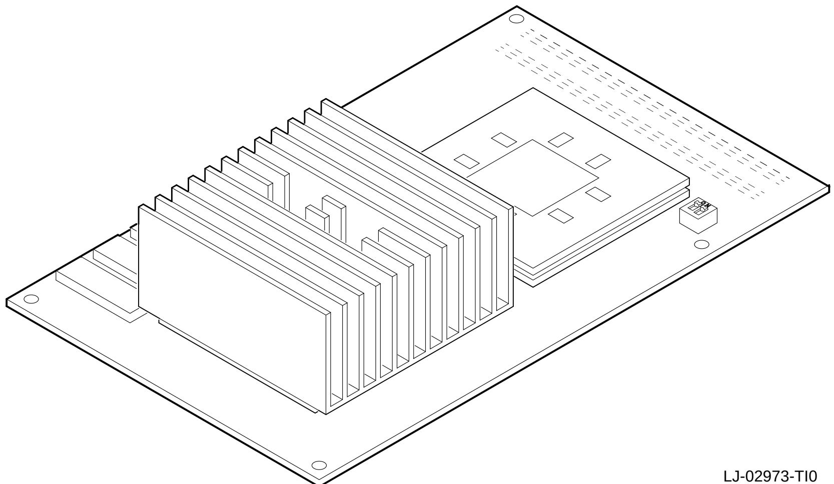


Figure 5-5. R4000 CPU module

Removing a CPU Module

1. Unlock the mounting posts that fasten the CPU module to the base system module. Use the PC Removal Tool (74-46254-01) to squeeze each mounting post lock. Then lift the corner of the CPU module board slightly to free it from the lock.
2. When the board is free of all locks, grip the board by the edges at both ends of the connector and lift the board up and out of the connector. If necessary, gently rock the module to loosen it. See Figure 5-6 which shows how to remove the cpu module from the mounting posts.

Caution: *Do not touch the CPU module heat sinks. The heat sink attachments are fragile and break easily. The heat sink may also be very hot if the unit was recently powered down.*

Installing a CPU Module

1. Check to see you have the correct CPU module you intend to install. Figure 5-4 and Figure 5-5 shows a diagram of the R3000 CPU Module and R4000 CPU Module respectively.
2. Position the CPU module so that its connector is aligned over the CPU module connector on the base system module. Align the holes in the CPU module over the mounting posts on the base system module.
3. Press the CPU module connector into the base system module connector.
4. Press the hole in each corner of the CPU module onto the corresponding mounting post lock.

   If you are upgrading your CPU module, perform the following additional steps...

5. Install the two EMI grounding clips (74-46746-01) to the base of the power supply. Use a regular flat-bladed screwdriver to push the clips under the power supply. Figure 5-2 shows the correct placement of clips.

6. Add the product conversion label (36-15946-11) to the top cover of the base system module. This label identifies the change of CPU modules from a KN03 (R3000) to a KN05 (R4000). The label should be installed near the back edge of the cover, centered between the two sides.

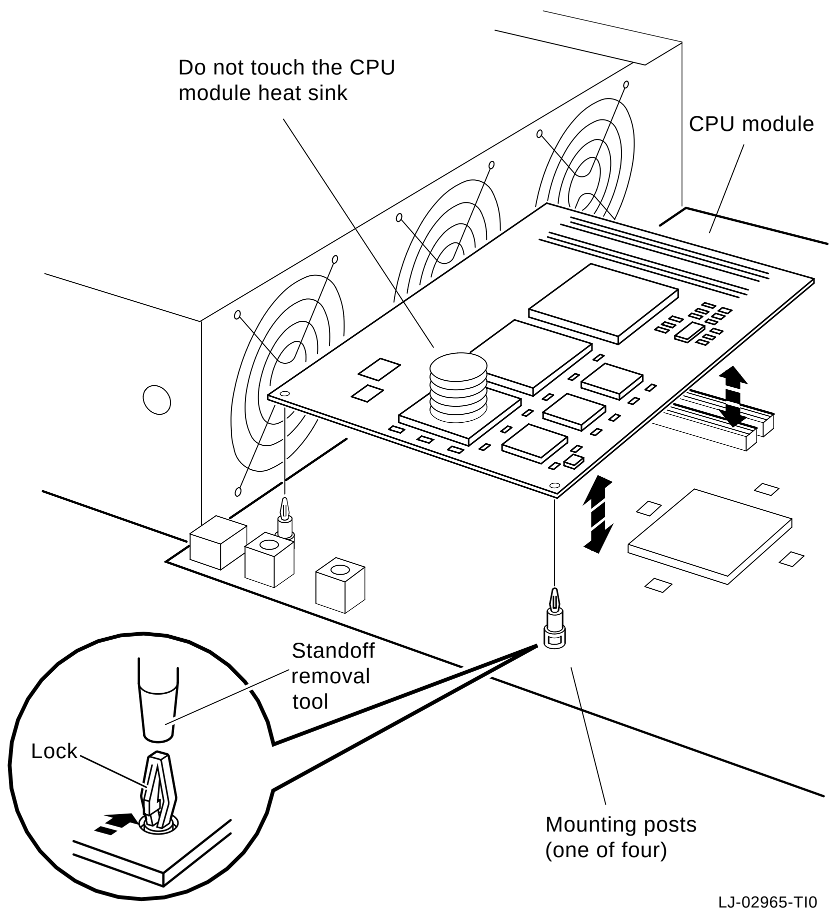


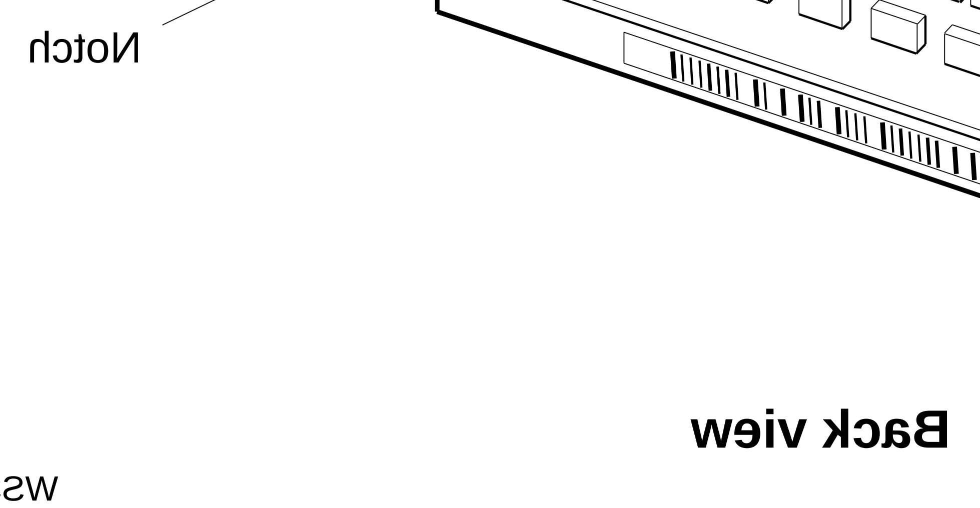
Figure 5-6. Removing and installing a CPU module

Memory Modules

The base system module holds up to fifteen 8-megabyte or 32-megabyte single-inline memory modules (SIMMs). A 1-megabyte nonvolatile random-addess memory (NVRAM) module can be installed in only slot 14.

Note: *At least one SIMM must be installed in slot 0 for console operations to execute.*

- SIMMs must be installed starting with the connector nearest the back of the system unit, slot 0. Each connector is identified by a slot number etched on the edge of the system module board. The connector nearest the front is slot number 14.
- The SIMMs installed in a system must be all 8-megabyte or all 32-megabyte modules. Never combine 8-megabyte and 32-megabyte SIMMs in the same system.
- The 8-megabyte SIMM is very similar to the 32-megabyte SIMM.
  - The 8-megabyte SIMM part number is MS02-AA /MS02L-AB.
  - The 32-megabyte SIMM part number is MS02-CA.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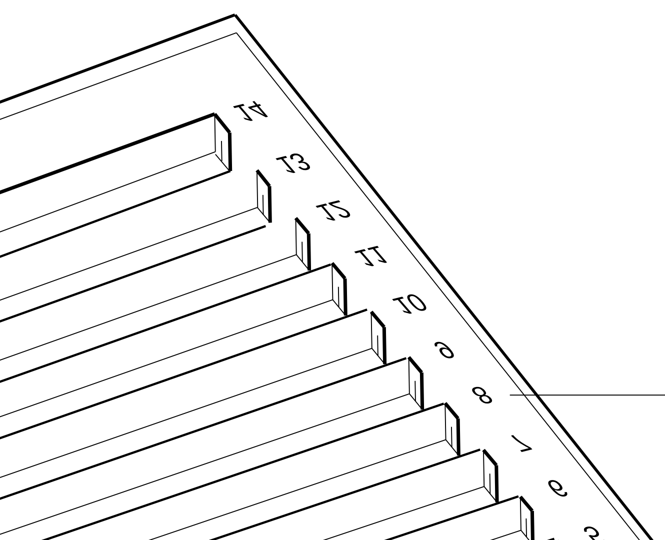
Memory Slot Numbers and Address Ranges

Figure 5-8 shows the memory module slot numbers. These slot numbers are used to identify the SIMMs or the NVRAM module in test commands and error messages.

Table 5-2 shows the address range for each memory module slot. When a memory error occurs, the error message contains the address of the error. You can identify the faulty SIMM or NVRAM module by the address.

Table 5-2. Memory Module Address Ranges

Memory Slot	8-Mbyte Module Address Ranges	32-Mbyte Module Address Ranges
0	0xA0000000 to 0xA07FFFFF	0xA0000000 to 0xA1FFFFFF
1	0xA0800000 to 0xA0FFFFFF	0xA2000000 to 0xA3FFFFFF
2	0xA1000000 to 0xA17FFFFF	0xA4000000 to 0xA5FFFFFF
3	0xA1800000 to 0xA1FFFFFF	0xA6000000 to 0xA7FFFFFF
4	0xA2000000 to 0xA27FFFFF	0xA8000000 to 0xA9FFFFFF
5	0xA2800000 to 0xA2FFFFFF	0xAA000000 to 0xABFFFFFF
6	0xA3000000 to 0xA37FFFFF	0xAC000000 to 0xADFFFFFF
7	0xA3800000 to 0xA3FFFFFF	0xAE000000 to 0xAFFFFFFF
8	0xA4000000 to 0xA47FFFFF	0xB0000000 to 0xB1FFFFFF
9	0xA4800000 to 0xA4FFFFFF	0xB2000000 to 0xB3FFFFFF
10	0xA5000000 to 0xA57FFFFF	0xB4000000 to 0xB5FFFFFF
11	0xA5800000 to 0xA5FFFFFF	0xB6000000 to 0xB7FFFFFF
12	0xA6000000 to 0xA67FFFFF	0xB8000000 to 0xB9FFFFFF
13	0xA6800000 to 0xA6FFFFFF	0xBA000000 to 0xBBFFFFFF
14	0xA7000000 to 0xA77FFFFF	0xBC000000 to 0xBDFFFFFF



slot numbers

Removing a SIMM Module

1. Turn off the system power. Remove the system unit cover. See the "System Unit Cover" section in Chapter 4.
2. Identify the slot that holds the SIMM you want to replace by the slot numbers printed beside the memory module connectors.
3. Loosen the two captive screws that hold the memory module retaining bar. Remove the bar.
4. Grip both ends of the memory module and pull the module out of its connector. Gently rock the module back and forth to remove it. If necessary, use the hooked end of the retaining bar to pull up the edge of the memory module.
5. Repeat the procedure to remove each SIMM.

Installing a SIMM Module

1. Always install a SIMM in the lowest-numbered vacant slot. Never leave an empty slot behind an installed SIMM.
2. Align the lower edge of the SIMM over the connector with the notched end of the SIMM toward the power supply.
3. Push the SIMM connector all the way into the memory module slot. Gently rock the SIMM back and forth if necessary.
4. Repeat steps 1 to 3 to install each SIMM.
5. Replace the retaining bar and tighten the two captive screws.
6. Replace the system unit cover. See the "System Unit Cover" section in Chapter 4.
7. Turn on the system unit. Check the power-up self-test results. Run the cnfg 3 test to verify that the memory is installed properly. If the power-up self-test reports a memory error, see Chapter 9.

NVRAM Module

An optional 1-megabyte NVRAM module (MS02-NV) can be installed in memory slot 14. The NVRAM module provides a disk cache for faster system operation when the proper optional software is installed.

The procedure for removing and installing the NVRAM module is identical to the procedure for removing and installing the SIMMs with the following additional rules:

- Always install the NVRAM module in memory slot 14.
- Install the NVRAM module with the battery toward the rear of the system unit.

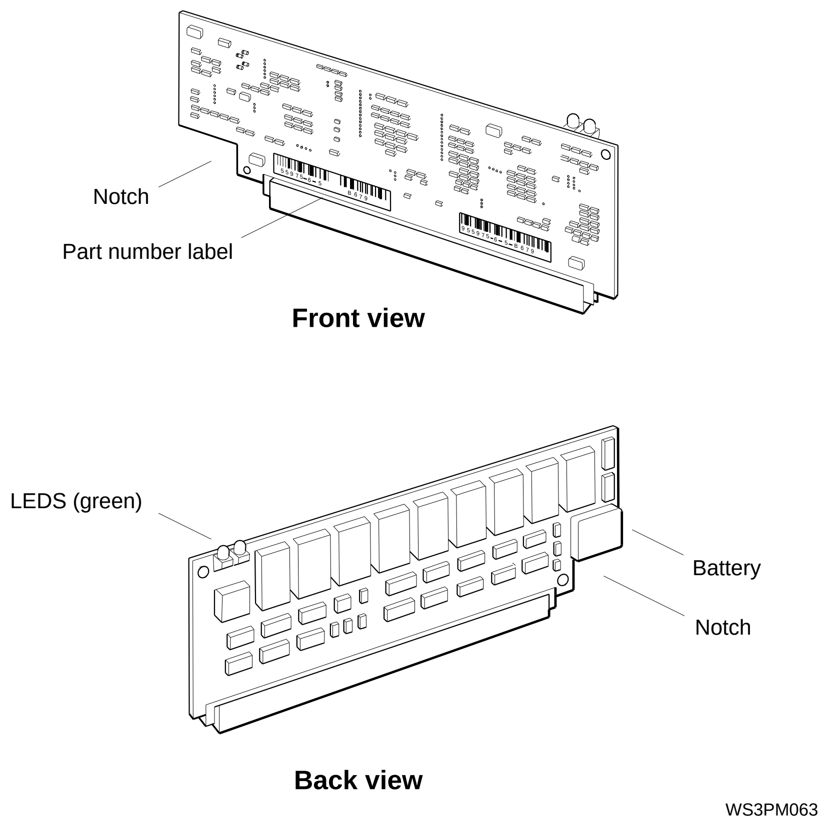


Figure 5-9. NVRAM module

Power Supply

The power supply provides 244 watts of DC power to the system unit Figure 5-10. The back of the power supply has an on/off switch, the main power connector, and the system-unit-to-monitor connector. The power supply fans draw air through the system unit enclosure, cooling all components. A green LED on the front of the power supply glows steadily when the power supply is operating properly.

The power supply can have part number 30-32506-01 or part number H7878A. The two power supplies are fuctionally identical.

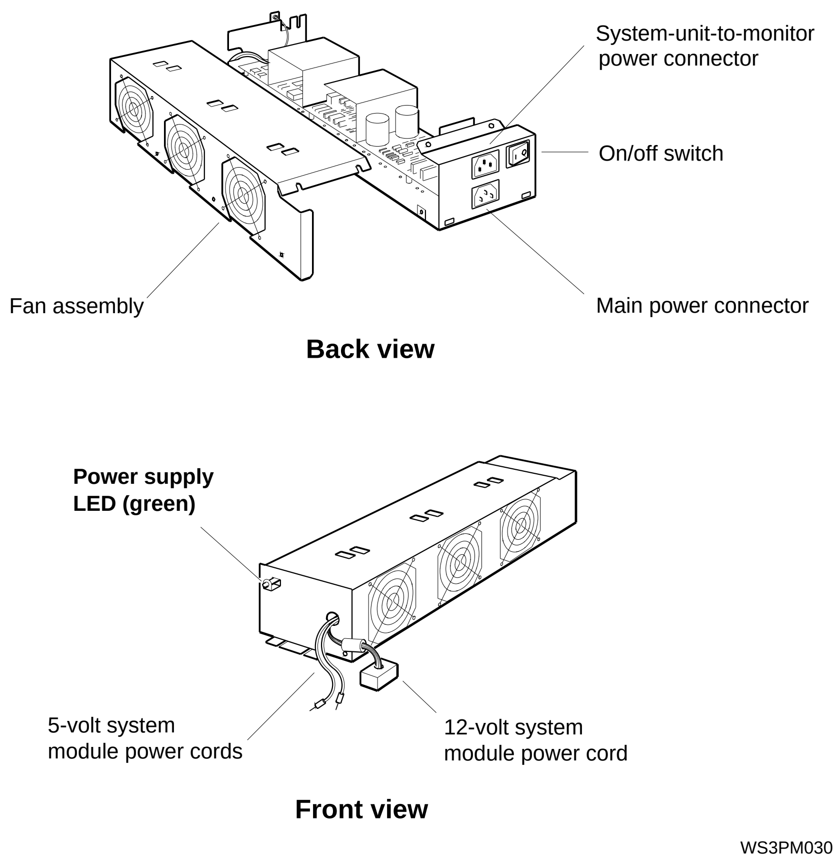


Figure 5-10. Power supply

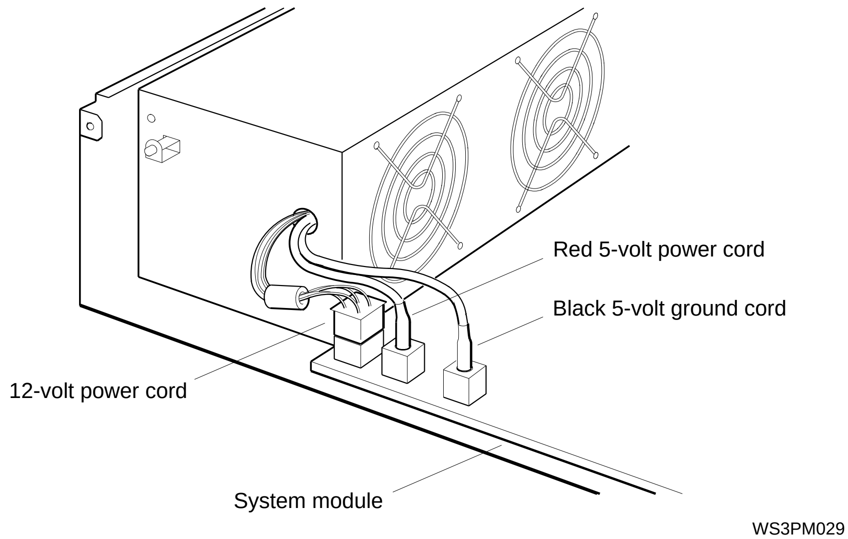
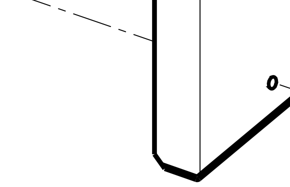


Figure 5-11. Power supply connections



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5. Disconnect the system module power cords from the connectors on the base system module.
6. Loosen the two captive allen screws that hold the power supply. Slide the power supply tabs out of the system unit chassis slots.
7. If the EMI grounding Figure 5-13 clips from the R4000 upgrade kit were installed, remove the clips prior to lifting out power supply and save for reinstallation with new power supply.
8. If this was an up-graded system, when the power supply is lifted out there will be two finger stocks sitting on the base. Leave these two finger stocks on the base when installing the new power supply. See Figure 5-14.
9. Pull the power supply away from the back of the system unit and out of the system unit chassis.

To Install the Power Supply

1. Make sure the power switch is off. (Press down on the 0.)
2. Position the power supply in the system unit chassis. The on/off switch should face the back of the chassis.
3. Tighten the two captive allen screws.
4. If the EMI grounding clips were installed, reinsert them between the power supply and chassis. Refer to Figure 5-13 for correct placement of clips.
5. Reconnect the system module power cords to the connectors on the base system module. Refer to Figure 5-11
   - Connect the black cord (5-volt ground) to the connector farthest from the power supply.
   - Connect the red cord (5-volt supply) to the center connector.
   - Connect the white connector with multiple leads (12-volt group) to the connector closest to the power supply.
6. Install the front cover plate and system unit cover. See the "Front Cover Plate" and "System Unit Cover" sections in Chapter 4.

7. Connect the main power cord to the main power connector.

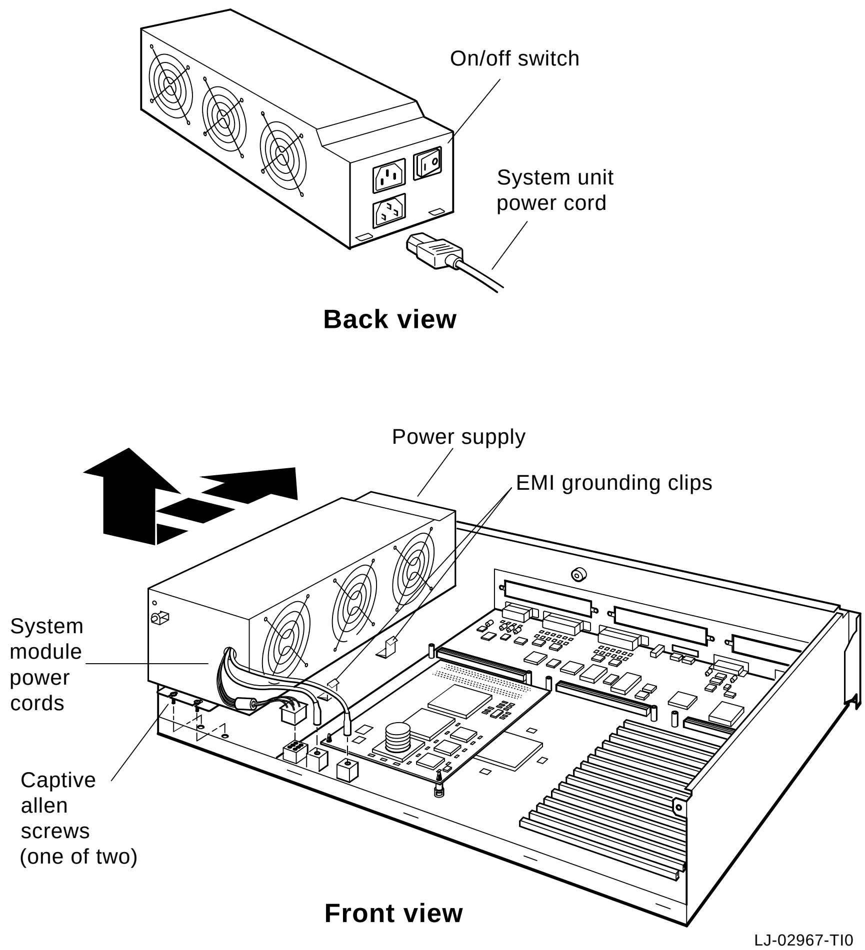


Figure 5-13. Removing and installing the power supply

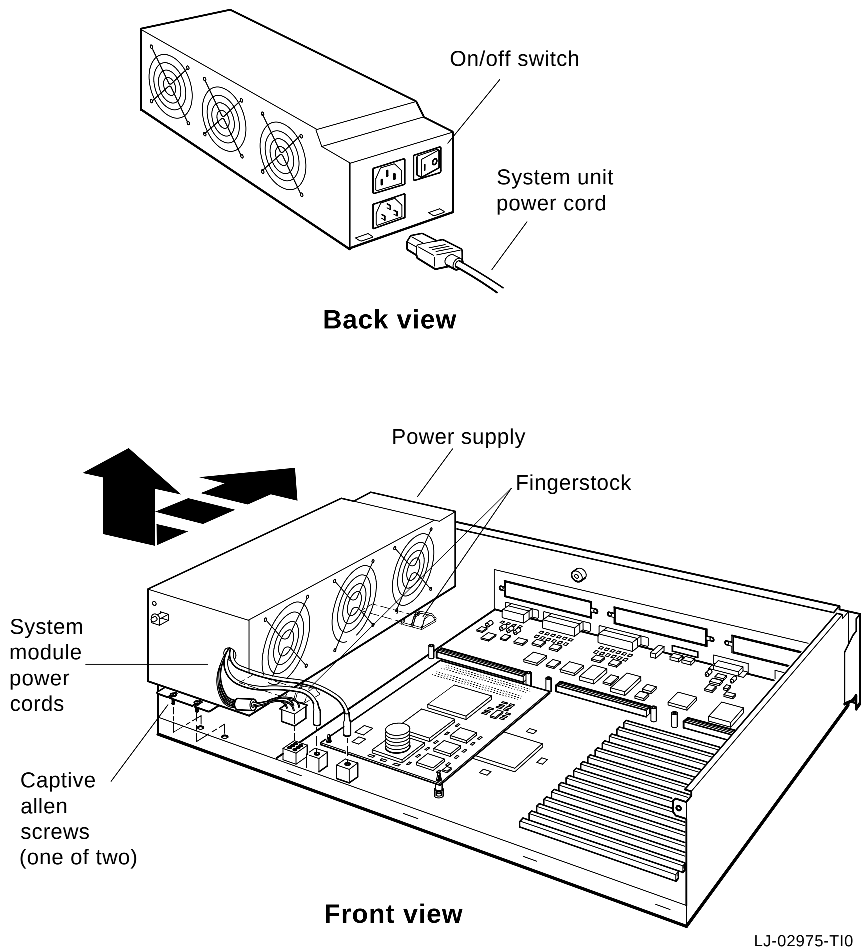


Figure 5-14. Finger Stock

TURBOchannel Option Modules

You can install up to three TURBOchannel option modules to provide additional functionality to the DECstation 5000 Models 240 and 260. TURBOchannel hardware from Digital Equipment Corporation and other suppliers includes, but is not limited to, the following:

- Numerous graphics interface options
- Ethernet interfaces
- SCSI interfaces
- Fiber optic data distribution interfaces (FDDI)
- Multimedia interfaces
- TURBOchannel extender for remote placement of an oversize graphics module

Any SCSI, Ethernet, or serial controller TURBOchannel option modules operate in addition to the equivalent functions on the base system module.

Caution: *Always follow antistatic procedures when handling option modules.*

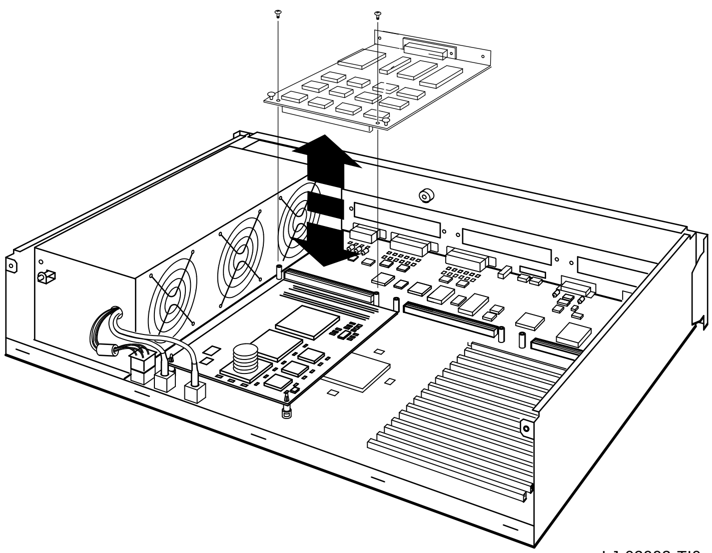
To Remove an Option Module

1. Turn off the workstation and remove the system unit cover. See the "System Unit Cover" section in Chapter 4.
2. Disconnect any cables connected to the rear of the option module.
3. If you are replacing an Ethernet option module, remove the ESAR chip from the old module. Save the ESAR chip for installation on the new Ethernet option module. See the "Ethernet Option Module ESAR" section in this chapter.
4. Remove the screws that hold the option module to the standoffs and the screws that hold the option module to the back of the system unit.

5. Grip the option module board by the edges at both ends of the connector and lift the board out of the connector. If necessary, gently rock the module to loosen it.

Installing an Option Module

1. If the rear panel opening for the option module is covered by a blank plate, remove the two screws and remove the plate.
2. Position the option module so that its external connector is in the appropriate opening on the back of the system unit, and its internal connector is aligned over the corresponding TURBOchannel option module connector on the base system module.
3. Firmly press the option module internal connector down into the base system module connector.
4. Insert and tighten the screws that fasten the module to the back of the system unit and the screws that fasten the module to the standoffs.
5. If you are replacing an Ethernet option module, install the ESAR chip from the old module. See the "Ethernet Option Module ESAR" section in this chapter. Insert the chip so that the notch on the top of the chip is toward the back of the system unit.
6. Connect the appropriate cable(s) to the back of the option module.



LJ-02993-TI0

Figure 5-15. Removing and installing a TURBOchannel option module

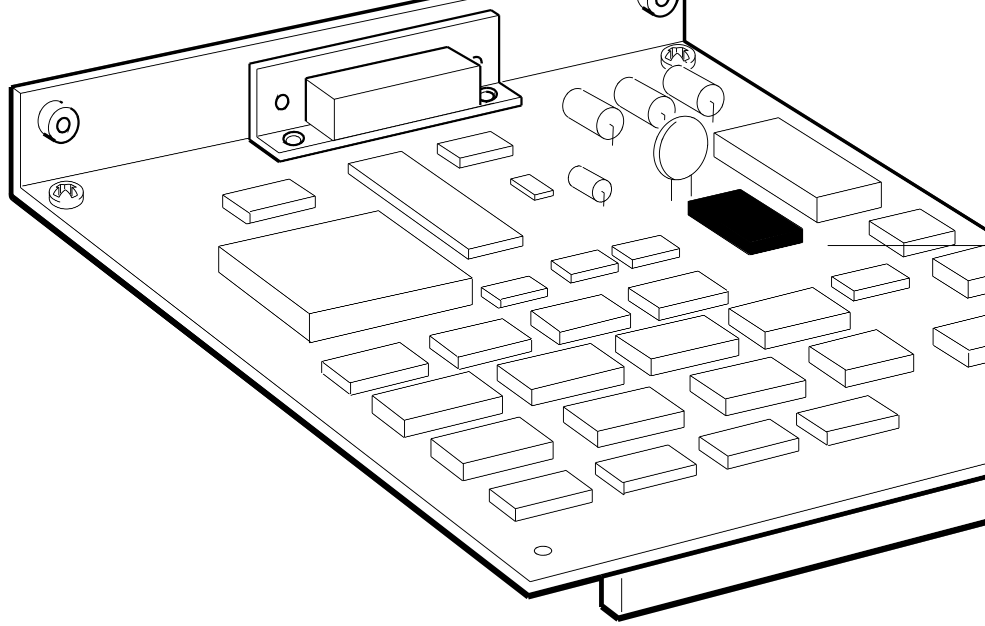
Ethernet Option Module ESAR Chip

Every Ethernet TURBOchannel option module has an Ethernet station address register (ESAR) chip (23-365A1-00), which provides the Ethernet address of the Ethernet controller. When you install a new Ethernet option module, remove the ESAR chip from the old option module and install it on the new one so the workstation will have the same address on the network.

The base system module also has an ESAR chip. See the "Base System ESAR" section in this chapter.

module ESAR chip

Back view



For Further Information

For information about identifying failed FRUs, see Chapters 8, 9, 10, and 11.

For complete information about console commands, see Appendix C.

For information about troubleshooting external drives, SCSI controllers, Ethernet controllers, and TURBOchannel option modules, refer to the *TURBOchannel Maintenance Guide*.

6

Storage Drives

This chapter discusses the requirements for using small computer system interface (SCSI) storage drives with the DECstation 5000 Models 240 and 260.

SCSI Requirements

The following requirements apply to SCSI drives connected to base system or TURBOchannel option SCSI controllers.

- A base system or TURBOchannel SCSI controller can support up to seven drives.
- SCSI drives are always linked in a daisy chain. Each drive has two connectors. The first drive in the chain is connected to the SCSI controller and to the second drive. The last drive in the chain must have a SCSI chain terminator (12-30552-01) installed on the second connector.
- An exception to the preceding requirement is the TURBOchannel Extender (TCE). The TCE has only one external SCSI connector and does not need an external chain terminator. When the TCE is used as a SCSI expansion box, it must be last in the SCSI chain. Because the system-unit-to-TCE cable is only 16 inches (40 cm) long, be careful to arrange the SCSI expansion boxes to accomodate the cable.
- Each drive in a SCSI chain must have a SCSI ID number from 0 to 6 that is unique in the chain. No two drives in a chain can have the same SCSI ID number. A SCSI controller, whether on the base system module or a TURBOchannel option module, always has SCSI ID number 7. If two numbers are the same, one must be changed. Refer to the drive documentation for information about how to change the SCSI ID.
- Normal SCSI protocol requires that a SCSI controller terminator (12-33626-01) be installed if no drives are present. However, the DECstation 5000 Models 240 and 260 base system SCSI controllers have a built-in SCSI controller terminator. Even if no drives are installed, it is not necessary to install a terminator on the SCSI controller connector. If a TURBOchannel option module SCSI controller is installed, the requirement for a terminator applies to the option module.

- As a rule of thumb, you should install no more than three external expansion boxes supplied by Digital Equipment Corporation in one SCSI chain. Any external expansion box, regardless of the number of drives it contains, counts toward this total of three boxes. Of course, the overall total of seven drives must never be exceeded.
- The length of all external and internal cables connecting the drives in a chain must not exceed 236 inches (6 meters).

SCSI Cable Lengths

Use the cable lengths in Table 6-1 to compute the total SCSI cable length for any combination of expansion boxes supplied by Digital Equipment Corporation.

Table 6-1. SCSI Cable Lengths

Cable or Box	Cable Length inches	cm
Base system SCSI controller and internal bus	52	132
BA40 storage expansion box internal cable	14	36
BA42 storage expansion box internal cable	31	79
RRD40 optical compact disk drive internal cable	6.5	16.5
TLZ04 tape drive internal cable	38	97
TK50Z internal cable	14	36
System-unit-to-TCE cable	26	66
TCE internal cable	52	132
50-pin to 50-pin box-to-box external cable	26	66
50-pin high-density to 50-pin system-unit-to-expansion-box external cable	38	96

For Further Information

For information about troubleshooting the SCSI controllers and drives, see Chapters 8, 9, 10, and 11.

For information about individual SCSI drives, refer to the documentation for the individual drive.

For information about TURBOchannel option module SCSI controllers, refer to the *TURBOchannel Option Module Maintenance Guide*.

For information about the SCSI drive terminator, see the "SCSI Chain Terminator" section in Chapter 4.

For information about the SCSI controller terminator, see the "SCSI Controller Terminator" section in Chapter 4.

7

Keyboards and Pointing Devices

This chapter discusses the devices through which the user communicates with the DECstation 5000 Models 240 and 260 workstations. When the system is used as a workstation, the input device configuration is one keyboard plus one of the following pointing device configurations:

- One mouse
- One tablet with puck
- One tablet with stylus

In addition, one of the following configurations can be installed:

- Lighted programmable function keyboard (LPFK) device
- Programmable function dials (PFD) device
- One LPFK plus one PFD

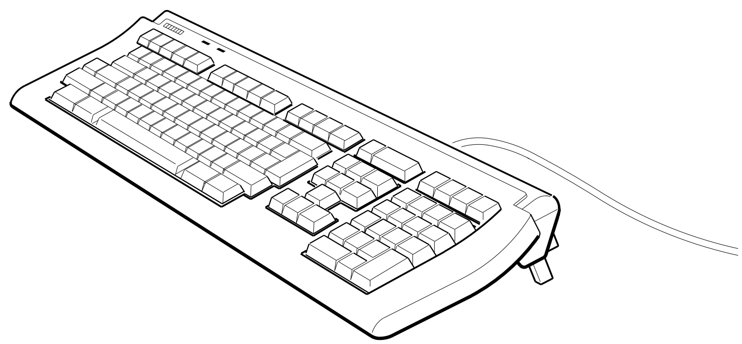
When the system is configured as a server, the user input and output devices are a terminal and keyboard connected to serial communications line 3.

Keyboards

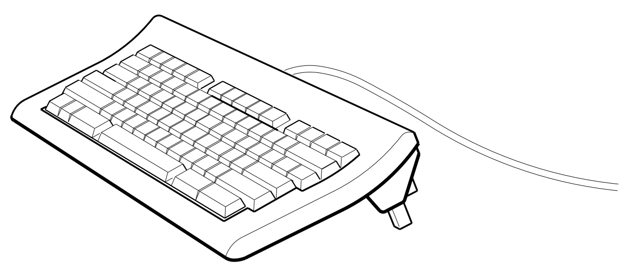
The system supports the following keyboards.

- LK401 keyboard
- LK421 keyboard

The keyboard is connected to the keyboard-mouse connector on the rear panel of the system unit through the keyboard-mouse cable.



LK401 keyboard



LK421 keyboard

WS3PM065

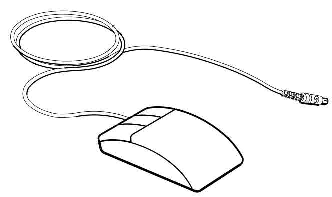
Figure 7-1. Keyboards

Mouse or Tablet

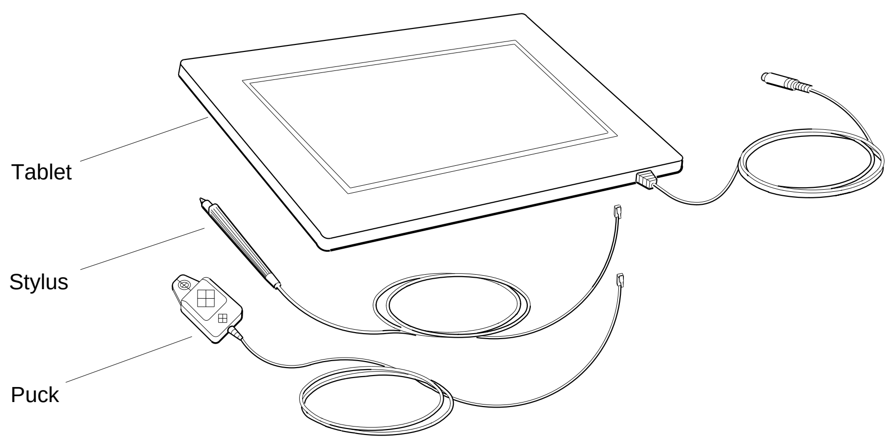
The system supports the following mouse and tablet devices:

- VSXXX-GA mouse
- VSXXX-AB tablet with stylus
- VSXXX-AB tablet with puck

The mouse or tablet is connected to the system unit through the keyboard-mouse cable that connects to the keyboard-mouse connector on the rear panel of the system unit. The stylus or puck connects to the tablet.



Mouse



Tablet with puck and stylus

WS3PM018

Figure 7-2. Mouse and tablet

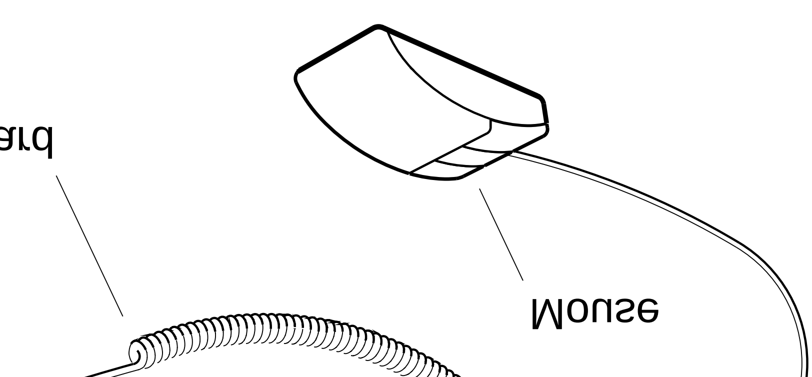
Removing and Installing Input Devices

To Remove the Keyboard, Mouse, and Cable

1. Pull the mouse or tablet cable connector straight out of the keyboard-mouse cable connector block.
2. Pinch the tab that holds the keyboard cable connector in the keyboard-mouse cable connector block. Pull the connector straight out of the connector block.
3. Loosen the screws that hold the keyboard-mouse cable connector on the rear panel of the system unit. Pull the cable connector straight out of the system unit connector.

To Install the Keyboard, Mouse, and Cable

1. Push the keyboard-mouse cable connector straight into the keyboard-mouse connector on the rear panel of the system unit. The cable connector fits only one way. Tighten the two screws on the cable connector.
2. Position the mouse or tablet cable connector so that the icon is up and aligned with the mouse icon on the keyboard-mouse cable connector block. Push the cable connector straight into the connector block.
3. With the tab down, push the keyboard cable connector straight into the keyboard connector on the keyboard-mouse cable connector block until the tab snaps into place.
4. Insert the flap on the keyboard-mouse cable connector block under the back of the monitor base.



stalling a keyboard and mouse

LPFK and PFD Devices

The system supports the lighted programmable function key (LPFK) and the programmable function dials (PFD) options. Each device is connected to the workstation through one of the serial ports. For maintenance information about the LPFK and PFD options, refer to the documentation supplied with these options.

Part II

Troubleshooting

8

Troubleshooting Overview

Introduction

This chapter provides a brief overview of the tools that are used when troubleshooting the workstation.

The service engineer will solve each problem differently as logic dictates. This chapter is an overview of the troubleshooting tools and techniques. Each of the tools and techniques mentioned is covered in detail in its own section.

- Chapter 9 discusses the information that the field service engineer uses to identify failed field-replaceable units (FRUs).
- Chapter 10 discusses the tools that the engineer uses to test the system and its components.
- Chapter 11 provides detailed troubleshooting procedures.

Listed below are some of the questions that a service engineer deals with when working on a system:

- What malfunction does the user report?
- What malfunction does the service engineer observe?
- Have the proper procedures been followed?
- Has the system run properly in the past or is it a new system?
- Are the cables and connectors in order?
- Is power getting to the system and its components?
- Does the screen work?
- When the power-up self-test sequence runs, do error messages appear on the screen or on the diagnostic LED array on the rear panel of the system unit?
- What useful information does the cnfg display provide?
- Are the environment variables set properly?
- What useful information can the tests and scripts provide?
- Is the software version appropriate? If this problem is suspected, check with the technical support group at Digital or the module vendor for further information.

Power

If the green LED on the front of the system unit or any of its peripherals doesn't light up, the first priority is to get power to the device. See the "Troubleshooting the Power Supply" section in Chapter 11.

Self-Tests

Run the self-test sequence:

- If an error code is displayed on the diagnostic LED array but not on the screen, use the LED error code to troubleshoot. See the "LED Displays" section in Chapter 9.
- If one or more error messages appears on the screen, use the error messages to troubleshoot. See the "Error Messages" section in Chapter 9 and the "Power-Up Self-Tests" section in Chapter 10.
- When the console prompt (>>) appears, you can use the console tests and utilities to get more information. See Chapter 10.

Configuration Displays

To see the configuration overview display, at the console prompt (>>) type

cnfg

and press Return.

To view the detailed configuration information for one module, type

cnfg *slot_number*

and press Return. Replace *slot_number* with the number of the slot where the module is installed. See the "cnfg Command" section in Appendix C.

Look for the following information:

- Does all of the installed hardware appear in the configuration display? If not, see the "When Hardware Does Not Appear in the cnfg Display" section in Chapter 11.
- Does the right amount of memory appear?
- Are the SCSI IDs correct?
- Is the firmware version appropriate? If this problem is suspected, check with the technical support group at Digital or the module vendor for further information.

Environment Variables

See how the environment variables are set. At the console prompt (>>) type

printenv

and press Return. See the "printenv Command" and "setenv Command" sections in Appendix C.

Look for the following information:

- Does the boot variable refer to the correct drive and is the drive working? See the "boot Command" section in Appendix C.
- Is the haltaction variable set as desired, either to autoboot or to stop in console mode? See Chapter 3 and the "setenv Command" section in Appendix C.

Tests and Scripts

The base system and the TURBOchannel option modules contain tests and scripts that can be used to test functions and components seperately or together.

Tests

To view the tests that are available for a module, at the console prompt (>>) type

t *slot_number*/**?**

and press Return. Replace *slot_number* with the number of the slot where the module to be tested is installed.

Table D-1, "Base System Module Tests and Utilities" in Appendix D, lists all of the tests for the base system module and indicates the function assessed by each test.

Scripts

To view the scripts available for a module, at the console prompt (>>) type

ls *slot_number*

and press Return. Replace *slot_number* with the slot where the module to be tested is installed.

To view the contents of a script, at the console prompt (>>) type

cat *slot_number/script_name*

and press Return.
Replace *slot_number* with the slot, replace *script_name* with the name of the script.

You can write your own script to assemble a set of tests and scripts appropriate to a given troubleshooting situation. See the "To Create a Test Script" section in Chapter 10.

9 Troubleshooting Information

This chapter describes the information available to help you identify failed FRUs. The types of troubleshooting information are as follows:

- LED displays
- Configuration displays
- Error messages
- Addresses
- ULTRIX error logs
- Registers

Some of the information, such as exception messages and power-up self-test error messages, is displayed automatically. Other information, such as configuration displays, test error messages, ULTRIX error logs, and registers, must be specifically generated or accessed by the engineer. ULTRIX error logs are accessible only in operating mode. All of the other types of configuration information are accessible only in console mode. See Chapter 2 for information about console and operating modes.

LED Displays

The following three LED displays provide information about malfunctions:

- Diagnostic LED array
- CPU module LEDs
- Power supply (DCOK) LED

Diagnostic LED Array

The system runs a series of tests whenever you turn on the system. If the test sequence fails, the system displays error messages on the console device and codes on the diagnostic LED array indicating where in the power-up sequence the system halted. The LED display is useful when the system cannot display error messages on the console device. Table 9-1 lists the LED array patterns and their meanings. See Chapter 11 for troubleshooting procedures for the various codes.

CPU Module LEDs

A pair of LEDs on the CPU module light up when certain power-up events occur. When the power-up self-test fails to complete, the status of the CPU module LEDs implies the following:

- If neither LED lights up, the CPU module is faulty.
- If only one LED lights up, the base system module is faulty.
- If both LEDs light up, the CPU and base system modules have completed basic communication operations with each other.

Power Supply LED

The green LED on the power supply indicates when DC power is functional. This LED is also referred to as the DCOK LED.

Table 9-1. LED Error Codes

LED Pattern	Hexadecimal Equivalent	Meaning
1111 1111	FF	Initial power-on and hardware initialization
0011 1111	3F	Firmware initialization
0011 0101	35	I/O application-specific integrated chip (ASIC) initialization
0011 0110	36	Firmware memory test of first 256k
0011 0111	37	Firmware calculating the cache size
0011 1110	3E	Calibrating millisecond (ms) delay loop
0011 1101	3D	Power-up versus reset setup code running, memory and modules being configured
xxxx 1011	xB	Loading console from module x
xxxx 0011	x3	Error reported from module x during the power-up self-test (pst)
xxxx 0010	x2	Firmware in module x started to execute
xxxx 0001	x1	System software loaded from module x started to execute
0000 0000	00	The system detected no errors during the power-up sequence.

Configuration Displays

The configuration displays show what components are installed in the system. Sometimes hardware does not show up on the configuration display, or shows up incorrectly. This can be useful for troubleshooting. You can also use configuration displays to obtain the following information about the components:

- The amount of RAM installed on a board
- Whether an NVRAM module is installed
- The Ethernet address of an Ethernet controller
- The SCSI ID of SCSI devices

See the "cnfg Command" section in Appendix C.

Note:

The screen output from cnfg command has changed slightly for the new R4000 CPU module. See the "Detailed Configuration" section of this chapter, or refer to Appendix C for output examples.

You can request configuration information in either of two forms:

- You can request a configuration overview, which provides basic information about the hardware installed in all of the TURBOchannel slots.
- You can request detailed information about the hardware in one particular TURBOchannel slot.

Configuration Overview

For the configuration overview, at the console prompt (>>) type

cnfg

and press Return. The following is a typical 240 configuration overview display:

```
3:   KN03-AA   DEC   V5.0a   TCF   ( 24MB,    1MB NVRAM)
                                   (enet: 08-00-2b-24-5b-82)
                                   (scsi = 7)

|        |      |      |      |    (Installed RAM)
|        |      |      |      |    (Ethernet address)
|        |      |      |      |    (SCSI ID)
|        |      |      |      |
|        |      |      |      Firmware type
|        |      |      Firmware version
|        |      Module vendor
|        Module name (base system module)
TURBOchannel slot number
```

- 24MB, 1MB NVRAM
  24 megabytes of RAM and 1 megabyte of NVRAM is installed on the base system module.
- enet: 08-00-2b-24-5b-82
  The Ethernet address of the base system Ethernet controller.
- scsi = 7
  The SCSI ID of the base system SCSI controller.

Detailed Configuration

For detailed information about the hardware in one TURBOchannel slot, at the console prompt (>>) type

cnfg *slot_number*

and press Return. Replace *slot_number* with the slot number of the module for which you want configuration information.

For example, for detailed information about the base system module hardware, at the console prompt (>>) type

cnfg 3

and press Return. The following is a typical detailed configuration display for the base system module with an R3000 CPU module installed:

```
3: KN03-AA  DEC  V5.0a  TCF0  ( 24MB,    1MB NVRAM)
                              (enet: 08-00-2b-24-5b-82)
                              (scsi = 7)
             ---------------------------------------------------
             DEV  PID            VID  REV   SCSI DEV
             ===  =============  ===  ===   ========
             rz1  RZ25  (c) DEC  DEC  0500  DIR
             rz2  RZ23  (c) DEC  DEC  2528  DIR
             rz3  RRD42 (c) DEC  DEC  1.4a  CD-ROM

          dcache  ( 64 KB), icache  ( 64 KB)
          mem( 0): a0000000:a07fffff  (  8 MB)
          mem( 1): a0800000:a0ffffff  (  8 MB)
          mem( 2): a1000000:a17fffff  (  8 MB)
          mem(14): a1800000:a18fffff  (  1 MB)   Presto-NVR

          mem(14): clean, batt ok, armed
```

The following is a typical detailed configuration display for the base system module with an R4000 CPU module installed:

```
>>cnfg 3
 3: KN05    DEC      V1.0a    TCF0   ( 32 MB)
                                     (enet: 08-00-2b-2d-84-c7)
                                     (SCSI = 7)
           ---------------------------------------------------
           DEV   PID                VID        REV    SCSI DEV
           ===== ================== ========== ====== ========
           rz1   RZ25  (c) DEC  DEC   0500  DIR
           rz2   RZ23  (c) DEC  DEC   2528  DIR
           rz3   RRD42 (c) DEC  DEC   1.4a  CD-ROM

       cache: I( 8 KB), D( 8 KB), S(1024 KB);  Scache line
       (32 bytes) processor revision (3.0)
       mem( 0):  a0000000:a07fffff  (  8 MB)
       mem( 1):  a0800000:a0ffffff  (  8 MB)
       mem( 2):  a1000000:a17fffff  (  8 MB)
       mem( 3):  a1800000:a1ffffff  (  8 MB)
```

The previous detailed configuration display example provides the following information in addition to the configuration overview:

- The three SCSI drives connected to the base system module are as follows:
  - `rz1 RZ25 (c) DEC DEC 0500 DIR`:
    An RZ25 drive with SCSI ID 1, manufactured by Digital Equipment Corporation, is using firmware version 0500 and is a hard disk drive (DIR).
  - `rz2 RZ23 (c) DEC DEC 2528 DIR`:
    An RZ23 drive with SCSI ID 2, manufactured by Digital Equipment Corporation, is using firmware version 2528 and is a hard disk drive (DIR).
  - `rz3 RRD42 (c) DEC DEC 1.4a CD-ROM`:
    An RRD42 drive with SCSI ID 3, manufactured by Digital Equipment Corporation, is using firmware version 1.4a and is an optical compact disk drive (CD-ROM).
- `dcache ( 64 KB), icache ( 64 KB)`:
  The base system module data cache is 64 kilobytes. The base system module instruction cache is 64 kilobytes.

- The RAM configuration is as follows:
  - `mem( 0): a0000000:a07fffff ( 8 MB):`
    Eight megabytes of memory in memory slot 0 are assigned memory addresses a0000000 to a07fffff.
  - `mem( 1): a0800000:a0fffff ( 8 MB):`
    Eight megabytes of memory in memory slot 1 are assigned memory addresses a0800000 to a0fffff.
  - `mem( 2): a1000000:a17fffff ( 8 MB):`
    Eight megabytes of memory in memory slot 2 are assigned memory addresses a1000000 to a17fffff.
  - `mem( 14): a1800000:a18ffff ( 1 MB):`
    Memory slot 14 contains a 1-megabyte NVRAM module. Addresses a1800000 to a18fffff are assigned to the NVRAM module.
  - `mem(14): clean, batt ok, armed:`
    The memory in the NVRAM module is clean, the battery is okay, and the battery is not turned on.

Additional output from R4000 CPU modules:

- `cache: I(8 KB), D( 8 KB), S(1024 KB); Scache line (32 bytes)`
  This line indicates the amount of Instrcution, Data, Secondary cache, and Scache line size respectively.
- `processor revision (3.0)`
  This line indicates the current installed revision of the R4000 CPU module.

Error Messages

An error message can be a test error message, a memory test error message, or a console exception message. Test error messages are displayed when an automatic or user-initiated test fails. Console exception messages are automatically displayed when console operations fail.

This section describes the following error message types:

- Test error messages
- Console exception messages
- Memory test error messages

Test Error Messages

When a test fails, the message appears on the screen in the following format:

```
?TFL slot_number/test_name
(n:description)
[module].
```

?TFL	Identifies a test error message.
slot_number	Identifies the module that reported the error.
test_name	Identifies the test that failed.
n	Indicates which part of the test failed.
description	Describes the failure; the message may include an address.
module	Indicates the module identification number.

For an explanation of system and memory module test error messages, see Appendix D. For information about other error messages, see Appendix C. For an explanation of TURBOchannel option module error messages, refer to the *TURBOchannel Maintenance Guide.*

This is a typical error message:

```
?TFL 3/scsi/cntl (3: cnt xfr) [KN03-AA]
```

This error message states that the KN03-AA module in slot number 3, the base system module, failed the SCSI controller test. The explanation of the SCSI controller test in Appendix D states that the message (`3: cnt xfr`) means the read and write operation reported a mismatch. Table 9-2 lists the base system tests and the corrective action indicated when each test is listed in a test error message.

Table 9-2. Base System Test Error Messages

Test Listed in Error Message	Component Tested	Corrective Action
cache/data cache/fill cache/isol cache/reload cache/seg fpu	CPU module	Replace the CPU module. If the problem persists, replace the system module. See the "CPU Module" and "System Module" sections in Chapter 5 and the appropriate test section in Appendix D.
ecc/cor mem mem/float10	Memory modules	See the "Troubleshooting the Memory Modules" section in Chapter 11 and the appropriate test section in Appendix D.
mem/select	Memory and system module	Replace the memory module that the test identifies. If the problem persists, replace the system module. See the "Memory Modules" and "Base System Module" sections in Chapter 5 and the mem/select test section in Appendix D.
misc/halt	System module	Replace the system module. See the "System Module" section in Chapter 5 and the misc/halt test section in Appendix D.
misc/kbd	Keyboard and system module	See the "Keyboard, Mouse, and Pointing Devices" section in Chapter 11 and the misc/kbd test section in Appendix D.

(continued on next page)

Table 9-2 (Cont.). Base System Test Error Messages

Test Listed in Error Message	Component Tested	Corrective Action
misc/mouse	Mouse and system module	See the "Troubleshooting the Keyboard and Mouse" section in Chapter 11 and the misc/mouse test section in Appendix D.
misc/pstemp	Power supply	See the "Troubleshooting the Power Supply," section in Chapter 11 and the misc/pstemp test section in Appendix D.
misc/wbpart	Memory modules	See the "Troubleshooting Memory Modules" section in Chapter 11 and the misc/wbpart test section in Appendix D.
ni/cllsn ni/common ni/crc ni/cntrs ni/dma1 ni/dma2 ni/esar ni/ext-lb ni/int ni/int-lb ni/m-cst ni/promisc ni/regs	Base system Ethernet controller	See the "Troubleshooting an Ethernet Controller" section in Chapter 11 and the appropriate test section in Appendix D.
prcache prcache/arm prcache/clear prcache/unarm	NVRAM memory module	See the "Troubleshooting the Memory Modules" section in Chapter 11 and the appropriate test section in Appendix D.
scache/data	CPU module R4000 Only	Replace the CPU module. See the "CPU Module" section in Chapter 5 and the appropriate test section in Appendix D.

(continued on next page)

Table 9-2 (Cont.). Base System Test Error Messages

Test Listed in Error Message	Component Tested	Corrective Action
rtc/nvr rtc/period rtc/regs rtc/time	System module	Replace the system module. See the "System Module" section in Chapter 5 and the appropriate test section in Appendix D.
scc/access scc/dma scc/init scc/io scc/pins scc/tx-rx	Serial line controllers and devices attached to them	See the "Troubleshooting a Printer, Modem, or Other Serial Line Device" section in Chapter 11 and the appropriate test section in Appendix D.
scsi/cntl scsi/sdiag scsi/target	Base system SCSI controller or device	See the "Troubleshooting SCSI Devices" section in Chapter 11 and the appropriate test section in Appendix D.
tlb/prb tlb/reg	CPU module	Replace the CPU module. See the "CPU Module" in Chapter 5 and the appropriate test section in Appendix D.

Memory Test Error Messages

When a memory test detects an error, the message appears on the screen in the following format:

```
?TFL 3/mem (n: board xx, MBE = yy, SBE = zz)
```

?TFL 3/mem	Indicates that a memory test failed.
n	Represents the number of the subtest that failed.
xx	Represents the memory slot where the faulty board is installed.
yy	Represents the number of multiple-bit errors that occurred.
zz	Represents the number of single-bit errors that occurred.

This is a typical memory test error message:

```
?TFL:3/mem (1: board 3, MBE = 25, SBE = 6))
```

In this example:

`3/mem`	Indicates that the mem test failed.
`1:`	Indicates that subtest number 1 failed.
`board 3`	Indicates that the SIMM in slot 3 is faulty.
`MBE = 25`	Indicates that 25 multiple bit errors occurred.
`SBE = 6`	Indicates that 6 single bit errors occurred.

Console Exception Messages

When a console operation fails, the system displays a console exception message. When a console exception message appears, first verify that any command and address that you entered are valid. If you are sure the command and address are correct but the console exception still occurs, interpret the message to determine what caused the exception. For information about interpreting console exception messages, see the "When a Console Exception Occurs" section in Chapter 11. For information about the registers, see Appendix E.

A console exception message can be recognized by the first line, which always begins with the characters `? PC:`. A console exception message includes some combination of the following entries:

```
? PC:  address
? CR:  cause
? SR:  status
? VA:  virtual address
? ER:  error address
? CK:  error syndrome
```

where:

- `address` represents the address of the exception instruction.
- `cause` represents the value in the cause register.
- `status` represents the contents of the status register.
- `virtual address` represents the virtual address of the exception.
- `error address` represents the contents of the error address register.
- `error syndrome` represents the value in the error syndrome register.

Example: Console Exception Message (R3000) The following example shows a typical value for each of the possible entries of a console exception message for an R3000 CPU module. In each entry, the information in brackets (<>) is the decoded version of the hexadecimal value that precedes it.

```
? PC: 0xbfc0d0d <vtr=NRML>
? CR: 0x210c <CE=0,IP6,EXC=DBE>
? SR: 0x30080000 <CU1,CU0,CM,IPL=8>
? VA: 0x0
? ER: 0xd0800006 <VALID,CPU,ECCERR,ADR=2000018>
? CK: 0x8c18c321
<VLDHI,CHKHI=C,SYNHI=18,VLDLO,CHKLO=43,SYNLO=21>
```

Example: Console Exception Message (R4000) The following example shows a typical value for each of the possible entries of a console exception message for an R4000 CPU module. In each entry, the information in brackets (<>) is the decoded version of the hexadecimal value that precedes it.

```
>>e 0

???
? PC:  0xbfc0cd60 <vtr=TLBM>
? CR:  0x00000008 <CE=0,EXC=TLBL>
? SR:  0x30010002 <CU1,CU0,DE,IPL=8,MODE=KNL,EXL>
? CFG: 0x10410243 <SB=8W,SC=Y,IC=8K,DC=8K,IB=4W,DB=4W,K0=CNC>
? VA:  0x00000000
?
? MB_CS:  0x00008000 <MSK=0,EE,ECC=0>
? MB_INT: 0x001f0000 <>

>>
>>
```

Addresses

Addresses of various types appear in error and exception messages. These addresses indicate the location of the malfunction. You use addresses in test commands to indicate which module or memory location the test is to address.

This section describes the following types of addresses:

- Slot numbers
- Memory addresses
- Hardware physical addresses

Slot Numbers

Test commands and error messages include slot numbers that identify the hardware to which the test command or error message refers, as shown in Table 9-3.

Table 9-3. Slot Numbers in Commands and Messages

Slot	Hardware Identified
0	Option module in slot 0 (farthest from the power supply)
1	Option module in slot 1 (middle option slot)
2	Option module in slot 2 (nearest the power supply)
3	Base system hardware, including – System module – CPU module – SIMMs – NVRAM – Keyboard and mouse – Serial communications controller – Base system SCSI controller – Base system Ethernet controller

Memory Addresses

When a memory error occurs, the error message contains the address of the error. You can identify the faulty SIMM by the address.

Addresses can appear in error messages in several formats, but you must use the kseg1 format to specify addresses in console commands. kseg1 format refers to uncached, unmapped address space. In kseg1 format, the uppermost three bits of the address are always 101 and the hexadecimal form of the address always begins with an A or a B. For example, if an address is listed in an error message as 0x04040404, you would use 0xA4040404 to specify that address in a console command. If an address is listed in an error message as 0x14040404, you would use 0xB4040404 to specify that address in a console command.

Table 9-4 lists the memory addresses in kseg1 format by slot number for 8-megabyte and 32-megabyte memory modules.

Table 9-4. Memory Module Address Ranges

Memory Slot	8-Mbyte Module Address Ranges	32-Mbyte Module Address Ranges
0	0xA0000000 to 0xA07FFFFF	0xA0000000 to 0xA1FFFFFF
1	0xA0800000 to 0xA0FFFFFF	0xA2000000 to 0xA3FFFFFF
2	0xA1000000 to 0xA17FFFFF	0xA4000000 to 0xA5FFFFFF
3	0xA1800000 to 0xA1FFFFFF	0xA6000000 to 0xA7FFFFFF
4	0xA2000000 to 0xA27FFFFF	0xA8000000 to 0xA9FFFFFF
5	0xA2800000 to 0xA2FFFFFF	0xAA000000 to 0xABFFFFFF
6	0xA3000000 to 0xA37FFFFF	0xAC000000 to 0xADFFFFFF
7	0xA3800000 to 0xA3FFFFFF	0xAE000000 to 0xAFFFFFFF
8	0xA4000000 to 0xA47FFFFF	0xB0000000 to 0xB1FFFFFF
9	0xA4800000 to 0xA4FFFFFF	0xB2000000 to 0xB3FFFFFF
10	0xA5000000 to 0xA57FFFFF	0xB4000000 to 0xB5FFFFFF
11	0xA5800000 to 0xA5FFFFFF	0xB6000000 to 0xB7FFFFFF
12	0xA6000000 to 0xA67FFFFF	0xB8000000 to 0xB9FFFFFF
13	0xA6800000 to 0xA6FFFFFF	0xBA000000 to 0xBBFFFFFF
14	0xA7000000 to 0xA77FFFFF	0xBC000000 to 0xBDFFFFFF
Reserved	0xA7800000	

Hardware Physical Addresses

The hardware addresses in Table 9-5 appear in ULTRIX error logs.

Table 9-5. Hardware Physical Addresses

Physical Address Range	Indicated Hardware
0x00000000 to 0x1DFFFFFF	RAM
0x1E000000 to 0x1E7FFFFF	TURBOchannel slot 0
0x1E800000 to 0x1EFFFFFF	TURBOchannel slot 1
0x1F000000 to 0x1F7FFFFF	TURBOchannel slot 2
0x1F800000 to 0x1FFFFFFF	Slot 3: Base system module

(continued on next page)

Table 9-5 (Cont.). Hardware Physical Addresses

Physical Address Range	Indicated Hardware
The following addresses are included in the system module address range:	
0x1F800000 to 0x1F83FFFF	System ROM
0x1F840000 to 0x1F87FFFF	Input/output control (IOCTL) registers and direct memory access (DMA) pointers
0x1F880000 to 0x1F8BFFFF	Ethernet address programmable read-only memory and electrically erasable programmable read-only memory (PROM /EEPROM)
0x1F8C0000 to 0x1F8FFFFF	Ethernet interface
0x1F900000 to 0x1F93FFFF	Serial communication chip (SCC)(0) registers
0x1F940000 to 0x1F97FFFF	Reserved
0x1F980000 to 0x1F9BFFFF	SCC(1) registers
0x1F9C0000 to 0x1F9FFFFF	Reserved
0x1FA00000 to 0x1FA3FFFF	Real-time clock
0x1FA40000 to 0x1FA7FFFF	Error address (EA) register (0x1FA40000)
0x1FA80000 to 0x1FABFFFF	Error syndrome (ES) register (1FA80000)
0x1FAC0000 to 0x1FAFFFFF	Control/status (CS) register (0xFAC0000)
0x1FB00000 to 0x1FB3FFFF	SCSI interface
0x1FB40000 to 0x1FB7FFFF	Reserved
0x1FB80000 to 0x1FBBFFFF	SCSI DMA
0x1FBC0000 to 0x1FBFFFFF	Reserved
0x1FC00000 to 0x1FC3FFFF	Boot ROM
0x1FC40000 to 0x1FFFFFFF	Reserved
0x20000000 to 0x3FFFFFFF	TURBOchannel slot 0
0x40000000 to 0x5FFFFFFF	TURBOchannel slot 1
0x60000000 to 0x7FFFFFFF	TURBOchannel slot 2
0x80000000 to 0xFFFFFFFF	Reserved
0x1FD00000 to 0x1FD7FFFF	MB_interrupt

(continued on next page)

Table 9-5 (Cont.). Hardware Physical Addresses

Physical Address Range	Indicated Hardware
0x1FD40000 to 0x1FD7FFFF	MB_EA
0x1FD80000 to 0x1FD8FFFF	MB_EC
0x1FDC0000 to 0x1FDFFFFF	MB_CS

ULTRIX Error Logs

The system records events and errors in the ULTRIX error logs. Use the memory error logs and the error and status register error logs to troubleshoot intermittent problems. This section describes ULTRIX error log formats and error log items that are useful for troubleshooting.

The ULTRIX error logs are not the same as the test error logs that appear when you use the erl command from the console prompt. A test error log is a record of errors reported by tests run in console mode.

Examining Error Logs

You must be running ULTRIX to examine error logs. At the ULTRIX prompt (#) type:

/etc/uerf -R | more

and press Return. A full display of ULTRIX error logs, with the newest error logs first, appears on the monitor.

For information about running ULTRIX, see the "System Software Management" section in Chapter 2. Information about the uerf command in the ULTRIX man facility can be obtained by typing **man uerf** at the ULTRIX prompt (#).

ULTRIX Error Log Format

The first part of each ULTRIX error log describes the type of error and system conditions in effect when the error occurred. The format of the first part is the same for all ULTRIX error logs, regardless of the event type.

The second part of each log provides specific information about the error and its location. In the second part, the information available for troubleshooting varies according to the event type.

The first part of all ULTRIX error logs is similar to this example:

```
****************** ENTRY   6.  ******************

----- EVENT INFORMATION -----
EVENT CLASS                       OPERATIONAL EVENT
OS EVENT TYPE               250.  ASCII MSG
SEQUENCE NUMBER               5.
OPERATING SYSTEM                  ULTRIX 32
OCCURRED/LOGGED ON                Mon Nov 11  10:39:27  1991 PST
OCCURRED ON SYSTEM                GRANITE
SYSTEM ID             x82040230  HW REV: x30
                                  FW REV: x2
                                  CPU TYPE: R2000A/R3000
PROCESSOR TYPE                    KN03
MESSAGE                     Error count on memory module 0 reached
                                  _2048, resetting count to zero.
```

- EVENT CLASS indicates the category of the error. The two event class categories are operational events and error events.
  - Operational events are changes in system operation that are not errors.
  - Error events are actual errors in system operation.
- OS EVENT TYPE describes the type of error or event recorded in the log. Table 9-6 lists the operating system event types and their codes. For information about memory error logs, error, and status register error logs, see the "ULTRIX Error Log Event Types" and "Memory Error Logs" sections in this chapter.
- SEQUENCE NUMBER indicates the order in which the system logged the event.
- OPERATING SYSTEM indicates the systems version of ULTRIX.
- OCCURRED/LOGGED ON indicates when the error occurred.
- OCCURRED ON SYSTEM identifies the system that reported the error.
- SYSTEM ID includes the following listings:
  - The first number is the system ID.
  - HW REV indicates the system hardware revision number.
  - FW REV indicates the system firmware revision number.
  - CPU TYPE indicates the type of CPU installed in the system.
  - PROCESSOR TYPE indicates the type of processor chip that the system uses.
- The MESSAGE field provides information about the event or error.

ULTRIX Error Log Event Types

The second line of each error log indicates the code number and event type of the error. Table 9-6 lists the error log event types.

Table 9-6. Error Log Event Types

Code	Event Type
100	Machine check
101	Memory error
102	Disk error
103	Tape error
104	Device controller error
105	Adapter error
106	Bus error
107	Stray interrupt
108	Asynchronous write error
109	Exception or fault
113	CPU error and status information
130	Error and status register
200	Panic (bug check)
250	Informational ASCII message
251	Operational message
300	System startup message
310	Time change message
350	Diagnostic information

The information in the second part of an error log varies according to the event type listed on line 2 of the first part of the error log.

For a detailed explanation of other error logs, refer to the ULTRIX documentation for the uerf function or the documentation for the device that the error log discusses.

Memory Error Logs

Memory error logs record errors that occur in the memory modules.

Memory error log example 1

The two examples in this section are two sequential ULTRIX error log entries that are related to each other. The two entries were generated when a correctable single-bit error occurred in the SIMM in slot 0. ENTRY 6 occurred within 1 second after ENTRY 5.

```
****************** ENTRY   6. ******************

----- EVENT INFORMATION -----
EVENT CLASS                         OPERATIONAL EVENT
OS EVENT TYPE            250.       ASCII MSG
SEQUENCE NUMBER            5.
OPERATING SYSTEM                    ULTRIX 32
OCCURRED/LOGGED ON                  Mon Nov 11  10:39:27  1991 PST
OCCURRED ON SYSTEM                  GRANITE
SYSTEM ID             x82040230     HW REV: x30
                                    FW REV: x2
                                    CPU TYPE: R2000A/R3000
PROCESSOR TYPE                      KN03
MESSAGE                      Error count on memory module 0 reached
                                    _2048, resetting count to zero.
```

```
****************** ENTRY 5.  ******************

-----------  EVENT INFORMATION  ----------------
EVENT CLASS                ERROR EVENT
OS EVENT TYPE         101. MEMORY ERROR
SEQUENCE NUMBER         4.
OPERATING SYSTEM           ULTRIX 32
OCCURRED/LOGGED ON            Mon Nov 11  10:39:27  1991 PST
OCCURRED ON SYSTEM         GRANITE
SYSTEM ID        x82040230 HW REV: x30
                       FW REV: x2
                       CPU TYPE: R2000A/R3000
PROCESSOR TYPE             KN03
------------- UNIT INFORMATION -------------
UNIT CLASS                 MEMORY
UNIT TYPE          MS02 MEMORY
ERROR SYNDROME             MEMORY CRD ERROR
------------- KN03 MEMORY REGISTERS -------
EPC                   x800AFA3C
MEMORY CSR     x00002400   CHECK VALUE x0
                       32 MB MEM MODULES
                       ECC ERROR CORRECTION ENABLED
PHYSICAL ERROR ADDR     x010205F8
CHECK SYNDROME            x00308CB4   SYND BITS x34
                                      SINGLE BIT ERROR
                                      CHECK BITS xC
                                      MODULE NUM. x0
                                      ERROR COUNT 3.
                                      INVALID PC MEMINTR
```

A troubleshooter would analyze the error logs in the preceding examples as discussed here. See Appendix E for detailed information about memory registers.

- The MESSAGE field of ENTRY 6 indicates that more than 2048 single-bit ECC errors have occurred on the memory module in memory slot 0 and the counter has been reset to zero. Since the memory error correction feature corrects single bit errors, this is an operational event, not strictly an error.
- ENTRY 5 reports the actual single-bit error that overflowed the counter, causing it to be reset. The information under the KN03 MEMORY REGISTERS heading is useful to the troubleshooter:
  - SINGLE BIT ERROR indicates that a single-bit correctable error occurred.
  - MODULE NUM x0 indicates that the error occurred on the module in slot 0.
  - The PHYSICAL ERROR ADDR field indicates the error address.
  - The value 32 MB MEM MODULES in the MEMORY CSR field indicates the size of the memory modules.

ECC memory is designed so that occasional single-bit errors can occur and correction will take place. If occasional errors occur on a module, the module should not be replaced. But if a particular memory module records errors frequently, the module should be replaced.

Memory error log example 2

The memory error log example in this section describes a multiple-bit uncorrectable error. The module where the error occurred must be changed.

```
******************* ENTRY   193. *******************

----- EVENT INFORMATION -----

EVENT CLASS                        ERROR EVENT
OS EVENT TYPE               101.   MEMORY ERROR
SEQUENCE NUMBER               7.
OPERATING SYSTEM                   ULTRIX 32
OCCURRED/LOGGED ON                 Tue Jan  7 10:52:18 1992
PST
OCCURRED ON SYSTEM                 csselab2
SYSTEM ID              x82040230   HW REV: x30
                                   FW REV: x2
                                   CPU TYPE: R2000A/R3000
PROCESSOR TYPE                     KN03

----- UNIT INFORMATION -----

UNIT CLASS                         MEMORY
UNIT TYPE                          MS02 MEMORY
ERROR SYNDROME                     MEMORY RDS ERROR

----- KN03 MEMORY REGISTERS -----

EPC                    x8011995C
MEMORY CSR             x00002400   CHECK VALUE x0
                                   32 MB MEM MODULES
                                   ECC ERROR CORRECTION ENABLED
PHYSICAL ERROR ADDR    x00FD5ECC
CHECK SYNDROME         x800080B5   SYND BITS x35
                                   SINGLE BIT ERROR
                                   CHECK BITS x0
                                   MODULE NUM. x0
                                   ERROR COUNT 0.
```

- The `ERROR SYNDROME` field describes the error. The value in that field (`MEMORY RDS ERROR`) indicates that a multi-bit uncorrectable error occurred.
- The information under the `KN03 MEMORY REGISTERS` heading provides the following useful information:
  - The value `NUM. x0` in the fourth line of the `CHECK SYNDROME` field indicates that the error occurred on the module in slot 0.
  - The `PHYSICAL ERROR ADDRESS` field indicates the error address.
  - The value `32 MB MEM MODULES` in the second line of the `MEMORY CSR` filed indicates the size of the memory modules.

Replace the indicated memory module. Multi-bit errors are not correctable, and will cause processes and the system to crash.

Registers

The system automatically displays CPU register information in the console exception message when console exception occurs. To access system registers, from the console prompt (>>) type

e *console_address*

and press Return.

Replace *console_address* with the address of the register that you want to examine. Use the kseg1 format for the address.

For information about the kseg1 format, see the "Memory Addresses" section in this chapter. For complete register information, see Appendix E. For information about the e command, see the "e Command" section in Appendix C.

For Further Information

To determine the corrective action indicated by a particular error message, refer to Chapter 11.

For an explanation of other error logs, refer to the ULTRIX documentation for the uerf function.

For an explanation of error logs for SCSI devices, refer to the documentation for the device described in the error log.

10

Troubleshooting Tools

This chapter discusses the system troubleshooting tools. It explains how to

- Run tests
- Use test scripts

Console Mode

You have to be in console mode to perform maintenance operations, such as the following:

- Run diagnostic tests
- Read error messages
- Set environment variables
- Display hardware configurations

See the "Console Mode" section in Chapter 2

Note: *You have to be in operating mode to use ULTRIX error logs.*

Alternate Terminal

If the system monitor is not working properly, install an alternate terminal to run tests and read error messages. See Chapter 3 for details about installing an alternate terminal.

Tests

The read-only memory (ROMs) on the base system module (R3000), on the R4000 CPU module, and on the TURBOchannel option modules contain numerous tests that verify the functions of the system. Tests can be used in the following ways to check system hardware operation:

- The automatic power-up self-test scripts run a comprehensive set of individual tests on the system and option module hardware.
- You can run individual tests in console mode to test specific system and option module functions.
- You can run one of several prepared scripts or create a script of your own, containing any set of tests that you find appropriate.

Slot Numbers in Test Commands and Error Messages

Test commands and error messages use slot numbers to identify the hardware to which the command or message refers.

- Slot 3 always refers to the base system hardware, which includes the following:
  - System module
  - CPU module
  - Memory modules (SIMMs and NVRAM)
  - Base system Ethernet controller
  - Base system SCSI controller
  - Serial line controllers
- Slot 0 refers to the TURBOchannel option slot farthest from the power supply.
- Slot 1 refers to the middle TURBOchannel option slot.
- Slot 2 refers to the TURBOchannel option slot nearest to the power supply.

Figure 10-1 shows the physical location of the base system and option module hardware that occupies each slot number.

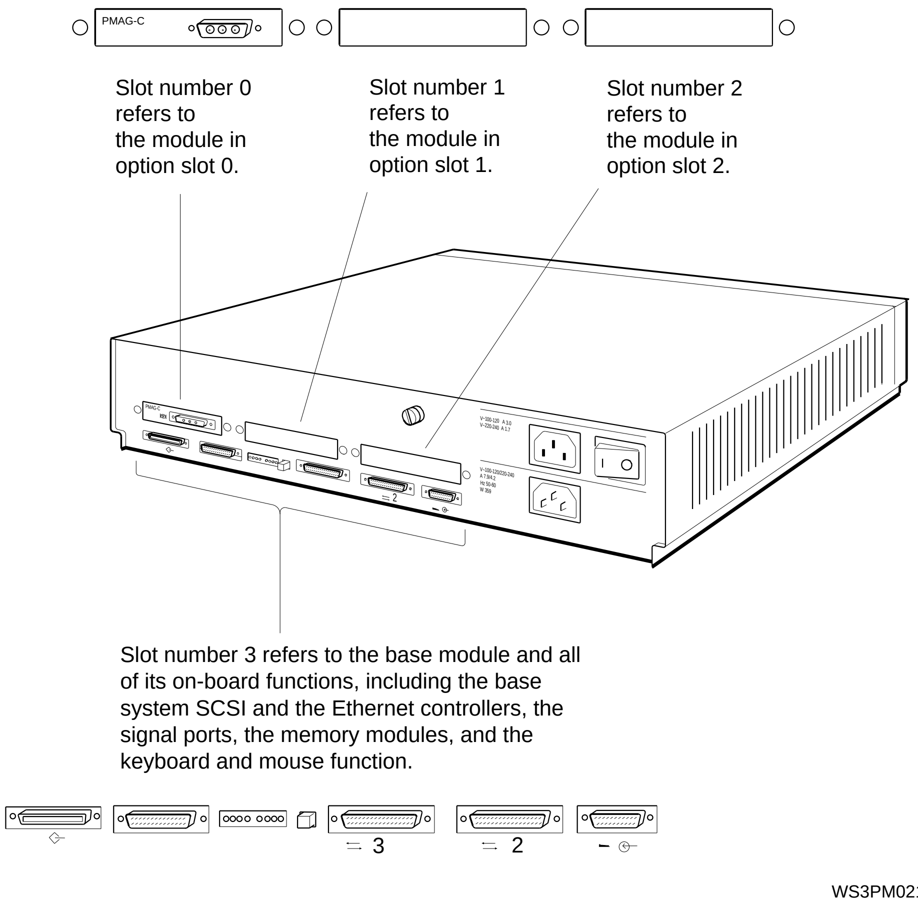


Figure 10-1. Slot numbers for system hardware

Power-Up Self-Tests

When you turn on the system power, the system automatically runs a power-up self-test script. The monitor and the diagnostic LED array report any errors the power-up self-tests detect. Self-test error codes are discussed in the "Error Messages" section in Chapter 9 and in Appendix D.

You can specify a quick or a thorough power-up self-test script to run when the system powers up.

- The quick script, usually specified for normal power-up, is a limited script that allows the system to boot quickly.
- The thorough script runs an extensive check of system hardware. The thorough script is most useful for field service troubleshooting. Some tests in the thorough script require loopbacks on the external connectors.

To select a power-up self-test script, use the setenv command to set the testaction environment variable. Type:

setenv testaction (q | t)

and press Return. The vertical bar (|) means that you choose one of the alternatives. In this case,

- Type **setenv testaction q** to select the quick test.
- Type **setenv testaction t** to select the thorough test.

You can use the powerup script to run the power-up self-tests without turning the power off and on again. To run the powerup script, at the console prompt (>>) type:

powerup

and press Return.

Console Mode Tests

From the console prompt (>>), use the t command to run an individual test or the sh command to run a test script. To see a list of available console commands and their formats, at the console prompt (>>), type:

?

and press Return. Appendix C describes the console commands in detail.

Using the t Command

To run an individual test, from the console prompt (>>) type:

t [-l] *slot_number*/*test_name* [*arg1*] [...] [*argn*]

and press Return.

t	Indicates the test command.
-l	Causes the test to loop until you press Ctrl-c or reset the system by pushing the Halt button or by switching the power off and then on.
slot_number	Replace with the slot number of the module to be tested.
test_name	Replace with the name of the test to be run.
arg1...argn	Specify individual test conditions.

Table 10-1. Slot Numbers in Test Commands

Slot Number	Component Tested
0	Option module in slot 0 (farthest from the power supply)
1	Option module in slot 1 (middle option slot)
2	Option module in slot 2 (nearest the power supply)
3	Base system hardware, which includes – System module – CPU module – Memory modules (SIMMs and NVRAM) – Base system SCSI controller – Base system Ethernet controller – Serial line controllers

To display a list of available tests

To display a list of tests available for a module, from the console prompt (>>) type:

t *slot_number*/**?**

and press Return. Replace *slot_number* with the number of the slot where the module is installed. A display similiar to this appears on the monitor:

```
cache/data       I or D[D]   address[80050000]
cache/isol       I or D[D]
cache/reload     I or D[D]   address[80050000]
cache/seg        I or D[D]   address[80050000]
fpu
mem              board[0]   thrsld[10]   pattern[55555555]
mem/init
mem/float10      address[A0100000]
mem/select
mfg/done
misc/pstemp
misc/wbpart
rtc/nvr           pattern[55]
rtc/period
rtc/regs
rtc/time
tlb/prb
tlb/reg          pattern[55555555]
```

- The first column lists the names of the tests available for the module in the slot that you specified.
- Entries in the other columns are individual test parameters. The value in brackets next to each parameter is the default value for that parameter.

Common Tests

This section briefly describes the following frequently used tests:

- SCSI controller test
- SCSI send diagnostics test
- Ethernet external loopback test
- Transmit and receive test
- Pins test

Appendix D describes the base system module tests and their parameters and error messages in detail. For information about the TURBOchannel module tests, refer to the *TURBOchannel Maintenance Guide*.

SCSI controller (cntl) test

The cntl test tests the operation of a SCSI controller. For example, to run the controller test on the base system SCSI controller, at the console prompt (>>) type:

t 3/scsi/cntl

and press Return. For information about SCSI controller test error messages, see the "SCSI Controller Test" section in Appendix D.

SCSI send diagnostics (sdiag) test

The sdiag test runs the self-test for an individual SCSI device. For example, to run the SCSI send diagnostics test on device 0 connected to the base system SCSI controller, at the console prompt (>>) type:

t 3/scsi/sdiag

and press Return. For information about sdiag test parameters and error messages, see the "SCSI Send Diagnostics Test" section in Appendix D.

Ethernet external loopback test

The Ethernet external loopback test tests an Ethernet controller and its connections. First install a ThickWire loopback connector on the external connector of the controller to be tested. Then, enter the xternal loopback test command. For example, to test the base system Ethernet controller, at the console prompt (>>) type:

t 3/ni/ext-lb

and press Return. For information about external loopback test error messages, see the "SCSI Controller Test" section in Appendix D.

SCC transmit and receive test

The SCC transmit and receive test tests the transmit and receive function of a serial port. First, install a communications adapter with an MMJ loopback connector on the serial connector to be tested, then enter the SCC transmit and receive test command. For example, to run the internal loopback test on serial line 3, at the console prompt (>>) type:

t 3/scc/tx-rx 3 int

and press Return. For information about the SCC transmit and receive test format and error messages, see the "SCC transmit and receive test" section in Appendix D.

SCC pins test

The SCC pins test tests the pins on a serial communications connector. First, install a modem loopback connector on the communications connector, then enter the SCC pins test command. For example, to test serial line 3 using a 29-24795 loopback connector, at the console prompt (>>) type:

t 3/scc/pins 3 29-24795

and press Return. For information about the SCC pins test format, the pins tested by the different loopback connectors, and the pins test error messages, see the "SCC Pins Test" section in Appendix D.

Test Scripts

The ROM for each module contains preprogrammed test scripts. A test script is a short program that includes a list of individual tests and other test scripts. When you run a test script, the system automatically runs the included tests and scripts in order.

Use the sh command to run a test script. To run a test script once and then stop, at the console prompt (>>) type:

sh *slot_number/test_script*

and press Return. Replace *slot_number* with the slot number of the module that you want to test. Replace *test_script* with the name of the test script that you want to run.

For example, to run the quick pst test script on the option module in slot 1, at the console prompt (>>) type:

sh -1/pst-q

and press Return.

To have a test script keep looping until you press Ctrl-c, at the console prompt (>>) type:

sh -l *slot_number/test_script*

and press Return.

For detailed information about scripts, see the "script Command" and "sh Command" sections in Appendix C.

To Display a List of Available Scripts

To display a list of scripts available for a module, from the console prompt (>>) type:

ls *slot_number*

and press Return. Replace *slot_number* with the slot number of the module.

This is a partial listing of the scripts in the base system module:

```
28          1         cnfg -> code
28          1         boot -> code
24          1         rst-q -> rst
24          1         rst-t -> rst
28          1         rst-m -> powerup
32          1         test-ni-m -> test-ni-t
28          1         init -> code
304         1         powerup
44          1         reset
36          1         halt-r
28          1         halt-b
192         1         pst-m
272         1         pst-q
196         1         pst-t
96          1         tech
121         1         test
2401        1         test-cache
132         1         test-cpu
1928        1         test-scc-m
868         1         test-scc-t
124         1         test-crt
60          1         test-misc
268         1         test-mem-m
80          1         test-mem-q
184         1         test-mem-t
196         1         test-ni-t
88          1         test-rtc
40          1         test-scsi
104         1         rst
88          1         cnsltest
```

To Display the Contents of a Script

To see which individual tests and other test scripts are in a specific test script, at the console prompt (>>) type:

cat *slot_number/script_name*

and press Return. Replace *slot_number* with the slot number of the module. Replace *script_name* with the name of the test script for which you want a listing.

The system displays a list of the individual tests and any other test scripts that are in the test script. The following example shows the cat command and the resulting listing of the contents of the test-rtc test script for slot 3 (the base system module):

```
>>cat 3/test-rtc
t ${#}/rtc/regs
t ${#}/rtc/nvr
t ${#}/rtc/period
t ${#}/rtc/time
```

In the listing of a test script, the character # represents the slot number of the module where the script resides.

The cat command displays the contents of test scripts only. It does not display the contents of other objects.

For further information about the cat command, see the "cat Command" section in Appendix C.

To Create a Test Script

You can create a test script to test modules under conditions you choose.

1. At the console prompt (>>), type:

   script *script_name*

   and press Return. Replace *script_name* with the name you want to give the script you are creating.

2. Type the test commands for the tests that you want to include in the script.

   – Type test commands in the same order that you want the tests to run. You can include individual tests and test scripts.

   – Specify any test parameters that you want to include with each entry.

   – Press Return after you finish typing each individual test command.

3. To finish creating the test script, press Return twice after you enter the last test command in the test script.

4. To run the script you just created, type:

   sh *script_name*

   and press Return. Replace *script_name* with the name you assigned the script.

The system stores the test script in volatile memory (RAM). The test script is lost when you turn off the system unit or halt the system with the Halt button. You can store only one script at a time.

If you use the ls command to list the test scripts for the base system, the test script you created appears in the test script list.

11

Troubleshooting Procedures

This chapter provides a set of flow charts and checklist troubleshooting procedures that are designed to help the field service engineer to identify failed FRUs logically and efficiently.

Table 11-1 lists the troubleshooting procedures in this chapter.

Table 11-1. Troubleshooting Procedures

Procedure	Page	Figure	Comment
Troubleshooting guide	11-5	11-1 11-2	Provides an overview of basic troubleshooting procedures; points to other procedures
When the power-up self-test does not complete	11-8		points back to this table
When the LED display is 1111 1111 (FF) 0011 1111 (3F) or 0011 1000 (35)	11-9	11-3 11-4 11-5	Outlines responses to CPU, base system, and TURBOchannel option module malfunction
When the LED disply is 0011 1110 (3E) 0011 1101 (3D) 0011 0111 (37) or 0011 0011 (33)	11-12	11-6	Outlines responses to CPU, base system, memory, and TURBOchannel option module malfunctions
When the LED display is 0011 0110 (36)	11-13	11-7	Outlines responses to memory module malfunctions
When the LED is 0010 0010 (22) 0001 0010 (12) 0000 0010 (02) 0010 0011 (23) 0001 0011 (13) or 0000 0011 (03)	11-14	11-8	Outlines responses to 2D and 3D graphics accelerator TURBOchannel opltion, and base system module malfunctions

(continued on next page)

Table 11-1 (Cont.). Troubleshooting Procedures

Procedure	Page	Figure	Comment
When the LED display is 0011 1011 (3B) 0010 1011 (2B) 0001 1011 (1B) or 0000 1011 (0B)	11-15	11-9 11-10	Outlines responses to console controller or display functions
When the monitor has no display	11-17	11-11 11-12	Outlines responses to display malfunctions
When an error messge appears on the monitor	11-19		Tells how to interpret error and exception messages
When a console exception occurs	11-21		Tells how to interpret console exception messages
When hardware does not appear in the cnfg display	11-25	11-13 11-14 11-15	Outlines responses to various module malfunctions

(continued on next page)

Table 11-1 (Cont.). Troubleshooting Procedures

Procedure	Page	Figure	Comment
Troubleshooting memory modules	11-28	11-16	Outlines responses to memory module malfunctions
Troubleshooting SCSI devices	11-29	11-17 11-18	Outlines responses SCSI malfunctions
Troubleshootng an Ethernet controller	11-31	11-19 11-20	Outlines responses to Ethernet malfunctions

(continued on next page)

Table 11-1 (Cont.). Troubleshooting Procedures

Procedure	Page	Figure	Comment
Troubleshooting a printer, modem, or other serial line device	11-33	11-21 11-22	Outlines responses to serial line malfunctions
Troubleshooting the power supply	11-35	11-23	Outlines the responses to power supply malfunctions
When the system unit overheats	11-36	11-24	Outlines responses to overheating
Troubleshooting the keyboard and mouse	11-37	11-25 11-26	outlines responses to keyboard and mouse malfunctions
When ULTRIX is running but the monitor has no display	11-39	11-27 11-28 11-29	Outlines respones display and various other malfucntions
Troubleshooting with ULTRIX error logs	11-42		Tells how to use ULTRIX error logs and respond to intermittent failures; points to Chapter 9.

Troubleshooting Guide

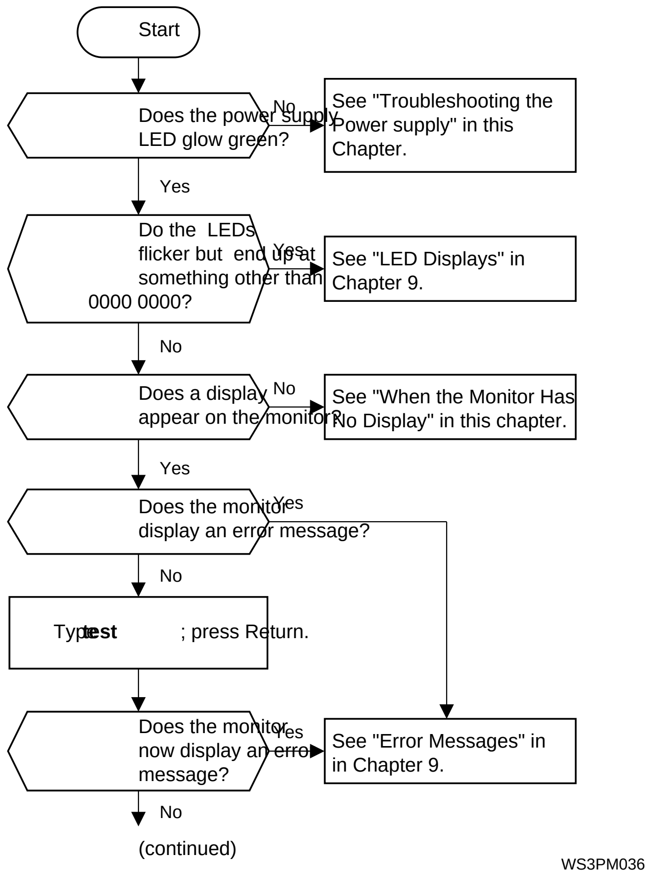


Figure 11-1. Troubleshooting guide, 1 of 2

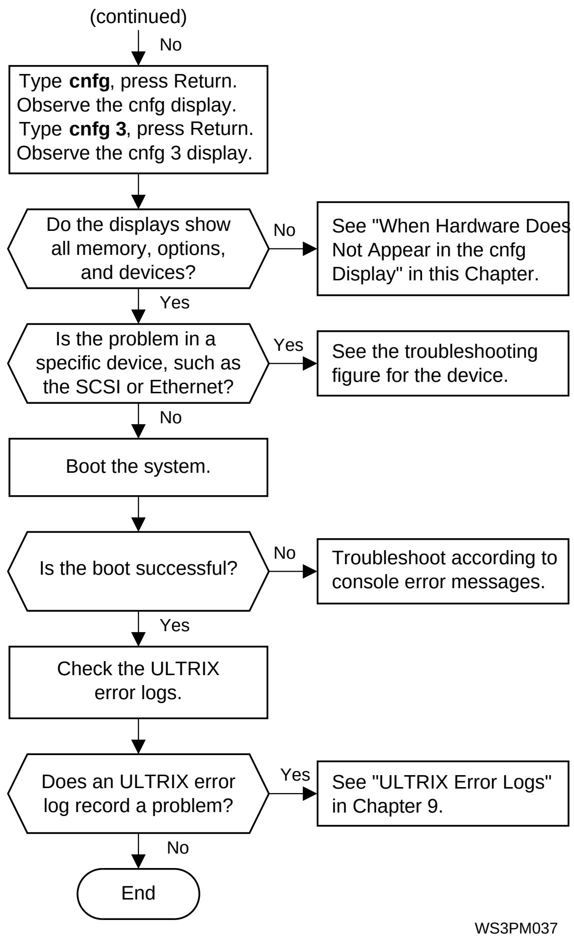


Figure 11-2. Troubleshooting guide, 2 of 2

Power-Up Self-Test Does Not Complete

If the console prompt (>>) does not appear on the monitor, the power-up self-test probably failed to complete. The diagnostic LED array displays an error code that indicates why the power-up self-test failed. Table 11-1 lists the troubleshooting procedure indicated by each diagnostic LED array error code.

The green DCOK LED on the power supply indicates when DC is functional. In addition, a pair of LEDs on the CPU module light up when certain power-up milestones occur. When the power-up self-test fails to complete, the CPU module LEDs indicate the following:

- If neither CPU module LED lights up, the CPU module is faulty.
- If only one CPU module LED lights up, the base system module is likely to be faulty.
- If both CPU module LEDs light up, the CPU module and the base system module display basic functionality. Troubleshoot further to determine why the test failed.

The power-up sequence is as follows:

1. Power on.
2. DCOK LED comes on when 5V and 12V power reach proper levels.
3. DCOK input to IOCTL ASIC.
4. IOCTL ASIC generates master reset.
5. MB chip on CPU module is reset.
6. MB generates reset for CPU.
7. CPU resets itself and attempts to read base system ROM.
8. MB forwards request to MT.
9. MT generates a TURBOchannel read to the ROM in slot 3.
10. CPU PAL latched signal and CPU module LED one comes on.
11. IOCTL ASIC pick up read and gets date from ROM.

12. ROM returns data to IOCTL ASIC.
13. IOCTL ASIC places data on TURBOchannel.
14. CPU PAL latched signal and CPU module LED also comes on.
15. Data based by MT to MS to CPU.
16. First Read complete.

Troubleshooting With LED Codes

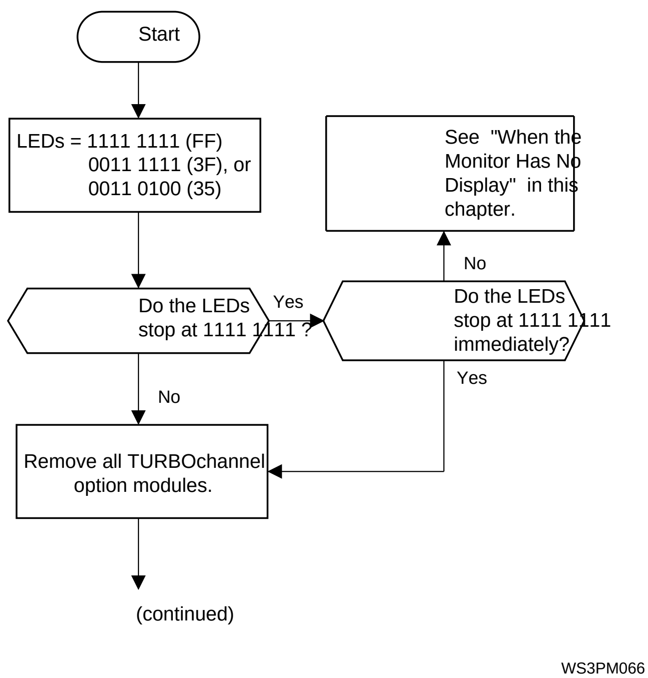


Figure 11-3. When the LED display is 1111 1111 (FF), 0011 1111 (3F), or 0011 0101 (35) 1 of 3

WS3PM068

isplay is 1111 1111 (FF), 0011 1111 (3F), or

3 of 3

WS3PM069

isplay is 0011 1110 (3E), 0011 1101 (3D), or
or 0011 0011 (33)

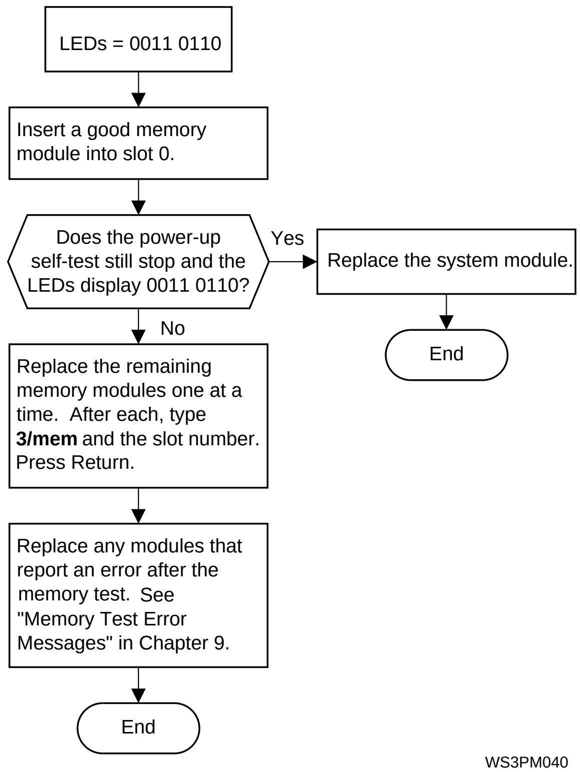
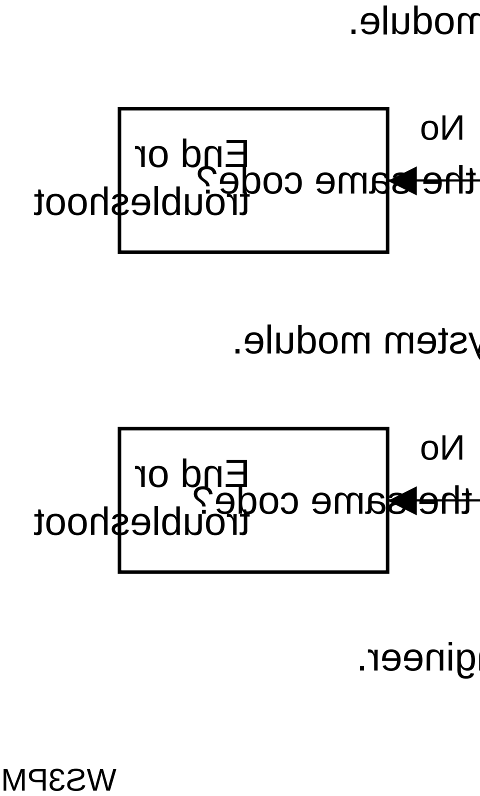


Figure 11-7. When the LED display is 0011 0110 (36)



isplay is 0010 0010 (22), 0001 0010 (12), 0010 0011 (23), 0001 0011 (13), or 0000

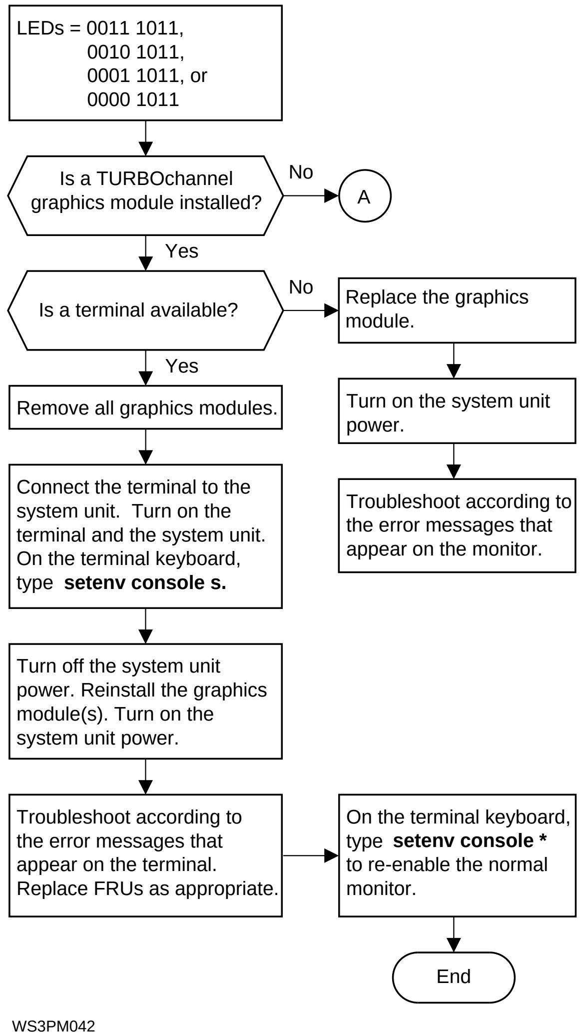


Figure 11-9. When the LED display is 0011 1011 (3B), 0010 1011 (2B), 0001 1011 (1B), or 0000 1011 (0B), 1 of 2

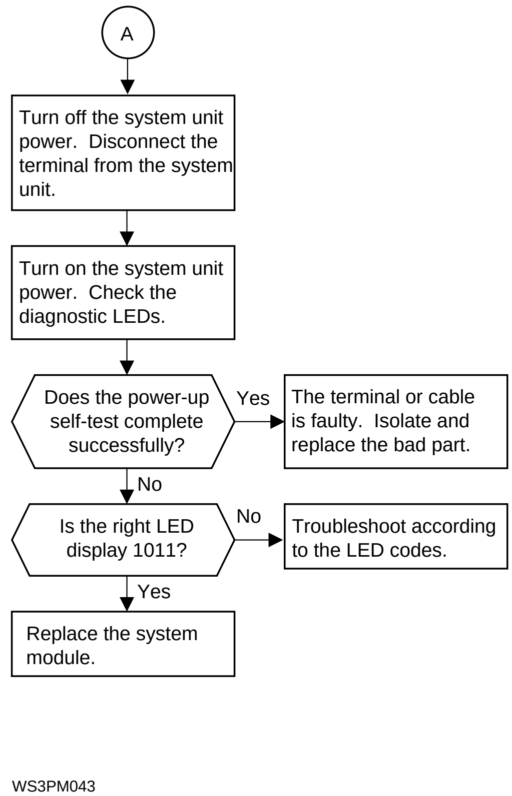


Figure 11-10. When the LED display is 0011 1011 (3B), 0010 1011 (2B), 0001 1011 (1B), or 0000 1011 (0B), 2 of 2

Monitor Has No Display

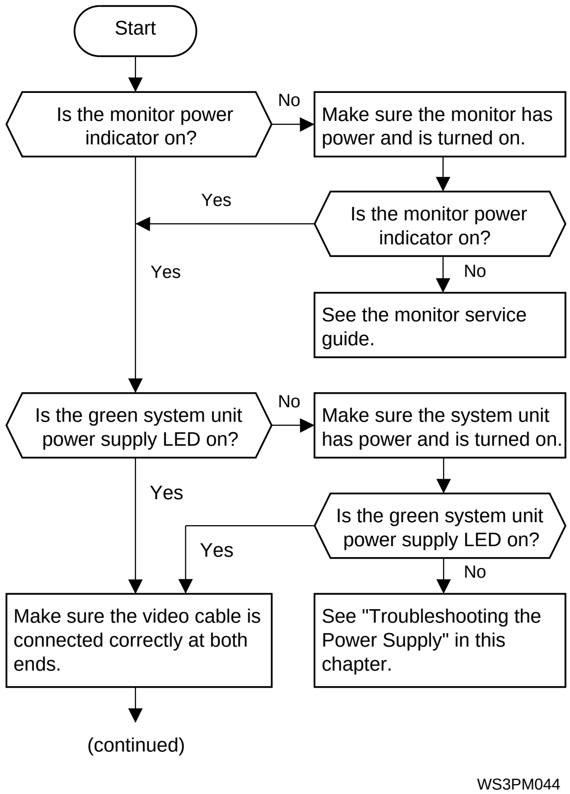


Figure 11-11. When the monitor has no display, 1 of 2

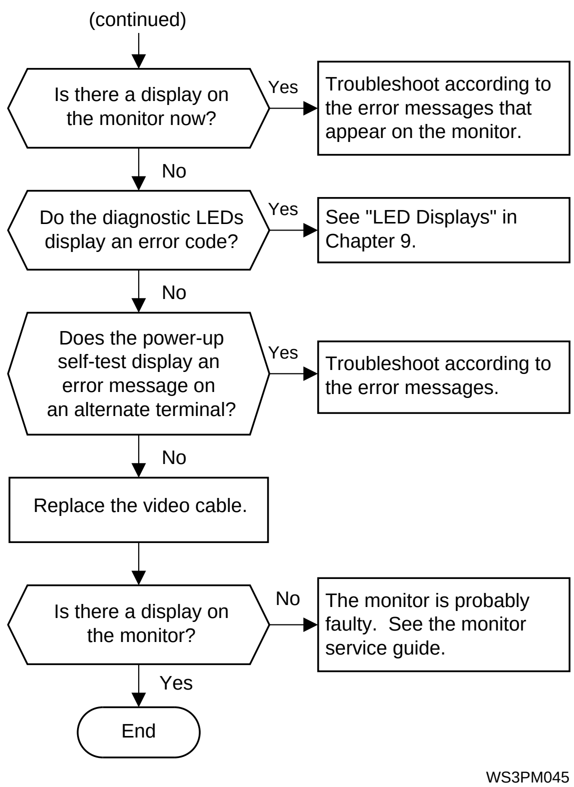


Figure 11-12. When the monitor has no display, 2 of 2

When an Error Message Appears on the Monitor

In console mode, the monitor dislpays error and exception messages.

- Messages that begin with ?TFL describe errors or exceptions that occur during tests.
- Messages that begin with ?PC followed by several lines that begin with question marks (?) describe console exceptions.

Test Exception Messages

Messages that include CUX or UEX followed by the word cause and a string of numbers describe exceptions that occurred during a test.

Test exception messages have the form

```
?TFL: slot_number/test_name (CUX|UEX, cause=xxxxxxxx) [KN03-AA]
```

- `?TFL: slot_number/test_name` indicates that a test reported an exception.
  - `?TFL: indicates that a test failed.`
  - `slot_number` represents the slot number of the module in which the exception occurred.
  - `test_name` represents the name of the test that reported the exception.
- `CUX` or `UEX` indicates that the error is an exception.
- `xxxxxxxx` represents the contents in the cause register when the exception occurred.
- `[KN03-GA]` is the CPU module identifier.

To troubleshoot when an exception occurs during a test, interpret the value in the cause register. Appendix E describes the cause register.

Messages that do not include CUX or UEX describe hardware errors detected by tests.

Test Error Messages

Error messages that appear on the monitor have the form

```
?TFL slot_number/test_name (description)
```

- `slot_number` represents the slot number of the FRU that reported the failure.
- `test_name` represents the name of the individual test that failed.
- `description` represents a detailed description of the error.

If the slot number listed in the error message is 0, 1, or 2, the probable failed FRU is a TURBOchannel option module. Refer to the TURBOchannel Maintenance Guide to troubleshoot.

If the slot number listed in the error message is 3, the probable failed FRU is in the base system hardware. The individual test listed in the message is the test that reported the error.

For more information about the error messages, see "Test error messages," section in Chapter 9. Table 9-2, "Base System Test Error Messages" lists the corrective action indicated by each error message for the base system module. For details about a specific error message, refer to the section in Appendix D that discusses the individual test listed in the error message.

When a Console Exception Occurs

When a console operation fails, the system displays a console exception message. When a console exception message appears, first verify that any command and address that you entered are valid. If you are sure the command and address are correct but the console exception still ocurs, interpret the message to determine what caused the exception. For an explanation of the registers, see Appendix E.

A console exception message (R3000 only) includes some combination of the following entries:

```
? PC:   address
? CR:   cause
? SR:   status
? VA:   virtual address
? ER:   error address
? CK:   error syndrome
```

where:

- `address` represents the address of the exception instruction.
- `cause` represents the value in the cause register.
- `status` represents the contents of the status register.
- `virtual address` represents the virtual address of the exception.
- `error address` represents the contents of the error address register.
- `error syndrome` represents the value in the error syndrome register.

Example: Console Exception Message

The following R3000 example shows a typical value for each of the possible entries of a console exception message. In each entry, the information in brackets is the decoded version of the hexadecimal value that preceeds it.

```
? PC:   0xbfc0d0d<vtr=nrml>
? CR:   0x210<ce=0,ip6,exc=dbe>
? SR:   0x30080000<cu1,cu0,cm,ipl=8>
? VA:   0x0
? ER:   0x0800006 <valid, cpu, eccerr, adr=2000018>
? CK:   0x8c18c321
<vldhi, chkhi=c, synhi=18, vldlo, chkllo=43, synlo=21>
```

The last term in the second line, the EXC = value, indicates what type of exception occurred.

If the EXC = value is MOD, TLBL, or TLBS, an address used in a console command was probably invalid.

The ? VA value is the virtual address that caused the exception. Retype the console command, using addresses in the following ranges only:

- 80000000 to 9FFFFFFF (cached memory)
- A0000000 to BFFFFFFF (uncached memory)

If the exc= value is AdEL or AdES, a console command probably attempted access on a boundary that was not a word. The ? VA value is the virtual address used in the console command. To correct the exception:

1. Retry the command with an address that starts on a word boundary.
2. If access still fails, turn the system unit power off and then on again to restart console mode.
3. If an exception still occurs, type **test** and press Return. Interpret any errors that the test script reports to identify the faulty hardware.

If the exc= value is IBE or DBE, a bus error occurred. The bus error is either a memory error or a timeout.

- Suspect a timeout error if either of the following conditions exist:
  - The ? ER and ? CK entries do not appear in the console exception error message.
  - The value of the ecc error bit (bit 28) in the error address register is 0.
- If neither of the conditions indicating a timeout error exist, suspect a memory error.

Troubleshoot a timeout error as follows:

1. Verify that your console command was entered properly.
2. If the adddress in your console operation was in the range of a particular slot, type *slot_number/**pst-t***, replacing *slot_number* with the number of the slot in question. If the test fails, replace the module in the indicated slot. See Table 9-5 for hardware address ranges. If the pst-t test passes and the console exception still occurs, go to step 3.
3. If the address in your console operation was in the range of a particular subsystem on the base system module (such as the base system SCSI controller), type *ls 3* to see a list of available tests for the base system module. Run the appropriate test (for example: test-scsi). If the subsystem test fails, use the address information on the error message to determine what item to replace. See Table 9-5 for hardware address ranges. See Appendix D for information about the base system module tests. If the subsystem test passes and the console exception still occurs, go to step 4.

4. If the pst-t or subsystem test passes, or if you cannot tell what address is causing your console operation to fail, and the console exception still occurs, run the thorough powerup self-test sequence by typing **test**. The thorough test can take 30 minutes to run, depending on your memory and option configurations. If the test fails, use the information in the error message to determine what item to replace. See Appendix D for information about the base system module tests. If the thorough test passes, and the console exception still occurs, call your support engineer.

Troubleshoot a memory error as follows:

1. Run the memory test for all slots. Type **t 3/mem *** and press Return. As the test runs, the system displays a rotating cursor and the number of the slot currently being tested. With large amounts of memory, the mem * test can take more then 15 minutes to run.
2. Replace the SIMM or NVRAM module identified in any mem test error message(s).

See the "mem Test" section of Appendix D for information about the memory test.

When Hardware Does Not Appear in the cnfg Display

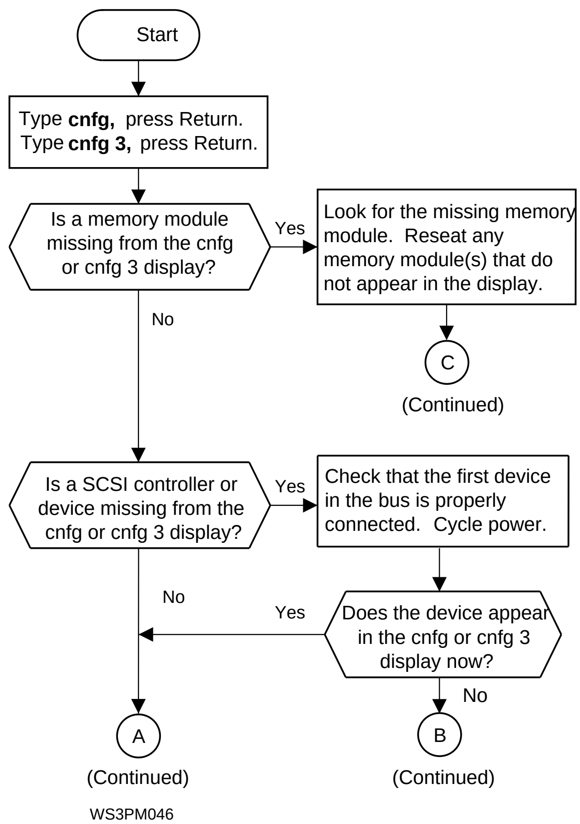


Figure 11-13. When hardware does not appear in cnfg display, 1 of 3

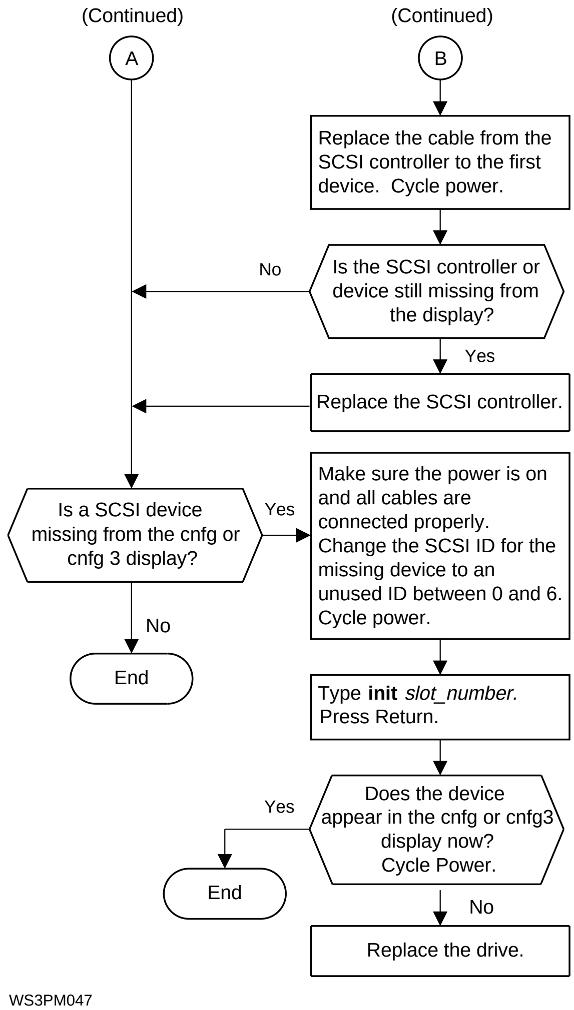


Figure 11-14. When hardware does not appear in cnfg display, 2 of 3

Troubleshooting the Memory Modules

For information about memory test error messages, see "Memory Test Error Messages" in Chapter 9.

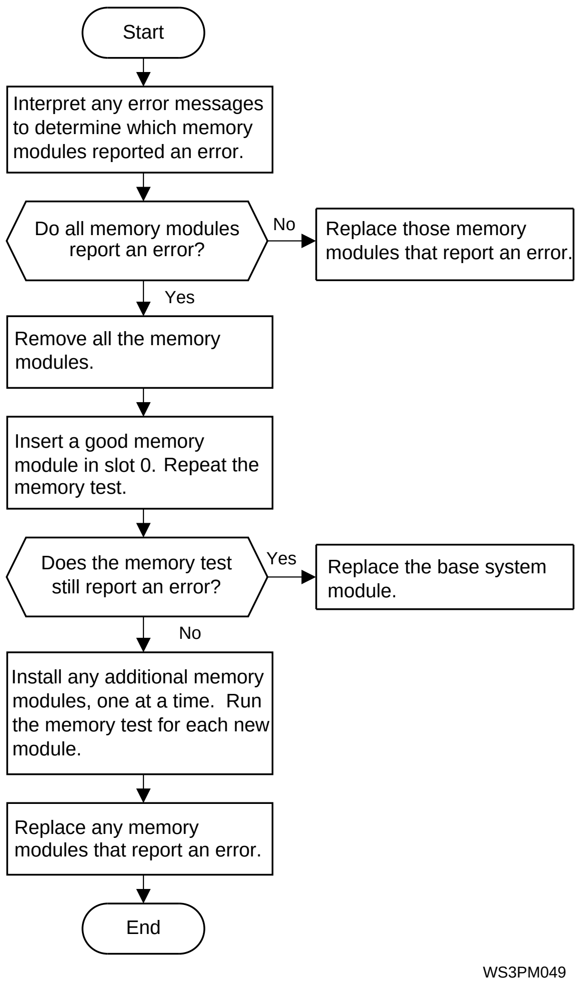


Figure 11-16. Troubleshooting memory modules

Troubleshooting SCSI Devices

For information about SCSI tests and error messages, see "SCSI Tests" in Appendix D.

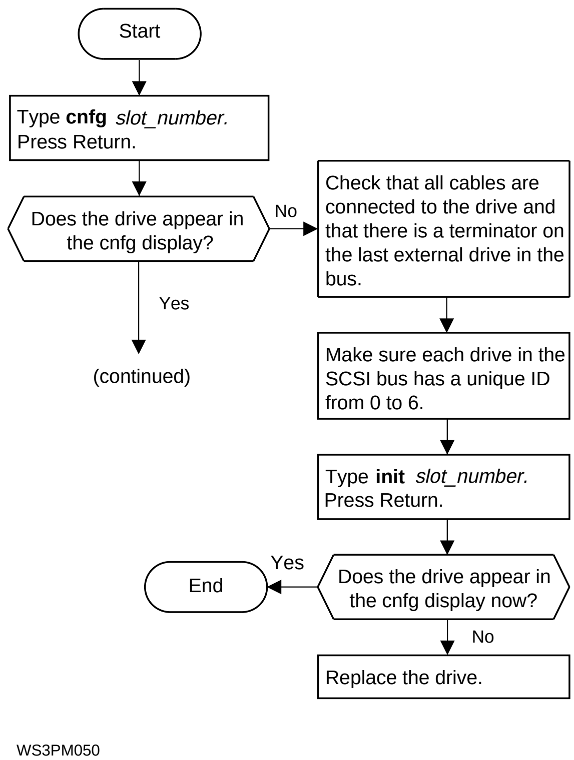


Figure 11-17. Troubleshooting SCSI devices 1 of 2

Troubleshooting an Ethernet Controller

For information about Ethernet tests and error messages, see "Ethernet Tests" in Appendix D.

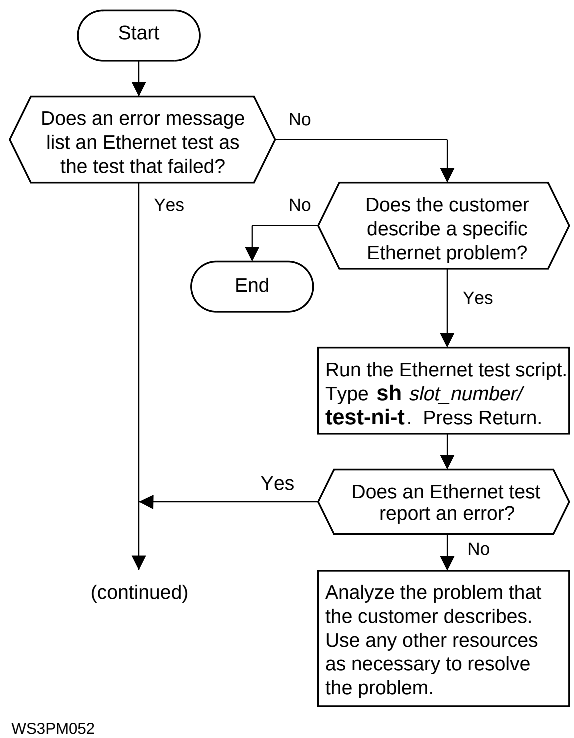


Figure 11-19. Troubleshooting Ethernet controller, 1 of 2

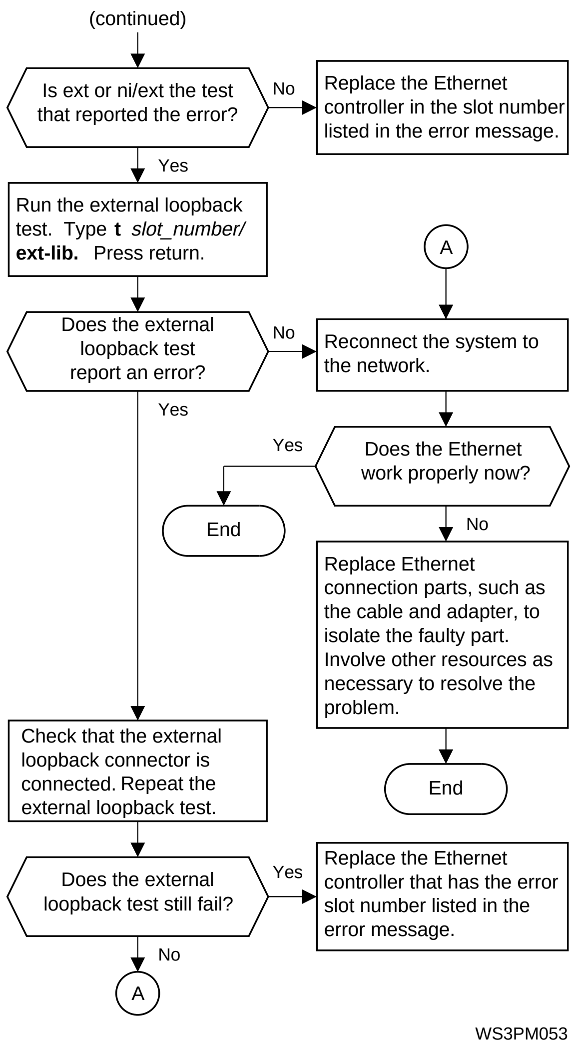


Figure 11-20. Troubleshooting Ethernet controller, 2 of 2

Troubleshooting a Printer, Modem, or Other Serial Line Device

For information about serial line tests and error messages, see "Serial Line Tests" in Appendix D.

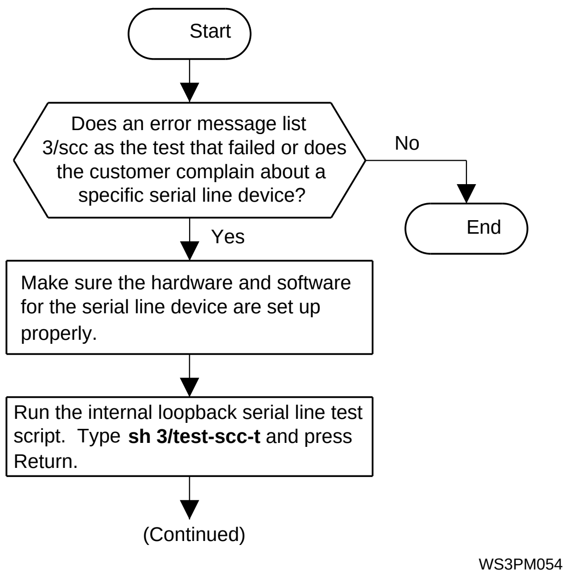


Figure 11-21. Troubleshooting a printer, modem, or other serial line device, 1 of 2

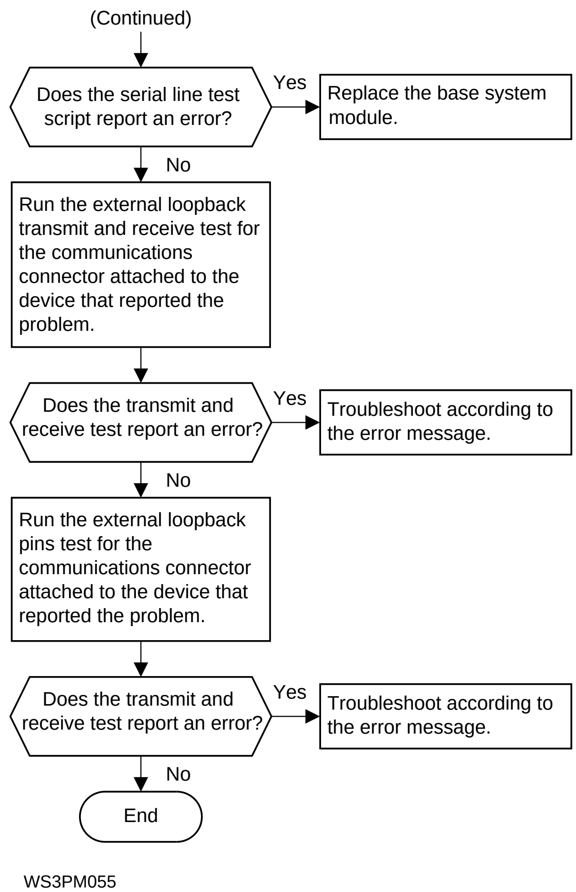


Figure 11-22. Troubleshooting a printer, modem, or other serial line device, 2 of 2

Troubleshooting the Power Supply

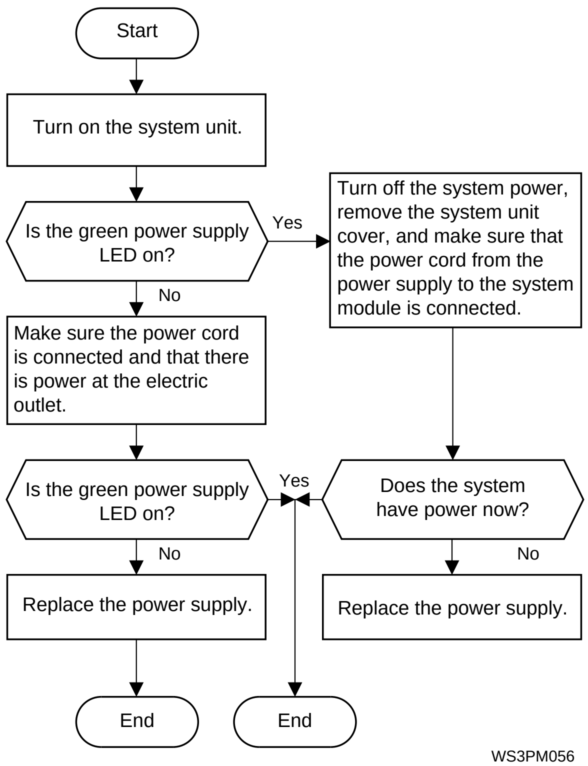


Figure 11-23. Troubleshooting the power supply

When the System Unit Overheats

The error message `?TFL 3/misc/pstemp` indicates that the system unit is overheating.

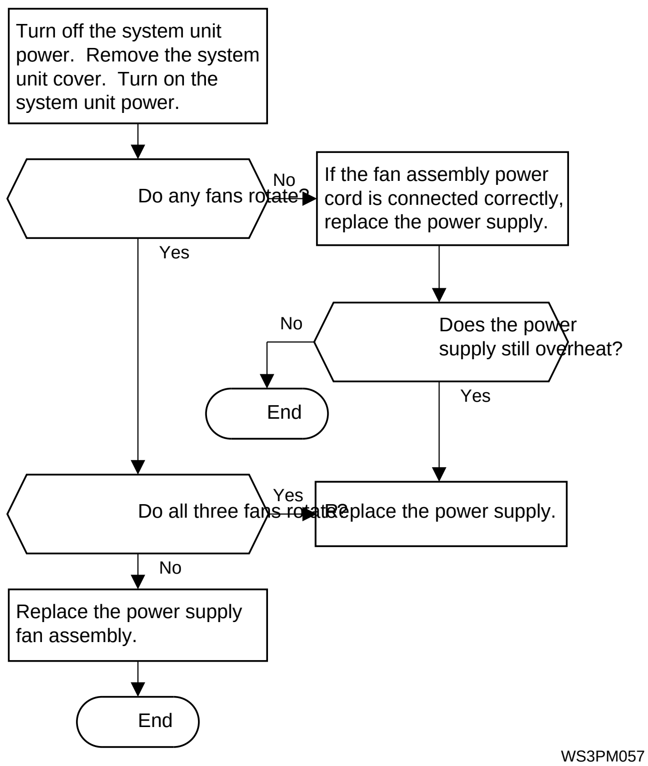


Figure 11-24. When the system unit overheats

Troubleshooting the Keyboard and Mouse

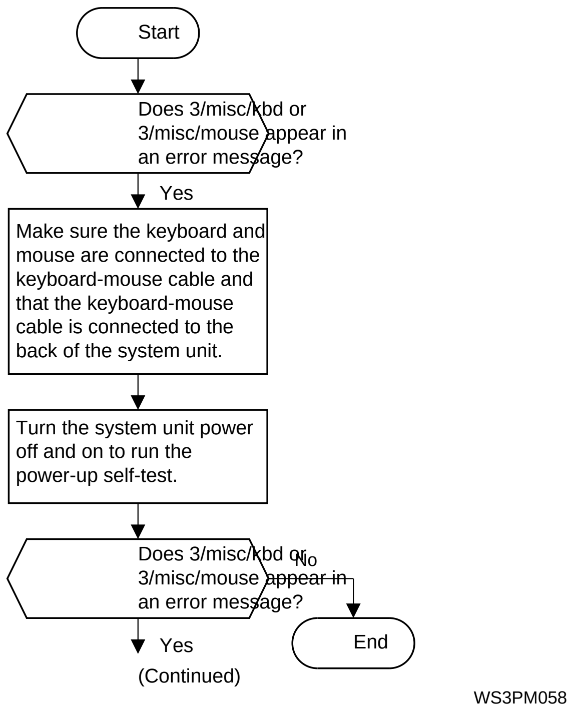


Figure 11-25. Troubleshooting the keyboard and mouse, 1 of 2

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g the keyboard and mouse, 2 of 2

When ULTRIX Is Running but the Monitor Has No Display

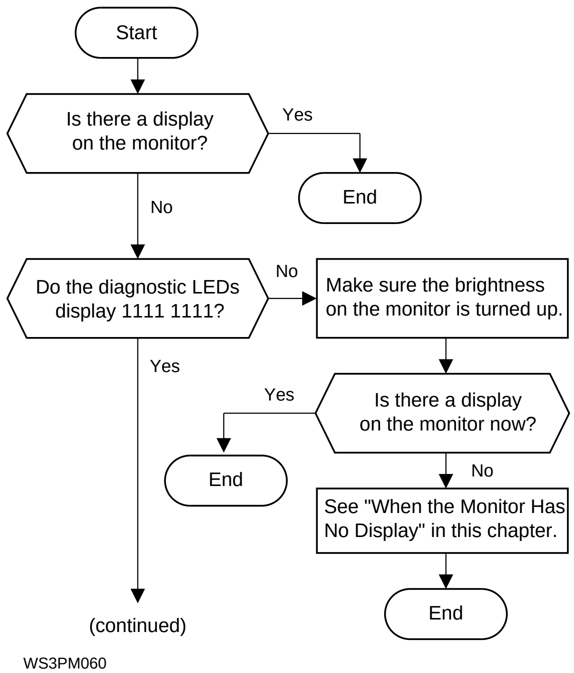


Figure 11-27. Troubleshooting when ULTRIX is running, but the monitor has no display, 1 of 3

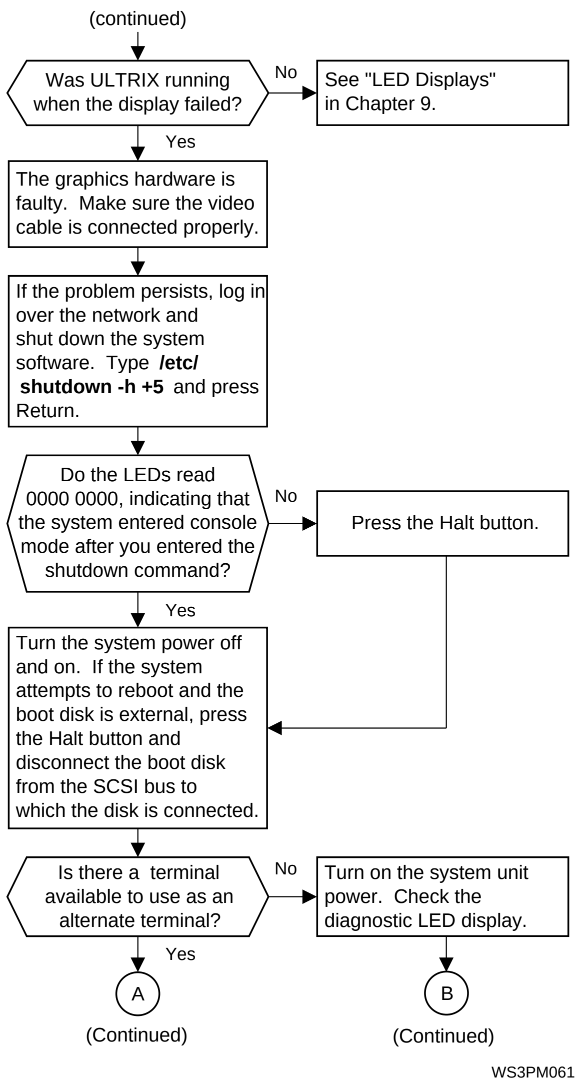
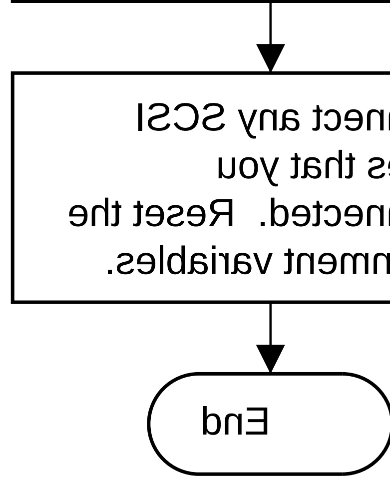


Figure 11-28. Troubleshooting when ULTRIX is running, but the monitor has no display, 2 of 3



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g when ULTRIX is running, but the monitor
, 3 of 3

Troubleshooting with ULTRIX Error Logs

ULTRIX error logs are useful for troubleshooting intermittent problems. Use the event type and physical address entries that appear in ULTRIX error logs to determine which part of the system hardware logged the error.

Replace the FRU that contains the hardware indicated by the error log. For FRU replacement procedures, refer to the section in Chapter 5 of this guide or the *TURBOchannel Maintenance Guide* that discusses the FRU you want to replace.

For a discussion of error log formats, see "ULTRIX Error Logs" in Section 9.

Part III

Appendices

A

Equipment Specifications

This appendix lists the physical specifications, operating conditions, and nonoperating conditions for the following items:

- DECstation 5000 Model 240 system unit
- DECstation 5000 Model 260 system unit
- LK401-AA keyboard
- VSXXX-GA mouse
- VSXXX-AB tablet
- BA42 expansion box
- RZ23L and RZ24L hard disk drive
- RZ25 and RZ26 hard disk drive
- RZ58 hard disk drive
- TK50Z and TZ30 tape drive
- TZ85 tape drive
- TZK10 QIC tape drive
- TLZ04 and TLZ06 cassette tape drive
- RRD42 optical compact disc drive
- RX23 and RX33 diskette drive

DECstation 5000 Model 240 System Unit Equipment Specifications

Table A-1. System Unit Description

Weight	12.70 to 22.70 kg (28.00 to 50.00 lb)
Height	9.14 cm (3.60 in)
Width	51.03 cm (20.09 in)
Depth	43.48 cm (17.12 in)
Input voltage	Auto adjust 100–120 Vac or 220–240 Vac
Input current	5 A at 100–120 Vac 2.4 A at 220–240 Vac
Power	
– Frequency	50 to 60 Hz
– Heat dissipation	359 watts, maximum

Table A-2. System Unit Operating Conditions

Temperature range[1]	10°C to 35°C (50°F to 95°F)
Temperature change rate	11°C (52°F) per hour, maximum
Relative humidity	10% to 90%, noncondensing
Maximum wet-bulb temperature	28°C (82°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	2,400 m (8,000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-3. System Unit Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Relative humidity	10% to 95%, noncondensing
Maximum wet-bulb temperature	46°C (115°F), packaged
Altitude	4,900 m (16,000 ft) maximum

DECstation 5000 Model 260 System Unit Equipment Specifications

Table A-4. System Unit Description

Weight	12.70 to 22.70 kg (28.00 to 50.00 lb)
Height	9.14 cm (3.60 in)
Width	51.03 cm (20.09 in)
Depth	43.48 cm (17.12 in)
Input voltage	Auto adjust 100–120 Vac or 220–240 Vac
Input current	5 A at 100–120 Vac 2.4 A at 220–240 Vac
Power	
– Frequency	50 to 60 Hz
– Heat dissipation	359 watts, maximum

Table A-5. System Unit Operating Conditions

Temperature range[1]	10°C to 35°C (50°F to 95°F)
Relative humidity	10% to 90%, noncondensing
Maximum wet-bulb temperature	28°C (82°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	2,400 m (8,000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-6. System Unit Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Relative humidity	10% to 95%, noncondensing
Maximum wet-bulb temperature	46°C (115°F), packaged
Altitude	4,900 m (16,000 ft) maximum

LK401-AA Keyboard Equipment Specifications

Table A-7. LK401-AA Keyboard Description

Weight	1.16 kg (2.56 lb)
Height	4.76 cm (1.88 in)
Width	47.80 cm (19.00 in)
Depth	19.20 cm (7.56 in)
Number of keys	108
Number of indicators	2 status LEDs
Language variations	15 Software selectable (keycaps required)
Cable	1.8 m (6 ft) uncoiled length 4-pin mmj connector at one end
Baud rate	4800
Electrical interface	EIA RS 423
Power consumption	2.0 watts maximum
Power input	12 V ±6% at 350 ma
Volume control	8 levels, plus off
Keystroke timing	20 ms minimum

Table A-8. LK401-AA Keyboard Operating Conditions

Temperature range [1]	10°C to 40°C (50°F to 104°F)
Relative humidity	10% to 90% noncondensing
Maximum wet-bulb temperature	32°C (90°F)
Minimum dew-point temperature	15°C (60°F)
Altitude	2,400 m (8,000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-9. LK401-AA Keyboard Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Relative humidity	10% to 95%, noncondensing
Maximum wet-bulb temperature	52°C (126°F), packaged
Altitude	4,900 m (16,000 ft) maximum

VSXXX-GA Mouse Equipment Specifications

Table A-10. VSXXX-GA Mouse Description

Weight	97 g (3.4 oz) without cable
Height	32.5 mm (1.28 in)
Diameter	60.9 mm (2.4 in)
Buttons	3
Cable length	1.5 m (5 ft) shielded, 5 conductors and terminals in a 7-pin micro-DIN-type connector (male)
Accuracy	±3% 0 to 25 cm (0 to 10 in) per second in any direction ±15% 25 to 50 cm (10 to 20 in) per second in any direction ±30% 50 to 75 cm (20 to 30 in) per second in any direction
Baud rate	4800
Data format	Delta mode
Electrical interfaces	RS-232 or TTL
Operating modes	Incremental or polling
Power requirements	+5 V ±5% at 130 ma −8 to −13 V at 20 ma (RS-232 mode)
Resolution	79 counts per cm (200 counts per in)
Tracking speed	76 cm (30 in) per second
Tracking rate	In incremental mode: 55 reports per second In polling mode: up to 95 reports per second

Table A-11. VSXXX-GA Mouse Operating Conditions

Temperature range [1]	10°C to 40°C (50°F to 104°F)
Relative humidity	10% to 90% noncondensing
Maximum wet-bulb temperature	18°C (64°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	3,050 m (10,000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-12. VSXXX-GA Mouse Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Relative humidity	5% to 95% noncondensing
Maximum wet-bulb temperature	46°C (115°F) packaged
Altitude	7,600 m (25,000 ft) maximum

VSXXX-AB Tablet Equipment Specifications

Table A-13. VSXXX-AB Tablet Description

Weight	3.18 kg (7.00 lb)
Height	20.32 cm (8.00 in)
Width	40.64 cm (16.00 in)
Depth	41.15 cm (16.20 in)
Puck	4 buttons
Stylus	2 buttons
Cable length	1.5 m (5 ft), terminated in a 7-pin micro-DIN-type connector
Output connector (power and data)	7-pin micro-DIN (pronged)
Mating connector	7-pin micro-DIN (prongless)
Active area	280 mm by 280 mm (11 in by 11 in)
Baud rate	4800 or 9600 baud (software selectable)
Electrical interfaces	Serial, asynchronous, full-duplex EIA RS-232-C signal levels
Incremental	Position reports generated when cursor is in motion and when pushbuttons are pressed or released
Operating modes	Incremental and polling
Power requirements	+12 V dc ±10% at 0.3 A
Proximity (nominal)	1.27 cm (5 in) cursor
Resolution	79 counts per cm (200 counts per in)
	0.63 cm (0.25 in) stylus
Remote request	X-Y coordinate update and proximity report when polled by host
Tracking rates	
– In incremental mode	55, 72, or 120 reports per second
– In polling mode	50 reports per second at 4800 baud 80 reports per second at 9600 baud

Table A-14. VSXXX-AB Tablet Operating Conditions

Temperature range [1]	10°C to 40°C (50°F to 104°F)
Relative humidity	20% to 80% noncondensing
Maximum wet bulb temperature	28°C (82°F)
Minimum dew point temperature	2°C (36°F)
Altitude	2400 m (8000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-15. VSXXX-AB Tablet Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Relative humidity	10% to 95% noncondensing
Maximum wet bulb temperature	46°C (115°F) packaged
Altitude	4900 m (16,000 ft) maximum

BA42 Storage Expansion Box Equipment Specifications

Table A-16. BA42 Storage Expansion Box Description

Weight	17.24 kg (38.00 lb) maximum
Height	10.16 cm (4.00 in)
Width	46.02 cm (18.12 in)
Depth	40.64 cm (16.00 in)
Input voltage	Automatically adjusting ac input 120–240 Vac
Frequency range	47 to 63 Hz
Power	90 watts maximum

Table A-17. BA42 Storage Expansion Box Operating Conditions

Temperature range[1]	10°C to 40°C (50°F to 104°F)
Temperature change rate	11°C (20°F) per hour maximum
Relative humidity	20% to 80% noncondensing
Maximum wet-bulb temperature	28°C (82°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	2400 m (8000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-18. BA42 Storage Expansion Box Nonoperating Conditions

Temperature range	5°C to 50°C (41°F to 122°F)
Relative humidity	10% to 95% noncondensing
Maximum wet-bulb temperature	46°C (115°F) packaged
Altitude	4900 m (16,000 ft) maximum

RZ23L SCSI Hard Disk Drive Equipment Specifications

Table A-19. RZ23L SCSI Hard Disk Drive Description

Internal drive	
Weight	0.54 kg (1.20 lb)
Height	2.54 cm (1.00 in)
Width	10.16 cm (4.00 in)
Depth	14.61 cm (5.75 in)
Capacity	
– Bytes per drive	121.65 MB
– Blocks per drive	237,588
– Block size	512 bytes
Data transfer rate	
– Bus asynchronous mode	3.0 MB per second
– Bus synchronous mode	4.0 MB per second
– To and from media	1.5 MB per second
Seek time	8 ms track-to-track 19 ms average 35 ms maximum
Average latency	8.8 ms
Interface	SCSI

Table A-20. RZ23L SCSI Hard Disk Drive Operating Conditions

Temperature range[1]	10°C to 55°C (50°F to 128°F)
Temperature change rate)	11°C (20°F per hour, maximum
Relative humidity	8% to 80% noncondensing
Maximum wet-bulb temperature	26°C (78°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	−300 to 4600 m (−1000 to 15,000 ft)

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-21. RZ23L SCSI Hard Disk Drive Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Temperature change rate)	20°C (36°F per hour, maximum
Relative humidity	8% to 95% packaged, noncondensing
Maximum wet-bulb temperature	46°C (115°F) packaged
Altitude	−300 to 12,200 m (−1,000 to 40,000 ft)

RZ24L SCSI Hard Disk Drive Equipment Specifications

Table A-22. RZ24L SCSI Hard Disk Drive Description

Internal drive	
– Weight	0.77 kg (1.70 lb)
– Height	4.14 cm (1.63 in)
– Width	10.16 cm (4.00 in)
– Depth	14.61 cm (5.75 in)
Capacity	
– Bytes per drive	245.4M
– Blocks per drive	479,350
– Block size	512 bytes
Data transfer rate	
– Bus asynchronous mode	3.0 MB per second
– Bus synchronous mode	4.0 MB per second
– To and from media	1.5 MB per second
Seek time	5 ms track-to-track 16 ms average 35 ms maximum
Average latency	8.3 ms
Interface	SCSI

Table A-23. RZ24L SCSI Hard Disk Drive Operating Conditions

Temperature range[1]	10°C to 55°C (50°F to 131°F)
Temperature change rate	11°C (20°F per hour, maximum)
Relative humidity	8% to 80% noncondensing
Maximum wet-bulb temperature	26°C (78°F)
Altitude	−300 to 4600 m (−1000 to 15,000 ft)

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-24. RZ24L SCSI Hard Disk Drive Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Relative humidity	8% to 95% packaged, noncondensing
Maximum wet-bulb temperature	46°C (115°F) packaged
Altitude	−300 m to 12,200 m (−1,000 ft to 40,000 ft)

RZ25 SCSI Hard Disk Drive Equipment Specifications

Table A-25. RZ25 SCSI Hard Disk Drive Description

Internal drive	
– Weight	0.82 kg (1.8 lb)
– Height	4.14 cm (1.63 in)
– Width	10.16 cm (4.00 in)
– Depth	14.61 cm (5.75 in)
Capacity	
– Bytes per drive	426 MB
– Blocks per drive	832, 527
– Block size	512 bytes
Data transfer rate	
– Bus asynchronous mode	3.0 MB per second
– Bus synchronous mode	4.0 MB per second
– To and from media	2.1–3.2 MB per second
Seek time	2.5 ms track-to-track 14 ms average 26 ms maximum
Average latency	6.8 ms
Interface	SCSI

Table A-26. RZ25 SCSI Hard Disk Drive Operating Conditions

Temperature range[1]	10°C to 55°C (50°F to 131°F)
Temperature change rate	11°C (20°F) per hour, maximum
Relative humidity	8% to 80% noncondensing
Maximum wet-bulb temperature	26°C (78°F)
Altitude	−300 to 3050 m (−1000 to 10,000 ft)

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-27. RZ25 SCSI Hard Disk Drive Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Temperature change rate	20°C (36°F) per hour, maximum
Relative humidity	8% to 95% packaged, noncondensing
Maximum wet-bulb temperature	46°C (115°F) packaged
Altitude	−300 m to 12,200 m (−1,000 ft to 40,000 ft)

RZ26 SCSI Hard Disk Drive Equipment Specifications

Table A-28. RZ26 SCSI Hard Disk Drive Description

Internal drive	
– Weight	0.9 kg (1.9 lb)
– Height	4.13 cm (1.625 in)
– Width	10.2 cm (4.00 in)
– Depth	14.6 cm (5.75 in)
Capacity	
– Bytes per drive	1050 M
– Bytes per surface	75M
– Bytes per track	29,640
– Buffer size	512 KB
Data transfer rate	
– To and from media	2.6 MB per second
Seek time	
– Track-to-track	1ms
– Average	10 ms
– Maximum (full stroke)	20 ms
Average latency	5.6 ms
Rotational speed	5363 rpm

Table A-29. RZ26 SCSI Hard Disk Drive Operating Conditions

Ambient temperature	10°C to 50°C (50°F to 122°F)
Relative humidity	10% to 90% noncondensing

Table A-30. RZ26 SCSI Hard Disk Drive Nonoperating Conditions

Ambient temperature	−40°C to 66°C (−40°F to 151°F)
Relative humidity	8% to 95% packaged, noncondensing

RZ58 SCSI Hard Disk Drive Equipment Specifications

Table A-31. RZ58 SCSI Hard Disk Drive Description

Internal drive	
– Weight	3.81 kg (8.40 lb)
– Height	8.26 cm (3.25 in)
– Width	14.61 cm (5.75 in)
– Depth	20.32 cm (8.00 in)
Capacity	
– Bytes per drive	1.38 gigabytes
– Blocks per drive	2,698,061 not including spares
– Block size	512 bytes
Data transfer rate	
– Bus asynchronous mode	1.6 MB per second
– Bus synchronous mode	5.0 MB per second
– To and from media	2.5 MB per second
Seek time	2.5 ms track-to-track 12.5 ms average 25 ms maximum
Average latency	5.6 ms
Interface	SCSI II

Table A-32. RZ58 SCSI Hard Disk Drive Operating Conditions

Temperature range[1]	10°C to 55°C (50°F to 131°F)
Temperature change rate	11°C (20°F) per hour, maximum
Relative humidity	8% to 80%
Maximum wet-bulb temperature	26°C (78°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	−300 to 4600 m (−1000 to 15,000 ft)

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-33. RZ58 SCSI Hard Disk Drive Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Temperature change rate	20°C (36°F) per hour, maximum
Relative humidity	8% to 95%, packaged
Maximum wet-bulb temperature	46°C (115°F), packaged
Altitude	−300 to 12,200 m (−1000 to 40,000 ft)

TK50Z Tape Drive Equipment Specifications

Table A-34. TK50Z Tape Drive Description

Expansion box	
– Weight	12.70 kg (28.00 lb)
– Height	13.97 cm (5.50 in)
– Width	32.39 cm (12.75 in)
– Depth	28.58 cm (11.25 in)
Bit density	6,667 bits per in
Cartridge capacity	95 MB approximate
Frequency	50 to 60 Hz
Heat dissipation	32 watts maximum
Input current	2.4 A: 100 to 120 Vac
	1.3 A: 220 to 240 Vac
Media	12.77 mm (0.5 in), 183 m (600 ft) long magnetic tape
Mode of operation	Streaming
Number of tracks	22
Power	160 watts
Track format	Serpentine
Data transfer rate	360 Kbits per second (45 KB per second)
Tape speed	75 in per second

Table A-35. TK50Z Tape Drive Operating Conditions

Temperature range[1]	10°C to 40°C (50°F to 104°F)
Temperature change rate	11°C (20°F) per hour, maximum
Relative humidity	10% to 80% noncondensing
Maximum wet-bulb temperature	28°C (82°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	2,400 m (8,000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-36. TK50Z Tape Drive Nonoperating Conditions

Temperature range	−30°C to 66°C (−22°F to 151°F)
Temperature change rate	20°C (36°F) per hour, maximum
Relative humidity	10% to 95% noncondensing
Maximum wet-bulb temperature	46°C (115°F) packaged
Altitude	9,140 m (30,000 ft) maximum

TZ30 Tape Drive Equipment Specifications

Table A-37. TZ30 Tape Drive Description

Internal drive	
– Weight	1.50 kg (3.31 lb)
– Height	4.14 cm (1.63 in)
– Width	14.48 cm (5.70 in)
– Depth	21.59 cm (8.50 in)
Bit density	2624 bits per cm (6667 bits per in)
Cartridge capacity	95 Mbytes, formatted (approximate)
Media	12.77 mm (0.5 in) unformatted magnetic tape
Mode of operation	Streaming
Number of tracks	22
Tape speed	190 cm per second (75 in per second)
Track format	Multiple track serpentine recording
Data transfer rate	62.5 Kbytes per second

Table A-38. TZ30 Tape Drive Operating Conditions

Temperature range[1]	10°C to 40°C (50°F to 104°F)
Temperature change rate	11°C (20°F) per hour, maximum
Relative humidity	20% to 80% noncondensing
Maximum wet-bulb temperature	25°C (77°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	2400 m (8000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-39. TZ30 Tape Drive Nonoperating Conditions

Temperature range	−40°C to 66°C (−40°F to 151°F)
Temperature change rate	20°C (36°F) per hour, maximum
Relative humidity	10% to 95%
Maximum wet-bulb temperature	2°C (36°F)
Altitude	9100 m (30,000 ft) maximum

TZ85 Tape Drive Equipment Specifications

Table A-40. TZ85 Tape Drive Description (Table Top)

– Weight	10 lb 1.5 ozs (box only)
– Weight	16 lb 15 ozs (box w/drive)
– Height	5.72 in
– Width	9.25 in
Bit density	42,500 bits per in
Cartridge capacity	2.6 Gbytes, formatted (approximate)
Mode of operation	Streaming
Number of tracks	48
Tape speed	100 in per second
Track format	Two track parallel, serpentine recording
Data transfer rate	800 Kilobytes per second (at tape)

Table A-41. TZ85 Tape Drive Operating Conditions (including media)

Temperature range	10°C to 40°C (50°F to 104°F)
Relative humidity	20% to 80% noncondensing
Altitude	2400 m (8000 ft) maximum
Noise level	35 dBA
Air Quality	Normal office environment

Table A-42. TZ85 Tape Drive Nonoperating Conditions (excluding media)

Temperature range	−40°C to 66°C (−40°F to 151°F)
Relative humidity	10% to 95%
Altitude	9100 m (30,000 ft) maximum

TZK10 QIC Tape Drive Equipment Specifications

Table A-43. TZK10 QIC Tape Drive Description

Internal drive	
– Weight	1.09 kg (2.40 lb)
– Height	4.39 cm (1.73 in)
– Width	14.61 cm (5.75 in)
– Depth	20.83 cm (8.20 in)
Cartridge capacity	320 MB (approximate) with DC6320 525 MB (approximate) with DC6525
Data density	16,000 bits per in
Drive interface	SCSI-2
Media	DC6320, DC6525, or Digital-approved equivalent
Mode of operation	Streaming
Number of tracks	26
Power consumption, normal	20 watts
Power consumption, peak	33 watts
Transfer rate	200 KB per second at average streaming mode 1.5 MB per second at SCSI maximum
Tape speed	305 cm (120 in) per second
Track format	Multiple track serpentine recording

Table A-44. TZK10 QIC Tape Drive Operating Conditions

Temperature range[1]	5°C to 40°C (50°F to 104°F)
Temperature change rate	11°C (20°F) per hour, maximum
Relative humidity	2% to 80% noncondensing
Maximum wet-bulb temperature	28°C (82°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	3900 m (13,000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-45. TZK10 QIC Tape Drive Nonoperating Conditions

Temperature range	−30°C to 60°(−22°F to 151°F)
Temperature change rate	20°C (36°F) per hour, maximum
Relative humidity	10% to 95%
Maximum wet-bulb temperature	46°C (115°F)
Altitude	12,200 m (40,000 ft) maximum

TLZ04 Cassette Tape Drive Equipment Specifications

Table A-46. TLZ04 Cassette Tape Drive Description

Expansion box	
– Weight	7.7 kg (17.00 lb)
– Height	11.50 cm (4.50 in)
– Width	35.00 cm (14.00 in)
– Depth	30.00 cm (12.00 in)
Cassette capacity	1.2 gigabyte
Drive interface	SCSI
Media	TLZ04-CA cassette tape
Mode of operation	Streaming and start/stop
Power consumption	230 watts
Power requirements	1.6 A: 100 to 120 Vac 1.0 A: 200 to 240 Vac
Track format	Digital data storage (DDS)
Transfer rate	156 KB per second

Table A-47. TLZ04 Cassettte Tape Drive Operating Conditions

Temperature range[1]	10°C to 40°C (50°F to 104°F)
Relative humidity	20% to 80% noncondensing
Altitude	0 m to 4600 m (0 to 15,000 ft)

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-48. TLZ04 Cassette Tape Drive Nonoperating Conditions

Temperature range	−40°C to 70°C (40°F to 158°F)
Relative humidity	5% to 95% noncondensing
Altitude	0 m to 15,200 m (0 to 50,000 ft)

TLZ06 Cassette Tape Drive Equipment Specifications

Table A-49. TLZ06 Cassette Tape Drive Description

Dimensions	
– Weight	2.2 kg (4.7 lb)
– Height	4.1 cm (1.6 in)
– Width	14.6 cm (5.75 in)
– Depth	30.00 cm (12.00 in)
Capacity	1.2
– Per drive	320 MB, approximate DC6320 cartridge
– Per drive	525 MB, approximate DC6525 cartridge
– Per surface	2.48 MB
– Blocks per drive	649,040

Table A-50. TLZ06 Cassettes

Cassette	Size	Capacity
TLZ06-CA	4mm x 90m	2 or 4 GB

Table A-51. TLZ06 Cassettte Tape Drive Operating Conditions

Operating temperature	10°C to 40°C (50°F to 104°F)
Operating humidity	20% to 80% noncondensing
Altitude	0 m to 4572 m (0 to 15,000 ft)

Table A-52. TLZ06 Cassette Tape Drive Nonoperating Conditions

Nonoperating temperature	−40°C to 70°C (40°F to 158°F)
Relative humidity	5% to 95% noncondensing
Altitude	0 m to 15,240 m (0 to 50,000 ft)

RRD42 Compact Disc Drive Equipment Specifications

Table A-53. RRD42 Compact Disc Drive Description

RRD42-AA	
– Weight	1.3 kg (2.8 lb)
– Height	4.15 cm (1.63 in)
– Width	14.60 cm (5.75 in)
– Depth	20.81 cm (8.2 in)
Capacity	600 MB
Seek time	450 ms average (typical) 700 ms maximum (typical)
Burst transfer rate	1.5 MB per second
Sustained transfer rate	150 KB per second
Heat dissipation	14 watts (typical)
Initialization startup time	2.0 seconds maximum
Interface	SCSI

Table A-54. RRD42 Compact Disc Drive Operating Conditions

Temperature range[1]	5°C to 50°C (41°F to 122°F)
Relative humidity	10% to 90% noncondensing
Maximum wet-bulb temperature	28°C (82°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	−300 to 4600 m (−1000 to 15,000 ft)

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-55. RRD42 Compact Disc Drive Nonoperating Conditions

Temperature range	−30 °C to 55°C (−22°F to 131°F)
Relative humidity	10 to 90% packaged, noncondensing
Maximum wet-bulb temperature	46°C (115°F) packaged, noncondensing
Altitude	−300 to 12,200 m (−1000 to 40,000 ft)

RX23 Diskette Drive Equipment Specifications

Table A-56. RX23 Diskette Drive Description

Internal drive	
– Weight	0.48 kg (1.06 lb)
– Height	3.00 cm (1.18 in)
– Width	10.16 cm (4.00 in)
– Depth	15.01 cm (5.91 in)
Number of tracks	80
Number of heads	2
Step rate	3 ms per track
Diskette size	8.9 cm (3.5 in)
Recording surfaces per diskette	2
Sectors per track	9 double density 18 high density
Capacity	
– Bytes per drive	737 KB double density
	1,474 KB high density
– Blocks per drive	1,440 double density
	2,880 high density
– Block size	512 bytes
Data transfer rate	
– To and from media	250 Kbits per second double density
	500 Kbits per second high density
Operating power	3.0 watts
Standby power	0.3 watts

Table A-57. RX23 Diskette Drive Operating Conditions

Temperature range[1]	5°C to 50°C (40°F to 122°F)
Temperature change rate	11°C (20°F) per hour, maximum
Relative humidity	8% to 80%, noncondensing
Maximum wet-bulb temperature	29°C (80°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	−300 to 3060 m (−1,000 ft to 10,000 ft)

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-58. RX23 Diskette Drive Nonoperating Conditions

Temperature	−40°C to 66°C (−40°F to 151°F)
Temperature change rate	20°C (36°F) per hour, maximum
Relative humidity	5% to 95%, packaged
Maximum wet-bulb temperature	46°C (115°F), packaged
Altitude	−300 to 12,300 m (−1,000 ft to 40,000 ft)

RX33 Diskette Drive Equipment Specifications

Table A-59. RX33 Diskette Drive Description

Internal drive	
– Weight	1.10 kg (2.43 lb)
– Height	4.32 cm (1.70 in)
– Width	14.61 cm (5.75 in)
– Depth	20.32 cm (8.00 in)
Number of tracks	80
Number of heads	2
Track density	96 tracks per inch
Step rate	3 ms per track
Diskette size	13.13 cm (5.25 in)
Recording surfaces per diskette	2
Sectors per track	10 normal density 15 high density
Capacity	
– Bytes per drive	409 KB normal density
	1200 KB high density
– Blocks per drive	800 normal density
	2400 high density
– Block size	512 bytes
Data transfer rate	
– To and from media	250 Kbits per second normal density
	500 Kbits per second high density
Operating power	4.1 watts
Standby power	1.5 watts

Table A-60. RX33 Diskette Drive Operating Conditions

Temperature range[1]	10°C to 46°C (50°F to 115°F)
Temperature change rate	11°C (20°F) per hour, maximum
Relative humidity	20% to 80% noncondensing
Maximum wet-bulb temperature	45°C (113°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	2400 m (8000 ft) maximum

[1]Reduce maximum temperature by 1.8°C for each 1,000 meter (1.0°F for each 1,000 ft) increase in altitude.

Table A-61. RX33 Diskette Drive Nonoperating Conditions

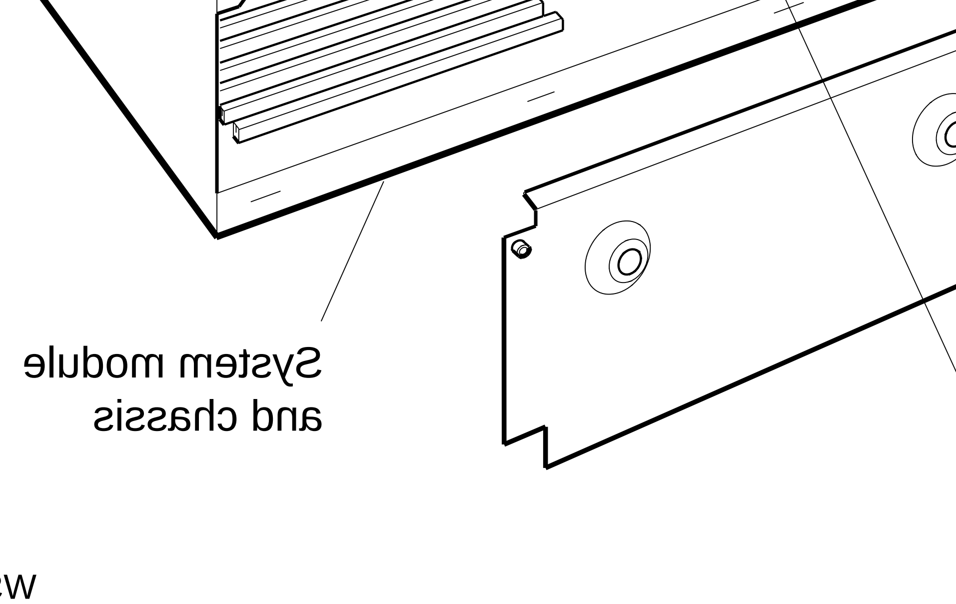
Temperature	−34°C to 60°C (−30°F) to 140°F)
Temperature change rate	20°C (36°F) per hour, maximum
Relative humidity	5% to 90%
Maximum wet-bulb temperature	45°C (113°F) packaged
Altitude	9100 m (30,000 ft) maximum

B

Part Numbers

This appendix lists part numbers for the following items related to the DECstation 5000 Models 240 and 260:

- Major field replaceable units (FRUs)
- TURBOchannel option (TCO) modules
- Monitors
- Input devices
- Cords and cables
- Connectors, adapters, and terminators
- Miscellaneous hardware
- Software documentation
- Hardware documentation



Model 240 major FRUs

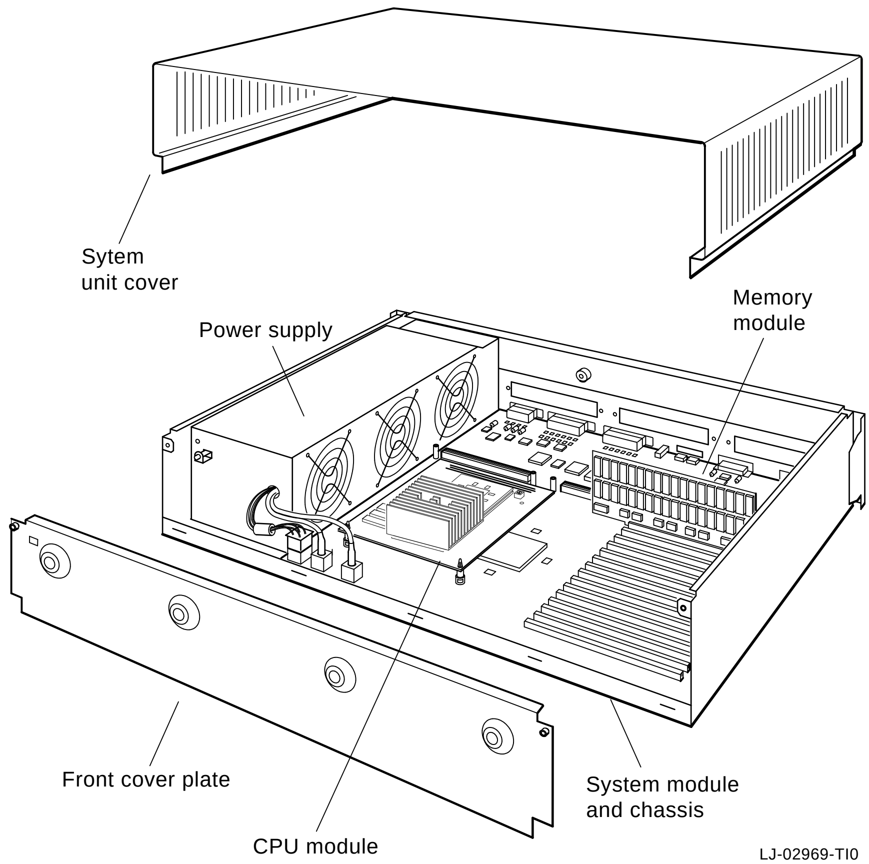


Figure B-2. DECstation 5000 Model 260 major FRUs

Table B-1. Part Numbers: Basic System Components

Item	FRU No.	Customer Order No.
CPU module only, (40 MHz)	54-20627-01	KN03-GA
CPU module only, (60 MHz)	54-21872-02	KN05-AA
Base system module with CPU module included	—	KN03B-HA
Base system module with chassis	70-28348-01	—
Power supply assembly (H7878A)	30-32506-01	—
Memory module (SIMM), 8 Mbyte	54-19813-AA	MS02L-AB
Memory module (SIMM), 32 Mbyte	54-19813-CA	MS02-CA
NVRAM module, 1Mbyte	54-20948-01	MS02-NV
System unit cover	70-27056-01	—
System unit chassis	70-27053-01	—

Table B-2. Part Numbers: SCSI Hardware

Item	FRU No.	Customer Order No.
SCSI controller option module	54-19876-01	PMAZ-AA/AB
SCSI system-unit-to-expansion-box cable	17-02641-01	BC09D-06
SCSI controller terminator	12-33626-01	—
SCSI chain terminator	12-30552-01	—

Table B-3. Part Numbers: TURBOchannel Option Modules

Item	FRU No.	Customer Order No.
Monochrome frame buffer (MX), 1 plane, 1280x1024, 72 Hz	54-20609-01	PMAG-AA/AB
Color frame buffer (CX), 8 plane, 1024x860, 60 Hz	54-19815-01	PMAG-BA/BB
Color frame buffer (HX), 8 plane, 1280x1024, 72/66 Hz	54-21143-01	PMAGB-BA/BB
Color frame buffer (HX), 8 plane, 1280x1024 @ 72 Hz, 1024x864 @ 66 Hz	54-21143-02	PMAGB-CA/CB
Color frame buffer (HX), 8 plane, 1280x1024/1024x768, 72 Hz	54-21143-03	PMAGB-DA/DB
True color frame buffer (TX), 24 plane, 1280x1024, 66 Hz	30-35790-01	PMAG-CA/CB
True color frame buffer (TX), 24 plane, 1280x1024, 72 Hz	30-35790-02	PMAG-CA/CB
2D graphics accelerator (PX), 8 plane, 1280x1024, 66 Hz	54-20314-01	PMAG-CA/CB
Lo 3D graphics accelerator (PXG), 8 plane, 1280x1024, 66 Hz	54-20185-01	PMAG-DA/DB
Lo 3D graphics accelerator (PXG+), 8 plane, 1280x1024, 72 Hz	54-20185-03	PMAG-DA/DB
Lo 3D graphics accelerator (PXG+), 8 plane, 1280x1024, 66 Hz	54-20185-04	PMAG-DC
Mid 3D graphics accelerator (PXG), 24 plane, 1280x1024, 66 Hz	54-20185-02	PMAG-EA/EB
Mid 3D graphics accelerator (PXG+), 24 plane, 24 bit z buffer, 1280x1024, 72 Hz	54-20185-05	PMAGB-EA/EB
Mid 3D graphics accelerator (PXG+), 24 plane, 24 bit z buffer, 1280x1024, 66 Hz	54-20185-06	PMAGB-EC/ED
Hi 3D graphics accelerator (PXG+), 24 plane, 24 bit z buffer, 1280x1024, 66 Hz	54-20114-01	PMAG-FA/FB

(continued on next page)

Table B-3 (Cont.). Part Numbers: TURBOchannel Option Modules

Item	FRU No.	Customer Order No.
Hi 3D graphics accelerator (PXG+), 24 plane, 24 bit z buffer, 1280x1024, 72 Hz	54-20114-02	PMAGB-FA/FB
8-to-24-plane upgrade	—	PMAG-GB
24-bit Z-buffer option module	—	PMAG-HA/HB
8-plane Z-buffer	54-20410-AA	—
16-plane Z-buffer	54-20352-AA	—
ThickWire Ethernet (NI) option module	54-19874-01	PMAD-AA/AB
FDDI fiber interface module	DEFZA-AA	DEFZA-AA
TURBOchannel extender (TCE) option module	54-20623-01	—
TCE interface module	54-20625-01	—
TCE power supply	H7826	—
SCSI controller option module	54-19876-01	PMAZ-AA/AB

Table B-4. Part Numbers: Monitors

Item	FRU No.	Customer Order No.
VR319, 19-inch monochrome monitor, 120/240 volts, Northern Hemisphere	—	VR319-DA
VR319, 19-inch gray-scale monitor, 120/240 volts, Northern Hemisphere	—	VR319-CA
VR319, 19-inch monochrome monitor, 240 volts, Southern Hemisphere	—	VR319-D4
VR319, 19-inch gray-scale monitor, 240 volts, Southern Hemisphere	—	VR319-C4
VRT16, 16-inch color monitor, 120 /240 volts, Northern Hemisphere	—	VRT16-DA
VRT16, 16-inch color monitor, 240 volts, Southern Hemisphere	—	VRT16-D4
VRT19, 19-inch color monitor, 120 volts	—	VRT19-DA
VRT19, 19-inch color monitor, 240 volts, Northern Hemisphere	—	VRT19-D3
VRT19, 19-inch color monitor, 240 volts, Southern Hemisphere	—	VRT19-D4

Table B-5. Part Numbers: Input Devices

Item	FRU No.	Customer Order No.
Keyboard, flat	—	LK201
Keyboard, curved	—	LK401
Mouse	—	VSXXX-AA
Tablet and stylus	—	VSXXX-AB
Lighted programmable function keyboard (LPFK) package, 120 volts	—	VSX20-AA
Lighted programmable function keyboard (LPFK) package, 240 volts	—	VSX20-A3
Programmable function dials (PFD) package, 120 volts	—	VSX30-AA
Programmable function dials (PFD)package, 240 volts	—	VSX30-A3
Combination LPFK and PFD package, 120 volts	—	VSX10-AA
Combination LPFK and PFD package, 240 volts	—	VSX10-A3

Table B-6. Part Numbers: Cords and Cables

Item	FRU No.	Customer Order No.
Monitor-to-system-unit power cord (U.S.)	17-00442-25	BN19P-1K
Monitor-to-system-unit power cord (Europe)	17-00365-19	BN19A-2C
System unit or expansion box primary power cord	17-00606-10	BN19P-K
Keyboard-mouse cable	17-02640-01	—
Serial line cable	—	BC16E-10
Printer/console cable	17-00811-	BC16E-
Modem cable	17-00322-	BC22E-10
SCSI system-unit-to-expansion-box cable	17-02641-01	BC09D-06
SCSI expansion-box-to-expansion-box cable	17-01351-04	BC19J-1E
ThickWire transceiver cable	17-01321-01	BNE4C-02
ThinWire cable, 12 ft	17-01241-12	BC16M-12
Video cable, color	17-02906-02	BC29G-03
Video cable, gray-scale	17-02878-01	—
Video cable, monochrome	17-03054-01	—
TURBOchannel extender (TCE) interface cable	17-03335-01	—
TCE internal SCSI cable	17-03055-01	—
TCE SCSI power harness	17-03064-01	—

Table B-7. Part Numbers: Connectors, Adapters, and Terminators

Item	FRU No.	Customer Order No.
Modified modular jack (MMJ) loopback connector	12-25083-01	—
ThickWire loopback connector	12-22196-02	—
SCSI controller terminator	12-33626-01	—
SCSI chain terminator	12-30552-01	—
ThinWire T-connector	12-25869-01	—
ThinWire terminators	12-26318-01	—
Jumper to clear NVR	12-14314-00	—
Comm-line-to-MMJ adapter	12-33190-01	—
Comm modem loopback	29-24795-00	—
ThinWire LAN assembly kit	22-00112-01	BC16T-12
DESTA ThickWire-to-ThinWire Ethernet adapter	70-22781-02	DESTA-BA
Twisted pair (10baseT) adapter	—	H3350-AA

Table B-8. Part Numbers: Small Hardware

Item	FRU No.	Customer Order No.
TURBOchannel cover	74-41143-05	—
CPU standoff post	12-35477-01	—
CPU standoff rivet	12-35477-02	—
Front cover plate	70-27053-01	—
Disposable grounding wrist strap	12-36175-01	—
Tamper-proof tape	36-33513-01	—
EMI grounding clips	74-46746-01	—
PC Removal Tool	74-46254-01	—
Product conversion label	36-15946-11	—

Table B-9. Part Numbers: Software Documentation

Item	FRU No.	Customer Order No.
ULTRIX Workstation Media (TK50) and Documentation Kit	—	QA-VV1AA-H5
ULTRIX Workstation Media (CD-ROM) and Documentation Kit	—	QA-VV1AA-H8
ULTRIX Workstation (OLD) On-line Documentation and Media Kit (both on CD-ROM)	—	QA-VV1AL-H8
DECnet ULTRIX/RISC Media (TK50) and Documentation Kit	—	QA-YT9AA-H5
DEC C for ULTRIX/RISC (TK50)	—	QA-YSJAA-H5
ULTRIX Guide to the Error Logger	—	AE-ME95B-TE
Technical Summary for RISC Processors	—	AA-MM35A-TE
Documentation Overview for RISC Processors	—	AA-MM05A-TE

Table B-10. Part Numbers: Hardware Documentation

Item	FRU No.	Customer Order No.
DECstation 5000 Model 200 Series User Documentation Kit	—	EK-PM38A-DK
Kit includes the following documents:		
DECstation 5000 Model 200 Series Installation Guide	—	EK-PM38B-IN-001
DECstation 5000 Model 200 Series Operator's Guide	—	EK-PM38C-OG-001
DECstation 5000 Model 200 Series Workstation Reference Card	—	EK-PM38D-RC-001
DECstation 5000 Model 200 Series Maintenance Guide	—	EK-PM38G-MD-001
DECstation 5000 Model 200 Series Pocket Reference Guide	—	EK-PM38E-PG-001
TURBOchannel Maintenance Guide	—	EK-TRBOC-MG-004

C

Console Commands

This appendix explains:

- The rules to follow when you type console commands
- Terms commonly used in this discussion of console commands
- The command format and purpose of each console command
- Possible console command error messages

Using This Appendix

Conventions Used in This Appendix

- **Letters in boldface type like this** are to be typed exactly as they appear.
- *Letters in italic type like this* are variables that you replace with actual values.
- Arguments enclosed in square brackets ([ ]) are optional.
- Ellipses (...) follow an argument that can be repeated.
- A vertical bar (|) separates choices. You can think of the bar as a symbol meaning.
- Parentheses enclose a group of values from which you must select one value. For example, -(b | h | w) means enter -*b* or -*h* or -*w*.

Some Terms Used in This Appendix

Controller - A hardware device that directs the operation and communication between devices or other controllers. Each controller in the system has a unique controller ID number.

Script - A collection of console commands that run in a set order. Test scripts, which are collections of individual tests and may also contain other test scripts, are commonly used for troubleshooting the system.

Slot - The physical location of a module or modules.

- TURBOchannel option modules occupy slots 0, 1, and 2.
- The base system occupies slot 3. Base system hardware includes the system module, CPU module, and memory modules. The system module contains the base system SCSI and Ethernet controllers.

Rules for entering console commands

You can use console commands when the system monitor displays the >> or R> prompt. When the system displays the R> prompt, you can use only the boot and passwd commands until you enter the console command password.

Follow these rules when you type console commands:

- Type uppercase and lowercase letters exactly as they appear in command lines. The system treats uppercase and lowercase letters as different input.
- Press Return after you type a command.
- Enter numbers as follows:
  - Enter decimal values as a string of decimal digits with no leading zeros (for example, 123).
  - Enter octal values as a string of octal digits with a leading zero (for example, 0177).
  - Enter hexadecimal values as a string of hexadecimal digits preceded by 0x (for example, 0x3ff).
- When reading or writing to memory, enter data as bytes, halfwords, or words. Because a word is 4 bytes, successive addresses referenced by a word are successive multiples of 4. For example, the address following 0x80000004 is 0x80000008. An error occurs if you specify an address that is not on a boundary for the data size you are using.
- The following key combinations have an immediate effect when the system is in console mode:
  - Ctrl-s freezes the screen display.
  - Ctrl-q releases a frozen screen display.
  - Ctrl-c aborts a command.
  - Ctrl-u erases a partially typed command line.

Console Command Reference

This section describes console commands used to test the following hardware:

- System module
- CPU module
- Memory modules
- Ethernet controllers
- SCSI controllers
- Color frame-buffer graphics modules
- 2D graphics accelerator modules
- 3D graphics modules

Console commands in this appendix appear in the same order as they appear in the system console command Help menu.

For information about console commands used by TURBOchannel options not on this list, refer to the *TURBOchannel Maintenance Guide*.

Console Command Format Summary

Here are the console commands and their formats displayed in the Help menu that appears when you enter **?**:

```
?[cmd]
boot [[-z #] [-n] #/path [ARG...]]
cat SCRPT
cnfg [#]
d [-bhw] [-S #] RNG val
e [-bhwcdoux] [-S #] RNG
erl [-c]
go [ADR]
init [#] [-m] [ARG...]
ls [#]
passwd [-c] [-s]
printenv [EVN]
restart
script SCRPT
setenv EVN STR
sh [-belvS] [SCRPT] [ARG..]
t [-l] #/STR [ARG..]
unsetenv EVN
```

The following sections describes the console commands in detail. Note that the command descriptions do not always use the format that appears in the Help menu. Table C-1 lists the console commands.

Table C-1. Console Commands

Command	Function
?*[cmd]*	Displays console commands and formats.
boot*[-**z**] [-**n**] [bootpath] [-**a**] [args...]*	Boots the system.
cat *slot_number /script_name*	Displays the contents of a script.
cnfg *[slot_number]*	Displays system configuration information.
d [- (b | h | w)] *[-**s**count]rng*	Deposits data into memory.

(continued on next page)

Table C-1 (Cont.). Console Commands

Command	Function
e [- (b | h | w)] [-c] [-d] [-o] [-u] [-x] *[-**s**count]rng*	Examines memory contents.
erl [-c]	Displays the error message log.
go *[address]*	Transfers control to a specific address.
init*[slot_number][-m]*	Resets the system or module.
ls *[slot_number]*	Displays the scripts and other files in a module.
passwd [-c][-s]	Sets and clears the console password.
printenv*[variable]*	Prints environment variables.
restart	Attempts to restart the operating system software specified in the restart block.
script *name*	Creates a temporary script of console commands.
setenv*variable value*	Sets an environment variable.
sh [-b] [-e] [-l] [-v] [-S] *[slot_number/script] [arg...]*	Runs a script.
t [-l] *slot_number /test_name [arg1]... [argn]*	Runs a test.
test	Runs a comprehensive test script that checks the system hardware.
unsetenv *variable*	Removes an environment variable.

? Command

Use the ? command to display a list of available console commands and their formats. The ? command format is:

? *[cmd]*

- To display the format for all available console commands, omit the optional *cmd* parameter.
- To display the format for a single command, replace the optional *cmd* parameter with the name of the command for which you want a command format display.

boot Command

Use the boot command to boot the system software. The boot command format is:

boot *[**-z**seconds] [**-n**] [bootpath] [**-a**] [args...]*

- Include the optional -zseconds parameter to have the system wait before starting the bootstrap operation. Replace seconds with the number of seconds the system should wait before the bootstrap operation starts.
- Include the optional -n parameter to have the boot command load, but not execute, the specified file.
- Replace the optional bootpath parameter with the specification for the file you are using to boot. The file specification form depends on the type of boot device you use.
  - To boot from Ethernet, use the file specification form:

    slot_number/protocol[/file]

    Replace *slot_number* with the slot number of the Ethernet controller you are using to boot. The protocol parameter represents the name of the network protocol that performs the boot operation.

    Replace *protocol* with either mop or tftp. The optional file parameter represents a specific file that you use to boot.

For example, to use the protocol named mop to boot from the base system Ethernet, which uses slot number 3, type boot 3/mop and press Return.

– To boot from a drive, use the file specification form:

*slot_number/(***rz | tz***)scsi_id/file_name*

Replace *slot_number* with the SCSI controller slot number. Use the (rz | tz) parameter to specify the type of drive that performs the boot operation. Specify rz to boot from a hard disk or compact disc drive. Specify tz to boot from a tape drive.

Replace *scsi_id* with the SCSI ID for the drive you are using to boot.

Replace *file_name* with the name of the specific file you want to boot.

Example: to boot the file named vmunix in multi-user mode from a hard disk drive with SCSI ID 1 that is on the SCSI bus connected to the base system SCSI controller in slot 3, type:

boot 3/rz1/vmunix -a

Example: to boot the file called vmunix from a tape drive that has SCSI ID 2 and is on the SCSI bus connected to a SCSI controller in option slot 1, type:

boot 1/tz2/vmunix

The tape labeled "Ultrix 4.L supported vol. 1 (RISC)" is the bootable tape.

- To perform a multi-user boot operation, include the -a argument. If you omit the -a argument, the system performs a single-user boot.

Important information about the boot command

- If you include no bootpath in the boot command, the system uses the boot environment variable as the string for the boot command.

- If you include any additional arguments, you must type the entire string in the boot command. The system ignores the boot environment variable whenever you specify any arguments in the boot command.
- If you use any spaces or tabs in the boot environment variable, you must surround the entire value with double quotation marks. For example, to set the boot environment variable to use the mop protocol to perform a multi-user boot from the base system Ethernet controller in slot 3, type:

  setenv boot "3/mop -a"

- For details about the boot command parameters for each TURBOchannel option module, refer to the respective TURBOchannel option module documentation.

cat Command

Use the cat command to display the contents of a script. The cat command format is:

cat *slot_number/script_name*

- Replace *slot_number* with the slot number of the module that has the contents you want to display.
- Replace *script_name* with the name of the script for which you want to display the contents.

Example: to display the individual self-tests contained in the test-rtc test script in the base system, type:

cat 3/test-rtc

The following list of the individual tests that are in the test-mem-m test script then appears on the monitor:

```
>>cat 3/test-rtc
t ${#}/rtc/regs
t ${#}/rtc/nvr
t ${#}/rtc/period
t ${#}/rtc/time
```

cnfg Command

Use the cnfg command to display hardware configuration information. The cnfg command format is:

cnfg *[slot_number]*

- To display general system configuration information, type the cnfg command without the *slot_number* parameter.
- To display detailed configuration information for an individual module, replace the optional *slot_number* parameter with the slot number of the module for which you want a configuration display.

General system configuration displays

The following sample general system configuration display is for a system with optional NVRAM, Ethernet, and SCSI modules installed:

```
>>cnfg
3: KN03-AA DEC X2.0d TCF0 ( 24MB,    1MB NVRAM)
                                        (enet: 08-00-2b-24-5b-82)
                                        (scsi = 7)

2: PMAD-AA DEC V5.1f TCF0 (enet: 08-00-2b-0f-43-31)
1: PMAZ-AA DEC V5.1e TCF0 (scsi = 7)
0: PMAG-BA DEC T5.2a TCF0 (CX -- D=8)
```

Note:

If an R4000 CPU module is installed, the screen output above would be the same except the KN03-AA designation would be KN05 for the R4000. All other entries are unchanged.

Lines that begin with 0, 1, 2, or 3 describe the modules, if any, that are in the option slots.

- The number that begins the line is the module slot number.
- The second term is the module name.
- The third term is the module vendor.
- The fourth term is the firmware version of the module.
- The fifth term is the type of firmware that is in the module ROM chip.

- The messages in parentheses in the rightmost column provide additional information about each module. The meaning of each message depends on the type of module being described.
  - For the system module, the three lines in this column describe base system hardware. The first line lists the amount of memory in the system. The second line lists the address for the base system Ethernet controller. The third line lists the ID number of the base system SCSI controller.
  - For TURBOchannel Ethernet controllers, the additional information is the Ethernet station address.
  - For TURBOchannel SCSI controllers, the additional information is the SCSI ID for the SCSI controller.
  - For graphics modules, the first part of the additional message identifies the type of graphics module that is in the system, as follows:

    CX indicates that the module is a color frame-buffer graphics module.

    PX indicates that the module is a 2D graphics accelerator module.

    DX indicates that the module is a low 3D graphics module.

    EX indicates that the module is a mid 3D graphics module.

    FX indicates that the module is a high 3D graphics module.

    The second part of the additional message has the form d=# where # is the number of bits that make up the pixel depth. The third part of the additional message is displayed only when a z-buffer option is installed on a 2D graphics accelerator module. The third part of the additional message has the form z=24.

Individual configuration displays begin with the same line that describes the module in the general system configuration.

Base system configuration displays

To obtain a base system configuration display, type:

cnfg 3

This is a sample configuration display for the base system configuration:

```
3:  KN03-AA   DEC   V5.2A   TCF0  ( 24 MB,    1 MB NVRAM)
                                  (enet: 08-00-2b-0f-45-72)
                                  (SCSI = 7)

            -----------------------------------------------
            DEV   PID              VID     REV    SCSI DEV
            ====  ==============  ======  =====  ========
            tz1                                  SEQ
            rz2   RZ55   (C) DEC  DEC     0700   DIR
            rz4   RX23   (C) DEC  DEC     0700   DIR

       dcache  ( 64 KB), icache ( 64 KB)

       mem( 0):  a0000000:a07fffff  (  8 MB)
       mem( 1):  a0800000:a0ffffff  (  8 MB)
       mem( 2):  a1000000:a17fffff  (  8 MB)
       mem(14):  a1800000:a18fffff  (  1 MB)   Presto-NVR

       mem(14):  clean, bat ok, armed
```

Notice that the display begins with the same information as in the general system configuration display. The rest of the display shows details of the devices and memory that are installed in the base slot. This example shows three devices and four memory modules.

The following list describes the information about the base system devices:

- DEV lists the general category of the drive and its SCSI ID.
  - rz indicates that the drive is a hard disk or optical compact disc drive.
  - tz indicates that the drive is a tape drive.
  - The number at the end of the entry is the drive SCSI ID.
- PID lists the product ID for some types of drives.
  - The term on the left indicates the specific drive type.

- The term on the right indicates the product manufacturer.

- VID lists the drive vendor.
- REV lists the firmware revision number for the drive.
- SCSI DEV further describes the drive type.
  - DIR, which represents a direct access drive, appears in entries for hard disk drives.
  - SEQ, which represents a sequential access drive, appears in entries for tape drives.
  - CD-ROM appears in entries for optical compact disc drives.

The following list describes the information about the base system memory modules. The items below pertain to the memory module section of the base system configuration display, read from left to right.

- mem denotes memory module
- Memory slot number
- Address range
- Amount of memory in the slot. The amount can be 8 or 32 megabytes for SIMMs and 1 megabyte for an optional NVRAM module. Except for the NVRAM module, the same amount of memory should be displayed for the slots because all of the SIMMs should be the same size.
- This display will reveal a mixed memory installation, but ULTRIX will not work properly with mixed memory.

Sample Output with R4000 CPU Module

If you have the R4000 CPU module installed, the screen output will resemble the following:

```
>>cnfg 3
 3: KN05     DEC      V1.0a    TCF0  ( 32 MB)
                                     (enet: 08-00-2b-2d-84-c7)
                                     (SCSI = 7)
         ------------------------------------------------------
         DEV   PID                 VID        REV    SCSI DEV
         ===== ================= ========= ====== ========
         rz1   RZ25  (c) DEC  DEC   0500  DIR
         rz2   RZ55  (c) DEC  DEC   0900  DIR
         rz3   RRD42 (c) DEC  DEC   1.4a  CD-ROM

      cache: I( 8 KB), D( 8 KB), S(1024 KB);  Scache line (32 bytes)
      processor revision (3.0)
         mem( 0):  a0000000:a07fffff  (  8 MB)
         mem( 1):  a0800000:a0ffffff  (  8 MB)
         mem( 2):  a1000000:a17fffff  (  8 MB)
         mem( 3):  a1800000:a1ffffff  (  8 MB)
```

- `cache: I( 8 KB), D( 8 KB), S( 1024 KB); Scache line (32 bytes)` represents the Instruction cache, Data cache, Secondary cache, and scache line size respectively.
- `processor revision (3.0)` shows the revision of the installed R4000 CPU module.

Ethernet controller configuration displays

To display an Ethernet controller option module configuration, type:

cnfg *slot_number*

Replace *slot_number* with the slot number of the Ethernet controller option module.

To see the base system Ethernet controller configuration display, type:

cnfg 3

The base system Ethernet controller configuration is displayed with the other base system configuration information.

The following is a sample Ethernet controller configuration display for an Ethernet controller option module in slot 1:

```
1:  PMAD-AA  DEC   V5.2a   TCF0   (enet: 08-00-2b-0c-e0-d1)
```

The Ethernet controller configuration display has the same meaning as the Ethernet controller description in the general system configuration display. For an explanation of the Ethernet controller configuration display, see the "General System Configuration Displays" earlier in this appendix.

SCSI controller displays

To display a SCSI controller option module configuration, type:

cnfg *slot_number*

Replace *slot_number* with the slot number of the SCSI controller option module.

To see the base system SCSI controller configuration, type:

cnfg 3

The base system SCSI controller configuration is displayed with the other base system configuration information.

The following is a sample configuration display for a SCSI controller in slot 2 that supports two hard disk drives, one optical compact disk drive, and one tape drive:

```
2:  PMAZ-AA   DEC   V5.2a   TCF0   (SCSI = 7)
               ---------------------------------------------
                DEV   PID              VID     REV    SCSI DEV
               ====  ==============  ======  =====  ========
                rz0    RZ55   (C) DEC  DEC     0700    DIR
                rz1    RZ56   (C) DEC  DEC     0200    DIR
                rz4    RRD40  (c) DEC  DEC     0700    CD-ROM
                tz5                                    SEQ
```

In the SCSI configuration display, the first line has the same meaning as the SCSI description in the general system configuration display. For an explanation of this first line, see "General System Configuration Displays" earlier in this appendix.

Lines following the first line describe drives on the SCSI bus.

- `DEV` lists the general category of the drive and its SCSI ID.
  - `rz` indicates that the drive is a hard disk or optical compact disc drive.
  - `tz` indicates that the drive is a tape drive.
  - The number at the end of the entry is the drive SCSI ID.
- `PID` lists the product ID for some types of drives.
  - The term on the left indicates the specific drive type.
  - The term on the right indicates the product manufacturer.
- `VID` lists the drive vendor.
- `REV` lists the firmware revision number for the drive.
- The `SCSI DEV` further describes the drive type.
  - `DIR`, which represents a direct access drive, appears in entries for hard disk drives.
  - `SEQ`, which represents a sequential access drive, appears in entries for tape drives.
  - `CD-ROM` appears in entries for optical compact disk drives.

Color frame buffer graphics module configuration displays To obtain a color frame-buffer graphics module configuration display, type:

cnfg *slot_number*

Replace *slot_number* with the slot number for the color frame-buffer graphics module for which you want a configuration display.

The following is a sample color frame buffer graphics module configuration display for a color frame buffer graphics module in slot 1:

```
0:    PMAG-BA  DEC    V5.2a    TCF0    (CX -- d=8)
```

For an explanation of the color frame-buffer graphics module configuration display see the color frame-buffer graphics module description for the general system configuration display; see the "General System Configuration Displays" section earlier in this appendix.

2D graphics accelerator module configuration displays To obtain a 2D graphics accelerator module configuration display, type:

cnfg *slot_number*

Replace *slot_number* with the slot number for the 2D graphics accelerator module for which you want a configuration display. The following is a sample configuration display for a 2D graphics accelerator module in option slot 1:

```
1: PMAG-AA DEC V5.2a TCF0 (PX---D=8)
```

The 2D graphics accelerator module display has the same meaning as the 2D graphics accelerator module description in the general configuration display. For an explanation of the 2D graphics accelerator module configuration display, see "General System Configuration Displays" section earlier in this appendix.

3D graphics module configuration displays To obtain a 3D graphics module configuration display, type:

cnfg *slot_number*

Replace *slot_number* with the slot number for the 3D graphics module.

The following is a sample configuration display for a low 3D graphics module:

```
1: PMAG-DA DEC V5.2a TCF0 (DA: PXG---D=8, z=24)
```

- The leftmost column lists the low 3D graphics module slot number.

- PMAG-DA is the part identifier for low and mid 3D graphics modules. High 3D graphics module displays list PMAG-FA as the part identifier.
- DEC is the module manufacturer.
- The fourth column lists the firmware version that each module contains.
- The fifth column lists the firmware type in each module.
- The string in the rightmost column indicates the 3D graphics module type and the number of VSIMMs and z-buffer modules on the base graphics module.
  - The left part of the phrase identifies the type of graphics module in the system.

    DA: PXG indicates that the module is a low 3D graphics module.

    EA: PXG indicates that the module is a mid 3D graphics module.

    PXG_T indicates that the module is a high 3D graphics module.
  - The right part of the phrase describes the VSIMM and z-buffer modules. The value after D= is the number of planes available for color generation. The value after z= is the number of bits available in the z-buffer modules.
- If the string at the end of the 3D cnfg display is (ERR: invld cnfgtbl) or ends with question marks (???), there is a problem in the graphics module hardware. Refer to the *TURBOchannel Maintenance Guide* to troubleshoot the 3D graphics module.

d Command

Use the d command to deposit values in memory.

The d command format is:

d [-(b | h | w)] *[-**S**count]rng*

- Use the one of the optional parameters -(b | h | w) to specify whether to deposit the contents as bytes, halfwords, or words.
  - Specify -b to deposit the contents as bytes.
  - Specify -h to deposit the contents as halfwords.
  - Specify -w to deposit the contents as words.
- Include the optional **-S***count* parameter to store the same value more than once. Replace count with the number of times that you want the value to be stored.
- Use the *rng* parameter to set the range of addresses across the stored values.
  - To deposit values at a single address, replace rng with that address.
  - To deposit a number of values across a range of addresses, replace *rng* with the address range. Use the form:

    address_low:address_high

    Replace *address_low* with the starting address for storing values and replace *address_high* with the ending address for storing values.
  - To deposit values at a series of addresses, replace *rng* with the starting address and the number of successive addresses at which you want to store values. Use the form:

    address_low#count

    to specify the addresses where you store values. Replace *address_low* with the starting address for storing values. Replace *count* with the number of values you want to store.

- To specify more than one address range, separate the range specifications with commas. Leave no spaces between the range specifications.

e Command

Use the e command to examine the contents of a specific address. The e command format is:

e [-b | h | w] [-c] [-d] [-o] [-u] [-x] *[-**S**count]rng*

- Use the optional parameter (-b | h | w) to specify whether to examine the contents as bytes, halfwords, or words.
  - Specify -b to examine the contents as bytes.
  - Specify -h to examine the contents as halfwords.
  - Specify -w to examine the contents as words.
- Specify -x to display the contents in hexadecimal format.
- Specify -o to display the contents in octal format.
- Specify -u to display the contents in unsigned decimal format.
- Specify -d to display the data in decimal format.
- Specify -c to display the data as ASCII characters.
- Include the optional -S *count* parameter to have the command repeatedly fetch the value, but display the value only once. When you type this parameter, replace count with the number of times that you want to fetch the value.
- Use the *rng* parameter to specify the range of addresses you want to examine.
  - To examine values at a single address, replace *rng* with that address.
  - To examine values at a range of addresses, replace *rng* with the address range. Use the form:

    address_low:address_high

    to define the range. Replace *address_low* with the starting address for storing values and replace *address_high* with the ending address for storing values.

- To examine values at a series of addresses, replace *rng* with the starting address and the number of successive addresses you want to examine. Use the form:

  address_low#count

  to specify the addresses where you store values. Replace *address_low* with the starting address for storing values. Replace *count* with the number of addresses at which you want to store values.
- To specify more than one address range, separate each range specification with commas. Leave no spaces between the ranges.

erl Command

Use the erl command to display or clear the log of errors that occurred since the most recent power-up or reset operation. When the buffer that holds these error log fills up, no further errors are recorded. If you intend to run tests and use these logs for information, use the erl -c command to clear the logs first. The erl command format is:

erl [-c]

- To display the current error message log, use the erl command without the -c option.
- To clear the error message log, include the -c option. When the error log buffer is full, no more messages are added until the buffer is cleared by the erl -c command.

go Command

Use the go command to transfer system control to a specific system address. The go command format is:

go *[address]*

- To transfer system control to the address specified in the last boot -n command, type the go command without the address parameter. If you omit the address parameter, and if no previous boot -n command has been issued, the system ignores the go command.

- To transfer system control to the contents of a specific address, include the *address* parameter. Replace the *address* parameter with the address to which you want to transfer control.

init Command

Use the init command to initialize module hardware. The init command format is:

init *[slot_number]* ***[-m]***

- To initialize the entire system, specify the init command with no additional arguments.
- To initialize an individual module, replace the optional *slot_number* parameter with the slot number of the module that you want to initialize.
- If you perform an init operation on the system module (slot 3), include the optional **-m** parameter to zero all memory modules in the system module.

ls Command

Use the ls command to list the scripts and other objects that are in system ROM. The ls command format is:

ls *[slot_number]*

To display a list of scripts or other objects that are available in an individual module, replace the optional *slot_number* parameter with the slot number of the module that contains the files you want to display.

This sample display is a portion of the ls display for the base system in slot 3:

```
>>ls 3
     28 1 cnfg -> code
     28 1 boot -> code
     24 1 rst-q -> rst
     24 1 rst-t -> rst
     28 1 rst-m ->powerup
     32 1 test-ni-m -> test-ni-t
     28 1 init -> code
    304 1 powerup
     44 1 reset
     36 1 halt-r
     28 1 halt-b
    192 1 pst-m
    272 1 pst-q
    196 1 pst-t
     96 1 tech
    156 1 test
```

The third column lists the names of the scripts and other objects in the module ROM in the specified slot.

passwd Command

Use the passwd command to enter, set, or clear a password. The passwd command format is:

passwd [-c] [-s]

If the console prompt is R>, you can use only the boot and passwd commands until you enter the correct password. To enter an existing password, type the passwd command without any additional parameters. At the pwd: prompt, enter the password, then press Return. After you enter the correct password, or if the system does not require a password, the system displays the console prompt >>. You can use all console commands whenever the console prompt is >>.

- To clear an existing password, include the -c parameter when you type the passwd command. First use the passwd command to enter the existing password. After the console prompt >> appears, type:

  passwd -c

  and press Return. The system then removes the password requirement.

- To set a new password, include the -s parameter. Enter the new password at the pwd: prompt. When the pwd: prompt appears a second time, type the password again. If the two password entries match, the system sets the new value as the password.
- The password must have at least 6 and no more than 32 characters. The system is case sensitive and treats uppercase and lowercase letters as different characters.

printenv Command

Use the printenv command to display the list of environment variables. The printenv command format is:

printenv *[variable]*

- To display the entire environment variable table, omit the optional *variable* parameter.
- To display an individual environment variable, replace *variable* with the name of the environment variable you want to display.

restart Command

Use the restart command to restart the system software. For the restart operation to succeed, the operating system software must have a restart block set up in memory. The restart command format is:

restart

script Command

Use the script command to create a temporary set of console commands that run in an order that you specify. The script command format is:

script *name*

Replace *name* with the name that you are giving the script.

After you press Return, type the commands that you want to include in the script. Press Return after each command that you type. Commands can be t or sh commands. Enter one command per line. When you finish typing the commands that you are including, press Ctrl-d or press Return twice to complete the script. To run the script, use the sh command described later in this appendix. When you run the script, the commands execute in the same order as you entered them when you created the script.

setenv Command

Use the setenv command to change an environment variable. Table C-2 lists the standard environment variables. When you change a standard environment variable (except osconsole and #), the system stores the new value in NVR and uses it until you use the setenv command to change it again or reset the NVR with the clear-NVR jumper. The setenv command format is:

setenv *variable value*

When you type the setenv command,

- Replace *variable* with the name of the environment variable you want to set.
- Replace *value* with the new value that you want to assign to the environment variable. Note that if the new value contains blank spaces or tabs, you must use double quotation marks (") at the beginning and end of the value.

Table C-2. Environment Variables for setenv Command

Environment Variable	Description
boot	Sets the default boot path. See the "boot Command" and the "unsetenv Command" sections in Appendix C.
console	Selects the system console. - Set the console variable to s to enable the terminal connected to the left comm connector (viewed from the back) as the active console.

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Table C-2 (Cont.). Environment Variables for setenv Command

Environment Variable	Description
	- If the console variable is set to anything other than s, the monitor connected to the graphics module in the lowest number slot is enabled. If no graphics module is installed, the terminal connected to the left serial connector is enabled.
	- If the console variable is set to 0 and a graphics module is installed, the console displays the language selection menu.
EPAWS	Specifies the way the system responds when a diagnostic test finds an error.
	- Set the EPAWS variable to EPAWS to cause the system to pause when a diagnostic test finds an error. Press any key to continue testing.
	- If the EPAWS variable is set to any value other then EPAWS, the system does not pause when an error occurs.
haltaction	Specifies the way the system responds when it halts.
	- Set the haltaction variable to b to cause the console to boot after the console performs the appropriate initialization and self-tests.
	- Set the haltaction variable to h to cause the console to halt and attempt no other action.
	- Set the haltaction variable to r to cause the console to restart and then attempt to boot if the restart operation fails.
more	Sets how the screen scrolls lines of text.
	- Set the more variable to 0 to have text scroll to the end before stopping.
	- Set the more variable to a number other than zero to have scrolling pause after that number of lines has been displayed.

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Table C-2 (Cont.). Environment Variables for setenv Command

Environment Variable	Description
osconsole	Contains the slot numbers of the console drivers. If a TTY driver from slot x serves as the console, osconsole is set to x. If a CRT driver from slot y and a kbd driver from slot z serve as the console, osconsole is set to y,z. Although the environment variable display includes the osconsole setting, you cannot set this variable. The system automatically sets the osconsole value.
testaction	Specifies the type of power-up self-test that the system runs. - Specify q to run a quick test when the power-up self-test runs. - Specify t to specify a thorough test when the power-up self-test runs.
#	Specifies the slot number of the module that contains the current script. If no script is active, the system specifies the base system module, slot number 3. Although the environment variable display includes the # setting, you cannot set this variable.

sh Command

Use the sh command to run a script. The sh command format is:

sh [-b] [-e] [-l] [-v] [-S] *[slot_number/script] [arg...]*

- Include the optional -b parameter to execute the script directly, instead of through a subshell.
- Include the optional -e parameter to stop the script if an error occurs.
- Include the optional -l parameter to have the script loop until you press Ctrl-C.
- Include the optional -v parameter to echo the script to the console as the test runs.
- Include the optional -S parameter to suppress any error messages if the script is not found.

- To run a specific script, include the optional *slot_number /script* parameter.
  - Replace *slot_number* with the slot number of the module that has the script you want to run.
  - Replace *script* with the name of the script you want to run.

For example, to run the thorough power-up self test script for a SCSI controller and drives in slot 2, type:

sh 2/pst-t

t Command

Use the t command to run individual tests. The t command format is:

t [-l] *slot_number/test_name [arg...]*

- Include the optional -l parameter to have the test loop until you press Ctrl-c or reset the system.
- Replace *slot_number* with the slot number of the module that you want to test.
- Replace *test_name* with the name of the individual test you want to run.
- Uses for additional arguments depend on the particular test you are running. For an explanation of the additional arguments used in an individual test, refer to Appendix D.

To display the name and format of all individual tests for a module, type:

t *slot_number/***?**

Replace *slot_number* with the slot number of the module for which you want to display tests.

test Command

Use the test command to run a thorough test of all system hardware. The test command format is:

test

unsetenv Command

Use the unsetenv command to remove an environment variable. The unsetenv command removes a standard environment variable (except osconsole and #) during the current session only. When the system is reset, reinitialized, or powered up, the values of the standard environment variables revert to their previously set values. Table C-2 in this appendix lists the standard environment values.

The unsetenv command format is:

unsetenv *variable*

When you type the unsetenv command, replace variable with the name of the environment variable that you want to remove.

Note: *To clear the boot environment variable, use setenv command as follows:*

setenv boot

Console Command Error Messages

Table C-3. Console Command Error Messages

Error Message	Description
?EV:ev_name	The specified environment variable does not exist.
?EVV:value	The specified environment variable value is invalid.
?IO:slot_number/device	An I/O device reported an error. *slot_number* represents the I/O device slot number, and *device* represents an additional message about the error.

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Table C-3 (Cont.). Console Command Error Messages

Error Message	Description
?IO:slot_number/device	The module in the slot represented by *slot_number* does not recognize the device represented by *device.*
?PDE3: slot_number	The module in the slot represented by *slot_number* contains an early version of firmware. The ROM chip must be upgraded.
?SNF: script	The system did not find the script that was to be run.
?TXT:	The name specified in the script command is not a valid script name.
?STF (4: Ln#0 Kbd self test)	The keyboard self-test failed. This is an information message and does not prevent the system from automatically booting.
?STF (4: Ln#0 Pntr self test)	A pointing-device self-test failed. This is an information message and does not prevent the system from automatically booting.
?STX: usage	A console command contained a syntax error. The usage parameter lists the correct syntax.
?STX: error	A console command contained a syntax error. The error parameter lists the incorrect portion of the command.
?TFL:slot_number/test	A test failed. *slot_number* represents the slot number of the module that reported the error, and *test* represents the name of the failed test.
?TNF:	Test not found. The test name was probably typed incorrectly.

D

Base System Test Commands and Messages

This appendix describes commands and messages for the following tests:

- System module tests
- CPU module tests
- Memory module tests
- Base system SCSI controller tests
- Base system Ethernet controller tests
- Initial power-up tests

In addition, Table D-37 lists the diagnostic LED codes and what they indicate when a power-up self-test fails. The LED codes provide information for troubleshooting when error messages are not available.

Locating Individual Tests in This Appendix

When an individual test fails, the name of the test appears in the error message. For details of each base system test, see the section in this appendix that describes the test and its error messages. The tests are listed in alphabetical order.

When troubleshooting the system, you can use the test command to run any single test when the console prompt (>>) appears. You can also write a test script to run a group of individual test. See the "t Command" and "script Command" sections in Appendix C for more information.

To help you select the individual tests that apply to a problem that you are troubleshooting, Table D-1 lists the individual tests grouped by the function that they test.

Table D-1. Base System Module Test and Utilities

Test or Utility	Command
	Base System Module Tests
Halt button test	**t 3/misc/halt** *[number]*
Nonvolatile RAM (NVR) test	**t 3/rtc/nvr** *[pattern]*
Overheat detect test	**t 3/misc/pstemp**
Real-time clock period test	**t 3/rtc/period**
Real-time clock register test	**t 3/rtc/regs**
Real-time test	**t 3/rtc/time**
	Serial Communications Tests
SCC DMA test	**t 3/scc/dma** *[line] [loopback] [baud]*
SCC interrupts test	**t 3/scc/int***[line]*

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Table D-1 (Cont.). Base System Module Test and Utilities

Test or Utility	Command
SCC input/output (I/O) test	**t 3/scc/io** *[line] [loopback]*
SCC pins test	**t 3/scc/pins***[line] [loopback]*
SCC transmit and receive test	**t 3/scc/tx-rx** *[line] [loopback][baud] [parity] [bits]*
	CPU module tests
Cache data test	**t 3/cache/data** *[cache] [address]*
Cache fill test	**t 3/cache/fill***[cache] [offset]*
Cache isolate test	**t 3/cache/isol***[cache]*
Cache reload test	**t 3/cache/reload***[cache] [offset]*
Cache segment test	**t 3/cache/seg***[cache] [address]*
Secondary cache test	**t 3/scache/data** [R4000 only]
CPU-type utility	**t 3/misc/cpu-type**
Floating-point unit test	**t 3/fpu**
Translation lookaside buffer (TLB) probe test	**t 3/tlb/prb**
TLB registers test	**t 3/tlb/reg** *[pattern]*
	Memory module tests
Error correction coding (ECC) correction test	**t 3/ecc/cor** *[address]*
Floating 1/0 memory test	**t 3/mem/float10** *[address]*
Memory module test	**t 3/mem***[module] [threshold] [pattern]*
RAM address select lines test	**t 3/mem/select**
Partial write test	**t 3/misc/wbpart**

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Table D-1 (Cont.). Base System Module Test and Utilities

Test or Utility	Command
Prcache quick test	**t 3/prcache**
Zero memory utility	**t 3/mem/init**
	Ethernet Controller Tests
Collision test	**t 3/ni/cllsn**
Cyclic redundancy code (CRC) test	**t 3/ni/crc**
Display miantenance operation protocol (MOP) counters utility	**t 3/ni/ctrs**
Ethernet-DMA registers test	**t 3/ni/dma1**
Ethernet-DMA transfer test	**t 3/ni/dma2**
Ethernet station address ROM (ESAR) test	**t 3/ni/esar**
External loopback test	**t 3/ni/ext-lb**
Internal loopback test	**t 3/ni/int-lb**
Interrupt request (IRQ) test	**t 3/ni/int**
Multicast test	**t 3/ni/m-cst**
Promiscuous mode test	**t 3/ni/promisc**
Registers test	**t 3/ni/regs**
	SCSI Tests
SCSI controller test	**t 3/scsi/cntl**
SCSI send diagnostics test	**t 3/scsi/sdiag** *scsi_id* **[d] [u] [s]**

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Table D-1 (Cont.). Base System Module Test and Utilities

Test or Utility	Command
SCSI target test	**t 3/scsi/target** *scsi_id* **[w][lloops]**
	Keyboard and Mouse Tests
Keyboard test	**t 3/misc/kbd**
Mouse test	**t 3/misc/mouse**

Tests

The following sections explain the commands, parameters, and error messages for each base system module test. The tests are presented in alphabetical order.

cache/data - Cache Data Test

The cache data test writes data patterns to the cache and then reads them. To run the cache data test, type:

t 3/cache/data *[cache] [address]*

When you type the cache test command:

- Replace *cache* with a value that specifies the cache you want to test.
  - Specify I to test the instruction cache.
  - Specify D to test the data cache. D is the default value.
- Replace the optional *address* parameter with a specific cache address where you want the test to start. Using the address parameter requires familiarity with the firmware specifications. The default address is 80500000.

Cache data test error messages

Cache data test error messages have the form:

`?TFL:3 /cache/data (code: [address=actual, sb expected])`

- `?TFL 3/cache/data` indicates that the cache data test reported an error.
- `code` represents a number that identifies which portion of the test failed.
- The optional `address=actual, sb expected` phrase indicates the expected and actual values in the cache.
  - `address` represents the address where the error message occurred.
  - `actual` represents the actual value at that address.

– expected represents the expected value for that address.

Table D-2 lists codes used in cache data test error messages.

Table D-2. Cache Data Test Error Codes

Error Code	Description
1	Error occurred writing data pattern to cache RAM.
2	Cache parity error occurred while test was reading floating 1.
3	Error occurred when test read data pattern in cache.
4	Cache parity error occurred while test was reading floating 0.
5	Error occurred when test wrote address complement to cache RAM.
6	Cache parity data error occurred.
7	Error occurred reading address complement.
8	Cache address read caused a parity error.

cache/fill - Cache Fill Test

The cache fill test writes rotating data patterns to memory in spans that are twice the size of the cache and then reads the patterns. To run the cache fill test, type:

t 3/cache/fill *[cache] [offset]*

When you type the cache fill test command:

- Replace *cache* with a value that specifies the cache you want to test.
  - Specify I to test the instruction cache.
  - Specify D to test the data cache. D is the default value.
- Replace *offset* with a specific cache address where you want the test to start. The default address is 80500000.

Cache fill test error messages

Cache fill test error messages have the form:

`?TFL: 3/cache/fill (description)`

- `?TFL 3/cache/fill` indicates that the cache fill test reported an error.
- `description` represents an additional message that describes the error.

Table D-3 lists descriptions used in cache fill test error messages.

Table D-3. Cache Fill Test Error Descriptions

Error Description	Meaning
(PE)	Unexpected parity error occurred.
(address= actual, sb expected)	Data pattern read reported a miscompare. – *address* represents the address where the miscompare occurred. – *actual* represents the actual value at that address. – *expected* represents the expected value for that address.
(PE @ address (C))	Parity error occurred. The address parameter lists the address where the error occurred.

cache/isol - Cache Isolate Test

The cache isolate test isolates data patterns to the cache and then reads and compares them. To run the cache isolate test, type:

t 3/cache/isol *[cache]*

When you type the cache isolate test command, replace *cache* with a value that specifies the cache you want to test.

- Specify I to test the instruction cache.
- Specify D to test the data cache. D is the default setting.

Cache isolate test error messages

Cache isolate test error messages have the form:

`?TFL: 3/cache/isol (code: [address=actual, sb expected])`

- `?TFL 3/cache/isol` indicates that the cache isolate test reported an error.
- `code` represents a number that identifies which portion of the test failed.
- The optional phrase `address= actual, sb expected` indicates the actual and expected values at the address where the error occurred.
  - `address` represents the address where the error occurred.
  - `actual` represents the actual value at that address.
  - `expected` represents the expected value at that address.

Table D-4 lists error codes used in cache isolate test error messages.

Table D-4. Cache Isolate Test Error Codes

Error Code	Description
1	Reading 00000000 pattern resulted in a cache parity error.
2	Reading 00000000 pattern resulted in a cache miss error.
3	Reading 00000000 pattern returned a data miscompare.
4	Reading 55555555 pattern resulted in a cache parity error.
5	Reading 55555555 pattern resulted a cache miss error.
6	Reading 55555555 pattern resulted in a data miscompare.
7	Reading AAAAAAAA pattern resulted in a cache parity error.
8	Reading AAAAAAAA pattern resulted in a cache miss error.
9	Reading AAAAAAAA pattern resulted in a data miscompare.
10	Reading data address pattern resulted in a cache parity error.
11	Reading data address pattern resulted in a parity error.
12	Reading data address pattern returned a miscompare error.

cache/reload - Cache Reload Test

The cache reload test writes rotating-parity data patterns to memory and then reads the patterns. To run the cache reload test, type:

t 3/cache/reload *[cache] [offset]*

When you type the cache reload test command:

- Replace *cache* with a value that specifies the cache you want to test.
  - Specify I to test the instruction cache.
  - Specify D to test the data cache. D is the default value.
- Replace *offset* with a specific cache address where you want the test to start. The default address is 80500000.

Cache reload test error messages

Cache reload test error messages have the form:

`?TFL: 3/cache/reload (description)`

- `?TFL 3/cache/reload` indicates that the cache reload test reported an error.
- `description` represents an additional message that describes the error.

Table D-5 lists descriptions used in cache reload test error messages.

Table D-5. Cache Reload Test Error Descriptions

Error Description	Meaning
(PE)	Unexpected parity error occurred.
(address= actual, sb expected)	Reading a data pattern reported a miscompare. – *address* represents the address where the miscompare occurred. – *actual* represents the actual value at that address. – *expected* represents the expected value for that address.
(PE @ address (C))	Parity error occurred. The address parameter lists the address where the error occurred.

cache/seg - Cache Segment Test

The cache segment test checks individual cache segments. To run the cache segment test, type:

t 3/cache/seg *[cache] [address]*

When you type the cache segment test command:

- Replace the optional *cache* parameter with a value that specifies the cache you want to test.
  - Specify D to test the data cache. D is the default value.
  - Specify I to test the instruction cache.
- Replace *address* with a specific address you want to test. The default address is 80500000. Note that using the optional address parameter correctly requires thorough knowledge of the firmware specifications.

Cache segment test error messages

Cache segment test error messages have the form:

`?TFL: 3/cache/seg (code : description)`

- `?TFL 3/cache/seg` indicates that the cache segment test reported an error.
- `code` represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-6 describes error codes and descriptions used in cache segment test error messages.

Table D-6. Cache Segment Test Error Codes and Descriptions

Error Code Syntax	Description
1: address=xxxxxxxx, sb yyyyyyyy	Error occurred when the system tried to read the cache contents. The address parameter is the actual value at a given address. The correct value follows.
2: address= xxxxxxxx, sb yyyyyyyy	Error occurred when the system tried to read the memory contents. The address parameter is the actual value at a given address. The correct value follows.
3: address =xxxxxxxx, sb yyyyyyyy	Error occurred when the system performed a read and write operation on the uncached memory. The address value is the actual value at a given address. The correct value follows.
4: address =xxxxxxxx, sb yyyyyyyy	Cache data was inconsistent. The address value is the actual value at a given address. The correct value follows.

ecc/cor - ECC Correction Test

The error correction coding (ECC) correction test writes data patterns XOR'd with floating ones to create single bit errors. then checks to see if the error was detected and corrected. To run the ECC correction test, type:

t 3/ecc/cor *[address]*

Replace *address* with a specific address you want to test. The default address is A0010000.

ECC correction test error messages

Cache segment test error messages have the form

`?TFL: 3/ecc/cor (code : description)`

- `?TFL 3/ecc/cor` indicates that the ECC correction test reported an error.
- `code` represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-7 describes error codes and descriptions used in ECC correstion test error messages.

Table D-7. ECC Test Error Codes and Descriptions

Error Code and Description	Meaning
(1: xxxxxxxx rd err) [KN03-AA]	Cannot read and write location with good data.
(2: sbe not det)	Single bit error in the data is not detected.
(3: sbe not cor)	Single bit error in the data is not corrected.

fpu - Floating-Point Unit Test

The floating-point unit (FPU) test uses the FPU to perform simple arithmetic and compares the result to known values. To run the FPU test, type:

t 3/fpu

FPU test error messages

FPU test error messages have the form:

`?TFL: 3/fpu (code)`

- `?TFL 3/fpu` indicates that the FPU test reported an error.
- `code` represents a number that identifies which portion of the test failed.

Table D-8 lists error codes used in FPU test error messages.

Table D-8. FPU Test Error Codes

Error Code	Meaning
1	Values did not match. Value should be 00000000.
2	Values did not match. Value should be 55555555.
3	Values did not match. Value should be AAAAAAAA.
4	Values did not match. Value should be FFFFFFFF.
5	Least-significant bit failed when the system was converting doubleword to word (CVT D.W.)
6	Most-significant bit failed when the system was converting doubleword to word (CVT D.W.)
7	Double miscompare occurred: n+n-n!=n
8	Double miscompare occurred: n+n==n
9	Convert float-double. Value should be 55555555.
10	FPU CSR double error occurred.
11	Single miscompare occurred. n+n-n!=n
12	Single miscompare occurred. n+n==n
13	Convert float-double. Value should be 55555555.
14	FPU CSR single error occurred. Value should be 00000000.
15	Single division failed. Value should be 00005555.
16	Single multiplication failed.
17	Double multiplication failed.
18	Double division failed.
19	Conversion error occurred. Pattern readback did not match.
21	FPU did not trap on overflow exception.
22	Did not get FPU interrupt.

mem - Memory Module Test

The memory module test performs a full pattern test on an entire memory module. To run the memory module test, type:

t 3/mem *[module] [threshold] [pattern] [bank]*

When you type the memory module test command:

- Include the *module* parameter to specify which memory module you want to test.
  - To test one memory module pair, specify the slot number of the memory module pair that you want to test. The default memory module slot number is 0.
  - To test all memory modules, specify an asterisk (*).
- Replace the optional *threshold* parameter with the number of single-bit errors the test allows before the test fails. The default threshold is 10.
- Replace the optional pattern parameter with a specific pattern that you want to use in the test. The default pattern is 55555555.

Memory module test error messages

Set the verbose environment variable to 1 to see compare error messages in the following form:

`?TFL:3/mem @ address=actual, expected`

- `?TFL 3/mem @` indicates that the memory test reported a compare error.
- The `address` parameter is the address at which the error occurred.
- `actual` represents the value at that address.
- `expected` represents the expected value at that address.

If the verbose environment variable is not set, the error messages appear in the following formats:

```
?TFL:3/mem  (1: board, L, MBE=M, SBE=N)
```

```
?TFL:3/mem  (2: board, L, too many SBEs :N)
```

where L represents the slot number of the failed memory module, M represents the number of multibit errors that occurred, and N represents the number of single-bit errors that occurred.

mem/float10 - Floating 1/0 Memory Test

The floating 1/0 memory test writes floating 1 and floating 0 across one location in RAM. To run the floating 1/0 memory test, type:

t 3/mem/float10 *[address] [bank]*

Replace the optional *address* parameter with a specific address at which you want to start writing 1s. The default address is A0100000.

Floating 1/0 memory test error messages

If a RAM module is tested, the only floating 1/0 memory test error message is:

```
?TFL: 3/mem/float10 (Err= N)
```

Where N represents the number of errors the memory module reported.

If an NVRAM module is tested and the module contains valid data, the floating 1/0 memory test error messages is:

```
?TFL: (1: (tst nocomp))
```

mem/init - Zero Memory Utility

The zero memory utility floods memory with zeros as fast as possible. To run the zero memory test, type:

t 3/mem/init

The zero memory utility returns no error codes.

mem/select - RAM Select Lines Test

The RAM select lines test checks for RAM select line faults by performing a read and write operation on one location in each memory module. To run the RAM select lines test, type:

t 3/mem/select

RAM select lines test error messages

The only RAM select test error message is:

`?TFL: 3/mem/select (address=actual, sb expected)`

- `?TFL: 3/mem/select` indicates that the RAM select lines test reported an error.
- `address` represents the memory address where the error occurred.
- `actual` represents the actual value at the listed address.
- `expected` represents what the correct value at the listed address should be.

misc/cpu-type - CPU-Type Utility

The CPU-type utility displays a message that identifies the CPU type. To run the CPU-type utility, type:

t 3/misc/cpu-type

CPU-type utility messages

The CPU-type utility has the form:

`3/misc/cpu-type's code NDX-type`

Where type represents a code that indicates the type of CPU module in the system. For example, the code `NDX-129A` identifies the KN03-GA module (40 Mhz). The code `NDX-111A` identifies the KN05 module (50 Mhz).

misc/halt - Halt Button Test

The halt button test checks whether the halt button is connected and can generate an interrupt. To run the halt button test, type:

t 3/misc/halt [number]

When you type the halt button command, replace number with the number that specifies the type of test you want to run.

- Specify 0 to check whether the halt button is pressed. If you specify 0 and the button is pressed when the test runs, the test reports an error. 0 is the default value.
- Specify a number from 1 to 9 to check whether the button responds when pressed. Press the button the same number of times as the number you specify in the test command.

Halt button test error messages

There are two halt button test error messages.

- `?TFL: 3/misc/halt (1:SIR=xxxxxxxx)` indicates that the halt button is pressed in. `xxxxxxxx` represents the value in the system interrupt register.
- `?TFL: 3/misc/halt (2: invld bits: SIR=xxxxxxxx)` indicates that the system interrupt register contains an impossible combination of halt-button bits. `xxxxxxxx` represents the value found in the system interrupt register.

misc/kbd - Keyboard Test

The keyboard test looks for the presence of a keyboard on the keyboard/mouse port. The keyboard test is not a loopback test, although the test will pass if an external loop-back is plugged into the keyboard/mouse connector.

To run the mouse test, type:

t 3/misc/mouse

Keyboard test error messages

If the keyboard test fails during the automatic power-up self-test sequence, the following messages is displayed:

`?STF (4: Ln#0 Kbd self test)`

When you enter the keyboard test at the console prompt, the test fails if the proper values are not returned or an external loopback connector is not attached.

Note that the `missing kbd, mouse or loopback ?` error message does not necessarily indicate a missing device, although that is the most common reason for that message to appear. It could also indicate a faulty keyboard device or even a system board malfunction.

Keyboard test error messages have the form:

`?TFL: 3/misc/kbd (code)`

- `?TFL 3/misc/kbd` indicates that the keyboard test reported an error.
- code represents a number that identifies which portion of the test failed.

Table D-9 lists error codes used in keyboard test error messages.

Table D-9. Keyboard Test Error Codes

Error Code	Meaning
1:tx bfr not empty. status=0X%2X	Unable to write single character due to non-empty transmit buffer.
2:missing kbd, mouse or loopback?	Something is missing or broken in the keyboard or mouse path.
3:failed selftest: XX XX	Invalid character returned by device after receiving the test command.

misc/mouse - Mouse Test

The mouse test checks for the presence of a mouse on the keyboard/mouse port. The mouse test is not a loopback test, although the test will pass if an external loop-back is plugged into the keyboard/mouse connector.

To run the mouse test, type:

t 3/misc/mouse

Mouse test error messages

If the mouse test fails during the automatic power-up self-test sequence, the following error message is displayed:

`?STF (4: Ln#0 Pntr self test)`

When you enter the mouse test at the console prompt, the test fails if the proper values are not returned or an external loopback connector is not attached. Note that the `missing kbd, mouse or loopback ?` error message does not necessarily indicate a missing device, although that is the most common reason for that message to appear. It could also indicate a faulty keyboard/mouse device or even a system board malfunction.

Mouse test error messages have the form:

`?TFL: 3/misc/mouse (code)`

- `?TFL 3/misc/mouse` indicates that the mouse test reported an error.
- `code` represents a number that identifies which portion of the test failed.

Table D-10 lists error codes used in mouse test error messages.

Table D-10. Mouse Test Error Codes

Error Code	Meaning
1:tx bfr not empty. status=0X%2X	Unable to write single character due to non-empty transmit buffer.
2:missing kbd, mouse or loopback?	Something is missing or broken in the keyboard or mouse path.
3:failed selftest: XX XX	Invalid character returned by device after receipt of test command.

misc/pstemp - Overheat Detect Test

The overheat detect test, checks whether the power supply is overheating. To run the overheat detect test, type:

t 3/misc/pstemp

Overheat detect test error message

When the overheat detect test fails, the following error message is displayed:

`?TFL: 3/misc/pstemp (system is *HOT*)`

This message indicates that the system is overheating.

misc/wbpart - Partial Write Test

The partial write test writes to a specific memory address and then checks whether the written values are correct. To run the partial write test, type:

t 3/misc/wbpart

Partial write test error messages

Partial write test error messages have the form:

`?TFL: 3/misc/wbpart (code)`

- `?TFL 3/misc/wbpart` indicates that the partial write test reported an error.
- code represents a number that identifies which portion of the test failed.

Table D-11 lists error codes used in partial write test error messages.

Table D-11. Partial Write Test Error Codes

Error Code	Meaning
1	Pattern that was read showed mismatch on word access.
2	Byte 0 failed partial byte write.
3	Byte 1 failed partial byte write.
4	Byte 2 failed partial byte write.
5	Byte 3 failed partial byte write.
6	Halfword 0 failed partial halfword write.
7	Halfword 1 failed partial halfword write.

ni/cllsn - Collision Test

The collision test checks Ethernet collision detect circuitry by forcing a collision on transmission. To run the collision test, type:

t 3/ni/cllsn

Collision test error messages

Collision test error messages have the form:

`?TFL: 3/ni/cllsn (code: description)`

- `?TFL: 3/ni/cllsn` indicates that the collision test reported a problem.
- `code` represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-12 lists error codes and descriptions used in collision test error messages.

Table D-12. Collision Test Error Codes and Descriptions

Error Code Syntax	Description
3: cllsn not dtctd	Ethernet controller chip failed to detect an Ethernet collision.
4: xmt [x]	Ethernet controller chip transmission failed.
6: LANCE-init [x]	Ethernet controller chip failed to initialize.

ni/common - Common Diagnostic Utilities

The common diagnostic utilities are run by Ethernet controller tests. You cannot run these diagnostic utilities by themselves.

Common diagnostic utility error messages

Common diagnostic utility error messages have the form:

`?TFL: 3/ni/test_name (code: description)`

- `?TFL: 3/ni` indicates a common diagnostic utility detected an error.
- `test_name` represents the name of the test in which the diagnostic utility detected an error.
- `code` represents a number that identifies which utility generated the error message.
- `description` represents additional information that describes the error.

Table D-13 lists error codes and descriptions used in common diagnostic utility error messages.

Table D-13. Common Diagnostic Utility Error Codes and Descriptions

Error Code and Description	Meaning
700: Invld param frmt [xxxxx]	Parameter was not in a valid format. The xxxxx value represents the parameter that had an invalid format.
901: err hltng LANCE	STOP bit did not halt the Ethernet controller chip.
902: LANCE-init timeout	Timeout occurred when the system tried to initialize the Ethernet controller chip.
903: LANCE-start timeout	Timeout occurred waiting for the Ethernet controller chip to start.
904: err initing LANCE	Utility could not initialize the Ethernet controller chip.
905: LANCE-stop timeout	Timeout occurred in the Ethernet controller chip.
906: err initing LANCE	I/O system failure occurred during Ethernet controller chip initialization.

ni/crc - Cyclic Redundancy Code Test

The cyclic redundancy code (CRC) test checks the Ethernet CRC verification and bad CRC detection abilities. To run the CRC test, type:

t 3/ni/crc

CRC test error messages

CRC test error messages have the form:

`?TFL: 3/ni/crc (code: description)`

- `?TFL: 3/ni/crc` indicates that the CRC test reported a problem.
- code represents a number that identifies which portion of the test failed.
- `xdescription` represents additional information that describes the failure.

Table D-14 lists error codes and descriptions used in CRC test error messages.

Table D-14. CRC Test Error Codes and Descriptions

Error Code and Description	Meaning
2: LANCE-init [x]	System could not initialize the Ethernet controller chip. The x represents a pass or fail code returned by one of the utilities that the test uses.
3: xmt [x]	Error occurred during packet transmission. The x represents a pass or fail code returned by one of the utilities that the test uses.
5: fls CRC err	Ethernet chip incorrectly flagged a good CRC as bad.
6: rcv [x]	Error occurred receiving a packet. The x represents a pass or fail code returned by one of the utilities that the test uses.
7: LANCE-init [x]	Error occurred when the test attempted to initialize the Ethernet controller chip. The x represents a pass or fail code returned by one of the utilities that the test uses.
8: xmt [x]	Error occurred transmitting data packet. The x represents a pass or fail code returned by one of the utilities that the test uses.
10: bad CRC not dtctd	Ethernet chip did not detect a bad CRC in an incoming packet.
11: rcv [x]	Error occurred in packet receive operation. The x represents a pass or fail code returned by one of the utilities that the test uses.

ni/ctrs - Display MOP Counters Utility

The display MOP counters utility displays the current MOP counters for the base system Ethernet controller. To run the MOP counters utility, type:

t 3/ni/ctrs

The display MOP counters utility produces no error messages.

ni/dma1 - Ethernet-Direct Memory Access Registers Test

The Ethernet-direct memory access (DMA) registers test checks the Ethernet-DMA control and error registers. The test then checks the ability of the system to detect a DMA error. To run the Ethernet-DMA registers test, type:

t 3/ni/dma1

Ethernet-DMA registers test error messages

Ethernet-DMA registers test error messages have the form:

`?TFL: 3/ni/dma1 (code: description)`

- `?TFL: 3/ni/dma1` indicates that the Ethernet-DMA registers test reported a problem.
- code represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-15 lists error codes and descriptions used in Ethernet-DMA registers test error messages.

Table D-15. Ethernet-DMA Registers Test Error Codes and Descriptions

Error Code and Description	Meaning
1: LDP wrt/rd [w=xxxxxxxx r=yyyyyyyy]	LDP register values matched when they should not. The w parameter is the value that was written to the LDP register. The r parameter is the value that was read from the LDP register.
LIOS wrt/rd [w=xxxxxxxx r=yyyyyyyy]	LANCE I/O slot register values matched when they should not. The w parameter is the value that was written to the LANCE I/O Slot register. The r parameter is the value that was read from the LANCE I/O Slot register.
3: LANCE select	LANCE I/O Slot register failed to select the LANCE.
4: LANCE deselect	LANCE I/O Slot register failed to deselect the LANCE.
5: err initing LANCE	Ethernet controller chip initialization failed.
6: LANCE-init timeout	Timeout occurred waiting for the LANCE initialization to finish.
7: MER	Page boundary error was not recorded in the MER register.
8: SIR	LANCE memory error bit was not set in the SIR register.
9:LANCE-start timeout	Timeout occurred waiting for LANCE to start.

ni/dma2 - Ethernet-Direct Memory Access Transfer Test

The Ethernet-direct memory access (DMA) transfer test checks Ethernet DMA operation. To run the Ethernet-DMA transfer test, type:

t 3/ni/dma2

Ethernet-DMA transfer test error messages

Ethernet-DMA transfer test error messages have the form:

`?TFL: 3/ni/dma2 (code: description)`

- `?TFL: 3/ni/dma2` indicates that the Ethernet-DMA transfer test reported a problem.
- code represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-16 lists error codes and descriptions used in Ethernet -DMA transfer test error messages.

Table D-16. Ethernet-DMA Registers Test Error Codes and Descriptions

Error Code and Description	Meaning
2: LANCE-init [xxxxxxxx]	Ethernet controller chip initialization failed. xxxxxxxx represents a code that describes the LANCE failure.
3: xmt [xxxxxxxx] sz=yyyy ptrn=AA	Ethernet controller chip transmission failed. xxxxxxxx represents a code that describes the transmission failure. The sz parameter is the packet size. The ptrn parameter is the pattern the test tried to transmit.
4: rcv [xxxxxxxx] sz=yyyy ptrn=AA	Ethernet controller chip receive operation failed. xxxxxxxx represents a code that describes the receive failure. The sz parameter is the packet size. The ptrn parameter is the pattern the test tried to receive.
8: LANCE-DMA	DMA error occurred after a packet was received.
9: LANCE-DMA	DMA error occurred when the test began.
10: LANCE-DMA	DMA error occurred after a packet was transmitted.

ni/esar - Ethernet Station Address ROM Test

The Ethernet station address ROM (ESAR) test checks the ESAR on the Ethernet controller. To run the ESAR test, type:

t 3/ni/esar

ESAR test error messages

ESAR test error messages have the form

`?TFL: 3/ni/esar (code: description)`

- `?TFL: 3/ni/esar` indicates that the ESAR test reported a problem.
- `code` represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-17 lists error codes and descriptions used in ESAR test error messages.

Table D-17. ESAR Test Error Codes and Descriptions

Error Code and Description	Meaning
2: ESAR[0-5] = 0's	First 6 bytes of the ESAR were 000000.
3: ESAR[0] = brdcst-sdrs	ESAR contained broadcast address.
5: checksum	ESAR checksum verification failed.
7: rvrs cpy !=	Reverse copy mismatch occurred.
8: frwrd cpy !=	Forward copy mismatch occurred.
9: ESAR[24-28] !=FF	Test pattern FF mismatch occurred.
10: ESAR[25-29] !=00	Test pattern 00 mismatch occurred.
11: ESAR[26-30] =55	Test pattern 55 mismatch occurred.
12: ESAR[27-31] !=AA	Test pattern AA mismatch occurred.

ni/ext-lb - External Loopback Test

The external loopback test checks the Ethernet controller and its connection to the network.

Before you run the external loopback test on the base system Ethernet controller, first install a ThickWire loopback connector on the Ethernet controller. To run the external loopback test, type:

t 3/ni/ext-lb

External loopback test error messages

External loopback test error messages have the form:

`?TFL: 3/ni/ext-lb (code: description)`

- `?TFL: 3/ni/ext-lb` indicates that the external loopback test reported a problem.
- `code` represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-18 lists error codes and descriptions used in external loopback test error messages.

Table D-18. External Loopback Test Error Codes and Descriptions

Error Code and Description	Meaning
1: (LANCE-init [xxxxxxxx])	LANCE initialization failed. xxxxxxxx represents a code that describes the LANCE failure.
3: (xmit [xxxxxxxx, yyyyyyyy] zzzzz)	LANCE initialization failed. xxxxxxxx, yyyyyyyy represents a code that describes the LANCE failure. zzzzz represents a code that describes the likely cause of the failure.
4: rcv [xxxxxxxx, yyyyyyyy]	System did not receive packet. xxxxxxxx, yyyyyyyy represents a code that describes the receive failure.
6: pkt-data !=	Transmitted packet was not received.
7	Fatal error occurred.

ni/int - Interrupt Request Test

The interrupt request (IRQ) test checks whether the Ethernet controller can generate an interrupt to the R3000A chip. To run the IRQ test, type:

t 3/ni/int

IRQ test error messages

IRQ test error messages have the form:

`?TFL: 3/ni/int (code: description)`

- `?TFL: 3/ni/int` indicates that the IRQ test reported a problem.
- code represents a number that identifies the type of failure that occurred.
- `description` represents additional information that describes the failure.

Table D-19 lists error codes and descriptions used in IRQ test error messages.

Table D-19. IRQ Test Error Codes and Descriptions

Error Code Syntax	Description
1: int pndng	Pending interrupt was invalid.
2: init LANCE err = x	Error occurred when the system tried to initialize the Ethernet controller chip.
4: intr err xmt-stat=x	System generated no interrupt on packet transmission.

ni/int-lb - Internal Loopback Test

The internal loopback test sends and receives data packets to and from Ethernet in internal loopback mode. To run the internal loopback test, type:

t 3/ni/int-lb

Internal loopback test error messages

Internal loopback test error messages have the form:

`?TFL: 3/ni/int-lb (code: description)`

- `?TFL: 3/ni/int-lb` indicates that the internal loopback test reported a problem.
- `code` represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-20 lists the error codes and error descriptions used in internal loopback test error messages.

Table D-20. Internal Loopback Test Error Codes and Descriptions

Error Code Syntax	Description
1: rd ESAR err	The system could not access the Ethernet station address ROM.
2: LANCE-init [xxxxxxxx]	Error occurred initializing the Ethernet controller chip. xxxxxxxx represents a code that describes the transmission failure.
3: xmt [xxxxxxxx] sz=yyyy ptrn=zz	System did not transmit packet. xxxxxxxx represents a code that describes the transmission failure. The sz parameter is the size of the packet. The ptrn parameter is the pattern that was in the packet.
4: rcv [xxxxxxxx] sz=yyyy ptrn=zz	System did not receive packet. xxxxxxxx represents a code that describes the failure. The sz parameter is the size of the packet. The ptrn parameter is the pattern that was in the packet.
5: rcvd size=x, xptd=x	Packets received and packets sent had different sizes.
6: pkt-data !=	Data received and data sent did not match.
7:	Received CRC was incorrect.

ni/m-cst - Multicast Test

The multicast test checks the Ethernet ability to filter multicast packets. To run the multicast test, type:

t 3/ni/m-cst

Multicast test error messages

Multicast test error messages have the form:

`?TFL: 3/ni/m-cst (code: description)`

- `?TFL: 3/ni/m-cst` indicates that the multicast test reported a problem.
- `code` represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-21 lists the error codes and descriptions used in multicast test error messages.

Table D-21. Multicast Test Error Codes and Descriptions

Error Code Syntax	Description
1: rd ESAR err	Error occurred reading Ethernet station address ROM.
2: LANCE-init [xxxxxxxx]	System failed to initialize the Ethernet controller chip. xxxxxxxx represents a code that describes the initialization failure.
3: xmt [xxxxxxxx]	Ethernet controller failed to send packet. xxxxxxxx represents a code that describes the transmission failure.
5: rcvd invld m-cst	Ethernet controller received a multicast packet when multicast function was disabled.
6: rcv [xxxxxxxx]	Packet receive routine reported an error. xxxxxxxx represents a code that describes the receive error.
7: LANCE-init [xxxxxxxx]	Error occurred when the system tried to initialize the Ethernet chip. xxxxxxxx represents a code that describes the initialization error.
8: xmt [xxxxxxxx]	Ethernet controller failed to transmit packet. xxxxxxxx represents a code that describes the transmission error.
9: rcv [xxxxxxxx]	Ethernet did not receive expected packet. xxxxxxxx represents a code that describes the receive error.

ni/promisc - Promiscuous Mode Test

The promiscuous mode test checks that the Ethernet controller can receive packets in promiscuous mode. To run the promiscuous mode test, type:

t 3/ni/promisc

Promiscuous mode test error messages

Promiscuous mode test error messages have the form:

`?TFL: 3/ni/promisc (code: description)`

- `?TFL: 3/ni/promisc` indicates that the promiscuous mode test reported a problem.
- code represents a number that identifies the type of failure that occurred.
- `description` represents additional information that describes the failure.

Table D-22 lists error codes and descriptions used in promiscuous mode test error messages.

Table D-22. Promiscuous Mode Test Error Codes and Descriptions

Error Code Syntax	Description
2: LANCE-init [xxxxxxxx]	Ethernet controller initialization failed. xxxxxxxx represents a code that describes the initialization failure.
3: xmt [xxxxxxxx]	Packet transmission failed. xxxxxxxx represents a code that describes the transmission failure.
5: rcvd invld adrs	An inappropriate packet was received in nonpromiscuous mode.
6: rcv [xxxxxxxx]	Packet receive routine failed.
7: LANCE-init [xxxxxxxx]	System failed to initialize Ethernet controller in promiscuous mode. xxxxxxxx represents a code that describes the initialization failure.
8: xmt [xxxxxxxx]	Packet transmission failed. xxxxxxxx represents a code that describes the transmission failure.
9: rcv [xxxxxxxx]	Ethernet did not receive the expected packet while in promiscuous mode. xxxxxxxx represents a code that describes the receive failure.

ni/regs - Registers Test

The registers test performs a read and write operation on the Ethernet registers. To run the registers test, type:

t 3/ni/regs

Registers test error messages

Registers test error messages have the form:

`?TFL: 3/ni/regs (code: description)`

- `?TFL: 3/ni/regs` indicates that the registers test reported a problem.
- `code` represents some number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.
  - The `CSR[n]` parameter, where n represents the number of a specific CSR register, indicates the actual value in the CSR register.
  - The `xpctd` parameter indicates the expected value for the same CSR register.

Table D-23 lists error codes and descriptions used in registers test error messages.

Table D-23. Registers Test Error Codes and Descriptions

Error Code Syntax	Description
1: CSR[n]=x - xpctd 0	Write and read operation to Ethernet CSR[n] failed. The n represents the number of the CSR involved in the failure.
3: CSR[1]=xxxx - xpctd 0xFFFE	Writing and reading 0xFFFE failed on CSR 1. xxxx represents the actual value in CSR 1.
4: CSR[2]=xxxx - xpctd 00FF	Writing and reading 0x00FF failed on CSR 2. xxxx represents the actual value in CSR 2.
5: CSR[1]=xxxx - bit lk frm CSR[2]	Bit leak from CSR2 to CSR1 occurred. xxxx represents the actual value in CSR[1].
6: CSR[2]= xxxx - bit lk frm CSR[1]	Bit leak from CSR1 to CSR2 occurred. xxxx represents the actual value in CSR[2].
7: Immediate write/read flr	Immediate write and read failure occurred.

prcache - Prcache Quick Test

The prcache quick test of NVRAM on power-up tests the scratch area of the optional NVRAM module. The diagnostic status bit in the diagnostic register on the NVRAM module is set on failure. The optional NVRAM module can be installed in memory slot 14, and is different form the system module NVR that is tested by the rtc/nvr test. To run the prcache quick test, type:

t 3/prcache

For a thorough test, first zero the NVRAM memory, then type:

t 3/prcache/clear

Then run the memory test by typing:

t 3/mem 14

Prcache quick test error messages

Prcache quick test error messages have the form:

`?TFL: 3/prcache (code: description)`

- `?TFL: 3/prcache` indicates that the prcache quick test reported a problem.
- code represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-24 lists error codes and descriptions used in registers test error messages.

Table D-24. Prcache Quick Test Error Codes and Descriptions

Error Code Syntax	Description
1: board 14: MBE = X SBE = Y	X multiple bit errors and Y single bit errors occurred on the NVRAM board in slot 14.
2: board 14, too many SBEs: X	Too many single bit errors. X single bit errors occurred on the NVRAM board in slot 14.

prcache/arm - Disconnect Battery

The prcache/arm command turns off the battery on the presto-nvram module. To run the prcache/arm command, type:

t 3/prcache/arm *[board]*

When you type the prcache/arm command, replace the optional *board* parameter with the slot number of the NVRAM module. Because the DECstation 5000 Model 240 must have the NVRAM module installed in slot 14, the default value is set at 14.

Prcache/arm command error message

If the prcache/arm command does not complete successfully, it returns the following error message:

```
?TFL: 3/prcache/arm (1:(tst nocomp))
```

prcache/clear - Zero NVRAM Memory

The prcache/clear command quickly writes zeros to all NVRAM memory addresses. To run the prcache/clear command, type:

t 3/prcache/clear *[board]*

When you type the prcache/clear command, replace the optional *board* parameter with the slot number of the NVRAM module. Because the DECstation 5000 Model 240 must have the NVRAM module installed in slot 14, the default value is set at 14.

If the prcache contains valid data, the system responds with the following prompt:

```
prcache valid data - wrt ? (1/0)
```

Type **1** to clear the cache. Type **0** to cancel the prcache/clear command.

Prcache clear error message

If the prcache/clear command does not complete successfully, it returns the following error message:

```
?TFL: 3/prcache/clear (1:(tst nocomp))
```

prcache/unarm - Connect battery

The prcache/unarm command turns on the battery on the presto-nvram module. To run the prcache/unarm command, type:

t 3/prcache/unarm *[board]*

When you type the prcache/arm command, replace the optional *board* parameter with the slot number of the NVRAM module. Because the DECstation 5000 Model 240 must have the NVRAM module installed in slot 14, the default value is set at 14.

Prcache/unarm command error message

The prcache/unarm command does not return an error message.

rtc/nvr - Nonvolatile RAM Test

The nonvolatile RAM (NVR) test checks the system module nonvolatile RAM. The system module NVR is not the same as the NVRAM cache module. To run the NVR test, type:

t 3/rtc/nvr *[pattern]*

When you type the NVR test command, replace the optional *pattern* parameter with a specific pattern that you want to use in the test. The default pattern is 55.

NVR test error messages

NVR test error messages have the form

`?TFL: 3/rtc/nvr (code: address=actual, sb expected)`

- `?TFL 3/rtc/nvr` indicates that the NVR test read an incorrect pattern from the NVR.
- code represents a number that identifies which portion of the test failed.
- `address` represents the address at which the error occurred.
- `actual` represents the value at that address.
- `expected` represents the expected value at that address.

rtc/period - Real-Time Clock Period Test

The real-time clock (RTC) period test checks the RTC periodic interrupt operation. To run the RTC period test, type:

t 3/rtc/period

RTC period test error messages

RTC period test error messages have the form:

`?TFL: 3/rtc/period/(code)`

- `?TFL 3/rtc/period` indicates that the RTC period test reported an error.
- `code` represents a number that identifies which portion of the test failed.

Table D-25 lists error codes used in RTC period test error messages.

Table D-25. RTC Period Test Error Codes

Error Code	Meaning
1	Update-in-progress (UIP) bit remained set past allotted time.
2	Real-time clock interrupt was pending when it should not have been.
3	Allowed time ran out while waiting for interrupt.

rtc/regs - Real-Time Clock Registers Test

The real-time clock registers test checks the real-time clock (RTC) registers. To run the real-time clock registers test, type:

t 3/rtc/regs

Real-time clock registers test error messages

Real-time clock register test error messages have the form:

`?TFL: 3/rtc/regs (code: description)`

- `?TFL 3/rtc/regs` indicates that the real-time clock register test reported an error.
- `code` represents a number that identifies which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-26 lists error codes and descriptions used in real-time clock register test error messages.

Table D-26. Real-Time Clock Register Test Error Codes

Error Code:Description	Meaning
1	UIP bit remained set past allotted time.
2 register=*actual*, sb *expected*	The test failed to write pattern correctly. The register value is the actual value in the named register, followed by the expected value.

rtc/time - Real-Time Test

The real-time test checks times generated by the real-time clock against hard-coded time values. To run the real-time test, type:

t 3/rtc/time

Real-time test error messages

Real-time test error messages have the form:

`?TFL: 3/rtc/time (code)`

- `?TFL 3/rtc/time` indicates that the real time test reported an error.
- `code` represents a number that identifies which portion of the test failed.

Table D-27 lists error codes used in real-time test error messages.

Table D-27. Real-Time Test Error Codes

Error Code	Meaning
1	UIP bit remained set past allotted time.
2	Real-time clock interrupt was pending when it should not have been.
3	Allowed time ran out while waiting for interrupt.
4	Allowed time ran out while waiting for second interrupt.
5	UIP bit remained set past second allotted time.
6	Real-time clock seconds were not set to 0 on wraparound.
7	Real-time clock minutes were not set to 0.
8	Real-time clock hours were not set to 0.
9	Real-time clock day-of-the-week was not set to 1.
10	Real-time clock date was not set to 1.
12	Real-time clock month was not set to 1.
13	Real-time clock year was not set to 0.

scache/data - Secondary Cache Test

This test run patterns through secondary cache RAM. To run the scache data test, type

t 3/scache/data

and press Return.

The secondary cache is implemented on the daughter-card as 11 16-bit wide static RAMs. This 176 (11 times 16) wire Scache interface is divided-up as follows:

- 25 Tag wires
- 07 Tag ECC wires
- 128 Data wires
- 16 Data ECC wires

Scache Error

Any error reported by the scache/data test indicate a fault in the secondary cache RAMs or in the interconnect between the R4000 and the secondary cache. Errors reported by this diagnostic could also be due to errors in reading or writing the memory; in-order to eliminate this possibility, first run the memory diagnostics.

scc/access - Serial Communication Chip Access Test

The serial communication chip (SCC) access test checks whether the system can perform a read and write operation on the SCC. To run the SCC access test, type:

t 3/scc/access

SCC access test error messages

The only SCC access test error message is:

`?TFL: 3/scc/access (1:LnM reg-N: actual=0xXX xpctd=0xYY)`

- `?TFL: 3/scc/access` indicates that the read and write operation on the SCC failed.
- `M` represents the number of the serial line in which the error occurred.
- `N` represents the number of the register that failed the test.
- The `actual` value is the value in that register.
- The `xpctd` value is the expected value for that register.

scc/dma - Serial Communication Chip Direct Memory Access Test

The serial communication chip (SCC) direct memory access (DMA) test checks the ability of the serial communication and IO-ASIC chips to perform a DMA operation. To run the SCC DMA test, type:

t 3/scc/dma *[line] [loopback] [baud]*

- Replace the optional `line` parameter with a value that specifies which line to test.
  - Specify 2 to test serial line number 2. 2 is the default value.
  - Specify 3 to test serial line number 3.

- Replace the optional `loopback` parameter with a value that specifies the type of loopback the test performs.
  - Specify intl to run an internal loopback. Intl is the default type of loopback that the test performs.
  - Specify extl to run an external loopback.
- Replace baud with the baud rate at which you want the test to run. You can specify one of the following baud rates:

  300
  1200
  2400
  4800
  9600
  19200
  38400

  The default baud rate is 38400.

SCC DMA test error messages

SCC DMA test error message have the form:

`?TFL: 3/scc/dma code:LnN SIR_xptd=xxxxxxxx SIR=yyyyyyyy SSR=zzzzzzzz`

- `?TFL: 3/scc/dma` indicates that the SCC DMA test reported an error.
- `code` represents a number that identifies which part of the test failed.
- `N` represents the number of the serial line that reported the error.
- The `SIR_xpted` value is the expected value for the system interrupt register.
- The `SIR` value is the actual value in the system interrupt register.
- The `SSR` value is the value in the system status register.

Table D-28 discusses the codes used in SCC DMA test error messages.

Table D-28. SCC DMA Test Error Codes

Error Code	Meaning
1	SIR values are invalid.
2	Miscompare occurred during DMA read and write operation.
3	Overrun occurred in the receive buffer.
4	Interrupt signal was not sent to the system.

scc/int - Serial Communication Chip Interrupts Test

The serial communication chip (SCC) interrupts test checks the ability of the SCC to perform internal, external, and countdown interrupts. To run the SCC interrupts test, type:

t 3/scc/int

SCC interrupts test error messages

SCC interrupts test error messages have the form:

`?TFL: 3/scc/int (code: lnN RR0=xx RR3=yy SIR=zzzzzzzz)`

- `?TFL: 3/scc/int` indicates that the SCC interrupts test reported an error.
- code represents a number that indicates which portion of the test reported the error.
  - If the number is an odd number, the bits to set the interrupt on were invalid.
  - If the number is an even number, the bits to set the interrupt off were invalid.
- `N` represents the number of the serial line in which the error occurred.
- The `RR0` value is the contents of the SCC read register 0.
- The `RR3` value is the contents of the SCC read register 3.
- The `SIR` value is the contents of the system interrupt register.

scc/io - Serial Communication Chip I/O Test

The serial communication chip (SCC) I/O test checks the ability of the SCC to perform an I/O operation on a serial line. To run the SCC I/O test, type:

t 3/scc/io *[line] [loopback]*

When you type the SCC I/O test command:

- Replace the optional `line` parameter with a value that specifies which line to test.
  - Specify 0 to test serial line 0. 0 is the default serial line.
  - Specify 1 to test serial line 1.
  - Specify 2 to test serial line 2.
  - Specify 3 to test serial line 3.
- Replace the optional `loopback` parameter with a value that specifies the type of loopback operation the test performs.
  - Specify intl to run an internal loopback operation. Intl is the default type of loopback that the test performs.
  - Specify extl to run an external loopback operation.

SCC I/O test error messages

SCC I/O test error messages have the form:

`?TFL: 3/scc/io (code: LnN description)`

- `?TFL: 3/scc/io` indicates that the SCC I/O test reported an error.
- `code` represents a number that identifies which portion of the test failed.
- `N` represents the number of the line in which the error occurred.
- `description` represents additional information that describes the error.

Table D-29 lists error codes and descriptions used in SCC I/O test error messages.

Table D-29. SCC I/O Test Error Codes and Descriptions

Error Code Syntax	Description
1: LnN tx bfr not empty. status=xx	System could not write a single character because the transmit buffer was not empty. N represents the line in which the error occurred. The status value is the contents of read register 0.
2: LnN char not rcvd. status=x	CHAR AVAIL signal not received when the system was expecting a character. N represents the line in which the error occurred. The status value is the contents of read register 0.
3: LnN expctd=xx, rcvd=yy, status=zz	The character that was received was different than the transmitted character. N represents the line in which the error occurred. The xx represents the transmitted value. The yy represents the received value. The status value is the contents of read register 0.

scc/pins - Serial Communication Chip Pins Test

The serial communication chip (SCC) pins test checks the control pins on the communications connectors. To run the SCC pins test, type:

t 3/scc/pins *[line] [attachment]*

- Replace the optional `line` parameter with a value that specifies the communications connector that you want to test.
  - Specify 2 to test the communications connector on the right as you face the back of the system unit.
  - Specify 3 to test the communications connector on the left as you face the back of the system unit.
- Replace the optional `attachment` parameter with a value that specifies the loopback hardware that you attach to the communications connector being tested.
  - Specify 29-24795 if you attach a 29-24795 loopback connector. 29-24795 is the default type of loopback connector.
  - Specify H8571 if you attach an H8571 loopback connector.
  - Specify hm if you attach an hm loopback connector.
  - Specify H3200 if you attach an H3200 loopback connector.

Table D-30 lists the specific pin pairs that each loopback test checks.

Table D-30. Pin Pairs Tested by Individual Loopback Connectors

Loopback Connector	Pins Pairs Tested	Description
29-24795	4-5	RTS to CTS
	23-6-8	SS to DSR and CD
		6-23 failure implies 6 broken.
		8-23 failure implies 8 broken.
		6-23 8-23 failure implies 23 broken.
H3200	4-5	RTS to CTS
	6-20	DSR to DTR
	12-23	SI to SS
H8571-A	4-5	RTS to CTS
	20-6-8	DTR to DSR and CD
		6-20 failure implies 6 broken.
		8-20 failure implies 8 broken.
		6-20 8-20 failure implies 20 broken.
hm	4-5	RTS to CTS

SCC pins test error messages

SCC pins test error message have the form:

`?TFL: 3/scc/pins (code: LnN: description)`

- `?TFL: 3/scc/pins` indicates that the SCC pins test reported an error.
- `N` represents the number of the serial line in which the error occurred.
- `description` represents additional information that describes the error.

Table D-31 lists error codes and descriptions used in SCC pins test error messages.

Table D-31. SCC Pins Test Error Codes and Descriptions

Error Code and Syntax	Description
1:Ln*N* Invld param *[xxxxx]*	The number used in the test command to specify the loopback was invalid. *N* represents the number of the serial line in which the error occurred. *xxxxx* represents the first two characters of the invalid value that was specified.
2:Ln*N* Startup R-*xx* xptd=*yy* actl= *zz* | pins |	Test failed to generate the expected SCC status bits. *N* represents the number of the serial line in which the error occurred. The Strtup R value is the number of SCC register that contains the status bits. The xptd value is the expected status bits. The actl value is the actual status bits. Pins represents the pin pairs for which the test was set up.
3: Ln*N* *xxxxx*	Pins failed to respond properly. *xxxxx* represents the numbers of one or more pin pairs that failed the test.

scc/tx-rx - Serial Communication Chip Transmit and Receive Test

The serial communication chip (SCC) transmit and receive test checks the ability of the SCC to transmit and receive information. To run the SCC transmit and receive test, type:

t 3/scc/tx-rx *[line] [loopback] [baud] [parity] [bits]*

- Replace the optional `line` parameter with a value that specifies which serial line to test.
  - Specify 0 to test serial line 0, the default serial line.
  - Specify 1 to test serial line 1.
  - Specify 2 to test serial line 2.
  - Specify 3 to test serial line 3.
- Replace the optional `loopback` parameter with a value that specifies the type of loopback operation the test performs.
  - Specify intl to run an internal loopback operation. Intl is the default type of loopback.
  - Specify extl to run an external loopback operation.
- Replace the optional baud parameter with a value that specifies the baud rate at which the test runs. You can specify one of these baud rates:

  300
  1200
  2400
  3600
  4800
  9600
  19200

  The default baud rate is 9600.
- Replace the optional `parity` parameter with a value that specifies the type of parity that the test uses.
  - Specify none to use no parity. None is the default value.
  - Specify odd to use odd parity.
  - Specify even to use even parity.

- Replace the optional `bits` parameter with a value that specifies the number of bits per characters that the test uses.
  - Specify 8 to use eight bits per character. 8 is the default value.
  - Specify 7 to use seven bits per character.
  - Specify 6 to use six bits per character.

SCC transmit and receive test error messages

SCC transmit and receive test error message have the form:

`?TFL: 3/scc/tx-rx (code:LnN description)`

- `?TFL: 3/scc/tx-rx` indicates that the SCC transmit and receive test failed.
- `code` represents a number that indicates which portion of the test failed.
- `description` represents additional information that describes the error.

Table D-32 lists the error codes and descriptions used in SCC transmit and receive error messages.

Table D-32. SCC Transmit and Receive Test Error Codes and Descriptions

Error Code and Description	Meaning
1: Ln*N* tx bfr not empty. status=*xx*	System could not write a single character because the transmit buffer was not empty. *N* represents the line in which the error occurred. The status value is the contents of SCC read register 0.
2: Ln*N* char not rcvd. status=*xx*	CHAR AVAIL signal not received when the system was expecting a character. *N* represents the line in which the error occurred. The status value is the contents of SCC read register 0.
3: Ln*N* expctd=*xx*, rcvd=*yy*, status=*zz*	The character that was received was different than the transmitted character. *N* represents the line in which the error occurred. The *xx* represents the transmitted value. The *yy* represents the received value. The status value is the contents of SCC read register 0.
4: Ln*N* Rx err. errs=*xx*	Receiving character in FIFO reported an error. *N* represents the line in which the error occurred. The errs value is the associated input character FIFO error bits.

scsi/cntl - SCSI Controller Test

The SCSI controller test checks SCSI controller operation. To run the SCSI controller test, type:

t 3/scsi/cntl

SCSI controller test error messages

SCSI controller test error messages have the form:

`? TFL: 3/scsi/cntl (code: description)`

- `?TFL 3/scsi/cntl` indicates that the SCSI controller test failed.
- `code` represents a number that indicates which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-33 lists error descriptions used in SCSI controller test error messages.

Table D-33. SCSI Controller Error Codes and Descriptions

Error Code Syntax	Description
1: rd cnfg	Values written to and read from configuration register did not match.
2: fifo flg	First in, first out (FIFO) load and FIFO flags did not match.
3: cnt xfr	Write and read operation on TCL register reported a mismatch.
4: illg cmd	Command was illegal and did not generate an interrupt.
5: int reg	Controller cannot clear internal interrupt register.
6: rd cnfg	Mismatch occurred when reading the write/read configuration register.

scsi/sdiag - SCSI Send Diagnostics Test

The SCSI send diagnostics test runs the self-test for an individual SCSI device. You can specify whether the test alters drive parameters and includes a write operation. To run the SCSI send diagnostics test, type:

t *slot_number***/scsi/sdiag scsi_id [d] [u] [s]**

- Replace *slot_number* with the slot number of the module to be tested.
- Replace *scsi_id* with the SCSI ID of the device you want to test. The default SCSI ID is 0.
- Include the optional d and u parameters to specify the conditions that those parameters set for the specific drive you are testing. Note that the result of including d and u depends on the specific drive. To determine the effect of including d and u, refer to the service guide for the drive that you want to test.
- Include the optional s parameter to suppress the error message display.

SCSI send diagnostics test error messages

SCSI send diagnostic test error messages have the form:

`?TFL: 3/sdiag (code: description)`

- `?TFL 3/scsi/sdiag` indicates that the SCSI send diagnostics test reported an error.
- code represents a number that indicates which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-34 lists error codes and descriptions used in SCSI send diagnostics test error messages.

Table D-34. SCSI Send Diagnostics Test Error Descriptions

Error	Description
1: dev ol	Test could not bring the unit on line.
2: dev ol	Test could not bring the unit on line.
3: sdiag	Device failed the send diagnostics test.

scsi/target - SCSI Target Test

The SCSI target test performs a read test on a specific SCSI device. If you include the optional write parameter, the test also performs a write test. To run the SCSI target test, type:

t 3/scsi/target *scsi_id [w] [l loops]*

- Replace the *scsi_id* parameter with the SCSI ID of the device you want to test.
- Specify the optional w parameter to include a write operation in the SCSI target test.
- Specify the optional l parameter to have the test repeat up to 9 times. If you include the l parameter, replace loops with the number of times you want the test to repeat.

Caution: *This test can destroy existing data if run with the w option. The test writes over existing data at random.*

SCSI target test error messages

SCSI target test error messages have the form:

`?TFL: 3/scsi/target (code: description)`

- `?TFL 3/scsi/target` indicates that the SCSI target test reported an error.
- code represents a number that indicates which portion of the test failed.
- `description` represents additional information that describes the failure.

Table D-35 lists error codes and descriptions used in SCSI target test error messages.

Table D-35. SCSI Target Test Error Codes and Descriptions

Error Code Syntax	Description
1: (dev ol) N	Test could not bring the device on line. N represents the SCSI ID of the device that could not be brought on line.
2: (tst nocomp) N	Command entered from the keyboard aborted the test. N represents the SCSI ID of the device being tested.
3: (ro dev) N	Test cannot perform write operation. Device is a read-only device. N represents the SCSI ID of the device specified in the test.
4: (dev type) N	Test does not test on the specified device. N represents the SCSI ID of the device specified in the test.
6: (rdCap) N	Read capacity command failed. N represents the SCSI ID of the device that could not be brought on line.
7: (rzWr) N	Write operation failed. N represents the SCSI ID of the device that failed.
8: (rzRd) N	Read operation failed. N represents the SCSI ID of the device that failed.
9: (cmp) N	Write and read values did not match. N represents the SCSI ID of the device involved in the miscompare.
10: (wrFlMrk) N	Write file mark failed. N represents the SCSI ID of the device being tested.
11: (tzWr) N	Write operation failed. N represents the SCSI ID of the device that failed.
12: (wrFlMrk) N	Write file mark failed. N represents the SCSI ID of the device being tested.
13: (spc) N	Space (-2) operation failed. N represents the SCSI ID of the device involved in the failure.
14: (spc) N	Space (1) operation failed. N represents the SCSI ID of the device involved in the failure.

(continued on next page)

Table D-35 (Cont.). SCSI Target Test Error Codes and Descriptions

Error Code Syntax	Description
15: (tzRd) N	Read operation failed. N represents the SCSI ID of the device being tested.
16: (cmp) N	Write and read values did not match. N represents the SCSI ID of the device involved in the miscompare.

tlb/prb - Translation Lookaside Buffer Probe Test

The translation lookaside buffer (TLB) probe test checks whether all TLB registers respond to an address match operation. To run the TLB probe test, type:

t 3/tlb/prb

TLB probe test error messages

The only TLB probe test error message is:

`?TFL: 3/tlb/prb (match(0, N)=actual, sb expected)`

- `?TFL: 3/tlb/prb (match(0,N))` indicates that the value at address 0 did not match the value at the address represented by *N*.
- `actual` represents the actual value found at the address represented by `N`.
- `expected` represents the expected value at the address represented by `N`.

tlb/reg - Translation Lookaside Buffer Registers Test

The translation lookaside buffer (TLB) registers test performs a read and write operation on the TLB. To run the TLB registers test, type:

t 3/tlb/reg *[pattern]*

Replace the optional *pattern* parameter with the pattern you want to use for the read and write operation. The default pattern is 55555555.

TLB registers test error messages

TLB registers test error messages have the form:

`?TFL: 3/tlb/regs (description)`

- `?TFL 3/tlb/regs` indicates that the TLB registers test reported an error.
- `description` represents additional information that describes the error.

Table D-36 lists descriptions used in TLB registers test error messages.

Table D-36. TLB Registers Test Error Descriptions

Error Description	Meaning
tlblo [*N*]= actual, sb expected	Pattern in TLB LO register was not the expected pattern. *N* represents the number of the register with the incorrect value. The actual and expected values follow.
tlbhi [*N*]= actual, sb expected	Pattern in TLB HI register was not the expected pattern. *N* represents the number of the register with the incorrect value. The actual and expected values in the register follow.

Diagnostic LED Array Codes

The system completes a series of tests and other functions whenever you turn on the system power. If the system halts at one of these functions, the diagnostic LED ARRAY displays a code that indicates where in the power-up sequence the system halted. Table D-37 lists the hexadecimal equivalent of the power-up LED displays and what they indicate about the power-up sequence.

Table D-37. Power-Up LED Displays

LED Pattern	Hexadecimal Equivalent	Description
1111 1111	FF	Initial power-on and hardware initialization.
0011 1111	3F	Firmware initialization started.
0011 0101	35	Initialized I/O ASIC[1].
0011 0110	36	Firmware memory test of first 256Kb.
0011 0111	37	Firmware calculating the cache size.
0011 1110	3E	Calibration of millisecond (ms) delay loop.
0011 1101	3D	Power-up versus reset setup code running, memory and modules being configured.
xxxx 1011	*x*B	Loading console from module *x* where *x* represents the slot number.
xxxx 0011	*x*3	Error reported during the power-up self-test (pst) where *x* represents the slot number of the option module.
xxxx 0010	*x*2	Firmware in module *x* started to execute. *x* represents the slot number of the module.
xxxx 0001	*x*1	System software loaded from module *x*started, where *x* represents the slot number of the module.
0000 0000	00	The system detected no errors during the power-up sequence.

[1]Input/Output Application-Specific Integrated Circuit

E

CPU and System Registers

This appendix describes the CPU and system registers. The CPU and system registers contain information that can be useful when troubleshooting.

There are two types of R3000 registers:

- R3000A CPU registers
- Model 240 system registers

The system automatically displays R3000A CPU register information on the screen when exceptions occur. Use the e command in console mode to access system registers.

CPU Registers

Table E-1 lists the CPU registers.

Table E-1. R3000A CPU Registers

Register	Description
Cause	Cause of last exception
EPC	Exception program counter
Status	Status register
BadVAddr	Bad virtual address (read only)

When an exception occurs, the system automatically displays CPU in one of two formats.

The first format is as follows

```
?TFL slot_number/test-name (CUX, cause= xxxxxxxx) [KN03-GA]
?TFL slot_number/test-name (UEX, cause= xxxxxxxx) [KN03-GA]
```

where

slot_number = Slot number of the option being tested
test-name = Test being run
cause = Cause register

The second format is as follows (R3000 CPU module):

```
? PC:  0x451<vtr=nrml>
? CR:  0x810<ce=0,ip4,exc=AdEL>
? SR:  0x30080000<cu1,cu0,cm,ipl=8>
? VA:  0x0x451
? ER:  i0x100003f0
? MER: 0x2000
```

where

PC = Address of the exception instruction
CR = Cause register
SR = Status register
VA = Virtual address of the exception
ER = Error address register
MER = Memory error register

The second format for the R4000 CPU module is as follows:

```
 ???
  ? PC:  0xbfc0cd60 <vtr=TLBM>
  ? CR:  0x00000008 <CE=0,EXC=TLBL>
  ? SR:  0x30010002 <CU1,CU0,DE,IPL=8,MODE=KNL,EXL>
  ? CFG: 0x10410243 <SB=8W,SC=Y,IC=8K,DC=8K,IB=4W,DB=4W,K0=CNC>
  ? VA:  0x00000000
  ?
  ? MB_CS:  0x00008000 <MSK=0,EE,ECC=0>
  ? MB_INT: 0x001f0000 <>
```

Note that the last two lines of the R4000 display is different than the R3000 display. The description of these two registers is beyond the scope of this guide.

Refer to Chapter 9 for detailed troubleshooting information.

CPU Registers for R4000 Only

Table E-2. R4000 CPU Registers

Register	Description
Cause	Cause of last exception
EPC	Exception program counter
Status	Status register
BadVAddr	Bad virtual address (read only)
Error EPC	Error Exception program counter
Config	Configuration register

Cause Register (R3000 Only)

The cause register is a 32-bit read/write register that describes the nature of the last exception. A 4-bit exception code indicates the cause of the exception, and the remaining fields contain detail information relevant to the handling of certain types of exceptions.

The branch delay (BD) bit indicates whether the EPC was adjusted to point at the branch instruction that precedes the next restartable instruction. For a coprocessor unusable exception, the coprocessor error (CE) field indicates the coprocessor unit number referenced by the instructions that caused the exception.

The interrupt pending (IP) field indicates which external, internal, coprocessor, and software interrupts are pending. You can write to $IP_{1..0}$ to set or reset software interrupts. The remaining bits, $IP_{7..2}$, are read only and represent external, internal, or coprocessor interrupts.

The number and assignment of the IP bits are implementation dependent. R3000A processors have six external interrupts, where IP5 is used for the MIPS floating-point coprocessor interrupt. IP2 is normally used for system bus (I/O) interrupts. The cause register has the following format:

```
   31   30   29  28 27                              16
+-----+-----+------+----------------------------------+
| BD  |  0  |  CE  |            0                     |
+-----+-----+------+----------------------------------+
   1     1     2               12

 15                      8 7    6 5         2 1   0
+-------------------------+------+-----------+-----+
|          IP             |  0   |  ExcCode  |  0  |
+-------------------------+------+-----------+-----+
            8                2         4        2
```

- BD indicates whether the last exception occurred during execution in a branch delay slot (0 = normal, 1 = delay slot).
- CE indicates the coprocessor unit number reference when a coprocessor unusable exception occurs.

- IP indicates whether an interrupt is pending.
- ExcCode is the exception code field. Table E-3 list the exception codes and their meanings.
- 0 is unused (ignored on write, zero when read).

Table E-3. Exception Codes

Number	Mnemonic	Description
0	Int	Interrupt
1	Mod	TLB modification exception
2	TLBL	TLB miss exception (load or instruction fetch)
3	TLBS	TLB miss exception (store)
4	AdEL	Address error exception (load or instruction fetch)
5	AdES	Address error exception (store)
6	IBE	Bus error exception (instruction fetch)
7	DBE	Bus error exception (data reference: load or store)
8	Sys	Syscall exception
9	Bp	Breakpoint exception
10	RI	Reserved instruction exception
11	CpU	Coprocessor unusable exception
12	OV	Arithmetic overflow exception
13-31		reserved

Cause Register (R4000 Only)

The R4000 Cause register for the most part is the same as the R3000 register. The R3000 uses a 4-bit exception code (ExcCode) while the R4000 uses a 5-bit exception code (ExcCode). There is also some new exception codes. Table E-4 list the exception code and a description of each code.

Table E-4. Exception Codes R4000

Number	Mnemonic	Description
0	Int	Interrupt
1	Mod	TLB modification exception
2	TLBL	TLB miss exception (load or instruction fetch)
3	TLBS	TLB miss exception (store)
4	AdEL	Address error exception (load or instruction fetch)
5	AdES	Address error exception (store)
6	IBE	Bus error exception (instruction fetch)
7	DBE	Bus error exception (data reference: load or store)
8	Sys	Syscall exception
9	Bp	Breakpoint exception
10	RI	Reserved instruction exception
11	CpU	Coprocessor unusable exception
12	OV	Arithmetic overflow exception
13	Tr	Trap exception
14	VCEI	Virtual Coherency Exception Instruction
15	FPE	Floating-Point exception
16-22	-	Reserved
23	WATCH	Reference to WatchHi/WatchLo address
24-30	-	Reserved
31	VCED	Virtual Coherency Exception Data

Exception Program Counter (EPC) Register (R3000 and R4000)

The EPC register for the R3000 and R4000 indicates the virtual address at which the most recent exception occurred. This register is a 32-bit read-only register that contains an address at which instruction processing can resume after an exception is serviced. For synchronous exceptions, the EPC register contains the virtual address of the instruction that was the direct cause of the exception. When that instruction is in a branch delay slot, the EPC register contains the virtual address of the immediately preceding branch or jump instruction.

If the exception is caused by recoverable, temporary conditions (such as a TLB miss), the EPC register contains a virtual address at the instruction that caused the exception. Thus, after correcting the conditions, the EPC registers contains a point at which execution can be legitimately resumed. The EPC register has the following format:

```
 31                                                    0
+-----------------------------------------------------+
|                        EPC                          |
+-----------------------------------------------------+
                          32
```

EPC is the exception program counter.

Status Register (R3000 Only)

The status register (SR) is a 32-bit read/write register that contains the kernel/user mode, interrupt enable, and diagnostic state of the processor. The SR contains a three-level stack (current, previous, and old) of the kernel/user (KU) bit and the interrupt enable (IE) bit. The stack is pushed when each exception is taken. The stack is popped by the restore from exception (RFE) instruction. These bits can also be directly read or written.

The status register has the following format:

```
 31                            28 27                  16
+-------------------------------+----------------------+
|            CU                 |        DS            |
+-------------------------------+----------------------+
             18                          12

 15        8 7    6    5     4     3     2     1     0
+------------+-----+-----+-----+-----+-----+-----+-----+
|     IM     |  0  | KUo | IEo | KUp | IEp | KUc | IEc |
+------------+-----+-----+-----+-----+-----+-----+-----+
       8        2     1     1     1     1     1     1
```

- The coprocessor usability (CU) field is a 4-bit field that individually controls the usability of each of the four coprocessor unit numbers (1 = usable, 0 = unusable). Coprocessor zero is always usable in kernel mode, regardless of the setting of the CU0 bit.
- The diagnostic status (DS) field is an implementation-dependent 12-bit diagnostic status field that is used for self-testing and checking of the cache and virtual memory system. For a detailed description of the DS field, see the "Diagnostic Status field" section.
- The interrupt mask field (IM) is an 8-bit field that controls the enabling of each of eight external interrupt conditions. It controls the enabling of each of the external, internal, coprocessor, and software interrupts (0 = disable, 1 = enable). If interrupts are enabled, an external interrupt occurs when corresponding bits are set in both the interrupt mask field of the SR and the interrupt pending (IP) field of the cause register. The actual width of this register is

machine dependent. For a description of the IP field, see "Cause register" section of this appendix.

- KUo is the old kernel/user mode (0 = kernel, 1 = user).
- IEo is the old interrupt enable setting (0 = disable, 1 = enable).
- KUp is the previous kernel/user mode (0 = kernel, 1 = user).
- IEp is the previous interrupt enable setting (0 = disable, 1 = enable).
- KUc is the current kernel/user mode (0 = kernel, 1 = user).
- IEc is the current interrupt enable setting (0 = disable, 1 = enable).

Diagnostic status field

The diagnostic facilities depend on the characteristics of the cache and virtual memory system of the implementation. Therefore, the layout of the diagnostic status field is implementation dependent. The diagnostic status field is normally used for diagnostic code, and in certain cases, for operating system diagnostic facilities (such as reporting parity errors). On some machines it is used for relatively rare operations such as flushing caches. Normally, this field should be set to 0 by operating system code. The diagnostic status bits are BEV, TS, PE, CM PZ, SwC, and IsC. This set of bits provides a complete fault detection capability, but is not intended to provide extensive fault diagnosis.

The diagnostic status field has the following format:

```
 27             23  22    21   20   19   18   17    16
+-----------------+-----+----+----+----+----+-----+-----+
|        0        | BEV | TS | PE | CM | PZ | SwC | IsC |
+-----------------+-----+----+----+----+----+-----+-----+
         5           1     1    1    1    1    1     1
```

- BEV controls the location of UTLB miss and general exception vectors (0 = normal, 1 = bootstrap).
- TS indicates that TLB shut down occurred.

- PE indicates that a cache parity error occurred. This bit can be cleared by writing 1 to this bit position.
- CM indicates whether a data cache miss occurred while the system was in cache test mode (0 = hit, 1 = miss).
- PZ controls the zeroing of cache parity bits (0 = normal, 1 = parity forced to zero).
- SwC controls the switching of the data and instruction caches (0 = normal, 1 = switched).
- IsC controls isolation of the cache (0 = normal, 1 = cache isolated).
- 0 is unused (ignored on write, zero when read).

Status Register (R4000 Only)

The status register (SR) is a 32-bit read/write register that contains the kernel/user mode, interrupt enable, and diagnostic state of the processor. The SR contains the kernel, user, supervisor, error level, exception level, and the interrupt enable (IE) bit. These bits can also be directly read or written.

The status register has the following format:

```
 31     28 27  26  25  24                              16
+---------+---+---+---+----------------------------------+
|   CU    |RP |FR |RE |               DS                 |
+---------+---+---+---+----------------------------------+
    4       1  1   1                 9
 15         8  7    6    5      4  3    2     1     0
+------------+----+----+-----+-------+-----+-----+----+
|     IM     | KX | SX | UX  |  KSU  | ERL | EXL | IE |
+------------+----+----+-----+-------+-----+-----+----+
       8        1    1     1     2     1     1     1
```

- The (CU) coprocessor usability field is a 4-bit field that individually controls the usability of each of the four coprocessor unit numbers (1 = usable, 0 = unusable). Coprocessor zero is always usable in kernel mode, regardless of the setting of the CU0 bit.
- The (RP) reduce power enables reduced-power operation by reducing the internal clock frequency.
- The (FR) floating-point register enables additional floating-point registers (0-16 registers; 1-32 registers).

- The (RE) reverse endian when set reverse byte orientation in User mode.
- The (DS) diagnostic status field is an implementation-dependent 9-bit diagnostic status field that is used for self-testing and checking of the cache and virtual memory system. See “Diagnostic Status Field” for a detailed description of the DS field.
- The interrupt mask field (IM) is an 8-bit field that controls the eight external, internal, coprocessor, and software interrupts (0 = disable, 1 = enable). If interrupts are enabled, an external interrupt occurs when corresponding bits are set in both the interrupt mask field of the SR and the interrupt pending (IP) field of the cause register.
- The (KX) enables 64-bit addressing in Kernel mode.
- The (SX) enables 64-bit addressing and operations in supervisor mode.
- The (UX) enables 64-bit addressing and operations in user mode.
- The (KSU) Mode (10-User, 01_supervisor, 00-Kernel)
- The (ERL) Error level (0-normal, 1-error)
- The (EXL) Exception level (0-normal, 1-exception)

Diagnostic Status Field The Diagnostic Status field has the following format:

```
24  23  22  21 20 19 18 17 16
+----+-----+--+--+--+--+--+--+
| 0  | BEV |TS|SR|0 |CH|CE|DE|
+----+-----+--+--+--+--+--+--+
   2    1   1  1  1  1  1  1
```

The following Table E-5 describes the Diagnostic Status Fields:

Table E-5. Diagnostic Status Fields

Field	Description
BEV	Controls the location of TLB refill and general exception vectors. (0 -> normal; 1 -> bootstrap)
TS	TLB shutdown has occurred (read-only)
SR	A soft reset has occurred
CH	"Hit" (tag match and valid state) or "miss" indication for last CACHE Hit Invalidate, Hit Write Back Invalidate, Hit Write Back, Hit Set Virtual, or Create Dirty Exclusion for a secondary cache.
CE	Contents of the ECC register are used to set or modify the check bits of the caches when CE equals 1.
DE	Specifies that cache parity or ECC errors are not to cause exceptions
0	Reserved. Must be written as zeroes, returns zeroes when read

BadVAddr Register (R3000 and R4000)

The bad virtual address (BadVAddr) register for the R3000 and R4000 is a 32-bit read-only register that contains the most recently translated virtual address for which a translation error occurred.

The bad virtual address register has the following format:

```
+-----------------------------------------------------+
|                       BadVAddr                      |
+-----------------------------------------------------+
```

BadVAddr is the bad virtual address.

Error Exception Program Counter (Error EPC)(R4000 Only)

The Error EPC register is similar to the EPC register, but it is used on ECC and parity error exceptions. It is also used to store the PC on Reset, Soft Reset and NMI exceptions. The address may be either:

- the virtual address of the instruction that caused the exception, or
- the virtual address of the immediately preceding branch or jump instruction when that address is in a branch delay slot.

There is no branch delay slot indication for the ErrorEPC register, the ErrorEPC register has the following format.

```
 31                                                   0
+-----------------------------------------------------+
|                     ErrorEPC                        |
+-----------------------------------------------------+
                         32
```

Configuration Register (R4000 Only)

The Configuration Register (Config) specifies various configuration options selected on R4000 processors. Some configuration options, as defined by Config bits 31...6, are set by the hardware during reset, and are included in this register as read-only status for software. Other configuration options are read/write (defined by Config bits 5..0) and controlled by software; on reset these fields are undefined. The Config register has the following format:

```
 31                           12 11 9 8  6 5  4   3 2   0
+---------------------------------+----+----+--+--+--+----+
|      Hardware Parameters        | IC | DC |IB|DB|CU| K0 |
+---------------------------------+----+----+--+--+--+----+
                                    3    3   1   1  1   3

    Bits 31..12 indicate the setting of hardware parameters
    which are loaded from the serial ROM on the daughter card.
    For more information on these bits refer to the MIPS R4000
    Microprocessor User's Manual.
```

Table E-6. Config Registers

Field/Bit Name	Description
IC	Primary ICache Size (ICache size = 2^{12+IC} bytes)
DC	Primary DCache Size (DCache size = 2^{12+DC} bytes)
IB	Primary ICache block size (1 -> 32 bytes; 0 ->16 bytes)
DB	Primary DCache line size (1 -> 32 bytes; 0 ->16 bytes)
CU	Update on Store Conditional (0 -> Store Conditional uses coherency algorithm specified by TLB; 1 -> SC uses cacheable coherent update on write)
K0	kesg0 coherency algorithm (2 -> uncached, 3 -> cached, non coherent)

System Registers

This section describes the system registers used for troubleshooting.

Data Buffers 3 to 0

The data buffers are general-purpose 32-bit read-write registers used by the I/O control ASIC. For test purposes, these registers can be read and written. Any DMA or access to a peripheral device can overwrite these registers. To ensure proper testing, disable all DMA engines.

Table E-7 lists the system registers.

Table E-7. System Registers

Register	Console Address	Description
SSR	0xBF840100	System support register
SIR	0xBF840110	System interrupt register
Mask	0xBF840120	System interrupt mask register
EAR	0xBFA40000	Error address register
ES	0xBFA80000	Memory error check/syndrome register
CS	0xBFAC0000	Memory bank size and ECC diagnostics register

Use the e command to examine the contents of a system register from the console. Enter the e command in the following format:

e *[options] [console_address]*

See Appendix C, "Console Commands," for information about the formats and options used with the e command and the other console commands.

System Support Register (SSR)

The system support register (SSR) can be both read from and written to. Bits <31:16> are used internally by the I/O control ASIC. Bits <15:0> generate signals visible outside the I/O control ASIC. Table E-8 shows the meaning of each bit position of the SSR.

Table E-8. System Support Register 0xBF840100

Bits	Access	Description
31	R/W	Communication port 1 transmit DMA enable (1=enable, 0=disable)
30	R/W	Communication port 1 receive DMA enable (1=enable, 0=disable)
29	R/W	Communication port 2 transmit DMA enable (1=enable, 0=disable)
28	R/W	Communication port 2 receive DMA enable (1=enable, 0=disable)
27:23	R/W	Reserved.
22	R/W	Reserved
21	R/W	Reserved
20	R/W	Reserved
19	R/W	Reserved
18	R/W	SCSI DMA direction, 0 = transmit (read from memory)
17	R/W	SCSI DMA enable (1=enable, 0=disable)
16	R/W	LANCE DMA enable (1=enable, 0=disable)
15	R/W	DIAGDN (diagnostic flag)
14:13	R/W	TXDIS (serial transmit disable)
12	R/W	Reserved
11	R/W	SCC reset (active low)
10	R/W	RTC reset (active low)
9	R/W	53C94 SCSI controller reset (SCSI active low)
8	R/W	LANCE reset (Ethernet active low)
7..0	R/W	LEDs

SSR<31>

When set to 1, this bit enables communication port 1 (serial line 2) to transmit DMA to SCC(0)-B. Communication port 1 is the right comm port, viewed from the back.

SSR<30>

When set to 1, this bit enables communication port 1 (serial line 2) to receive DMA from SCC(0)-B. Communication port 1 is the right comm port, viewed from the back.

SSR <29>

When set to 1, this bit enables communication port 2 (serial line 3) to transmit DMA to SCC(1)-B. Communication port 2 is the left comm port, viewed from the back.

SSR <28>

When set to 1, this bit enables communication port 2 (serial line 3) to receive DMA from SCC(1)-B. Communication port 2 is the left comm port, viewed from the back.

SSR <27:19>

These bits are reserved.

SSR <18>

This bit, set to 0 on power up or reset, determines the direction of the SCSI DMA transfer. If the bit is 0, then memory data will be supplied to the 53C94 SCSI controller upon demand from the address specified by the SCSI DMA pointer. If the bit is set to 1, data bursts of two words supplied from the 53C94 SCSI controller are written to memory.

SSR <17>

When set to 1, this bit enables SCSI DMA; 0 disables it.

SSR <16>

When set to 1, this bit enables LANCE DMA so that the Ethernet interface can begin data transfer.

SSR <15> DIAGDN

This bit reflects the state of the DIAGDN pin on the motherboard, which is used by manufacturing diagnostics.

SSR <14:13> TXDIS

The bits allow diagnostics to disable the EIA drivers on the serial lines.

When TXDIS are 0's, the EIA drivers are active. When TXDIS are 1's, the EIA drivers are disabled.

Since the TXDIS signals are automatically cleared at power up or reset, the EIA drivers are enabled by default.

TXDIS<0> disables communication port 1 (serial line 2) and the mouse, and TXDIS<1> disables communication port 2 (serial line 3) and the keyboard.

SSR <12>

This bit is reserved.

SSR <11>

This signal can be read from and written to. The SCC UARTS are placed in a hard reset state when this bit is 0. This bit is cleared to 0 at power up or reset, resetting the two SCC's.

SSR <10>

This bit can be read from and written to. The time-of-year controller is placed in a hard reset state when this bit is 0. This bit is cleared to 0 at power up or reset, resetting the TOY. When reset, the TOY loses neither its date nor its 50 bytes of permanent storage.

SSR <9>

This bit can be read from and written to. The 53C94 SCSI controller is placed in a hard reset state when this bit is 0. This bit is cleared to 0 at power up or reset, resetting the 53C94 SCSI controller.

SSR <8>

This bit can be read from and written to. LANCE is placed in a hard reset state when this bit is 0. This bit is cleared to 0 at power up or reset, resetting LANCE.

SSR <7:0>

These bits determine the on/off state of the diagnostic LEDs. When a register bit is 0, the corresponding LED is on. When a register bit is 1, the corresponding LED is off. Since the LEDs bits are automatically cleared at power up or reset, all the LEDs are initially on.

Note: *The relationship between the state of these register bits and the on/off state of the LEDs is the opposite of the LED error codes represented in a table in Chapter 9 and in Appendix D. In the cited tables, the on state is represented by 1 and the off state is represented by 0. Remember that the cited tables have nothing to do with the register bits.*

The correspondence between these register bits and the diagnostic LEDs is not one to one right to left. Table E-9 lists the LED controlled by each register bit. The LEDs are numbered 0 to 7 right to left when viewed from the rear.

Table E-9. LEDs Controlled by SSR LEDS Register Bits

Bit	LED Controlled
0	3
1	2
2	1
3	0
4	7
5	6
6	5
7	4

System Interrupt Register (SIR)

The SIR register consists of two sections. Bits <31:16> are set by the DMA engine for sundry DMA conditions. These bits are always set by the system and can be cleared by writing 0 to them. Writing 1 has no effect. These bits are cleared to 0 during system power up or reset.

Bits <15:0> reflect the status of specific system devices and are read only. A few of these are not usually used as interrupts and should be masked. These bits may or may not be reset to 0 during system power up reset, depending on the state of the interrupting device.

Table E-10. System Interrupt Register 0xBF840110

Bits	Access	Description
31	R/W0C	Communication port 1 transmit page end interrupt
30	R/W0C	Communication port 1 transmit DMA memory read error
29	R/W0C	Communication port 1 receive half page interrupt
28	R/W0C	Communication port 1 receive DMA page overrun
27	R/W0C	Communication port 2 transmit page end interrupt
26	R/W0C	Communication port 2 transmit DMA memory read error
25	R/W0C	Communication port 2 receive half page interrupt
24	R/W0C	Communication port 2 receive DMA overrun
23	R/W0C	Reserved
22	R/W0C	Reserved
21	R/W0C	Reserved
20	R/W0C	Reserved
19	R/W0C	SCSI DMA interrupt, (DMA buffer pointer loaded)
18	R/W0C	SCSI DMA overrun error
17	R/W0C	SCSI DMA memory read error
16	R/W0C	LANCE DMA memory read error
15	R	Reserved

(continued on next page)

Table E-10 (Cont.). System Interrupt Register 0xBF840110

Bits	Access	Description
14	R	NVR mode jumper
13	R	TURBOchannel slot 2 interrupt
12	R	TURBOchannel slot 1 interrupt
11	R	TURBOchannel slot 0 interrupt
10	R	NRMOD manufacturing mode jumper
9	R	SCSI interrupt from 53C94 SCSI controller
8	R	Ethernet interrupt
7	R	SCC(1) serial interrupt (communication 2 and keyboard)
6	R	SCC(0) serial interrupt (communication 1 and mouse)
5	R	TOY interrupt
4	R	PSWARN power supply warning indicator
3	R	Reserved
2	R	SCSI data ready
1	R	PBNC
0	R	PBNO

Note: *Communication port 1 is the same as serial line 2. Communication port 2 is the same as serial line 3.*

SIR<31>

This interrupt is generated by the communication port 1 transmit DMA logic. The DMA transmitter, when enabled, transmits bytes until the pointer reaches a 4-Kbyte page boundary. At this point it stops DMA and interrupts the processor. DMA is disabled whenever this bit is set. To restart, clear this bit by writing 0; writing 1 has no effect.

SIR<30>

When a parity error, page crossing error, or maximum transfer length error occurs during a communication transmit port 1 DMA, this bit is set and the DMA is disabled. The DMA pointer contains the error address. Check the memory sections for more information. To restart, software must clear this bit by writing 0; writing 1 has no effect.

SIR<29>

When the receive DMA pointer associated with communication port 1 reaches a half page (2-Kbyte) boundary, this bit is set. Software must disable DMA and then load a new pointer and restart DMA without being interrupted. Clear this bit by writing 0; writing 1 has no effect. The value of this bit is informational only and does not stop the DMA.

SIR<28>

When the receive DMA pointer associated with communication port 1 reaches a page boundary, this bit is set and the DMA disabled. To restart, clear this bit by writing 0; writing 1 has no effect. Note that bit <29> is set whenever this bit is set.

SIR<27>

This interrupt is generated by the communication port 2 transmit DMA logic. The DMA transmitter, when enabled transmits bytes until the pointer reaches a page boundary. At this point it stops DMA and interrupts the processor. DMA is disabled whenever this bit is set. Clear this bit by writing 0; writing 1 has no effect. Clearing this bit may restart the DMA if the DMA enable bit is still on.

SIR<26>

When a parity error, page crossing error, or maximum transfer length error occurs during a communication transmit port 2 DMA, this bit is set and the DMA is disabled. The DMA pointer will contain the error address. Check the memory sections for more information. To restart, software must clear this bit by writing 0; writing 1 has no effect.

SIR<25>

When the receive DMA pointer associated with communication port 2 reaches a (2-Kbyte) half-page boundary, this bit is set. Software must disable DMA, load a new pointer, and restart DMA quickly. Clear this bit by writing 0. Writing 1 has no effect. This bit will always be set when bit 24 is set. The value of this bit is informational only and does not stop the DMA.

SIR<24>

When the receive DMA pointer associated with communication port 2 reaches a page boundary, this bit is set and the DMA disabled. To restart, clear this bit by writing 0; writing 1 has no effect. Note that bit<25> is also set whenever this bit is set.

SIR<23:20>

These bits are reserved.

SIR<19>

This interrupt is set whenever the SCSI DMA buffer pointer associated with the SCSI port is loaded into the SCSI DMA pointer register. Software uses this interrupt to load a new buffer pointer into the SCSI buffer pointer register. Clear this interrupt by writing 0 to it.

SIR<18>

This bit is set when the buffer pointer is not reloaded soon enough. It indicates an overrun condition as the data buffer space is exhausted. DMA is disabled when this bit is set. Clear this bit by writing 0 to it.

SIR<17>

This bit is set when the SCSI DMA encounters a memory read error during a DMA. DMA is disabled when this bit is set. Clear this bit by writing 0 to it.

SIR<16>

This bit is set to 1 when the LANCE DMA encounters a memory read error, disabling DMA. The LANCE will then enter a timeout state, interrupting the processor to handle the problem. The address of the error will be visible in the LPR. Clear this bit by writing 0 to it; writing 1 to it has no effect.

SIR<15>

This bit is reserved.

SIR<14> UNSCUR

When this bit is set, the contents of the NV RAM in the TOY clock chip are set to default system values. Any password that had been saved is lost.

SIR<13> TCO 2 interrupt

This bit reflects the value of the TURBOchannel slot 2 interrupt.

SIR<12> TCO 1 interrupt

This bit reflects the value of the TURBOchannel slot 1 interrupt.

SIR<11> TCO 0 interrupt

This bit reflects the value of the TURBOchannel slot 0 interrupt.

SIR<10> NRMMOD

This bit reflects the state of the manufacturing jumper on the module. When the jumper is absent, NRMMOD is 0, and the console should perform its normal power up or reset tests and boot. When the jumper is installed, NRMMOD is 1, and the console will execute manufacturing tests.

SIR<9>

This bit follows the state of the interrupt from the 53C94 SCSI controller chip. This interrupt indicates that the transfer is complete.

SIR<8>

This bit follows the state of the interrupt from the LANCE.

SIR<7>

This interrupt is generated by SCC(1), which contains both the communication port 2 (ch B.) and the keyboard port UART (ch A.). Software must read SCC(1) internal registers to determine the appropriate course of action. Communication port 2 is the same as serial line 3.

SIR<6>

This interrupt is generated by SCC(0), which contains both the communication port 1 (ch B.) and the mouse port UART (ch A.). Software must read SCC(0) internal registers to determine the appropriate course of action. Communication port 1 is the same as serial line 2.

SIR<5>

This bit follows the state of the time-of-year clock interrupt.

SIR<4>

This bit follows the state of the power supply warning indicator. When this bit is set, the operating system should report an error. When the power supply overheats, this bit is set to 1.

SIR<3>

This bit is reserved.

SIR<2>

This bit indicates SCSI receive data in the FIFO of the 53C94 SCSI controller. When transfers are aligned and the DMA is enabled, data is moved from the FIFO to main memory by the I/O control ASIC, and this interrupt is masked by software. Unaligned transfers cannot use DMA and thus cannot use this interrupt to signal when the processor must move data to memory.

SIR<1>

This bit reflects the state of the halt button on the back of the system unit. This bit is set to 0 when the button is pushed. This interrupt should always be masked.

SIR<0>

This bit reflects the state of the halt button on the back of the system unit. This bit is set to 1 when the halt button is pushed. On R3000A systems, this interrupt should always be masked. The halt interrupt is also presented at the processor interface, so it should be visible to the CPU.

System Interrupt Mask Register

Table E-11. System Interrupt Mask Register 0xBF840120

Bits	Access	Description
31:0	R/W	Interrupt mask

<31:0>

These bits, if 0, mask the corresponding interrupt observable in the SIR. Bit <0> masks SIR<0>, bit <1> masks) SIR<1>, and so on. The mask does not prevent an interrupt from showing up in the SIR; it merely keeps the CPU from being interrupted. The interrupt mask is set to 0's on power up, masking all interrupts. Software must be set to 1 for those interrupts that it wants enabled.

Error Address Register (EAR)

The error address register (EAR) (address: 0xBFA40000) is the primary error log register that records the physical address of TC I/O timeouts, TC DMA overruns, and memory ECC errors. The EA register is cleared by system reset or by a processor write. When an error occurs, EA.VALID is set along with the log bits. Table E-12 shows the format of the EA register during reads.

Table E-12. Error Address Register 0xBFA40000

Base	Size	Name
31	1	VALID
30	1	CPU
29	1	WRITE
28	1	ECCERR
27	1	RSRVD
0	27	ADDRESS

EAR<31> - EA.VALID

This bit is set to 1 when error information is clocked into the register. When EA.VALID is already set, error logging is disabled. That is, the EA register indicates only the first error that occurred if there are multiple errors.

EAR<30> - EA.CPU

If this bit is 1, the error occurred during a processor transaction. If this bit is 0, the error occurred during a TC DMA transaction.

EAR<29> - EA.WRITE

If this bit is 1, the error occurred on an I/O write or memory write transaction. If this bit is 0, the error occurred on an I/O read or memory read transaction.

EAR<28> - EA.ECCERR

If this bit is 1, an ECC error occurred. If this bit is 0, an I/O timeout or DMA overrun occurred.

EAR<27> - EA.RSRVD

This bit is reserved and stuck at 0.

EAR<26:0> - EA.ADDRESS

This field records the value of the pipelined address in effect at the time the error occurred. For I/O transactions and partial memory writes, this is the word address issued by the processor. For DMA overrun errors, this is the word address of the last valid word transferred (127). For processor and DMA memory reads, this is the word address in the memory controller. However, due to pipelining of the memory controller, the column field of the word address has advanced five stages before the ECC error status is available. Software must extract ADDRESS[11:0], perform a signed subtract of five, and then reinsert this value into ADDRESS[11:0] to recover the address of the word that contained the ECC error. Table E-13 lists the values of bits <30>, <29>, and <28> for the different types of system errors. During read conflicts, the memory controller may service the same read request several times (while stalling the processor) until conflicting write data in the write buffer has been flushed. It is possible for ECC read errors to occur during processor read conflicts when the processor is stalled. However, after the write buffer is flushed, the error is overwritten with new data, so the processor will not receive a bus error on termination of the read. Also, if the processor is waiting for a memory space partial write to complete, and a multi bit ECC error occurs during the read/modify/write of the partial data, invalid data and valid ECC check bits will be loaded into memory. In this case, the ensuing read will complete without causing an exception even though the read data is invalid. If the address is a cached location, invalid data will be loaded into the cache and the cache entry will be incorrectly marked valid. Regardless of the type of masked error, a memory interrupt will be generated, and the offending ECC read error or processor partial write error will be correctly logged in the EA and ES registers.

Table E-13. EA Error Log Types

bit <30> CPU	bit <29> CPU	bit <28> CPU	Error Type
0	0	0	DMA read overrun
0	0	1	DMA memory read ECC
0	1	0	DMA write overrun
0	1	1	Invalid combination
1	0	0	Processor I/O read timeout
1	0	1	Processor memory read ECC
1	1	0	Processor I/O write timeout
1	1	1	Processor partial memory write ECC

If the MB ASIC has prefetching enabled, it is possible to log processor read hard ECC errors without a processor error if the ECC error occurs in the prefetched portion of the cache block.

Error Syndrome Register (ES)

The error syndrome (ES) register (address: 0xBFA80000) is a slave error log register that records check bits and syndrome bits of the last memory read. The ES register is frozen when EA <31> is 1. The ES register is cleared by system reset and processor writes.

Table E-14 shows the format of the ES register during reads. The syndrome bytes are only valid if EA <31> is 1. The CHKHI byte is only valid if the VLDHI bit <31> is set to 1. The CHKLO byte is only valid if the VLDLO bit <15> is set to 1.

Table E-14. Error Syndrome Register 0xBFA80000

Base	Size	Name
31	1	VLDHI
24	7	CHKHI
23	1	SNGHI
16	7	SYNHI
15	1	VLDLO
8	7	CHKLO
7	1	SNGLO
0	7	SYNLO

ES<31> - ES.VLDHI

This bit is set to 1 whenever the CHKHI field <30:24> is updated.

ES<30:24> - ES.CHKHI

In the absence of errors, this field records the last check bits read from the high bank of memory (odd word). Once an error occurs, and the EA.VALID bit EA <31> is set to 1, this field is frozen.

ES <23> - ES.SNGHI

This bit records the single-versus-double bit error output of the ECC logic at the time that an error was detected by the high bank of memory. If it is 1, a single-bit error occurred. If it is 0, a double-bit error occurred. This bit is valid when the ES.SYNHI <22:16> field is valid.

ES<22:16> - ES.SYNHI

This field records the syndrome bits calculated by the ECC logic at the time that an error was detected by the high bank of memory (odd words). The EA.ADDRESS field (EA <26:0>) field must be used to determine whether the error pertains to a low or high word of memory. This field is undefined for low bank errors. The syndrome can be used to determine which bit was in error. See the next section, "ECC logic," for a description of the syndrome logic.

ES<15> - ES.VLDLO

This bit is set to 1 whenever the CHKLO field <14:8> is updated.

ES<14:8> - ES.CHKLO

In the absence of errors, this field records the last check bits read from the low bank of memory (even word). Once an error occurs, and the EA.VALID bit (EA<31>) is set to 1, this field is frozen.

ES<7> - ES.SNGLO

This bit records the single-versus-double bit error output of the ECC logic at the time that an error was detected by the high bank of memory. If it is 1, a single-bit error occurred. If it is 0, a double-bit error occurred. This bit is valid when the ES.SYNLO <6:0> field is valid.

ES<6:0> - ES.SYNLO

This field records the the syndrome bits calculated by the ECC logic at the time that an error was detected by the low bank of memory (even words). The EA.ADDRESS field (EA <26:0>) field must be used to determine whether the error pertains to a low or high word of memory. This field is undefined for high bank errors. The syndrome can be used to determine which bit was in error. See the next section, "ECC logic," for a description of the syndrome logic.

Control Register (CS)

The control (CS) register (address: 0xBFAC0000) controls the memory array size decoding via the CS.BNK32M bit <10>. The CS register also controls the ECC data path. CS is a read/write register that is cleared by system reset.

Table E-15 shows the format of the CS register during reads and writes.

Table E-15. Control Register 0xBFAC0000

Base	Size	Name
16	16	RSRVD2
15	1	DIAGCHK
14	1	DIAGGEN
13	1	CORRECT
11	2	RSRVD1
10	1	BNK32M
7	3	RSRVD0
0	7	CHECK

CS<31:16> - CS.RSRVD2

This field must be written with zeros.

CS<15> - CS.DIAGCHK

This bit controls a diagnostic multiplexor in the ECC read data path. If the CS.DIAGCHK bit <15> is 0, check bits from the memory array card are used during memory reads. If the CS DIAGCHK bit <15> is 1, the CS.CHECK field <6:0> specifies the check bits during memory reads. Since CS is cleared by system reset, check bits are read from memory by default.

CS<14> - CS.DIAGGEN

This bit controls a diagnostic multiplexor in the ECC write data path. If the CS.DIAGGEN bit <14> is 0, check bits are calculated from the processor or TC data word during memory writes. If the CS DIAGGEN bit <14> is 1, the CS.CHECK field <6:0> specifies the check bits during memory writes. Since

CS is cleared by system reset, check bits are generated from processor or TC data by default.

CS<13> - CS.CORRECT

This bit controls whether or not the ECC logic corrects single-bit errors in memory read data. When this bit is 1, the single-bit error in the read data is complemented as specified by the ECC syndrome. When this bit is 1 and the ECC logic detects a multi-bit error, the output of the ECC logic is undefined. The state of this bit does not affect memory interrupts, error logging, or bus errors; it only controls modification of memory data. Since CS is cleared by system reset, ECC correction is disabled by default.

CS<12:11> - CS.RSRVD1

This field must be written with zeroes.

CS<10> - CS.BNK32M

This bit controls the memory bank stride. If this bit is 0, the stride is 8 Mbytes. If this bit is 1, the stride is 32 Mbytes. Powerup/reset sets this bit and determines whether each memory module is an 8- or 32-Mbyte module. Then, if no 32-Mbyte modules are found, this bit is cleared. Since CS is cleared by system reset, the memory bank stride defaults to 8 Mbytes.

CS<9:7> - CS.RSRVD0

This field must be written with zeroes.

CS<6:0> - CS.CHECK

This field specifies the diagnostic check value used by the CS.DIAGCHK and CS.DIAGGEN multiplexors.

ECC logic

This section describes the error correction code (ECC) logic.

MT generates seven check bits for each word written to the memory arrays. For each word read from the memory arrays, MT verifies that the check bits are consistent with the data bits. If a single-bit error is detected, the erroneous bit is automatically corrected if CS CORRECT (bit <>) is 1. If a single- or double-bit error is detected, and EA.VALID (bit EA<>) is 0, the EA and ES registers are written and frozen with the address, check, and syndrome bits of the memory word.

Table E-16 lists the data bits included in the exclusive-or logic for each check bit. The ES.CHKLO (ES <>), ES.CHKHI (ES <>), and CS.CHECK (CS <>) fields correspond to:

```
64*C16 | 32*C8 | 16*C4 | 8*C1 | 2*C0 | CX
```

Table E-16. Participating Data Bits in Check Bit Calculation

Bit	Parity	
CX	even	0,4,6,7,8,9,11,14
C0	even	0,1,2,4,6,8,10,12
C1	odd	0,3,4,7,9,10,13,15
C2	odd	0,1,5,6,7,11,12,13
C4	even	2,3,4,5,6,7,14,15
C8	even	8,9,10,11,12,14,15
C16	even	0,1,2,3,4,5,6,7
CX	even	17,18,19,21,26,28,29,31
C0	even	16,17,18,20,22,24,26,28
C1	odd	16,19,20,23,25,26,29,31
C2	odd	16,17,21,22,23,27,28,29
C4	even	18,19,20,21,22,23,30,31
C8	even	24,25,26,27,28,29,30,31
C16	even	24,25,26,27,28,29,30,31

Table E-17 lists the significance of each syndrome code logged in the ES register. The multi-bit syndrome codes are shown for completeness; MT does not report these as hard errors with the assertion of either p.mc.~rErr or t.mo.~err as appropriate. MT only reports double-bit errors as hard errors. If the operating system detects a multi-bit error syndrome code, it should log the error and shut down immediately.

Table E-17. Syndrome Decoding

Syndrome	Error	Syndrome	Error	Syndrome	Error	Syndrome	Error
00	none	20	C8	40	C16	60	double
01	CX	21	double	41	double	61	multi
02	C0	22	double	42	double	62	D24
03	double	23	D8	43	multi	63	double
04	C1	24	double	44	double	64	D25
05	double	25	D9	45	multi	65	double
06	double	26	D10	46	multi	66	double
07	multi	27	double	47	double	67	D26
08	C2	28	double	48	double	68	D27
09	double	29	D11	49	multi	69	double
0A	double	2A	D12	4A	D1	6A	double
0B	D17	2B	double	4B	double	6B	D28
0C	double	2C	D13	4C	multi	6C	double
0D	multi	2D	double	4D	double	6D	D29
0E	D16	2E	double	4E	double	6E	multi
0F	double	2F	multi	4F	D0	6F	double
10	C4	30	double	50	double	70	D30
11	double	31	D14	51	multi	71	double
12	double	32	multi	52	D2	72	double
13	D18	33	double	53	double	73	multi
14	double	34	D15	54	D3	74	double
15	D19	35	double	55	double	75	D31
16	D20	36	double	56	double	76	multi
17	double	37	multi	57	D4	77	double
18	double	38	multi	58	D5	78	double
19	D21	39	double	59	double	79	multi
1A	D22	3A	double	5A	double	7A	multi

(continued on next page)

Table E-17 (Cont.). Syndrome Decoding

Syndrome	Error	Syndrome	Error	Syndrome	Error	Syndrome	Error
1B	double	3B	multi	5B	D6	7B	double
1C	D23	3C	double	5C	double	7C	multi
1D	double	3D	multi	5D	D7	7D	double
1E	double	3E	multi	5E	multi	7E	double
1F	multi	3F	double	5F	double	7F	multi

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Connector Pin Assignments

This appendix lists pin assignments for the following connectors:

- SCSI cable connectors
- Keyboard and mouse or tablet connectors
- Serial communications connectors
- ThickWire Ethernet connectors
- Power supply connector
- Modem loopback
- Ethernet loopback

It also provides a summary of loopback connectors.

Table F-1. SCSI Cable Connector Pin Assignments

Pin	Signal	Pin	Signal
50	~ I/O	25	GND
49	~ REQ	24	GND
48	~ C/O	23	GND
47	~ SEL	22	GND
46	~ MSG	21	GND
45	~ RST	20	GND
44	~ ACK	19	GND
43	~ BSY	18	GND
42	GND	17	GND
41	~ ATN	16	GND
40	GND	15	GND
39	RSVD	14	GND
38	TERMPWR	13	NC
37	RSVD	12	GND
36	GND	11	GND
35	GND	10	GND
34	~ PARITY	9	GND
33	~ DATA<7>	8	GND
32	~ DATA<6>	7	GND
31	~ DATA<5>	6	GND
30	~ DATA<4>	5	GND
29	~ DATA<3>	4	GND
28	~ DATA<2>	3	GND
27	~ DATA<1>	2	GND
26	~ DATA<0>	1	GND

Table F-2. Keyboard and Mouse or Tablet Connector Pin Assignments

Pin	Source	Signal	Description
1		GND	Ground
2		KEY.TX	Keyboard transmitted data
3	Keyboard	KEY.RX	Keyboard received data
4		+12V	Keyboard/tablet power
5		GND	Ground
6	Mouse /Tablet	MSE.RX	Mouse received data
7		MSE.TX	Mouse transmitted data
8		GND	Ground
9		GND	Ground
10		NC	
11		NC	
12		NC	
13		+5V	Mouse power
14		–12V	Mouse power
15		GND	Ground

Table F-3. Serial Communications Connectors Pin Assignments

Pin	Source	Signal	CCITT[1]	EIA[2]	Description
1		GND	102	AB	Signal ground
2	CPU Module	TX	103	BA	Modem transmitted data
3	Modem/printer	RX	104	BB	Modem received data
4	CPU Module	RTS	105	CA	Request to send
5	Modem/printer	CTS	106	CB	Clear to send
6	Modem/printer	DSR	107	CC	Data set ready
7		GND	102	AB	Signal ground
8	Modem/printer	CD	109	CF	Carrier detector
9					Unconnected
10					Unconnected
11					Unconnected
12	Modem/printer	SI	112	CI	SPDMI
13					Unconnected
14					Unconnected
15	Modem/printer	TxCk (DCE)	114	DB	Modem transmit clock
16					Unconnected
17	Modem/printer	RxCk (DEC)	115	DD	Modem transmit clock
18					Unconnected
19					Unconnected
20	CPU Module	DTR	108.2	CD	Data terminal ready
21					Unconnected
22	Modem/printer	RI	125	CE	Ring indicator
23	CPU Module	SS	111	CH	DSRS
24					Unconnected
25					Unconnected

[1]Comite Consultatif International Telegraphique et Telephonique, an international consultative committee that sets international communications standards

[2]Electronic Industries Association

Table F-4. ThickWire Ethernet Connector Pin Assignments

Pin	Source	Signal	Description
1			Shield
2	XCVR	ACOL+	Collision presence
3	KNO3A-AA	ATX+	Transmission
4		GND	Ground
5	XCVR	ARX+	Reception
6	XCVR	GND	Power return
7		CTL+	Control output
8		GND	Ground
9	XCVR	ACOL–	Collision presence
10	KNO3A-AA	ATX–	Transmission
11		GND	Ground
12	XCVR	ARX–	Reception
13	KNO3A-AA	+12V	Power
14		GND	Ground
15		CTL–	Control output

Table F-5. Power Supply Pin Assignments

Pin	Signal	Wire Gauge
1	+12 volt	18
2	Ground	18
3	–12 volt	22
4	Ground	22
5	POK	22
6	Warning	22

Table F-6. Modem Loopback Connector Pin Assignments

From Pin No.	Signal	To Pin No.	Signal
P4-2	TX2	P4-3	RX2
P4-4	RTS2	P4-5	CTS2
P4-6	DSR2	P4-20	DTR2
P4-12	SPDMI2	P4-23	DSRS2
P4-18	LLPBK2	P4-8	CI2
P4-18	LLPBK2	P4-22	RI2
P4-18	LLPBK2	P4-25	TMI2

Table F-7. Ethernet Loopback Connector Pin Assignments

From Pin No.	Signal	To Pin No.	Signal	Description
P6-3	TRA+	P6-5	REC+	Through capacitor
P6-10	TRA–	P6-12	REC–	Through capacitor
P6-13	PWR	P6-6	RET	Through resistor and LED

Table F-8. Summary of Loopback Connectors

Function	Standard/ Unique	Part Number	Option Number
Communications loopback connector	Standard	12-15336-13	H3200
ThickWire loopback connector	Standard	12-22196-02	N/A
ThinWire T-connector	Standard	12-25869-01	H8223
ThinWire terminator	Standard	12-26318-01	H8225

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