

DECstation 5000 Model 100 Series

Maintenance Guide

First printing, May 1991
Second printing, January 1992
Third printing, April 1993

The information in this document is subject to change without notice and should not be construed as a commitment by Digital Equipment Corporation. Digital Equipment Corporation assumes no responsibility for any errors that may appear in this document.

The software described in this document is furnished under a license and may be used or copied only in accordance with the terms of such license.

Digital Equipment Corporation assumes no responsibility for the use or reliability of its software on equipment that is not supplied by Digital or its affiliated companies.

© Digital Equipment Corporation 1993.
All Rights Reserved
Printed in U.S.A.

USA

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.

The following are trademarks of Digital Equipment Corporation:

DEC	PDP	VAXBI
DECnet	ThinWire	VAXcluster
DECstation	TURBOchannel	VAXstation
DECsystem	ULTRIX	VMS
DECUS	ULTRIX-32	VT
MicroVAX	UNIBUS	
MicroVMS	VAX	

Contents

About This Guide	xxi
-------------------------------	------------

1 A Look at DECstation 5000 Model 100 Series Hardware

System Hardware Configurations	1-1
Basic System Hardware	1-3
System Unit	1-3
System Unit Controls and Indicators	1-5
System Unit Connectors	1-6
Hardware Options	1-8
CPU Modules	1-9
Additional Memory Modules	1-9
Optional TURBOchannel Modules	1-9
Drives	1-9
Monitors and Terminals	1-10
Keyboard, Mouse, and Other Pointing Devices	1-10
For Further Information	1-11

2 Service Operations

Using an Antistatic Kit	2-2
Using an Alternate Terminal	2-3
Removing and Installing the System Unit Cover	2-5
How to Remove the System Unit Cover	2-6
How to Install the System Unit Cover	2-6
Removing and Installing Loopback Connectors and Terminators	2-6
How to Remove a ThickWire Loopback Connector	2-7

How to Install a ThickWire Loopback Connector	2-7
How to Remove a Communications Loopback Connector	2-8
How to Install a Communications Loopback Connector	2-8
How to Remove a SCSI Chain Terminator	2-9
How to Install a SCSI Chain Terminator	2-9
How to Remove a Communications Line Adapter	2-11
How to Install a Communications Line Adapter	2-11
How to Remove a SCSI Controller Terminator	2-12
How to Install a SCSI Controller Terminator	2-12
Entering Console and Operating Modes	2-13
How to Enter Console Mode	2-14
How to Enter Operating Mode	2-14
Using Console Command Passwords	2-15
To Set or Change a Password	2-15
To Remove a Requirement for a Password	2-15
To Erase a Password You Do Not Know	2-16
Inserting and removing a clear-NVR jumper	2-17
Booting the System Software	2-18
Setting System Boot ROM Switches	2-18
Shutting Down the System Software	2-20

3 Troubleshooting Tools

Using Tests	3-2
Using Slot Numbers in Test Commands and Error Messages	3-2
Running Power-Up Self-Tests	3-4
Running Subtests	3-5
How to Run Individual Tests	3-5
How to Run Test Scripts	3-6
How to Display Lists of Available Tests	3-6
Displaying a list of available test scripts	3-7
Displaying the contents of a test script	3-7
How to Create Test Scripts	3-8
Interpreting Test Error Messages	3-9
Using ULTRIX Error Logs	3-10
Examining Error Logs	3-10
Error Log Format	3-10
Error log example	3-11
Event Types	3-12
Using Memory Error Logs	3-13
Analyzing the Memory Error Example	3-14

Using Error and Status Register Error Logs	3-15
Example 1: Error and status register error log ..	3-15
Analysis of Example 1	3-17
Example 2: Error and status register error log ..	3-18
Analysis of Example 2	3-20
Physical address space	3-21
For Further Information	3-22

4 Identifying Failed FRUs

Troubleshooting Process	4-2
Troubleshooting When the Power-Up Self-Test Does Not Complete	4-4
How to Troubleshoot When the Diagnostic LED Display Is 0011 1011, 0010 1011, 0001 1011, or 0000 1011.....	4-10
Troubleshooting when the right diagnostic LED display is 1011 and the system has a graphics module	4-10
Troubleshooting when the right diagnostic LED display is 1011 and the system has no graphics module	4-11
Troubleshooting When the Monitor Has No Display	4-12
Troubleshooting When an Error Message Appears on the Monitor	4-14
How to Troubleshoot When an Error or Exception Occurs During a Test.....	4-14
How to Troubleshoot When a Test Reports an Error	4-15
How to Troubleshoot When a Console Exception Occurs	4-19
Example: R4000 Console exception message	4-19
Example: R3000 Console exception message	4-20
Troubleshooting When Hardware Does Not Appear in the cnfg Display	4-22
Troubleshooting the Memory Modules	4-24
To Interpret Memory Test Error Messages	4-26
Example: Memory test error message	4-26
Troubleshooting SCSI Controllers and Devices.....	4-27
How to Use the sdiag Test.....	4-29
Troubleshooting an Ethernet Controller	4-30
How to Use the External Loopback Test	4-32
Example: External loopback test error messages	4-32
Troubleshooting a Printer, Modem, or Other Serial Line Device	4-33

How to Use the Transmit and Receive Test	4-35
Example: SCC transmit and receive test error messages	4-36
How to Use the Pins Test	4-37
Example: Pins test error messages	4-37
Troubleshooting the Power Supply	4-38
Troubleshooting If the System Unit Overheats	4-39
Troubleshooting the Keyboard and Mouse.....	4-42
Troubleshooting When ULTRIX Is Running but the Monitor Has No Display	4-44
Troubleshooting with ULTRIX Error Logs	4-47
To Interpret Error Log Event Types.....	4-47
To Interpret Physical Address Registers	4-48
For Further Information	4-50
Troubleshoot Daughter Card LEDs	4-50

5 Base System FRUs

System Module	5-2
System Module HardwareDescription	5-2
Removing and Installing a System Module.....	5-3
How to remove the system module.....	5-4
How to install a system module	5-6
Removing and Installing an ESAR Chip on the System Module	5-7
How to remove and install an ESAR chip.....	5-8
CPU Module	5-9
CPU Module Hardware Description	5-9
Removing and Installing a CPU Module	5-13
How to remove a CPU module	5-14
How to install a CPU module	5-14
Memory Modules.....	5-15
Memory Module Hardware Description	5-15
Removing and Installing Memory Modules	5-21
How to remove a memory module	5-22
How to install a memory module	5-24
Power Supply.....	5-26
Power Supply Hardware Description	5-26
Removing and Installing the Power Supply	5-28
How to remove the power supply	5-29
How to install the power supply	5-29

Removing and Installing the Power Supply Fan Assembly	5-30
How to remove the power supply fan assembly ..	5-31
How to install the power supply fan assembly ...	5-31
Removing and Installing an Option Module	5-32
How to remove an option module	5-32
How to install an option module	5-32
How to Remove and Install an ESAR Chip on a ThickWire Ethernet Option Module	5-33
For Further Information	5-35

6 Internal Drives

Internal Drives as Part of the System	6-2
Internal Drive Locations	6-2
Internal and External Drive Combinations	6-3
Internal Drive SCSI and Power Cable Connections	6-3
For Further Information About System Drives	6-5
Removing and Installing a Removable Media Drive	6-6
How to Remove a Removable Media Drive	6-7
How to Install a Removable Media Drive	6-8
Removing and Installing the Removable Media Drive Panel	6-9
How to Remove the Removable Media Drive Panel	6-10
How to Install the Removable Media Drive Panel	6-10
Removing and Installing a System Unit Cover Bezel	6-11
How to Remove a Bezel from the System Unit Cover ...	6-12
How to Install a Bezel in the System Unit Cover	6-12
Removing and Installing a Hard Disk Drive	6-13
How to Remove a Hard Disk Drive	6-14
How to Install a Hard Disk Drive	6-14
Information About Individual Drives	6-15
RZ23 Hard Disk Drive	6-16
RZ23L Half-Height Hard Disk Drive	6-18
RZ24 Hard Disk Drive	6-20
RZ24L Hard Disk Drive	6-23
RZ25 Hard Disk Drive	6-24
RZ26 Hard Disk Drive	6-28
RX23 Diskette Drive	6-30
RRD42 Optical Compact Disc Drive	6-32
TLZ06 Casette Tape Drive	6-34
TZK10 Quarter-inch Cartridge (QIC) Drive	6-35

7 Keyboards and Other Input Devices

Keyboard Hardware	7-2
Mouse and Tablet Hardware	7-3
Removing and Installing the Keyboard and Mouse	7-4
To Remove the Keyboard and Mouse and Their Cables	7-5
To Install the Keyboard and Mouse and Their Cables ..	7-5
LPFK and PFD Hardware	7-5

A Equipment Specifications

Environment Specifications	A-2
VR262 Monitor Equipment Specifications	A-3
VR297 Monitor Equipment Specifications	A-6
VR319-CA and VR319-C4 Monitor Equipment Specifications	A-8
VR319-DA and VR319-D4 Monitor Equipment Specifications	A-11
VRT16-DA and VRT16-D4 Monitor Equipment Specifications	A-14
VRT19-DA and VRT19-D4 Monitor Equipment Specifications	A-16
LK401-AA Keyboard Equipment Specifications	A-18
VSXXX-GA Mouse Equipment Specifications	A-20
VSXXX-AB Tablet Equipment Specifications	A-22
BA42 Storage Expansion Box Equipment Specifications	A-24
RZ23L SCSI Hard Disk Drive Equipment Specifications ...	A-25
RZ24L SCSI Hard Disk Drive Equipment Specifications ...	A-27
RZ25 SCSI Hard Disk Drive Equipment Specifications	A-29
RZ26 SCSI Hard Disk Drive Equipment Specifications	A-31
TK50Z Tape Drive Equipment Specifications	A-33
TZ30 Tape Drive Equipment Specifications	A-35
TZK10 QIC Tape Drive Equipment Specifications	A-37
TLZ04 Cassette Tape Drive Equipment Specifications	A-39
TLZ06 Cassette Tape Drive Equipment Specifications	A-40
RRD40 Compact Disc Drive Equipment Specifications	A-41
RRD42 Compact Disc Drive Equipment Specifications	A-42
RX23 Diskette Drive Equipment Specifications	A-43
RX33 Diskette Drive Equipment Specifications	A-45

B Recommended Spares List

C Console Commands

Entering Console Commands	C-2
Rules for Entering Console Commands	C-2
Conventions Used in This Chapter	C-3
Some Terms Used in This Chapter	C-3
Console Command Reference	C-4
Console Command Format Summary	C-5
? Command	C-7
boot Command	C-7
Important information about typing the boot command	C-8
cat Command	C-9
cnfg Command	C-10
General system configuration displays	C-10
Display with R4000 CPU Module	C-10
Display with R3000 CPU Module	C-10
Base system configuration displays	C-12
Display with the R4000 CPU Module	C-12
Display with the R3000 CPU Module	C-13
Ethernet controller configuration displays	C-14
SCSI controller displays	C-15
Color frame-buffer graphics module configuration displays	C-16
2D graphics accelerator module configuration displays	C-17
3D graphics module configuration displays	C-17
d Command	C-18
e Command	C-19
erl Command	C-21
go Command	C-21
init Command	C-21
ls Command	C-22
Sample display	C-22
passwd Command	C-23
printenv Command	C-23
restart Command	C-24
script Command	C-24
setenv Command	C-24
sh Command	C-27
t Command	C-28
test Command	C-28

unsetenv Command	C-28
Console Command Error Messages	C-30

D Base System Test Commands and Messages

Locating Individual Tests	D-2
System Module Tests	D-5
Halt Button Test	D-5
Halt button test error messages	D-5
Nonvolatile RAM (NVR) Test	D-6
NVR test error messages	D-6
Overheat Detect Test	D-6
Overheat detect test error message	D-6
Real-Time Clock (RTC) Period Test	D-7
RTC period test error messages	D-7
Real-Time Clock Registers Test	D-8
Real-time clock registers test error messages	D-8
Real-Time Test	D-9
Real-time test error messages	D-9
Serial Communication Chip (SCC) Access Test	D-10
SCC access test error messages	D-10
Serial Communication Chip (SCC) Direct Memory Access (DMA) Test	D-11
SCC DMA test error messages	D-12
Serial Communication Chip (SCC) Interrupts Test	D-13
SCC interrupts test error messages	D-13
Serial Communication Chip (SCC) I/O Test	D-14
SCC I/O test error messages	D-14
Serial Communication Chip (SCC) Pins Test	D-16
SCC pins test error messages	D-17
Serial Communication Chip (SCC) Transmit and Receive Test	D-19
SCC transmit and receive test error messages	D-20
CPU Module Tests	D-22
Cache Data Test	D-22
Cache data test error messages	D-22
Cache Fill Test	D-24
Cache fill test error messages	D-24
Cache Isolate Test	D-26
Cache isolate test error messages	D-26
Cache Reload Test	D-28
Cache reload test error messages	D-28
Cache Segment Test	D-30
Cache segment test error messages	D-30

Secondary Cache Test - scache/data	D-31
Scache Error	D-32
Floating-Point Unit (FPU) Test	D-32
FPU test error messages	D-32
CPU-Type Utility	D-34
CPU-type utility messages	D-34
Translation Lookaside Buffer (TLB) Probe Test	D-34
TLB probe test error messages	D-34
Translation Lookaside Buffer (TLB) Registers Test	D-35
TLB registers test error messages	D-35
Memory Module Tests	D-36
Floating 1/0 Memory Test	D-36
Floating 1/0 memory test error messages	D-36
Memory Module Test	D-37
Memory module test error messages	D-37
Zero Memory Utility	D-38
RAM Select Lines Test	D-38
RAM select lines test error messages	D-38
Partial Write Test	D-39
Partial write test error messages	D-39
Base System Ethernet Controller Tests	D-40
Collision Test	D-40
Collision test error messages	D-40
Common Diagnostic Utilities	D-41
Common diagnostic utility error messages	D-41
Cyclic Redundancy Code (CRC) Test	D-42
CRC test error messages	D-42
Display MOP Counters Utility	D-44
Ethernet-Direct Memory Access (DMA) Registers Test ..	D-44
Ethernet-DMA registers test error messages	D-44
Ethernet-Direct Memory Access (DMA) Transfer Test ...	D-46
Ethernet-DMA transfer test error messages	D-46
Ethernet Station Address ROM (ESAR) Test	D-48
ESAR test error messages	D-48
External Loopback Test	D-49
External loopback test error messages	D-49
Interrupt Request (IRQ) Test	D-50
IRQ test parameters and error codes	D-50
Internal Loopback Test	D-51
Internal loopback test error messages	D-51
Multicast Test	D-52
Multicast test error messages	D-52
Promiscuous Mode Test	D-54
Promiscuous mode test error messages	D-54

Registers Test	D-56
Registers test error messages	D-56
Base System SCSI Controller and Drive Tests	D-58
SCSI Controller Test	D-58
SCSI controller test error messages	D-58
SCSI Send Diagnostics Test	D-59
SCSI send diagnostics test error messages	D-59
SCSI Target Test	D-60
SCSI target test error messages	D-60
Power-Up LED Displays	D-63

E CPU and System Registers

CPU Registers - R3000 CPU Module	E-2
CPU Registers for R4000 Only	E-3
Cause Register (R3000 Only)	E-3
Cause Register (R4000 Only)	E-6
Exception Program Counter (EPC) (R3000 and R4000)	E-7
Status Register (R3000 Only)	E-8
Diagnostic status	E-9
Status Register (R4000 Only)	E-11
Diagnostic Status Field	E-13
BadVAddr Register (R3000 and R4000)	E-13
Error Exception Program Counter (Error EPC) (R4000 Only)	E-14
Configuration Register (R4000 Only)	E-14
Model 100 System Registers	E-16
Data Buffers 3 to 0	E-16
System Support Register (SSR)	E-17
System Interrupt Register (SIR)	E-21
System Interrupt Mask Register	E-28
Memory Error Register (MER)	E-29
Memory Size Register (MSR)	E-30
Error Address Register (EAR)	E-31

Index

Figures

1-1	Possible system hardware configurations	1-2
1-2	System unit	1-4
1-3	System unit controls and indicators	1-5
1-4	System unit connectors	1-7
1-5	Memory and expansion slots on the system module	1-8
2-1	How to use an antistatic kit	2-2
2-2	Connecting an alternate terminal	2-4
2-3	How to remove and install the system unit cover	2-5
2-4	How to remove and install a ThickWire loopback connector	2-7
2-5	How to remove and install a communications loopback connector	2-8
2-6	How to remove and install a SCSI chain terminator	2-10
2-7	How to remove and install a communications line adapter ..	2-11
2-8	How to remove and install a SCSI controller terminator	2-12
2-9	How to insert and remove a clear-NVR jumper	2-17
2-10	System Boot ROM Switches	2-19
3-1	Slot numbers for system hardware	3-3
4-1	Troubleshooting procedure	4-2
4-2	Troubleshooting when the LED display is 1111 1111, 0011 1111, 0011 1110, or 0011 1101	4-6
4-3	Troubleshooting when the LED display is 0011 0110	4-8
4-4	Troubleshooting when the LED display is 0010 0011, 0001 0011, 0000 0011, or 0000 0000	4-9
4-5	Troubleshooting when the monitor has no display	4-12
4-6	Troubleshooting when hardware does not appear in the cnfg display	4-22
4-7	Troubleshooting memory modules	4-25
4-8	Troubleshooting SCSI controllers and devices	4-27
4-9	Troubleshooting an Ethernet controller	4-30
4-10	Troubleshooting a printer, modem, or other serial line device	4-33
4-11	Troubleshooting when the system unit has no power	4-38
4-12	System module power cord connections	4-39
4-13	Troubleshooting if the system unit overheats	4-40
4-14	Checking the fan assembly power cord connection	4-41
4-15	Troubleshooting the keyboard and mouse	4-42
4-16	Troubleshooting the keyboard and mouse	4-43

4-17	Troubleshooting when ULTRIX is running but the monitor has no display	4-44
4-18	Troubleshooting when ULTRIX is running but the monitor has no display	4-46
5-1	System module	5-2
5-2	Removing a system module	5-3
5-3	Installing a system module	5-5
5-4	ESAR chip location	5-7
5-5	20- or 25-MHz CPU module	5-10
5-6	33-MHz CPU module	5-11
5-7	50-MHz R4000-based CPU module	5-12
5-8	Removing and installing a CPU module	5-13
5-9	2-Mbyte MS01-AA memory module	5-16
5-10	2-Mbyte MS01L-AB memory module	5-17
5-11	8-Mbyte memory module	5-18
5-12	Memory module slot numbers	5-19
5-13	Removing and installing a memory module	5-21
5-14	Removing a memory module	5-23
5-15	Installing a memory module	5-25
5-16	Power supply hardware	5-27
5-17	Removing and installing the power supply	5-28
5-18	Connecting the power supply fan assembly	5-30
5-19	Removing and installing an option module	5-33
5-20	Removing and installing an ESAR chip on a ThickWire Ethernet option module	5-34
6-1	Internal drive locations	6-2
6-2	Internal SCSI cable connectors	6-4
6-3	Internal power cable connectors	6-5
6-4	Disconnecting a removable media drive	6-6
6-5	Removing and installing a removable media drive	6-7
6-6	Removing and installing the removable media drive panel ..	6-9
6-7	Removing and installing a bezel in the system unit cover ...	6-11
6-8	Removing and installing a hard disk drive	6-13
6-9	RZ23 hard disk drive	6-16
6-10	RZ23 drive SCSI ID jumper settings	6-17
6-11	RZ23L half-height hard disk drive	6-18
6-12	RZ23L drive SCSI ID jumper settings	6-19
6-13	RZ24 hard disk drive	6-21
6-14	RZ24 drive SCSI ID jumper settings	6-22

6-15	RZ24L drive SCSI ID jumper settings	6-23
6-16	RZ25 hard disk drive	6-25
6-17	RZ25 hard disk drive front jumper settings	6-26
6-18	RZ25 hard disk drive side jumper settings	6-27
6-19	RZ26 hard disk	6-28
6-20	RZ26 hard disk drive jumper settings	6-29
6-21	RX23 diskette drive	6-30
6-22	RX23 drive SCSI ID switch settings	6-31
6-23	RRD42 optical compact disc drive	6-32
6-24	RRD42 drive SCSI ID jumper settings	6-33
6-25	TLZ06 Cassette tape drive.....	6-34
6-26	TZK10 quarter-inch streaming tape drive.....	6-35
6-27	TZK10 drive SCSI ID jumper settings.....	6-36
7-1	LK201 and LK401 keyboards	7-2
7-2	Mouse	7-3
7-3	Tablet	7-3
7-4	Removing and installing a keyboard and mouse	7-4
B-1	Major FRUs for the DECstation 5000 Model 100 Series.....	B-2

Tables

1	Conventions Used in This Guide	xxiii
3-1	Slot Numbers Used in Test Commands	3-5
3-2	Error Log Event Types.....	3-12
3-3	Hardware Physical Addresses	3-21
4-1	Troubleshooting Procedure for Each LED Error Code	4-5
4-2	Interpreting Base System Test Error Messages Displayed on the Monitor	4-16
4-3	Error Log Event Types	4-48
4-4	Hardware Physical Addresses	4-49
5-1	Memory Module Slot Address Ranges	5-20
A-1	DECstation 5000 Model 100 Series Operating Conditions ...	A-2
A-2	DECstation 5000 Model 100 Series Nonoperating Conditions	A-2
A-3	VR262 Monitor Description	A-3
A-4	VR262 Monitor Operating Conditions	A-5
A-5	VR262 Monitor Nonoperating Conditions	A-5
A-6	VR297 Monitor Description	A-6
A-7	VR297 Monitor Operating Conditions	A-7

A-8	VR297 Monitor Nonoperating Conditions	A-7
A-9	VR319-CA and VR319-C4 Monitor Description	A-8
A-10	VR319-CA and VR319-C4 Monitor Operating Conditions	A-10
A-11	VR319-CA and VR319-C4 Monitor Nonoperating Conditions	A-10
A-12	VR319-DA and VR319-D4 Monitor Description	A-11
A-13	VR319-DA and VR319-D4 Monitor Operating Conditions	A-13
A-14	VR319-DA and VR319-D4 Monitor Nonoperating Conditions	A-13
A-15	VRT16-DA and VRT16-D4 Monitor Description	A-14
A-16	VRT16-DA and VRT16-D4 Monitor Operating Conditions ...	A-15
A-17	VRT16-DA and VRT16-D4 Monitor Nonoperating Conditions	A-15
A-18	VRT19-DA and VRT19-D4 Monitor Description	A-16
A-19	VRT19-DA and VRT19-D4 Monitor Operating Conditions ...	A-17
A-20	VRT19-DA and VRT19-D4 Monitor Nonoperating Conditions	A-17
A-21	LK401-AA Keyboard Description	A-18
A-22	LK401-AA Keyboard Operating Conditions	A-19
A-23	LK401-AA Keyboard Nonoperating Conditions	A-19
A-24	VSXXX-GA Mouse Description	A-20
A-25	VSXXX-GA Mouse Operating Conditions	A-21
A-26	VSXXX-GA Mouse Nonoperating Conditions	A-21
A-27	VSXXX-AB Tablet Description	A-22
A-28	VSXXX-AB Tablet Operating Conditions	A-23
A-29	VSXXX-AB Tablet Nonoperating Conditions	A-23
A-30	BA42 Storage Expansion Box Description	A-24
A-31	BA42 Storage Expansion Box Operating Conditions	A-24
A-32	BA42 Storage Expansion Box Nonoperating Conditions	A-24
A-33	RZ23L SCSI Hard Disk Drive Description	A-25
A-34	RZ23L SCSI Hard Disk Drive Operating Conditions	A-26
A-35	RZ23L SCSI Hard Disk Drive Nonoperating Conditions	A-26
A-36	RZ24L SCSI Hard Disk Drive Description	A-27
A-37	RZ24L SCSI Hard Disk Drive Operating Conditions	A-28
A-38	RZ24L SCSI Hard Disk Drive Nonoperating Conditions	A-28
A-39	RZ25 SCSI Hard Disk Drive Description	A-29
A-40	RZ25 SCSI Hard Disk Drive Operating Conditions	A-30
A-41	RZ25 SCSI Hard Disk Drive Nonoperating Conditions	A-30
A-42	RZ26 SCSI Hard Disk Drive Description	A-31

A-43	RZ26 SCSI Hard Disk Drive Operating Conditions	A-32
A-44	RZ26 SCSI Hard Disk Drive Nonoperating Conditions	A-32
A-45	TK50Z Tape Drive Description	A-33
A-46	TK50Z Tape Drive Operating Conditions	A-34
A-47	TK50Z Tape Drive Nonoperating Conditions	A-34
A-48	TZ30 Tape Drive Description	A-35
A-49	TZ30 Tape Drive Operating Conditions	A-36
A-50	TZ30 Tape Drive Nonoperating Conditions	A-36
A-51	TZK10 QIC Tape Drive Description	A-37
A-52	TZK10 QIC Tape Drive Operating Conditions	A-38
A-53	TZK10 QIC Tape Drive Nonoperating Conditions	A-38
A-54	TLZ04 Cassette Tape Drive Description	A-39
A-55	TLZ04 Cassette Tape Drive Operating Conditions	A-39
A-56	TLZ04 Cassette Tape Drive Nonoperating Conditions	A-39
A-57	TLZ06 Cassette Tape Drive Description	A-40
A-58	TLZ06 Cassettes	A-40
A-59	TLZ06 Cassette Tape Drive Operating Conditions	A-40
A-60	TLZ06 Cassette Tape Drive Nonoperating Conditions	A-40
A-61	RRD40 Compact Disc Drive Description (Tabletop)	A-41
A-62	RRD40 Compact Disc Drive Operating Conditions (Tabletop)	A-41
A-63	RRD40 Compact Disc Drive Nonoperating Conditions (Tabletop)	A-41
A-64	RRD42 Compact Disc Drive Description	A-42
A-65	RRD42 Compact Disc Drive Operating Conditions	A-42
A-66	RRD42 Compact Disc Drive Nonoperating Conditions	A-42
A-67	RX23 Diskette Drive Description	A-43
A-68	RX23 Diskette Drive Operating Conditions	A-44
A-69	RX23 Diskette Drive Nonoperating Conditions	A-44
A-70	RX33 Diskette Drive Description	A-45
A-71	RX33 Diskette Drive Operating Conditions	A-46
A-72	RX33 Diskette Drive Nonoperating Conditions	A-46
B-1	Major FRUs	B-3
B-2	Internal Drives	B-4
B-3	TURBOchannel Option Modules	B-4
B-4	Monitors	B-5
B-5	Input Devices	B-6
B-6	Cords, Cables, and Connectors	B-7

B-7	Loopback Connectors, Plugs, Test Media, and Miscellaneous Items	B-8
B-8	Software Documentation	B-9
B-9	Hardware Documentation	B-10
C-1	Console Command Functions	C-6
C-2	Environment Variables in the Environment Variable Display	C-25
C-3	Console Command Error Messages	C-30
D-1	Individual Tests and Utilities	D-2
D-2	RTC Period Test Error Codes	D-7
D-3	Real-Time Clock Register Test Error Codes and Descriptions	D-8
D-4	Real-Time Test Error Codes	D-9
D-5	SCC DMA Test Error Codes	D-12
D-6	SCC I/O Test Error Codes and Descriptions	D-15
D-7	Pin Pairs Tested by Individual Loopback Connectors	D-17
D-8	SCC Pins Test Error Codes and Descriptions	D-18
D-9	SCC Transmit and Receive Test Error Codes and Descriptions	D-21
D-10	Cache Data Test Error Codes	D-23
D-11	Cache Fill Test Error Descriptions	D-25
D-12	Cache Isolate Test Error Codes	D-27
D-13	Cache Reload Test Error Descriptions	D-29
D-14	Cache Segment Test Error Codes and Descriptions	D-31
D-15	FPU Test Error Codes	D-33
D-16	TLB Registers Test Error Descriptions	D-35
D-17	Partial Write Test Error Codes	D-39
D-18	Collision Test Error Codes and Descriptions	D-40
D-19	Common Diagnostic Utility Error Codes and Descriptions ...	D-41
D-20	CRC Test Error Codes and Descriptions	D-43
D-21	Ethernet-DMA Registers Test Error Codes and Descriptions	D-45
D-22	Ethernet-DMA Registers Test Error Codes and Descriptions	D-47
D-23	ESAR Test Error Codes and Descriptions	D-48
D-24	External Loopback Test Error Codes and Descriptions	D-49
D-25	IRQ Test Error Codes and Descriptions	D-50
D-26	Internal Loopback Test Error Codes and Descriptions	D-52
D-27	Multicast Test Error Codes and Descriptions	D-53
D-28	Promiscuous Mode Test Error Codes and Descriptions	D-55

D-29	Registers Test Error Codes and Descriptions	D-57
D-30	SCSI Controller Error Codes and Descriptions.....	D-58
D-31	SCSI Send Diagnostics Test Error Descriptions	D-60
D-32	SCSI Target Test Error Codes and Descriptions	D-61
D-33	Power-Up LED Displays	D-63
E-1	R3000A CPU Registers	E-2
E-2	R4000 CPU Registers	E-3
E-3	Exception Codes	E-5
E-4	Exception Codes R4000	E-6
E-5	Diagnostic Status Fields	E-13
E-6	Config Registers	E-15
E-7	Model 100 System Registers	E-16
E-8	System Support Register 0x1C040100	E-17
E-9	LEDs Controlled by SSR LEDS Register Bits	E-20
E-10	System Interrupt Register 0x1C040110	E-22
E-11	System Interrupt Mask Register 0x1C040120	E-28
E-12	Memory Error Register 0x0C400000	E-29
E-13	Memory Size Register 0x0C800000	E-30
E-14	Error Address Register.....	E-31

About This Guide

Intended Audience

This guide is for Digital customer service representatives who have completed training in DECstation 5000 Model 100 Series 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). Chapters 1, 2, and 3 give background information about the system hardware and operations regularly used for customer service. Chapter 4 describes how to determine which FRU failed. Chapters 5, 6, and 7 explain how to troubleshoot and replace base system FRUs.

For an overview of the system hardware and its configurations, refer to Chapter 1, “A Look at DECstation 5000 Model 100 Series Hardware.”

To perform routine service operations, refer to Chapter 2, “Service Operations.”

To run tests and interpret their error codes, refer to Chapter 3, “Troubleshooting Tools.”

To identify which FRU failed, refer to Chapter 4, “Identifying Failed FRUs.”

For a description of the hardware and replacement procedures for individual FRUs that make up the base system, refer to Chapter 5, “Base System FRUs.”

For a description of the hardware and replacement procedures for base system drives, refer to Chapter 6, “Internal Drives.”

For a description of the hardware and replacement procedures for the keyboard, mouse, and other pointing devices, refer to Chapter 7, “Keyboards and Other Input Devices.”

For equipment specifications, refer to Appendix A, “Equipment Specifications.”

For equipment part numbers and a recommended spares list, refer to Appendix B, “Recommended Spares List.”

For an explanation of console commands, including configuration displays, SCSI utilities, and boot commands, refer to Appendix C, “Console Commands.”

For information about individual tests, refer to Appendix D, “Base System Test Commands and Messages.”

For information about R3000A and R4000 CPU and registers, refer to Appendix E, “CPU and System Registers.”

For information about TURBOchannel options that are installed in the system, refer to the *TURBOchannel Maintenance Guide*.

Conventions Used in This Guide

Table 1. Conventions Used in This Guide

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.
<i>Italic type</i>	<i>Any part of a command that you replace with an actual value is set in italic type, like this.</i>

A Look at DECstation 5000 Model 100 Series Hardware

This chapter describes

- Possible system hardware configurations
- Basic system hardware

System Hardware Configurations

The DECstation 5000 Model 100 Series are a reduced instruction set computer (RISC), ULTRIX-based, desktop system. Basic DECstation 5000 Model 100 Series hardware supports small computer system interface (SCSI) buses, Ethernet connections, TURBOchannel options, serial line devices such as a modem and printer, and additional memory. If the R4000 CPU module is installed, the system is designated as a Model 150. If the R3000 CPU module is installed, the system is designated as a Model 120, 125 or a 133.

Figure 1-1 shows the possible base system configurations. Each item in Figure 1-1 is a field-replaceable unit (FRU).

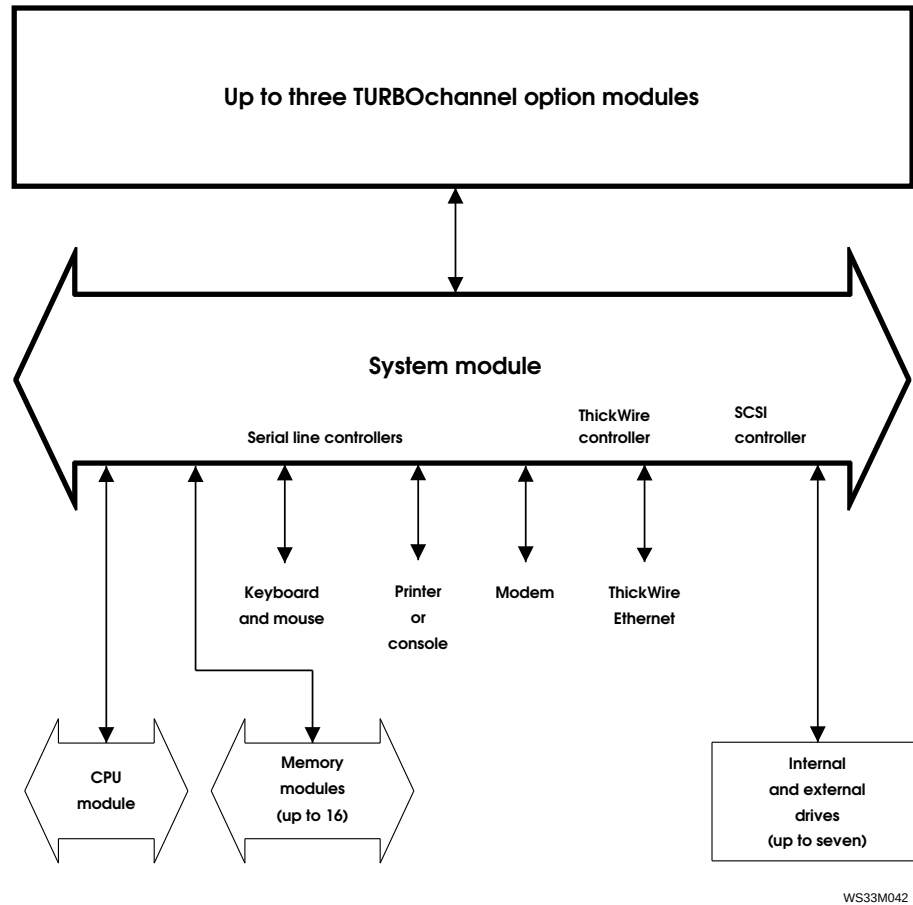


Figure 1-1. Possible system hardware configurations

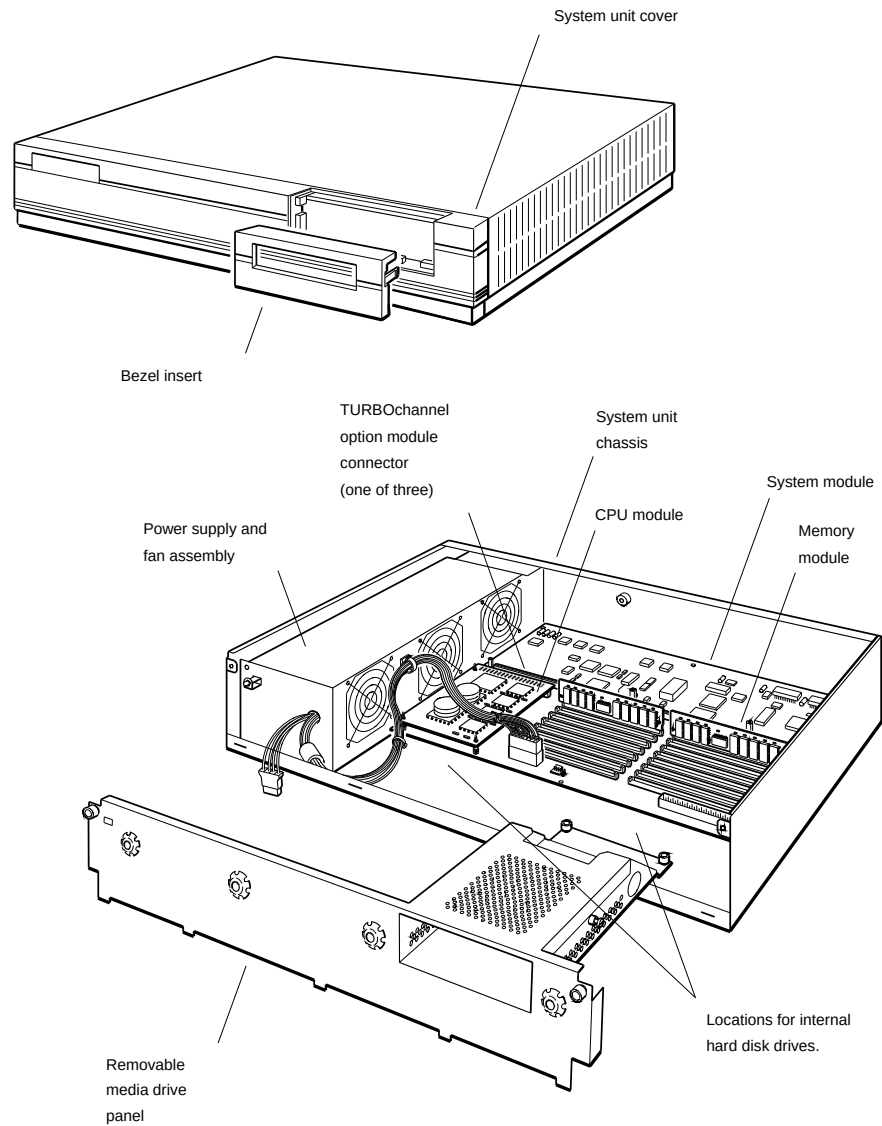
Basic System Hardware

The basic system hardware includes a system unit with controls, indicators, and system connectors.

System Unit

The system unit, shown in Figure 1-2, includes the following:

- One system module, which includes
 - One small computer system interface (SCSI) controller
 - Two serial line controllers
 - One ThickWire Ethernet controller
 - Sixteen slots for memory modules
 - Three expansion slots for TURBOchannel option modules
- One CPU module, which has a floating-point unit (FPU) and cache memories
- One to eight pairs of 2-Mbyte or 8-Mbyte memory modules that connect to the system module
- One power supply, which has three cooling fans
- Space for up to three internal drives
- A removable system unit cover and removable media drive panel
- One metal chassis that holds the system module, internal drives, and power supply



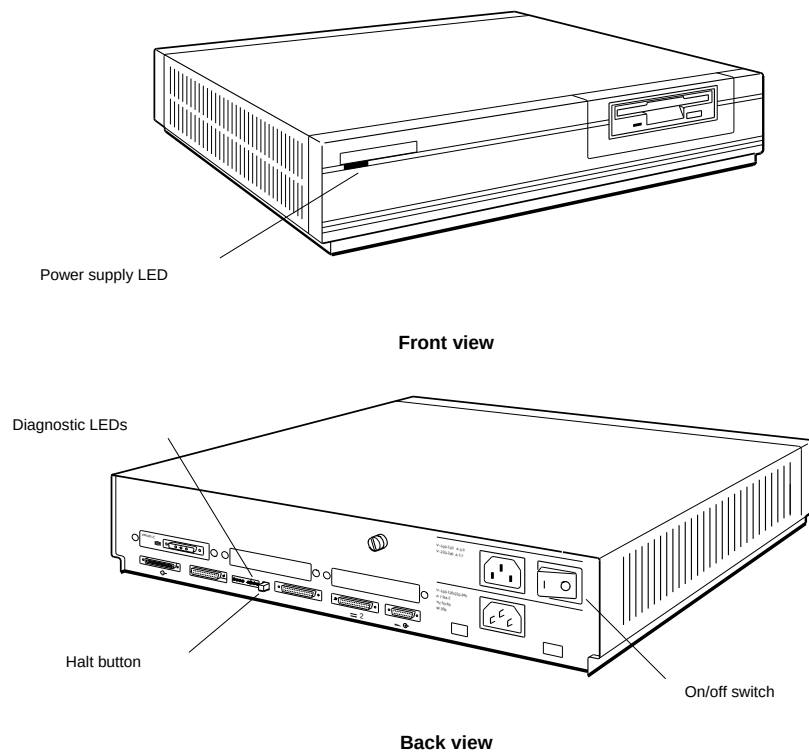
WS33M056

Figure 1-2. System unit

System Unit Controls and Indicators

The system unit controls and indicators, shown in Figure 1-3, have the following uses:

- The on/off switch turns the system unit on and off.
- The power indicator glows green when the power supply is operating properly.
- The diagnostic LEDs display binary error codes that indicate test results.
- Pressing the halt button puts the system in console mode.



WS33M014

Figure 1-3. System unit controls and indicators

System Unit Connectors

The system unit connectors, shown in Figure 1-4, have the following purposes:

- The power connector is where the system unit power cord is inserted.
- The monitor-to-system-unit connector is where the monitor power cord is inserted.
- The base system ThickWire Ethernet connector links the system unit to an Ethernet network.
- The base system SCSI connector connects the system module's SCSI controller to a chain of external drives.
- The keyboard-mouse connector links the system unit to the keyboard-mouse cable.
- The communications connectors join serial line controllers to devices such as printers, modems, and console terminals. If the system includes a console terminal, the terminal connects to the "Serial Line 3" communications connector on the back of the system.
- If an option module is installed, the connectors used to attach interface cables to the external device will be seen on the face plate of the option module which protrudes from one of the three option module slots just above the bottom row of connectors on the back. The option module number is printed above each option module connector.

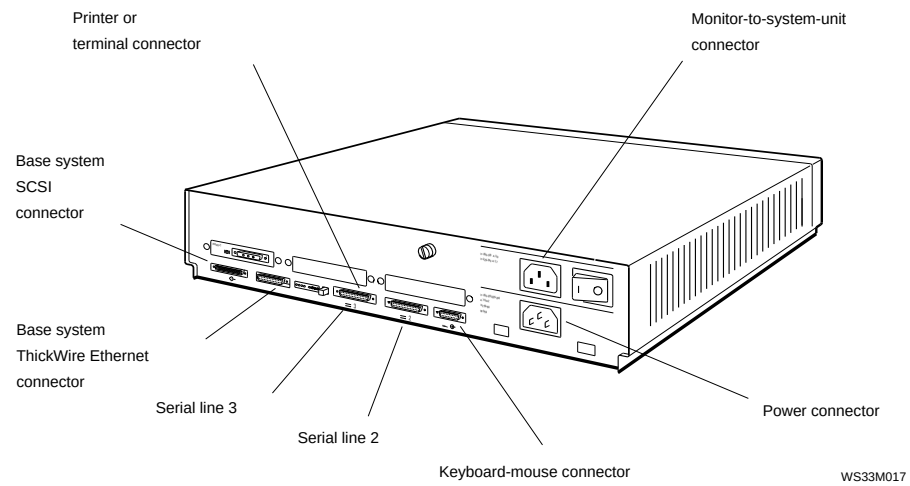


Figure 1-4. System unit connectors

Hardware Options

Figure 1-5 shows the system module with its replaceable CPU module slot, slots for additional memory modules, an internal SCSI connector, and three TURBOchannel option module slots.

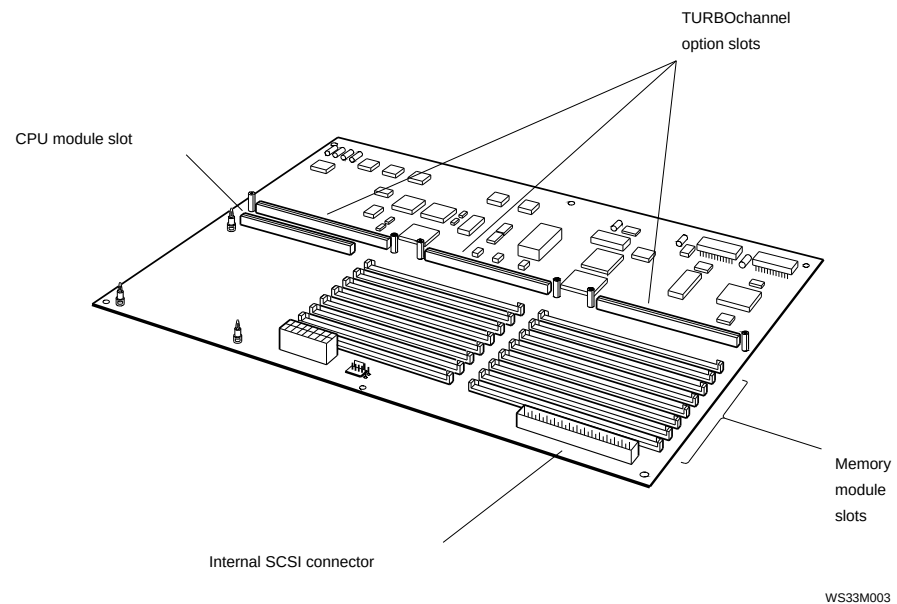


Figure 1-5. Memory and expansion slots on the system module

CPU Modules

The CPU module slot holds one of the following CPU modules:

- 20 MHz R3000 CPU module
- 25 MHz R3000 CPU module
- 33 MHz R3000 CPU module
- 50 MHz R4000 CPU module

Additional Memory Modules

The system module has eight pairs of slots for additional memory modules. Each memory slot supports one 2-Mbyte or 8-Mbyte memory module.

The memory modules must be installed in pairs, starting with the paired memory slots numbered 0, which are the slots nearest the back of the system. Do not mix 2-Mbyte and 8-Mbyte memory modules in a single system.

Optional TURBOchannel Modules

The TURBOchannel slots on the system unit support up to three TURBOchannel option modules.

SCSI or Ethernet TURBOchannel option modules operate in addition to the SCSI and ThickWire Ethernet controllers that are already on the system module.

Drives

Each SCSI controller supports up to seven drives.

- The base system SCSI controller supports up to seven internal and external drives.
 - Up to three internal drives can reside inside the system unit, near the front. These drives connect to a cable that attaches to an internal SCSI connector on the system module.
 - External drives connect in a separate chain that attaches to the base system SCSI connector on the back of the system unit. You can add external drives to the base system SCSI controller until there are a total of seven drives on the entire SCSI bus. The maximum

SCSI cable length is 6 meters (236 inches), including the internal cable length.

- Each TURBOchannel SCSI option module supports up to seven external drives that connect in a chain attached to the SCSI option module connector on the back of the system unit. The cable connecting the drives can be up to 6 meters (236 inches) long.

Monitors and Terminals

The system supports different monitors, depending on which graphics modules are in the system. Refer to the *TURBOchannel Maintenance Guide* for a description of the monitors that each graphics module supports.

The system can also display text on a VT320 terminal when attached to the Serial Line 3 communications connector on the back of the system unit.

Keyboard, Mouse, and Other Pointing Devices

The system uses a keyboard and a mouse or other pointing device. The keyboard and pointing device connect to the back of the system unit through the keyboard-mouse cable.

The keyboard can be one of the following:

- LK201 keyboard
- LK401 keyboard

The mouse or other pointing device can be one of the following:

- VSXXX-GA mouse
- VSXXX-AB tablet
- Lighted programmable function keyboard (LPFK)
- Programmable function dials (PFD)

For Further Information

For system hardware troubleshooting information, refer to Chapter 3 and Chapter 4.

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

For further information about TURBOchannel option module hardware and troubleshooting procedures, refer to the *TURBOchannel Maintenance Guide*.

Service Operations

The contents of this chapter explain how to:

- Avoid electrostatic damage when handling components
- Use an alternate terminal
- Remove the system unit cover
- Install and remove terminators and loopback connectors
- Enter console mode and operating mode
- Use console command passwords
- Boot the system software
- Setting the system boot ROM switches
- Shut down the system software

Using an Antistatic Kit

The Digital antistatic kit contains the equipment you need to handle static-sensitive materials safely. When handling static-sensitive materials, always

- Connect the antistatic mat to the system chassis.
- Place the antistatic wrist strap around your wrist. Then attach the other end of the strap to the snap-on fastener on the antistatic mat before you handle any static-sensitive component.
- Place the static-sensitive component on the antistatic mat when you set it down.

Figure 2-1 shows the antistatic kit parts and their proper use.

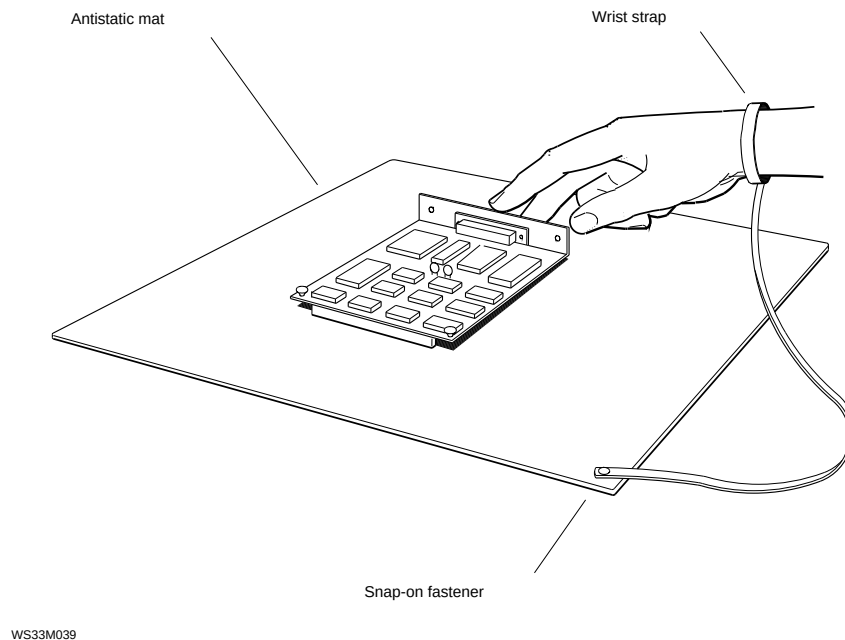


Figure 2-1. How to use an antistatic kit

Using an Alternate Terminal

If the system monitor is not working properly, you can use a VT320 terminal set to 9600 baud as an alternate console.

Figure 2-2 shows how to connect an alternate terminal.

To connect an alternate terminal,

1. Go to console mode to shut down system software, if necessary. Refer to “How to Enter Console Mode” section of this chapter for specific instructions.
2. Turn off the system unit.
3. Install a communications line adapter on the Serial Line 3 communications connector that is on the back of the system. Refer to “How to Install a Communications Line Adapter” section of this chapter for more specific instructions.
4. Insert the end of the VT320 cable into the communications line adapter on the back of the system unit. Make sure that the alternate keyboard is connected to the VT320.
5. Turn on the alternate terminal.
6. Turn on the system unit.
7. On the regular keyboard, at the console prompt (>>) or after approximately two minutes if no prompt appears, type **setenv console s** and press Return. The system then sets the alternate terminal as the console. Even if the graphics module doesn’t work and the console prompt doesn’t appear, the regular keyboard should still work. See Appendix C for information about the **setenv** command.
8. If the regular keyboard does not work or the system does not accept the **setenv console s** command for some reason, proceed as follows:
 - Shut down the system unit.
 - Remove the graphics module. Refer to “How to remove an option module” section in Chapter 5 for specific instructions.
 - Connect the alternate terminal and keyboard.
 - Turn on the system unit.

The system starts with the alternate terminal and keyboard enabled.

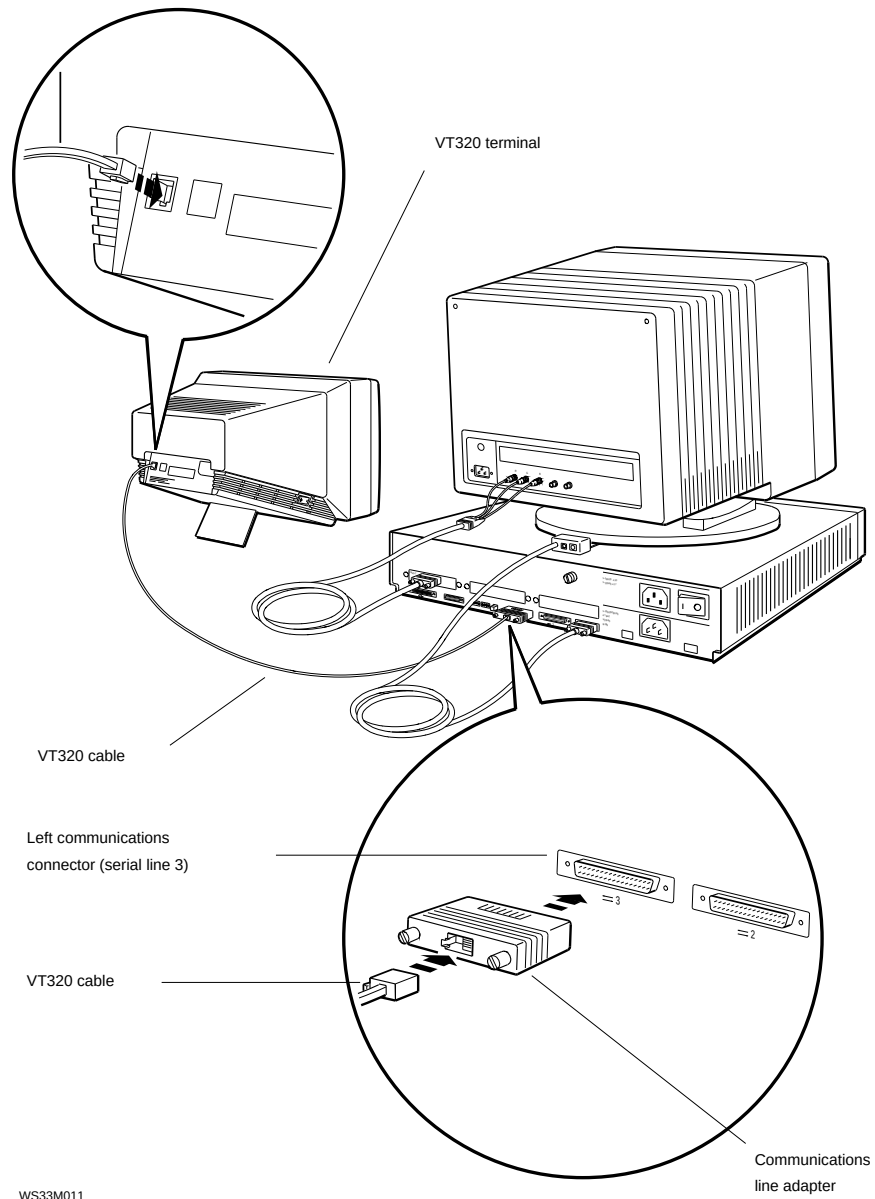


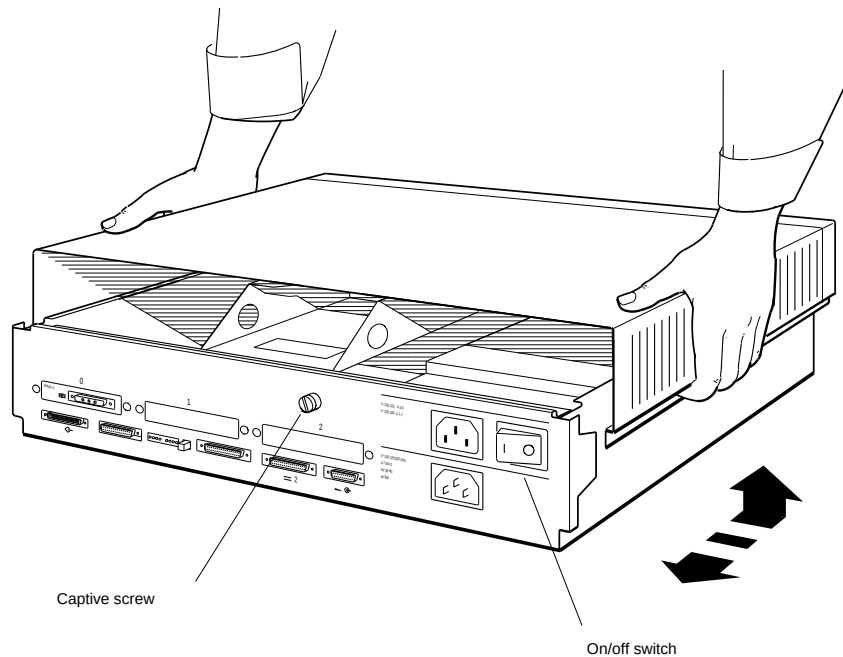
Figure 2-2. Connecting an alternate terminal

To return to using a monitor as the console, type **setenv console *** and press Return. The system then returns to using the monitor connected to the graphics module in the lowest-numbered TURBOchannel option slot as the console.

When acting as the console, the alternate terminal displays the same text as a regular system monitor. When the alternate terminal is activated, you can type commands only from the alternate keyboard.

Removing and Installing the System Unit Cover

Figure 2-3 shows how to remove and install the system unit cover.



WS33M036

Figure 2-3. How to remove and install the system unit cover

How to Remove the System Unit Cover

1. Turn off system power.
2. Loosen the captive screw that holds the cover.
3. Face the front of the system unit and grip each side of the system unit cover.
4. Pull the cover toward you until it comes loose from the chassis. Then lift the cover up and away from the system unit.

How to Install the System Unit Cover

1. Place the system unit cover on the chassis. Leave at least 2 inches between the cover and the back of the system unit.
2. Make sure that all cables, especially drive cables, are safely within the enclosure before closing the cover. If you catch a cable with the cover, you can disconnect a drive or damage a cable or other component.
3. Slide the system unit cover toward the back of the system unit until it pops into place.
4. Tighten the captive screw.

Removing and Installing Loopback Connectors and Terminators

This section provides instructions on how to remove and install a specific loopback connector or terminator.

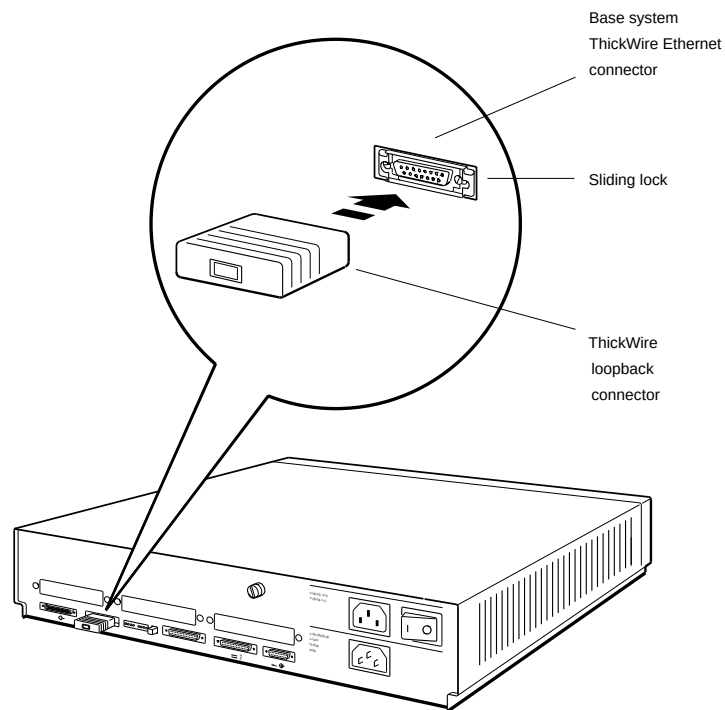
Note: Care should be taken when installing any loopback connector or terminator in that they should be inserted and extracted with a straight forward or straight back motion. Tilting the connector to one side with force may damage connector pins.

How to Remove a ThickWire Loopback Connector

1. Ensure the connector sliding lock is disengaged.
2. Firmly grip the ThickWire loopback connector.
3. Pull the ThickWire loopback connector away from the ThickWire connector.

How to Install a ThickWire Loopback Connector

1. Align the wide end of the loopback connector and the wide end of the ThickWire Ethernet connector.
2. Firmly press the loopback connector onto the ThickWire Ethernet connector.
3. Engage the connector sliding lock to securely hold connector in place.



WS33M035

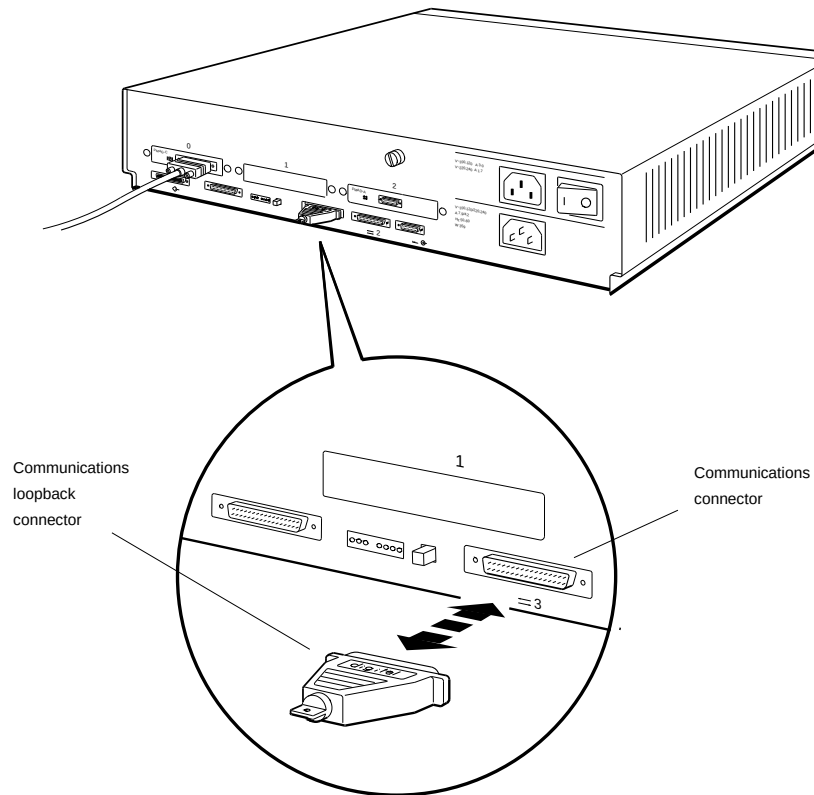
Figure 2-4. How to remove and install a ThickWire loopback connector

How to Remove a Communications Loopback Connector

1. Firmly grip the communications loopback connector.
2. Pull the communications loopback connector away from the communications connector on the system unit.

How to Install a Communications Loopback Connector

1. Align the wide end of the loopback connector and the wide end of the communications connector.
2. Firmly press the loopback connector onto the communications connector.



WS33M037

Figure 2-5. How to remove and install a communications loopback connector

How to Remove a SCSI Chain Terminator

The last externally-mounted SCSI drive in a chain requires a terminator on its unused connector. To remove the SCSI chain terminator from the drive at the end of an externally-mounted chain of SCSI drives:

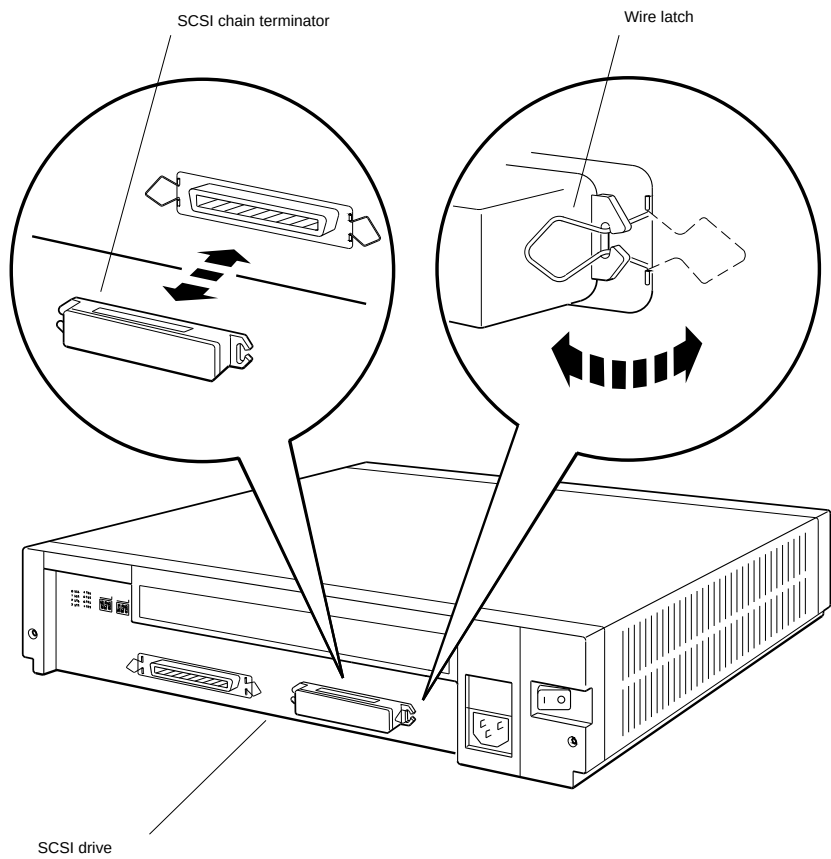
1. Push the wire latches away from the terminator.
2. Pull the terminator off the SCSI connector.

How to Install a SCSI Chain Terminator

The last externally-mounted SCSI drive in a chain requires a terminator on its unused connector. Install the terminator as follows:

1. Firmly press the chain terminator onto the unused connector on the drive at the end of the chain.
2. Press the SCSI connector wire latches onto the SCSI terminator.

Note: *These instructions apply only to externally-mounted SCSI drives. The internal SCSI cable includes a hard-wired terminator.*



WS33M038

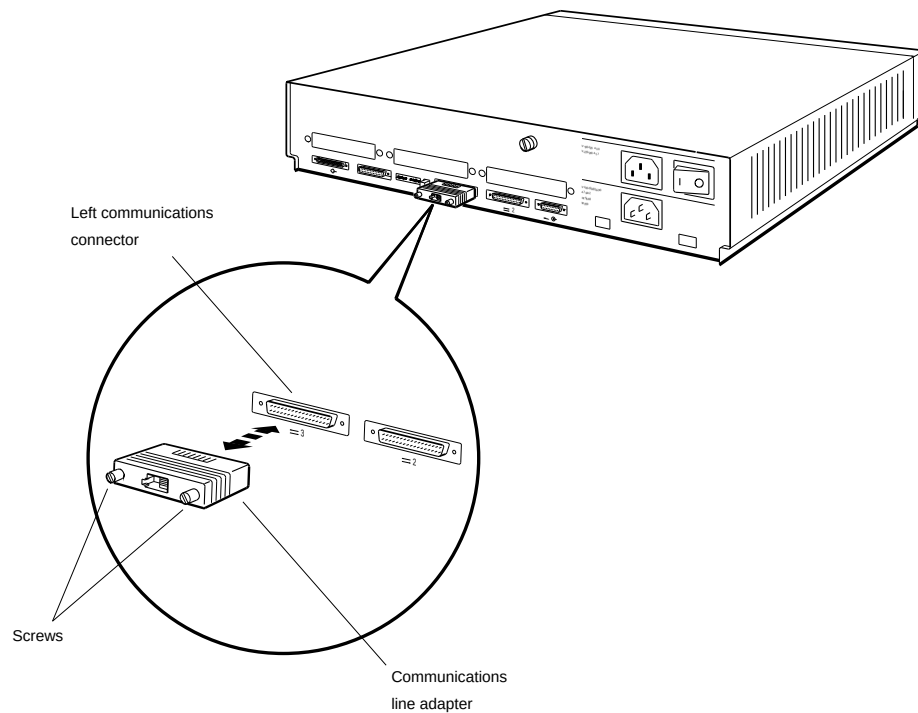
Figure 2-6. How to remove and install a SCSI chain terminator

How to Remove a Communications Line Adapter

1. Loosen the two screws that hold the adapter to the communications connector.
2. Pull the communications line adapter away from the system unit.

How to Install a Communications Line Adapter

1. Firmly press the communications line adapter onto the communications connector.
2. Tighten the two screws.



WS33M040

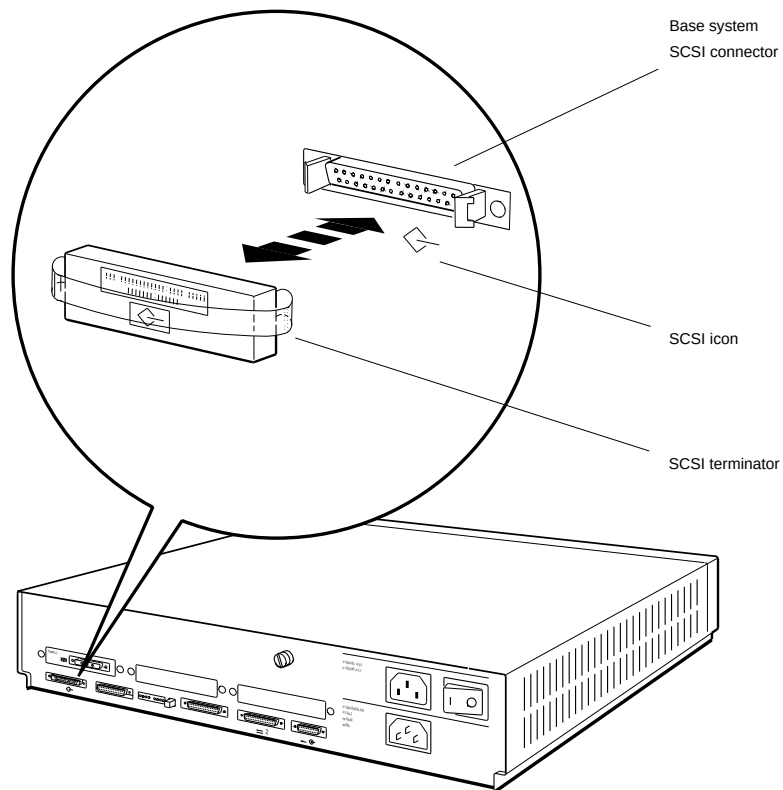
Figure 2-7. How to remove and install a communications line adapter

How to Remove a SCSI Controller Terminator

1. Grip the end of the SCSI controller terminator.
2. Pull the terminator off the SCSI connector and away from the system unit.

How to Install a SCSI Controller Terminator

1. Align the terminator over the SCSI connector so that the D-connectors line up with each other.
2. Firmly press the terminator onto the SCSI connector.



WS33M044

Figure 2-8. How to remove and install a SCSI controller terminator

Entering Console and Operating Modes

The system operates in one of two modes: console mode or operating mode.

- *Console mode*

Use console mode to

- Run diagnostic tests
- Display hardware configurations
- Set environment variables
- Boot the system software

You can use all console commands whenever the system displays the >> prompt. If the system displays the R> prompt, you can use only the boot and password console commands until you enter the correct password.

- *Operating mode*

In operating mode, the system displays the appropriate ULTRIX prompt. Use operating mode for regular software operation.

How to Enter Console Mode

Enter console mode by turning on the system power or pressing the halt button. If the system is running software, shut down the system software before you enter console mode. Refer to “Shutting Down the System Software” section for information about shutting down the system software. The system enters console mode automatically when system software is shut down. When you turn on the system power, the system completes a power-up self-test before displaying the console prompt.

If the system displays the `R>` prompt, you can use only the boot and password commands until you enter the password. To enter the password, type **passwd** and press Return. At the `pwd:` prompt, type the password and press Return. When you have access to all console commands, the system displays the `>>` prompt.

For information about setting and removing console command passwords, refer to “Using Console Command Passwords” section of this chapter.

How to Enter Operating Mode

Enter operating mode by booting the system. Specific booting instructions are contained in “Booting the System Software” section of this chapter.

If the system is set up for autoboot, the system goes directly to operating mode after the power-up self-test without displaying the console prompt. Autoboot performs on power-up when the halt action environment variable has been set to `b` and the boot environment variable has been set to a meaningful bootpath.

For further command information, refer to “boot Command” and “setenv Command” sections in Appendix C.

Using Console Command Passwords

To be able to use all console commands on a system that requires a password, type **passwd** at the **R>** prompt. Then type the password and press Return. The system then allows you to use all console commands. Whenever all console commands are available, the system uses the **>>** prompt.

To Set or Change a Password

To set or change a password, use the **passwd** command with the **-s** option.

1. Type **passwd -s** at the **>>** prompt and press Return.
2. At the **pwd:** prompt, type the new password and press Return.
3. The system then repeats the **pwd:** prompt. Enter the password a second time at the **pwd:** prompt.

Note that passwords must

- Have at least six characters
- Have no more than 32 characters
- Use uppercase and lowercase letters the same as when you first entered the password

If the two password entries match, the entry becomes the new password. If the two entries do not match, the old password remains in effect.

To Remove a Requirement for a Password

To remove a requirement for a password, type **passwd -c** at the **>>** prompt and press Return. Note that you must first enter the existing password to be able to use the **-c** option with the **passwd** command.

To Erase a Password You Do Not Know

You can erase a password by inserting a clear-nonvolatile-RAM (NVR) jumper. After you insert a clear-NVR jumper, you will need to reset all environment variables.

To erase a password you do not know,

1. Turn off the system power.
2. Install the clear-NVR jumper (part # 12-14314-00). Refer to the next section for installation directions.
3. Turn on the system and wait for the console prompt to appear.
4. Turn off the system again.
5. Remove the clear-NVR jumper.
6. Turn on the system power.
7. Use the `setenv` command to reset environment variables to the values you want.

After you erase the password, the console commands have no password protection until you set a new password.

Use the `setenv` command to reset the environment variables. For an explanation of the `setenv` command, refer to “Console Commands.” section in Appendix C.

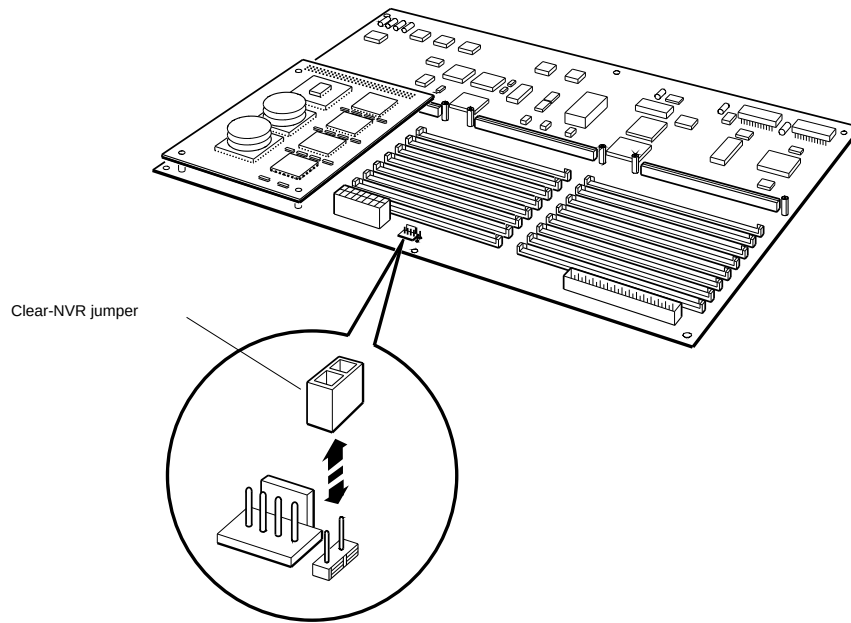
Inserting and removing a clear-NVR jumper

Figure 2-9 shows how to insert and remove a clear-NVR jumper.

To insert the jumper,

1. Turn off the system unit.
2. Locate the clear-NVR pins on the system module. The clear-NVR jumper pins form a two-pin fixture.
3. Slide the jumper entirely over the clear-NVR pins.

To remove the jumper, slide the jumper up and away from the clear-NVR pins.



WS33M016

Figure 2-9. How to insert and remove a clear-NVR jumper

Booting the System Software

Use the boot command to boot the system.

Booting a system can take several minutes. If the system displays the ULTRIX prompt # before the login: prompt appears, press Ctrl-d to continue the boot operation.

If the boot is successful, the monitor displays the login: prompt.

If the system fails to boot, do the following:

1. Use the printenv command to display the environment variables table.
2. 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 use to boot.
3. Use the boot command to boot the system.

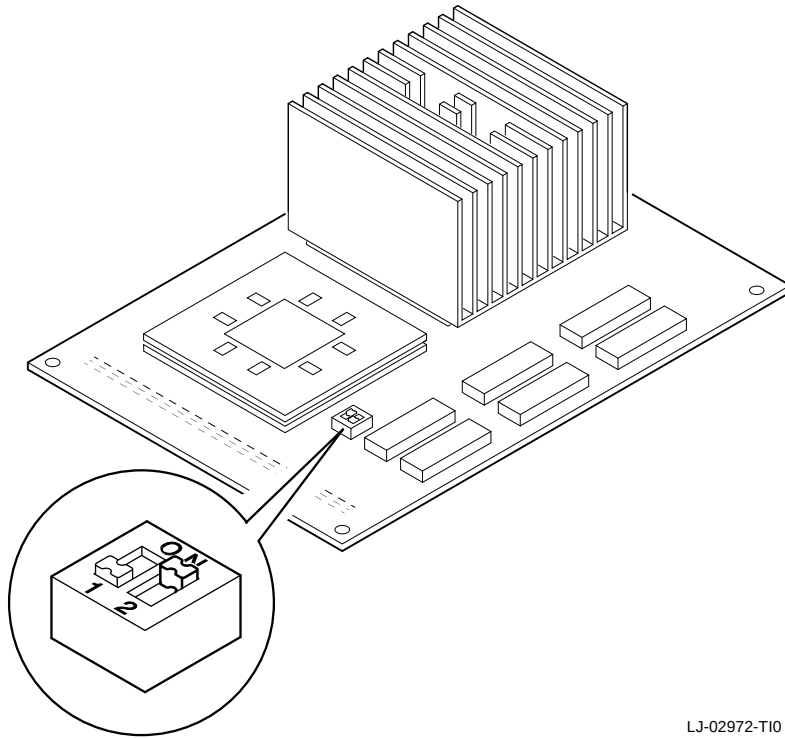
For a detailed explanation of these console commands, refer to Appendix C.

If the system still does not boot, check any boot error messages that appear on the monitor. Refer to Appendix C to find the meaning of boot error messages.

Setting System Boot ROM Switches

The Boot ROM on the system module does not need to be replaced, because there is a Boot ROM on the R4000 CPU. Two switches on the R4000 control the access to the Boot ROM. Refer to Figure 2-10 for location of switches. Switch one must be off. Switch two must be on.

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



LJ-02972-T10

Figure 2-10. System Boot ROM Switches

Shutting Down the System Software

If the system is running software, shut down the system before you perform customer service. To shut down the software, type the following command at the ULTRIX prompt:

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

- 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 monitor displays the >> or R> prompt when shutdown is complete.

Troubleshooting Tools

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

- Use different types of tests
- Set up tests for groups of selected modules
- Interpret test results
- Examine and interpret error logs

Using Tests

The system uses two types of tests to check system hardware operation:

- Power-up self-tests, which run a comprehensive test of the system hardware
- Subtests, which run individual tests or test scripts

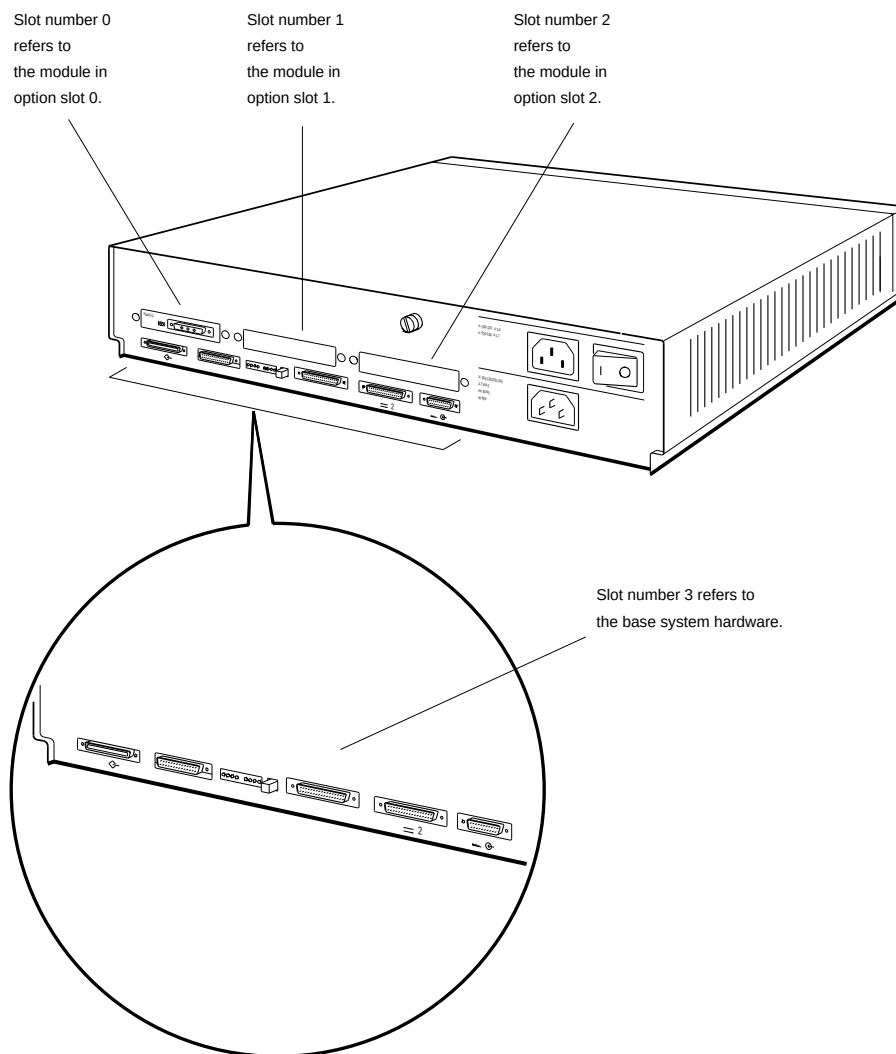
If you run a test script, you can select one of several prepared scripts or create your own.

Using Slot Numbers in Test Commands and Error Messages

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

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

Figure 3-1 shows the slot numbers for the base system and the option modules.



WS33M050

Figure 3-1. Slot numbers for system hardware

Running Power-Up Self-Tests

The system automatically runs a power-up self-test when you turn on the system power. The monitor and diagnostic LEDs report any errors the power-up self-test detects. To find the corrective action for any error codes the power-up self-test reports, refer to Chapter 4.

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

- The quick test script is a limited script that minimizes the time until the system boots.
- The thorough script runs an extensive check of system hardware. The thorough power-up self-test script is most useful for field service troubleshooting.

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.

- Specify `q` to select the quick test.
- Specify `t` to select the thorough test.

Running Subtests

In addition to the power-up self-test, you can use subtests to troubleshoot. Subtests run individual tests or test scripts.

How to Run Individual Tests

To run an individual test, type

t [-l] *slot_number/test_name* [*arg1*] [*arg2*] [*arg3*]

When you type an individual test command,

- Use **t** as the command to run a test.
- Include the optional **-l** parameter to make the test loop continuously until you press Ctrl-C or reset the system.
- Replace *slot_number* with the slot number of the module to be tested. Table 3-1 lists the slot numbers assigned to each module.
- Replace *test_name* with the name of the particular test you want to run.
- Include optional extended arguments (*arg1* and so on) to specify individual test conditions. For example, to test bank 2 of memory, enter **t 3/mem 2**. Refer to Appendix D for further explanation of the arguments used for individual tests.

Table 3-1. Slot Numbers Used in Test Commands

Slot Number	Unit Tested
0	Option module in slot 0 (slot farthest from the power supply)
1	Option module in slot 1 (middle option slot)
2	Option module in slot 2 (slot nearest the power supply)
3	Base system hardware, which includes - System module - CPU module - Memory modules - Base system SCSI controller - Base system Ethernet controller

How to Run Test Scripts

Use the **sh** command to run a test script.

- To run a test script once and then stop, type **sh** followed by the slot number of the script, a slash (/), and the name of the test script you want to run, then press Return. For example, to run the quick pst on the option module in slot 1, type **sh 1/pst-q**.
- To have a test script run and keep looping until you press Ctrl-c, type **sh -l** followed by the slot number of the script, a slash (/), and the name of the test script you want to run, then press Return.

How to Display Lists of Available Tests

To display a list of all individual tests available for a specific module, type **t slot_number/?**, where you replace *slot_number* with the slot number of the module for which you want a list of tests, then press Return.

The monitor displays a list of tests similar to this sample listing of tests for the system module:

```
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]
ecc/gen         address[A0100000]
fpu
mem             board[0]      thrld[10]    pattern[55555555]
mem/init
mem/float10     address[A0100000]
mem/select
mfg/done
misc/pstemp
misc/refresh
misc/wbpart
rtc/nv          pattern[55]
rtc/period
rtc/regs
rtc/time
tlb/probe
tlb/reg         pattern[55555555]
```

In this list,

- The left column lists the names of the individual 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.

For a detailed explanation of individual self-tests and their parameters, refer to Appendix D.

Displaying a list of available test scripts

To display a list of all scripts and other objects that are in an individual module, type **ls** followed by the slot number of the module for which you want a list, then press Return.

A list of test scripts and other objects that are in the module then appears on the screen. The following sample listing is a portion of the ls display for 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
```

Displaying the contents of a test script

To find which individual tests and other test scripts are in a specific test script, type **cat** *slot_number/script_name*, where *slot_number* is the slot number of the module and *script_name* is the name of the test script for which you want a listing, then press Return.

For further information about the cat command, refer to “cat Command” on page C-9.

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

A list of the individual tests and any other test scripts that are in the test script, that appears on the screen. The following sample listing is the contents of the `test-mem-m` test script for slot 3 (the base system module):

```
>>cat 3/mem-m
t ${#}/mem/select
t ${#}/mem/wbpart
t ${#}/mem 0 0 55555555 -q
t ${#}/mem 1 0 55555555 -q
t ${#}/mem 2 0 55555555 -q
t ${#}/mem 3 0 55555555 -q
t ${#}/mem 4 0 55555555 -q
t ${#}/mem 5 0 55555555 -q
t ${#}/mem 6 0 55555555 -q
t ${#}/mem 7 0 55555555 -q
t ${#}/mem/float10
```

How to Create Test Scripts

You can create test scripts that test modules under conditions you choose.

To create a test script,

1. Type **script** followed by the name that you want to give the script you are creating, then press Return.
2. Type the test commands for the tests that you want to include in the script. When you type test commands, do the following;
 - Type test commands in the same order that you want the tests to run. You can include individual tests or test scripts.
 - Specify any test parameters that you want to include when you type the test command.
 - Press Return after you finish typing each individual test command.
3. Finish creating the test script by pressing Return twice after you enter the last test command in the test script.

4. To run the script you just created, type **sh** followed by the name you assigned the script, then press Return.

The system stores the test script in volatile memory. The test script is lost when you turn off the system unit or press 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.

Interpreting Test Error Messages

For every error that a test detects, an error message appears on the screen. Error messages appear in the following format:

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

- ?TFL indicates that a test reported an error.
- *slot_number* represents the slot number of the module that reported the error.
- *test_name* represents the name of the individual test that failed.
- *n* represents a number that indicates which portion of the test failed.
- *description* represents an additional message that describes the failure.
- *module* represents the module identification number.

This is a sample error message:

```
?TFL 3/scsi/cntl (3: cnt xfr) [KN04-BA]
```

This error message states that the module in slot number 3, the base system, failed the SCSI controller test. The explanation of the SCSI controller test in Appendix D states that the message (3: cnt xfr) means that the read and write operation reported a mismatch.

For an explanation of error messages generated by the system module or memory modules, refer to Appendix D.

For an explanation of error messages generated by a TURBOchannel option, refer to the *TURBOchannel Maintenance Guide*.

Using ULTRIX Error Logs

The system records events and errors in ULTRIX error logs. The memory error logs and the error and status register error logs may be used to troubleshoot intermittent problems.

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

The following sections describe ULTRIX error log formats and error log items that are useful for troubleshooting.

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 error log, with the newest error logs first, appears on the monitor.

Further information about the `uerf` command is available in the ULTRIX man facility. Type `man uerf` and press Return.

Error Log Format

The first part of each error log describes the type of error and system conditions in effect when the error occurred. The first part is the same for all 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.

Error log example The first part of all error logs is similar to the following example:

```

----- EVENT INFORMATION -----
EVENT CLASS                                OPERATIONAL EVENT
OS EVENT TYPE                            300.        SYSTEM STARTUP
SEQUENCE NUMBER                          0.
OPERATING SYSTEM                        ULTRIX 32
OCCURRED/LOGGED ON                      Tue Oct 24 09:06:16 1989
OCCURRED ON SYSTEM                      GRANITE
SYSTEM ID                                x82020120      HW REV: x20
                                                FW REV: x1
                                                CPU TYPE: R4000
PROCESSOR TYPE                          KN04/R4000

```

The fields of the first part of an error log, as shown in the preceding example, are as follows:

- **EVENT CLASS** lists the general category of the error log. 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 3-2 lists the operating system event types and their codes.
- **SEQUENCE NUMBER** lists the order in which the system logged the event.
- **OPERATING SYSTEM** lists the system's version of ULTRIX.
- **OCCURRED/LOGGED ON** lists when the error occurred.
- **OCCURRED ON SYSTEM** lists the individual system that reported the error.
- **SYSTEM ID** includes several listings:
 - The first number to the right of **SYSTEM ID** is the system ID.
 - **HW REV** lists the system hardware revision number.
 - **FW REV** lists the system firmware revision number.
 - **CPU TYPE** lists the type of CPU used in the system.

- PROCESSOR TYPE lists the type of processor chip that the system uses.

Event Types

The second line of each error log lists the code number and name of the error log event type. Table 3-2 lists the event type codes and their meaning.

Table 3-2. 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 registers
200	Panic (bug check)
250	Informational ASCII message
251	Operational message
300	System startup message
310	Time change message
350	Diagnostic information

The following sections describe the second part of memory error logs, error, and status error logs. 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.

Using Memory Error Logs

Memory error logs record errors that occur in the memory modules. The following example shows a typical memory error log showing a memory parity error and a related previous entry. The example records a memory parity error. See Appendix E for detailed information about memory registers.

```
***** ENTRY 1 *****

----- EVENT INFORMATION -----
EVENT CLASS                      ERROR EVENT
OS EVENT TYPE                    101.  MEMORY ERROR
SEQUENCE NUMBER                  2.
OPERATING SYSTEM                 ULTRIX 32
OCCURRED/LOGGED ON              Tue Jan 22 16:12:54 1991
OCCURRED ON SYSTEM              ft3
SYSTEM ID                       x82030230  HW REV: x30
                                      FW REV: x2
                                      CPU TYPE: R4000

PROCESSOR TYPE                   KN04-BA
----- UNIT INFORMATION -----
UNIT CLASS                      MEMORY
UNIT TYPE                      Undefined x001C
ERROR SYNDROME                  memory parity error
----- KN02BA MEMORY REGISTERS -----
MEM REG                       xBE000002  HARD CNT 2.
                                      SOFT CNT 0.
                                      TRAN CNT 0.
                                      DATA BIT IN ERROR
                                      HIGH BYTE IN ERROR
                                      MEMORY PARITY ERROR: HARD
                                      D0-15 ON BANK # x2

PHYSICAL ADDR                  x010205F8
EPC                            x004255F8
BAD VIRT ADR                   x004255F8
```

```

***** ENTRY 2 *****
-----EVENT INFORMATION-----
EVENT CLASS                OPERATIONAL EVENT
OS EVENT TYPE              250      ASCII MSG
SEQUENCE NUMBER           6
OPERATING SYSTEM          ULTRIX 32
OCCURRED/LOGGED ON        Tue Jan 22 14:58:40 1991
OCCURRED ON SYSTEM        ft3
SYSTEM ID                  x82030230  HW REV: x30
                                FW REV: x2
                                CPU TYPE: R4000
PROCESSOR TYPE            KN04-BA
MESSAGE                   ioasicint: memory read error

```

Analyzing the Memory Error Example The following list describes the useful information in ENTRY 1 and ENTRY 2. Since this is a memory error, the last entries under MEM REG in ENTRY 1 are of particular interest because they identify which SIMM failed.

- The ERROR SYNDROME field indicates that this is a memory parity error.
- The following MEM REG fields list details about the memory failure:
 - The CNT fields list the count of hard (recurred on both read and write operations), soft (recurred on read, but cleared on write), and transient (didn't recur on read) errors.
 - The DATA BIT IN ERROR statement indicates that a data bit (rather than a parity bit) failed.
 - The BYTE IN ERROR can be either high or low.
 - The MEMORY PARITY ERROR field lists the type (hard, soft, transient) of error for this entry.
 - D0-15 indicates that the low SIMM failed. The low SIMM is the left SIMM in a bank, looking from the front, labeled D0-15 on the system module. The value D16-31 in this position indicates that the high SIMM failed. The high SIMM is the right SIMM in a bank, labeled D16-31 on the module. BANK tells which bank of memory failed. The eight banks are labeled 0 to 7 on both sides of the memory SIMMs. To replace the

bad SIMM, use the bank number to get the correct bank and use D0-15 or D16-31 to select the low or high SIMM of the bank.

- The PHYSICAL ADDRESS field identifies the physical address that was being read when the failure was detected. Since the system uses DMA block read operations (more than one word is read in a read operation), the parity error could have occurred in any word in the block. This address points to only the block being read, not necessarily to the bad word.
- ENTRY 2, occurring prior to a memory parity error, indicates that the memory parity error was detected by an I/O device performing a DMA operation from memory.

Using Error and Status Register Error Logs

Error and status register error logs record nonmemory system errors. The following examples show two kinds of error and status error events: a CPU write timeout and a bus timeout. In both examples the event type is PANIC. Therefore, the initial error log is followed by a related error and status register error log.

Example 1: Error and status register error log

The first entry in the following example, labeled ENTRY 2, records a CPU write timeout error. Because the event type is PANIC, it is followed by a related log, labeled ENTRY 3, that records the error and status register values at the time of the error. See Appendix E for detailed information about memory registers.

```

***** ENTRY 2. *****
----- EVENT INFORMATION -----
EVENT CLASS                      ERROR EVENT
OS EVENT TYPE                    200. PANIC
SEQUENCE NUMBER                  2.
OPERATING SYSTEM                 ULTRIX 32
OCCURRED/LOGGED ON              Tue Feb 26 06:38:28 1991 EST
OCCURRED ON SYSTEM              csse1ab1
SYSTEM ID                       x82030230 HW REV: x30
                                   FW REV: x2
                                   CPU TYPE: R4000
PROCESSOR TYPE                  KN04-BA
PANIC MESSAGE                   CPU write timeout
***** ENTRY 3. *****
----- EVENT INFORMATION -----
EVENT CLASS                      ERROR EVENT
OS EVENT TYPE                    130. ERROR & STATUS REGS
SEQUENCE NUMBER                  1.
OPERATING SYSTEM                 ULTRIX 32
OCCURRED/LOGGED ON              Tue Feb 26 06:38:26 1991 EST
OCCURRED ON SYSTEM              csse1ab1
SYSTEM ID                       x82030230 HW REV: x30
                                   FW REV: x2
                                   CPU TYPE: R4000
PROCESSOR TYPE                  KN04-BA
- ----- KN02BA REGISTERS -----
CAUSE                           x00002800
                                   EXCEPTION CODE EXTERNAL INTERRUPT
                                   HW INTERRUPT 1 PENDING
                                   HW INTERRUPT 3 PENDING
EPC                             x801266FC
STATUS                          xFFFFDC84
                                   CURRENT INTERRUPT STATE DISABLED
                                   CURRENT MODE KERNEL
                                   PREVIOUS INTERRUPT STATE ENABLED
                                   PREVIOUS MODE KERNEL
                                   OLD INTERRUPT STATE DISABLED
                                   OLD MODE KERNEL
                                   HW INTERRUPT 0 ENABLED
                                   HW INTERRUPT 1 ENABLED
                                   HW INTERRUPT 2 ENABLED
                                   HW INTERRUPT 4 ENABLED
                                   HW INTERRUPT 5 ENABLED
                                   D_CACHE ISOLATED FROM MEMORY
                                   CACHE STATE SWITCHED
                                   PARITY ZERO SET

```


		CACHE MISS SET
		CACHE PARITY ERROR SET
		TLB SHUTDOWN SET
		BOOTSTRAP EXCEPTION VECTOR SET
BAD VIRT ADR	x10000000	
SP	xFFFFDDA8	
SSR	x50070F00	
		LANCE DMA DISABLE
		SCSI DMA ENABLE
		SCSI DMA WRITE TO MEMORY
		COMM PORT 2 RECEIVE DMA DISABLE
		COMM PORT 2 TRANSMIT DMA ENABLE
		COMM PORT 1 RECEIVE DMA DISABLE
		COMM PORT 1 TRANSMIT DMA ENABLE
SIR	x00001002	
		CPU I/O - WRITE TIMEOUT
SIRM	x0000F204	
		SCSI INTERRUPT FROM 53C94 ENABLED

Analysis of Example 1 The following list describes the useful information in ENTRY 2 and ENTRY 3.

- ENTRY 2 records the error.
 - The OS EVENT TYPE field indicates the PANIC type.
 - The PANIC MESSAGE field indicates that the error is a CPU write timeout.
- ENTRY 3 records the error and status register values at the time of the CPU write timeout error.
 - The CAUSE register has no information because the write timeout is an interrupt.
 - The BAD VIRT ADR register identifies the address of the timeout.
 - The SIR register indicates that the system interrupt was a CPU I/O write timeout.

Example 2: Error and status register error log

The first entry in the following example, labeled ENTRY 7, is a panic frame. It shows a bus timeout error (a read timeout). Because the event type is PANIC, it is followed by a related log, labeled ENTRY 8, that records the error and status register values at the time of the error. See Appendix E for detailed information about memory registers.

***** ENTRY 7. *****

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

EVENT CLASS		ERROR EVENT
OS EVENT TYPE	200.	PANIC
SEQUENCE NUMBER	2.	
OPERATING SYSTEM		ULTRIX 32
OCCURRED/LOGGED ON		Tue Feb 26 06:22:14 1991 EST
OCCURRED ON SYSTEM		csselab1
SYSTEM ID	x82030230	HW REV: x30
		FW REV: x2
		CPU TYPE: R4000
PROCESSOR TYPE		KN04-BA
PANIC MESSAGE		bus timeout

***** ENTRY 8. *****

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

EVENT CLASS		ERROR EVENT
OS EVENT TYPE	130.	ERROR & STATUS REGS
SEQUENCE NUMBER	1.	
OPERATING SYSTEM		ULTRIX 32
OCCURRED/LOGGED ON		Tue Feb 26 06:22:12 1991 EST
OCCURRED ON SYSTEM		csselab1
SYSTEM ID	x82030230	HW REV: x30
		FW REV: x2
		CPU TYPE: R4000
PROCESSOR TYPE		KN04-BA

----- KN02BA REGISTERS -----

CAUSE	x0000081C	EXCEPTION CODE BUS ERR (DATA LOAD _OR STORE) HW INTERRUPT 1 PENDING
EPC	x8010E164	
STATUS	x0000F204	CURRENT INTERRUPT STATE DISABLED CURRENT MODE KERNEL PREVIOUS INTERRUPT STATE ENABLED PREVIOUS MODE KERNEL OLD INTERRUPT STATE DISABLED OLD MODE KERNEL SW INTERRUPT 1 ENABLED HW INTERRUPT 2 ENABLED HW INTERRUPT 3 ENABLED HW INTERRUPT 4 ENABLED HW INTERRUPT 5 ENABLED CACHE STATE NORMAL
BAD VIRT ADR	xB0000000	
SP	xFFFFDDA8	
SSR	x50070F00	LANCE DMA DISABLE SCSI DMA ENABLE SCSI DMA WRITE TO MEMORY COMM PORT 2 RECEIVE DMA DISABLE COMM PORT 2 TRANSMIT DMA ENABLE COMM PORT 1 RECEIVE DMA DISABLE COMM PORT 1 TRANSMIT DMA ENABLE
SIR	x00000002	
SIRM	xFF0F13E0	TOY INTERRUPT ENABLED SCC(0) SERIAL INTERRUPT ENABLED SCC(1) SERIAL INTERRUPT ENABLED ETHERNET INTERRUPT ENABLED SCSI INTERRUPT FROM 53C94 ENABLED LANCE DMA MEM READ ERR ENABLED SCSI DMA MEM READ ERR ENABLED SCSI DMA OVERRUN ERROR ENABLED SCSI DMA INTERRUPT ENABLED COMM PORT 2 RCV DMA OVERRUN ENABLED COMM PORT 2 RCV HALF PAGE INTR _ENABLED COMM PORT 2 TRANSMIT DMA MEM READ _ERR ENABLED COMM PORT 2 TRANSMIT PAGE END

```
_INTR ENABLED  
COMM PORT 1 RCV DMA OVERRUN ENABLED  
COMM PORT 1 RCV HALF PAGE INTR  
_ENABLED  
COMM PORT 1 TRANSMIT DMA MEM READ  
_ERR ENABLED  
COMM PORT 1 TRANSMIT PAGE END  
_INTR ENABLED
```

Analysis of Example 2 The following list describes the useful information in ENTRY 7 and ENTRY 8.

- ENTRY 7 records the error.
 - The OS EVENT TYPE field indicates the PANIC type.
 - The PANIC MESSAGE field indicates that the error is a bus timeout.
- ENTRY 8 records the error and status register values at the time of the bus timeout error.
 - The CAUSE register indicates a bus error during a data load or store operation.
 - The BAD VIRT ADR register identifies the address of the timeout.

Physical address space

Table 3-3 lists the system hardware physical addresses and the FRUs where they are located. In the event of a memory error, this table will help to isolate which FRU should be replaced.

Table 3-3. Hardware Physical Addresses

Physical Address Range	Indicated Hardware
0x00000000 to 0x07FFFFFFF	Memory array banks 0 to 7
0x08000000 to 0x0BFFFFFFF	Reserved
0x0C000000 to 0x0DFFFFFFF	Memory registers
0x0E000000 to 0x0FFFFFFF	CPU control ASIC registers
0x10000000 to 0x13FFFFFFF	Slot 0, TURBOchannel option
0x14000000 to 0x17FFFFFFF	Slot 1, TURBOchannel option
0x18000000 to 0x1BFFFFFFF	Slot 2, TURBOchannel option
0x1C000000 to 0x1FFFFFFF	Base system hardware, identified as slot 3 in commands and error messages, includes the subsystems listed below
0x1C000000 to 0x1C03FFFFF	System ROM
0x1C040000 to 0x1C07FFFFF	I/O control registers and DMA pointers
0x1C080000 to 0x1C0BFFFFF	Ethernet address PROM
0x1C0C0000 to 0x1C0FFFFF	Ethernet interface
0x1C100000 to 0x1C13FFFFF	SCC(0) registers
0x1C140000 to 0x1C17FFFFF	Reserved
0x1C180000 to 0x1C1BFFFFF	SCC(1) registers
0x1C1C0000 to 0x1C1FFFFF	Reserved
0x1C200000 to 0x1C23FFFFF	Real-time clock
0x1C240000 to 0x1C29FFFFF	Reserved
0x1C300000 to 0x1C33FFFFF	SCSI interface
0x1C340000 to 0x1C37FFFFF	Reserved
0x1C380000 to 0x1C3BFFFFF	SCSI DMA
0x1C3C0000 to 0x1FBFFFFFFF	Reserved
0x1FC00000 to 0x1FC3FFFFF	Boot ROM
0x1FC40000 to 0x1FFFFFFF	Reserved

(continued on next page)

Table 3-3 (Cont.). Hardware Physical Addresses

Physical Address Range	Indicated Hardware
0x1FD40000 to 0x1FD3FFFF	MB_Interrupt
0x1FD40000 to 0x1FD7FFFF	MB_EA
0x1FD80000 to 0x1FDBFFFF	MB_EC
0x1FDC0000 to 0x1FDFFFFFF	MB_CS

For Further Information

To determine the corrective action indicated by a particular error message, refer to Chapter 4.

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.

Identifying Failed FRUs

This chapter explains how to

- Follow the recommended troubleshooting process for this system
- Troubleshoot when the power-up self-test does not complete
- Troubleshoot when the monitor has no display
- Interpret test error messages to identify failed FRUs
- Troubleshoot when hardware does not appear in the cnfg display
- Troubleshoot these FRUs:
 - Memory modules
 - SCSI controllers and devices
 - Ethernet controllers
 - Printers, modems, or an alternate terminal
 - The power supply
- Interpret error logs to find intermittent failures
- Troubleshoot using the Daughter Card LED's

Troubleshooting Process

Figure 4-1 shows the troubleshooting procedure for the system.

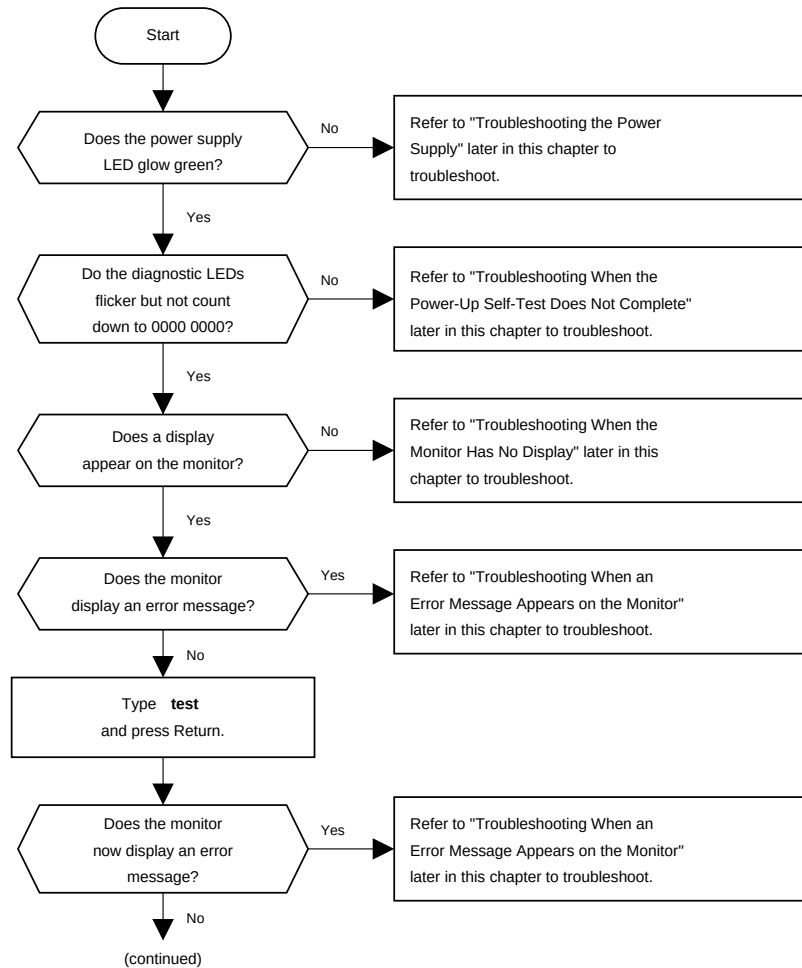
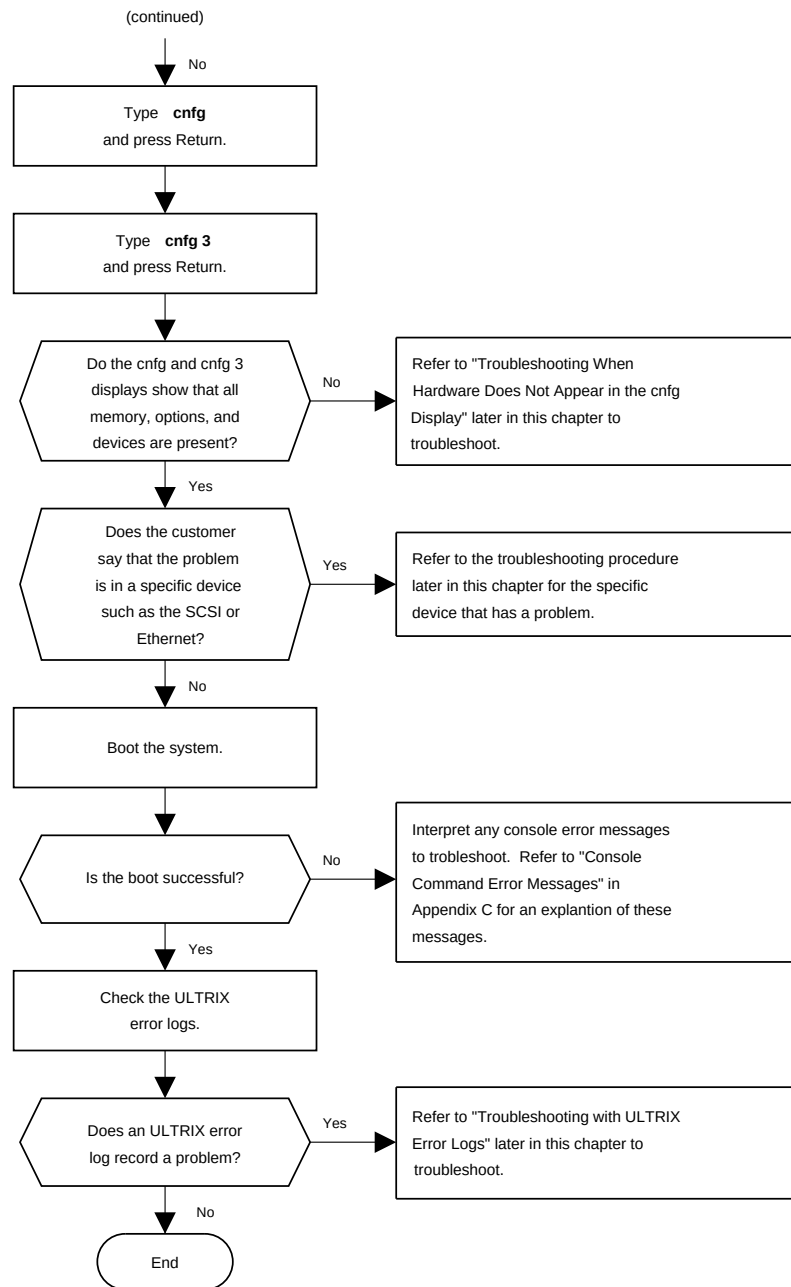


Figure 4-1. Troubleshooting procedure



WS33M089

Figure 4-1. Troubleshooting procedure

Troubleshooting When the Power-Up Self-Test Does Not Complete

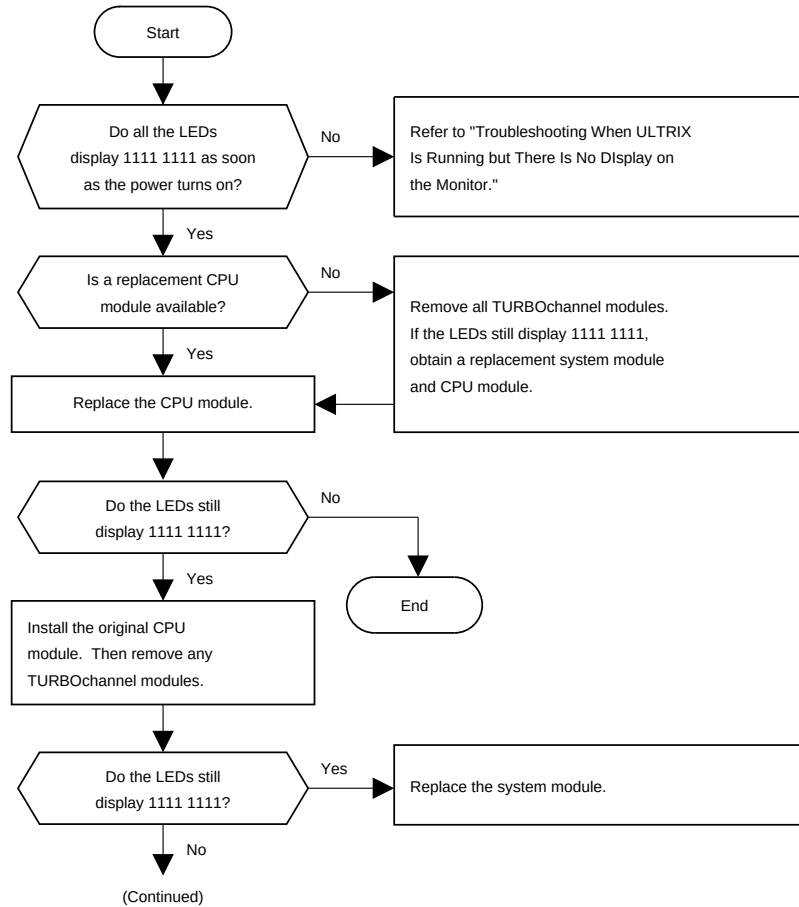
If the console prompt (>>) does not appear on the monitor, the power-up self-test failed to complete. When the power-up self-test does not complete, the diagnostic LEDs will display an error code that indicates why the power-up self-test failed.

- The number on the four leftmost LEDs, as you face the back of the system, indicates which part of the power-up self-test failed.
- The number on the four rightmost LEDs is a code that gives additional information about the failure.

Table 4-1 lists the troubleshooting procedure indicated by each error code that appears on the diagnostic LEDs.

Table 4-1. Troubleshooting Procedure for Each LED Error Code

LED Error Code (1=0n)	Troubleshooting Procedure
1111 1111 0011 1111 0011 1110 0011 1101	See Figure 4-2 to troubleshoot.
0011 0111	Replace the CPU module. If the power-up self-test still stops and the LEDs display 0011 0111, replace the system module. Refer to Chapter 5 for directions.
0011 0110	See Figure 4-3 to troubleshoot.
0011 1011 0010 1011 0001 1011 0000 1011	See “To Troubleshoot When the Diagnostic LED Display is 0011 1011, 0010 1011, 0001 1011, or 0000 1011” section to troubleshoot.
0010 0011 0001 0011 0000 0011 0000 0000	See Figure 4-4 to troubleshoot.



WS33M091

Figure 4-2. Troubleshooting when the LED display is 1111 1111, 0011 1111, 0011 1110, or 0011 1101

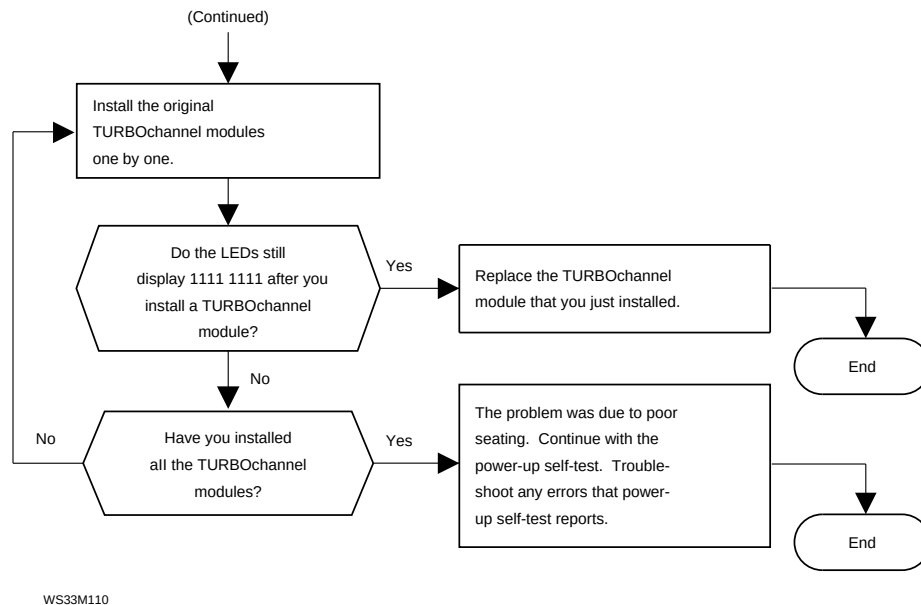
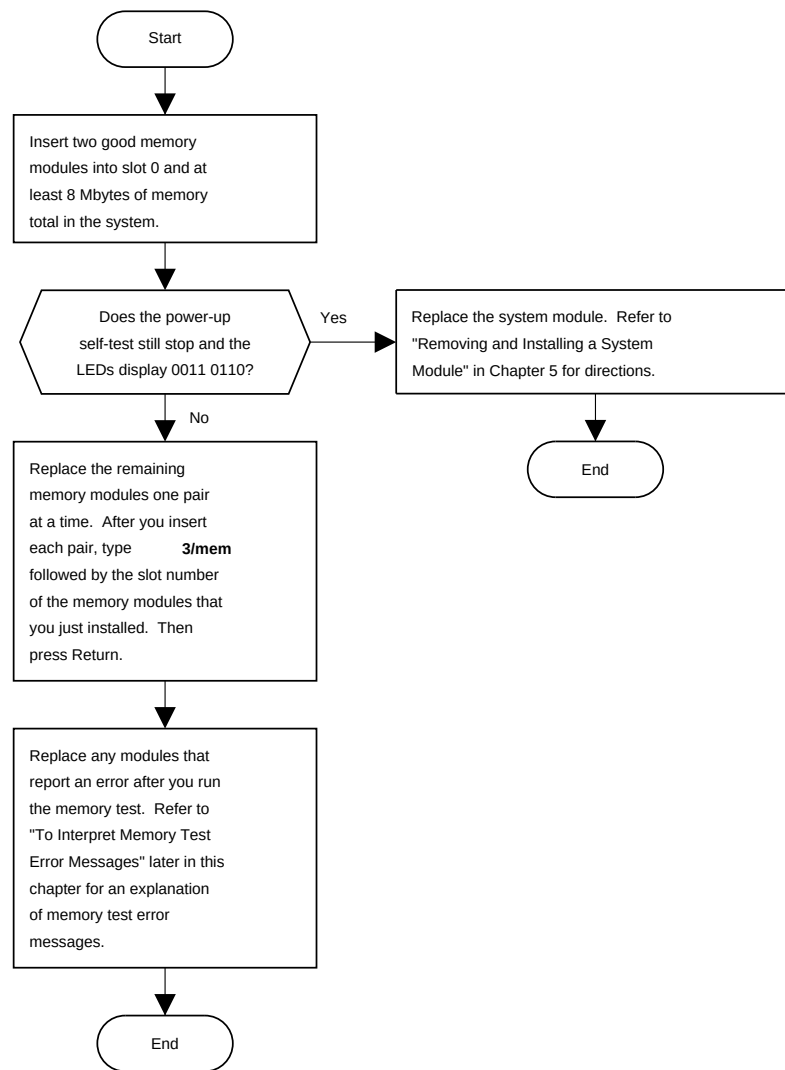
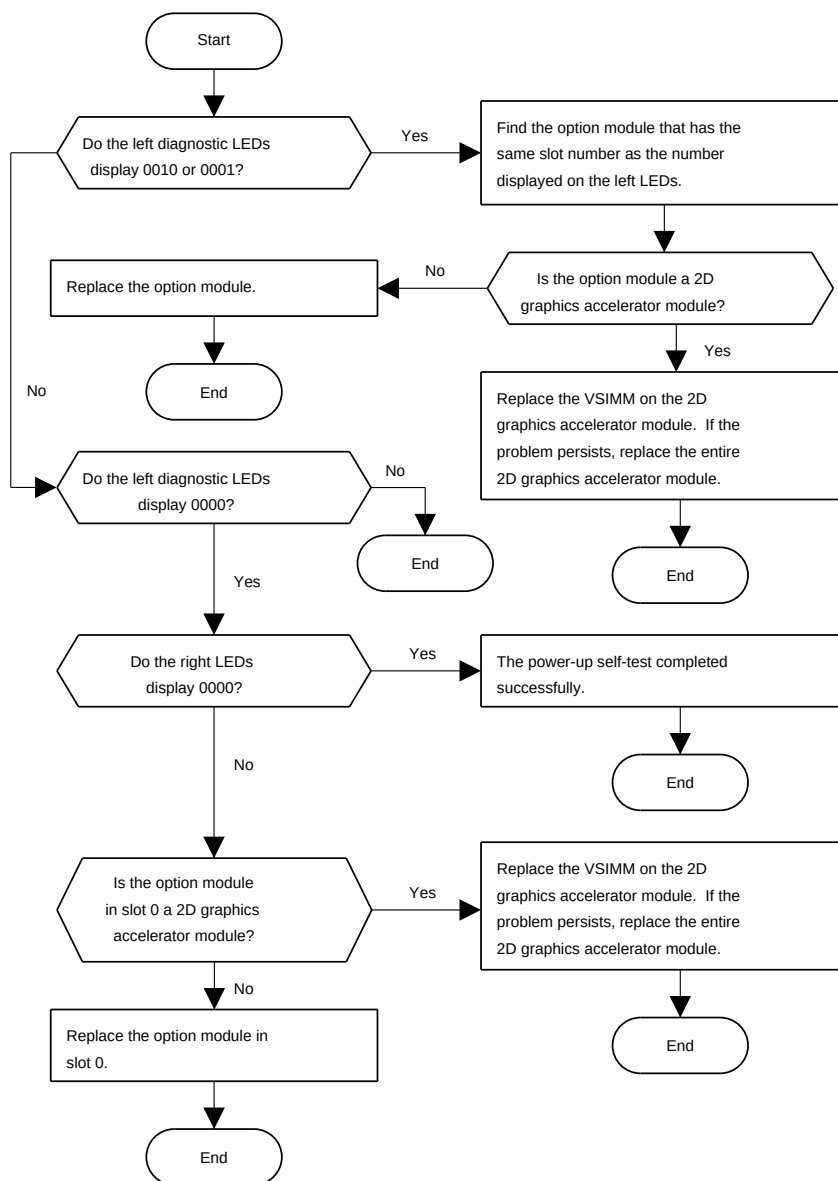


Figure 4-2. Troubleshooting when the LED display is 1111 1111, 0011 1111, 0011 1110, or 0011 1101



WS33M093

Figure 4-3. Troubleshooting when the LED display is 0011 0110



WS33M103

Figure 4-4. Troubleshooting when the LED display is 0010 0011, 0001 0011, 0000 0011, or 0000 0000

How to Troubleshoot When the Diagnostic LED Display Is 0011 1011, 0010 1011, 0001 1011, or 0000 1011

- *If the system has no graphics module*, use the troubleshooting procedure in the section “Troubleshooting when the right diagnostic LED display is 1011 and the system has no graphics module” on page 4-10 to troubleshoot.
- *If the system has a graphics module in one of the TURBOchannel option slots*, use the troubleshooting procedure in the next section to troubleshoot.

Troubleshooting when the right diagnostic LED display is 1011 and the system has a graphics module

- *If a VT320 terminal is available*,
 1. Connect the terminal to the system unit. Refer to “Using an Alternate Terminal” in Chapter 2 for directions.
 2. Remove any graphics modules installed in the system.
 3. Turn on the system unit and the alternate terminal.
 4. Type **setenv console s** and press Return. The system then sets the alternate terminal as the console.
 5. Turn off the system unit power.
 6. Install the graphics module that you just removed from the system.
 7. Turn on the system unit power.
 8. Use any error messages that appear on the terminal to troubleshoot. Refer to “Troubleshooting When an Error Message Appears on the Monitor” for directions.
 9. After you replace the failed FRU, type **setenv console *** and press Return. The system then returns to using the monitor attached to the graphics module as the console.

- *If no VT320 terminal is available,*
 1. Replace the graphics module.
 2. Turn on the system unit power.
 3. Troubleshoot any errors that the power-up self-test reports.

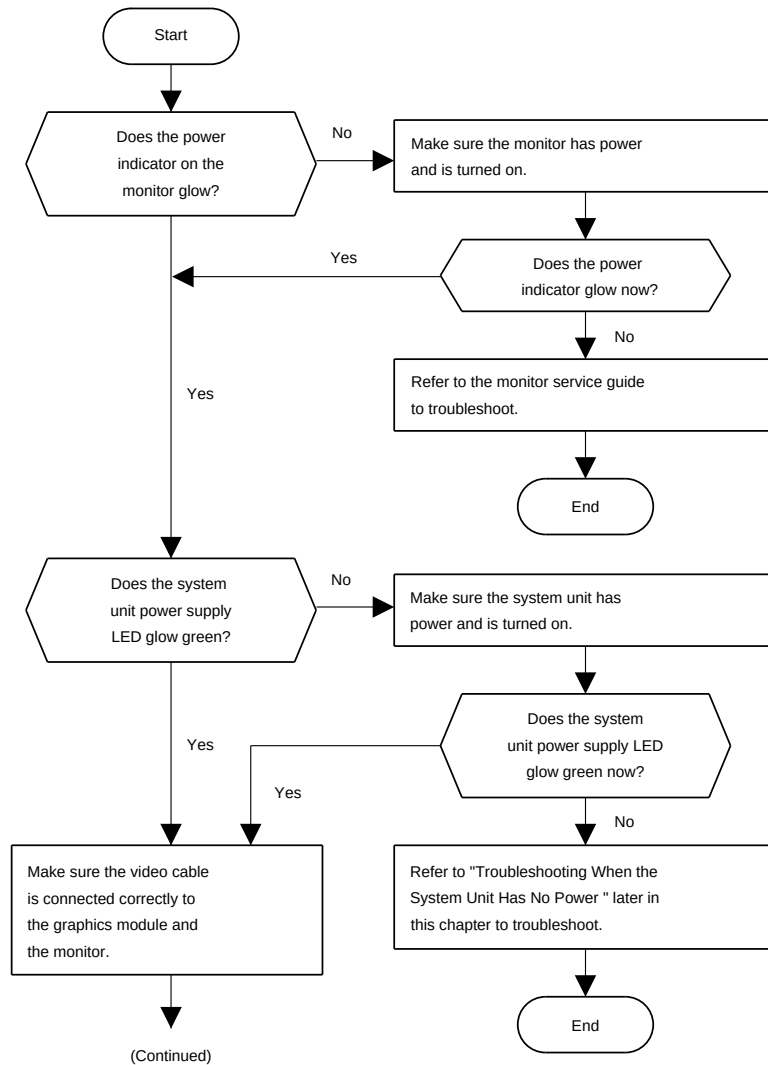
Troubleshooting when the right diagnostic LED display is 1011 and the system has no graphics module

1. Turn off the system unit power.
2. Disconnect the terminal from the communications connector.
3. Turn on the system unit power and check the results of the power-up self-test.
4. *If the power-up self-test still stops and the right diagnostic display is 1011, replace the system module. Refer to “Removing and Installing a System Module” in Chapter 5 for directions.*

If the power-up self-test does not stop, the terminal or cable is faulty. Isolate and replace the bad part.

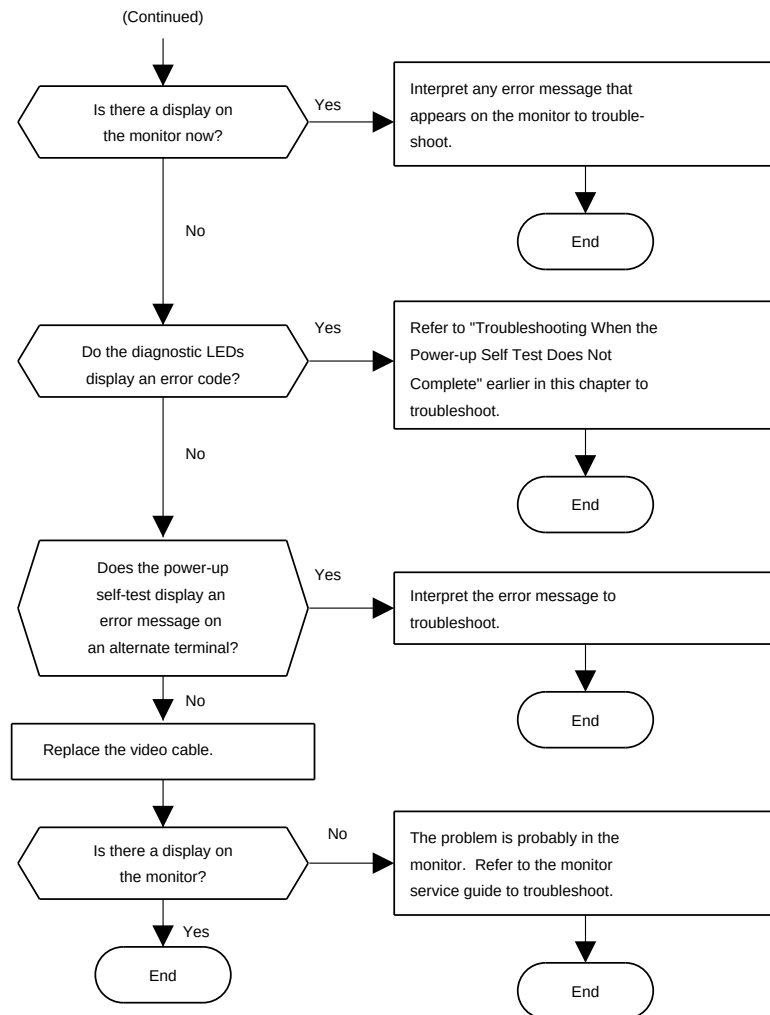
Troubleshooting When the Monitor Has No Display

If the monitor has no display, follow the procedure shown in Figure 4-5 to troubleshoot.



WS33M096

Figure 4-5. Troubleshooting when the monitor has no display



WS33M097

Figure 4-5. Troubleshooting when the monitor has no display

Troubleshooting When an Error Message Appears on the Monitor

In console mode, the monitor can display error and exception messages.

- Messages that begin with ?TFL describe error or exceptions that occur during tests. Refer to the next section, “How to Troubleshoot When an Error or Exception Occurs During a Test,” to troubleshoot.
- Messages that begin with ? PC followed by several lines that begin with question marks (?) describe console exceptions. To troubleshoot when a console exception message appears, refer to “How to Troubleshoot When a Console Exception Occurs” section.

How to Troubleshoot When an Error or Exception Occurs During a Test

Messages that begin with ?TFL: describe errors and exceptions reported by tests.

- 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)
[KN02-BA]

- ?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.
- [KN02-BA] 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.

To troubleshoot when a test detects a hardware error, refer to the next section, “Troubleshooting When a Test Reports an Error.”

How to Troubleshoot When a Test Reports an Error

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 an 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 an 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.

Table 4-2 shows the corrective action indicated by each error message for the base system hardware. For a detailed explanation of these error messages, refer to the section in Appendix D that discusses the individual test listed in the error message.

Table 4-2. Interpreting Base System Test Error Messages Displayed on the Monitor

Test Listed in the Error Message	Component Tested	Corrective Action
cache/data cache/fill cache/isol cache/reload cache/seg fpu	CPU module	Replace the CPU module. Refer to “Removing and Replacing a CPU Module” in Chapter 5 for directions. If the problem persists, replace the system module. Refer to “Removing and Replacing a System Module” in Chapter 5 for directions.
mem mem/float10	Memory modules	Refer to “Troubleshooting the Memory Modules” later in this chapter to troubleshoot.
mem/select	Memory and system module	Replace the memory module that the mem/select test reports is bad. If the problem persists, replace the system module. Refer to “Removing and Replacing a Memory Module” and “Removing and Replacing a System Module” in Chapter 5 for directions.
misc/halt	System module	Replace the system module. Refer to “Removing and Replacing a System Module” in Chapter 5 for directions.
misc/kbd	Keyboard and system module	Refer to “Troubleshooting the Keyboard and Mouse” later in this chapter to troubleshoot.
misc/mouse	Mouse and system module	Refer to “Troubleshooting the Keyboard and Mouse” later in this chapter to troubleshoot.
misc/pstemp	Power supply	Refer to “Troubleshooting the Power Supply” later in this chapter to troubleshoot.

(continued on next page)

Table 4-2 (Cont.). Interpreting Base System Test Error Messages Displayed on the Monitor

Test Listed in the Error Message	Component Tested	Corrective Action
misc/wbpart	Memory modules	Refer to “Troubleshooting the Memory Modules” later in this chapter to troubleshoot.
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 ni/setup	Base system Ethernet controller	Refer to “Troubleshooting an Ethernet Controller” later in this chapter to troubleshoot.
rtc/nvr rtc/period rtc/regs rtc/time	System module	Replace the system module. Refer to “Removing and Installing a System Module” in Chapter 5 for directions.
scc/access scc/enable scc/io scc/regs scc/pins scc/tx-rx	Serial line controllers and devices attached to them	Refer to “Troubleshooting a Printer, Modem, or Other Serial Line Device” later in this chapter to troubleshoot.
scsi/cntl scsi/sdiag scsi/target	Base system SCSI controller or device	Refer to “Troubleshooting SCSI Controllers and Devices” later in this chapter to troubleshoot.

(continued on next page)

Table 4-2 (Cont.). Interpreting Base System Test Error Messages Displayed on the Monitor

Test Listed in the Error Message	Component Tested	Corrective Action
scache/data	Secondary cache	Replace CPU module
tlb/prb tlb/reg	CPU module	Replace the CPU module. Refer to “Removing and Replacing the CPU Module” in Chapter 5 for directions.

How to Troubleshoot When a Console Exception Occurs

Interpret the R3000 register values listed in the console exception message to determine what caused the exception.

Console exception error messages have the form

? PC: *address*
? CR: *cause*
? SR: *status*
? VA: *virtual address*
? ER: *error address*
? MER: *memory error*

- *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.
- *memory error* represents the value in the memory error register.

For an explanation of the registers that appear in console exception messages, refer to Appendix E.

Example: R4000 Console exception message This is a sample R4000 console exception message:

```
? PC:      0x451<vtr=nrml>
? CR:      0x810<ce=0, ip4, exc=AdEL>
? SR:      0x30030000<cu1, cu0, cm, ipl=8>
? CGF:     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<>
```

Example: R3000 Console exception message This is a sample R3000 console exception message:

```
? PC:      0x451<vtr=nrml>
? CR:      0x810<ce=0, ip4, exc=AdEL>
? SR:      0x30030000<cu1, cu0, cm, ipl=8>
? VA:      0x451
? ER:      0x100003f0
? MER:     0x2000
```

The last term in the second line is the exception code, ("exc=")
The exception code describes what type of exception occurred.

If the exception code is MOD, TLBL, or TLBS, an address used in a console command was probably invalid. The value that follows ? VA is the virtual address that caused the exception.

To correct the exception, always use addresses 80000000 to 9fffffff or a0000000 to bfffffff only.

If the exception code 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 these types of exceptions,

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 isolate the problem hardware.

If the exception code is IBE or DBE, a bus error occurred. The bus error is either a memory error or a timeout.

- If MER bits 16, 15, and 11 through 8 are clear, a timeout occurred.
- If MER bits 16, 15, or 11 through 8 are set, a memory error occurred.

If a timeout occurred, use the following procedure:

1. Find the number that follows ? ER in the message. This is the address where the exception occurred.

2. Refer to Table 4-4 later in this chapter to determine which module contains the address at which the exception occurred.
3. If the module involved in the exception is a TURBOchannel option module, use the e command to examine the address at which the exception occurred. Refer to Appendix C for an explanation of the e command. Be sure to add 0xa0000000 to the address listed after ? ER when you type the e command.
4. If the module fails to respond to the e command, move the module to another option slot and repeat the e command.
5. If you still cannot examine the address reported in the exception message, replace the module.

If a memory error occurred, use the following procedure:

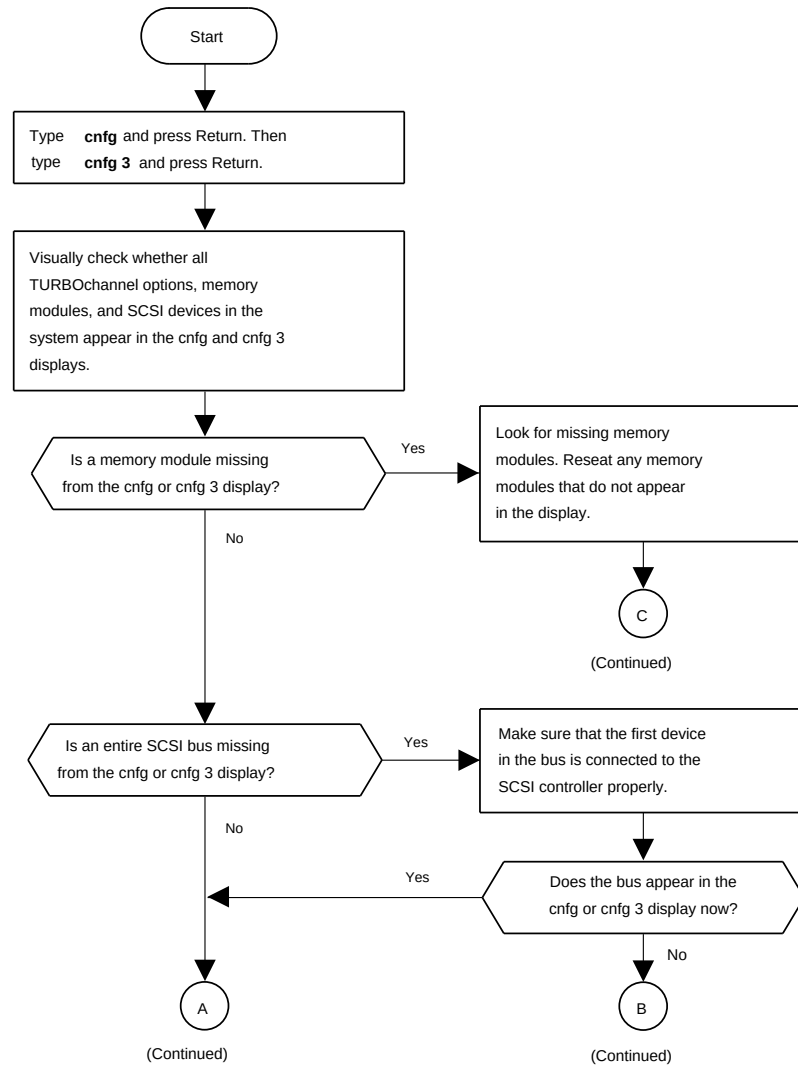
1. Check the value listed after ? MER in the exception message. This is the address at which the exception occurred.
2. Refer to Table 5-1 to determine which pair of modules contains the address involved in the exception.
3. Replace the memory module in which the exception occurred. If bit 9 or 8 is set in the memory error register, the exception occurred in the module nearest the power supply. For example, if the MER contents are 0x200 or 0x100, the error occurred in the memory module nearest the power supply.

If bit 11 or 10 is set, the exception occurred in the module farthest from the power supply. For example, if the MER contents are 0x800 or 0x400 the error occurred in the memory module farthest from the power supply.

If bit 16 or 15 is set, a software or firmware problem caused the exception. Do not replace the memory module if the exception was caused by a software or firmware problem.

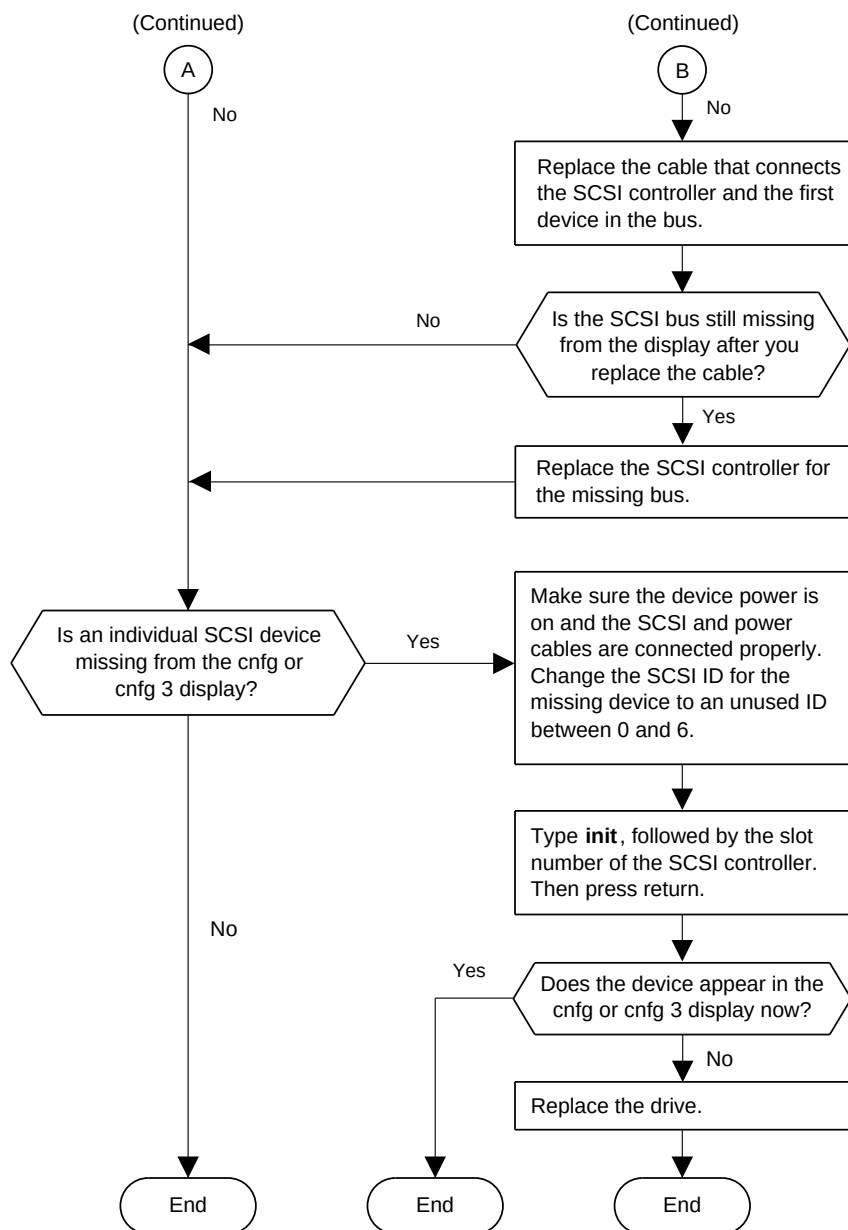
Troubleshooting When Hardware Does Not Appear in the cnfg Display

When hardware does not appear in the cnfg or cnfg 3 display, follow the procedure shown in Figure 4-6 to troubleshoot.



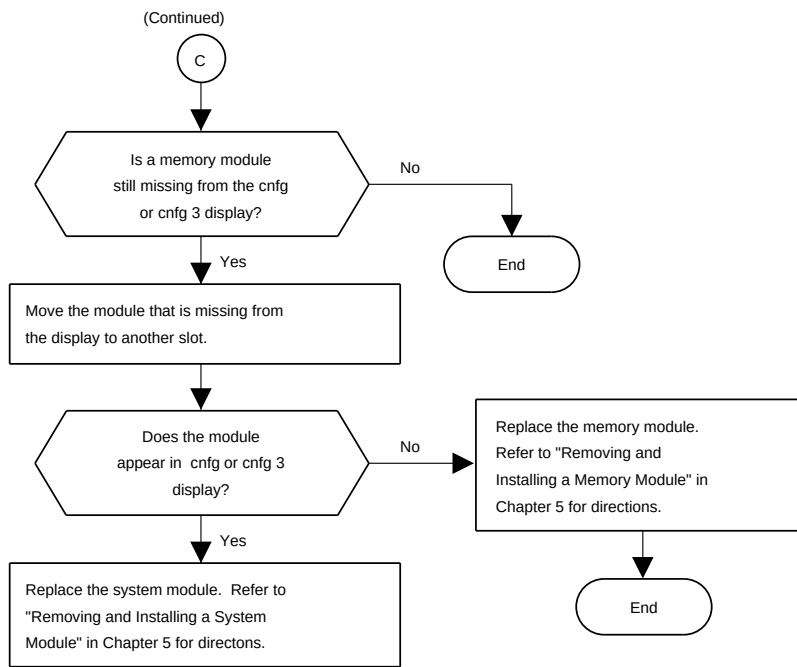
WS33M094

Figure 4-6. Troubleshooting when hardware does not appear in the cnfg display



WS33M095

Figure 4-6. Troubleshooting when hardware does not appear in the cnfg display

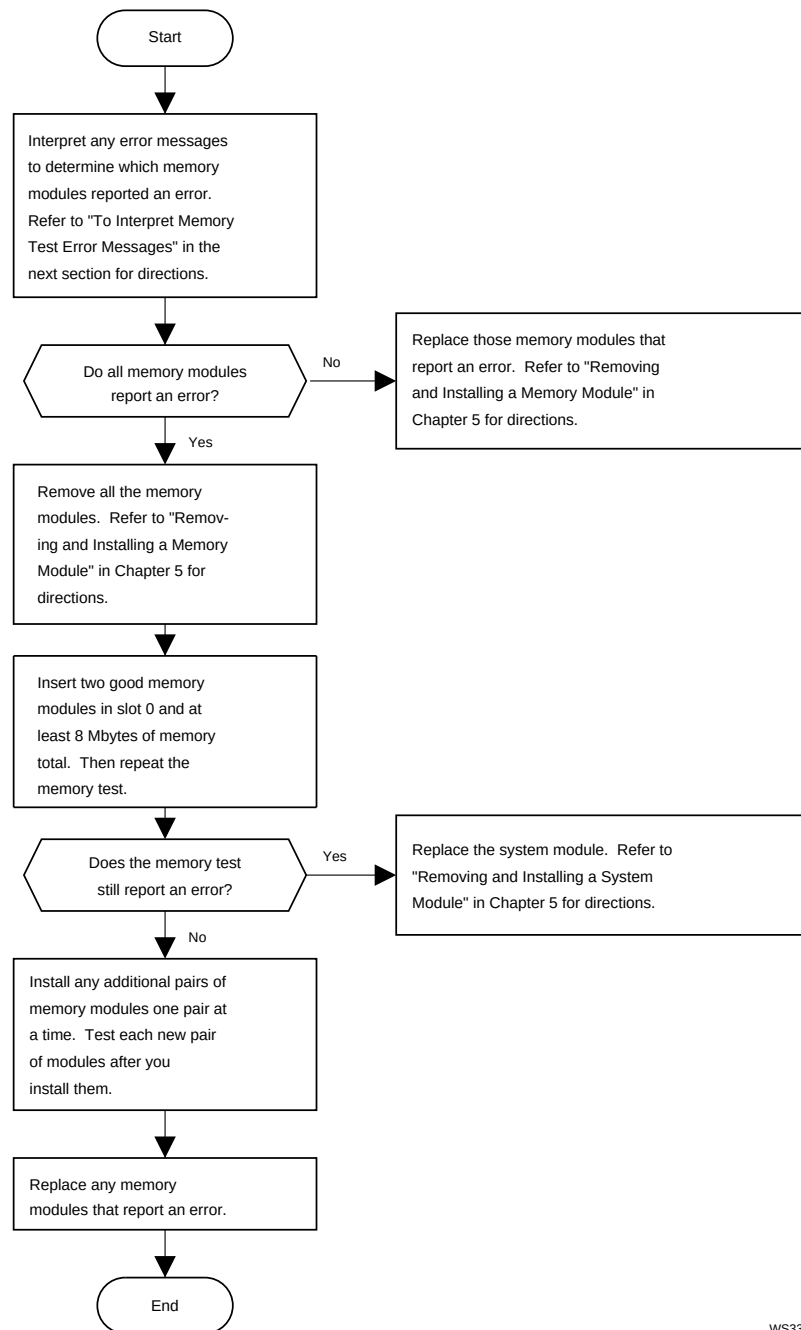


WS33M113

Figure 4-6. Troubleshooting when hardware does not appear in the cnfg display

Troubleshooting the Memory Modules

The flow chart in Figure 4-7 shows the procedure for troubleshooting memory modules.



WS33M092

Figure 4-7. Troubleshooting memory modules

To Interpret Memory Test Error Messages

The numbers following the word bank in the memory test error message indicate which memory module reported the error.

- The first number after the word bank is the slot number of the problem module.
- The code after the slot number indicates which memory module in the slot reported the error.
 - If the code after the slot number is D16-31, the problem module is the one farthest from the power supply.
 - If the code after the slot number is D0-15, the problem module is the one nearest to the power supply.

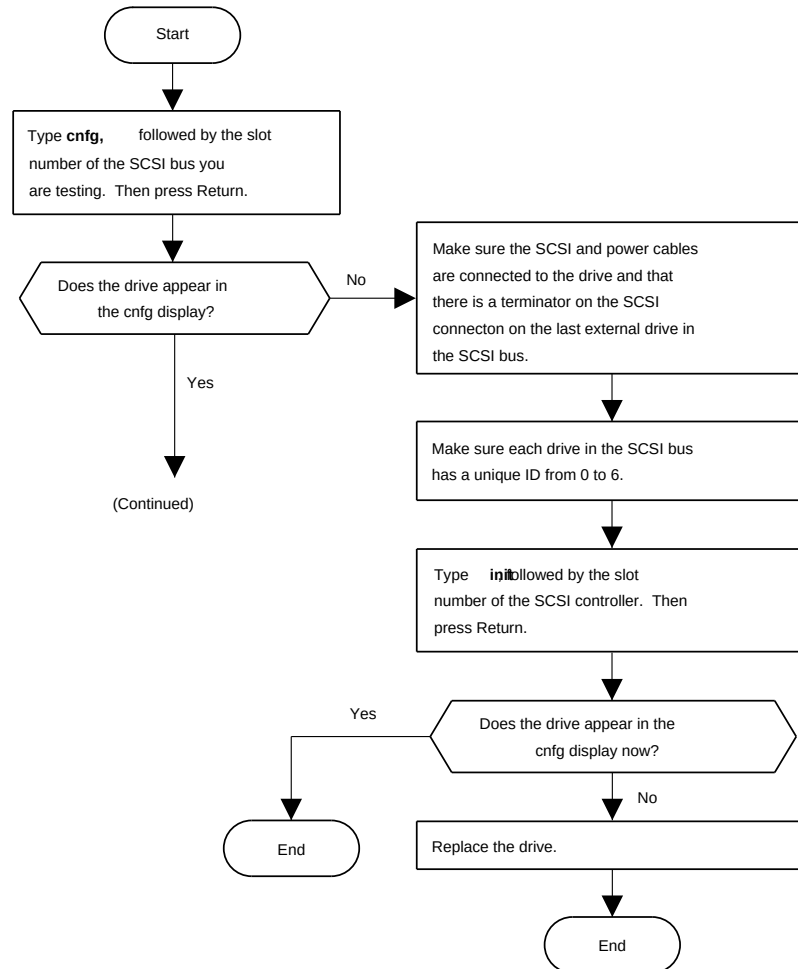
Example: Memory test error message The listing below is a sample of a typical memory test error message:

```
?TFL:3/mem(PER, cause=0000001C, DBE=0040000c,  
Bank 2, D16-31, d23-d16)
```

In this sample message, the problem module is in memory slot 2. The code D16-31 indicates that the failed module is the one farthest from the power supply.

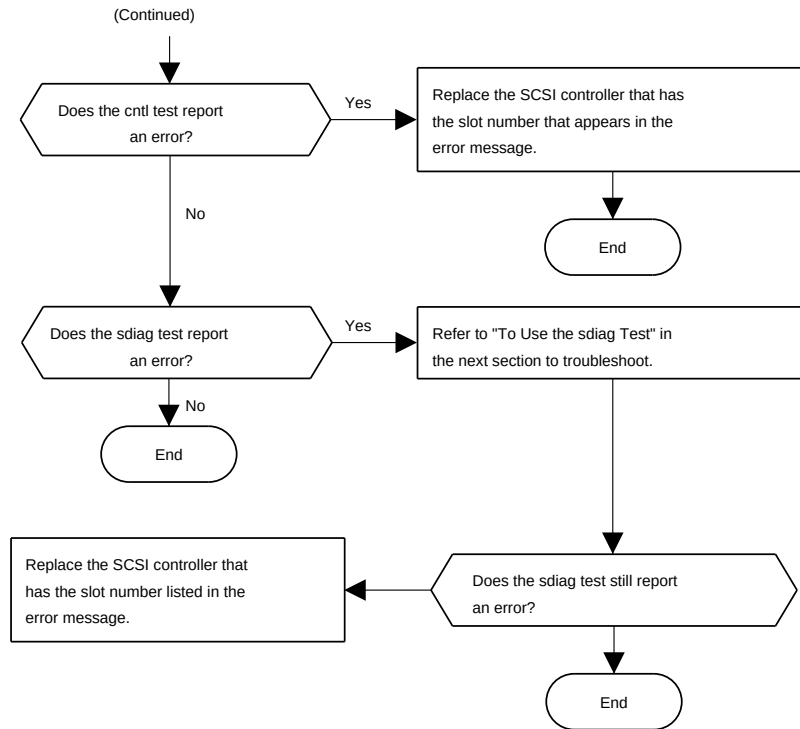
Troubleshooting SCSI Controllers and Devices

The flow chart in Figure 4-8 shows how to troubleshoot a SCSI controller or device.



WS33M100

Figure 4-8. Troubleshooting SCSI controllers and devices



WS33M101

Figure 4-8. Troubleshooting SCSI controllers and devices

How to Use the sdiag Test

The sdiag test runs the self-test for an individual SCSI device.

To run the SCSI send diagnostics test, type

t *slot_number*/**scsi**/**sdiag** *scsi_id* [**d**] [**u**] [**s**] and press Return.

When you type the SCSI send diagnostics command,

- Replace *slot_number* with the slot number of the controller for the SCSI device that you want to test.
- 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 perform the operation that these parameters specify. The result of specifying d and u depends on the type of drive that you are testing.

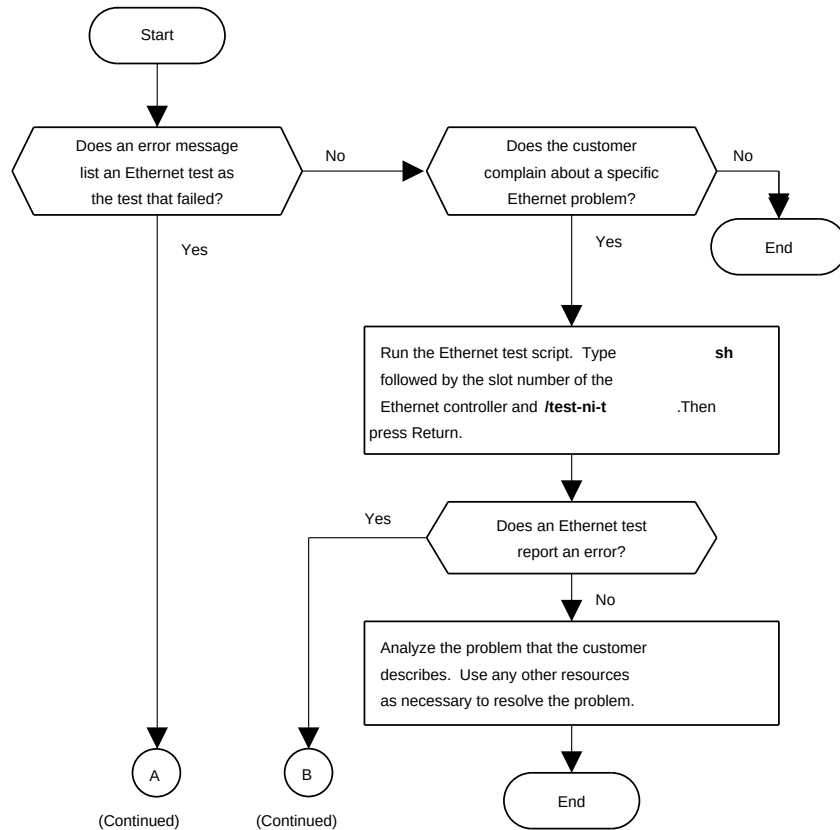
Specify only the default power-up self-test unless you are sure how the device responds.

- Include the optional s parameter to suppress the error message display.

The meaning of the sdiag test error message depends on the specific device you are testing. For an explanation of an sdiag test error message, refer to the service guide for the drive that generated the error.

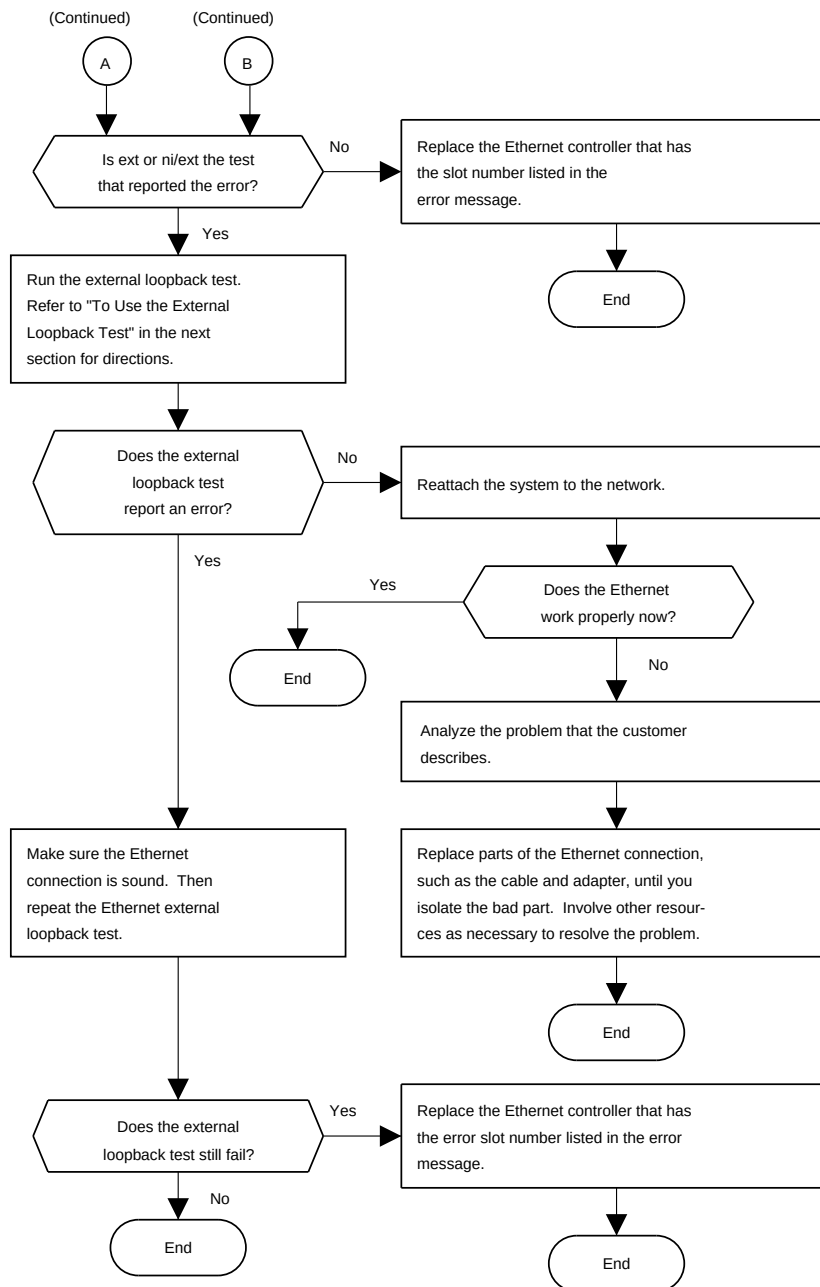
Troubleshooting an Ethernet Controller

The flow chart in Figure 4-9 shows how to troubleshoot an Ethernet controller.



WS33M102

Figure 4-9. Troubleshooting an Ethernet controller



WS33M107

Figure 4-9. Troubleshooting an Ethernet controller

How to Use the External Loopback Test

The external loopback test checks the Ethernet controller and its connection to the network.

Before you run the external loopback test, first install a ThickWire loopback connector on the Ethernet controller that you want to test.

- To run the external loopback test on the base system Ethernet controller, type **t 3/ni/ext-lb** and press Return.
- To run the external loopback test on a TURBOchannel option Ethernet controller, type **t slot_number/ext-lb**, where you replace *slot_number* with the slot number of the Ethernet controller you want to test, and press Return.

Example: External loopback test error messages

This is a sample external loopback test error message:

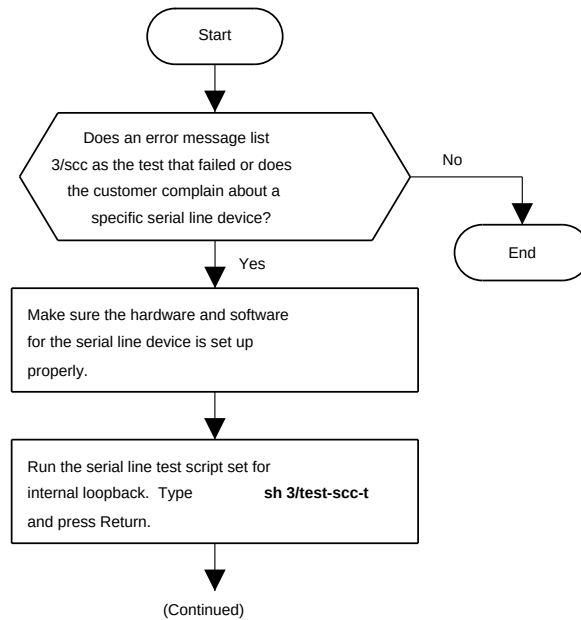
```
?TFL: 3/ni/ext-lb (6: (pkt-data !=))
```

?TFL: 3/ni/ext-lb indicates that the external loopback test failed. The phrase inside the parentheses describes which part of the test failed.

For a detailed explanation of external loopback test error messages, refer to the description of the external loopback test in Appendix D.

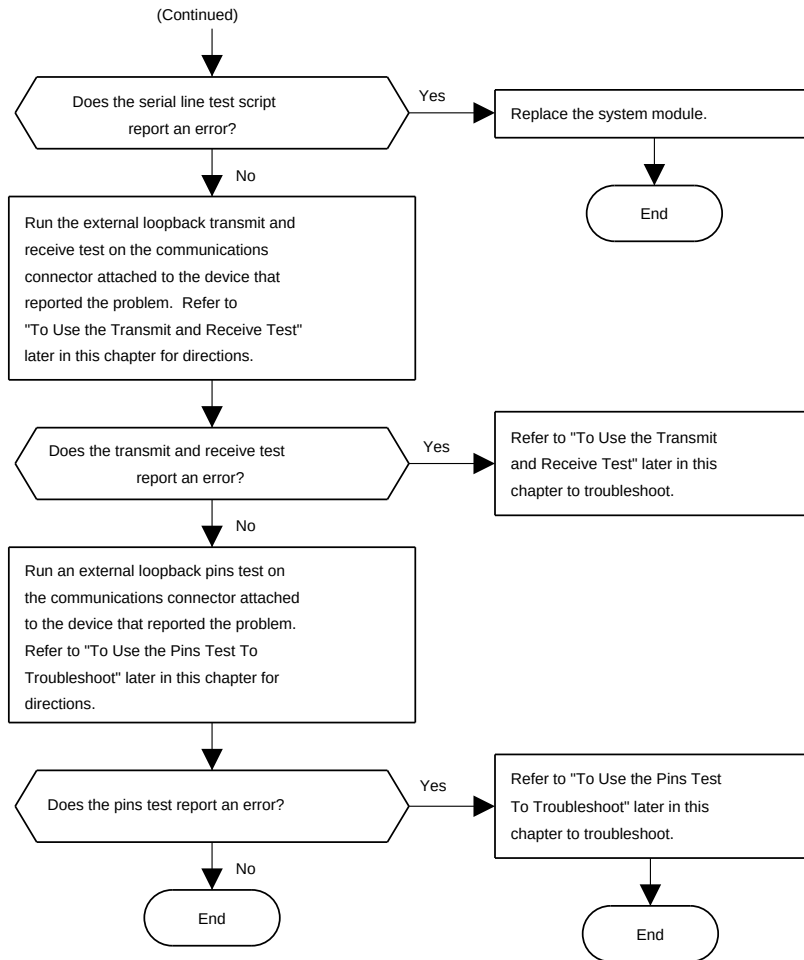
Troubleshooting a Printer, Modem, or Other Serial Line Device

The flow chart in Figure 4-10 shows how to troubleshoot a printer, modem, or other serial line device.



WS33M104

Figure 4-10. Troubleshooting a printer, modem, or other serial line device



WS33M105

Figure 4-10. Troubleshooting a printer, modem, or other serial line device

How to Use the Transmit and Receive Test

Use the external transmit and receive test to check the ability of the SCC to transmit and receive information. To run the external SCC transmit and receive test, first install a communications adapter with an MMJ loopback connector on the communications connector for the serial device that is not operating properly.

The command syntax is:

t 3/scc/tx-rx *connector* **extl** [*baud*] [*parity*] [*bits*]

where:

- *connector* with the number of the serial line to which you attached a communications connector.
 - Specify 2 to test the communications connector that is on the right as you face the back of the system.
 - Specify 3 to test the communications connector that is on the left as you face the back of the system.
- *baud* with the baud rate at which you want to run the test. 9600 baud is the default baud rate.
- *parity* with a value that specifies the type of parity you want to use in the test.
 - Specify none to use no parity. No parity is the default value.
 - Specify odd to use odd parity.
 - Specify even to use even parity.
- *bits* with the number of bits per character that you want the test to use.
 - Specify 8 to use 8 bits per character. 8 is the default value.
 - Specify 7 to use 7 bits per character.
 - Specify 6 to use 6 bits per character.

Example: SCC transmit and receive test error messages

This is a sample external transmit and receive test error message:

?TFL: 3/scc/tx-rx (1: Ln3 tx bfr not empty. status=0345)

?TFL: 3/scc/tx-rx indicates that the external transmit and receive test failed. The Ln value is the number of the serial line in which the error occurred. In this sample message, the error occurred in serial line 3.

For a detailed explanation of external transmit and receive error messages, refer to the description of the SCC transmit and receive test in Appendix D.

How to Use the Pins Test

The pins test checks the pins on the communications connectors. To run the pins test, first install a modem loopback connector on the communications connector for the serial line device that is not operating properly.

The command syntax is:

t 3/scc/pins *line loopback*

where:

- *line* with the number of the serial line to which you attached the modem connector.
 - 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.
- *loopback* with the part number for the modem loopback connector that you attached to the communications connector.
 - Specify 29-24795-00 if you installed a 29-24795-00 loopback connector.
 - Specify H8571-A if you installed an H8571-A loopback connector.
 - Specify H3200 if you installed an H3200 loopback connector.

Example: Pins test error messages

This is a sample pins test error message:

```
?TFL: 3/scc/pins (1: Ln2 20-22)
```

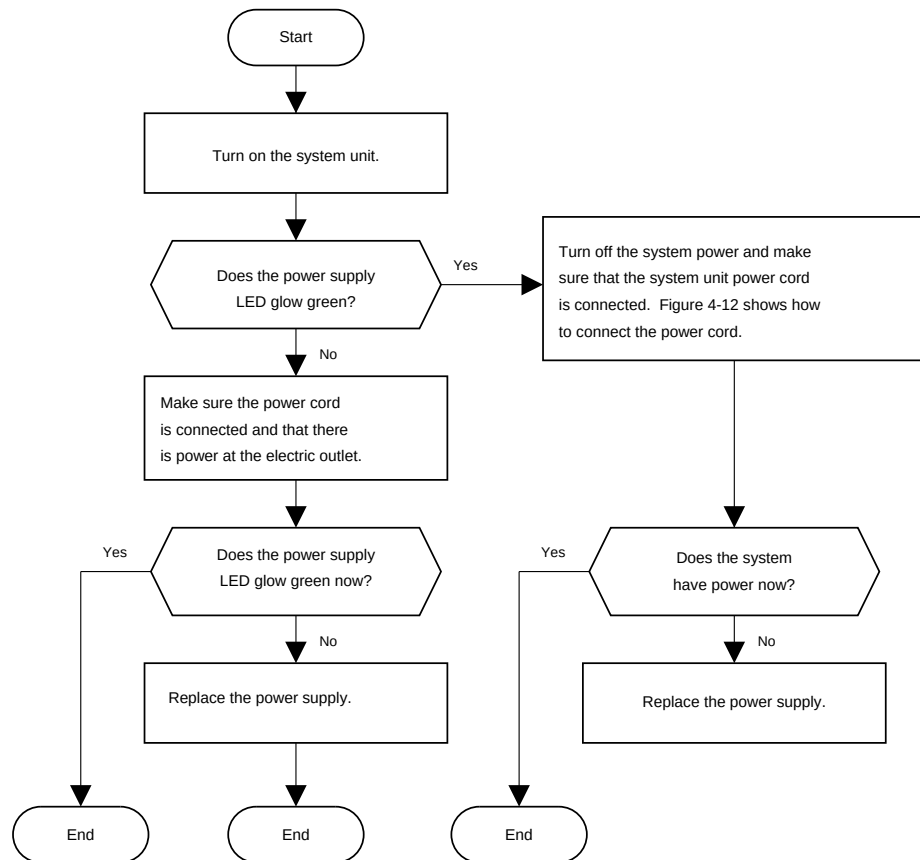
?TFL: 3/scc/pins indicates that the pins test reported an error. The Ln value is the number of the communications connector that reported the error. In this sample message, the error occurred in communications connector 2.

Numbers that follow the communications connector number indicate the specific connector pins that failed.

For a detailed explanation of the pins test, refer to Appendix D.

Troubleshooting the Power Supply

The flow chart in Figure 4-11 shows how to troubleshoot if the system unit has no power.



WS33M090

Figure 4-11. Troubleshooting when the system unit has no power

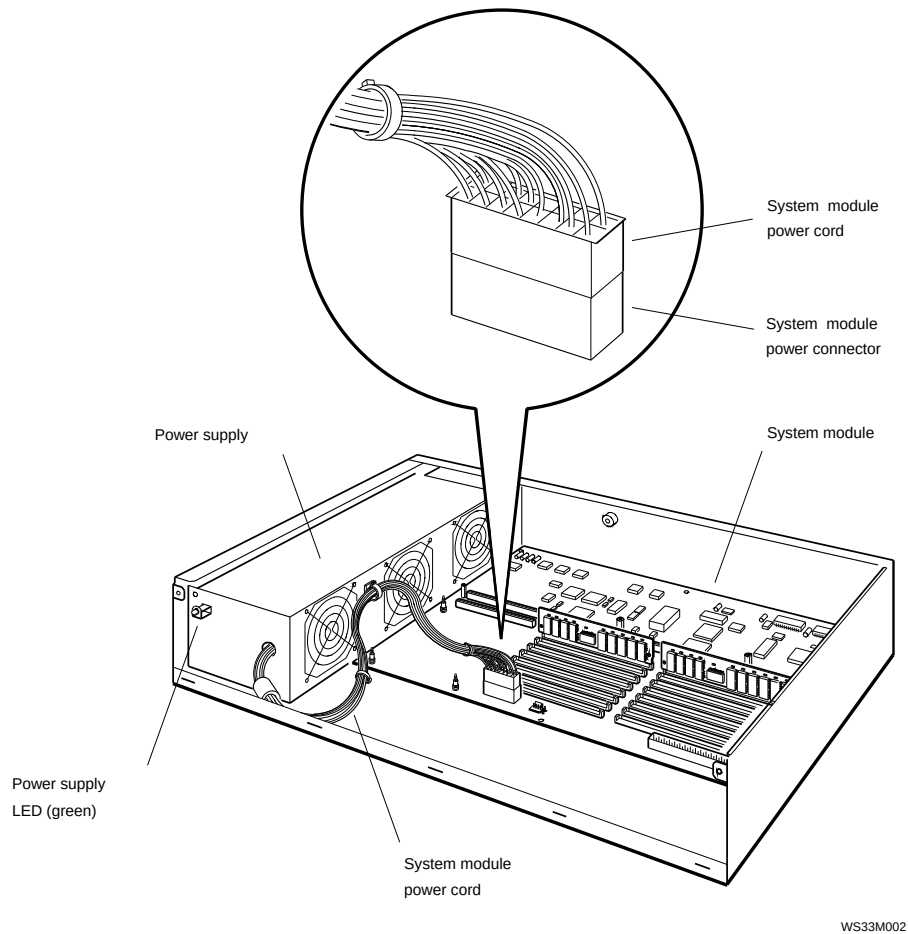
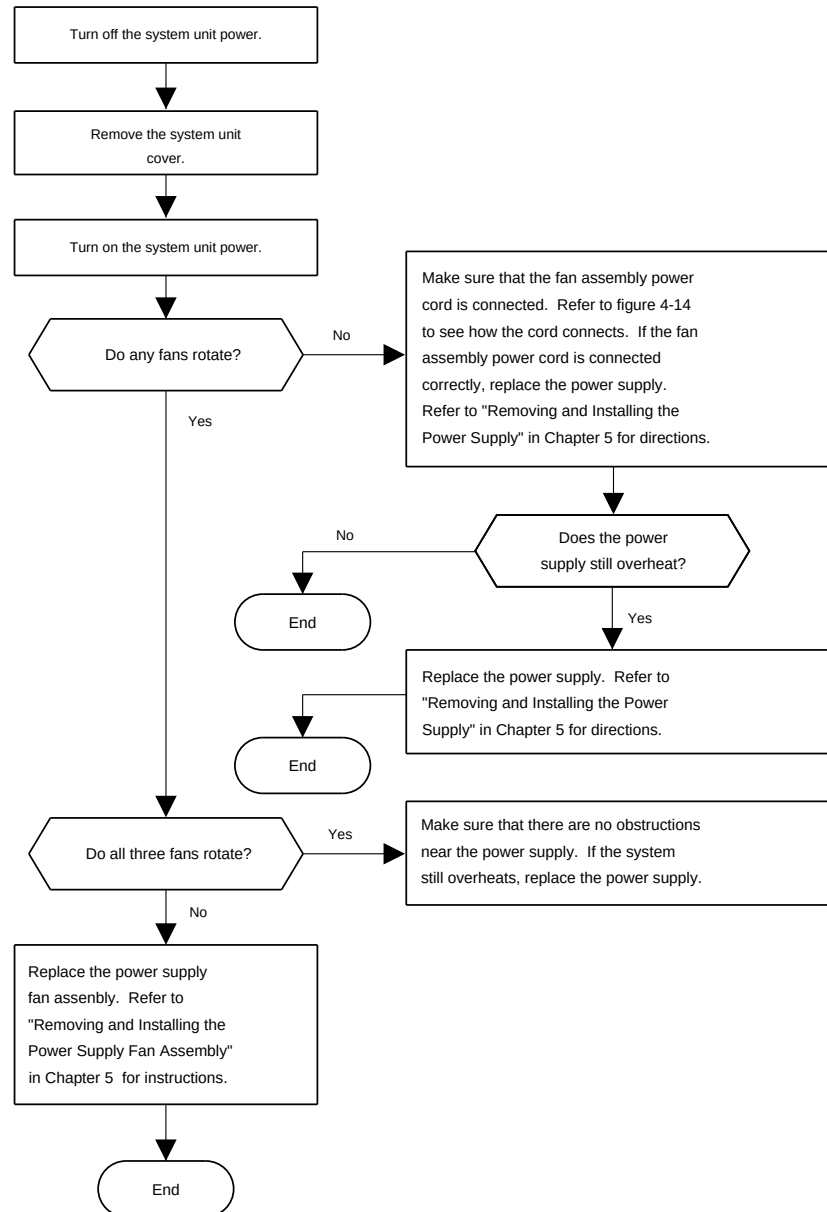


Figure 4-12. System module power cord connections

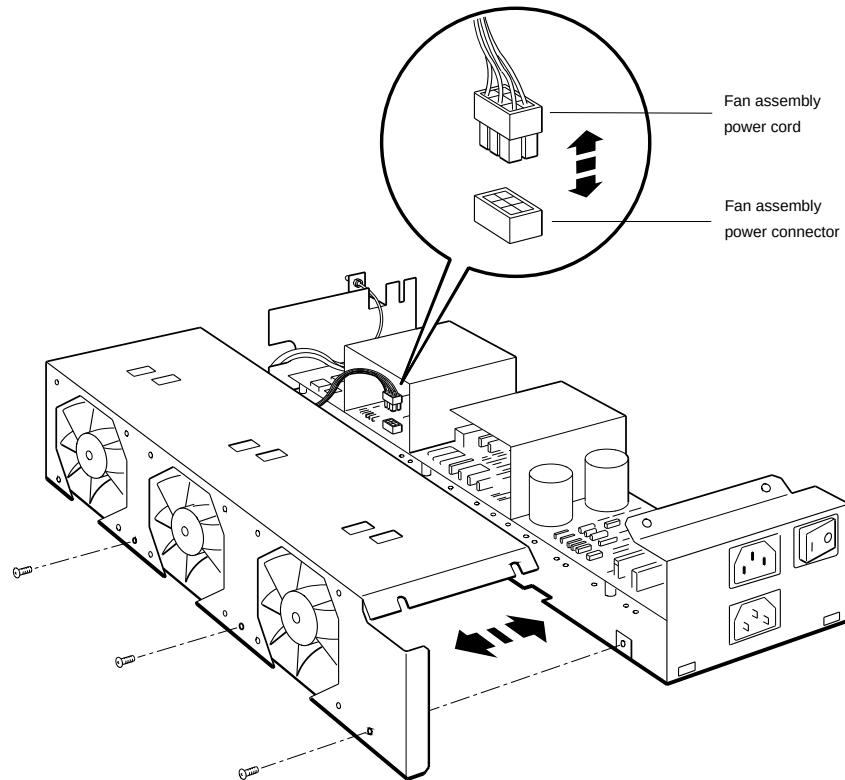
Troubleshooting If the System Unit Overheats

If the system returns the error message ?TFL 3/misc/pstemp, the system unit is overheating. The flow chart in Figure 4-13 shows how to troubleshoot if the system unit overheats.



WS33M084

Figure 4-13. Troubleshooting if the system unit overheats

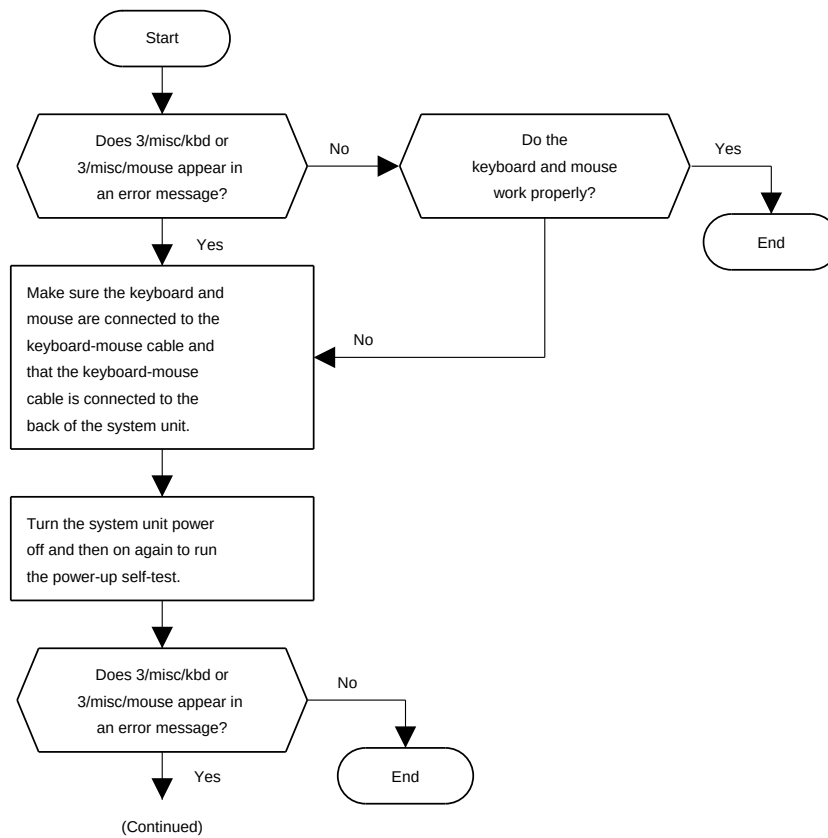


WS33M033

Figure 4-14. Checking the fan assembly power cord connection

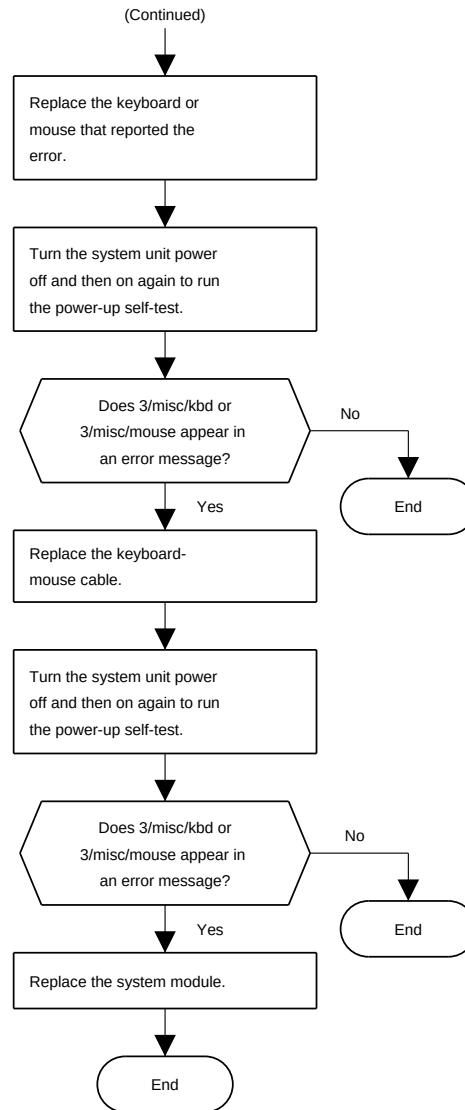
Troubleshooting the Keyboard and Mouse

The flow chart in Figure 4-15 shows how to troubleshoot the keyboard and mouse.



WS33M106

Figure 4-15. Troubleshooting the keyboard and mouse

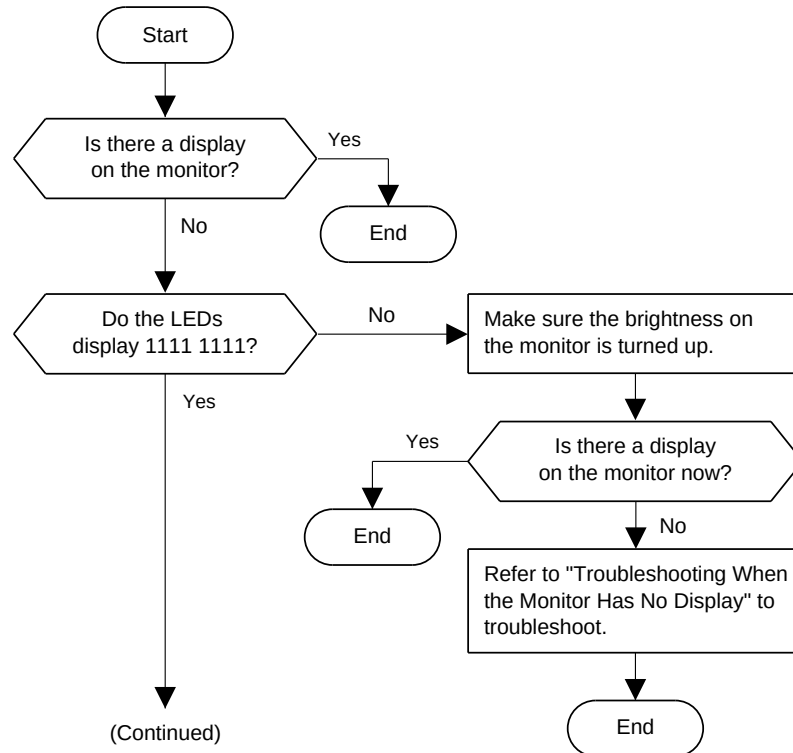


WS33M108

Figure 4-16. Troubleshooting the keyboard and mouse

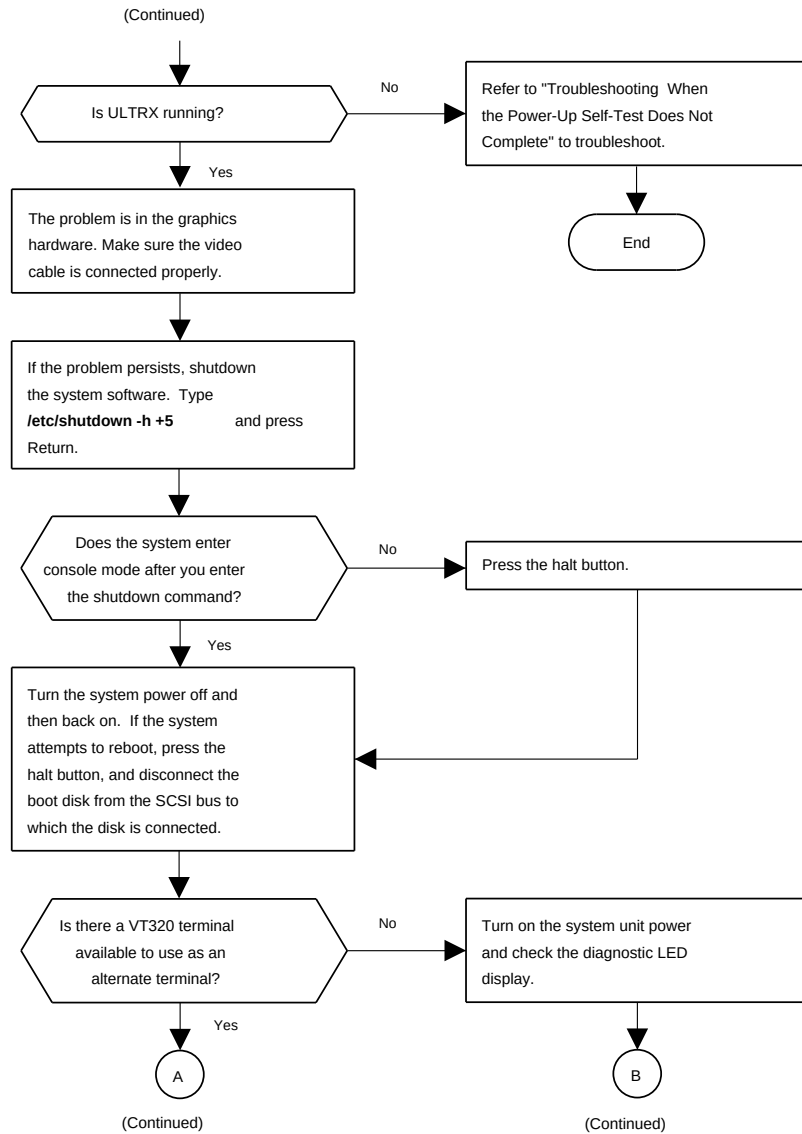
Troubleshooting When ULTRIX Is Running but the Monitor Has No Display

The flow chart in Figure 4-17 shows how to troubleshoot when ULTRIX is running but the monitor has no display.



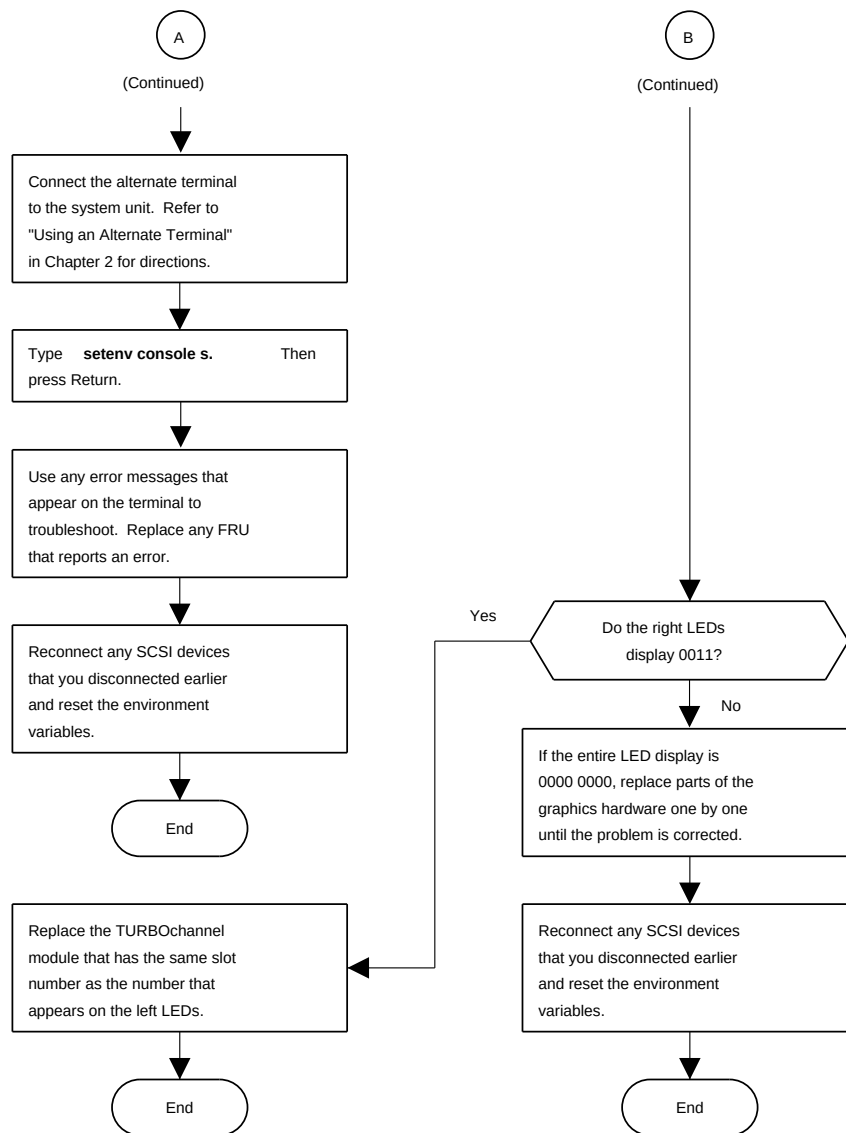
WS33M114

Figure 4-17. Troubleshooting when ULTRIX is running but the monitor has no display



WS33M098

Figure 4-17. Troubleshooting when ULTRIX is running but the monitor has no display



WS33M099

Figure 4-18. Troubleshooting when ULTRIX is running but the monitor has no display

Troubleshooting with ULTRIX Error Logs

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 failed hardware component indicated by the error log. Refer to the section in Chapter 5 of this guide, or the *TURBOchannel Maintenance Guide* for specific replacement instructions.

For a detailed explanation of error log formats, refer to “Using ULTRIX Error Logs” in Chapter 3.

To Interpret Error Log Event Types

The event type listed in the second line of an ULTRIX error log describes the general event that the error log recorded. Table 4-3 lists possible event type codes and their meaning.

Table 4-3. 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

To Interpret Physical Address Registers

Many error logs list the physical address for the hardware involved in the error. Table 4-4 lists the hardware that each address indicates.

Table 4-4. Hardware Physical Addresses

Physical Address Range	Indicated Hardware
0x00000000 to 0x07FFFFFFF	Memory array banks 0 to 7
0x08000000 to 0x0BFFFFFFF	Reserved
0x0C000000 to 0x0DFFFFFFF	Memory registers
0x0E000000 to 0x0FFFFFFF	CPU control ASIC registers
0x10000000 to 0x13FFFFFFF	TURBOchannel slot 0
0x14000000 to 0x17FFFFFFF	TURBOchannel slot 1
0x18000000 to 0x1BFFFFFFF	TURBOchannel slot 2
0x1C000000 to 0x1FFFFFFF	TURBOchannel slot 3: System board peripherals (includes the subsystems listed below)
(Includes these address ranges:)	
0x1C000000 to 0x1C03FFFFF	System ROM
0x1C040000 to 0x1C07FFFFF	I/O control registers and DMA pointers
0x1C080000 to 0x1C0BFFFFF	Ethernet address PROM
0x1C0C0000 to 0x1C0FFFFFFF	Ethernet interface
0x1C100000 to 0x1C13FFFFF	SCC(0)
0x1C140000 to 0x1C17FFFFF	Reserved
0x1C180000 to 0x1C1BFFFFF	SCC(1) registers
0x1C1C0000 to 0x1C1FFFFFFF	Reserved
0x1C200000 to 0x1C23FFFFF	Real-time clock
0x1C240000 to 0x1C29FFFFF	Reserved
0x1C300000 to 0x1C33FFFFF	SCSI interface
0x1C340000 to 0x1C37FFFFF	Reserved
0x1C380000 to 0x1C3BFFFFF	SCSI DMA
0x1C3C0000 to 0x1FBFFFFFFF	Reserved
0x1FC00000 to 0x1FC3FFFFF	Boot ROM
0x1FC40000 to 0x1FFFFFFF	Reserved
0x1FD00000 to 0x1FD3FFFFF	MB_Interrupt
0x1FD40000 to 0x1FD7FFFFF	MB_EA
0x1FD80000 to 0x1FDBFFFFF	MB_EC
0x1FDC0000 to 0x1FDFFFFFF	MB_CS

For Further Information

For an explanation of troubleshooting procedures for monitors, SCSI drives, and TURBOchannel option modules, refer to the *TURBOchannel Maintenance Guide*.

Troubleshoot Daughter Card LEDs

Two LEDs on the daughter card can provide a quick indication of the working condition of the daughter card and system module. If either of the LEDs is off, replace the daughter card.

Base System FRUs

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

- System module
- CPU module
- Memory modules
- Power supply

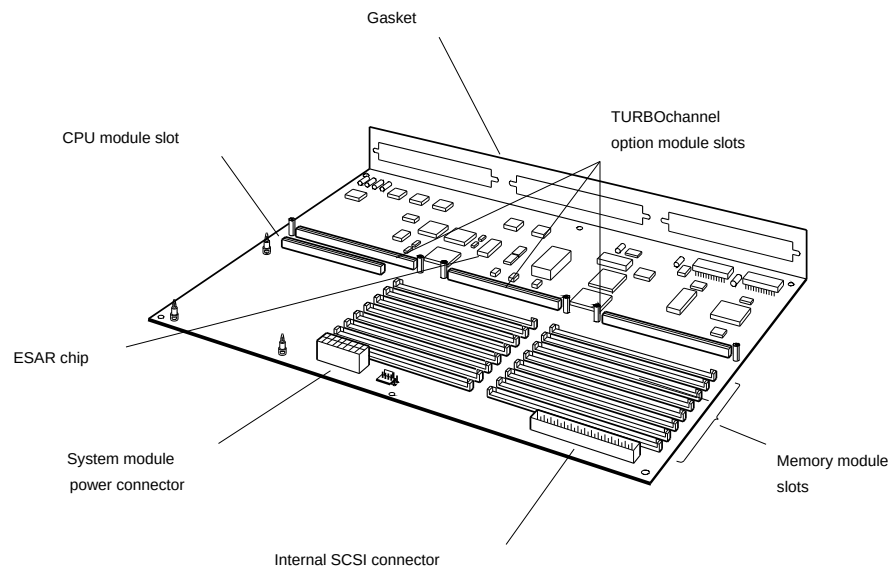
Caution: *Always follow antistatic procedures when handling electronic components.*

System Module

System Module HardwareDescription

The system module, shown in Figure 5-1, provides basic system functions. The system module contains:

- One system ROM chip
- One Ethernet station address register (ESAR) chip
- One SCSI controller
- One ThickWire Ethernet controller
- Two serial line controllers
- One CPU module slot
- Three option module slots
- Sixteen memory module slots

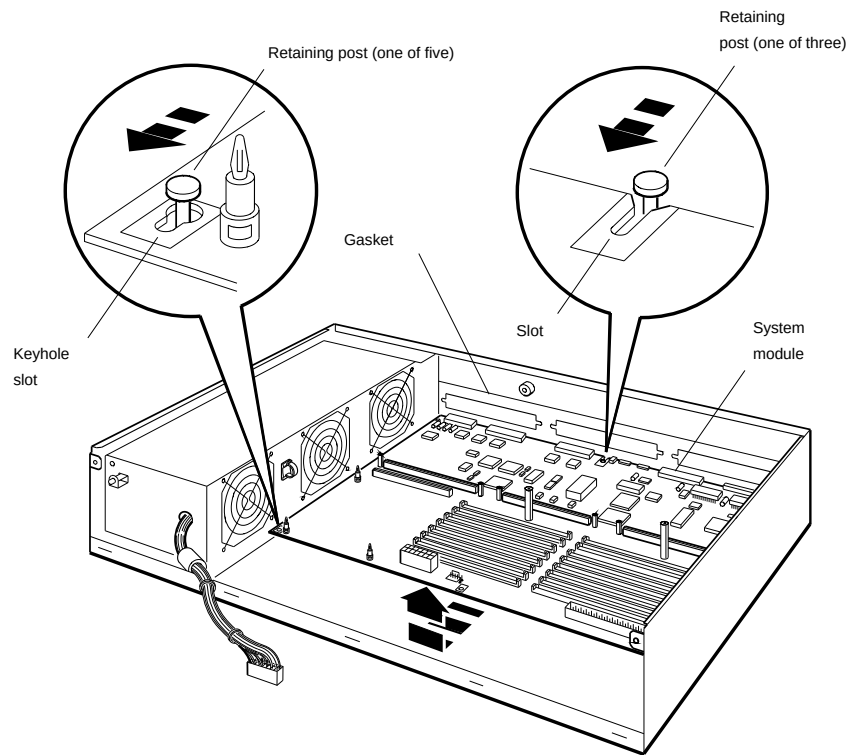


WS33M043

Figure 5-1. System module

Removing and Installing a System Module

Figure 5-2 shows how to remove a system module.



WS33M048

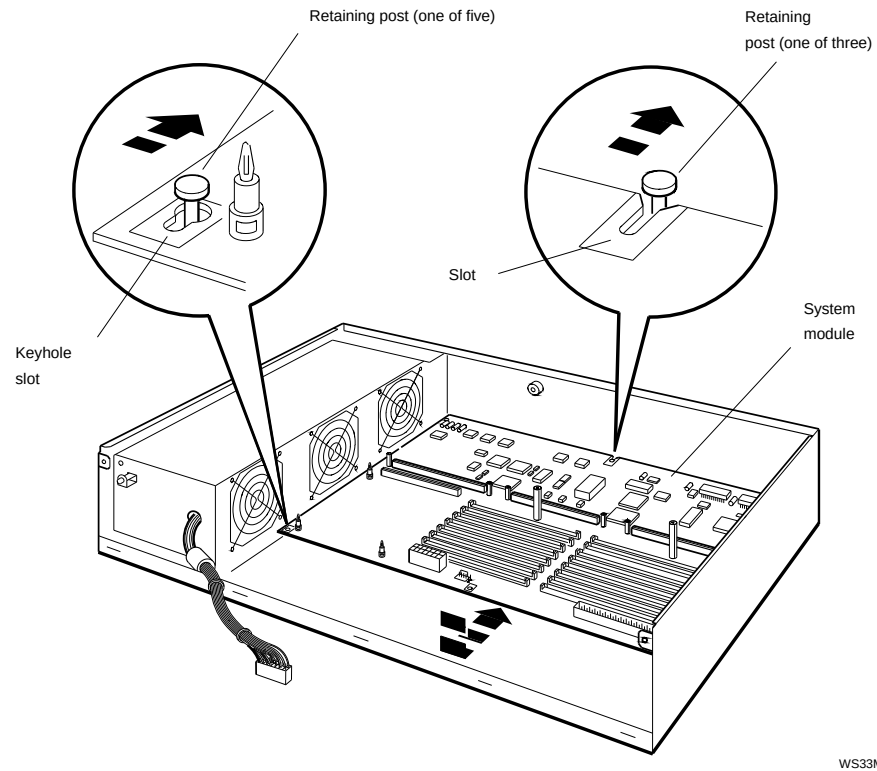
Figure 5-2. Removing a system module

How to remove the system module

1. Disconnect the system module power cord from the system module.
2. Remove the removable media drive panel. Refer to “Removing and Installing the Removable Media Drive Panel” on page 6-9 for directions.
3. Disconnect any cables attached to the back of the system unit.
4. Remove any option modules attached to the system module. Refer to “Removing and Installing an Option Module” on page 5-30 for directions.
5. Remove the CPU module. Refer to “Removing and Installing a CPU Module” on page 5-12 for directions.
6. Disconnect the internal SCSI cable. Remove the hard disk drives.
7. Remove any memory modules attached to the system unit. Refer to “Removing and Installing Memory Modules” on page 5-19 for directions.
8. Remove the ESAR address chip from the system module. Refer to “Removing and Installing an ESAR Chip on the System Module” on page 5-7 for directions.
9. Unscrew the option module standoffs and the removable media bracket standoffs.
10. Pull the system module toward the front of the system unit until the large end of the keyhole slots are over the mounting posts.
11. Lift the system module over the mounting posts and away from the chassis.

Caution: *Be careful not to damage the gasket on the system module.*

Figure 5-3 shows how to install a system module.



WS33M047

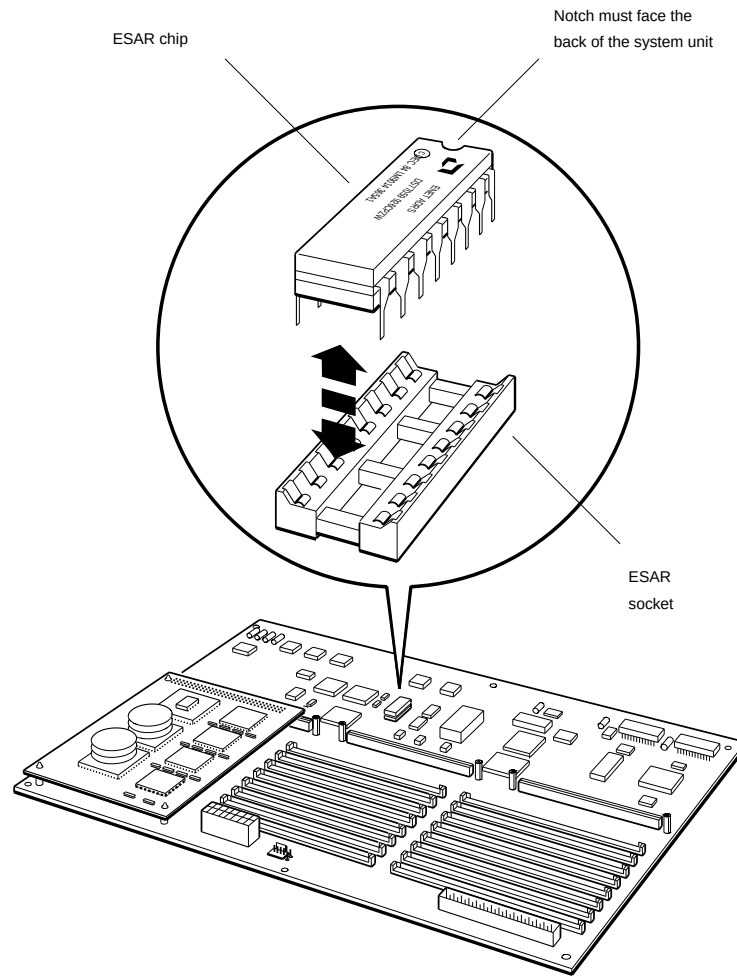
Figure 5-3. Installing a system module

How to install a system module

1. Position the system module over the chassis so that the side with the memory module slots are farthest from the power supply.
2. Pass the large ends of the keyhole slots in the system module over the mounting posts on the chassis.
3. Slide the system module toward the back of the system unit until the mounting posts enter the small ends of the slots.
4. Reinstall the option module standoffs and the removable media bracket standoffs removed earlier. To do this, you must push the system module to the back of the box while inserting the standoffs. Notice that the standoffs hold the board in place against the back of the chassis.
5. Reinstall any hard disks removed earlier.
6. Reconnect the internal SCSI cable.
7. Install the ESAR chip from the old system module onto the new system module. Refer to “Removing and Installing an ESAR Chip on the System Module” on page 5-7 for directions.
8. Install the CPU module.
9. Reinstall any memory modules and option modules that you removed earlier. Refer to “Removing and Installing Memory Modules” on page 5-19 and “Removing and Installing an Option Module” on page 5-30 for directions.
10. Reconnect any cables that were attached to the back of the old system unit.
11. Reconnect the system module power cord.
12. Replace the removable media drive panel. Refer to “Removing and Installing the Removable Media Drive Panel” on page 6-9 for directions.
13. Turn on the system unit and check the power-up self-test results to make sure the system runs properly.

Removing and Installing an ESAR Chip on the System Module

Figure 5-4 shows how to remove and install an ESAR chip on the system module.



WS33M015

Figure 5-4. ESAR chip location

How to remove and install an ESAR chip

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

To remove an ESAR chip,

1. Turn off the system unit power and remove the system unit cover.
2. Remove the TURBOchannel module in slot 1, if one is installed.
3. Locate the ESAR chip.
4. Gently pry the ESAR chip loose taking care not to bend the chip pins. A chip extraction tool is recommended for removing chips.

To install an ESAR chip,

1. Position the chip as shown in Figure 5-4. The notched end of the chip must face the back of the system unit. Make sure that each pin is over a hole in the ESAR chip socket.
2. Press the chip pins into the ESAR socket. Be careful not to bend the pins.

CPU Module

CPU Module Hardware Description

The system module holds one of the following removable CPU modules:

- 20-MHz CPU module
- 25-MHz CPU module
- 33-MHz CPU module
- 50-MHz CPU module

A Model 120 system has a 20-MHz CPU module, a Model 125 system has a 25-MHz CPU module, and a Model 133 system has a 33-MHz CPU module. The 20- and 25-MHz CPU modules are similar in appearance. A label on the CPU module specifies whether it is a 20-MHz or 25-MHz module. A Model 150 includes a 50-MHz CPU. If your system has been upgraded from a Model 120, 125, or 133 to a 150 the 50-MHz module is distinguished by a single ASIC chip, and single CPU chip with a rectangular shaped heatsink mounted on top of the CPU.

To distinguish between 20-, 25-, 33-, and 50-MHz CPU modules functionally, run the CPU type test by entering the `t` command in console mode:

t 3/misc/cpu-type

If the CPU speed is 20 MHz, the system returns the following message:

```
3/misc/cpu-type's code: NDX-91A
```

If the CPU speed is 25 MHz, the system returns the following message:

```
3/misc/cpu-type's code: NDX-97A
```

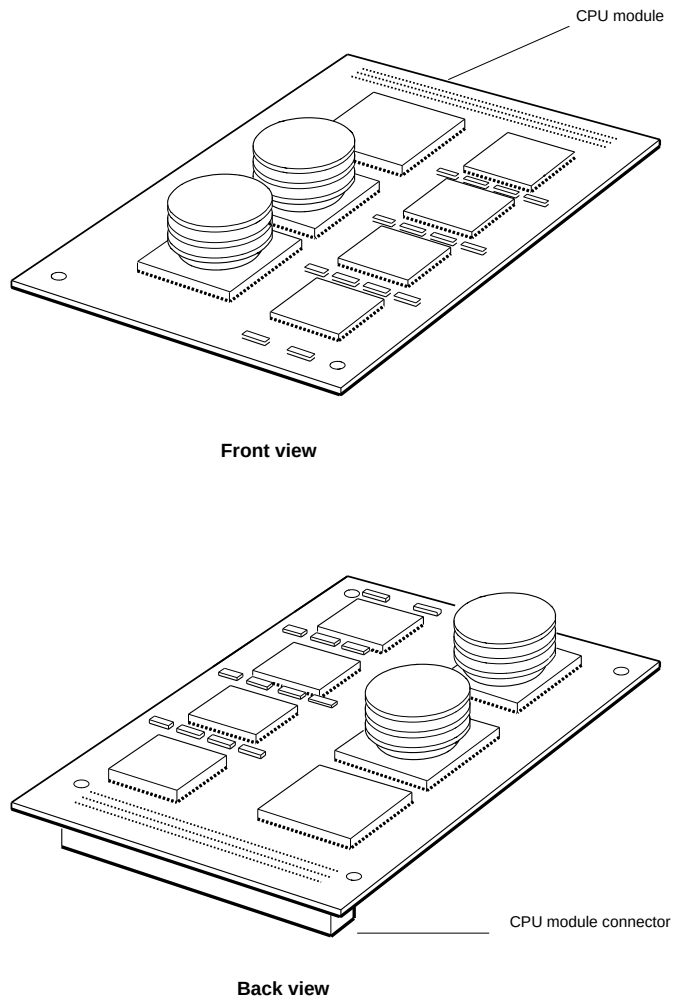
If the CPU speed is 33 MHz, the system returns the following message:

```
3/misc/cpu-type's code: NDX-103A
```

If the CPU is a 50-MHz R4000, the system returns the following message:

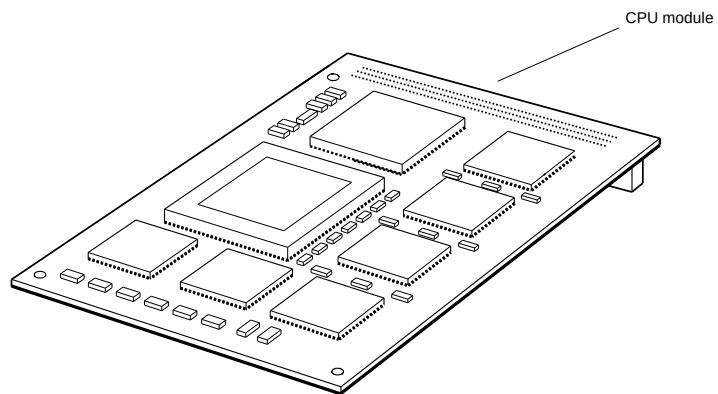
3/misc/cpu-type's code: NDX-65A

Figure 5-5 shows a 20- or 25-MHz CPU module. Figure 5-6 shows a 33-MHz CPU module. Figure 5-7 shows a 50-MHz R4000-based CPU module.

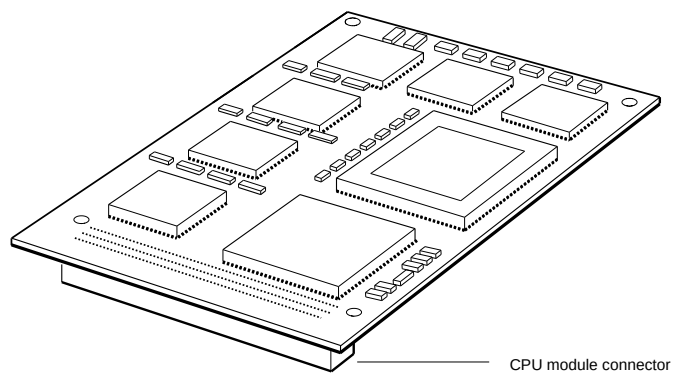


WS33M006

Figure 5-5. 20- or 25-MHz CPU module



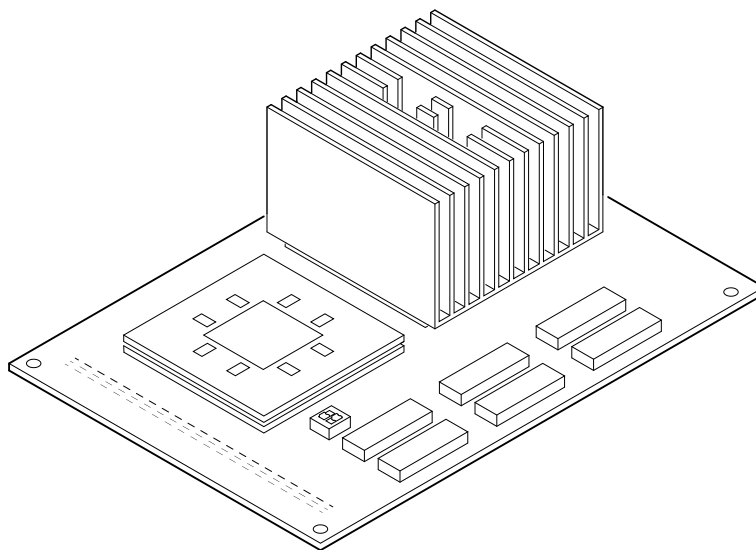
Front view



Back view

WS33O125

Figure 5-6. 33-MHz CPU module



LJ-02971-T10

Figure 5-7. 50-MHz R4000-based CPU module

Removing and Installing a CPU Module

Figure 5-8 shows how to remove and install a CPU module.

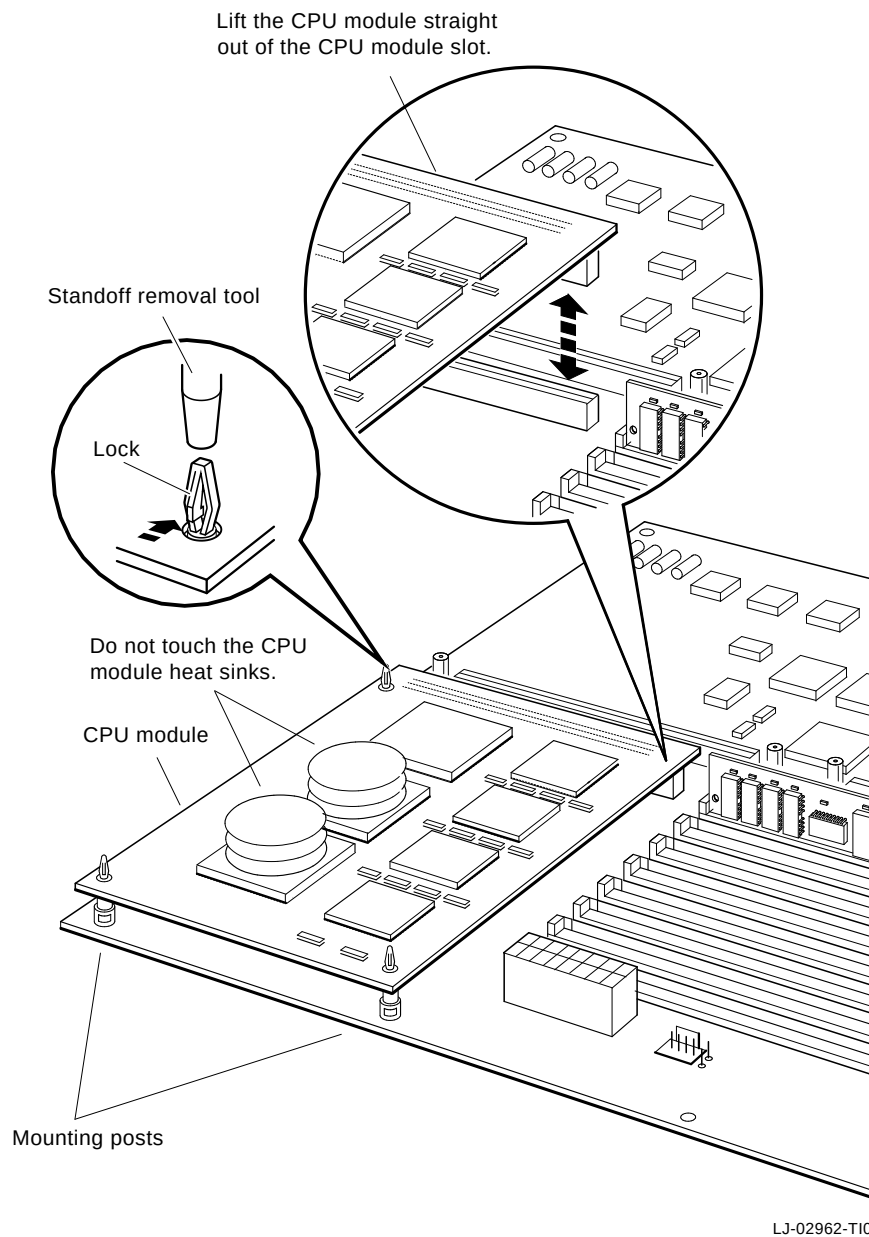


Figure 5-8. Removing and installing a CPU module

How to remove a CPU module

1. For each standoff, use the PC Removal Tool (74-46254-01) or a small pliers to squeeze the standoff lock. Lift the corner of the board slightly to free it from the lock.

Located under the heat sink there is a standoff which requires needle-nose pliers to remove the CPU from the standoff.

2. When the board is free of all three locks, use both hands to pull the board straight up out of the CPU module slot.

Caution: *Never touch the CPU module heat sinks. The heat sinks are fragile and break easily.*

How to install a CPU module

1. Press the CPU module connector into the CPU module slot on the system module.
2. Press the hole in each corner of the CPU module onto the standoff lock beneath that hole.
3. Place the upgrade (product conversion) label on the system top cover, along the top-back edge, half way between the two sides.
4. Install the new system medallion.
5. Return the old label, box, and CPU module to Digital as instructed in the upgrade kit.

Memory Modules

Memory Module Hardware Description

The system module memory slots hold up to eight pairs of 2-Mbyte MS01-AA or MS01L-AB memory modules or 8-Mbyte MS01-CA memory modules. The 2-Mbyte MS01-AA and the 8-Mbyte MS01-CA modules look identical except for the location of the etch part number. The different memory module types are shown in Figure 5-9, Figure 5-10, and Figure 5-11.

The memory modules are installed in pairs starting with the two slots nearest the back of the system unit. All of the memory modules in a system must be the same size.

Note: *Do not combine 2-Mbyte and 8-Mbyte memory modules in the same system.*

Figure 5-12 shows the memory module slot numbers.

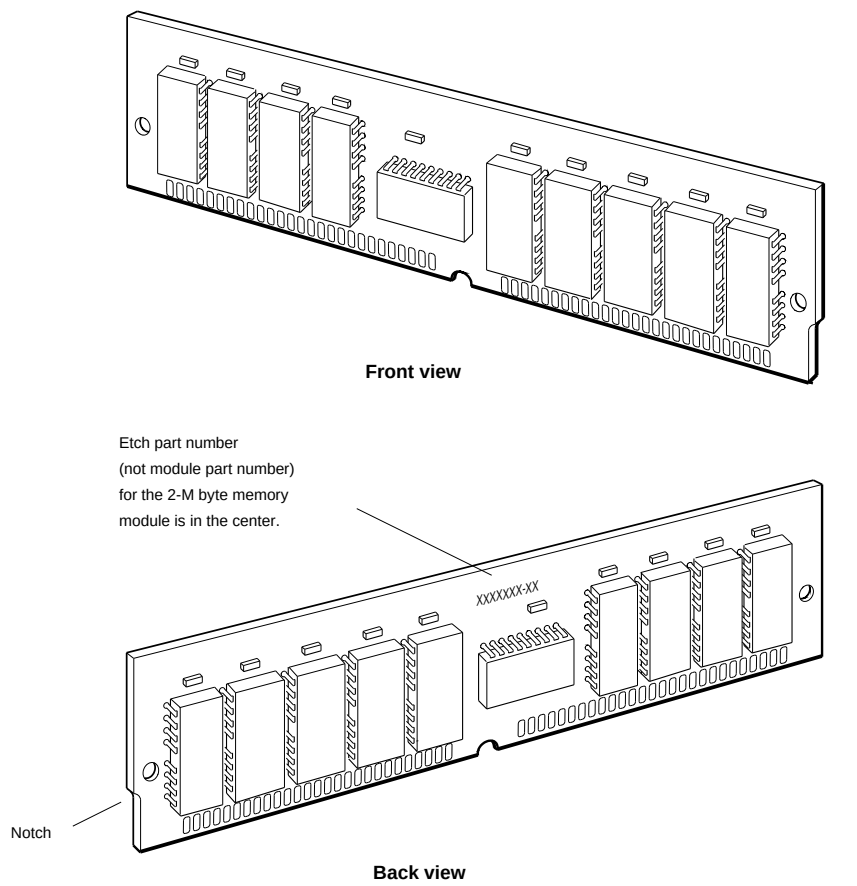
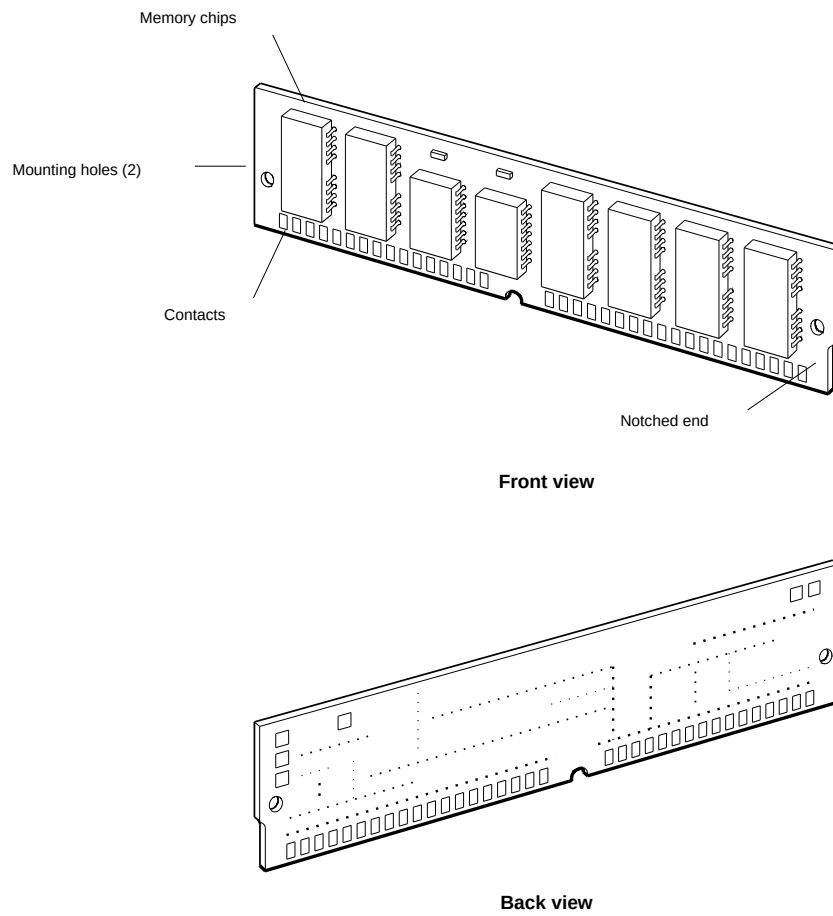
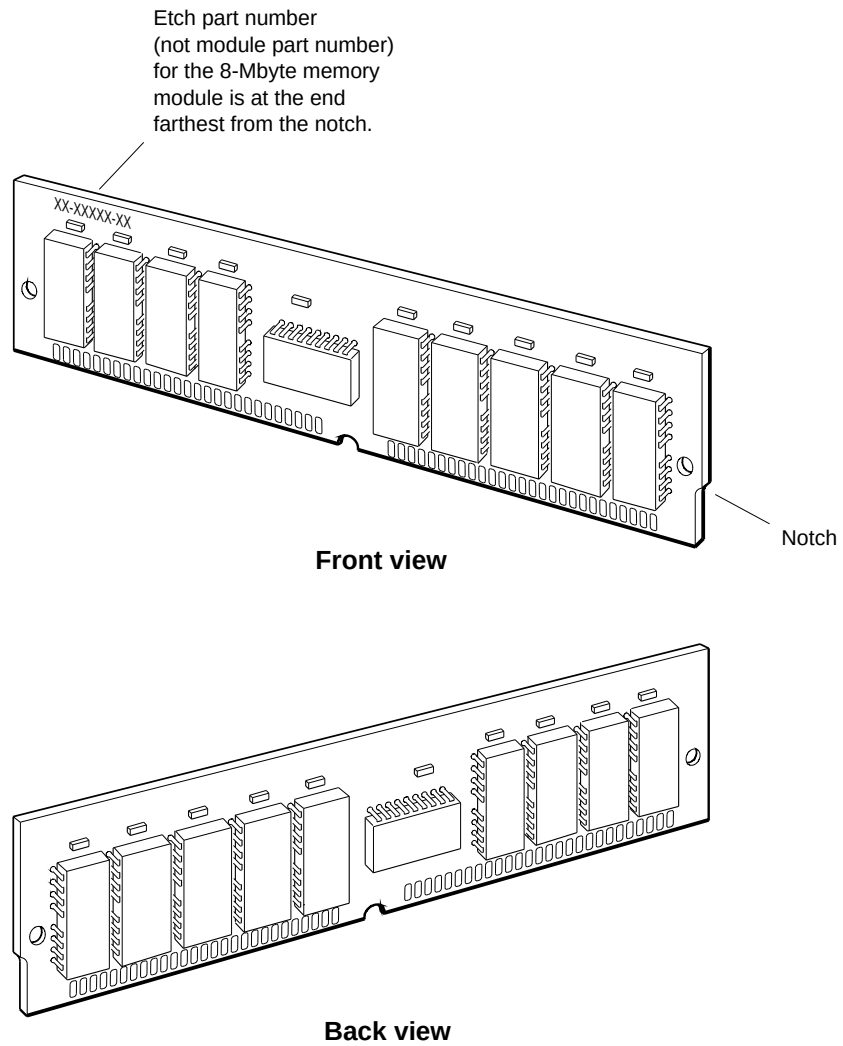


Figure 5-9. 2-Mbyte MS01-AA memory module



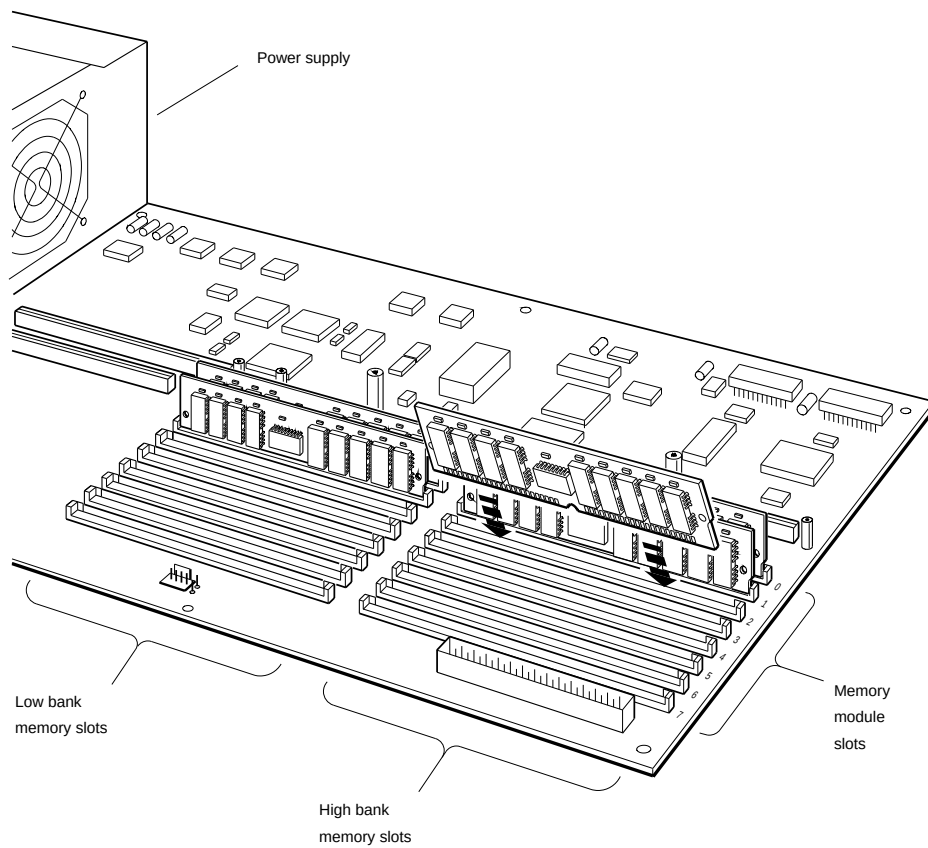
WS330130

Figure 5-10. 2-Mbyte MS01L-AB memory module



WS33M078

Figure 5-11. 8-Mbyte memory module



WS33M079

Figure 5-12. Memory module slot numbers

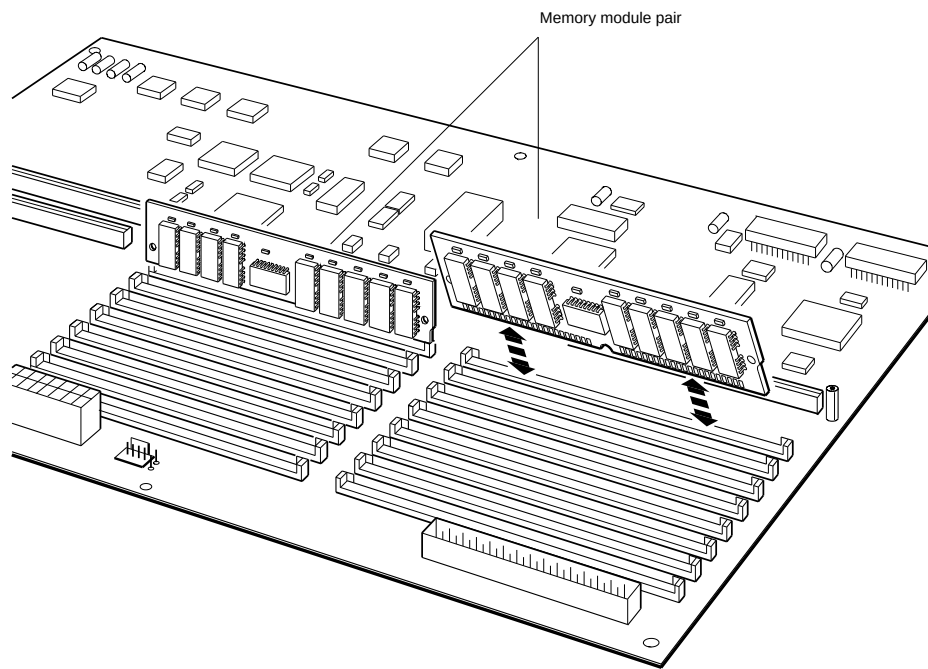
Table 5-1 shows the address range for each memory module slot.

Table 5-1. Memory Module Slot Address Ranges

Slot Numbers	2-Mbyte Module Addresses	8-Mbyte Module Addresses
0	0000000 - 03FFFFFF	0000000 - 0FFFFFFF
1	0400000 - 0FFFFFFF	1000000 - 1FFFFFFF
2	0800000 - 0FFFFFFF	2000000 - 2FFFFFFF
3	0C00000 - 0FFFFFFF	3000000 - 3FFFFFFF
4	1000000 - 1FFFFFFF	4000000 - 4FFFFFFF
5	1400000 - 1FFFFFFF	5000000 - 5FFFFFFF
6	1800000 - 1FFFFFFF	6000000 - 6FFFFFFF
7	1C00000 - 1FFFFFFF	7000000 - 7FFFFFFF

Removing and Installing Memory Modules

Figure 5-13 shows how a memory module should be removed and installed on a system board. Note that the memory module is tilted toward the front of the system board prior to lifting it out of the module socket.



WS33M004

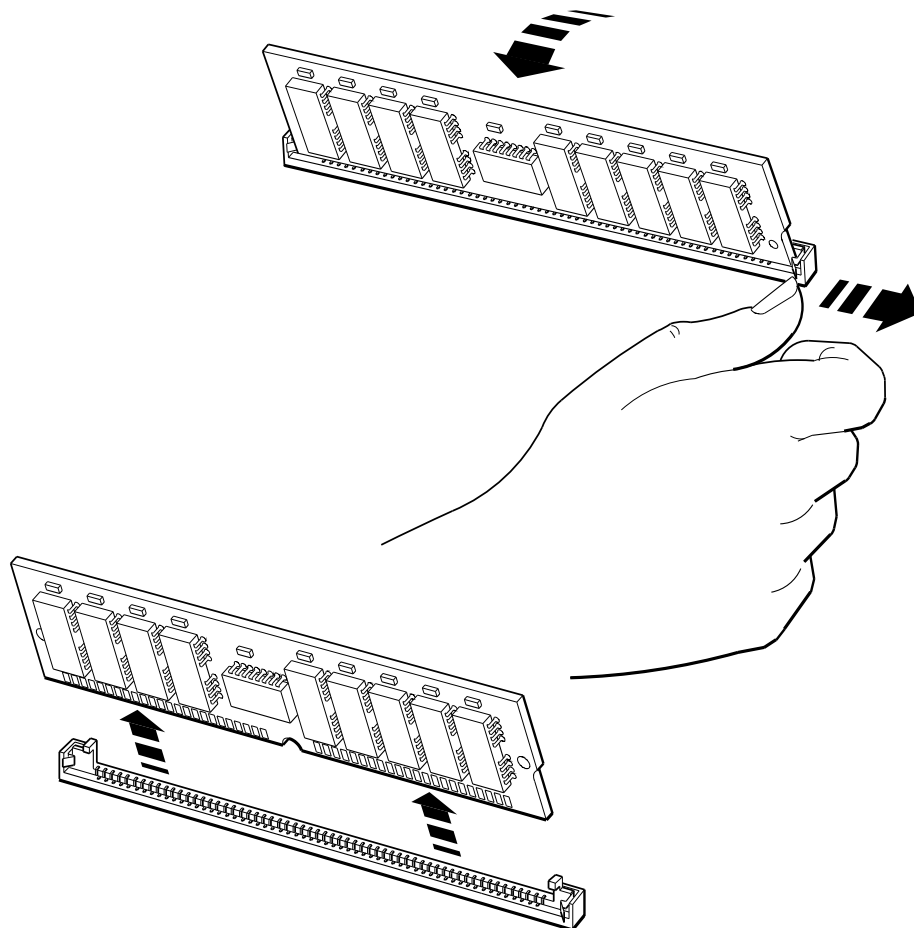
Figure 5-13. Removing and installing a memory module

How to remove a memory module

1. Remove the removable media drive panel. Refer to “Removing and Installing the Removable Media Drive Panel” on page 6-10 for directions.
2. To identify the slot that holds the memory module you want to replace, look at the slot numbers printed beside each memory module slot.
 - The slot farthest from the power supply is the high memory bank (D16-31).
 - The slot nearest the power supply is the low memory bank (D0-15).
3. Use your thumbs to push the memory module latches away from the module. Then tilt the module toward the front of the system unit as shown in Figure 5-14.

Caution: *There is not enough room to remove a memory module unless it is at the front of the line. Remove any memory modules between the module you are removing and the front of the system unit first.*

4. Lift the memory module out of the slot.

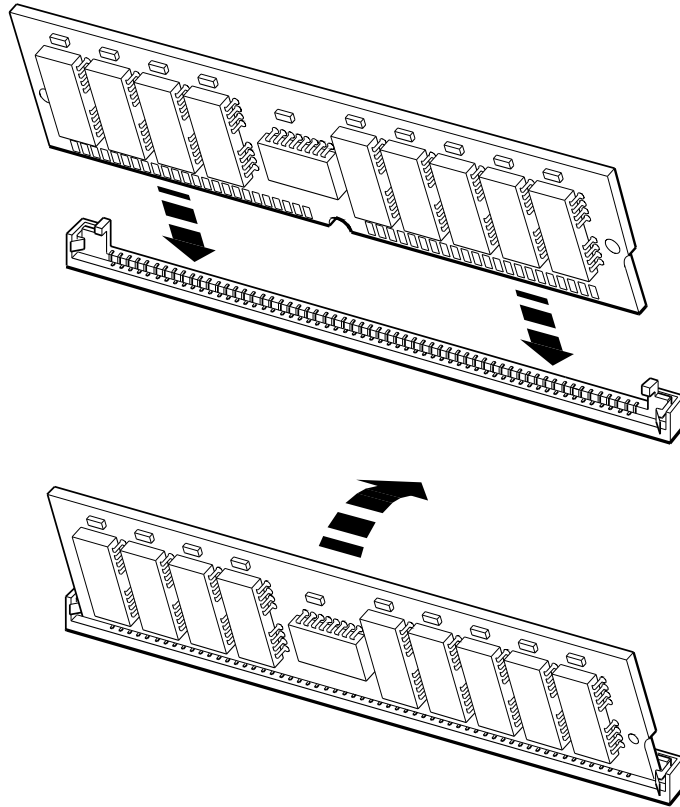


WS33M076

Figure 5-14. Removing a memory module

How to install a memory module

1. Look at the slot numbers printed beside the memory module slots and find the unused slot with the lowest number.
2. Align the memory module connectors above the slot as shown in Figure 5-15. Make sure that the notched end of the memory module is farthest from the power supply.
3. Lean the top of the memory module toward the front of the system unit and place the memory module connectors into the memory module slot.
4. Tilt up the top of the memory module until the memory module latches snap into place.
5. Use the same procedure to replace any other memory modules that you removed. Memory modules must be installed in pairs.
6. Replace the system unit cover.
7. Turn on the system unit. Check the power-up self-test results to make sure the system works properly. Run the cnfg 3 test to verify that the memory is there.
8. If the power-up self-test reports an error, refer to Chapter 4 to troubleshoot.



WS33M075

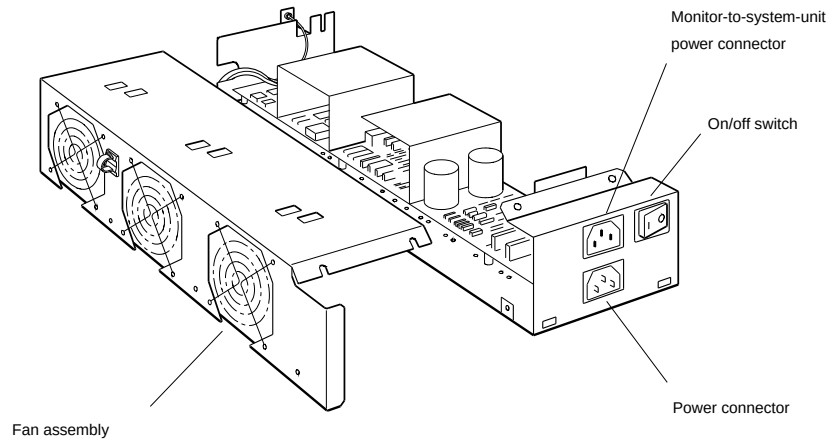
Figure 5-15. Installing a memory module

Power Supply

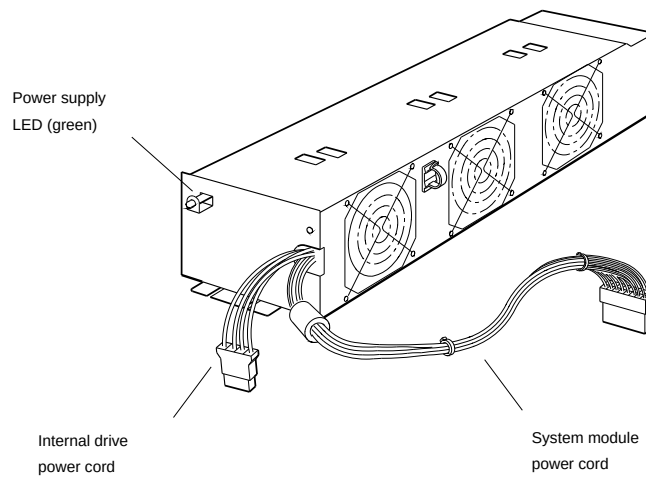
Power Supply Hardware Description

The power supply (H7826-AA), shown in Figure 5-16, provides 196 watts of DC power to the system unit. The back of the power supply has a power connector and a monitor-to-system-unit connector. An LED on the front panel glows green when the power supply is operating properly.

The power supply consists of a power supply base and a removable panel with three fans that cool the system unit.



Back view



Front view

WS33M034

Figure 5-16. Power supply hardware

Removing and Installing the Power Supply

Figure 5-17 shows how to remove and install the power supply.

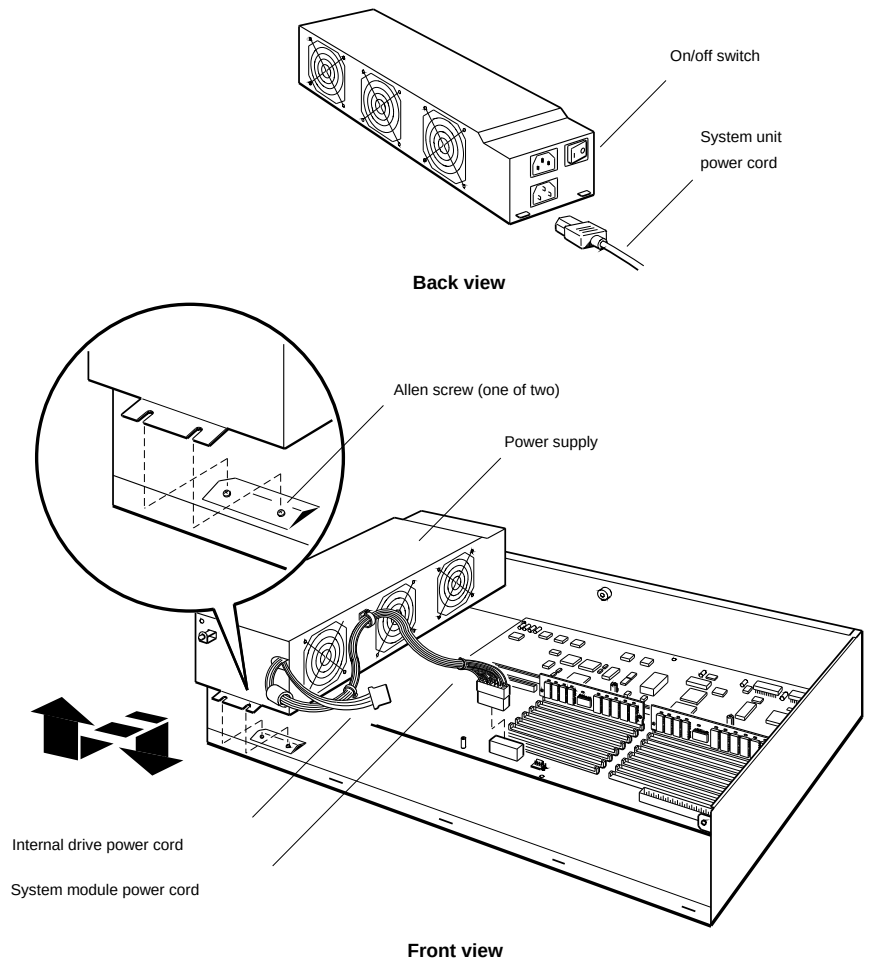


Figure 5-17. Removing and installing the power supply

How to remove the power supply

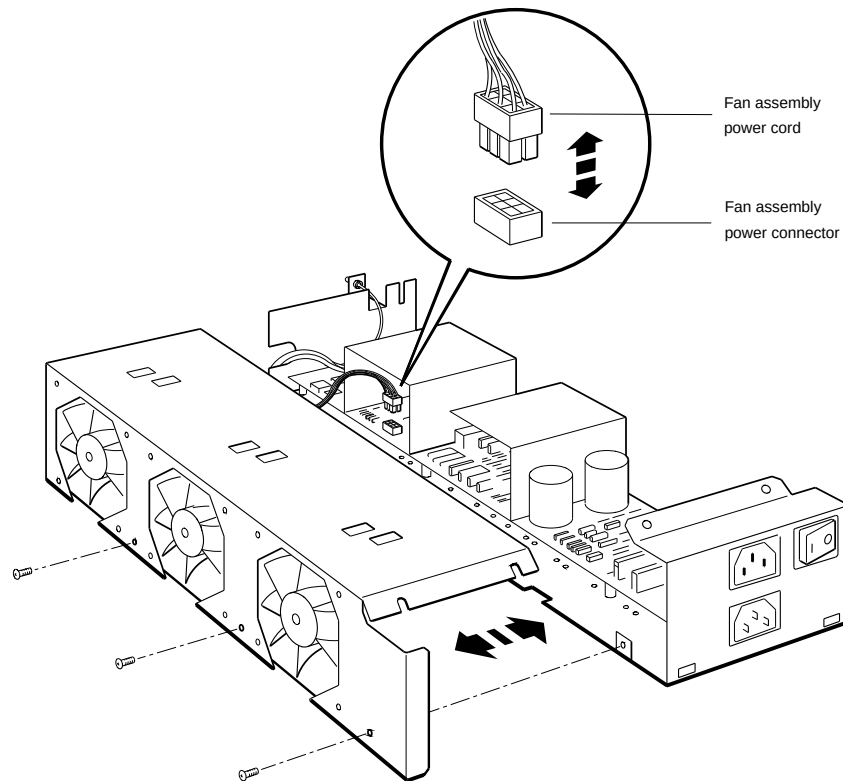
1. Turn off the workstation.
2. Disconnect the system unit power cord from the back of the system unit.
3. Remove the removable drive panel. Refer to “Removing and Installing the Removable Media Drive Panel” section for directions.
4. Disconnect the system module and internal drive power cords.
5. Loosen the two screws that hold the power supply.
6. Pull the power supply away from the back of the system unit and out of the system unit chassis.

How to install the power supply

1. Make sure the power supply switch is off (press down the 0 on the switch) and the power cord is disconnected.
2. Place the power supply in the system unit chassis. The power supply on/off switch should face the back of the system unit.
3. Tighten the two screws.
4. Reconnect the system module power cord to the system module.
5. Reconnect the internal drive power cord to the internal drives.
6. Replace the removable media drive panel. Refer to “Removing and Installing the Removable Media Drive Panel” section for directions.
7. Reconnect the system unit power cord to the back of the system unit.

Removing and Installing the Power Supply Fan Assembly

Figure 5-18 shows how to remove and install the power supply fan assembly.



WS33M033

Figure 5-18. Connecting the power supply fan assembly

How to remove the power supply fan assembly

1. Turn off the system power.
2. Disconnect the monitor power cord (if present) and system unit power cords.
3. Remove the power supply from the system unit. Refer to “Removing and Installing the Power Supply” section for instructions.
4. Remove the eight screws that hold the fan assembly to the power supply base.
5. Hold the fan assembly away from the power supply base.
6. If you are installing a new fan assembly, disconnect the fan assembly power cord.
7. Set aside the old fans to be returned.

How to install the power supply fan assembly

1. Make sure the fan assembly power cord is connected properly to the fan assembly power connector.
2. Align the screw holes on the fan assembly housing and power supply base. Then replace the eight screws that hold the fan to the power supply base.
3. Connect the system unit and monitor power cords.

Removing and Installing an Option Module

Figure 5-19 shows how to remove and install an option module.

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

How to remove an option module

1. Turn off the workstation and remove the system unit cover.
2. Disconnect any cables that are connected to the rear of the option module.
3. If the module is a ThickWire Ethernet option module, gently pry the ThickWire Ethernet Station Address ROM (ESAR) chip away from the module. Save the ESAR chip for installation onto the new ThickWire option module. Figure 5-20 shows how to remove the ESAR chip.
4. Remove the screws that hold the option module to the standoffs.
5. Remove the screws that hold the option module to the back of the system unit.
6. Grip the option module end near the expansion slot and pull the option module out of the slot. If necessary, gently rock the module to loosen it.

How to install an option module

1. If the back of the system unit has a blank plate over the opening for the option module connector, remove the two screws and remove the plate.
2. Pass the option module cable connector through the opening on the back of the system unit.
3. Firmly press the end of the option module that connects to the system module into the expansion slot.
4. Insert and tighten the screws that hold the module to the back of the system unit.
5. Insert the screws that hold the option module to the standoffs.

6. If the module is a ThickWire Ethernet module, insert the ESAR chip from the old ThickWire Ethernet option module onto the new ThickWire Ethernet option module. Figure 5-20 shows how to install the ESAR chip. Insert the chip so that the notch on the top of the chip is nearest the back of the system unit.
7. Connect the appropriate cable(s) to the back of the option module.

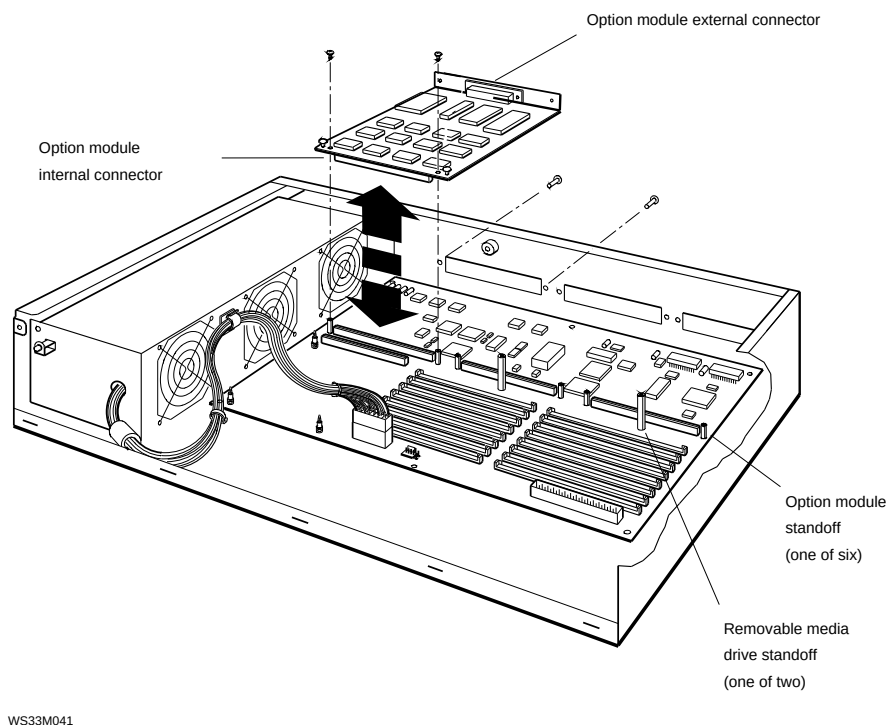
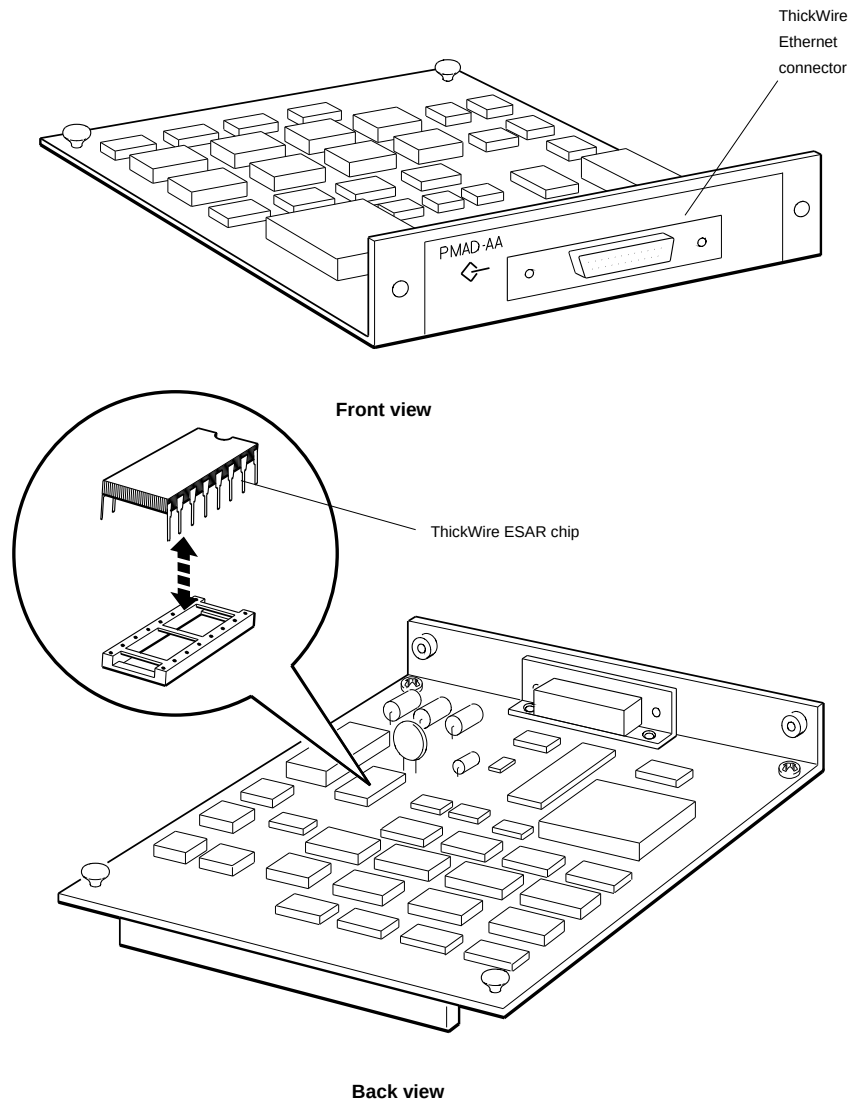


Figure 5-19. Removing and installing an option module

How to Remove and Install an ESAR Chip on a ThickWire Ethernet Option Module

Figure 5-20 shows how to remove and install an ESAR chip on a ThickWire Ethernet option module. A chip extraction tool is recommended for performing this function.



WS33M032

Figure 5-20. Removing and installing an ESAR chip on a ThickWire Ethernet option module

For Further Information

For information about troubleshooting internal SCSI drives, see Chapter 6. For information about troubleshooting external drives, SCSI controllers, Ethernet controllers, and TURBOchannel option modules, refer to the *TURBOchannel Maintenance Guide*.

For information about console commands, refer to Appendix C.

6

Internal Drives

This chapter discusses the internal drives that are supported. The topics covered are:

- Where you can install internal drives
- How to troubleshoot internal drives
- How to remove and install the removable media drive panel
- How to remove and install removable media drives
- How to remove and install hard disk drives
- Details about the internal drives that the system supports, including
 - Drive storage capacity
 - Drive appearance
 - Drive SCSI ID settings

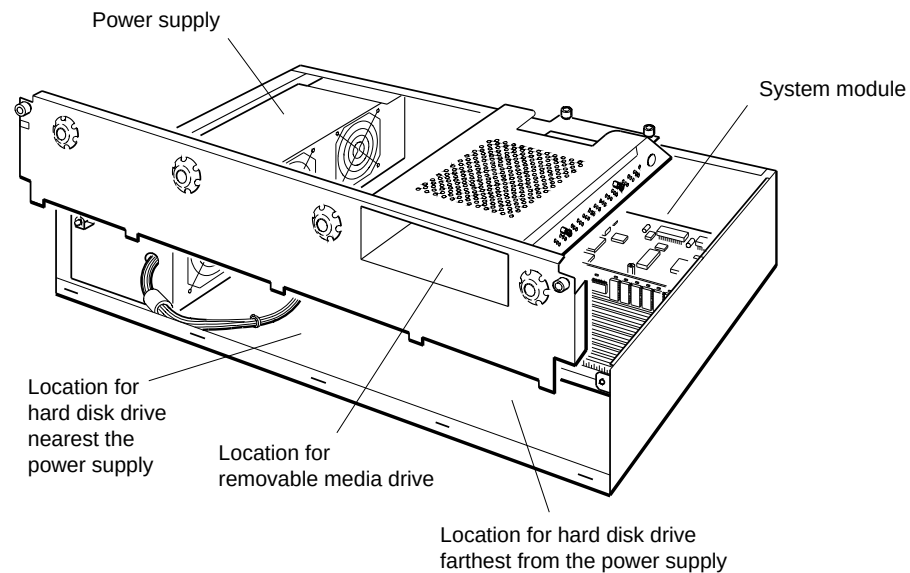
Internal Drives as Part of the System

Internal Drive Locations

The system supports up to three internal drives.

- One removable media drive can reside in the removable media drive panel. This panel holds the removable media drive above the memory modules.
- One or two hard disk drives can mount on the system unit chassis near the front of the system unit.

Figure 6-1 shows where you can install drives inside the system unit.



WS33M031

Figure 6-1. Internal drive locations

Internal and External Drive Combinations

You can connect external drives to the base system SCSI controller until you have a total of seven devices, whether internal, external, or a combination of both. The external drives are connected in a chain that attaches to the base system SCSI controller using the SCSI connector on the back of the system unit.

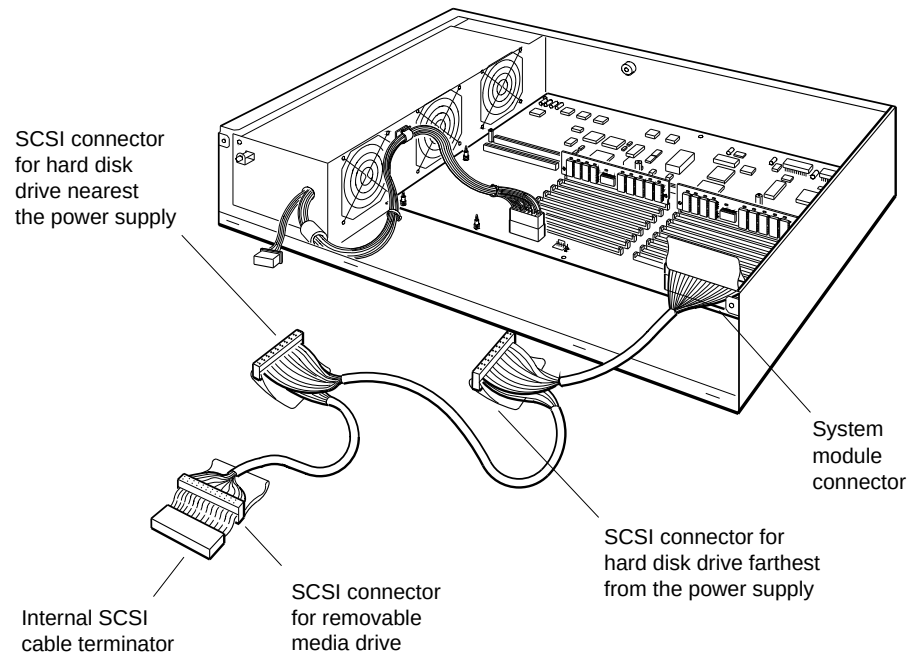
Each drive connected to the base system SCSI controller must be assigned a unique SCSI ID number from 0 to 6.

Internal Drive SCSI and Power Cable Connections

For each internal SCSI drive:

- A SCSI cable connection links each drive to the base system SCSI controller.
- An internal drive power cable connection supplies electrical power to each internal drive.

Figure 6-2 shows which drive each internal SCSI connector supports.



WS33M027

Figure 6-2. Internal SCSI cable connectors

Figure 6-3 shows which drive each internal power cable connector supports.

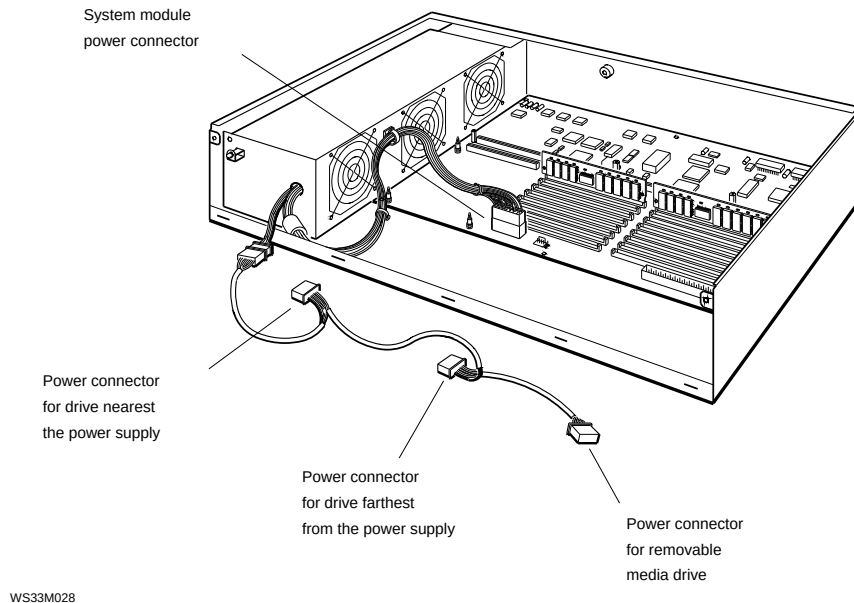


Figure 6-3. Internal power cable connectors

For Further Information About System Drives

For more information about specific internal drives, refer to the section in this chapter that discusses the drive in which you are interested.

For information about external drives that the system supports, refer to the *TURBOchannel Maintenance Guide*.

Removing and Installing a Removable Media Drive

Figure 6-4 shows how to disconnect and attach cables on a removable media drive.

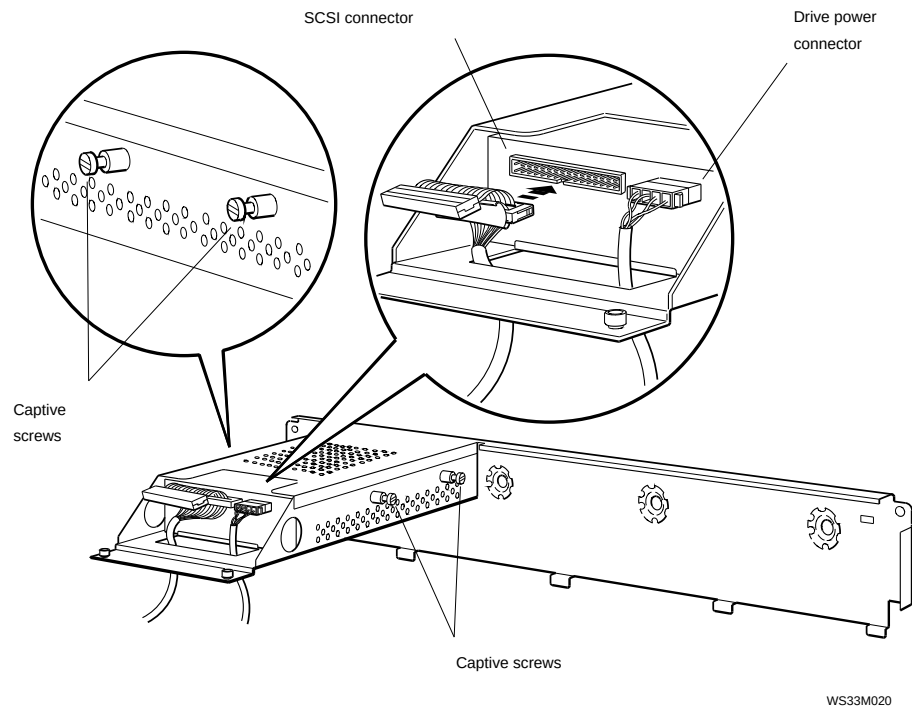
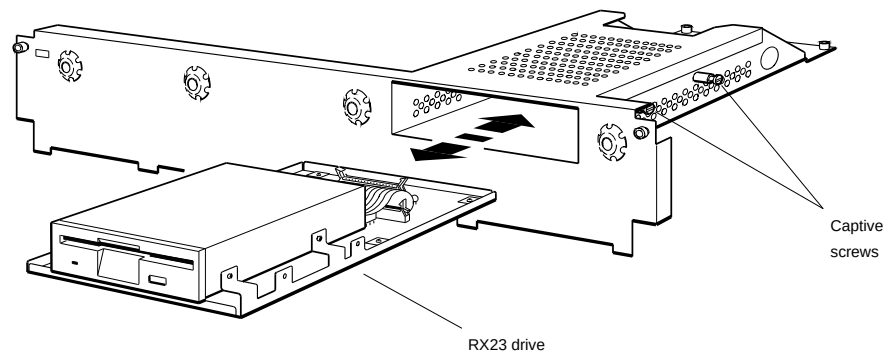


Figure 6-4. Disconnecting a removable media drive

How to Remove a Removable Media Drive

1. Disconnect the SCSI and power cables that are attached to the drive.
2. Loosen the four captive screws that hold the drive. If you cannot loosen the screws by hand, remove the panel and use a screwdriver to loosen the screws. Refer to “Removing and Installing the Removable Media Drive Panel” on page 6-9 for directions.
3. Grip the front of the drive and slide the drive out of the panel.

Figure 6-5 shows how to remove a removable media drive.



WS33M009

Figure 6-5. Removing and installing a removable media drive

How to Install a Removable Media Drive

1. Make sure that the drive has the correct SCSI ID. To determine the SCSI ID settings for a specific drive, refer to the section of this chapter that discusses the specific type of drive you are installing.
2. Make sure that the system unit cover has the correct bezel for the type of drive that you are installing. For directions on removing and installing the bezel, refer to “Removing and Installing a System Unit Cover Bezel” section.
3. Slide the drive into the removable media drive panel.
4. Tighten the four captive screws that hold the drive inside the panel.
5. Connect the SCSI ID cable and internal power cable to the drive.

Removing and Installing the Removable Media Drive Panel

Figure 6-6 shows how to remove and install the removable media drive panel.

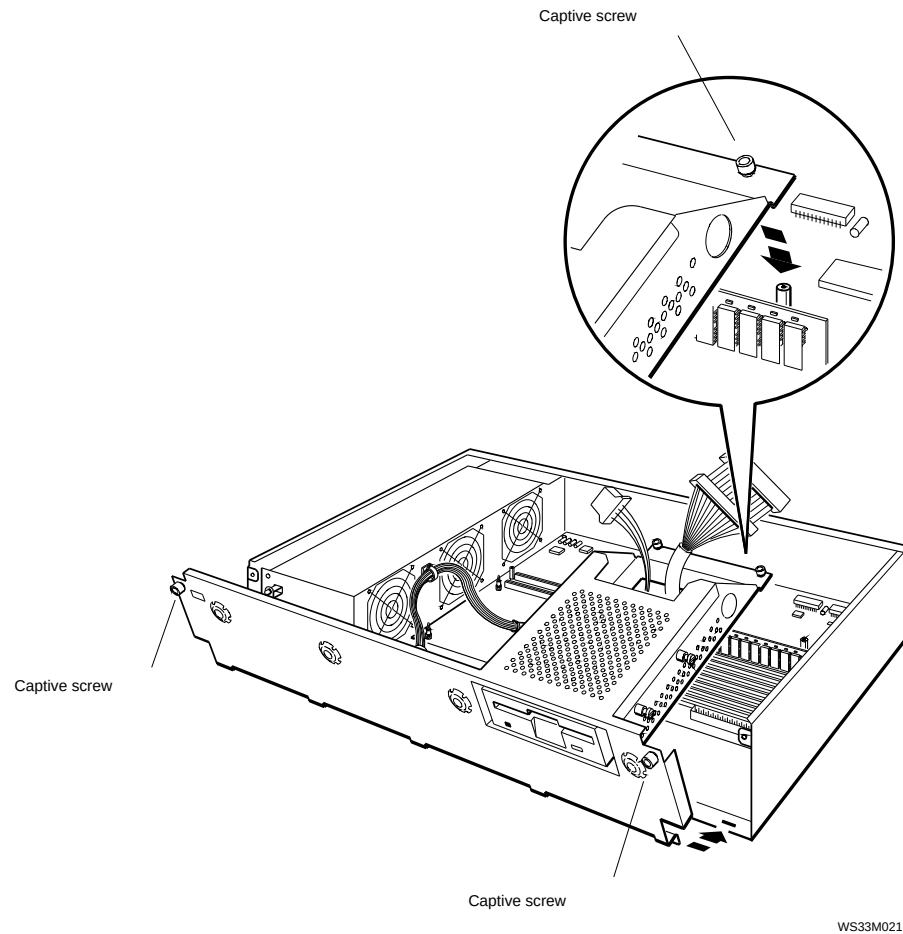


Figure 6-6. Removing and installing the removable media drive panel

How to Remove the Removable Media Drive Panel

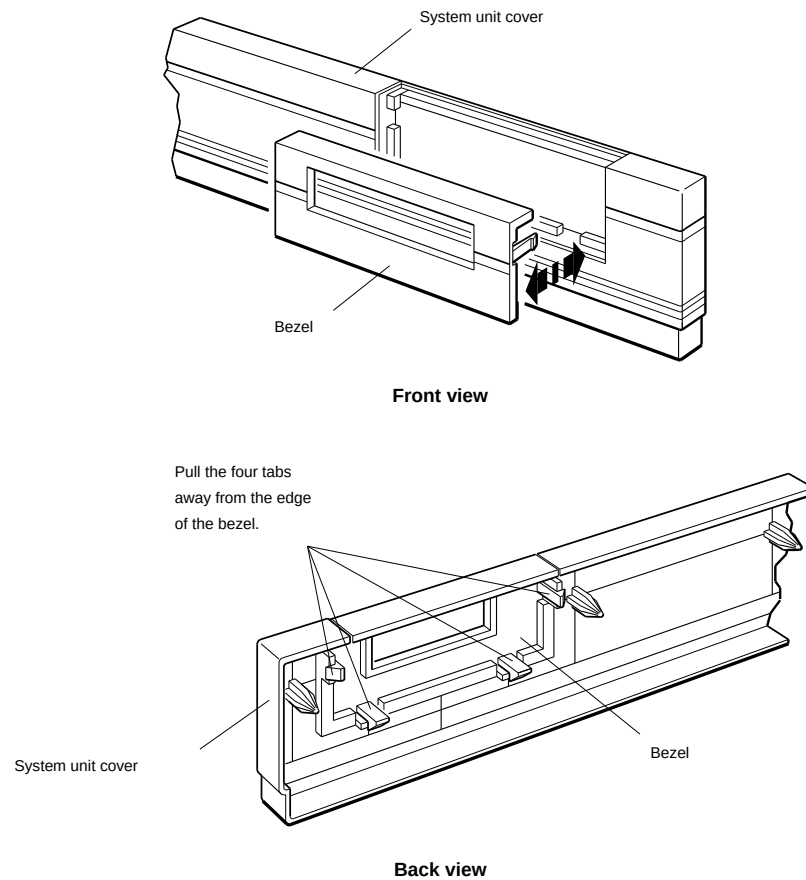
1. Loosen the two captive screws that hold the back of the panel to the standoffs.
2. Loosen the two captive screws that hold the panel to the front of the chassis.
3. Disconnect the internal SCSI and power cables from the drive, if a drive is in the panel.
4. Lift the back of the panel up from the standoffs.
5. Lift the panel away from the system unit.

How to Install the Removable Media Drive Panel

1. Pass the ends of the internal SCSI and power cables through the hole near the back of the panel.
2. Position the panel on the system unit. Carefully align the five tabs along the bottom of the removable media drive panel with the five slots along the front of the system unit chassis. Position the back of the removable media drive panel so that the two captive screws on the back of the panel are over the standoffs.
3. Tighten the captive screws into the standoffs.
4. Tighten the two captive screws that hold the panel to the front of the system unit chassis.

Removing and Installing a System Unit Cover Bezel

Figure 6-7 shows how to remove and install a bezel in the system unit cover.



WS33M053

Figure 6-7. Removing and installing a bezel in the system unit cover

How to Remove a Bezel from the System Unit Cover

1. Use your fingers to push the four tabs on the bezel toward the hole in the bezel.
2. Pull the bezel out of the cover.

How to Install a Bezel in the System Unit Cover

1. Align the bezel over the hole in the system unit cover.
2. Press the bezel into the cover until the bezel snaps into place.

Removing and Installing a Hard Disk Drive

Figure 6-8 shows how to remove and install a hard disk drive.

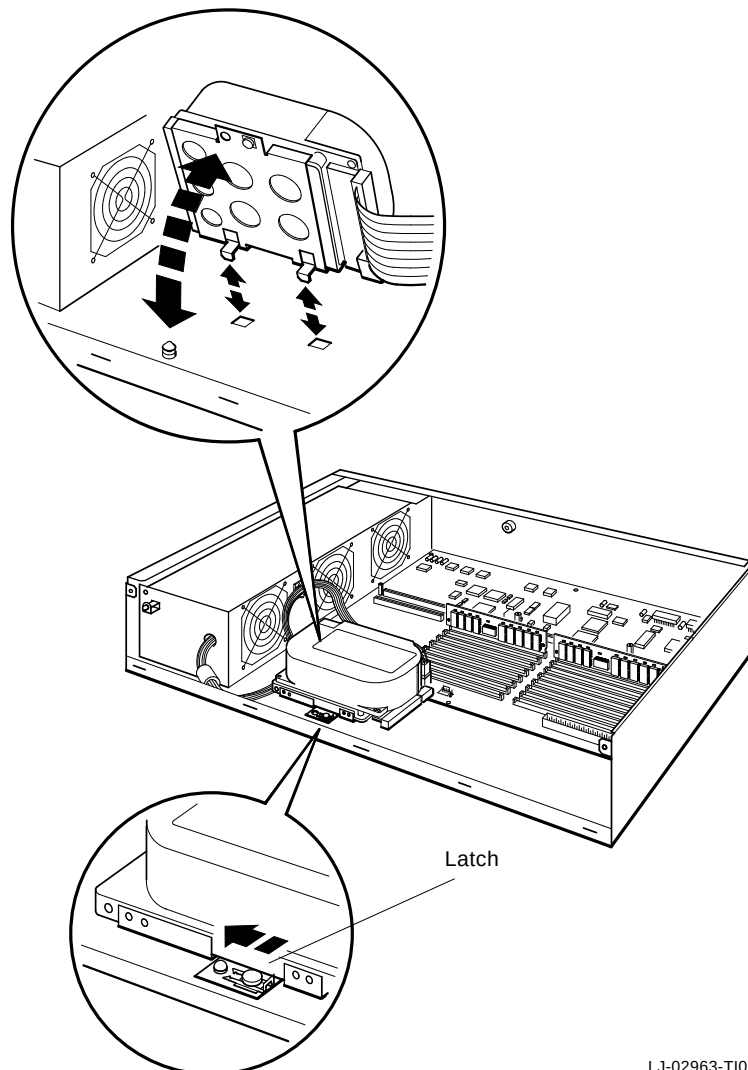


Figure 6-8. Removing and installing a hard disk drive

How to Remove a Hard Disk Drive

1. Loosen the latch that holds the drive onto the chassis.
2. Tilt up the side of the drive that has the latch and lift the drive away from the chassis.
3. Disconnect the SCSI and power cables that are attached to the drive.

How to Install a Hard Disk Drive

1. Make sure the drive has the correct SCSI ID setting. To find the SCSI ID settings for a specific drive, refer to the section at the end of this chapter that discusses the type of drive you are installing.
2. Connect the internal SCSI cable and internal power cable to the drive. Make sure the key on the SCSI data cable connector is up.
3. Slide the tabs on the drive mounting bracket into the holes in the system unit chassis.
4. Fasten the latch on the drive mounting bracket by sliding the latch toward the power supply.

Caution: *Be sure the latch is fully engaged.*

Information About Individual Drives

The following sections describe internal drives that the system supports. Each section explains

- The type and capacity of the drive
- The SCSI ID settings for the drive
- The specifications for the drive

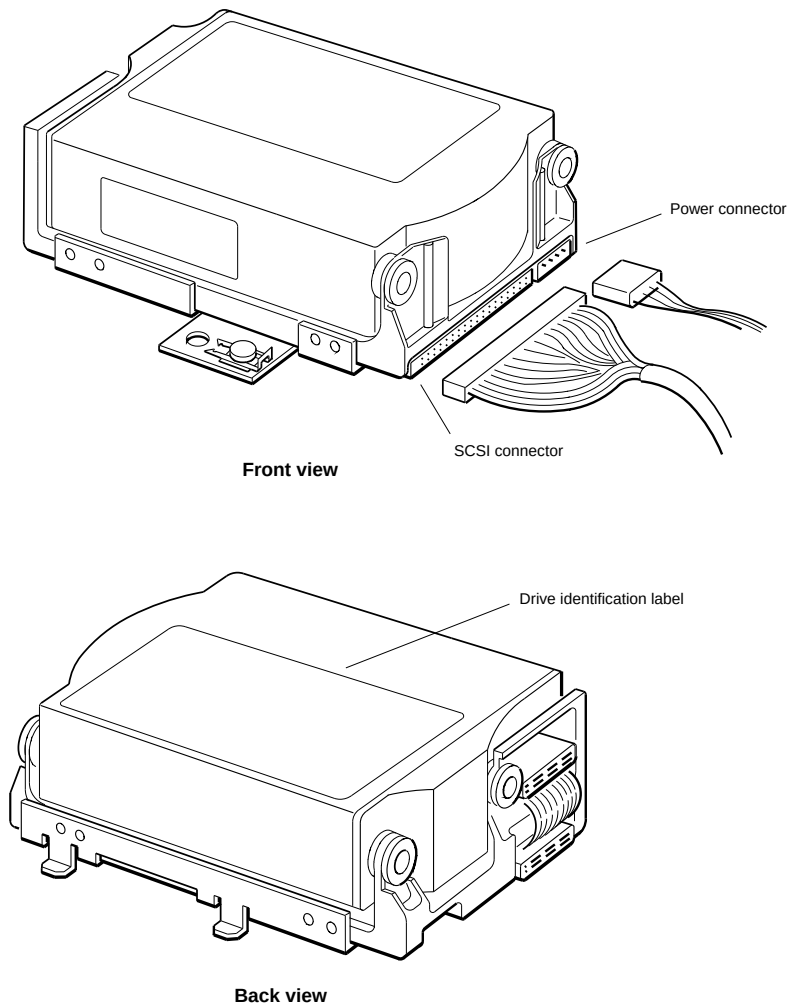
The system supports the following internal drives:

- RZ23 hard disk drive (upgrade systems only)
- RZ23L half-height hard disk drive
- RZ24 and RZ24L hard disk drive
- RZ25 and RZ26 hard disk drive
- RZ26 hard disk drive
- RX23 3-1/2 inch diskette drive
- TLZ06 cassette tape drive
- RRD42 optical compact disc drive
- TZK10 quarter-inch cartridge (QIC) drive

RZ23 Hard Disk Drive

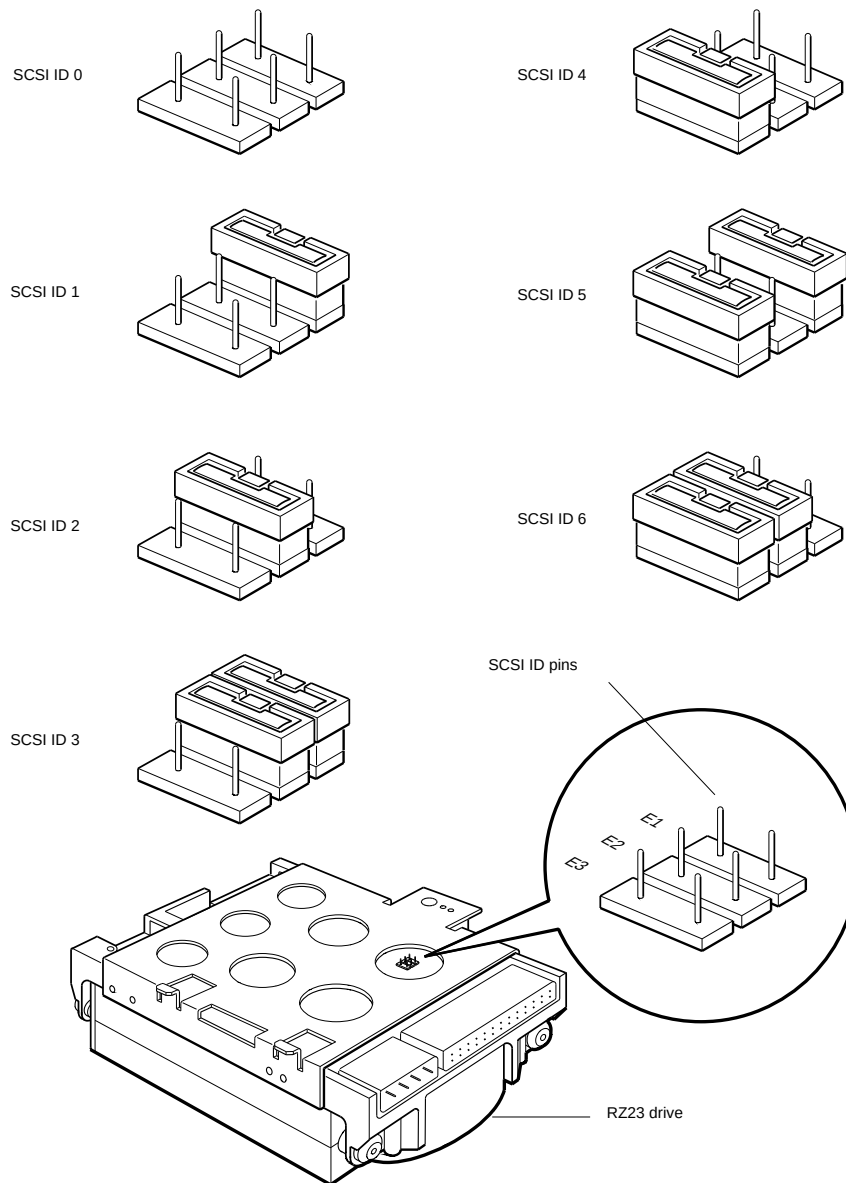
The RZ23 is a 104-Mbyte hard disk drive that mounts on the floor of the system unit. A label on the top of the drive identifies the drive as an RZ23 drive.

Figure 6-9 shows the RZ23 hard disk drive with its SCSI connector, power connector, and label. Figure 6-10 shows the SCSI ID jumper settings for the RZ23 drive.



WS33M025

Figure 6-9. RZ23 hard disk drive



WS33M066

Figure 6-10. RZ23 drive SCSI ID jumper settings

RZ23L Half-Height Hard Disk Drive

The RZ23L is a 121-Mbyte hard disk drive that mounts on the floor of the system unit. A label on the top of the drive identifies the drive as an RZ23L drive.

Figure 6-11 shows the RZ23L hard disk drive with its SCSI connector, power connector, and label. Figure 6-12 shows the SCSI ID jumper settings for the RZ23L drive.

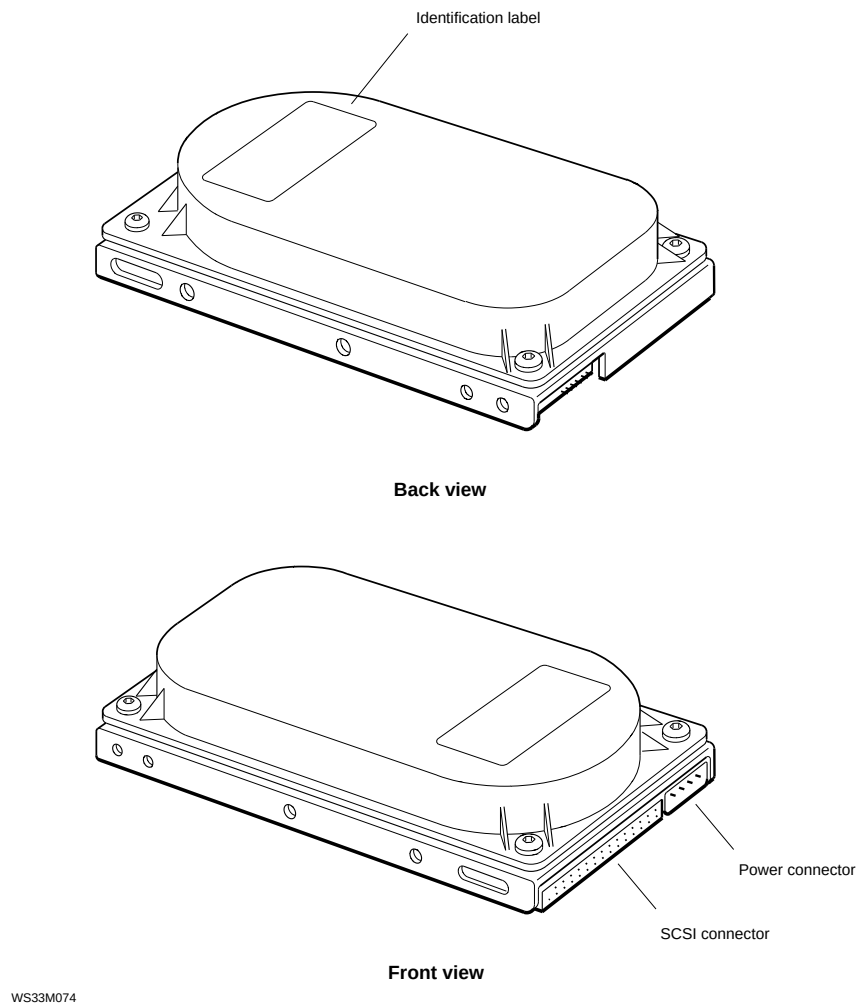
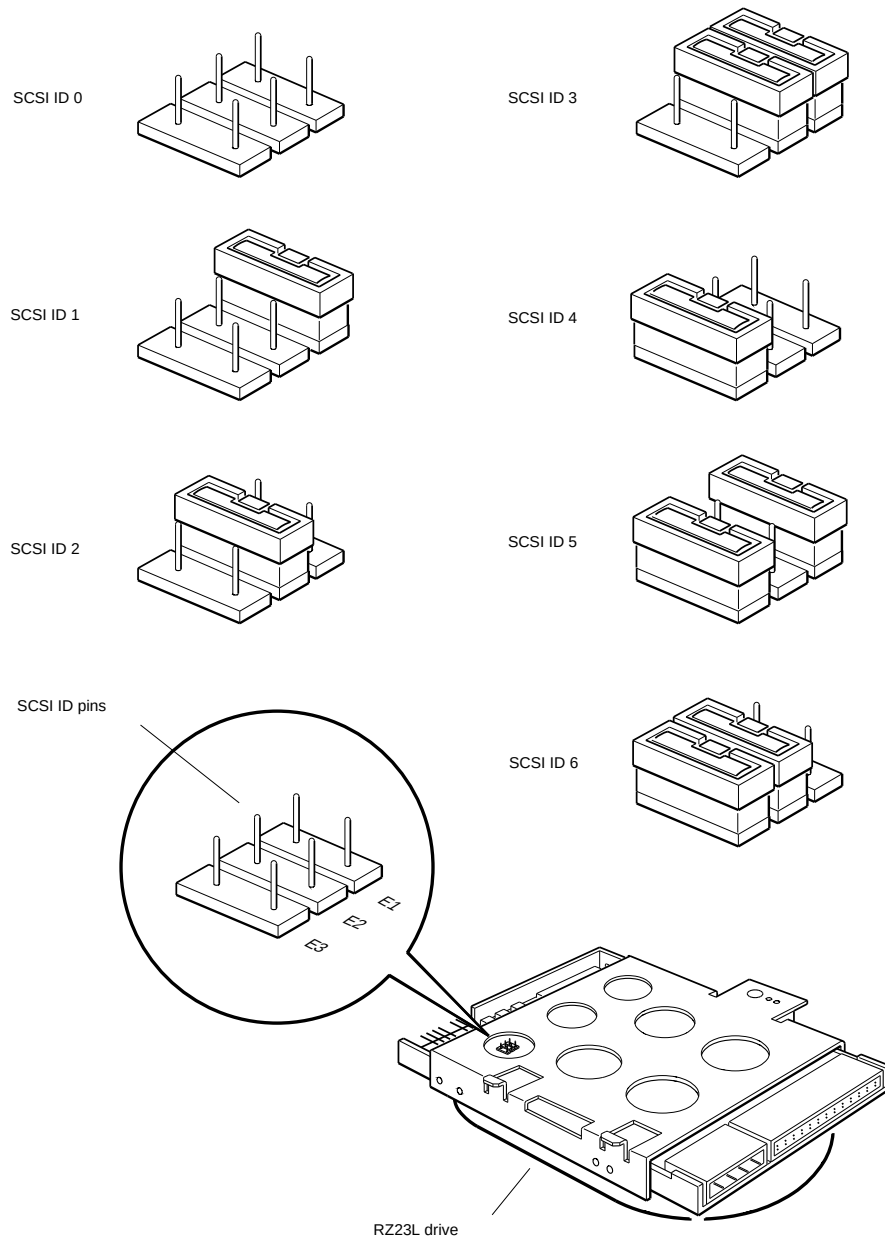


Figure 6-11. RZ23L half-height hard disk drive



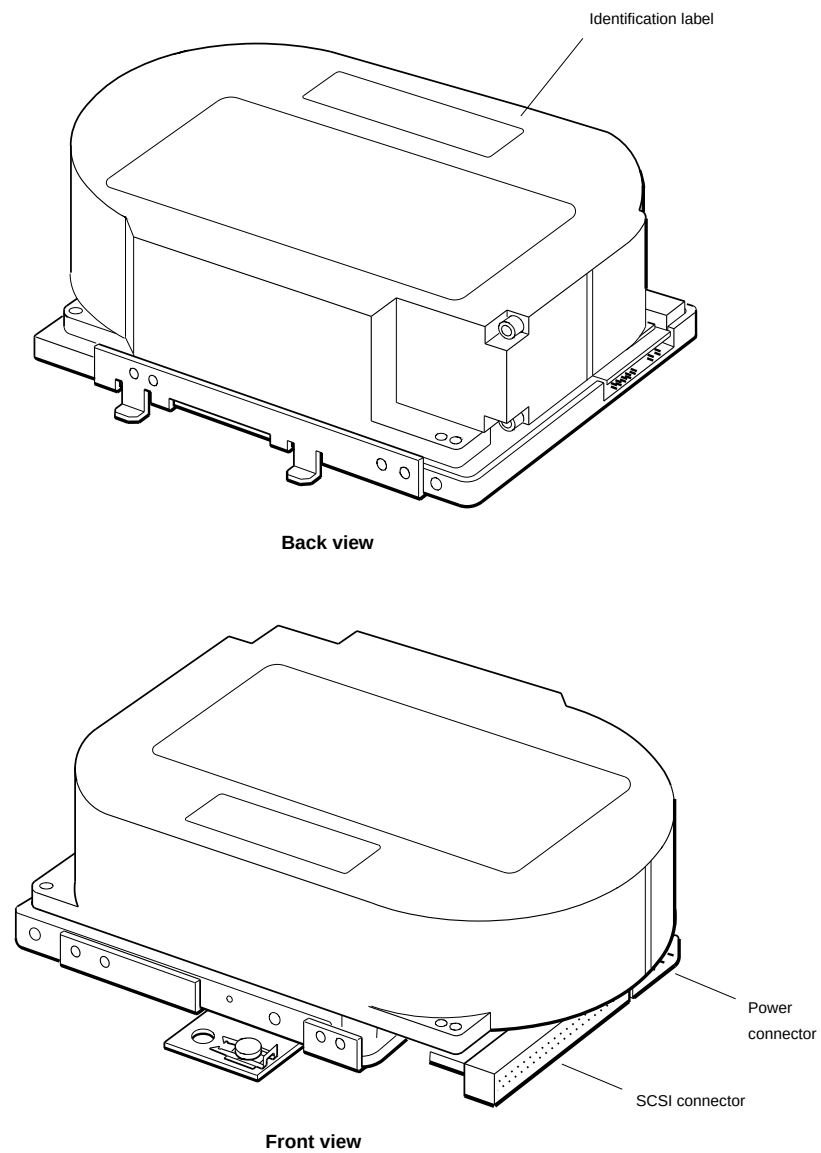
WS33M077

Figure 6-12. RZ23L drive SCSI ID jumper settings

RZ24 Hard Disk Drive

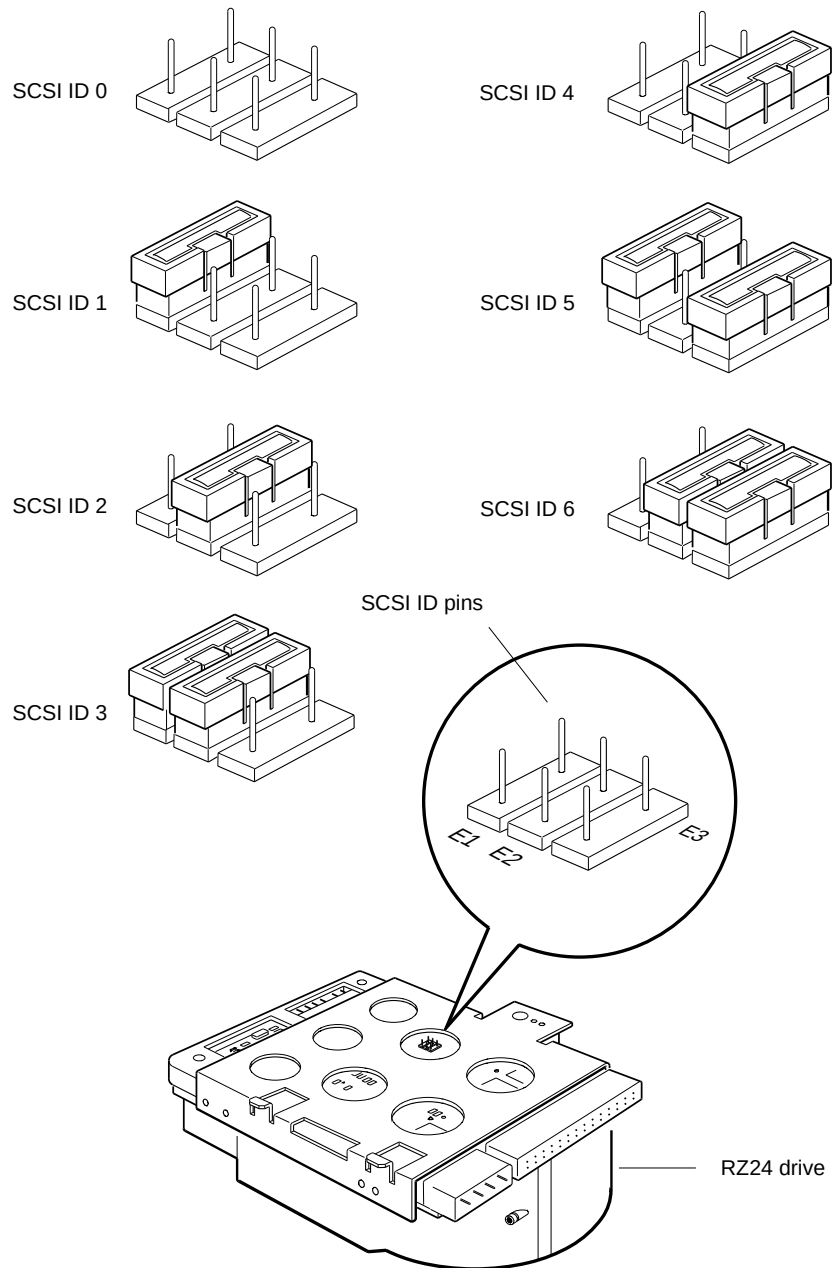
The RZ24 is a 209-Mbyte hard disk drive that mounts on the floor of the system unit. A label on the top of the drive identifies the drive as an RZ24 drive.

Figure 6-13 shows the RZ24 hard disk drive with its SCSI connector, power connector, and label. Figure 6-14 shows the SCSI ID jumper settings for the RZ24 drive.



WS33M030

Figure 6-13. RZ24 hard disk drive



WS33M065

Figure 6-14. RZ24 drive SCSI ID jumper settings

RZ24L Hard Disk Drive

The RZ24L is a hard disk drive that mounts on the floor of the system unit. A label on the top of the drive identifies the drive as an RZ24L drive.

Figure 6-15 shows the SCSI ID jumper settings for the RZ24 drive.

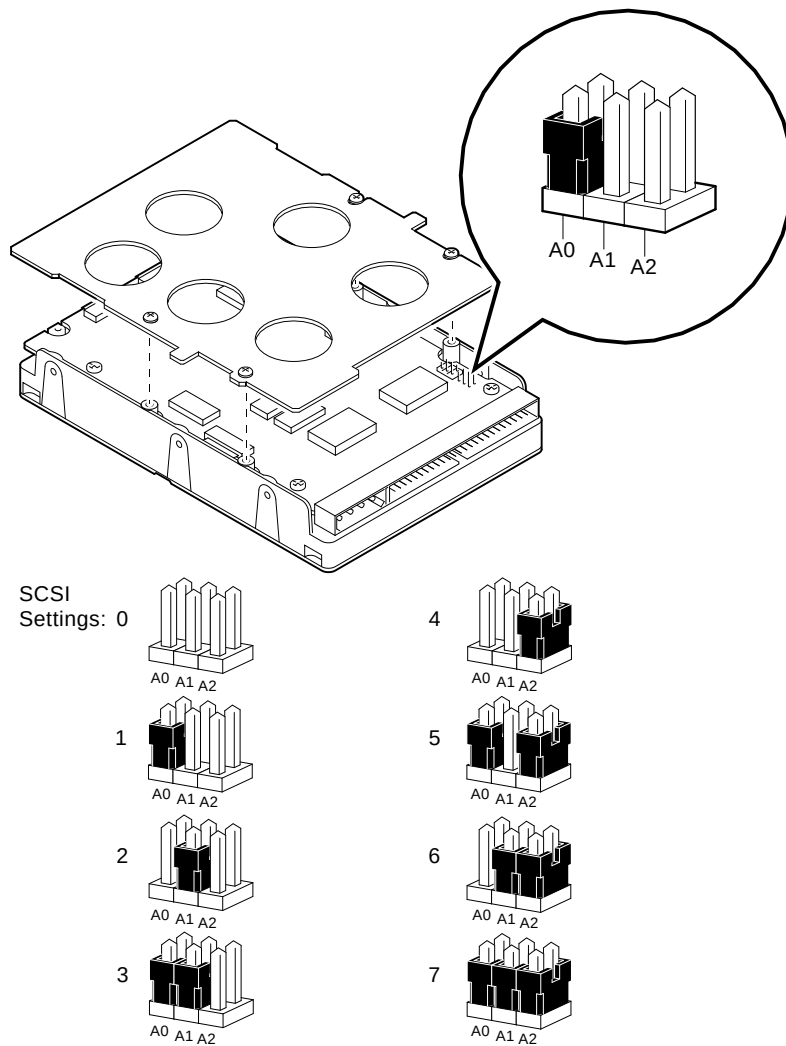


Figure 6-15. RZ24L drive SCSI ID jumper settings

LJ-02990-T10

RZ25 Hard Disk Drive

The RZ25 is a 426-Mbyte hard disk drive that mounts on the floor of the system unit. A label on the top of the drive identifies the drive as an RZ25 drive.

Figure 6-16 shows the RZ25 hard disk drive with its SCSI connector, power connector, and label. Figure 6-17 and Figure 6-18 show the SCSI ID jumper settings for the RZ25 drive.

The RZ25 has front and side jumpers. Pin 4 on the RZ25 front jumpers must always be in place. When the front jumpers are used, all pins must be removed from the side jumpers. When the side jumpers are used, all pins except pin 4 must be removed from the front jumpers.

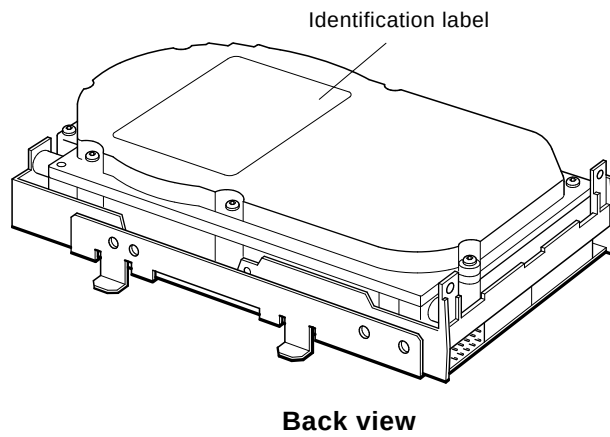
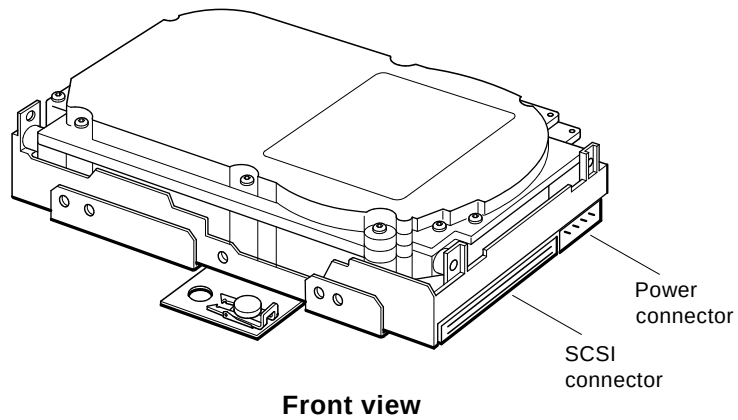


Figure 6-16. RZ25 hard disk drive

LJ-02959-T10

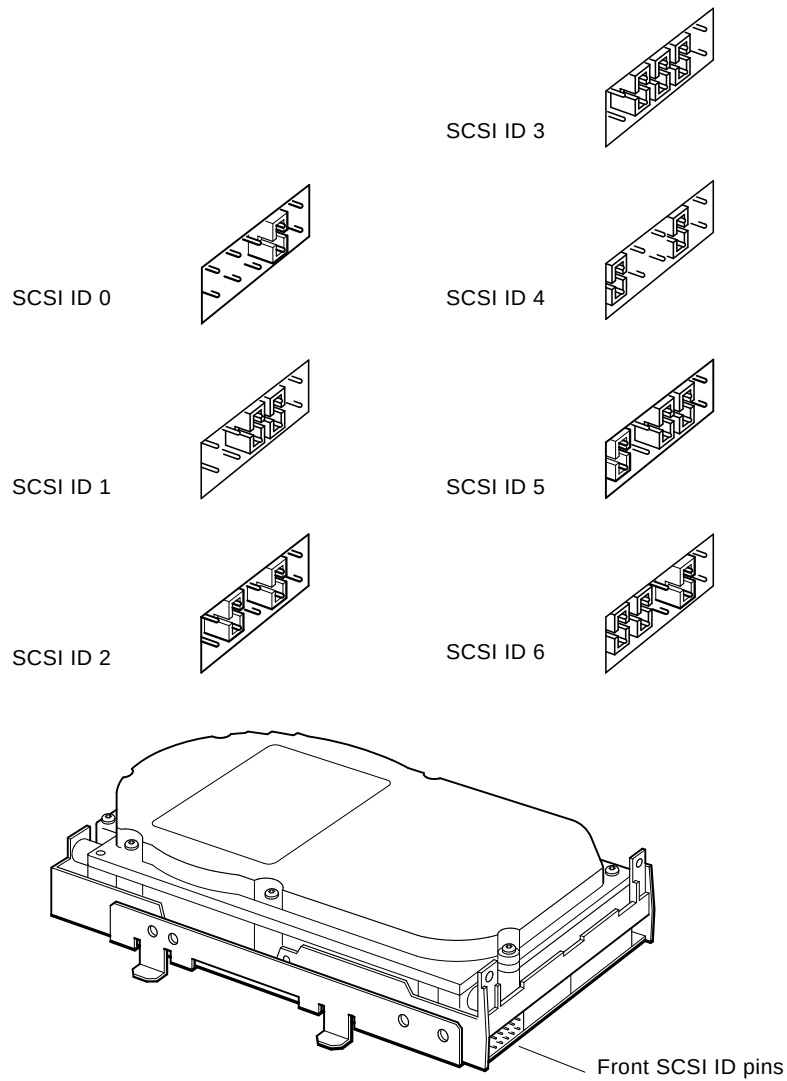


Figure 6-17. RZ25 hard disk drive front jumper settings

LJ-02960-T10

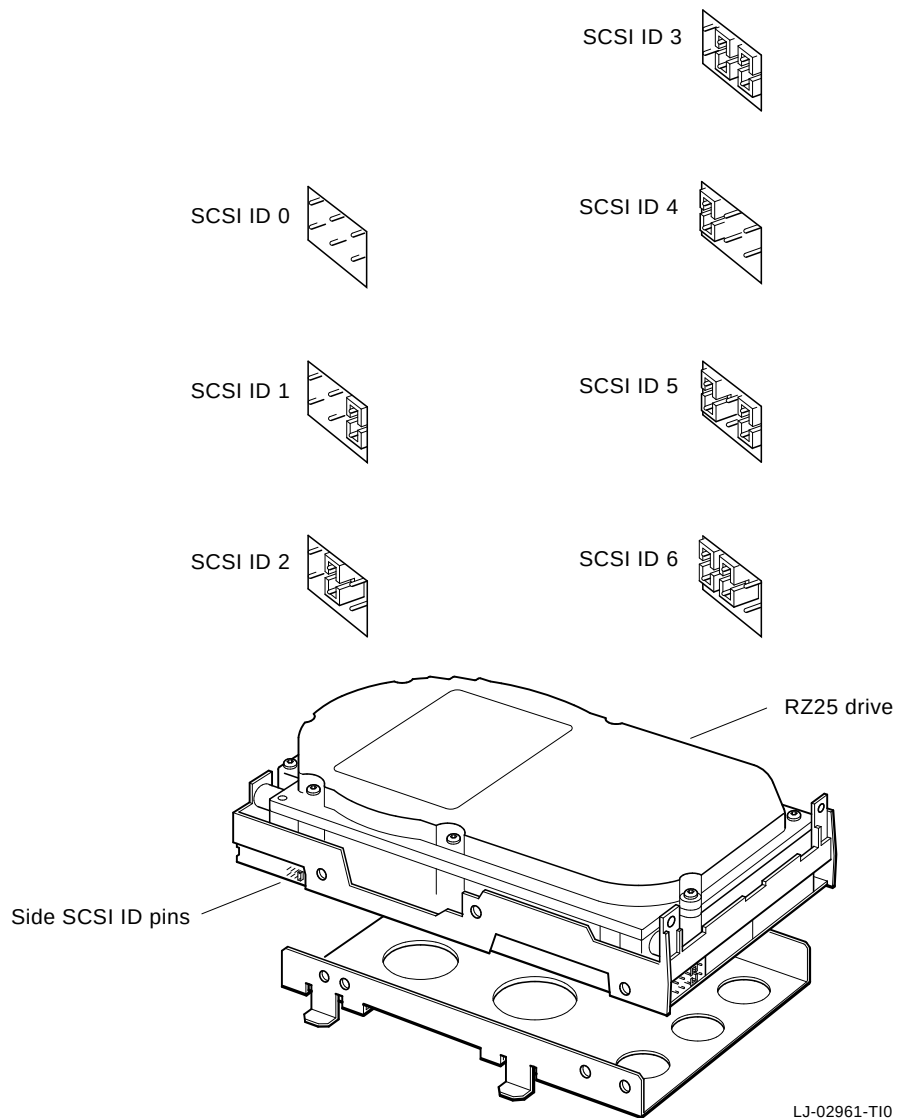
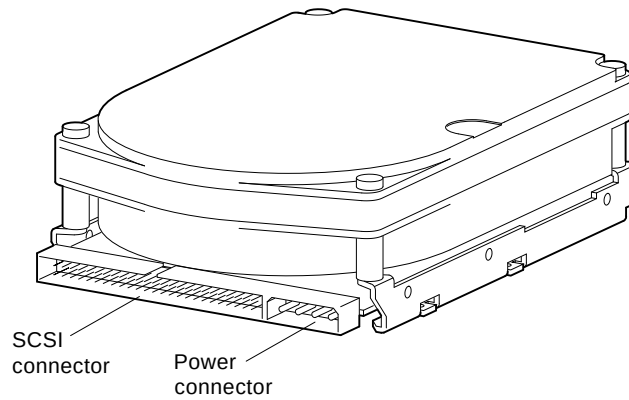


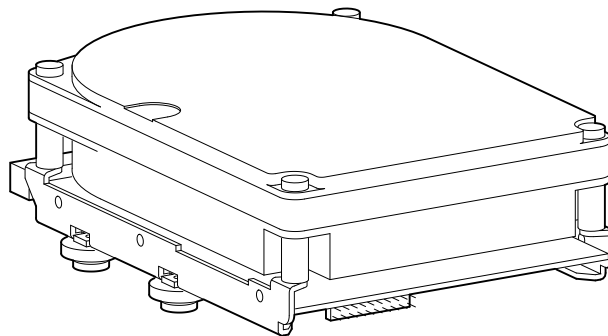
Figure 6-18. RZ25 hard disk drive side jumper settings

RZ26 Hard Disk Drive

The RZ26 is a 1050-Mbyte hard disk drive that mounts on the floor of the system unit. A label on the top of the drive identifies the drive as an RZ26 drive.



Front view



Back view

LJ-02980-T10

Figure 6-19. RZ26 hard disk

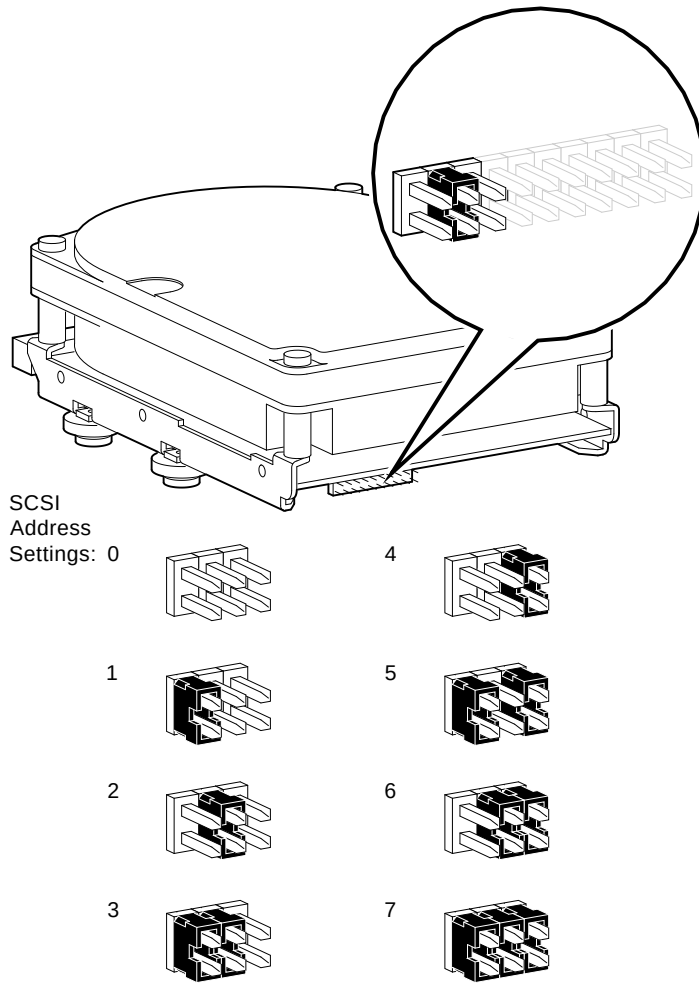
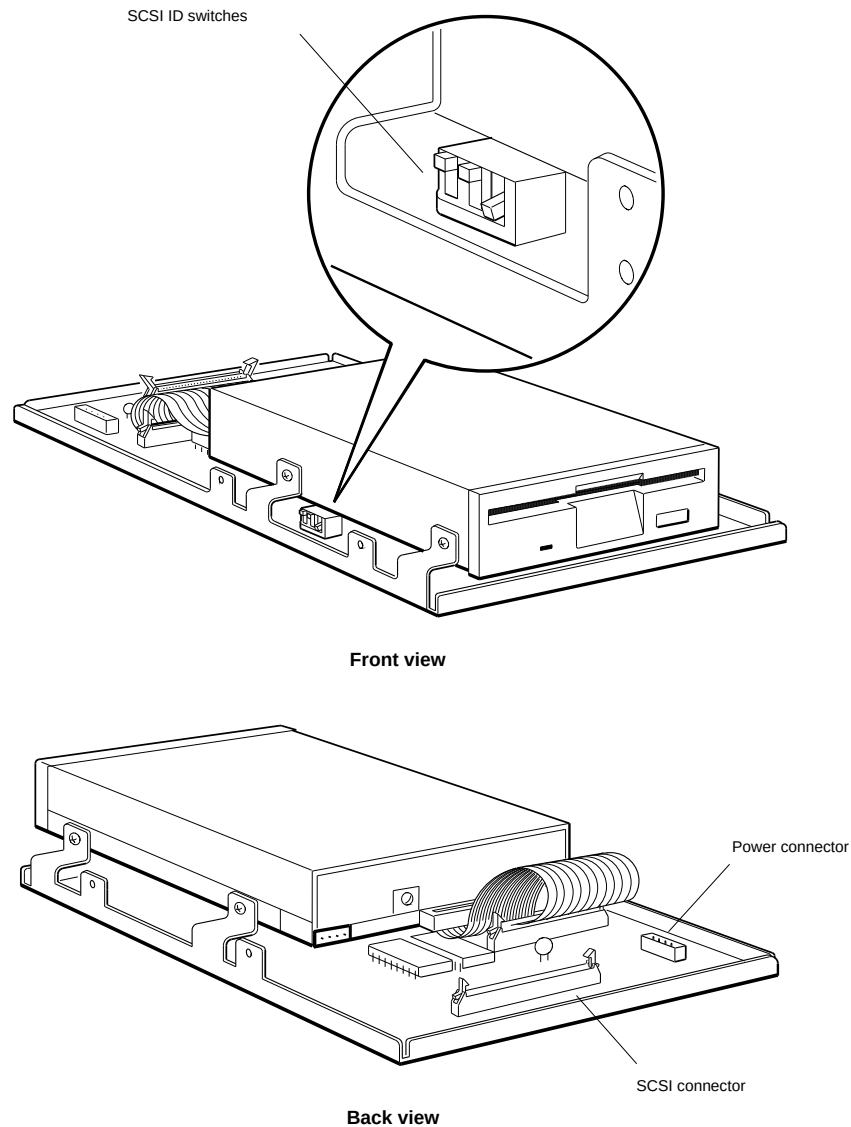


Figure 6-20. RZ26 hard disk drive jumper settings

RX23 Diskette Drive

The RX23 is a 1.4-Mbyte 3.5-inch diskette drive that mounts in the removable media drive panel.

Figure 6-21 shows the RX23 drive with its SCSI ID switches, SCSI connector, and power connector.



WS33M026

Figure 6-21. RX23 diskette drive

Figure 6-22 shows the SCSI ID switch settings for the RX23 drive.

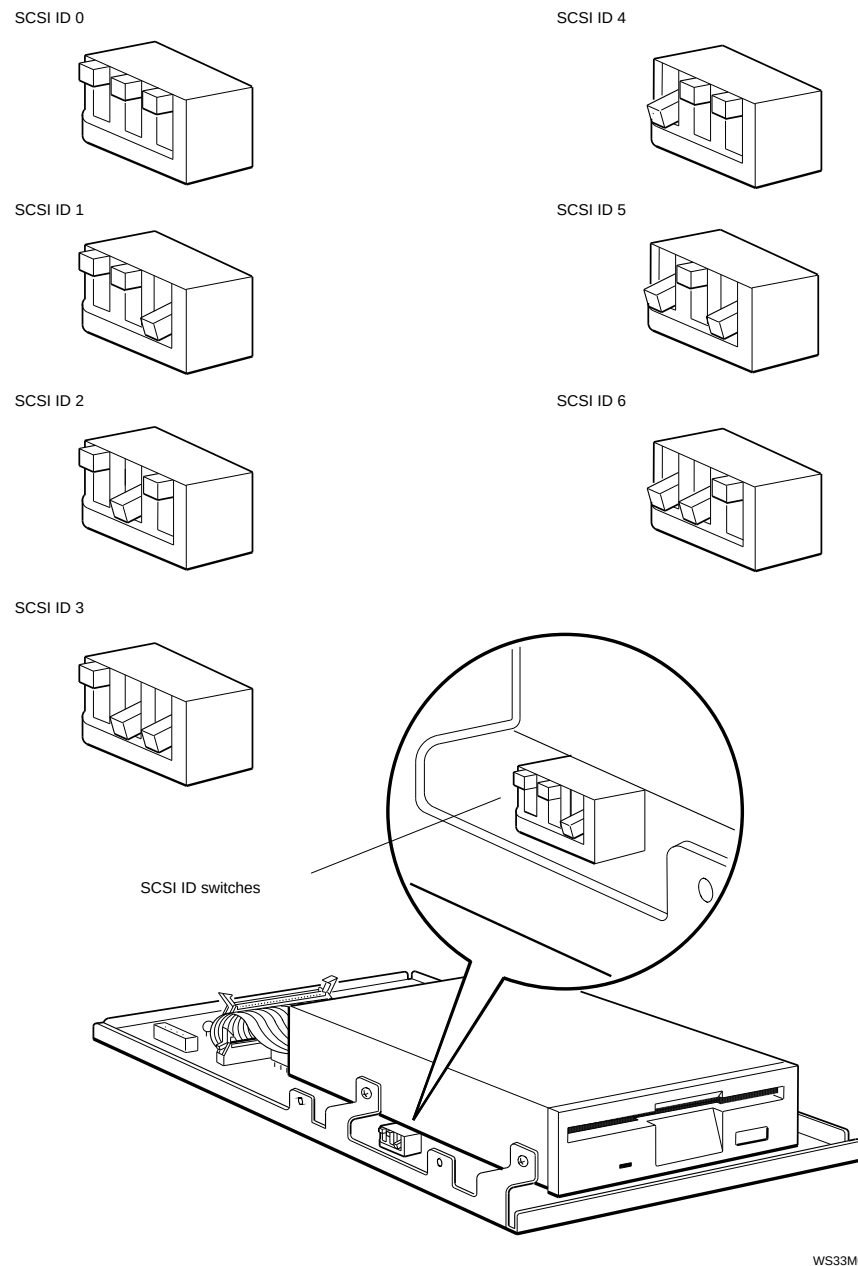
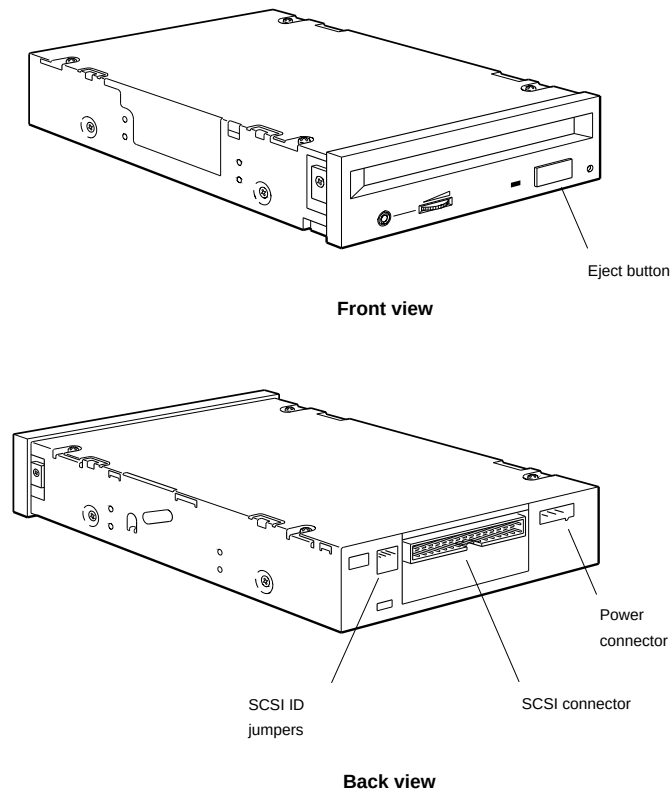


Figure 6-22. RX23 drive SCSI ID switch settings

RRD42 Optical Compact Disc Drive

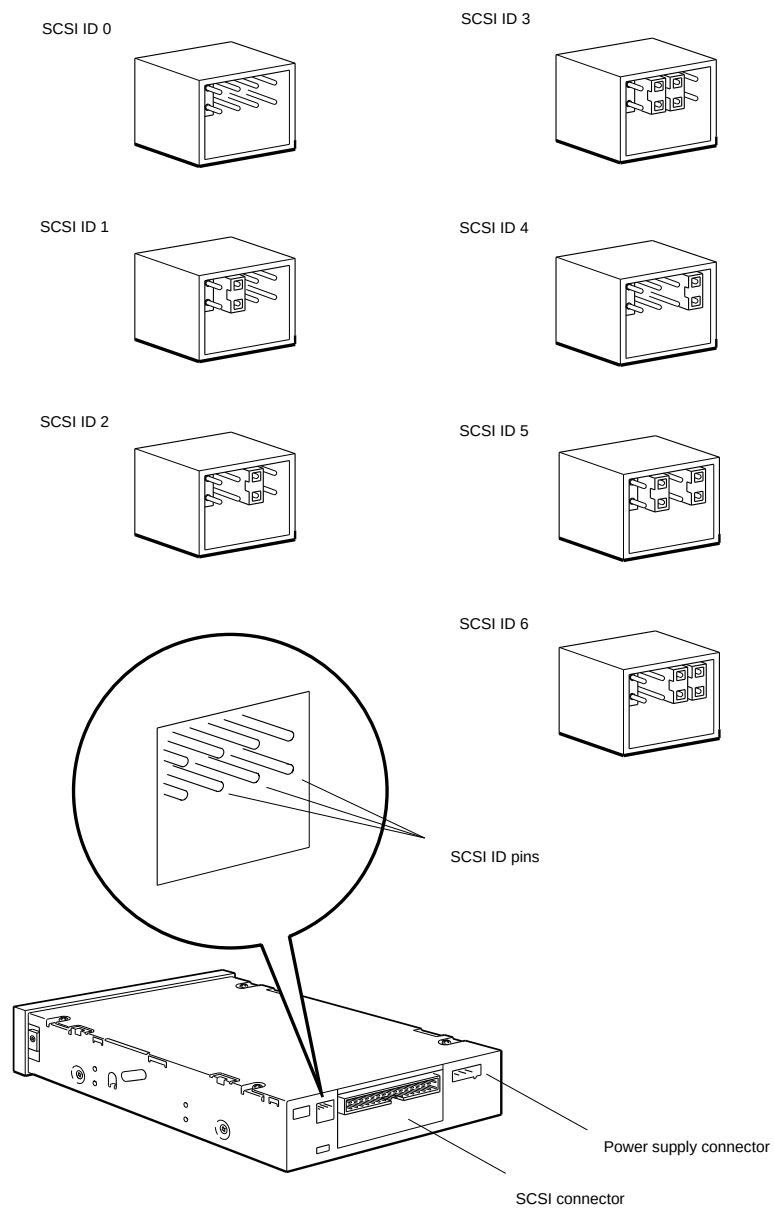
The RRD42 is a 600-Mbyte optical compact disc drive that mounts in the removable media drive panel.

Figure 6-23 shows the RRD42 drive with its SCSI ID jumpers, SCSI connector, and power connector. Figure 6-24 shows the SCSI ID jumper settings for the RRD42 drive.



WS33M061

Figure 6-23. RRD42 optical compact disc drive

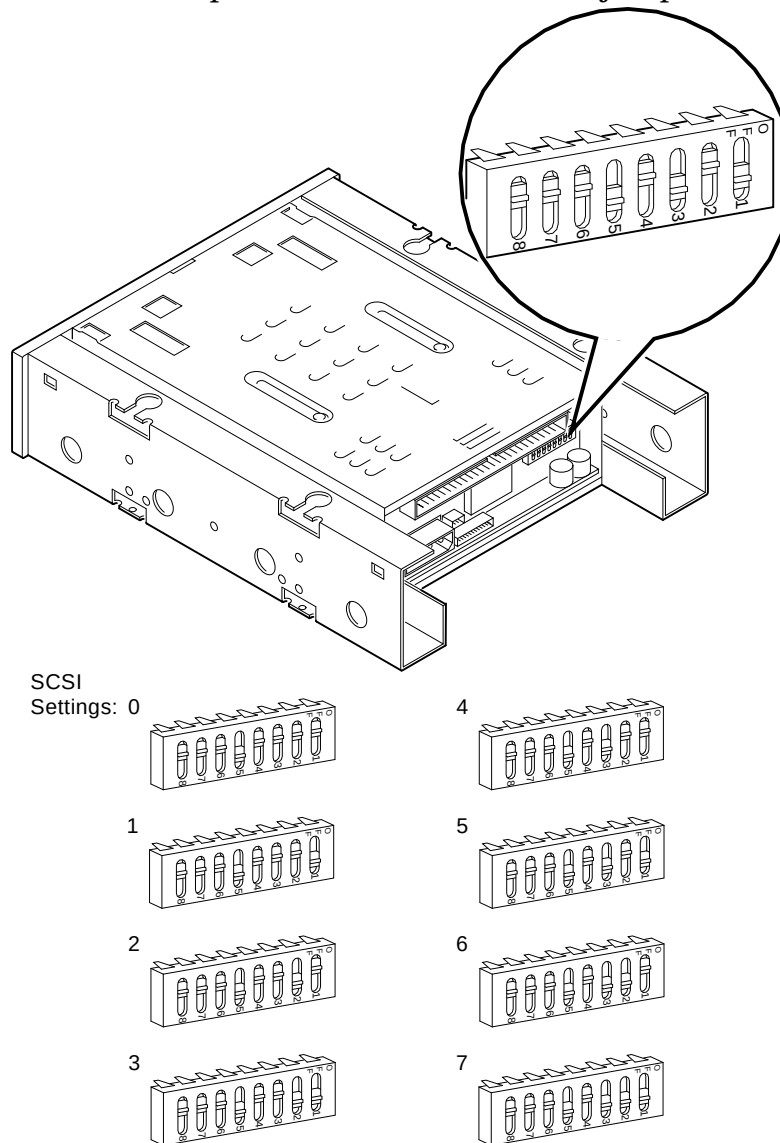


WS33M087

Figure 6-24. RRD42 drive SCSI ID jumper settings

TLZ06 Cassette Tape Drive

The TLZ06 Cassette Tape drive is a quarter-inch cartridge tape drive that mounts in the removable media drive panel. The capacity of the TLZ06 is 320 Megabytes with the DC6320 tape and 525 Megabytes with the DC6525 tape. Figure 6-25 shows the TLZ06 tape drive with its SCSI ID jumpers.



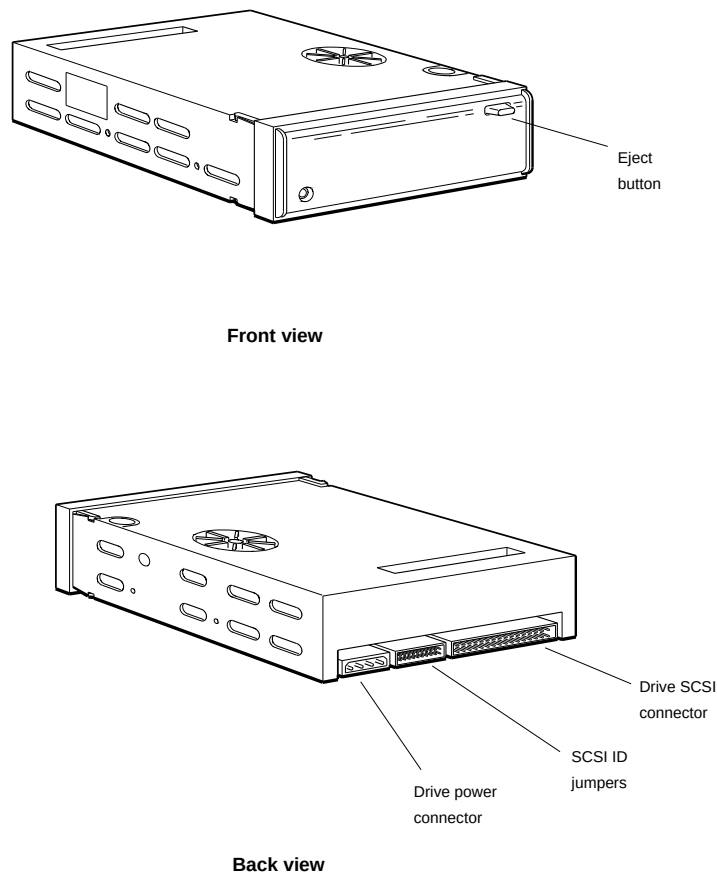
LJ-02989-T10

Figure 6-25. TLZ06 Cassette tape drive

TZK10 Quarter-inch Cartridge (QIC) Drive

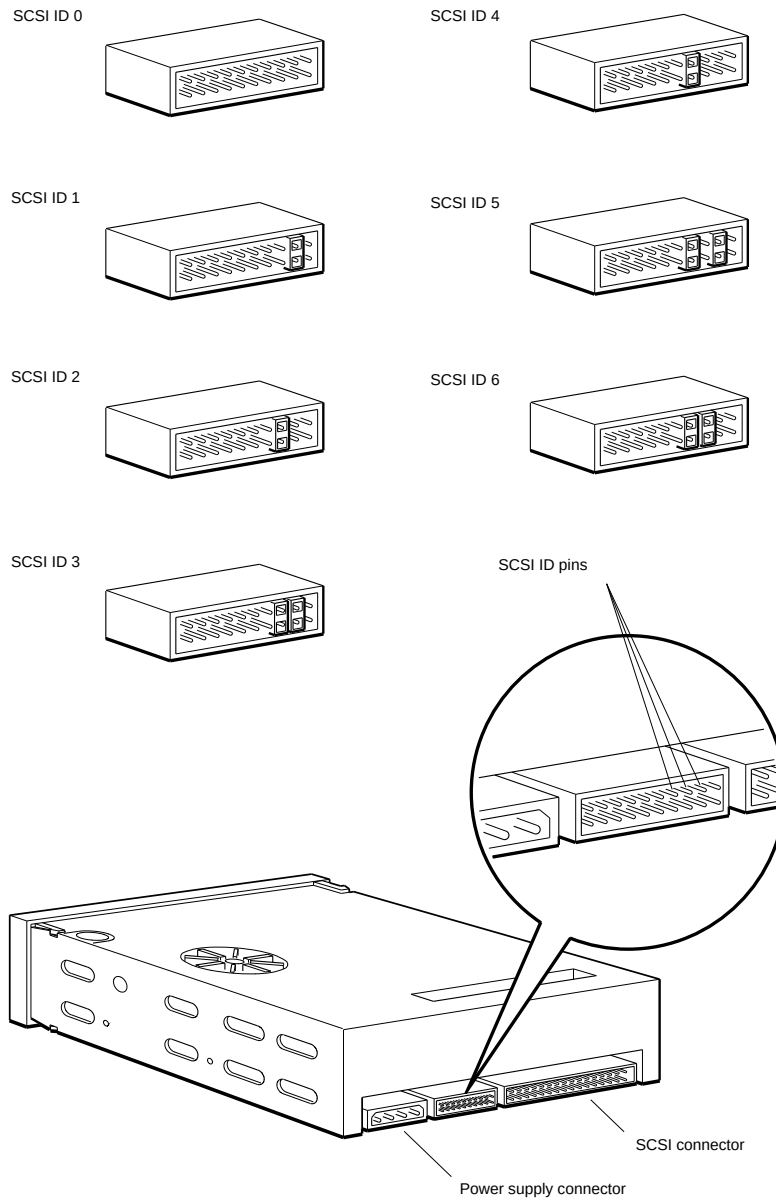
The TZK10 is a quarter-inch cartridge tape drive that mounts in the removable media drive panel. The capacity of the TZK10 is 320 Megabytes with the DC6320 tape and 525 Megabytes with the DC6525 tape.

Figure 6-26 shows the TZK10 drive with its SCSI ID jumpers, SCSI connector, and power connector, and controls. Figure 6-27 shows the SCSI ID jumper settings for the TZK10 drive.



WS33M112

Figure 6-26. TZK10 quarter-inch streaming tape drive



WS33M111

Figure 6-27. TZK10 drive SCSI ID jumper settings

Keyboards and Other Input Devices

This chapter discusses the following keyboards and other input devices:

- LK201 keyboard
- LK401 keyboard
- VSXXX-GA mouse
- VSXXX-AB tablet
- Lighted programmable function keyboard (LPFK)
- Programmable function dials (PFD)

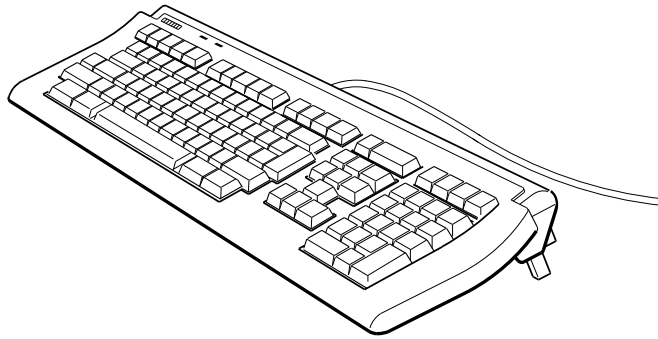
Keyboard Hardware

The system supports the LK201 and the LK401.

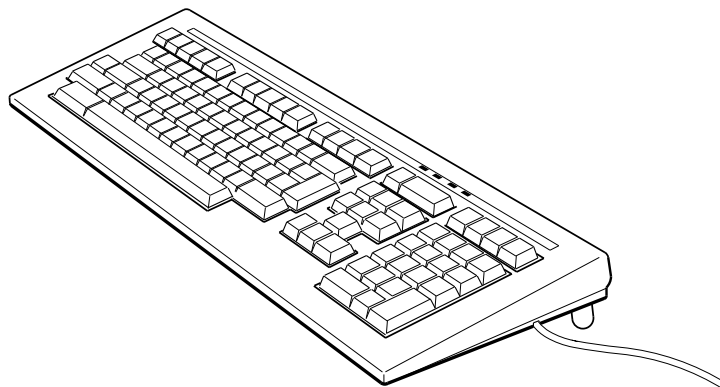
- The LK201 is a flat, full-sized keyboard.
- The LK401 is a curved, full-sized keyboard.

All three keyboards connect to a keyboard-mouse cable that connects to the back of the system unit.

Figure 7-1 shows the LK201 and LK401 keyboards.



LK401 keyboard



LK201 keyboard

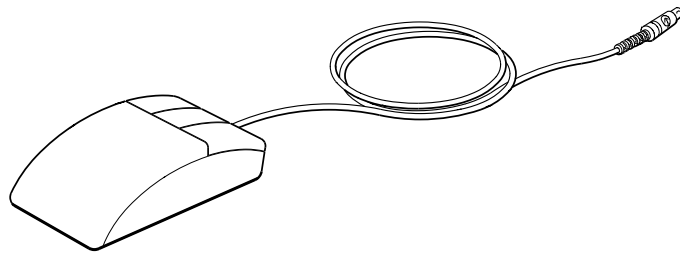
WS33M070

Figure 7-1. LK201 and LK401 keyboards

Mouse and Tablet Hardware

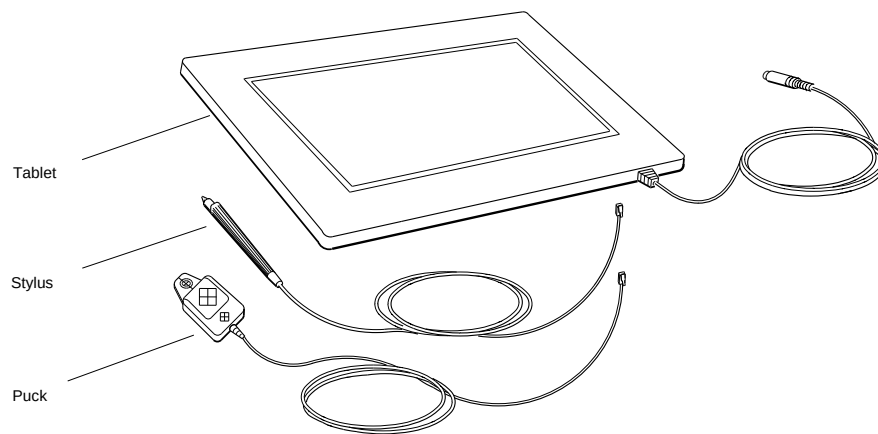
The system supports the VSXXX-GA mouse, which attaches to a keyboard-mouse cable that connects to the back of the system unit.

The system also supports the VSXXX-AB tablet. The mouse and tablet are shown in Figure 7-2 and Figure 7-3. The tablet can be used in place of the mouse and plugs into the same connector.



WS331106

Figure 7-2. Mouse



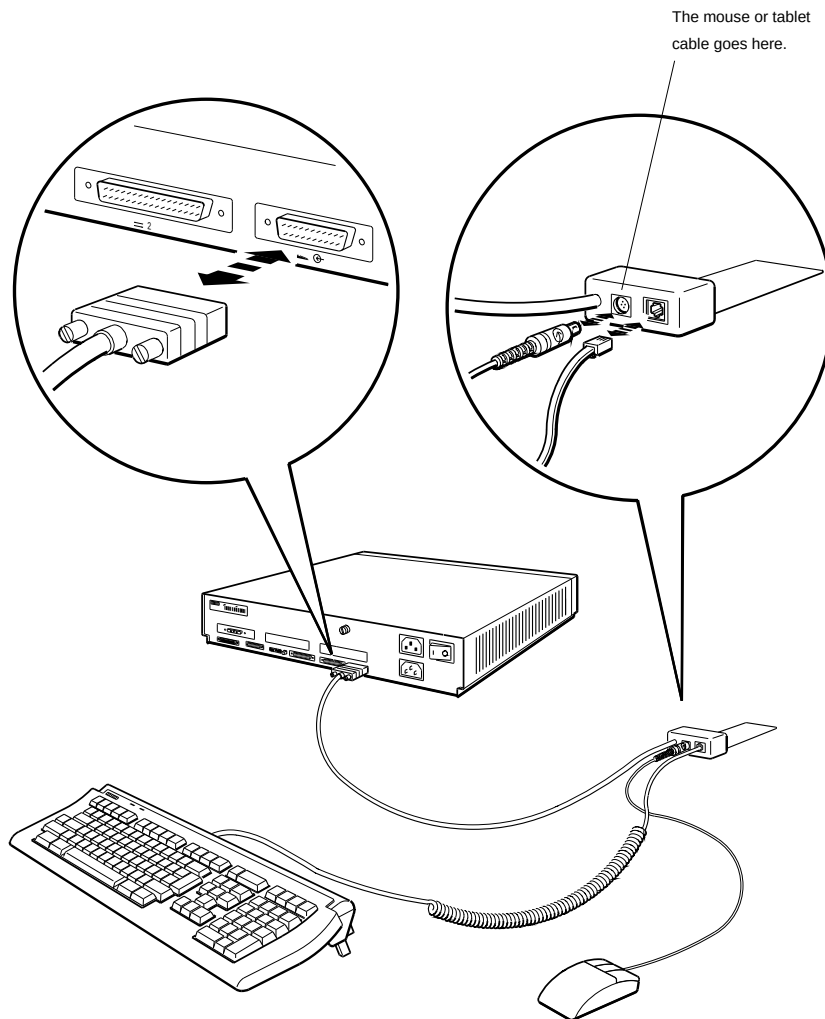
Tablet with puck and stylus

WS330132

Figure 7-3. Tablet

Removing and Installing the Keyboard and Mouse

Figure 7-4 shows how to remove and install a keyboard and mouse.



WS33M117

Figure 7-4. Removing and installing a keyboard and mouse

To Remove the Keyboard and Mouse and Their Cables

To remove the mouse or tablet, pull the end of the mouse or tablet cable out of its connector.

To remove the keyboard, pinch the tab on the end of the keyboard cable. Then pull the cable out of its connector.

To detach the keyboard-mouse cable from the back of the system unit, loosen the connector screws. Then pull the cable away from the keyboard-mouse connector.

To Install the Keyboard and Mouse and Their Cables

To install the keyboard-mouse cable, firmly push the D-connector end of the cable onto the keyboard-mouse connector on the back of the system unit. Then tighten the two screws on the cable connector.

To connect the mouse or tablet, turn the connector on the end of the mouse or tablet cable until the icon on the connector is up and aligned with the mouse icon on the mouse connector of the keyboard-mouse cable connector block. Then push the mouse or tablet connector into the keyboard-mouse cable.

To connect the keyboard, hold the keyboard cable connector so that the tab on the connector faces down. Then press the connector into the keyboard connector on the keyboard-mouse cable connector block until the tab snaps into place.

Finally, insert the flap on the keyboard-mouse cable connector block under the back of monitor base.

LPFK and PFD Hardware

The system supports the lighted programmable function key (LPFK) and the programmable function dials (PFD) options. For maintenance information about the LPFK and PFD options, refer to the documentation supplied with those options.

A

Equipment Specifications

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

- DECstation 5000 Model 100 Series system unit
- VR262 monitor
- VR297 monitor
- VR319-CA and VR319-C4 monitor
- VR319-DA and VR319-D4 monitor
- VRT16 monitor
- VRT19 monitor
- LK401 keyboard
- VSXXX-GA mouse
- VSXXX-AB tablet
- BA42 expansion box
- RZ23L and RZ24L hard disk drive
- RZ25 and RZ26 hard disk drive
- TK50Z and TZ30 tape drive
- TZK10 QIC tape drive
- TLZ04 and TLZ06 cassette tape drive
- RRD40 and RRD42 optical compact disc drive
- RX23 and RX33 diskette drive

Environment Specifications

This appendix contains the operating and environmental specifications for the DECstation 5000 Model 100 Series systems.

Table A-1. DECstation 5000 Model 100 Series 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

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

Table A-2. DECstation 5000 Model 100 Series 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

VR262 Monitor Equipment Specifications

Table A-3. VR262 Monitor Description

Weight	19.05 kg (42.00 lb)
Height	39.37 cm (15.50 in)
Width	45.47 cm (17.90 in)
Depth	39.12 cm (15.40 in)
External controls, switches, and indicators	Brightness Contrast Power switch Power indicator
Cathode-ray tube (CRT)	483 mm (19 in) diagonal Monochrome Paper-white phosphor High-efficiency antiglare treatment
Display characteristics	1,024 pixels horizontal by 864 pixels vertical Approximate picture size 334 by 282 mm Maximum brightness no less than 30 footlamberts (fl)
Video input	
– Termination	75 ohms BNC
– Amplitude	1.0 Vpp composite video
Horizontal rate timing	
– Active video time	14.8 μ s
– Back porch	1,690 ns
– Blanking interval	3.70 μ s maximum
– Frequency	54.054 kHz
– Front porch	160 ns
– Horizontal period	18.5 μ s
– Pixels displayed	1,024
– Sync pulse	1,850 ns
Vertical rate timing	
– Active video time	16.0 ms
– Blanking interval	37 horizontal lines maximum

(continued on next page)

Table A-3 (Cont.). VR262 Monitor Description

– Frequency	60 Hz
– Front porch	0 horizontal lines
– Lines displayed	864
– Sync pulse	3 horizontal lines
– Vertical period	16.67 ms
Power	
– Power supply type	Transistor, switch mode ac to dc converter
– ac input	100–120 Vac or 220–240 Vac Switch selectable
– Frequency	47 to 63 Hz
– Power consumption	Approximately 65 watts
Fuse	100–120 Vac: 1 A 6.35 by 31.8 mm (0.25 by 1.25 in) slow blow (Digital part number 90-07212-00) 220 to 240 Vac: 1 A 5 by 20 mm time lag (Digital part number 12-19283-00)

Table A-4. VR262 Monitor Operating Conditions

Temperature range ¹	10°C to 35°C (50°F to 95°F)
Temperature change rate	11° (20°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

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

Table A-5. VR262 Monitor 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

VR297 Monitor Equipment Specifications

Table A-6. VR297 Monitor Description

Weight	29.03 kg (64.00 lb)
Height	40.64 cm (16.00 in)
Width	40.64 cm (16.00 in)
Depth	45.07 cm (17.75 in)
External controls, switches, and indicators	Contrast Power switch Power indicator V-STAT, H-STAT, V-CENT
Tilt range	–5° to 15°
Swivel range	±60°
Cathode-ray tube (CRT)	432 mm (17 in) diagonal Color 0.26 mm phosphor pitch aperture grill 90° deflection High-efficiency antiglare treatment
Display characteristics	1,024 pixels horizontal by 864 pixels vertical Maximum brightness no less than 30 footlamberts (fl)
Video input	
– Termination	75 ohms BNC
– Amplitude	Red: 0.7 Vpp Green (with sync): 1 Vpp Blue: 0.7 Vpp
Horizontal rate timing	
– Active video	14.8 μ s
– Back porch	1,680 ns
– Blanking interval	3.70 μ s
– Frequency	54.054 kHz
– Front porch	160 ns
– Sync pulse	1.850 μ s
Vertical rate timing	

(continued on next page)

Table A-6 (Cont.). VR297 Monitor Description

– Active video	16.0 ms
– Blanking interval	37 lines
– Frequency	60 Hz
– Front porch	0 lines
– Sync pulse	3 lines
– Vertical period	16.67 ms
Video rate	
– Pixel frequency	69.189 MHz
– Pixel period	14.45 ns nominal
Power	
– ac input	110–120 or 220–240 Vac Switch selectable
– Frequency	47 to 63 Hz
Fuse	100–120 V for VR297-DA Domestic 220–240 V for VR297-D3 Northern Hemisphere

Table A-7. VR297 Monitor 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	2600 m (10,000 ft) maximum

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

Table A-8. VR297 Monitor 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	13,000 m (50,000 ft) maximum

VR319-CA and VR319-C4 Monitor Equipment Specifications

Table A-9. VR319-CA and VR319-C4 Monitor Description

Weight	22.68 kg (50.00 lb)
Height	45.72 cm (18.00 in)
Width	49.55 cm (19.50 in)
Depth	40.13 cm (15.80 in)
External controls, switches, and indicators	Brightness Contrast Degauss Power switch Power indicator Rotation H-center V-center
Tilt range	5° to 15°
Swivel range	±90°
Cathode-ray tube (CRT)	483 mm (19 in) diagonal Monochrome High resolution Paper-white phosphor High-efficiency antiglare treatment
Display characteristics	1280 pixels horizontal by 1024 lines vertical Approximate picture size 342 by 273 mm Maximum brightness no less than 30 footlamberts (fl)
Video input	
– Termination	75 ohms BNC
– Amplitude	1.0 Vpp composite video
Refresh rate	66 Hz Factory or field service configurable
Horizontal rate timing	
– Active video time	10.6806 μ s
– Back porch	1.8691 ns
– Blanking interval	3.4712 μ s

(continued on next page)

Table A-9 (Cont.). VR319-CA and VR319-C4 Monitor Description

– Frequency	70.662 kHz
– Front porch	0.2670 ns
– Horizontal period	14.1519 μ s
– Pixels displayed	10.6806
– Sync pulse	1.3351 ns
Vertical rate timing	
– Active video time	14.4915 μ s
– Back porch	0.467011 ns
– Blanking interval	0.551922 μ s
– Front porch	0.042455 ns
– Horizontal period	15.0434 μ s
– Lines displayed	14.4915
– Sync pulse	0.042455 ns
Power	
– Power supply type	Switch mode ac to dc converter
– ac input	Automatic voltage select
– Frequency	47 to 63 Hz
– Power consumption	Approximately 123 watts
Fuse	
	250 V: 5 A
	6.35 by 31.8 mm (0.25 by 1.25 in) slow blow

Table A-10. VR319-CA and VR319-C4 Monitor Operating Conditions

Temperature range ¹	10°C to 35°C (50°F to 95°F)
Temperature change rate	11° (20°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

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

Table A-11. VR319-CA and VR319-C4 Monitor 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

VR319-DA and VR319-D4 Monitor Equipment Specifications

Table A-12. VR319-DA and VR319-D4 Monitor Description

Weight	22.68 kg (50.00 lb)
Height	45.72 cm (18.00 in)
Width	49.55 cm (19.50 in)
Depth	40.13 cm (15.80 in)
External controls, switches, and indicators	Brightness Contrast Degauss Power switch Power indicator Rotation H-center V-center
Tilt range	5° to 15°
Swivel range	±90°
Cathode-ray tube (CRT)	483 mm (19 in) diagonal Monochrome High resolution Paper-white phosphor High-efficiency antiglare treatment
Display characteristics	1280 pixels horizontal by 1024 lines vertical Approximate picture size 342 by 273 mm Maximum brightness no less than 30 footlamberts (fl)
Video input	
– Termination	75 ohms BNC
– Amplitude	1.0 Vpp composite video
Refresh rate	72 Hz Factory or field service configurable
Horizontal rate timing	
– Active video time	9.7853 μ s
– Back porch	1.7124 ns
– Blanking interval	3.1802 μ s

(continued on next page)

Table A-12 (Cont.). VR319-DA and VR319-D4 Monitor Description

– Frequency	77.173 kHz
– Front porch	0.2446 ns
– Horizontal period	12.9579 μ s
– Pixels displayed	9.7853
– Sync pulse	1.2232 ns
Vertical rate timing	
– Active video time	13.2767 μ s
– Back porch	0.427864 ns
– Blanking interval	0.505658 μ s
– Front porch	0.038897 ns
– Horizontal period	13.7842 μ s
– Lines displayed	13.2767
– Sync pulse	0.038897 ns
Power	
– Power supply type	Switch mode ac to dc converter
– ac input	Automatic voltage select
– Frequency	47 to 63 Hz
– Power consumption	Approximately 123 watts
Fuse	
	250 V: 5 A
	6.35 by 31.8 mm (0.25 by 1.25 in) slow blow

Table A-13. VR319-DA and VR319-D4 Monitor Operating Conditions

Temperature range ¹	10°C to 35°C (50°F to 95°F)
Temperature change rate	11° (20°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

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

Table A-14. VR319-DA and VR319-D4 Monitor 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

VRT16-DA and VRT16-D4 Monitor Equipment Specifications

Table A-15. VRT16-DA and VRT16-D4 Monitor Description

Weight	25.00 kg (56.00 lb)
Height	40.90 cm (16.10 in)
Width	40.60 cm (16.00 in)
Depth	45.30 cm (17.80 in)
External controls, switches, and indicators	Brightness Contrast Power switch Power indicator V-CENT, H-STAT, V-STAT
Swivel range	$\pm 45^\circ$
Tilt range	-5° to $+15^\circ$
Cathode-ray tube (CRT)	432 mm (17 in) diagonal Trinitron aperture grill 0.25 mm triad pitch 90° deflection angle 3 color High-efficiency antiglare treatment
Display characteristics	1,280 by 1,024 pixels Maximum brightness no less than 30 footlamberts (fl)
Video input	
– Termination	75 ohms BNC
– Amplitude	Red: 0.7 Vpp Green (with sync): 1 Vpp Blue: 0.7 Vpp
Horizontal rate timing	
– Active video	10.6806 μ s
– Back porch	1,869.1 ns
– Blanking interval	3.4712 μ s
– Frequency	70.6621 kHz
– Front porch	267 ns
– Horizontal period	14.1518 μ s

(continued on next page)

Table A-15 (Cont.). VRT16-DA and VRT16-D4 Monitor Description

– Sync pulse	1,335.1 ns
Vertical rate timing	
– Active video	14.4915 ms
– Blanking interval	39 horizontal lines
– Frequency	66.4743 Hz
– Front porch	3 horizontal lines
– Sync pulse	3 horizontal lines
– Vertical period	15.0434 ms
Video rate	
– Pixel frequency	119.843 MHz
– Pixel period	8.3443 ns nominal
Power	
– ac input voltage	90–132 or 198–264 Vac Switch selectable
– Frequency	47 to 63 Hz
– Power consumption	200 watts maximum

Table A-16. VRT16-DA and VRT16-D4 Monitor Operating Conditions

Temperature range ¹	10°C to 35°C (50° to 95°F)
Relative humidity	10% to 95%
Maximum wet-bulb temperature	32°C (89°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	10,000 ft maximum

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

Table A-17. VRT16-DA and VRT16-D4 Monitor Nonoperating Conditions

Temperature range	–40°C to 60°C (–40°F to 145°F)
Relative humidity	10% to 95%
Maximum wet-bulb temperature	46°C (115°F) packaged
Altitude	12,780 m (50,000 ft) maximum

VRT19-DA and VRT19-D4 Monitor Equipment Specifications

Table A-18. VRT19-DA and VRT19-D4 Monitor Description

Weight	34.02 kg (75.00 lb)
Height	47.55 cm (18.72 in)
Width	49.94 cm (19.66 in)
Depth	46.96 cm (18.49 in)
External controls, switches, and indicators	Brightness Contrast Power switch Power indicator V-CENT, H-STAT, V-STAT
Swivel range	$\pm 45^\circ$
Tilt range	-5° to $+15^\circ$
Cathode-ray tube (CRT)	508 mm (20 in) diagonal Trinitron aperture grill 0.31 mm triad pitch 90° deflection angle 3 color High-efficiency antiglare treatment
Display characteristics	1,280 by 1,024 pixels Maximum brightness no less than 30 footlamberts (fl)
Video input	
– Termination	75 ohms BNC
– Amplitude	Red: 0.7 Vpp Green (with sync): 1 Vpp Blue: 0.7 Vpp
Horizontal rate timing	
– Active video	10.6806 μ s
– Back porch	1,869.1 ns
– Blanking interval	3.4712 μ s
– Frequency	70.6621 kHz
– Front porch	267 ns
– Horizontal period	14.518 μ s

(continued on next page)

Table A-18 (Cont.). VRT19-DA and VRT19-D4 Monitor Description

– Sync pulse	1,335.1 ns
Vertical rate timing	
– Active video	14.4915 ms
– Blanking interval	39 horizontal lines
– Frequency	66.4743 Hz
– Front porch	3 horizontal lines
– Sync pulse	3 horizontal lines
– Vertical period	15.0434 ms
Power	
– ac input voltage	90–132 to 198–264 Vac
– Frequency	47 to 63 Hz
– Power consumption	220 watts maximum

Table A-19. VRT19-DA and VRT19-D4 Monitor Operating Conditions

Temperature range ¹	10°C to 35°C (50° to 95°F)
Relative humidity	10% to 95%
Maximum wet-bulb temperature	32°C (89°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	10,000 ft maximum

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

Table A-20. VRT19-DA and VRT19-D4 Monitor Nonoperating Conditions

Temperature range	–40°C to 60°C (–40°F to 145°F)
Relative humidity	10% to 95%
Maximum wet-bulb temperature	46°C (115°F) packaged
Minimum dew-point temperature	2°C (36°F)
Altitude	12,780 m (50,000 ft) maximum

LK401-AA Keyboard Equipment Specifications

Table A-21. 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 $\pm 6\%$ at 350 ma
Volume control	8 levels, plus off
Keystroke timing	20 ms minimum

Table A-22. LK401-AA Keyboard 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	32°C (90°F)
Minimum dew-point temperature	15°C (60°F)
Altitude	2,400 m (8,000 ft) maximum

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

Table A-23. 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-24. 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	$\pm 3\%$ 0 to 25 cm (0 to 10 in) per second in any direction $\pm 15\%$ 25 to 50 cm (10 to 20 in) per second in any direction $\pm 30\%$ 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 $\pm 5\%$ 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-25. VSXXX-GA Mouse 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	18°C (64°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	3,050 m (10,000 ft) maximum

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

Table A-26. 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-27. 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 $\pm 10\%$ 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-28. VSXXX-AB Tablet Operating Conditions

Temperature range ¹	10°C to 35°C (50°F to 95°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

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

Table A-29. 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-30. 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-31. BA42 Storage Expansion Box Operating Conditions

Temperature range ¹	10°C to 35°C (50°F to 95°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

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

Table A-32. 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-33. 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-34. 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)

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

Table A-35. 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-36. 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-37. 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)

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

Table A-38. 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-39. 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-40. 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)

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

Table A-41. 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-42. 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-43. 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-44. 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

TK50Z Tape Drive Equipment Specifications

Table A-45. 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-46. TK50Z Tape Drive Operating Conditions

Temperature range ¹	10°C to 35°C (50°F to 95°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

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

Table A-47. 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-48. 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-49. TZ30 Tape Drive Operating Conditions

Temperature range ¹	10°C to 35°C (50°F to 95°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

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

Table A-50. 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

TZK10 QIC Tape Drive Equipment Specifications

Table A-51. 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-52. TZK10 QIC Tape Drive Operating Conditions

Temperature range ¹	5°C to 35°C (50°F to 95°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

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

Table A-53. TZK10 QIC Tape Drive Nonoperating Conditions

Temperature range	–30°C to 60°C (–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-54. 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-55. TLZ04 Cassette Tape Drive Operating Conditions

Temperature range ¹	10°C to 35°C (50°F to 95°F)
Relative humidity	20% to 80% noncondensing
Altitude	0 m to 4600 m (0 to 15,000 ft)

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

Table A-56. 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-57. 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-58. TLZ06 Cassettes

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

Table A-59. TLZ06 Cassette 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-60. 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)

RRD40 Compact Disc Drive Equipment Specifications

Table A-61. RRD40 Compact Disc Drive Description (Tabletop)

Weight	3.99 kg (8.80 lb)
Height	7.62 cm (3.00 in)
Width	23.19 cm (9.13 in)
Depth	27.94 cm (11.00 in)
Access time	Maximum 1,000 ms, including latency Average 500 ms
Average latency	155 ms at outer track 60 ms at inner track
Average transfer rate	175.2 KB per second
Capacity per disc	635 MB
Heat dissipation	14 watts (typical)
Initialization startup time	Less than 6 second
Interface	SCSI

Table A-62. RRD40 Compact Disc Drive Operating Conditions (Tabletop)

Temperature range ¹	10°C to 50°C (50°F to 122°F)
Relative humidity	10% to 80% noncondensing
Maximum wet-bulb temperature	28°C (82°F)
Minimum dew-point temperature	2°C (36°F)
Altitude	3400 m (11,150 ft) maximum

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

Table A-63. RRD40 Compact Disc Drive Nonoperating Conditions (Tabletop)

Temperature range	4°C to 70°C (40°F to 158°F)
Relative humidity	5% to 95% noncondensing
Maximum wet-bulb temperature	46°C (115°F) packaged
Minimum dew-point temperature	2°C (36°F)
Altitude	13,600 m (44,600 ft) maximum

RRD42 Compact Disc Drive Equipment Specifications

Table A-64. 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-65. 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)

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

Table A-66. 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-67. 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-68. 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)

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

Table A-69. 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-70. 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-71. 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

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

Table A-72. 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

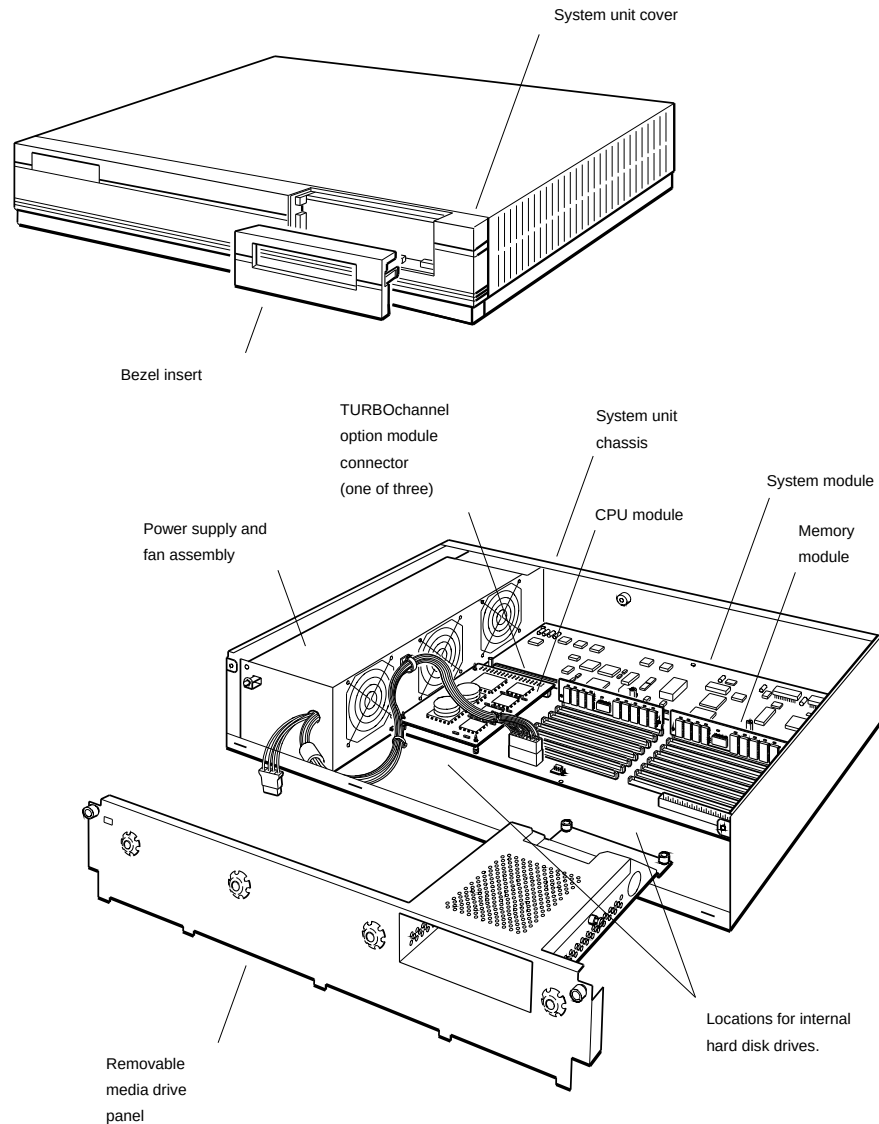
B

Recommended Spares List

This appendix lists part numbers for the following items related to the DECstation 5000 Model 100 Series:

- Major FRUs
- Internal drives
- Monitors
- Input devices
- Cords, cables, and connectors
- Loopback connectors, plugs, terminators, test media, and miscellaneous
- Software documentation
- Hardware documentation

Figure B-1 shows the major FRUs for the DECstation /DECsystem 5000 Model 100 Series. The tables that follow Figure B-1 list the part numbers and order numbers for the hardware components and documentation of the DECstation /DECsystem 5000 Model 100 Series systems.



WS33M056

Figure B-1. Major FRUs for the DECstation 5000 Model 100 Series

B-2 Recommended Spares List

Table B-1. Major FRUs

Item	Part Number	Customer Order Number
System module	70-28336-01	—
CPU module only, 20 MHz	54-20615-01	KN02-BC
CPU module only, 25 MHz	54-20615-02	KN02-CC
CPU module only, 33 MHz	54-221331-01	KN02-DA
CPU module only, 50 MHz	54-21872-01	KN04-AA
Power supply assembly	H7826-AA	—
Power supply fan assembly	70-28334-01	—
Memory module, 2 Mbyte, single	57-30735-02	—
Memory module, 4 Mbyte pair (two 2 Mbyte modules)	—	MS01-AA
Memory module, 2 Mbyte, single	54-21213-01	—
Memory module, 4 Mbyte pair (two 2 Mbyte modules)	—	MS01L-AB
Memory module, 8 Mbyte, single	57-34320-01	—
Memory module, 16 Mbyte pair (two 8 Mbyte modules)	—	MS01-CA
System unit cover	70-28337-01	—
System unit chassis	70-28320-01	—
Removable media drive panel	70-28338-01	—

Table B-2. Internal Drives

Item	Part Number	Customer Order Number
RX23 diskette drive	—	RX23-FL
RX23 diskette drive unit	RX23-A0	—
RX23 diskette drive adapter card	54-19288-01	—
RZ23 hard disk drive	RZ23-E0	—
RZ23L half-height hard disk drive	RZ23L-E0	RZ23L-FL
RZ24 hard disk drive	—	RZ24-FL
RZ24 hard disk drive PCB	29-28144-01	—
RZ24 hard disk drive head disk assembly (HDA)	29-28145-01	—
RZ25 hard disk drive	—	RZ25-E
RRD42 optical compact disc drive	RRD42-AA	RRD42-FL

Table B-3. TURBOchannel Option Modules

Item	Part Number	Customer Order Number
1-plane Monochrome Graphics Frame Buffer (MFB)	54-20609-01	PMAG-AB
8-plane Color Graphics Frame Buffer (CFB)	54-19815-01	PMAG-BB
8-plane 2D Graphics Accelerator	54-20314-01	PMAG-CB
8-plane 3D Graphics Accelerator	54-20185-01	PMAG-DB
24-plane 3D Graphics Accelerator	54-20185-02	PMAG-EB
96-plane High-performance 3D Graphics	54-20114-01	PMAG-FB
8-to-24-plane Upgrade	—	PMAG-GB
24-bit Z-buffer Option Module	—	PMAG-HA
ThickWire Ethernet Option Module	54-19874-01	PMAD-AB
SCSI Controller Option Module	54-19876-01	PMAG-AB

Table B-4. Monitors

Item	Part Number	Customer Order Number
VR262, 19-inch monochrome monitor, 120 volts	—	VR262-AA
VR262, 19-inch monochrome monitor, 240 volts	—	VR262-A3
VR297, 16-inch color monitor, 120 volts	—	VR297-DA
VR297, 16-inch color monitor, 240 volts, Northern Hemisphere	—	VR297-D3
VR297, 16-inch color monitor, 240 volts, Southern Hemisphere	—	VR297-D4
VR299, 19-inch color monitor, 120 volts	—	VR299-DA
VR299, 19-inch color monitor, 240 volts, Northern Hemisphere	—	VR299-D3
VR299, 19-inch color monitor, 240 volts, Southern Hemisphere	—	VR299-D4
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
VRT16, 16-inch color monitor, 66/72 Hz	—	VRT16-HA
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
VRT19, 19-inch color monitor, 66/72 Hz	—	VRT19-HA

Table B-5. Input Devices

Item	Part Number	Customer Order Number
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. Cords, Cables, and Connectors

Item	Part Number	Customer Order Number
Monitor-to-system-unit power cord (U.S.)	17-00442-26	—
System unit or expansion box power cord	17-00606-10	BN19P-K
SCSI expansion-box-to-expansion-box cable	17-01351-04	BC19J-1E
Keyboard-mouse cable	17-02640-01	—
Serial line cable	—	BC16E-10
SCSI system-unit-to-expansion-box cable	17-02641-02	BC09D-06
SCSI internal data cable for upgrade (RZ23)	17-03175-01	—
ThickWire transceiver cable	17-01321-01	BNE4C-02
ThinWire cable, 12 ft	17-01241-12	BC16M-12
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
Video cable, color	17-02906-01	BC29G-09
Video cable, grayscale	17-02878-01	—
Video cable, monochrome	17-3054-01	—
SCSI internal data cable	17-3055-01	—
SCSI internal power cable	17-3064-01	—

Table B-7. Loopback Connectors, Plugs, Test Media, and Miscellaneous Items

Item	Part Number	Customer Order Number
MMJ loopback connector	12-25083-01	—
ThickWire loopback connector	12-22196-02	—
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	—
SCSI controller terminator	12-33626-01	—
CPU standoff post	12-35477-01	—
CPU standoff rivet	12-35477-02	—
Comm modem loopback	29-24795-00	—
RX23 bezel insert	74-42126-01	—
Blank bezel insert	74-42126-02	—
RRD42 bezel insert	74-42126-03	—
TZK10 bezel insert	74-42126-04	—

Table B-8. Software Documentation

Item	Part Number	Customer Order Number
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
<i>ULTRIX Guide to the Error Logger</i>	—	AE-ME95B-TE
<i>Technical Summary for RISC Processors</i>	—	AA-MM35A-TE
<i>Documentation Overview for RISC Processors</i>	—	AA-MM05A-TE

Table B-9. Hardware Documentation

Item	Part Number	Customer Order Number
DECstation 5000 Model 100 Series User Documentation Kit	—	EK-PM32A-DK-001
<i>DECstation 5000 Model 100 Series Installation Guide</i>	—	EK-PM32B-IN-001
<i>DECstation 5000 Model 100 Series Operator's Guide</i>	—	EK-PM32C-OG-001
<i>DECstation 5000 Model 100 Series Workstation Reference Card</i>	—	EK-PM32D-RC-001
<i>DECstation 5000 Model 100 Series Maintenance Guide</i>	—	EK-PM32G-MG-001
<i>DECstation 5000 Model 100 Series Pocket Reference Guide</i>	—	EK-PM32E-PS-001
<i>TURBOchannel Maintenance Guide</i>	—	EK-TRBOC-MG-003
Components and Add-Ons		
<i>RX23 Disk Drive Service Manual</i>	—	
<i>RZ23 Disk Drive Service Manual</i>	—	
<i>RZ23L Disk Drive Service Manual</i>	—	
<i>RZ24 Disk Drive Service Manual</i>	—	
<i>RRD42 Owner's Manual</i>	—	
<i>Installing and Using the LN03</i>	—	EK-0LN03-UG
<i>LN03 PLUS User's Guide</i>	—	EK-LN03S-UG
<i>ScriptPrinter Installation Guide</i>	—	EK-LN03R-UG
<i>ScriptPrinter Operator's Guide</i>	—	EK-LN03R-OG

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

Entering Console Commands

This section describes the conventions to follow when you enter console commands.

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.

Conventions Used in This Chapter

- **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 *or*.
- 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 Chapter

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.

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 each console command and its function.

Table C-1. Console Command Functions

Command	Function
?	Displays a list of console commands and formats
boot	Boots the system
cat	Displays the contents of a script
cnfg	Displays system configuration information
d	Deposits data into memory
e	Examines memory contents
erl	Displays the error message log
go	Transfers control to a specific address
init	Resets the system
ls	Displays the scripts and other files that are in a module
passwd	Sets and clears the console password
printenv	Prints environment variables
restart	Attempts to restart the operating system software that is specified in the restart block
script	Creates a temporary script of console commands
setenv	Sets an environment variable
sh	Runs a script
t	Runs a test
test	Runs a comprehensive test script that checks the system hardware
unsetenv	Removes an environment variable

? Command

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

The ? command format is
? [cmd]

When you type the ? command,

- 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 [-zseconds] [-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*.

When you type this file specification,

- 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.

For 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** and press Return. 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** and press Return.

- 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 typing 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*

When you type the cat command,

- 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.

For example, to display the individual self-tests contained in the mem-m test script in the base system, type **cat3/test-mem-m** and press Return.

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

```
>>cat 3/test-mem-m
t ${#}/mem/select
t ${#}/misc/wbpart
t ${#}/mem 0 0 55555555 -q
t ${#}/mem 1 0 55555555 -q
t ${#}/mem 2 0 55555555 -q
t ${#}/mem 3 0 55555555 -q
t ${#}/mem 4 0 55555555 -q
t ${#}/mem 5 0 55555555 -q
t ${#}/mem 6 0 55555555 -q
t ${#}/mem 7 0 55555555 -q
t ${#}/mem/float10
```

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 Ethernet, SCSI, and color frame buffer modules:

Display with R4000 CPU Module

```
>>cnfg
3:  KN04      DEC  V1.0a      TCF0      ( 32 MB)
      (enet: 08-00-2b-2d-84-c7)
      (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  V5.2a      TCF0      (CX -- d=8)
```

Display with R3000 CPU Module

```
>>cnfg
3:  KN02-BA   DEC  V5.2c      TCF0      ( 24 MB)
      (enet:08-00-2b-0c-e0-d1)
      (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  V5.2a      TCF0      (CX -- d=8)
```


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 from the left is the module name.
- The third term from the left is the module vendor.
- The fourth term from the left is the firmware version of the module.
- The fifth term from the left 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** and press Return.

Display with the R4000 CPU Module This is a sample configuration display for the base system configuration:

```
>>cnfg 3
3: KN04      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      SCSI device info
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:a07ffffff ( 8 MB)
mem( 1): a0800000:a0ffffff ( 8 MB)
mem( 2): a1000000:a17ffffff ( 8 MB)
mem( 3): a1800000:a1ffffff ( 8 MB)
```

Note in the above example, the screen output is the same as a R3000 based system, with two exceptions:

1. *cache* line of the R4000 screen changes to Instruction, Data, Secondary and Secondary cache line size on an R4000-type system.

2. An additional Processor revision information line just below the *cache* line.

Display with the R3000 CPU Module This is a sample configuration display for the base system configuration:

```
3:  KN02-BA   DEC       V5.2A   TCF0   ( 24 MB)
                                         (enet: 08-00-2b-0f-45-72)
                                         (SCSI = 7)
```

```
-----
DEV  PID                      VID      REV      SCSI DEV
=====
tz1
rz2  RZ55      (C) DEC  DEC      0700  DIR
rz4  RX23      (C) DEC  DEC      0700  DIR
dcache ( 64 KB), icache ( 64 KB)
mem( 0): a0000000:a03ffffff ( 4 MB)
mem( 1): a0400000:a07ffffff ( 4 MB)
mem( 2): a0800000:a0bffffff ( 4 MB)
mem( 3): a0c00000:a0ffffff ( 4 MB)
mem( 4): a1000000:a13ffffff ( 4 MB)
mem( 5): a1400000:a17ffffff ( 4 MB)
```

Notice that the display begins with the same information as 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 six memory modules.

The following list describes the information for 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.

- Memory slot number
- Address range
- Amount of memory in the slot. The amount can be 4 or 16 megabytes. All the slots should have the same amount of memory, because all memory modules in a workstation must be the same size.
- This display will not reveal a mixed memory installation. The system assumes that all occupied memory slots contain SIMMs identical to that in the first slot.

Ethernet controller configuration displays

- To display an Ethernet controller option module configuration, type **cnfg** *slot_number*, where you replace *slot_number* with the slot number of the Ethernet controller option module.
- To see the base system Ethernet controller configuration, display the base system configuration display by typing **cnfg 3** and pressing Return. 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, refer to “General system configuration displays” on page C-10.

SCSI controller displays

- To display a SCSI controller option module configuration, type **cnfg slot_number**, where you replace *slot_number* with the slot number of the SCSI controller option module.
- To see the base system SCSI controller configuration, display the base system configuration display by typing **cnfg 3** and pressing Return. 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 disc 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, refer to “General system configuration displays” on page C-10.

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.
- 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.

Color frame-buffer graphics module configuration displays

To obtain a color frame-buffer graphics module configuration display, type **cnfg** *slot_number*, where you replace *slot_number* with the slot number for the color frame-buffer graphics module for which you want a configuration display, and press Return.

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)
```

The color frame-buffer graphics module configuration display has the same meaning as the color frame-buffer graphics module description in the general system configuration display. For an explanation of the color frame-buffer graphics module configuration display, refer to “General system configuration displays” on page C-10.

2D graphics accelerator module configuration displays

To obtain a 2D graphics accelerator module configuration display, type **cnfg slot_number**, where you replace *slot_number* with the slot number for the 2D graphics accelerator module for which you want a configuration display, and press Return.

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, refer to “General system configuration displays” on page C-10.

3D graphics module configuration displays

To obtain a 3D graphics module configuration display, type **cnfg 1**, where 1 is the slot number for the 3D graphics module. Then press Return.

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)
```

In this display,

- 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.
- Digital is the module manufacturer.
- The fourth column from the left lists the firmware version that each module contains.
- The fifth column from the left lists the firmware type in each module.

- The phrase 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 last phrase in 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)] [-Scount] 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 -Scount 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 which the values are stored.
 - 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* to define the range.

When you enter the address range, 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. When you type this address range format, replace *address_low* with the starting address for storing values. Then replace *count* with the number of values you want to store.
 - To specify more than one address range, separate each range specification 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.

When you enter the address 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. When you type this address range format, 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 the errors that occurred since the most recent power-up or reset operation.

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.

Sample 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 that are contained in the module 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*

When you type the script command, replace *name* with the name that you are giving the script. Then press Return.

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 lists environment variables that appear in the environment variable display.

Table C-2. Environment Variables in the Environment Variable Display

Environment Variable	Description
boot	Sets the default boot path. Refer to “boot Command” on page C-7 and to “unsetenv Command” on page C-29.
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. - If the console variable is set to anything other than s, the monitor connected to the graphics module in the lowest slot number is enabled. If no graphics module is installed, the terminal connected to the left comm connector is enabled. - If the console variable is set to 0 and a graphics module is installed, the console displays the language selection menu.

(continued on next page)

Table C-2 (Cont.). Environment Variables in the Environment Variable Display

Environment Variable	Description
haltaction	Specifies how the system responds if 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.
osconsole	Contains the slot numbers of the console drivers. If a TTY driver from slot <i>x</i> serves as the console, osconsole is set to <i>x</i>. If a CRT driver from slot <i>y</i> and a kbd driver from slot <i>z</i> serve as the console, osconsole is set to <i>y,z</i>. 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, which uses 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...*]

When you type the sh command,

- 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.
- The use of any additional arguments depends on the particular script you specified in the sh command.

You can also run a script by typing *slot_number/script*.

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

t Command

Use the **t** command to run individual tests.

The **t** command format is

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

When you type the **t** command,

- 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 additional arguments depending 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/?**, where you replace *slot_number* with the slot number of the module for which you want to display tests, and press Return.

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 on page C-26 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 boot`**, not **`unsetenv boot`**.

Note: Environment variables stored in NVR can be only temporarily unset.

Console Command Error Messages

Table C-3 lists the error messages that the console commands can return.

Table C-3. Console Command Error Messages

Error Message	Meaning
?EV: <i>ev_name</i>	The specified environment variable does not exist.
?EVV: <i>value</i>	The specified environment variable value is invalid.
?IO: <i>slot_number</i> <i>/device</i>	An I/O device reported an error. Here, <i>slot_number</i> represents the I/O device slot number and, <i>device</i> represents an additional message about the error.
?IO: <i>slot_number</i> <i>/device</i>	The module with the slot number represented by <i>slot_number</i> does not recognize the device represented by <i>device</i> .
?PDE3: <i>slot_number</i>	The module with the slot number represented by <i>slot_number</i> contains an early version of firmware. The ROM chip must be upgraded.
?SNF: <i>script</i>	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: <i>usage</i>	A console command contained a syntax error. The <i>usage</i> parameter lists the correct syntax.
?STX: <i>error</i>	A console command contained a syntax error. The <i>error</i> parameter lists the incorrect portion of the command.
?TFL: <i>slot_number/test</i>	A test failed. Here, <i>slot_number</i> represents the slot number of the module that reported the error and <i>test</i> represents the name of the failed test.
?TNF:	Test not found.

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

Locating Individual Tests

This appendix groups together individual tests for each base system module. The individual tests in each group are listed in alphabetical order by test command. Table D-1 lists the individual tests for each module.

Table D-1. Individual Tests and Utilities

Module Tested	Individual Test or Utility	Test or Utility Command
System module	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 communication chip (SCC) access test	t 3/scc/access
	Serial communication chip (SCC) DMA test	t 3/scc/dma [line] [loopback] [baud]
	Serial communication chip (SCC) interrupts test	t 3/scc/int [line]
	Serial communication chip (SCC) I/O test	t 3/scc/io [line] [loopback]
	Serial communication chip (SCC) pins test	t 3/scc/pins [line] [loopback]
	Serial communication chip (SCC) transmit and receive test	t 3/scc/tx-rx [line] [loopback] [baud]
CPU module	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]

(continued on next page)

Table D-1 (Cont.). Individual Tests and Utilities

Module Tested	Individual Test or Utility	Test or Utility Command
	Cache reload test	t 3/cache/reload [cache] [offset]
	Cache segment test	t 3/cache/seg [cache] [address]
	Scache/data test	t 3/cache/data
	CPU-type utility	t 3/misc/cpu-type
	Floating-point unit test	t 3/fpu
	Secondary cache test	t 3 scache/data
	Translation lookaside buffer (TLB) probe test	t 3/tlb/prb
	Translation lookaside buffer (TLB) registers test	t 3/tlb/reg [pattern]
Memory module	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
	Zero memory utility	t 3/mem/init
Base system Ethernet controller	Collision test	t 3/ni/cllsn
	Cyclic redundancy code(CRC) test	t 3/ni/crc
	Display 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

(continued on next page)

Table D-1 (Cont.). Individual Tests and Utilities

Module Tested	Individual Test or Utility	Test or Utility Command
	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
Base system SCSI controller and drives	SCSI controller test	t 3/scsi/cntl
	SCSI send diagnostics test	t 3/scsi/sdiag <i>scsi_id [d] [u] [s]</i>
	SCSI target test	t 3/scsi/target <i>scsi_id [w] [l loops]</i>
Keyboard and mouse	Keyboard test	t 3/misc/kbd
	Mouse test	t 3/misc/mouse

System Module Tests

The following entries explain the commands, parameters, and error messages for each system module test.

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*], and press Return.

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=xxxxxxx) 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=xxxxxxx) indicates that the system interrupt register contains an impossible combination of halt- button bits. xxxxxxxx represents the value found in the system interrupt register.

Nonvolatile RAM (NVR) Test

The nonvolatile RAM (NVR) test checks the system module nonvolatile RAM. To run the NVR test, type **t 3/rtc/nvr** [*pattern*] and press Return.

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.

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** and press Return.

Overheat detect test error message

The only overheat detect test error message is ?TFL: 3/misc /pstemp (system is *HOT*), which indicates that the system is overheating.

Real-Time Clock (RTC) 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** and press Return.

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-2 lists error codes used in RTC period test error messages.

Table D-2. 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.

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** and press Return.

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-3 error codes and descriptions used in real-time clock register test error messages.

Table D-3. Real-Time Clock Register Test Error Codes and Descriptions

Error Code and Description	Meaning
1 (2: <i>register</i> = <i>actual</i> , sb <i>expected</i>)	UIP bit remained set past allotted time. The test failed to write pattern correctly. The <i>register</i> value is the actual value in the named register, followed by the expected value.

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** and press Return.

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-4 lists error codes used in real-time test error messages.

Table D-4. 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 zero on wraparound.
7	Real-time clock minutes were not set to zero.
8	Real-time clock hours were not set to zero.
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 zero.

Serial Communication Chip (SCC) 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** and press Return.

SCC access test error messages

The only SCC access test error message is ?TFL: 3/scc/access (1:Ln*M* reg-*N*: actual=0x*XX* xpctd=0x*YY*), which 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.

Serial Communication Chip (SCC) Direct Memory Access (DMA) 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*] and press Return.

When you type the SCC DMA test command,

- 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 these baud rates:

300	4800
1200	9600
2400	19200
3600	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*:Ln*N* SIR_xptd=xxxxxxx SIR=yyyyyyy
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_xptd 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-5 discusses the codes used in SCC DMA test error messages.

Table D-5. 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.

Serial Communication Chip (SCC) 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** and press Return.

SCC interrupts test error messages

SCC interrupts test error messages have the form ?TFL: 3/scc/int (*code*: ln*N* RR0=*xx* RR3=*yy* SIR=*zzzzzzzzzz*)

- ?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.

Serial Communication Chip (SCC) 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*] and press Return.

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*: Ln*N 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-6 lists error codes and descriptions used in SCC I/O test error messages.

Table D-6. SCC I/O Test Error Codes and Descriptions

Error Code and Description	Meaning
1: LnN tx bfr not empty. status=xx	System could not write a single character because the transmit buffer was not empty. <i>N</i> represents the line in which the error occurred. The status value is the contents of read register 0.
2: LnN char not rcvd. status=xx	CHAR AVAIL signal not received when the system was expecting a character. <i>N</i> 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. <i>N</i> represents the line in which the error occurred. The <i>xx</i> represents the transmitted value. The <i>yy</i> represents the received value. The status value is the contents of read register 0.

Serial Communication Chip (SCC) 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]* and press Return.

When you type the SCC pins test command,

- 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-7 lists the specific pin pairs that each loopback tests.

Table D-7. Pin Pairs Tested by Individual Loopback Connectors

Loopback Connector	Pin Pairs Tested	Meaning
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 (H8571-A)	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-8 lists error codes and descriptions used in SCC pins test error messages.

Table D-8. SCC Pins Test Error Codes and Descriptions

Error Code and Description	Meaning
1:LnN Invld param [xxxxx]	The number used in the test command to specify the loopback was invalid. <i>N</i> represents the number of the serial line in which the error occurred. <i>xxxxx</i> represents the first two characters of the invalid value that was specified.
2:LnN Strtup R-xx xptd=yy actl=zz pins	Test failed to generate the expected SCC status bits. <i>N</i> represents the number of the serial line in which the error occurred. The Startup 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: LnN xxxxx	Pins failed to respond properly. <i>xxxxx</i> represents the numbers of one or more pin pairs that failed the test.

Serial Communication Chip (SCC) 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*] and press Return.

When you type the SCC transmit and receive test command,

- 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	4800
1200	9600
2400	19200
3600	38400

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-9 lists the error codes and descriptions used in SCC transmit and receive error messages.

Table D-9. SCC Transmit and Receive Test Error Codes and Descriptions

Error Code and Description	Meaning
1: LnN tx bfr not empty. status=xx	System could not write a single character because the transmit buffer was not empty. <i>N</i> represents the line in which the error occurred. The status value is the contents of SCC read register 0.
2: LnN char not rcvd. status=xx	CHAR AVAIL signal not received when the system was expecting a character. <i>N</i> represents the line in which the error occurred. The status value is the contents of SCC read register 0.
3: LnN expctd=xx, rcvd=yy, status=zz	The character that was received was different than the transmitted character. <i>N</i> represents the line in which the error occurred. The <i>xx</i> represents the transmitted value. The <i>yy</i> represents the received value. The status value is the contents of SCC read register 0.
4: LnN Rx err. errs=xx	Receiving character in FIFO reported an error. <i>N</i> represents the line in which the error occurred. The <i>errs</i> value is the associated input character FIFO error bits.

CPU Module Tests

The following entries explain the commands, parameters, and error messages for each CPU module test.

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*] and press Return.

When you type the cache data 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. Note that using the optional *address* parameter requires familiarity with the firmware specifications.

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-10 lists codes used in cache data test error messages.

Table D-10. 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 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*] and press Return.

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-11 lists descriptions used in cache fill test error messages.

Table D-11. Cache Fill Test Error Descriptions

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

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*] and press Return.

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-12 lists error codes used in cache isolate test error messages.

Table D-12. 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 AAAAAAAAAA pattern resulted in a cache parity error.
8	Reading AAAAAAAAAA pattern resulted in a cache miss error.
9	Reading AAAAAAAAAA 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 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*] and press Return.

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-13 lists descriptions used in cache reload test error messages.

Table D-13. Cache Reload Test Error Descriptions

Error Description	Meaning
(PE) (<i>address= actual, sb expected</i>)	Unexpected parity error occurred. Reading a data pattern reported a miscompare. – <i>address</i> represents the address where the miscompare occurred. – <i>actual</i> represents the actual value at that address. – <i>expected</i> represents the expected value for that address.
(PE @ <i>address</i> (C))	Parity error occurred. The <i>address</i> parameter lists the address where the error occurred.

Cache Segment Test

The cache segment test checks individual cache segments.

To run the cache segment test, type **t 3/cache/seg** [*cache*] [*address*] and press Return.

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-14 describes error codes and descriptions used in cache segment test error messages.

Table D-14. Cache Segment Test Error Codes and Descriptions

Error Code and Description	Meaning
(1: <i>address= xxxxxxxx</i> , sb <i>yyyyyyyy</i>)	Error occurred when the system tried to read the cache contents. The <i>address</i> parameter is the actual value at a given address. The correct value follows.
(2: <i>address= xxxxxxxx</i> , sb <i>yyyyyyyy</i>)	Error occurred when the system tried to read the memory contents. The <i>address</i> parameter is the actual value at a given address. The correct value follows.
(3: <i>address =xxxxxxxx</i> , sb <i>yyyyyyyy</i>)	Error occurred when the system performed a read and write operation on the uncached memory. The <i>address</i> value is the actual value at a given address. The correct value follows.
(4: <i>address =xxxxxxxx</i> , sb <i>yyyyyyyy</i>)	Cache data was inconsistent. The address value is the actual value at a given address. The correct value follows.

Secondary Cache Test - *scache/data*

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.

Floating-Point Unit (FPU) 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** and press Return.

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-15 lists error codes used in FPU test error messages.

Table D-15. 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: $n+n \neq n$
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. $n+n \neq n$
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.

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** and press Return.

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. Refer to “CPU Module” in Chapter 5 to determine the CPU type indicated by a specific *type* value.

Translation Lookaside Buffer (TLB) 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** and press Return.

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*.

Translation Lookaside Buffer (TLB) 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*] and press Return.

When you type the TLB registers test command, 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-16 lists descriptions used in TLB registers test error messages.

Table D-16. TLB Registers Test Error Descriptions

Error Description	Meaning
(tlblo [<i>N</i>]= <i>actual</i> , sb <i>expected</i>)	Pattern in TLB LO register was not the expected pattern. <i>N</i> represents the number of the register with the incorrect value. The actual and expected values follow.
(tlbhi [<i>N</i>]= <i>actual</i> , sb <i>expected</i>)	Pattern in TLB HI register was not the expected pattern. <i>N</i> represents the number of the register with the incorrect value. The actual and expected values in the register follow.

Memory Module Tests

The following entries explain the commands, parameters, and error messages for each memory module test.

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*] and press Return.

When you type the floating 1/0 memory test, 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

The only floating 1/0 memory test error message is ?TFL: 3/mem/float10 (Err= *N*, which indicates that the floating 1/0 test failed.) The *N* represents the number of errors the memory module reported.

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** [*modules*] [*threshold*] [*pattern*] and press Return.

When you type the memory module test command,

- Use the *modules* 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.
- Replace the optional *pattern* parameter with a specific pattern that you want to use in the test.

Memory module test error messages

There are two types of memory test error messages.

- Parity error messages, which have the form ?TFL:3/mem (PER, cause=xxxxxxx, DBE=yyyyyyyy, Bank *n*, *side* byte)
 - ?TFL 3/mem PER indicates that the memory test reported a parity error.
 - The *cause* parameter is the value in the cause register.
 - The DBE parameter is the value at the data bus error address.
 - The Bank parameter is the slot number of the memory module that reported the error.
 - *side* indicates which module in the pair reported the error. If *side* is D16-31, the problem module is the one farthest from the power supply. If *side* is D0-15, the problem module is the one nearest the power supply.
 - *byte* represents the byte in which the error occurred.

- Compare error messages, which have the 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.

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** and press Return.

The zero memory utility returns no error codes.

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** and press Return.

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.

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** and press Return.

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-17 lists error codes used in partial write test error messages.

Table D-17. 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.

Base System Ethernet Controller Tests

The following entries explain the commands, parameters, and error messages for each individual Ethernet controller test.

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** and press Return.

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-18 lists error codes and descriptions used in collision test error messages.

Table D-18. Collision Test Error Codes and Descriptions

Error Code and Description	Meaning
(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.

Common Diagnostic Utilities

The Ethernet tests use a common set of diagnostic utilities that 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/*test_name*, where *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-19 lists error codes and descriptions used in common diagnostic utility error messages.

Table D-19. 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 initng LANCE)	Utility could not initialize the Ethernet controller chip.
(905: LANCE-stop timeout)	Timeout occurred in the Ethernet controller chip.
(906: err initng LANCE)	I/O system failure occurred during Ethernet controller chip initialization.

Cyclic Redundancy Code (CRC) 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** and press Return.

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.
- *description* represents additional information that describes the failure.

Table D-20 lists error codes and descriptions used in CRC test error messages.

Table D-20. CRC Test Error Codes and Descriptions

Error Code and Description	Meaning
(2: LANCE-init [x])	System could not initialize the Ethernet controller chip. The <i>x</i> 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 <i>x</i> 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 <i>x</i> 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 <i>x</i> 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 <i>x</i> 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 <i>x</i> represents a pass or fail code returned by one of the utilities that the test uses.

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** and press Return.

The display MOP counters utility produces no error messages.

Ethernet-Direct Memory Access (DMA) 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** and press Return.

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-21 lists error codes and descriptions used in Ethernet-DMA registers test error messages.

Table D-21. 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.
(2: 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.

Ethernet-Direct Memory Access (DMA) 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** and press Return.

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-22 lists error codes and descriptions used in Ethernet-DMA transfer test error messages.

Table D-22. Ethernet-DMA Registers Test Error Codes and Descriptions

Error Code and Description	Meaning
(2: LANCE-init [xxxxxxx])	Ethernet controller chip initialization failed. <i>xxxxxxx</i> represents a code that describes the LANCE failure.
(3: xmt [xxxxxxx] sz=yyyy ptrn=AA)	Ethernet controller chip transmission failed. <i>xxxxxxx</i> represents a code that describes the transmission failure. The <i>sz</i> parameter is the packet size. The <i>ptrn</i> parameter is the pattern the test tried to transmit.
(4: rcv [xxxxxxx] sz=yyyy ptrn=AA)	Ethernet controller chip receive operation failed. <i>xxxxxxx</i> represents a code that describes the receive failure. The <i>sz</i> parameter is the packet size. The <i>ptrn</i> 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.

Ethernet Station Address ROM (ESAR) 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** and press Return.

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-23 lists error codes and descriptions used in ESAR test error messages.

Table D-23. ESAR Test Error Codes and Descriptions

Error Code and Description	Meaning
(2: ESAR[0-5] = 0's)	First 6 bytes of the ESAR were all zero.
(3: ESAR[0] = brdcst-sdrs)	ESAR contained broadcast address.
(5: checksum)	ESAR checksum verification failed.
(7: rvrs cpy !=)	Reverse copy mismatch occurred.
(8: frwrdr 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.

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** and press Return.

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-24 lists error codes and descriptions used in external loopback test error messages.

Table D-24. External Loopback Test Error Codes and Descriptions

Error Code and Description	Meaning
(1: (LANCE-init [xxxxxxxx]))	LANCE initialization failed. <i>xxxxxxxx</i> represents a code that describes the LANCE failure.
(3: (xmit [xxxxxxxx, yyyyyyyy] zzzzz))	LANCE initialization failed. <i>xxxxxxxx</i> , <i>yyyyyyyy</i> represents a code that describes the LANCE failure. <i>zzzzz</i> represents a code that describes the likely cause of the failure.
(4: rcv [xxxxxxxx, yyyyyyyy])	System did not receive packet. <i>xxxxxxxx</i> , <i>yyyyyyyy</i> represents a code that describes the receive failure.
(6: pkt-data !=)	Transmitted packet was not received.
(7)	Fatal error occurred.

Interrupt Request (IRQ) 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** and press Return.

IRQ test parameters and error codes

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-25 lists error codes and descriptions used in IRQ test error messages.

Table D-25. IRQ Test Error Codes and Descriptions

Error Code and Description	Meaning
(1: int pndng)	Pending interrupt was invalid.
(2: init LANCE err = <i>x</i>)	Error occurred when the system tried to initialize the Ethernet controller chip.
(4: intr err xmt-stat= <i>x</i>)	System generated no interrupt on packet transmission.

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** and press Return.

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-26 lists the error codes and error descriptions used in internal loopback test error messages.

Table D-26. Internal Loopback Test Error Codes and Descriptions

Error Code and Description	Meaning
(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. <i>xxxxxxxx</i> represents a code that describes the transmission failure.
(3: xmt [xxxxxxxx] sz=yyyy ptrn=zz)	System did not transmit packet. <i>xxxxxxxx</i> represents a code that describes the transmission failure. The <i>sz</i> parameter is the size of the packet. The <i>ptrn</i> parameter is the pattern that was in the packet.
(4: rcv [xxxxxxxx] sz=yyyy ptrn=zz)	System did not receive packet. <i>xxxxxxxx</i> represents a code that describes the failure. The <i>sz</i> parameter is the size of the packet. The <i>ptrn</i> 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.

Multicast Test

The multicast test checks the Ethernet ability to filter multicast packets. To run the multicast test, type **t 3/ni/m-cst** and press Return.

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-27 lists the error codes and descriptions used in multicast test error messages.

Table D-27. Multicast Test Error Codes and Descriptions

Error Code and Description	Meaning
(1: rd ESAR err)	Error occurred reading Ethernet station address ROM.
(2: LANCE-init [xxxxxxx])	System failed to initialize the Ethernet controller chip. <i>xxxxxxx</i> represents a code that describes the initialization failure.
(3: xmt [xxxxxxx])	Ethernet controller failed to send packet. <i>xxxxxxx</i> 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 [xxxxxxx])	Packet receive routine reported an error. <i>xxxxxxx</i> represents a code that describes the receive error.
(7: LANCE-init [xxxxxxx])	Error occurred when the system tried to initialize the Ethernet chip. <i>xxxxxxx</i> represents a code that describes the initialization error.
(8: xmt [xxxxxxx])	Ethernet controller failed to transmit packet. <i>xxxxxxx</i> represents a code that describes the transmission error.
(9: rcv [xxxxxxx])	Ethernet did not receive expected packet. <i>xxxxxxx</i> represents a code that describes the receive error.

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** and press Return.

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-28 lists error codes and descriptions used in promiscuous mode test error messages.

Table D-28. Promiscuous Mode Test Error Codes and Descriptions

Error Code and Description	Meaning
(2: LANCE-init [xxxxxxx])	Ethernet controller initialization failed. <i>xxxxxxx</i> represents a code that describes the initialization failure.
(3: xmt [xxxxxxx])	Packet transmission failed. <i>xxxxxxx</i> represents a code that describes the transmission failure.
(5: rcvd invld adrs)	An inappropriate packet was received in nonpromiscuous mode.
(6: rcv [xxxxxxx])	Packet receive routine failed.
(7: LANCE-init [xxxxxxx])	System failed to initialize Ethernet controller in promiscuous mode. <i>xxxxxxx</i> represents a code that describes the initialization failure.
(8: xmt [xxxxxxx])	Packet transmission failed. <i>xxxxxxx</i> represents a code that describes the transmission failure.
(9: rcv [xxxxxxx])	Ethernet did not receive the expected packet while in promiscuous mode. <i>xxxxxxx</i> represents a code that describes the receive failure.

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** and press Return.

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-29 lists error codes and descriptions used in registers test error messages.

Table D-29. Registers Test Error Codes and Descriptions

Error Code and Description	Meaning
(1: CSR[n]=x - xpctd 0)	Write and read operation to Ethernet CSR[n] failed. The <i>n</i> represents the number of the CSR involved in the failure.
(3: CSR[1]=xxxx - xpctd 0xFFFE)	Writing and reading 0xFFFE failed on CSR 1. <i>xxxx</i> represents the actual value in CSR 1.
(4: CSR[2]=xxxx - xpctd 00FF)	Writing and reading 0x00FF failed on CSR 2. <i>xxxx</i> represents the actual value in CSR 2.
(5: CSR[1]=xxxx - bit lk frm CSR[2])	Bit leak from CSR2 to CSR1 occurred. <i>xxxx</i> represents the actual value in CSR[1].
(6: CSR[2]= xxxx - bit lk frm CSR[1])	Bit leak from CSR1 to CSR2 occurred. <i>xxxx</i> represents the actual value in CSR[2].
(7: immediate write/read flr)	Immediate write and read failure occurred.

Base System SCSI Controller and Drive Tests

The following entries explain the commands, parameters, and error messages for each base system SCSI controller and SCSI drive test.

SCSI Controller Test

The SCSI controller test checks SCSI controller operation. To run the SCSI controller test, type **t 3/scsi/cntl** and press Return.

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-30 lists error descriptions used in SCSI controller test error messages.

Table D-30. SCSI Controller Error Codes and Descriptions

Error Code and Description	Meaning
(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 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 3/scsi/sdiag** *scsi_id* [**d**] [**u**] [**s**] and press Return.

When you type the SCSI send diagnostics command,

- 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-31 lists error codes and descriptions used in SCSI send diagnostics test error messages.

Table D-31. SCSI Send Diagnostics Test Error Descriptions

Error Description	Meaning
(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 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/target scsi_id [w] [l loops]** and press Return.

When you type the SCSI target test command,

- 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 ruin 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-32 lists error codes and descriptions used in SCSI target test error messages.

Table D-32. SCSI Target Test Error Codes and Descriptions

Error Code and Description	Meaning
(1: (dev ol) <i>N</i>)	Test could not bring the device on line. <i>N</i> represents the SCSI ID of the device that could not be brought on line.
(2: (tst nocomp) <i>N</i>)	Command entered from the keyboard aborted the test. <i>N</i> represents the SCSI ID of the device being tested.
(3: (ro dev) <i>N</i>)	Test cannot perform write operation. Device is a read-only device. <i>N</i> represents the SCSI ID of the device specified in the test.
(4: (dev type) <i>N</i>)	Test does not test on the specified device. <i>N</i> represents the SCSI ID of the device specified in the test.
(6: (rdCap) <i>N</i>)	Read capacity command failed. <i>N</i> represents the SCSI ID of the device that could not be brought on line.
(7: (rzWr) <i>N</i>)	Write operation failed. <i>N</i> represents the SCSI ID of the device that failed.
(8: (rzRd) <i>N</i>)	Read operation failed. <i>N</i> represents the SCSI ID of the device that failed.
(9: (cmp) <i>N</i>)	Write and read values did not match. <i>N</i> represents the SCSI ID of the device involved in the miscompare.
(10: (wrFlMrk) <i>N</i>)	Write file mark failed. <i>N</i> represents the SCSI ID of the device being tested.
(11: (tzWr) <i>N</i>)	Write operation failed. <i>N</i> represents the SCSI ID of the device that failed.
(12: (wrFlMrk) <i>N</i>)	Write file mark failed. <i>N</i> represents the SCSI ID of the device being tested.
(13: (spc) <i>N</i>)	Space (-2) operation failed. <i>N</i> represents the SCSI ID of the device involved in the failure.

(continued on next page)

Table D-32 (Cont.). SCSI Target Test Error Codes and Descriptions

Error Code and Description	Meaning
(14: (spc) <i>N</i>)	Space (1) operation failed. <i>N</i> represents the SCSI ID of the device involved in the failure.
(15: (tzRd) <i>N</i>)	Read operation failed. <i>N</i> represents the SCSI ID of the device being tested.
(11: (cmp) <i>N</i>)	Write and read values did not match. <i>N</i> represents the SCSI ID of the device involved in the miscompare.

Power-Up LED Displays

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 LEDs display a code that indicates where in the power-up sequence the system halted.

Table D-33 lists the hexadecimal equivalent of the power-up LED displays and what they indicate about the power-up sequence.

Table D-33. Power-Up LED Displays

LED Display	Meaning
ff	Hardware initialization has not started.
3f	Firmware initialization started. First memory module test started.
3e	Firmware initialization started. Calibration of millisecond delay loop begun.
3d	Firmware initialization started. Power-up versus reset code has started to run.
3b	Console terminal initialization started.
37	Firmware began to calculate the cache size.
36	Firmware began memory tests.
35	Firmware initialized I/O ASIC to a known state.
xb	Module initialization started. The <i>x</i> represents the slot number of the base system or option module being initialized.
x3	An option module reported an error during the power-up self-test. The <i>x</i> represents the slot number of the option module.
x2	Firmware in an individual module started to execute. The <i>x</i> represents the slot number of the module with the firmware that has started to execute.
x1	System software loaded from an individual module started to execute. The <i>x</i> represents the slot number of the module with the software that has started to execute.
00	The system detected no errors during the power-up sequence.

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 registers for the R3000: R3000A CPU registers and Model 100 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 Model 100 system registers.

CPU Registers - R3000 CPU Module

Table E-1 lists the R3000A 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 R3000A register information in one of two formats.

The first format is as follows:

```
?TFL #/test-name (CUX, cause= xxxxxxxx) [KN02-BA]
?TFL #/test-name (UEX, cause= xxxxxxxx) [KN02-BA]
```

where

= Slot number of the option being tested
test-name = Test being run
cause = Cause register

The second format is as follows:

```
? 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

Refer to Chapter 4 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:

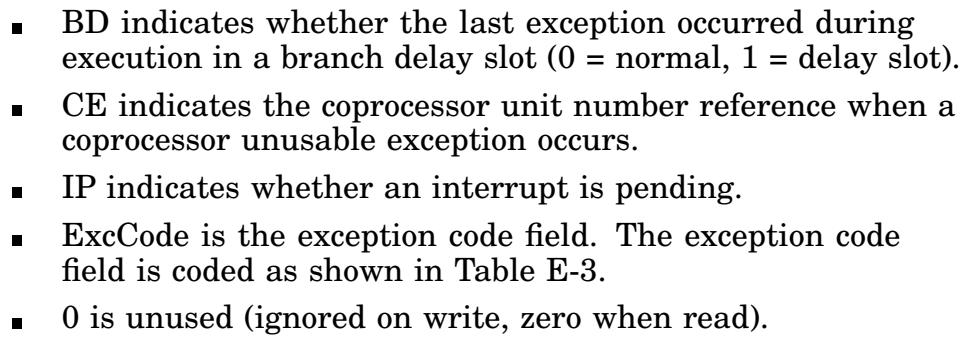


Table E-3. Exception Codes

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.

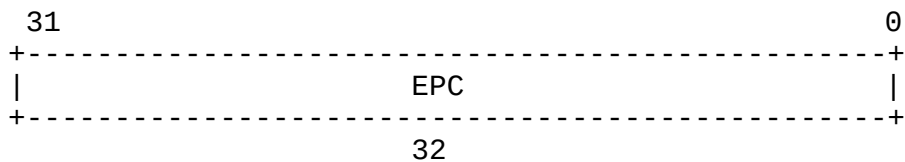
Table E-4. Exception Codes R4000

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) (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:

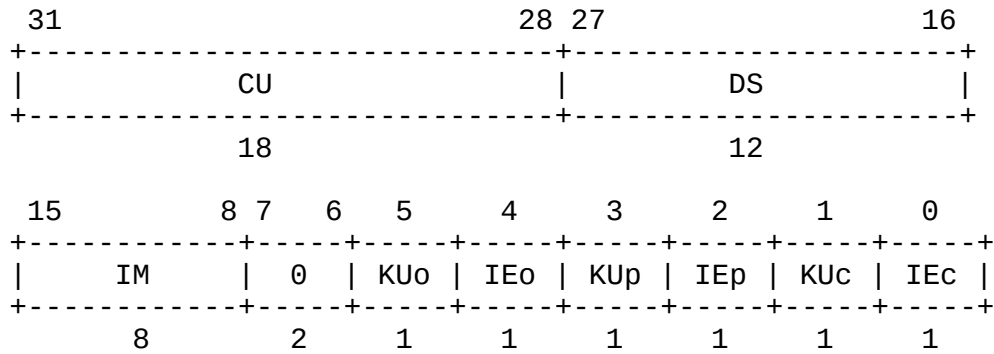


EPC is the exception program counter.

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:



- 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. See the “Diagnostic status” on page E-7 for a detailed description of the DS field.
- 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 (R3000 Only)” on page E-3.

- 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

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 zero 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 SwC bit controls the switching of control signals for instructions and data caches associated with the processor. When the bit is changed, cache control signals are altered so that instruction and data caches are effectively interchanged. The processor must be executing from an uncached region and must not be executing loads or stores near the time of cache switching.

The IsC bit, when set, effectively isolates the cache currently being used as the data cache from the rest of the memory system, making cache diagnostics possible. The selection of the data cache depends on the state of the SwC bit. When

the IsC bit is set, store operations affect only the cache (main memory writes are inhibited), and load operations return the data at the addressed location in the cache, whether a cache miss occurs (main memory reads are inhibited). Uncached data references are not generally useful with IsC set. Uncached store operations affect neither the cache nor the main memory system, and uncached load operations return the data at the addressed location in the cache. IsC affects only data reference; instruction fetches are not affected. This bit can also be used by operating system code to flush caches without causing associated main memory accesses.

The PZ bit, when set, causes zero to replace the normal outgoing parity bits that are generated on a store instruction, covering both cache data and tags. This permits the writing of incorrect parity bits in the caches and the checking of each parity tree individually within the cache diagnostics.

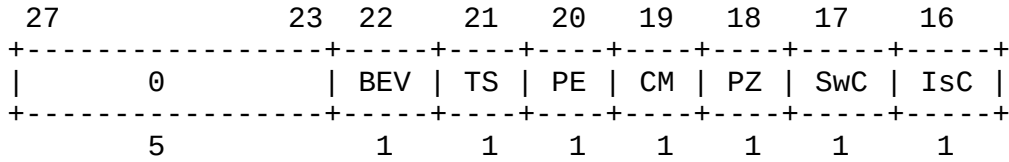
The CM bit, when the cache is isolated, indicates whether the most recent data cache load resulted in a cache miss. This bit is used by cache test programs to verify the proper functioning of the cache tag and parity bits.

The PE bit indicates whether a cache parity error occurred. It is set on a cache parity error and reset by writing 1 to this bit. Writing a zero to this bit does not affect its value. This bit is used to log cache parity errors in software; otherwise, recovery from them is completely transparent. Within cache diagnostics, the PE bit is used to verify proper functioning of the cache parity bits and the cache parity trees.

The TS bit is read only and indicates that the TLB has shut down due to attempts to access several entries in the TLB simultaneously. This mechanism protects the TLB from hardware failures in the event of catastrophic software misuse of the TLB. When the TLB is in this state, all translations and PROBE accesses are inhibited and have undefined effects. This state can be cleared only by a reset operation.

The bootstrap exception vectors (BEV) bit, when set, relocates the UTLB miss exception vector to an address of 0xbfc00100 and the general exception vector to 0xbfc00180 (general), respectively.

The format of the diagnostic status field is

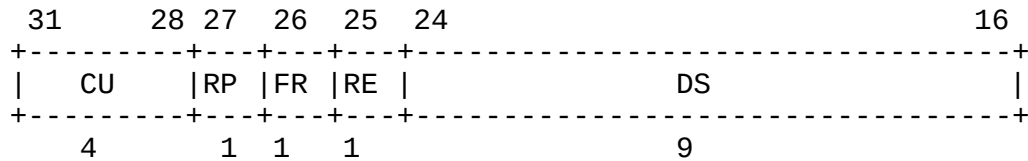


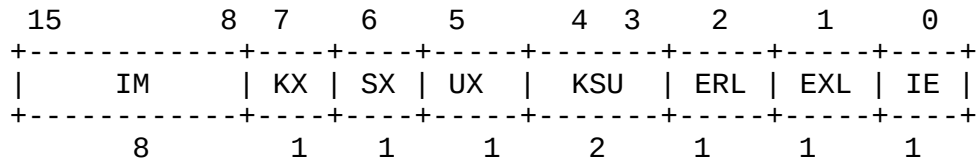
- BEV controls the location of UTLB miss and general exception vectors (0 = normal, 1 = bootstrap).
- TS indicates that TLB shut down occurred.
- PE indicates that a cache parity error occurred. This bit can be cleared by writing 1 to this bit position.
- CM indicates whether a data cache miss occurred 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:





- 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)
- The (IE) Interrupt Enable (0-disable, 1-enable)

Diagnostic Status Field The Diagnostic Status field has the following format:

[illegible]

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

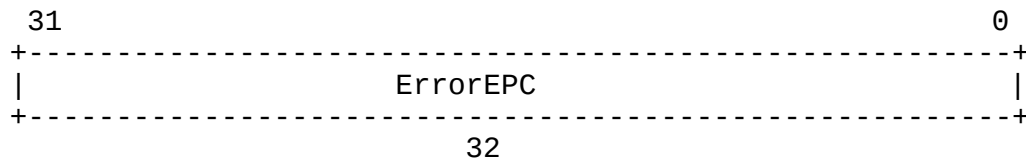
- BadVAddr is the bad virtual address.

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:

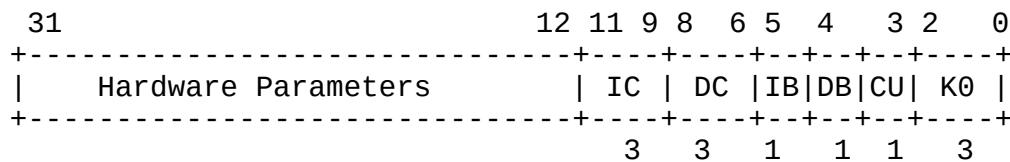
- the virtual address of the instruction that caused the exception, or
- the virtual address of the immediately preceding branch or jump instruction when that address is in a branch delay slot.

There is no branch delay slot indication for the ErrorEPC register. The ErrorEPC register has the following format.



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:



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)

Model 100 System Registers

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 Model 100 system registers.

Table E-7. Model 100 System Registers

Register	Console Address	Description
SSR	0xBC040100	System support register
SIR	0xBC040110	System interrupt register
Mask	0xBC040120	System interrupt mask register
MER	0xAC400000	Memory error register
MSR	0xAC800000	Memory size register
EAR	0xAE000004	Error address register

Use the `e` command to examine the contents of a Model 100 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 SSR can be both read from and written to. Bits <31:16> are used inside the I/O control ASIC. Bits <15:0> generate signals visible outside the I/O control ASIC.

Table E-8. System Support Register 0x1C040100

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

These 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.

<7:0> LEDS

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 Table 4-1 in Chapter 4 and Table D-33 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 interrupt 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 0x1C040110

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
14	R	NVR mode jumper
13	R	Reserved
12	R	CPU I/O-write timeout interrupt
11	R	Reserved
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

(continued on next page)

Table E-10 (Cont.). System Interrupt Register 0x1C040110

Bits	Access	Description
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>

This bit is reserved.

SIR<12> processor I/O write timeout

This interrupt is generated by the processor when an I/O write fails to respond within the timeout period. The error address should be logged in the error address register in the processor. See the processor specifications for more information.

SIR<11>

This bit is reserved.

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 0x1C040120

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 set to 1 those interrupts that it wants enabled.

Memory Error Register (MER)

The memory error register stores error information so that a bad memory card can be identified and replaced. Byte masks on writes to this register have no effect. The entire register is always written as a word. This register is visible in memory space and differs from all other system registers in one respect. It is read from and written to via DMA accesses rather than I/O accesses. Options using the DMA feature of the TURBOchannel can read the MER and obtain some error information.

Table E-12. Memory Error Register 0x0C400000

Bits	Access	Description
31:17		Reserved
16	R/W	Page boundary error
15	R/W	Transfer length error
14	R/W	PARDIS memory error disable
13:12		Reserved
11:8	R/W	Last byte error
7:0		Reserved

MER<31:17>

These bits are reserved.

MER<16>

This bit is set when any memory access crosses a 2-Kbyte boundary.

MER<15>

This bit is set when any memory access exceeds 128 words in length.

MER<14>

PARDIS disables parity errors when written to 1. This register disables loading of MER<11:8>.

MER<13:12>

These bits are reserved.

MER<11:8>

This field indicates which byte or bytes had a parity error during a memory read. When set to 1, MER<11> indicates that memory data byte <31:24> is in error, MER<10> corresponds to memory data byte <23:16>, and so on. These bits is set on any memory access where an error occurred and remain set until they are cleared by writing them to 0. MER<14> disables loading this register via memory error.

MER<7:0>

These bits are reserved.

Memory Size Register (MSR)

The memory size register programs the size of memory used.

Table E-13. Memory Size Register 0x0C800000

Bits	Access	Description
31:14	R/W	Reserved
13		Size
12:0		Reserved

MSR<31:14>

These bits are reserved.

MSR<13>

SIZE is set to 0 when it is reset causing the use of 4-Mbyte banks. If SIZE is set to 1 the memory can use 16-Mbyte banks. Different-sized memory SIMMs, when mixed in a system do not provide optimal storage space.

MSR<12:0>

These bits are reserved.

Error Address Register (EAR)

Table E-14. Error Address Register

Register	Console Address	Description
EAR	0xAE000004	Error address register

<28:2>

The EAR contains address bits <28:2>, used to access memory at the time of a timeout or a memory parity error. Addresses stored in the EAR remain there until the next error condition is detected and a new address is stored. The EAR should be accessed in response to a timeout interrupt or a buserror trap.

<1:0>

Bits are reserved.

<31:29>

Bits are reserved.

Index

A

Alternate terminal, 2-3 to 2-5
Antistatic kit, 2-2

B

Booting software, 2-18

C

Cache tests, D-22 to D-32
Collision test, D-40
Communication connectors, 1-6
Communications line adapter
 removing and installing, 2-11
Communications line controller, 5-2
Communications loopback connector
 removing and installing, 2-8
Connectors
 system unit, 1-6 to 1-7
Console command
 key combinations, C-2
 passwords, 2-15 to 2-17
 using, C-1 to C-3
Console mode, 2-13 to 2-14
Console prompt (>>), 2-13
Control key combinations, C-2
Controls and indicators
 system unit, 1-5

CPU registers R3000A Only
 Cause, E-3
Cyclic Redundancy Code (CRC) Detect
 test, D-43
Cyclic Redundancy Code (CRC) test,
 D-42

D

Daughter Card LED's
 FRU failure, 4-50
Diagnostic LEDs
 in power-up self-tests, 3-4
 system unit, 1-5
Diagnostic ROM, 5-2
Drives, 1-9

E

equipment specifications
 RZ24L hard disk drive, A-27
 RZ26 hard disk drive, A-31
Equipment specifications
 BA42 storage expansion box, A-24
 DECstation 5000 Model 100 Series,
 A-2
 LK401-AA keyboard, A-18 to A-19
 RRD40 optical compact disc drive,
 A-41
 RRD42 optical compact disc drive,
 A-42

Equipment specifications (cont'd)

- RX23 diskette drive, A-43 to A-44
- RX33 diskette drive, A-45 to A-46
- RZ23L hard disk drive, A-25 to A-26
- RZ25 hard disk drive, A-29 to A-30
- TK50Z tape drive, A-33 to A-34
- TLZ04 cassette tape drive, A-39
- TLZ06 cassette tape drive, A-40
- TZ30 tape drive, A-35 to A-36
- TZK10 QIC tape drive, A-37 to A-38
- VR262 monitor, A-3 to A-5
- VR297 monitor, A-6 to A-7
- VR319-C4 monitor, A-8 to A-10
- VR319-CA monitor, A-8 to A-10
- VR319-D4 monitor, A-11 to A-13
- VR319-DA monitor, A-11 to A-13
- VRT16-D4 monitor, A-14 to A-15
- VRT16-DA monitor, A-14 to A-15
- VRT19-D4 monitor, A-16 to A-17
- VRT19-DA monitor, A-16 to A-17
- VSXXX-AB tablet, A-22 to A-23
- VSXXX-GA mouse, A-20 to A-21

Error codes

- FRU failure, 4-16

Error logs

- code numbers, 3-12
- error and status register, 3-10
- examining, 3-10 to 3-12
- format, 3-10
- FRU failure, 4-44, 4-47
- hardware addresses, 3-21
- memory, 3-10

Error messages

- interpreting, 3-9 to 3-10

ESAR chip, 5-4

- removing and installing, 5-8

Ethernet connector, 1-6

Ethernet controller

- tests, D-40 to D-48

External loopback test, D-49

F

FPU test, D-32 to D-33

FRU (Field Replacement Unit)

- identifying failure, 4-1

H

Hardware

- basic configuration, 1-7
- options, 1-2, 1-8

I

Individual tests, 3-5 to 3-7, D-2 to D-4

Internal Loopback test, D-51

Interrupt Request test, D-50

K

Keyboard-mouse connector, 1-6

L

Loopback connectors and terminators

- removing and installing, 2-6 to 2-11

Loopback test

- external, D-49
- internal or external, D-51 to D-52

M

Memory module, 5-15

- address ranges, 5-19, 5-20
- expansion slots, 1-8
- removing and installing, 5-21
- tests, D-36 to D-39
- troubleshooting, 4-24

Memory modules

- information in cnfg displays, C-14

Modem

- troubleshooting, 4-44

Module options

- removing and installing, 5-33

Monitors, 1-10

Monitor-system unit connector, 1-6

Multicast test, D-52 to D-53

N

Nonvolatile RAM test, D-6

NVR jumper

removing and installing, 2-16 to 2-17

O

On/off switch

system unit, 1-5

Operating mode, 2-13 to 2-14

Option module

connectors, 1-5

expansion slots, 1-8, 5-2

Options, 1-8

Overheat Detect test, D-6

P

Partial Write test, D-39

Part numbers

cords, cables, and connectors, B-6

hardware, B-8

hardware documentation, B-9

internal drives, B-3

loopback connectors, B-7

major FRUs, B-2

software documentation, B-9

TURBOchannel option modules, B-4

passwd command, 2-15 to 2-16

Power connector

system unit, 1-5

Power indicator light

system unit, 1-5

Power supply

description, 5-26

removing and installing, 5-28, 5-29

Power-up self-tests, 3-4

Printer

troubleshooting, 4-44

Promiscuous Mode test, D-54

Q

Quick test script, 3-4

R

RAM

board test, D-36

select lines test, D-38

Real-time tests, D-8

Registers test, D-56

Reset button

system unit, 1-5

S

SCSI

connector, 1-6

SCSI chain terminator

removing and installing, 2-9

SCSI controller, 5-2

options, 1-9

tests, D-58 to D-62

SCSI send diagnostics test, 4-29 to D-60

Slot number

test commands, 3-6

Software

booting, 2-18

Boot ROM switches, 2-18

shutting down, 2-20

troubleshooting, 2-18

Static-sensitive materials, 2-2

System module

diagram, 1-4

hardware, 5-2

power connectors, 5-2

removing and installing, 5-3 to 5-8

tests, D-5 to D-21

System unit, 1-3 to 1-4

connectors, 1-6 to 1-8

controls and indicators, 1-5

System unit cover
removing and installing, 2-5 to 2-6

T

Tests
individual tests, 3-5 to 3-7, D-2 to D-4
interpreting error messages, 3-9 to 3-10
power-up self-test, 3-2
subtests, 3-2, 3-5 to 3-9
system module, D-5 to D-21
Test scripts, 3-2, 3-6 to 3-9

ThickWire Ethernet loopback connector
removing and installing, 2-7

ThinWire Ethernet controller, 5-2

Troubleshooting

FRU failure, 4-2
memory modules, 4-24 to 5-22
software, 2-18
tests used for, 3-2
t *slot/?* command, 3-6

Z

Zero Memory Utility, D-38