DECsystem 5100

digital

Maintenance Guide

Order Number: EK–422AA–MG.001

DECsystem 5100

Maintenance Guide

EK-422AA-MG.001

August 1990

This guide describes how to troubleshoot, adjust, and repair DECsystem 5100 systems to field replaceable unit (FRU) level.

Revision/Update Information: This is a new guide.

digital equipment corporation
maynard, massachusetts

August 1990

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This document was prepared using VAX DOCUMENT, Version 1.2.

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Preface

Purpose of This Guide

This document describes how to isolate hardware failures that occur during the operation of the DECsystem 5100. It contains procedures for running diagnostic self-tests and replacing field replaceable units (FRUs).

Who Should Read This Guide

This guide is intended for Digital Customer Service personnel who provide support and maintenance for the DECsystem 5100 hardware, or customers who have a self-maintenance agreement with Digital.

Readers of this guide should have experience of replacing hardware components.

Document Structure

This guide contains the following chapters and appendixes.

Section	Title	Description
Chapter 1	General Maintenance	This chapter describes how to shut down the operating system, run and interpret the power-up self-test, use the console menu, and reboot the system.
Chapter 2	Extended Self-Test Diagnostics	This chapter explains how to run and interpret the DECsystem 5100 extended self-tests.
Chapter 3	FRU Removal and Replacement	This chapter contains instructions on replacing FRUs that diagnostic tests have indicated are faulty.
Appendix A	Console Commands	This appendix describes the console commands that you can enter when the system is in console mode.
Appendix B	System Specifications	This appendix lists the system specifications.
Appendix C	Recommended Spares List	This appendix lists the recommended spare parts for the DECsystem 5100.
Appendix D	Status LED Display	This appendix describes how to interpret the status LED display on the back of the system unit.
Appendix E	Parameters Returned by Diagnostic Tests	This appendix describes the significance of the parameters that certain diagnostic tests use.

Associated Documents

The following documents provide additional hardware information about the DECsystem 5100:

- *DECsystem 5100 Installation Guide, EK-420AA-IN.001*
- *DECsystem 5100 Operator's Guide, EK-421AA-OG.001*
- *DECsystem 5100 Illustrated Parts Breakdown, EK-5100X-IP.001*

Conventions

The following conventions are used in this document.

Convention	Description
`MONOSPACE`	Text displayed on the screen is shown in monospaced type.
[ ]	In command syntax descriptions, brackets [ ] indicate optional elements.
|	In command syntax descriptions, a vertical line | separates similar options, one of which you can choose.
blue-green ink	Blue-green ink in interactive examples indicates information that you must enter from the keyboard.
italic type	Italic type emphasizes important information, indicates variables, and references titles of other manuals.
Ctrl/C	A sequence such as Ctrl/C indicates that you hold down the Ctrl key while you press another key (indicated here by C).
Note	A note contains information of special importance to the reader.
Caution	A caution contains information to prevent damage to the equipment.
Warning	A warning contains information to prevent personal injury.

1
General Maintenance

1.1 System Overview

The DECsystem 5100 is a multiuser ULTRIX desktop system based on Reduced Instruction Set Computer (RISC) technology. The system supports VT series terminals.

Some DECsystem 5100 systems are supplied with factory installed software (FIS), which means that the ULTRIX operating system is preloaded onto the system disk at the factory. For other DECsystem 5100 systems, the owner must install the operating system software.

1.1.1 System Module

The system module provides most of the functionality of the system. It provides external connections for the following:

- Three DEC423 compatible asynchronous lines (MMJ connectors)
- One RS232 modem port
- Ethernet connection—ThinWire or Standard Ethernet, but not both simultaneously

The system module also provides eight connectors for MS44 memory modules. These eight connectors are arranged in four banks. To fill a bank of memory, you must install two MS44 memory modules. There are two different types of MS44 memory modules as follows:

- MS44-AA—4MB
- MS44-CA—16MB

The minimum memory possible in the system is 8MB. You can add memory in 8MB (MS44-BA) and 32MB (MS44-DA) increments to a maximum of 128MB.

A switch on the system module and a password in nonvolatile memory provide a security system that allows only privileged users (those who know the password) to access the full range of console commands.

On the system module, there is also a status LED display. This provides system status and diagnostic test status information.

The system module supports a programmable halt/reset button. In console mode, the switch is reset. Press the switch to invoke the power-up diagnostic tests. You can program the switch to halt the operating system and enter console mode.

1.1.2 Internal Storage Devices

The DECsystem 5100 can house mass storage devices internally. The devices are mounted on two drive mounting panels in the system unit. A DECsystem 5100 may contain any of the following devices internally:

- RZ23 disk drive
- RZ24 disk drive
- TZ30 tape drive
- RX23 diskette drive

1.1.3 External Storage Expansion Boxes

DECsystem 5100 systems also have a small computer system interface (SCSI) connector that allows you to connect external mass storage expansion boxes. The maximum number of expansion boxes that you can connect is two.

1.1.4 Optional Communications Module

The DECsystem 5100 supports the DHT80 asynchronous module option. It provides external connections for the following:

- Seven DEC423 compatible asynchronous lines (MMJ connectors)
- One RS232 modem connector

1.2 Maintenance Overview

The remainder of this chapter describes the following general maintenance procedures:

- Visually checking the equipment
- Shutting down the operating system software
- Running the power-up self-tests
- Interpreting the power-up self-tests
- Monitoring the status LED display
- Interpreting the status LED display
- Using the console menu
- Booting the operating system software after running diagnostics

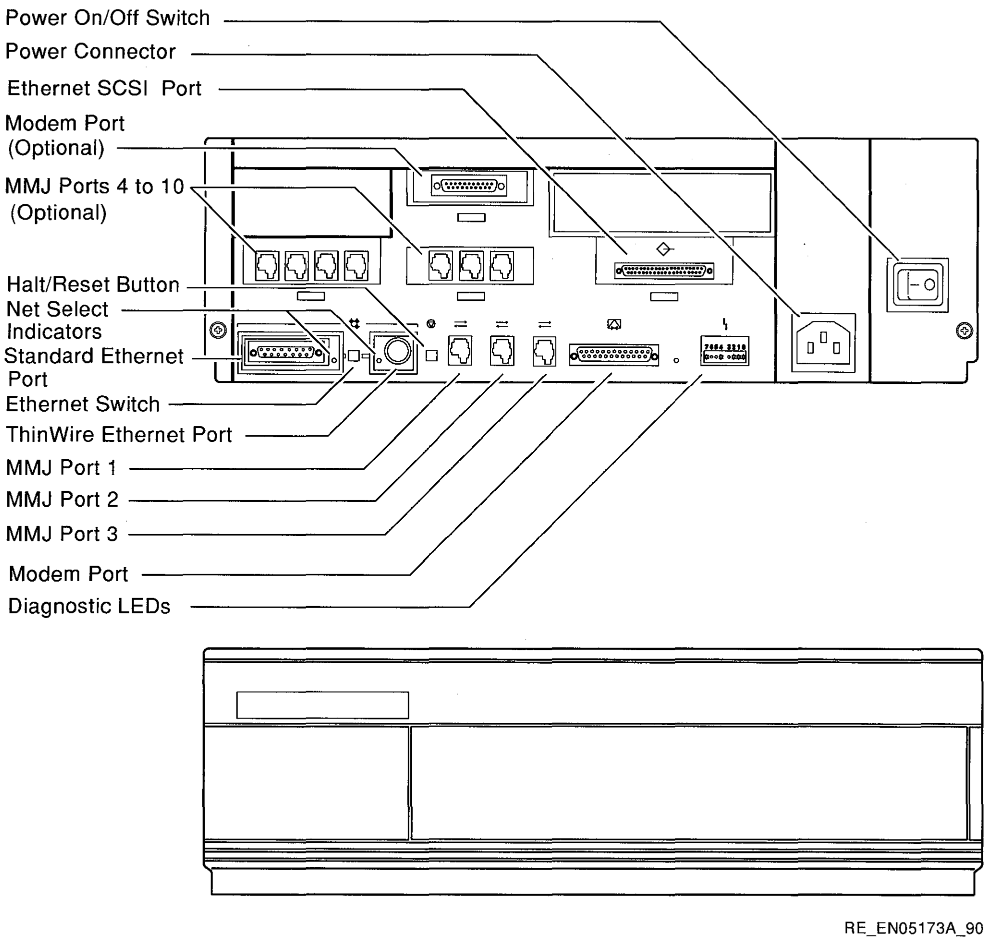
1.3 Performing Visual Checks

Examine all external connections, cables, power cords, and monitor the operation of the system. Table 1–1 describes common problems that you may encounter with the system. Figure 1–1 shows the locations of the various connectors, switches, and indicators on the system unit.

Table 1–1 Visual Check Problems

Problem	Cause	Action
The power indicator LED is off and the fans are off.	Power cord is not connected properly.	Make sure that there is power at the power outlet. Reconnect the power cord.
	The power supply assembly is not functioning.	Replace the power supply (see Chapter 3).
The fans start up but the LED is off.	Power supply assembly is not functioning.	Check internal power cabling and connections. Replace the power supply (see Chapter 3).

Figure 1–1 Connectors, Switches, and Indicators



1.4 Shutting Down the Operating System Software

Before you can run diagnostic self-tests, you must shut down the operating system software. If the operating system software is not running, go to Section 1.5.

Before shutting down the operating system, obtain permission from the system manager. To shut down the operating system software, log in to the ULTRIX field account or an account that has superuser privileges. Table 1–2 shows the commands that you can enter at the system prompt (#) to shut down the system.

Table 1–2 Shutdown Commands

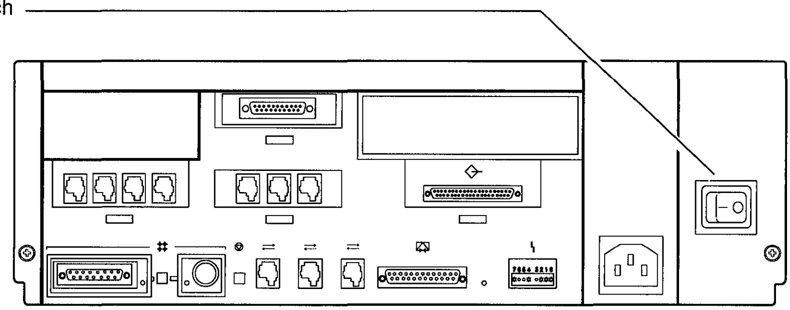
Command	Result
/etc/shutdown -h now	This command immediately starts the operating system software shutdown procedure, without issuing warning messages.
/etc/shutdown -h hhmm	This command shuts down the operating system software at a specified time. In this table, hh indicates hours, mm indicates minutes. The system sends warning messages to all users on the Local Area Network (LAN) indicating shutdown time.
/etc/shutdown -h +n	This command shuts down the operating system software after a specified number of minutes. In this table, n indicates the number of minutes after which the operating system software shuts down. The system sends warning messages to all users on the LAN at an increasing frequency.

1.5 Running the Power-Up Self-Test

The power-up self-test checks each component, subsystem, and connection. If the environment variable *bootmode* (see Table A–1) is set to a value other than d, the DECsystem 5100 runs the power-up self-test when you turn on the system.

To turn on the system, push the on/off switch on the system unit to the on (I) position. Figure 1–2 shows the location of the system unit on/off switch.

Figure 1–2 Location of On/Off Switch



If the environment variable *bootmode* is set to any value other than d, then the system begins to build a power-up self-test display on the console terminal. Example 1–1 shows the power-up self-test display when it completes successfully.

Example 1–1 Successful Power-Up Self-Test Display

```
26..25..24..23..22..21..20..19..18..17..16..15..14..14..14..
13..12..11..10..9..8..7..6..5..4..3..❶

KN230 Vx.x           ❷
08-00-2b-55-55-55    ❸
0x1000000            ❹
>>                   ❺
```

❶ These numbers represent tests or groups of tests on specific system functions.

❷ The version of the system module console program. The character V indicates the version type of the system firmware. The digits x.x indicate the release number.

❸ The Ethernet address of the system.

❹ The size of memory in hexadecimal format. Table 1–3 shows the possible values for the various memory configurations.

Table 1–3 Memory Size Indication

Hexadecimal Value	Memory Size
0x800000	8MB
0x1000000	16MB
0x1800000	24MB
0x2000000	32MB
0x2800000	40MB
0x3000000	48MB
0x3800000	56MB
0x4000000	64MB
0x4800000	72MB
0x5000000	80MB
0x6000000	96MB
0x6800000	104MB
0x8000000	128MB

❺ The console prompt. This prompt may also be S> if security is enabled and a valid password exists (see Section 1.7.1)

You may see a display similar to that shown in Example 1–2 if the system detects memory errors.

Example 1–2 Power-Up Self-Test Display with Memory Error

```
26..25..24..23..22..21..20..19..18..17..16..15..14..14..14..
13..12..11..10..9..8..7..6..5..4..3..

KN230 Vx.x
08-00-2b-55-55-55
0x1000000
Bad mem: 0x1400    ❶
>>
```

❶ A message to indicate that some bad memory exists but you can use the system.

1.5.1 Unsuccessful Power-Up Self-Test

If during the power-up self-test, one of the individual tests fails, the system halts and displays an error report summary. Example 1–3 shows a typical error report summary resulting from the failure of test group 21. An error report summary contains five lines of diagnostic information. See Section 2.5.1 for more information on error reports.

Example 1–3 Unsuccessful Power-Up Self-Test Example

```
26..25..24..23..22..21.. ❶
?1f 03 ff 0001 ❷

P1= 00000000 P2= 00000000 P3= 00000000 P4= 00000000 P5= 00000000 ❷
P6= 00000000 P7= 00000000 P8= 00000000 P9= 00000000 P10=00000000 ❷
gp= 17bcbcfc sp= a000f7b0 fp=bfc00480  sr= 00000000 ❷
epc=bfc20a70 badvaddr=00060000 cause=3000000        ❷

20..19..18..17..16..15..14..14..14.. ❸
13..12..11..10..9..8..7..6..5..4..3..

>> ❹
```

❶ Power-up self-test in progress

❷ Five line error report summary on the failing test, test 1f (see Section 2.5.1)

❸ Power-up self-test continuing after error

❹ Console prompt, optionally S>, if security is enabled and a valid password exists (see Section 1.7.1)

Note the number of the test that failed. It is the number after the ? in the error report summary (test 1f in Example 1–3).

If the power-up self-test display is not displayed on the console terminal, you can use the status LED display to determine the probable cause of the problem (see Section 1.6).

1.5.2 Interpreting Power-Up Self-Test Results

This section describes how to interpret the power-up self-test results.

If an error occurs during the power-up self-test, proceed as follows:

1. Make sure that all external cables and power cords are properly connected.
2. Make sure that the Ethernet cable is properly connected.

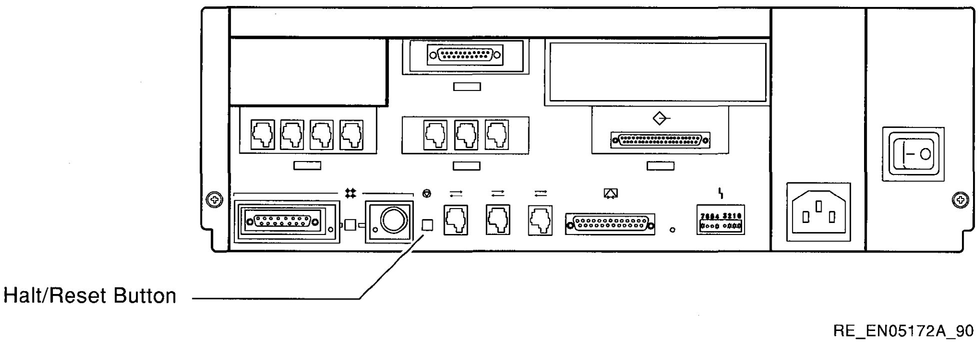
Note *If you want to run external loopback tests on the serial ports, you must install loopback connectors on the ports you want to test (see Section 2.6.5).*

If you locate and correct an external problem, you can run the power-up self-test again, using one of the following methods:

- Press the halt/reset button on the back of the system unit (see Figure 1–3).
- Enter the following command at the console prompt:

```
>> test 0x0
```

Figure 1–3 Location of Halt/Reset Button



If you cannot locate an external problem, compare the code of the test that failed during the power-up self-test with the codes in Table 1–4, and note the entry under the column heading Most Likely Failing Component.

Table 1–4 Interpreting Test Results

Test Group	Test Group Name	Most Likely Failing Component
25	Exception Test	System Module
24	FPU Test	System Module
23	Write Buffer Test	System Module
22	Data Cache Tests	System Module
21	Instruction Cache Tests	System Module
20	TLB Test	System Module
19	Data Cache Tests	System Module
18	Instruction Cache Tests	System Module
17	Data Cache Test	System Module
16	Instruction Cache Test	System Module
15	Memory Bitmap Placing Test	MS44 Memory Modules [1] or System Module
14	Memory Address Test	MS44 Memory Module [1] or System Module
13	Memory Data Test	MS44 Memory Module [1] or System Module
12	Memory Moving Inversions Test	MS44 Memory Module [1] or System Module
11	Memory Data Shorts Test	MS44 Memory Module [1]
10	RTC Test	System Module
9	DZ Test	System Module or DHT80 Asynchronous Module[2]
8	SCSI Test	System Module or SCSI device [3]
7	LANCE Test	System Module
6	EEPROM Test	System Module

[1]See the test description in Chapter 2 for instructions on how to identify which MS44 memory module is faulty.

[2]Depends on which serial line fails. See the test description in Chapter 2 to identify which serial lines belong to which module.

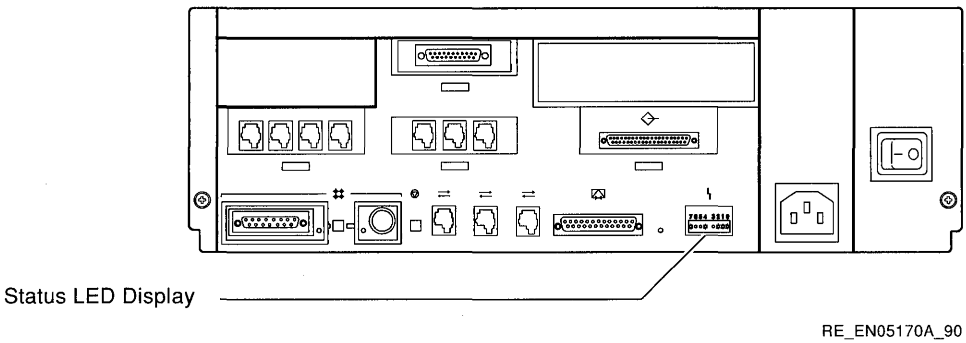
[3]Run the test when the SCSI cable is disconnected from the system module. If the test passes, the fault is in the cable or one of the SCSI devices. If the test fails, the fault is on the system module.

1.6 Monitoring the Status LED Display

If the environment variable *bootmode* is set to a value other than d (see Table A–1), and if the console terminal does not show the power-up self-test display, you can use the status LED display to determine the cause of the problem and determine if the system is able to run diagnostic tests.

The status LED display contains eight LEDs. Appendix D describes the functions of all the LEDs in the status LED display. This section describes the five LEDs that provide power-up and extended self-test information. Figure 1–4 shows the location of the status LED display on the back of the system unit.

Figure 1–4 Location of Status LED Display



During the power-up self-test, or when running extended self-test diagnostics (see Chapter 2), LEDs 7, 6, 5, 4, and 2 on the status LED display show a binary code. If the system detects an error, it halts and displays a code indicating the number of the test that failed.

1.6.1 Interpreting the Status LED Display

Compare the code that you noted on LEDs 7, 6, 5, 4, and 2 on the status LED display during the power-up self-test with the list of codes in Table 1–5 to get an indication of the system component that failed.

Table 1–5 LED Power-Up Self-Test Display Codes

LED Display[1] 2	7654	Decimal Value	Hexadecimal Value	Component Tested
1	1111	31	1F	Initial state at power-up, no code has executed
1	1110	30	1E	Entered ROM, some instructions have executed
1	1101	29	1D	Stack tested and set
1	1100	28	1C	NXM taken
1	1011	27	1B	Security initialization
1	1010	26	1A	DZ initialization
1	1001	25	19	Exception test
1	1000	24	18	FPU test
1	0111	23	17	Write buffer test
1	0101	22	16	Data cache tag test
1	0110	21	15	Instruction cache tag test
1	0100	20	14	TLB test
1	0011	19	13	Data cache test
1	0010	18	12	Instruction cache test
1	0001	17	11	Data cache i-stream test
1	0000	16	10	Instruction cache i-stream test
0	1111	15	0F	Memory bitmap placing test
0	1110	14	0E	Memory address test
0	1101	13	0D	Memory data test
0	1100	12	0C	Memory moving inversions test
0	1011	11	0B	Memory data shorts test
0	1010	10	0A	RTC test
0	1001	9	09	DZ test
0	1000	8	08	SCSI test
0	0111	7	07	LANCE test
0	0110	6	06	EEPROM test
0	0101	5	05	Option card test

[1] 1 = LED is on, 0 = LED is off

(continued on next page)

Table 1–5 (Cont.) LED Power-Up Self-Test Display Codes

LED Display[1] 2	7654	Decimal Value	Hexadecimal Value	Component Tested
0	0100	4	04	Reserved
0	0011	3	03	Console I/O mode
0	0010	2	02	Primary bootstrap
0	0001	1	01	Secondary bootstrap
0	0000	0	00	Operating system running

[1]1 = LED is on, 0 = LED is off

1.7 Using the System in Console Mode

You can enter commands at the console prompt (>>) to view and control the operation of the system. There are specific commands that allow you to set operator preferences and run diagnostic tests.

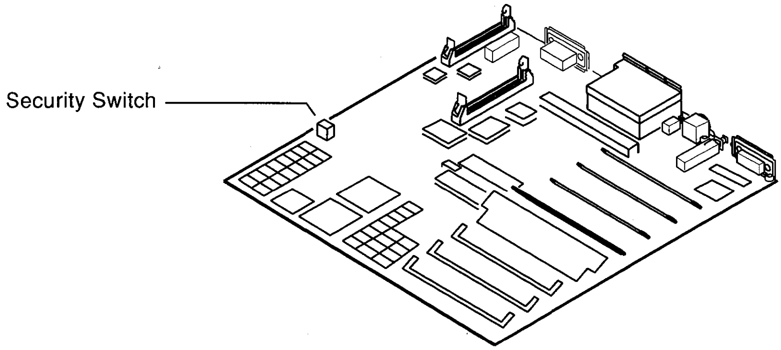
1.7.1 System Security and Operator Privileges

A switch on the system module (see Figure 1–5) and a password in nonvolatile memory provide a security system that prevents unauthorized users from entering console commands that could damage the system. The system is shipped with the security switch in the secure (up) position and the password is not set.

If the system owner forgets the password or if the password becomes corrupted, the Customer Service engineer can override the system security as follows:

1. Set the system on/off switch to the off (O) position.
2. Disassemble the system (see Chapter 3) to enable access to the security switch (see Figure 1–5) on the system module.

Figure 1–5 Location of Security Switch



3 Set the security switch on the system module to the down (insecure) position.

4 Set the system on/off switch to the on (I) position. This clears the owner's password.

5 Set the system on/off switch to the off (O) position.

6 Reset the security switch on the system module to the up (secure) position.

7 Set the system on/off switch to the on (I) position. This allows the owner to enter a new password (see Section 1.7.3).

1.7.2 Console Modes of Operation

The security system provides three console modes of operation as follows:

- Console mode

  When you use the system for the first time or when you reset the password, using the security switch on the system module, the system is in console mode. The system accepts all console commands from all users.

  The console prompt in console mode is displayed as follows:

  >>

- Unprivileged console mode

After you set a security password, the system is in unprivileged console mode. The system accepts only commands that cannot damage the system. You can use only the following commands without arguments or options:

```
S> passwd
```

or

```
S> boot
```

The console prompt in unprivileged console mode is displayed as follows:

```
S>
```

- Privileged console mode

  If you know the security password, you can use the system in privileged console mode after entering that password. In privileged console mode, the system accepts all the console commands.

  The console prompt in privileged console mode is displayed as follows:

  ```
  >>
  ```

1.7.3 Putting the System in Unprivileged Console Mode

The following procedure describes how to set the security password, putting the system in unprivileged console mode:

1. Enter the following command to set the security password:

   ```
   >> passwd -s
   ```

   The system prompts you for a new password.

2. Enter a password between 8 and 32 characters long and press Return. The system does not display the password as you enter it.

   The system then prompts you to verify the password that you entered.

3. Enter the password again and press Return. As before, the system does not display the password as you enter it.

   The password is now set and the console prompt changes to the unprivileged mode console prompt, as follows:

   ```
   S>
   ```

   This prompt indicates that the system is in unprivileged console mode.

When the system is in unprivileged console mode, you can use only two console commands:

- The **boot** command, without options or arguments
- The **passwd** command, without options or arguments

1.7.4 Putting the System in Privileged Console Mode

You can put the DECsystem 5100 in privileged console mode only if you know the password. In privileged console mode, you can use all the console commands supported by the DECsystem 5100. Appendix A contains a description of all the console commands.

The following procedure describes how to put the DECsystem 5100 in privileged console mode:

1 Enter the following command at the unprivileged console mode console prompt:

```
S> passwd
```

2 Enter the password at the prompt and press Return. The system does not display the password as you enter it.

  If the password is correct, the system changes the console prompt to the privileged mode console prompt:

```
>>
```

You are now in privileged mode and can use all the console commands.

1.7.5 Exiting Privileged Console Mode

To return the system to unprivileged console mode, enter the following command:

```
>> passwd -u
```

The system returns to unprivileged console mode and displays the following console prompt:

```
>>
```

1.7.6 Clearing the Security Password

The following procedure describes how to clear the security password:

1 Enter the following command at the unprivileged console mode prompt:

```
S> passwd
```

2 Enter the current security password at the prompt and press Return. The system does not display the password as you enter it.

  If the password is correct, the system changes the unprivileged mode console prompt to the privileged mode console prompt:

```
>>
```

3 Enter the following command at the console prompt to clear the security password:

```
>> passwd -c
```

The DECsystem 5100 is now in console mode.

1.7.7 Console Menu

The console menu lists the commands you can use in console mode, that is, when the system displays the console prompt (>>). To display the console menu, enter one of the following commands at the console prompt and press Return:

```
>> ?
```

or,

```
>> help
```

The system displays the console menu (see Example 1–4).

Example 1–4 Console Menu

```
>> ?

CMD:
  boot [-f FILE] [-(s|m)] [-n] [ARG...]
  conf [-(b|f|m|s|g)]
  continue
  d [[[-b|h|w)] [ADDR]] | [(-H REG)]] VAL
  disable DEV
  dump [-H] | [[[[-(b|h|w)] [-(o|d|u|x|c|B)]] | [-I]] RNG]
  e [-(b|h|w)] [ADDR]
  enable DEV
  fill [-(b|h|w)] [-v VAL] RNG
  go [PC]
  help [CMD]
  init
  passwd [-(c|s|u)]
  printenv [EVAR...]
  setenv EVAR STR
  scsi [?] | [cmd [unit] [parm]]
  test [?] | [[-v] [-(f|h)] [-r[REPS]] [-s] TNUM [parm1 parm2 parm3....]]
  unsetenv EVAR
  ? [CMD]
RNG:
  ADDR#CNT
  ADDR:ADDR
```

Appendix A describes the console commands in detail.

1.7.8 Console Command Conventions

The following command conventions apply when you are entering console commands:

- The commands you enter at the console prompt are *case sensitive*. The system recognizes uppercase and lowercase letters as completely different input.
- To enter any console command, enter the command *exactly* as it is displayed on the console menu, add the appropriate arguments (if necessary), and press Return.
- To enter numeric values, use the following conventions:
  - Decimal - enter a string of decimal digits (for example, 123).
  - Octal - enter a string of octal digits with a leading zero (for example, 0177).
  - Hexadecimal - enter a string of hexadecimal digits preceded by 0x (for example, 0x3ff).
  - Binary - enter a string of binary digits preceded by 0b (for example, 0b1001).

In console mode, certain ASCII control characters have a special significance. Table 1–6 describes the significance of these control characters.

Table 1–6 Console Mode Control Characters

Character	Significance
CR	Ends a command line. The system enters command characters into a buffer until a carriage-return is received.
Delete	Deletes the previously typed character. If the console terminal is set as hardcopy (environment variable term set to hardcopy), the system echoes the deleted text enclosed by backslashes.
Ctrl/C	Causes the console program to abort the processing of a command.
Ctrl/O	Causes the console program to discard output until you enter the next Ctrl/O character, or until it receives the next console prompt or error message. Ctrl/C also cancels Ctrl/O.
Ctrl/Q	Resumes console output that the control character Ctrl/S suspends.
Ctrl/R	Causes the current command line to display, omitting any deleted characters.

(continued on next page)

Table 1–6 (Cont.) Console Mode Control Characters

Character	Significance
Ctrl/S	Suspends the current command line that the console program displays until the next Ctrl/Q.
Ctrl/U	Discards all characters that the console program accumulates for the current command line.
Ctrl/V	Suppresses any special meaning that the next character of the console command line has.
Ctrl/Z	Causes the console program to perform an exception dump.

1.8 Booting the Operating System

Booting is the process of loading and transferring control to an operating system. The DECsystem 5100 supports the ULTRIX operating system.

In the DECsystem 5100, the operating system boots in one of the following circumstances:

- You set the environment variable *bootmode* to the value a, and you press the halt/reset button.
- You set the environment variable *bootmode* to a value other than a, and you enter the boot command at the console prompt (see Section A.1).
- The operating system software initiates a boot operation.

See Section A.14 for more information about the environment variable *bootmode*.

If an error occurs when booting the system, the error may be the result of the Ethernet switch being set to the wrong position. The Ethernet switch is a two position push-button switch on the back of the system unit (see Figure 1–1). You can use a pen to change the switch position if necessary. Set the switch to the in position for ThinWire Ethernet, or set the switch to the out position for Standard Ethernet.

1.8.1 Boot Devices

You can boot the DECsystem 5100 from one of three different device types as follows:

- Hard disk drive
- Tape drive
- Ethernet

The boot command specifies the boot device and the boot file (see Section A.1).

2 Extended Self-Test Diagnostics

2.1 Introduction

This chapter describes how to run and interpret the DECsystem 5100 extended self-test diagnostics. You can use the extended self-test diagnostics to diagnose component and subsystem malfunctions in the system unit.

2.2 ULTRIX Diagnostic Tools

If the system you are testing is experiencing intermittent hardware errors, examine the ULTRIX error logs before running extended self-tests. You can use the ULTRIX tools, uerf and netstat, to trace some hardware errors. See Section 8 in the ULTRIX documentation set for information about uerf, and Section 1 for information about netstat.

2.3 Connecting a Console Terminal

You can enter console commands from the console terminal connected to MMJ port 3 on the back of the system unit (see Figure 2–1).

To connect a terminal to this port, do the following:

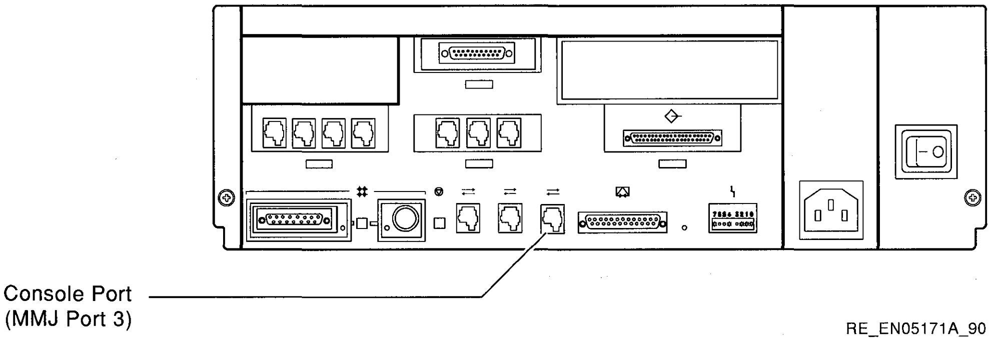
1 Connect the cable from the terminal to the console port, MMJ port 3 (see Figure 2–1).

2 On the terminal, set the power on/off switch to the on (|) position.

3 On the terminal, set the communication parameters as follows:

- Baud rate: 9600
- No of bits: 8
- Parity: none
- No of stop bits: 1

Figure 2–1 Console Port



2.4 Preparing for Console Extended Self-Tests

Before running the extended self-tests:

1 Display the test menu to find the correct commands (see Section 2.4.1).

2 Install terminators or loopback connectors as necessary (see Section 2.4.2).

2.4.1 Viewing Test Commands

To view the test menu, which lists all valid diagnostic test commands, enter the following command at the console prompt:

```
>> test ?
```

The system displays the test menu (see Figure 2–2).

Figure 2–2 Test Menu

```
Test#    Name                                 Parameters
----------------------------------------------------------------------
0x1      Exception test
0x2      FPU test
0x3      Write Buffer test
0x4      RTC test
0x5      DZ test                              [int/ext,line]
0x6      SCSI test
0x7      LANCE test
0x8      EEPROM test
0x10     TLB test
0x15     Data Cache Segment test
0x16     Data Cache Tag Mats test
0x17     Data Cache Tag Mats Parity test
0x18     Data Cache Data Parity Mats test
0x19     Data Cache Valid Bit test
0x1A     Data Cache Tag Shorts test
0x1B     Instruction Cache Segment test
0x1C     Instruction Cache Tag Mats test
0x1D     Instruction Cache Tag Mats Parity test
0x1E     Instruction Cache Data Parity Mats test
0x1F     Instruction Cache Valid Bit test
0x20     Instruction Cache Tag Shorts test
0x21     Data Cache Reload test
0x22     Instruction Cache Reload test
0x23     Data Cache Istream test
0x24     Instruction Cache Istream test
0x30     Bitmap Placing test
0x31     Memory Address test    [start_addr,end_addr,OFFset]
0x32     Memory Data test
0x33     Moving Inversions test
0x34     Memory Data Shorts test
Script# Name
----------------------------------------------------------------------
0xA0     Memory tests
0xA1     Data Cache tests
0xA2     Instruction Cache tests
0xA3     Device (RTC,DZ,SII,LANCE) tests
```

2.4.2 Terminating Connectors for Diagnostic Tests

During normal system operation, it is recommended that you run the system with the SCSI terminator connected to the external SCSI port on the back of the system. However, if you are isolating a fault related to internal SCSI devices, it is recommended that you remove the SCSI terminator. The SCSI terminator may mask a fault caused by the internal SCSI terminators on the system module.

When you run external loopback tests on the Ethernet, you must install a loopback connector on the Ethernet port you want to test (see Section 2.6.7).

Note *If you run an external loopback test on an Ethernet port with the Ethernet cable attached, the system displays error messages on the console terminal.*

You can run tests on individual serial ports with or without external loopback connectors (see Section 2.6.5).

2.5 Running Console Extended Self-Tests

To run a console extended self-test, enter the test command and the test number at the console prompt. For example, to run the FPU test, enter the following command:

```
>> test 0x2
```

Note *You must enter the test number in hexadecimal format (see Section 1.7.8).*

When the test completes without errors, the system displays the console prompt (>>).

To get information about a test as it executes, you can add the -v (verbose) option to the command line. You can also choose to repeat a test by adding the -r (repeat) option to the command line. To exit a repeating test, press Ctrl/C. See Section A.17 for more information on the test command.

Note *When using Ctrl/C to halt a test, it may take some time for the test to halt.*

To get a list of the tests you can run and their corresponding test numbers, enter the following command:

```
>> test ?
```

The system displays the test menu (see Section 2.4.1).

2.5.1 Error Reports

If an error occurs during the power-up or extended self-test, the system displays an error report on the console terminal if possible. Example 2–1 shows a typical error display resulting from a failed self-test.

Example 2–1 Error Report Summary Example

```
?1f 03 ff 0001 ❶

P1= 00000000 P2= 00000000 P3= 00000000 P4= 00000000 P5= 00000000 ❷
P6= 00000000 P7= 00000000 P8= 00000000 P9= 00000000 P10=00000000 ❷
gp= 17bcbcfb sp= a000f7b0 fp= bfc00480 sr= 00000000 ❸
epc=bfc20a70 badvaddr=00060000  cause=3000000c     ❸
```

❶ Test summary contains four hexadecimal fields as follows:

- ?1f is the test number that failed.
- 03 is the number of the subtest that failed. You can use this number to identify the location of the failure in the diagnostic listing.
- ff is an error code. This code indicates a condition that the diagnostic executive expects on test failure. The possible codes are as follows:
  - ff—Normal error, exit from diagnostic
  - fe—Unanticipated exception
  - fd—Interrupt in cleanup routine
  - fc—Interrupt in interrupt handler
  - fb—Failure to meet script requirements
  - fa—No such diagnostic
  - ef—Unanticipated exception in executive
- 0001 is a count value. This is the number of previous errors that occurred.

❷ P1 to P10 are specific parameters used during the diagnostic test. The values shown are the values of the parameters when the test failed. Appendix E gives the significance of the parameters for each test that uses parameters.

❸ gp, sp, fp, sr, epc, badvaddr, and cause are CPU registers. The values shown are the values of the registers when the test failed.

2.6 Test Descriptions

Table 2–1 lists the test command, the name of the test and a reference to a section that describes the test in this chapter.

Table 2–1 Console Extended Self-Tests

Test Command	Test Name	Section
Miscellaneous Tests		
test 0x1	Exception tests	2.6.1
test 0x2	FPU test	2.6.2
test 0x3	Write buffer test	2.6.3
test 0x4	RTC test	2.6.4
test 0x5	DZ test	2.6.5
test 0x6	SCSI test	2.6.6
test 0x7	LANCE test	2.6.7
test 0x8	EEPROM test	2.6.8
test 0x10	TLB test	2.6.9
Data Cache Tests		
test 0x15	Data cache segment test	2.6.10
test 0x16	Data cache tag mats test	2.6.11
test 0x17	Data cache tag mats parity test	2.6.12
test 0x18	Data cache data parity mats test	2.6.13
test 0x19	Data cache valid bit test	2.6.14
test 0x1A	Data cache tag shorts test	2.6.15
test 0x21	Data cache reload test	2.6.16
test 0x23	Data cache I-stream test	2.6.17

(continued on next page)

Table 2–1 (Cont.) Console Extended Self-Tests

Test Command	Test Name	Section
Instruction Cache Tests		
test 0x1B	Instruction cache segment test	2.6.18
test 0x1C	Instruction cache tag mats test	2.6.19
test 0x1D	Instruction cache tag mats parity test	2.6.20
test 0x1E	Instruction cache data parity mats test	2.6.21
test 0x1F	Instruction cache valid bit test	2.6.22
test 0x20	Instruction cache tag shorts test	2.6.23
test 0x22	Instruction cache reload test	2.6.24
test 0x24	Instruction cache I-stream test	2.6.25
Memory Tests		
test 0x30	Bitmap placing test	2.6.26
test 0x31	Memory address test	2.6.27
test 0x32	Memory data tests	2.6.28
test 0x33	Moving inversions test	2.6.29
test 0x34	Memory data shorts test	2.6.30

2.6.1 Exception Test (t 0x1)

This test verifies that the processor can invoke, detect, and process all types of program exceptions.

To run the Exception Test, enter the following command:

```
>> test 0x1
```

If an error occurs, replace the system module (see Section 3.11). Table E–1 describes the significance of the parameters P1 and P2 in the error report.

2.6.2 FPU Test (test 0x2)

This test checks the operation of the Floating Point Unit (FPU). The test uses the addition, subtraction, multiplication, and division instructions to test the FPU and ensures that errors are detected as appropriate.

To run the FPU Test, enter the following command:

```
>> test 0x2
```

If an error occurs, replace the system module (see Section 3.11).

2.6.3 Write Buffer Test (test 0x3)

This test verifies that the CPU can write data through, and correctly read back data through the LR3220 read-write buffer.

To run the Write Buffer Test, enter the following command:

```
>>  test 0x3
```

If an error occurs, replace the system module (see Section 3.11). Table E–2 describes the significance of the parameters P1 to P3 in the error report.

2.6.4 RTC Test (test 0x4)

This test checks the operation of the Real Time Clock (RTC), and the non-volatile RAM associated with the RTC.

To run the RTC Test, enter the following command:

```
>>  test 0x4
```

If an error occurs, replace the system module (see Section 3.11). Table E–3 describes the significance of the parameters P1 to P3 in the error report.

2.6.5 DZ Test (test 0x5)

This test checks the serial ports on the system module and on the DHT80 asynchronous module (if installed) to ensure that the serial ports transmit and receive serial data correctly.

To run the DZ Test, enter the following command:

```
>>  test 0x5
```

You can enter parameters at the command line. Enter the first parameter, 0 or 1, to specify internal loopback (0) or external loopback (1). If you specify external loopback, you must install a loopback connector on the serial port under test. Enter the second parameter, a number in the range 1 to 12, to specify the serial port you want to test. These parameters are P1 and P2 respectively (see Table E–4). For example, to run an external loopback test on serial port 3, connect a loopback connector to serial port 3 on the back of the system unit, then use the console terminal to enter the following command:

```
>>  test 0x5 1 3
```

If an error occurs, you can determine from the error report which serial line on which unit failed. Table E–4 describes the significance of the parameters P1 to P6 in the error report. Table 2–2 shows the following:

- The port names
- The mnemonics that the ULTRIX operating system assigns to the ports

- The modules to which the ports are associated

Table 2–2 Serial Port Numbers and ULTRIX Mnemonics

Port Name	ULTRIX Mnemonic	Module
MMJ 1	/dev/tty02	System Module
MMJ 2	/dev/tty00	System Module
MMJ 3	/dev/console	System Module
MODEM	/dev/tty01	System Module
MMJ 4	/dev/tty09	DHT80 Asynchronous Module
MMJ 5	/dev/tty08	DHT80 Asynchronous Module
MMJ 6	/dev/tty07	DHT80 Asynchronous Module
MMJ 7	/dev/tty010	DHT80 Asynchronous Module
MMJ 8	/dev/tty06	DHT80 Asynchronous Module
MMJ 9	/dev/tty04	DHT80 Asynchronous Module
MMJ 10	/dev/tty03	DHT80 Asynchronous Module
B2 MODEM	/dev/tty05	DHT80 Asynchronous Module

Note *The ULTRIX mnemonics shown in Table 2–2 are the default assignments. You may change these while the ULTRIX operating system is running. See your ULTRIX documentation.*

2.6.6 SCSI Test (test 0x6)

This test verifies that the SCSI controller chip functions correctly.

To run the SCSI Test, enter the following command:

```
>> test 0x6
```

If an error occurs, disconnect the SCSI cable from the system module and run the test again. If the test passes, the SCSI cable, or one of the SCSI devices, is the cause of the problem. If the test fails, replace the system module (see Section 3.11). Table E–5 describes the significance of the parameters P1 to P3 in the error report.

2.6.7 LANCE Test (test 0x7)

This test verifies the functionality of the LANCE Ethernet controller chip and support hardware on the system module. This test checks the operation of the LANCE CSRs (control status registers), packet generation, packet reception, CRC (Cycle Redundancy Code) generation, bad CRC detection and interrupt control.

You can run this test, using the internal loopback facility or using external loopback connectors.

To run the LANCE Test, using the internal loopback facility, enter the following command:

```
>> test 0x7
```

To run the LANCE Test, using external loopback connectors, you must install the Standard Ethernet loopback connector, or the ThinWire Ethernet T-connector and terminators, depending on the type of Ethernet you are using.

Also, you must check that the Ethernet switch is in the correct position for the type of Ethernet loopback connector you install. The Ethernet switch is a two position push-button switch. Use a pen to change the switch position. Set the switch to the in position for ThinWire Ethernet, or set the switch to the out position for Standard Ethernet. The LED, opposite the selected port, lights. Figure 1–1 shows the location of the Ethernet switch.

To run the LANCE Test, using the external loopback connectors, enter the following command:

```
>> test 0x7 0x1
```

If an error occurs, replace the system module (see Section 3.11).

2.6.8 EEPROM Test (test 0x8)

This test verifies that the EEPROM on the system module contains the correct information. The test calculates the checksum of the EEPROM and compares it with a stored value.

To run the EEPROM Test, enter the following command:

```
>> test 0x8
```

The system may display the following message:

```
? 08 03 ff 0001
warning EEPROM Reinitialized
```

This is not an error, but an indication that the system has reinitialized the EEPROM.

If an error occurs, replace the system module (see Section 3.11). Table E–6 describes the significance of the parameters P1 and P2 in the error report.

2.6.9 TLB Test (test 0x10)

This test checks the Translation Lookaside Buffer (TLB). The test comprises two subtests. The first subtest writes and verifies data patterns to all of the TLB locations. The second subtest ensures that TLB locations respond to probes when an address match is found.

To run the TLB Test, enter the following command:

```
>> test 0x10
```

If an error occurs, replace the system module (see Section 3.11).

2.6.10 Data Cache Segment Test (test 0x15)

This test verifies that the data cache RAMs correctly cache data when addressed through unmapped cached memory. The test also verifies that the data cache RAMs do not cache data when addressed through unmapped uncached memory.

To run the Data Cache Segment Test, enter the following command:

```
>> test 0x15
```

If an error occurs, replace the system module (see Section 3.11). Table E–7 describes the significance of the parameters P1 to P3 in the error report.

2.6.11 Data Cache Tag Mats Test (test 0x16)

This test checks the data cache tags for addressing faults, and verifies that none of the bits are stuck at a certain level.

To run the Data Cache Tag Mats Test, enter the following command:

```
>> test 0x16
```

If an error occurs, replace the system module (see Section 3.11). Table E–7 describes the significance of the parameters P1 to P3 in the error report.

2.6.12 Data Cache Tag Parity Mats Test (test 0x17)

This test checks the data cache tag parity for addressing faults, and verifies that none of the bits are stuck at a certain level.

To run the Data Cache Tag Parity Mats Test, enter the following command:

```
>> test 0x17
```

If an error occurs, replace the system module (see Section 3.11). Table E–7 describes the significance of the parameters P1 to P3 in the error report.

2.6.13 Data Cache Data Parity Mats Test (test 0x18)

This test checks the data cache data parity for addressing faults, and verifies that none of the bits are stuck at a certain level.

To run the Data Cache Data Parity Mats Test, enter the following command:

```
>> test 0x18
```

If an error occurs, replace the system module (see Section 3.11). Table E–7 describes the significance of the parameters P1 to P3 in the error report.

2.6.14 Data Cache Valid Bit Test (test 0x19)

This test checks the data cache valid bit for addressing faults, and verifies that none of the bits are stuck at a certain level.

To run the Data Cache Valid Bit Test, enter the following command:

```
>> test 0x19
```

If an error occurs, replace the system module (see Section 3.11). Table E–7 describes the significance of the parameters P1 to P3 in the error report.

2.6.15 Data Cache Tag Shorts Test (test 0x1a)

This test checks the ability of the Data Cache RAM to modify all tag bits.

To run the Data Cache Tag Shorts Test, enter the following command:

```
>> test 0x1a
```

If an error occurs, replace the system module (see Section 3.11). Table E–7 describes the significance of the parameters P1 to P3 in the error report.

2.6.16 Data Cache Reload Test (test 0x21)

This test verifies the integrity of the data cache RAMs. It also verifies that there are no parity problems generated in data transfers between the main memory and the data cache RAMs.

To run the Data Cache Reload Test, enter the following command:

```
>> test 0x21
```

If an error occurs, replace the system module (see Section 3.11).

2.6.17 Data Cache I-Stream Test (test 0x23)

This test verifies that the CPU, data cache RAMs, and main memory can operate at full speed when the caches are swapped. When the caches are swapped, the data cache is used for the instruction stream, and the instruction cache is used for the data stream.

To run the Data Cache I-Stream Test, enter the following command:

```
>>  test 0x23
```

If an error occurs, replace the system module (see Section 3.11).

2.6.18 Instruction Cache Segment Test (test 0x1b)

This test verifies that the instruction cache RAMs correctly cache data when addressed through unmapped cached memory, and do not cache data when addressed through unmapped uncached memory.

To run the Instruction Cache Segment Test, enter the following command:

```
>>  test 0x1b
```

If an error occurs, replace the system module (see Section 3.11). Table E–7 describes the significance of the parameters P1 to P3 in the error report.

2.6.19 Instruction Cache Tag Mats Test (test 0x1c)

This test checks the instruction cache tags for addressing faults, and verifies that none of the bits are stuck at a certain level.

To run the Instruction Cache Tag Mats Test, enter the following command:

```
>>  test 0x1c
```

If an error occurs, replace the system module (see Section 3.11). Table E–8 describes the significance of the parameters P1 to P3 in the error report.

2.6.20 Instruction Cache Tag Parity Mats Test (test 0x1d)

This test checks the instruction cache tag parity for addressing faults, and verifies that none of the bits are stuck at a certain level.

To run the Instruction Cache Tag Parity Mats Test, enter the following command:

```
>>  test 0x1d
```

If an error occurs, replace the system module (see Section 3.11). Table E–8 describes the significance of the parameters P1 to P3 in the error report.

2.6.21 Instruction Cache Data Parity Mats Test (test 0x1e)

This test checks the instruction cache data parity for addressing faults, and verifies that none of the bits are stuck at a certain level.

To run the Instruction Cache Data Parity Mats Test, enter the following command:

```
>>  test 0x1e
```

If an error occurs, replace the system module (see Section 3.11). Table E–8 describes the significance of the parameters P1 to P3 in the error report.

2.6.22 Instruction Cache Valid Bit Test (test 0x1f)

This test checks the instruction cache valid bit for addressing faults, and verifies that none of the bits are stuck at a certain level.

To run the Instruction Cache Valid Bit Test, enter the following command:

```
>>  test 0x1f
```

If an error occurs, replace the system module (see Section 3.11). Table E–8 describes the significance of the parameters P1 to P3 in the error report.

2.6.23 Instruction Cache Tag Shorts Test (test 0x20)

This test checks the ability of the Instruction Cache RAMs to modify all tag bits.

To run the Instruction Cache Tag Shorts Test, enter the following command:

```
>>  test 0x20
```

If an error occurs, replace the system module (see Section 3.11). Table E–8 describes the significance of the parameters P1 to P3 in the error report.

2.6.24 Instruction Cache Reload Test (test 0x22)

This test verifies the integrity of the instruction cache RAMs. It also verifies that there are no parity problems generated in data transfers between the main memory and the instruction cache RAMs.

To run the Instruction Cache Reload Test, enter the following command:

```
>>  test 0x22
```

If an error occurs, replace the system module (see Section 3.11).

2.6.25 Instruction Cache I-Stream Test (test 0x24)

This test verifies that the CPU, instruction cache RAMs, and main memory can operate at full speed when the instruction cache is used for the instruction stream, and the data cache is used for the data stream.

To run the Instruction Cache I-Stream Test, enter the following command:

```
>>  test 0x24
```

If an error occurs, replace the system module (see Section 3.11).

2.6.26 Bitmap Placing Test (test 0x30)

This test determines the size of the memory and sets up a bitmap in memory for use during the memory tests. When this test is complete, the bitmap identifies the following:

- The parts of the memory that are available for use
- The parts of the memory that are faulty
- The parts of the memory that are used for the bitmap

Caution *This test uses a destructive sizing routine. It destroys the contents of the memory it sizes.*

This test is always run, before other memory tests, to make sure that the memory bitmap is present. Normally, the test is run only once.

To run the Bitmap Placing Test, enter the following command:

```
>> test 0x30
```

Enter the following command to get a list of all the bad memory pages.

```
>> test 0x30 0x1
```

If an error occurs, the system generates an error report. Table E–9 describes the significance of the parameters P1 to P6 in the error report. When this test fails, it indicates a serious hardware error. There is not enough good memory available to store the bitmap used for testing the memory.

2.6.27 Memory Address Test (test 0x31)

This test verifies that the CPU can uniquely address each location in memory.

The test writes a unique pattern from the starting address to the ending address, then reads back and checks that the data is the same as that originally written. Because this is an addressing test and not a data check, the test ignores single bit errors that it corrects.

To run the Memory Address Test, enter the following command:

```
>> test 0x31
```

If an error occurs, the system generates an error report. Table E–9 describes the significance of the parameters P1 to P6 in the error report.

To determine which memory bank failed, enter the following command at the console prompt:

```
>> conf -m
```

Example 2–2 shows the memory configuration that the system displays.

Example 2–2 Memory Configuration Display

```
memory: total size 104MBs
     bank0  16MB SIMMs  size:32MBs        0 bad pages
     bank1  16MB SIMMs  size:32MBs        0 bad pages
     bank2  16MB SIMMs  size:32MBs        0 bad pages
     bank3   4MB SIMMs  size: 8MBs        0 bad pages
```

Figure 3–24 identifies the connectors of the memory modules in each memory bank. The connector numbers are also marked on the system module.

2.6.28 Memory Data Test (test 0x32)

This test verifies that the MS44 memory modules can store data correctly.

To run the Memory Data Test, enter the following command:

```
>>   test 0x32
```

If an error occurs, the system generates an error report. Table E–9 describes the significance of the parameters P1 to P6 in the error report.

Use the conf -m command (see Example 2–2) to display the bad memory pages in each memory bank. Figure 3–24 identifies the connectors of the memory modules in each memory bank.

2.6.29 Moving Inversions Test (test 0x33)

This test verifies that the system can store various data patterns in all of the memory locations provided by the MS44 memory modules.

To run the Moving Inversions Test, enter the following command:

```
>>   test 0x33
```

If an error occurs, the system generates an error report. Table E–9 describes the significance of the parameters P1 to P6 in the error report.

Use the conf -m command (see Example 2–2) to display the bad memory pages in each memory bank. Figure 3–24 identifies the connectors of the memory modules in each memory bank.

2.6.30 Memory Data Shorts Test (test 0x34)

This test checks for shorts in all of the memory locations provided by the MS44 memory modules.

To run the Memory Data Shorts Test, enter the following command:

```
>>   test 0x34
```

If an error occurs, the system generates an error report. Table E–9 describes the significance of the parameters P1 to P6 in the error report.

Use the conf -m command (see Example 2–2) to display the bad memory pages in each memory bank. Figure 3–24 identifies the connectors of the memory modules in each memory bank.

2.7 Power Supply Troubleshooting Procedures

Figure 2–3 shows a flowchart that helps you to isolate a fault in the power supply.

Figure 2–3 Flowchart for Troubleshooting the Power Supply

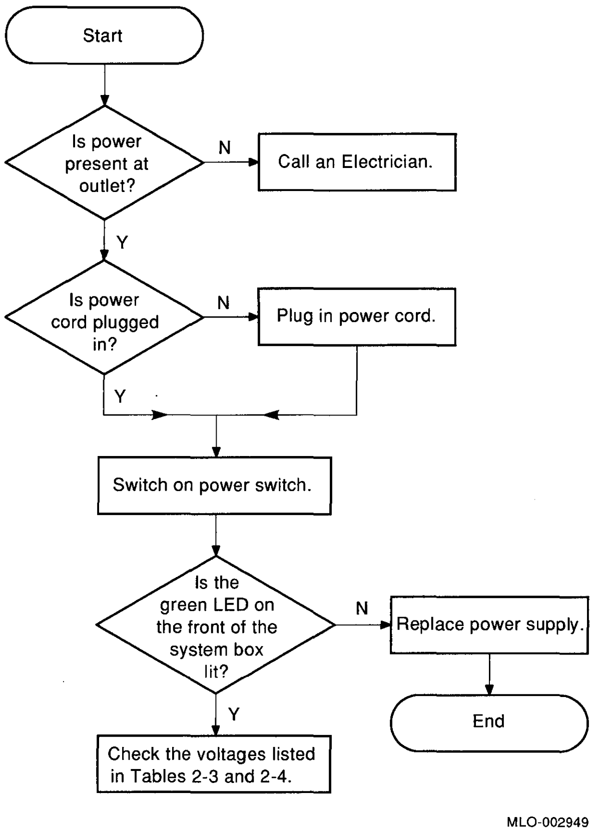


Figure 2–4 identifies the power connector pins on the system module. Table 2–3 lists the voltages on the respective pins.

Figure 2–4 Power Connector Pin Voltages on the System Module

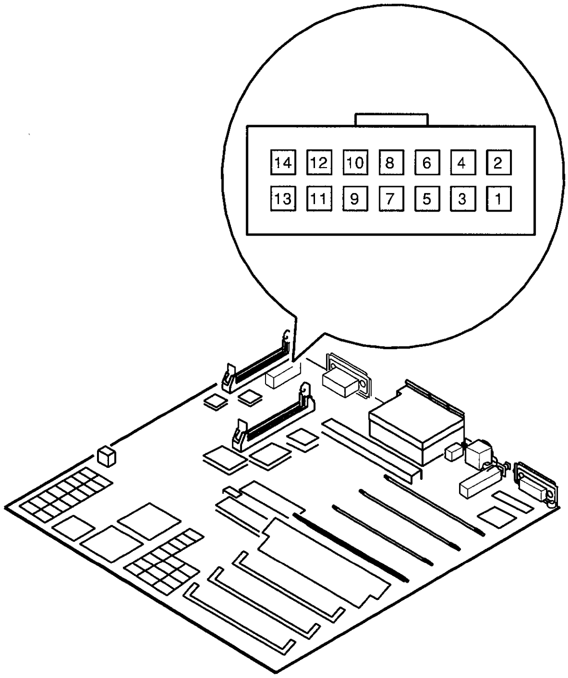


Table 2–3 System Module Power Connector Voltages

Pin Number	Voltage	Tolerance
1	- 12.1 Vdc	5%
2	Ground	—
3	Ground	—
4	Ground	—
5	+ 5.1 Vdc	5%

(continued on next page)

Table 2–3 (Cont.) System Module Power Connector Voltages

Pin Number	Voltage	Tolerance
6	+ 5.1 Vdc	5%
7	+ 3.5 to + 5.25 Vdc	—
8	+ 5.1 Vdc	5%
9	+ 12.1 Vdc	5%
10	+ 5.1 Vdc	5%
11	Ground	—
12	Ground	—
13	- 9 Vdc[1]	5%
14	- 9 Vdc return[2]	—

[1]Measurement made with negative lead connected to pin 14

[2]Ground for the - 9 Vdc supply (an isolated supply)

Figure 2–5 identifies the drive power connector pins. Table 2–4 lists the voltages on the respective pins.

Figure 2–5 Drive Power Connector Pin Voltages

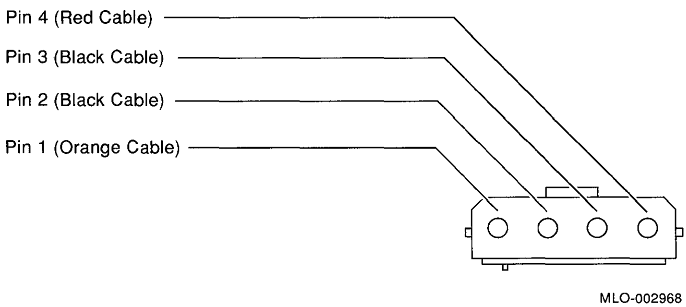


Table 2–4 Drive Power Connector Voltages

Pin Number	Voltage	Tolerance
1	+ 12.1 Vdc	5%
2	Ground	—
3	Ground	—
4	+ 5.1 Vdc	5%

3

FRU Removal and Replacement

3.1 Introduction

This chapter describes the procedures that you use to remove and replace the field replaceable units (FRUs) in the DECsystem 5100. See Table 3–1 to find the name of the faulty FRU, then go to the section listed opposite the FRU entry. Follow the steps in the section to remove the FRU and reverse the procedures to replace the FRU. Always test the replacement device for proper operation.

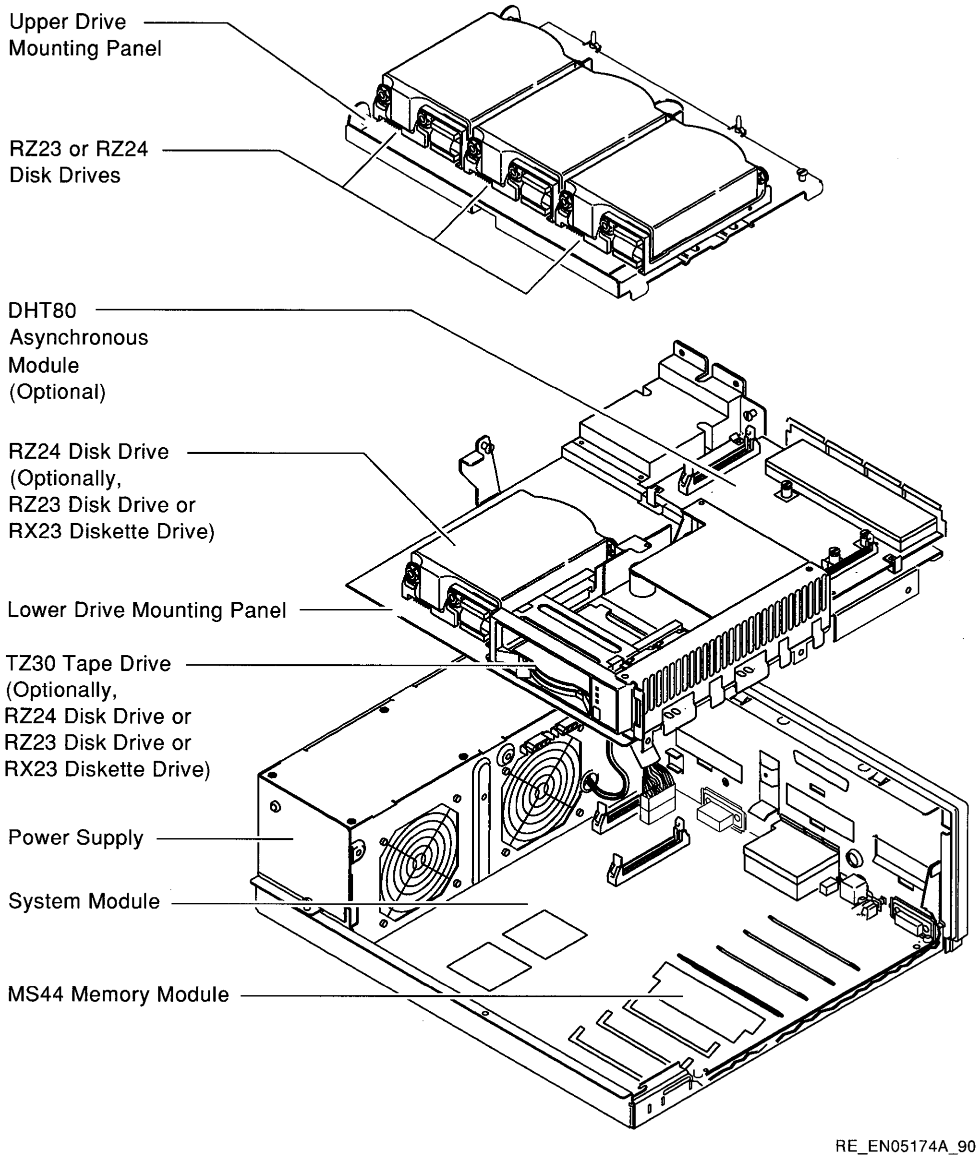
Caution *Wear an anti-electrostatic wrist strap and use an anti-electrostatic mat when replacing FRUs.*

Table 3–1 FRU Section References

FRU	Section
DHT80 asynchronous module	3.4
RZ23 disk drive	3.6
RZ24 disk drive	3.7
TZ30 tape drive	3.8
RX23 diskette drive	3.9
MS44 memory module	3.10
System module	3.11
Power supply	3.12

Figure 3–1 shows the locations of the FRUs.

Figure 3–1 FRU Locations

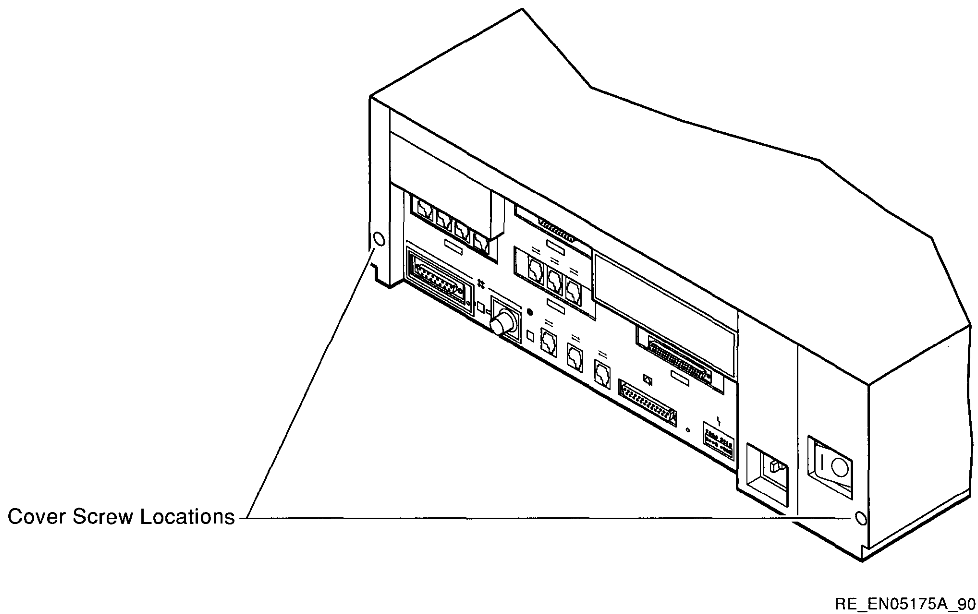


3.2 System Unit Cover Removal

Remove the system unit cover as follows:

1. Set the on/off switch on the system unit to the off (O) position.
2. Disconnect all the cables connected to the system unit.
3. Loosen the two cover screws on the back panel of the system unit (see Figure 3–2).
4. Slide the cover forward, and up, off the system unit.

Figure 3–2 Cover Screw Locations



3.3 Upper Drive Mounting Panel Removal

Depending on your system configuration, the upper drive mounting panel can contain one, two, or three hard disk drives. These drives can be either RZ23 or RZ24 disk drives.

Remove the upper drive mounting panel as follows:

1. Remove the system unit cover (see Section 3.2).

Caution *It is important to note which cables connect to which drives. When disconnecting cables, write the type of drive and its position on a piece of tape and wrap the tape around the connector before you disconnect the cable. This will help you to reinstall the upper drive mounting panel.*

2 Disconnect the power cables and the SCSI bus cable from the drives on the upper drive mounting panel (see Figure 3–3).

3 Unscrew the four captive screws (see Figure 3–4).

Figure 3–3 Drive Mounting Panel Power and Signal Cabling

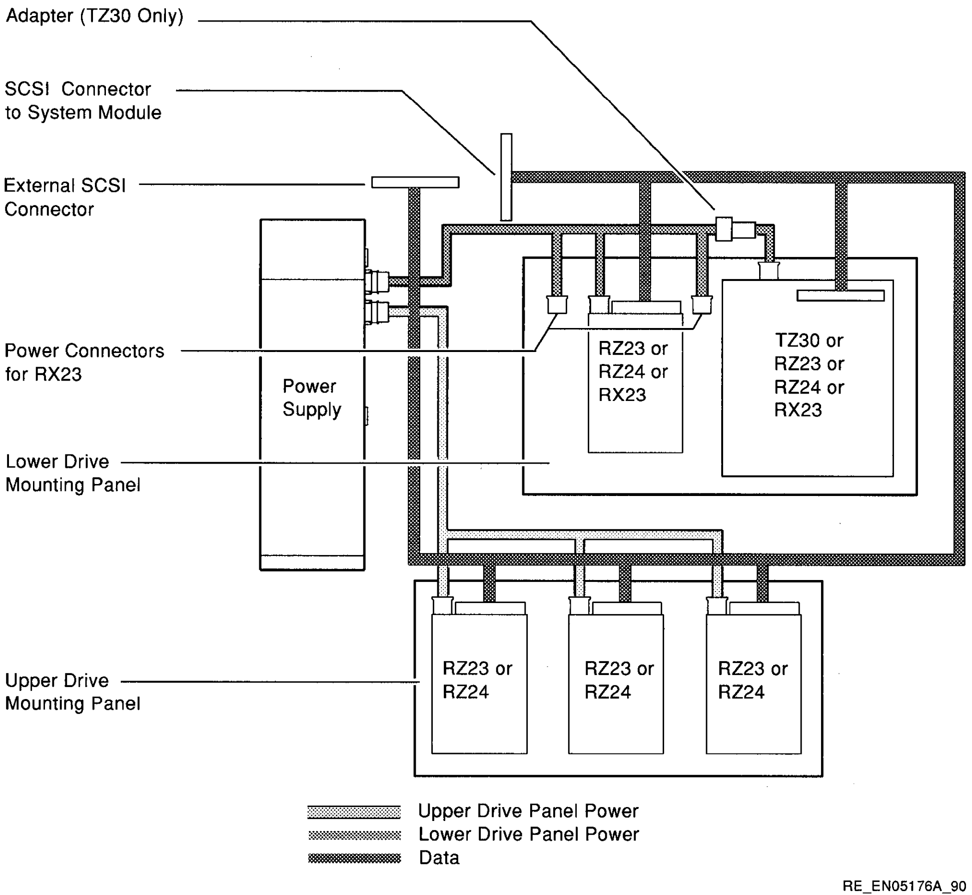
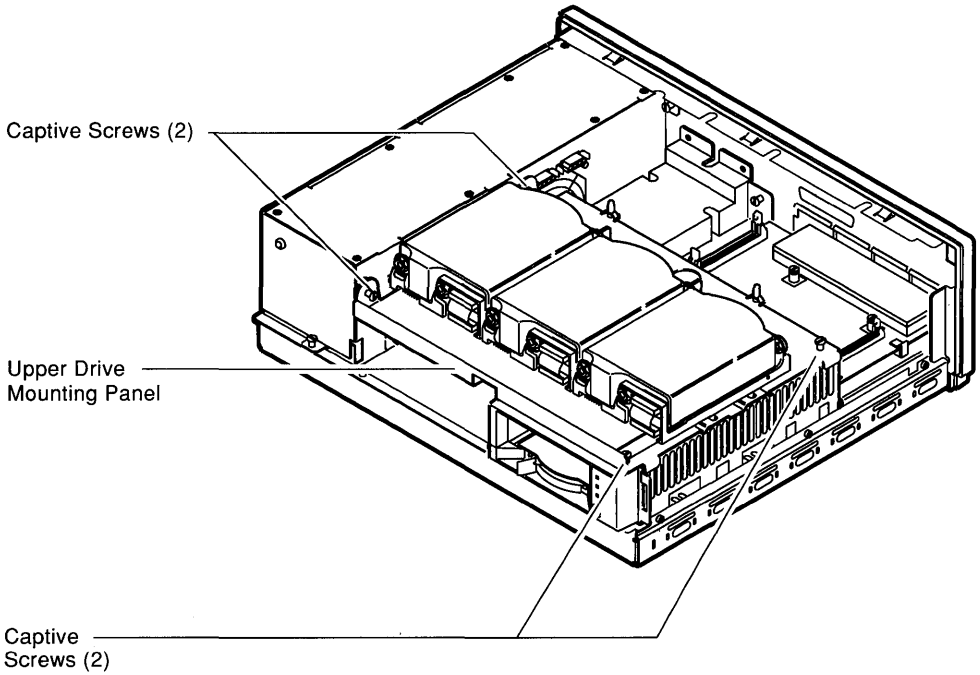


Figure 3–4 Releasing the Upper Drive Mounting Panel



4 Lift the upper drive mounting panel from the lower drive mounting panel and gently set it aside.

3.4 DHT80 Asynchronous Module Removal

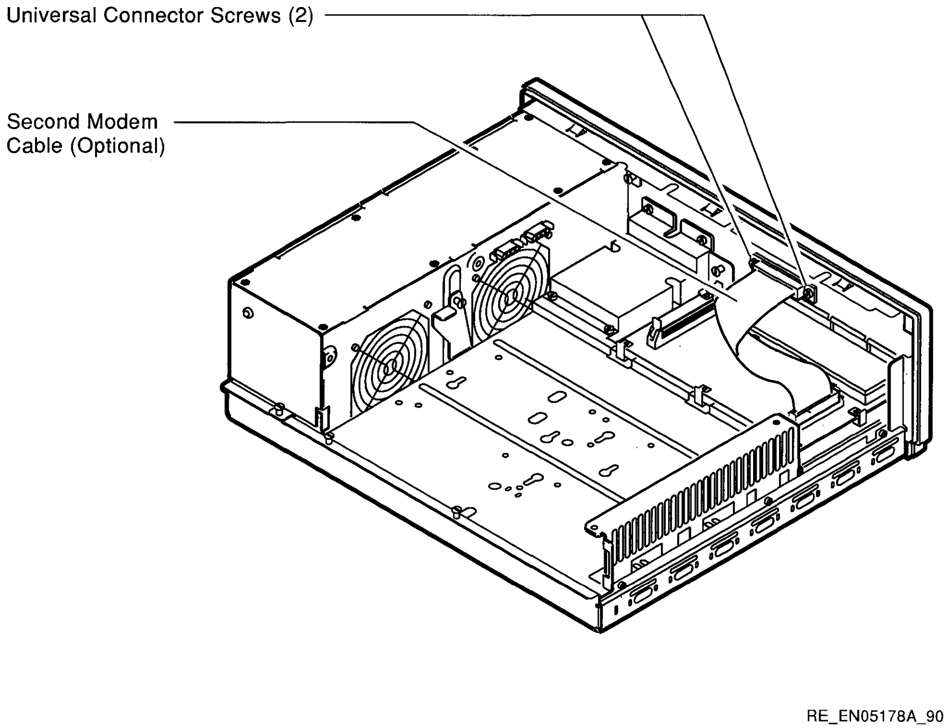
Depending on the configuration, the DECsystem 5100 that you are servicing can contain the optional DHT80 asynchronous module. If the system contains this option, you can remove the module as follows:

1 Remove the system unit cover (see Section 3.2).

2 Disconnect the cable from the second modem port connector (see Figure 3–5).

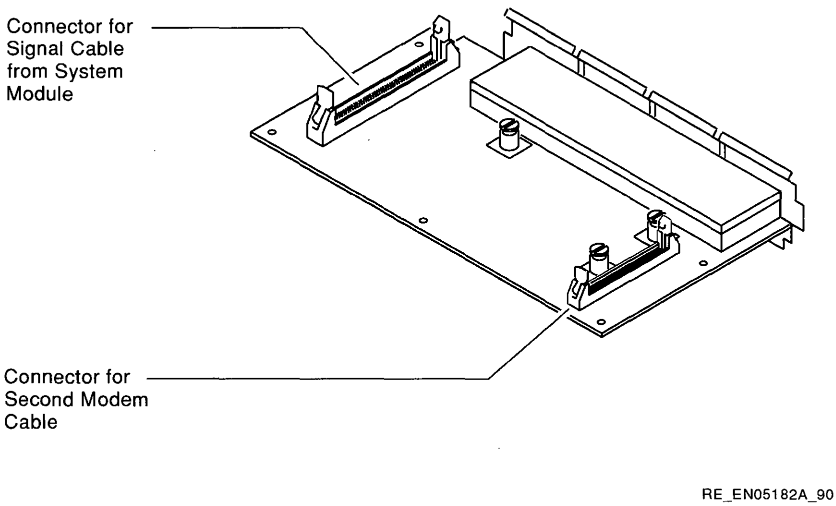
3 Remove the two universal connector screws, and then remove the second modem cable from the system unit (see Figure 3–5).

Figure 3–5 Second Modem Cable Removal



4 Disconnect the signal cable from the system module. Figure 3–6 shows the location of the connector for the signal cable (from the system module).

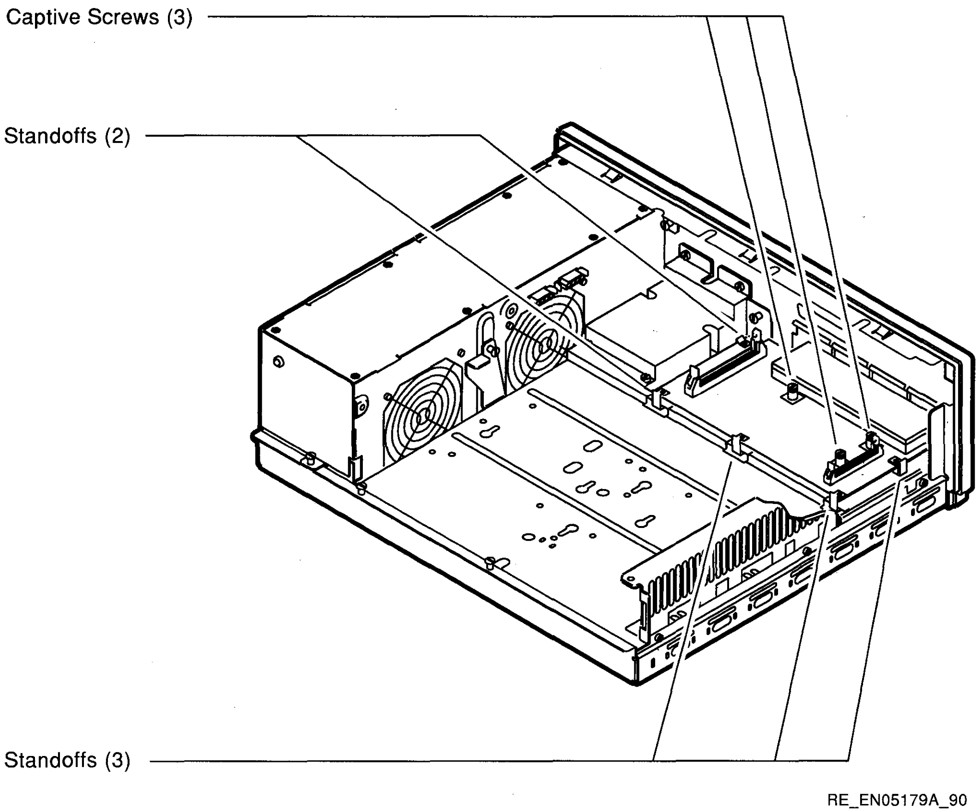
Figure 3–6 DHT80 Connectors



5 Unscrew the three captive screws on the DHT80 asynchronous module (see Figure 3–7).

6 Release the DHT80 asynchronous module from the five standoffs and remove it from the system unit (see Figure 3–7).

Figure 3–7 DHT80 Asynchronous Module Removal



3.5 Lower Drive Mounting Panel Removal

The lower drive mounting panel can contain devices in combinations that are restricted by the following rules:

- You can install the RZ23 disk drives and the RX23 diskette drive in either the left, or right compartments.
- You can install the TZ30 tape drive in the right compartment only.

Remove the lower drive mounting panel as follows:

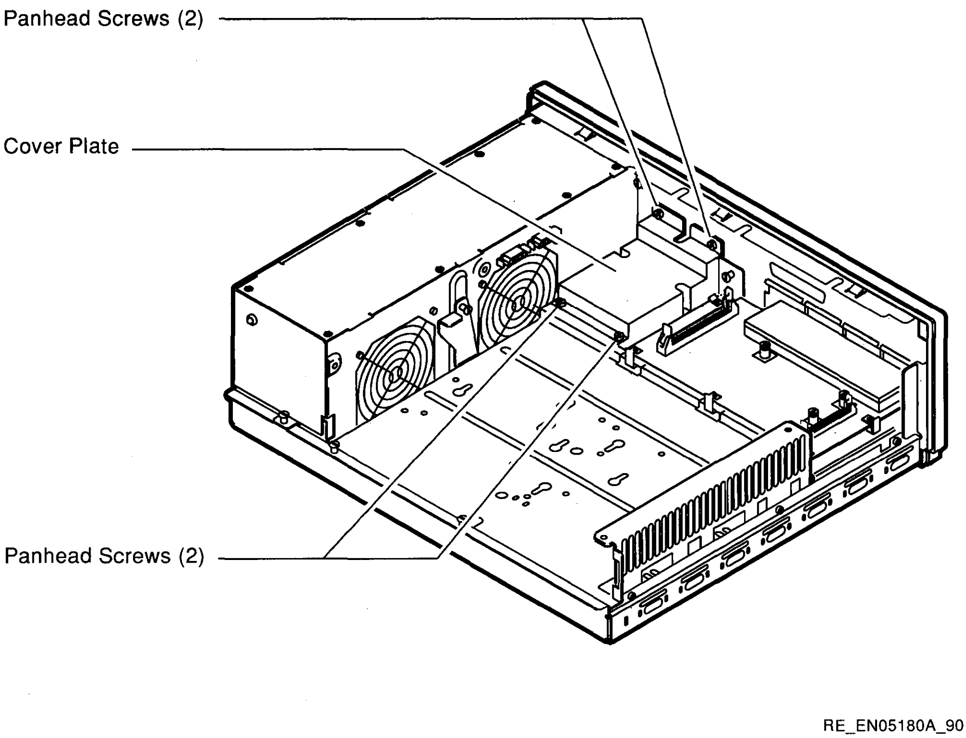
1 Remove the system unit cover (see Section 3.2).

2 Remove the upper drive mounting panel, if not already removed (see Section 3.3).

3 Disconnect the SCSI cable and the power cable connected to the drives on the lower drive mounting panel (see Figure 3–3).

4 Remove the two screws securing the cover plate to the lower drive mounting panel (see Figure 3–8). Remove the two screws securing the cover plate to the back panel of the system unit. Remove the cover plate. Store the screws in a safe place.

Figure 3–8 Cover Plate Removal

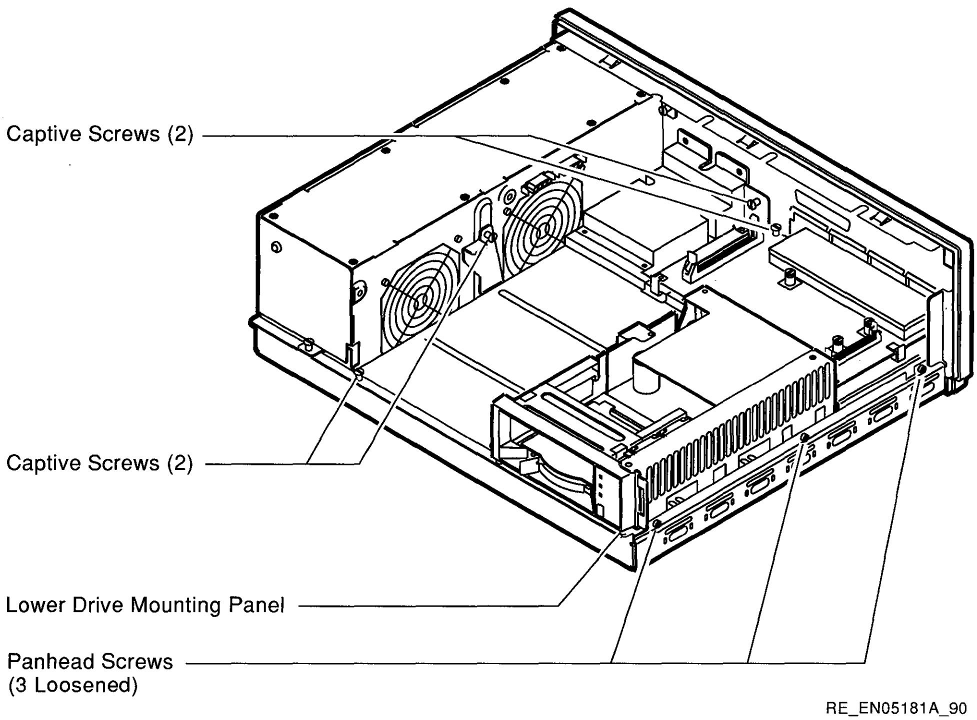


5 Remove the DHT80 asynchronous module, if installed (see Section 3.4).

6 Unscrew the four captive screws and remove the three panhead screws (see Figure 3–9). Store the panhead screws in a safe place.

7 Slide the panel forward (with the devices attached), then lift the panel from the system unit, and gently set it aside.

Figure 3–9 Releasing the Lower Drive Mounting Panel



3.6 RZ23 Disk Drive Removal

Depending on the configuration, the system you are servicing can contain a maximum of three RZ23 disk drives on the upper drive mounting panel, and a maximum of two RZ23 disk drives on the lower drive mounting panel. On the upper drive mounting panel, the disk drive on the right side (as viewed from the front) is the system disk. All RZ23 disk drives connect to the SCSI bus.

The RZ23 disk drive comprises two major components: the head/disk assembly (HDA), and the module/frame assembly (see Figure 3–10).

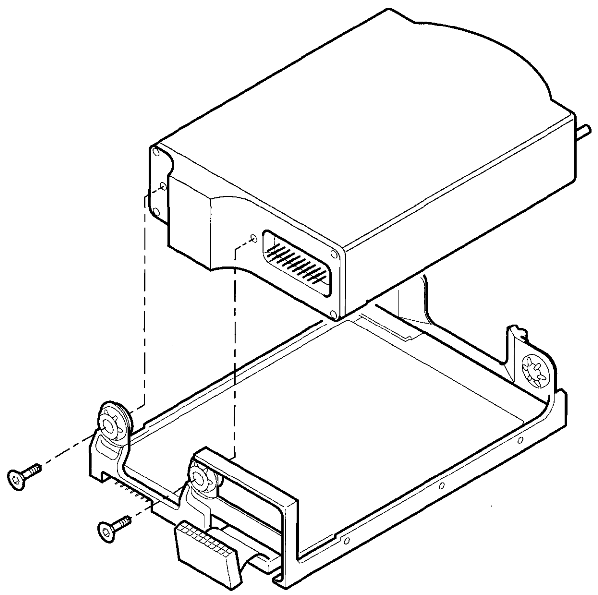
When replacing RZ23 disk drives, replace the module/frame assembly first. If replacing the module/frame assembly does not correct the fault, replace the complete disk drive.

Note *The HDA is not a separate FRU.*

The following procedure describes how to remove a drive from the system, and how to remove and replace the module/frame assembly:

1. Remove the system unit cover (see Section 3.2).
2. Remove the drive mounting panel on which the faulty drive is mounted (see Section 3.3, or Section 3.5).
3. Turn the drive mounting panel over, and while supporting the RZ23 disk drive with one hand, remove the four screws from the drive.
4. Disconnect the drive interconnect cable and remove the two screws (see Figure 3–10) with a 1/8 inch Allen wrench.

Figure 3–10 Separating the RZ23 HDA from the Module/Frame Assembly



Caution *RZ23 disk drives are fragile. Handle them with care.*

5. Push the HDA back against the rubber stops. Then lift up the front of the HDA and remove it from the frame.
6. Slide the HDA into the rubber stops on the new module/frame assembly.
7. Screw in the two new screws supplied.
8. Connect the drive interconnect cable on the new module/frame assembly to the HDA.

9 Position the jumper wires on the new drive module to the same position as the jumper wires on the drive module that you removed. Figure 3–11 shows the location of the jumper wires on the RZ23 disk drive.

Figure 3–11 RZ23 SCSI ID Jumper Wire Locations

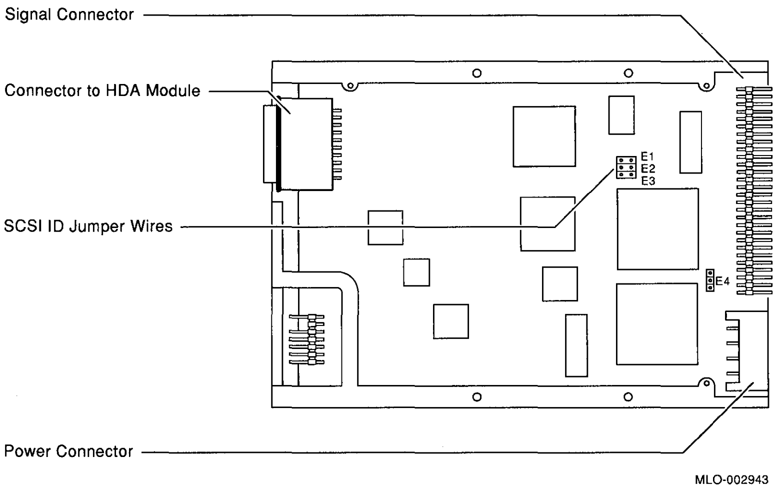


Table 3–2 shows the jumper wire combinations for the valid SCSI ID addresses.

Table 3–2 RZ23 SCSI ID Jumper Wire Combinations

Address ID on SCSI Bus	RZ23 Jumper Wire Settings E1	E2	E3	E4
0	Out	Out	Out	Out
1	In	Out	Out	Out
2	Out	In	Out	Out
3	In	In	Out	Out
4	Out	Out	In	Out
5	In	Out	In	Out
6	Out	In	In	Out
7[1]	In	In	In	Out

[1]Reserved address ID for SCSI bus controller.

3.7 RZ24 Disk Drive Removal

Depending on the configuration, the system you are servicing can contain a maximum of three RZ24 disk drives on the upper drive mounting panel, and a maximum of two RZ24 disk drives on the lower drive mounting panel. On the upper drive mounting panel, the disk drive on the right side (as viewed from the front) is the system disk. All RZ24 disk drives connect to the SCSI bus.

The RZ24 disk drive comprises two major components; the head/disk assembly (HDA), and the module/frame assembly. When replacing an RZ24 disk drive, replace the module/frame assembly first. If replacing the module/frame assembly does not correct the fault, replace the HDA.

Note *The HDA and the module/frame assembly are two separate FRUs.*

The following procedure describes how to remove a drive from the system:

1. Remove the system unit cover (see Section 3.2).
2. Remove the drive mounting panel on which the faulty drive is mounted (see Section 3.3, or Section 3.5).
3. Turn the drive mounting panel over, and while supporting the RZ24 disk drive with one hand, remove the four torx screws from the RZ24 disk drive with a T10 torx screw driver.

Caution *RZ24 disk drives are fragile. Handle them with care.*

4. Position the jumper wires on the new drive module to the same position as the jumper wires on the drive module that you removed. Figure 3–12 shows the location of the jumper wires on the RZ24 disk drive.

Figure 3–12 RZ24 SCSI ID Jumper Wire Locations

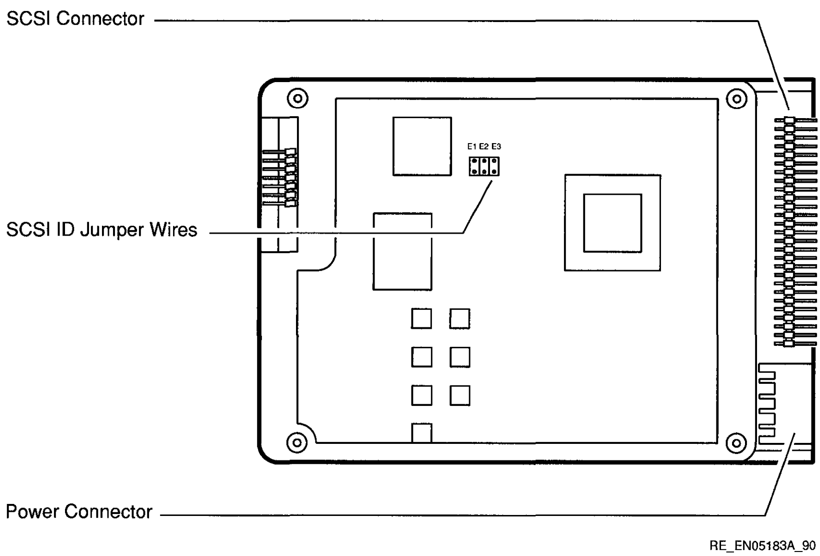


Table 3–3 shows the jumper wire combinations for the valid SCSI ID addresses.

Table 3–3 RZ24 SCSI ID Jumper Wire Combinations

Address ID on SCSI Bus	RZ24 Jumper Wire Settings E1	E2	E3
0	Out	Out	Out
1	Out	Out	In
2	Out	In	Out
3	Out	In	In
4	In	Out	Out
5	In	Out	In
6	In	In	Out
7[1]	In	In	In

[1]Reserved address ID for SCSI bus controller.

3.8 TZ30 Tape Drive Removal

The TZ30 tape drive is on the lower drive mounting panel. It is positioned on the right-hand side (as viewed from the front).

Remove the TZ30 tape drive as follows:

1. Remove the system unit cover (see Section 3.2).
2. Remove the upper drive mounting panel (see Section 3.3).
3. Remove the DHT80 asynchronous module (see Section 3.4).
4. Remove the lower drive mounting panel (see Section 3.5).
5. Turn the lower drive mounting panel over, and while supporting the TZ30 with one hand, loosen two of the screws holding the drive to the mounting panel, and remove the other two screws.
6. Slide the drive to one side and remove it from the mounting panel.
7. Set the switches on the right side of the new TZ30 to the setting of the TZ30 that you removed. Figure 3–13 shows the location of the SCSI ID switches on the TZ30 tape drive.

Note *Ensure the rubber grommets stay in place.*

Figure 3–13 TZ30 SCSI Switch Locations

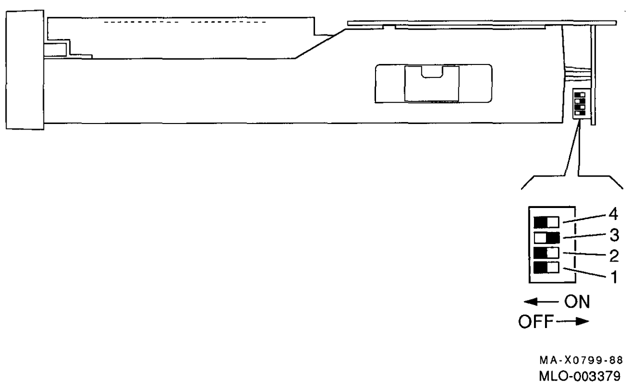


Table 3–4 shows the TZ30 SCSI ID switch settings for the valid SCSI ID addresses.

Table 3–4 TZ30 SCSI ID Switch Settings

Address ID on SCSI Bus	TZ30 Tape Drive Switch Settings 4	3	2	1
0	Off	Off	Off	On
1	On	Off	Off	On
2	Off	On	Off	On
3	On	On	Off	On
4	Off	Off	On	On
5	On	Off	On	On
6	Off	On	On	On
7[1]	On	On	On	On

[1]Reserved address ID for SCSI bus controller.

3.9 RX23 Diskette Drive and FDI Board Removal

Depending on the system configuration, the lower drive mounting panel can contain an RX23 diskette drive in the left or right compartment, or one in each compartment.

Remove the RX23 diskette drive and floppy disk interface (FDI) board as follows:

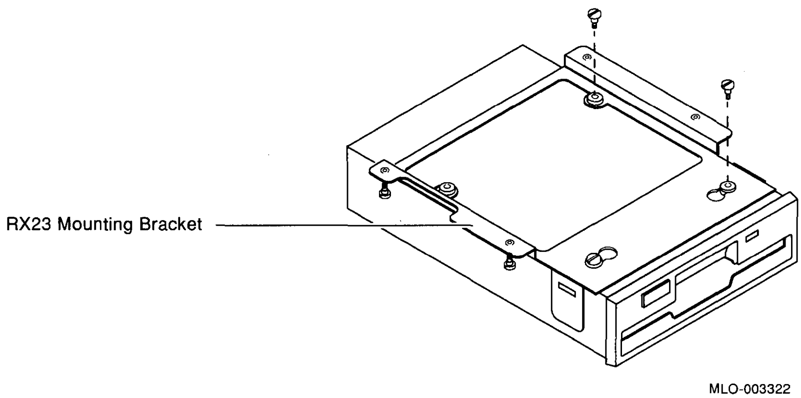
1 Remove the system unit cover (see Section 3.2).

2 Remove the upper drive mounting panel (see Section 3.3).

3 Disconnect the ribbon cable and the power cable from the connectors at the back of the RX23 diskette drive.

4 Unscrew the four screws securing the RX23 mounting bracket to the drive mounting panel, and lift out the RX23 with the bracket attached (see Figure 3–14).

Figure 3–14 RX23 Mounting Bracket Screws

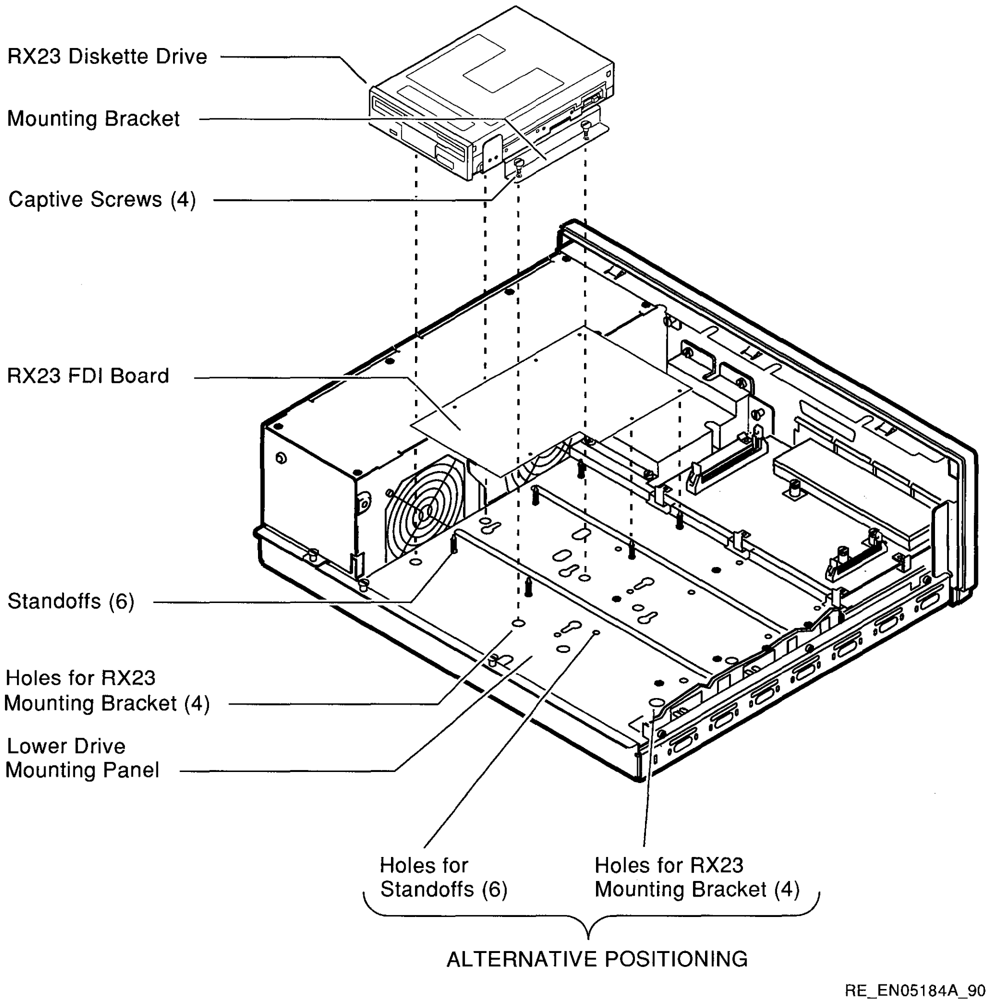


5 Remove the four screws securing the faulty RX23 diskette drive to the mounting bracket.

6 Disconnect the SCSI cable and the power cable from the connectors on the FDI board.

7 Release the FDI board from the six standoffs, then lift it off the drive mounting panel (see Figure 3–15).

Figure 3–15 Removing the FDI Board



8 Set the switches on the new FDI board to the settings of the drive that you removed. Figure 3–16 shows the location of the SCSI switches on the FDI board.

Figure 3–16 FDI Board SCSI Switch Locations

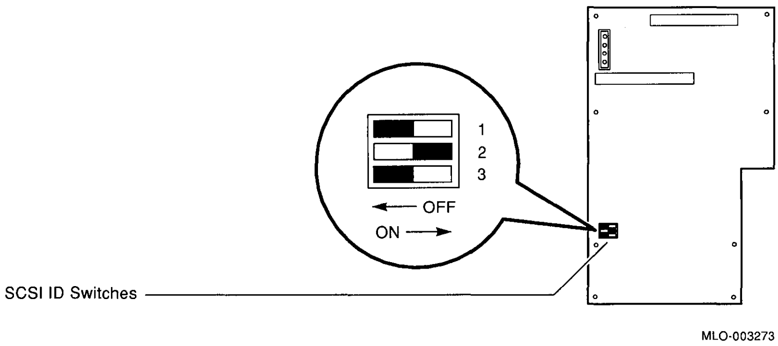


Table 3–5 shows the setting of the SCSI ID switches on the RX23 FDI board for the valid SCSI ID addresses.

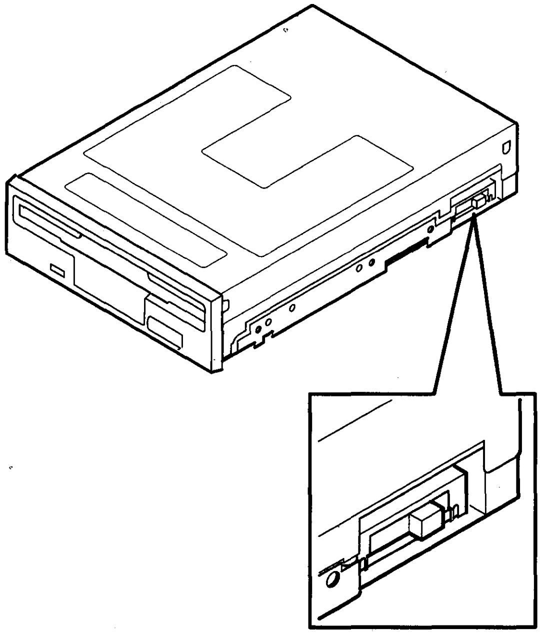
Table 3–5 RX23 SCSI ID Switch Settings

Address ID on SCSI Bus	RX23 Switch Settings 1	2	3
0	Off	Off	Off
1	Off	Off	On
2	Off	On	Off
3	Off	On	On
4	On	Off	Off
5	On	Off	On
6	On	On	Off
7[1]	On	On	On

[1]Reserved address ID for SCSI bus controller.

9 Set the select switch on the new drive to the setting on the drive that you removed. Figure 3–17 shows the location of the select switch.

Figure 3–17 RX23 Select Switch Position



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3.10 MS44 Memory Module Removal

Remove an MS44 memory module as follows:

1 Remove the system unit cover (see Section 3.2).

2 Remove the upper drive mounting panel (see Section 3.3).

3 Remove the DHT80 asynchronous module, if installed (see Section 3.4).

4 Remove the lower drive mounting panel (see Section 3.5).

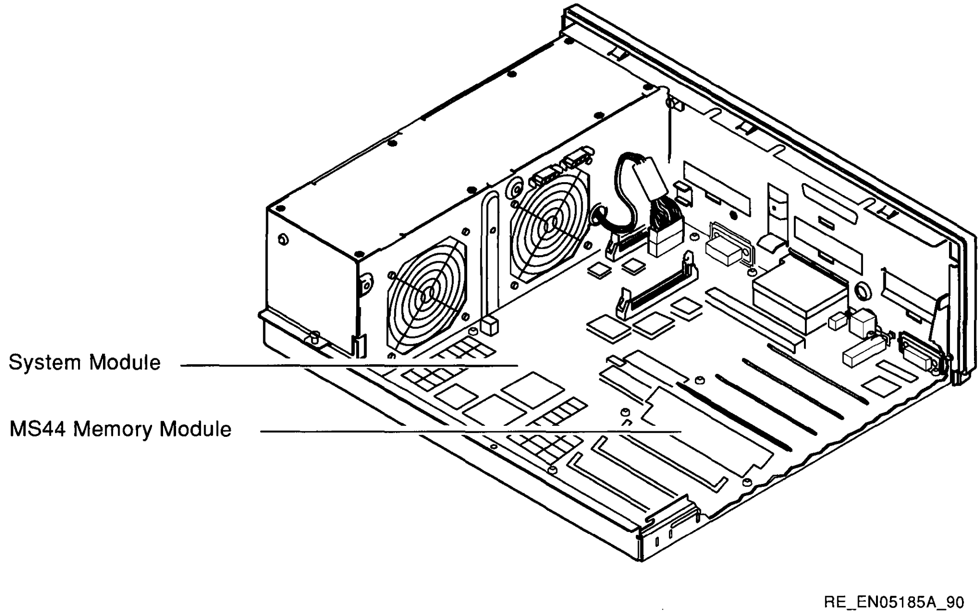
5 Locate the faulty MS44 memory module.

Note *Note the position of the faulty MS44 memory module on the system module. You must install a replacement in this position.*

6 Push the tabs on the MS44 memory module connector away from the center, tilt the MS44 memory module forward, and lift it out of its connector.

Caution *The MS44 memory module connectors are keyed so that you cannot install them with an incorrect orientation. Do not try to force the module into the connector with an incorrect orientation.*

Figure 3–18 MS44 Memory Module Removal



3.11 System Module Removal

Remove the system module as follows:

1 Remove the system unit cover (see Section 3.2).

2 Remove the upper drive mounting panel (see Section 3.3).

3 Remove the DHT80 asynchronous module, if installed (see Section 3.4).

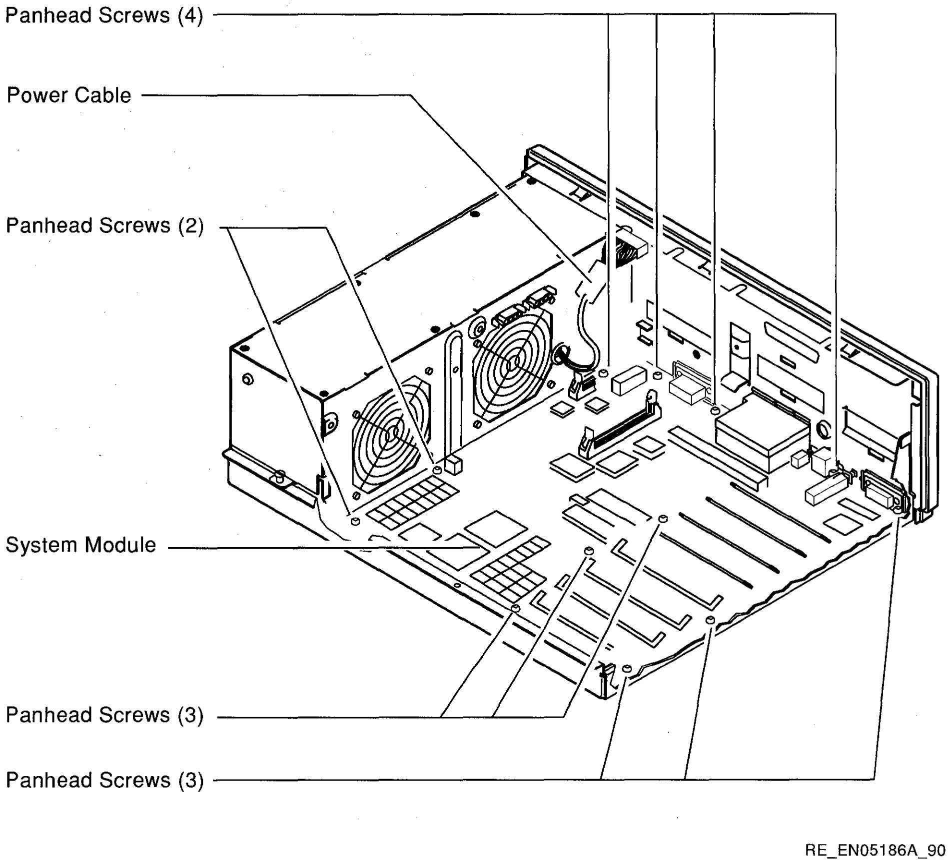
4 Remove the lower drive mounting panel (see Section 3.5).

5 Disconnect the power cable from the system module (see Figure 3–19).

Note *The power cable connector has a release tab. You must press this tab to disconnect the power cable from the system module.*

6 Remove the 12 panhead screws from the system module (see Figure 3–19).

Figure 3–19 System Module Screw Locations



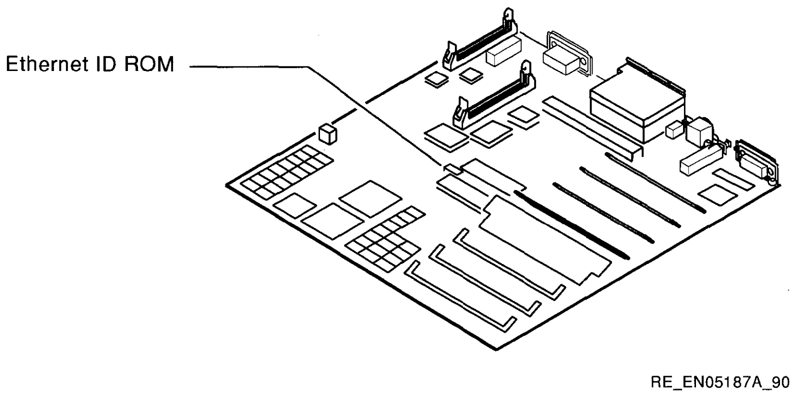
7 Remove the system module by carefully lifting the module out of the system unit.

Note *When reinstalling the system module, first install the connector end through the openings in the back of the unit. Push the module back to load the connector ground tabs. All screw holes are then aligned.*

Caution *In step 8, be careful not to bend the pins on the Ethernet ID ROM chip.*

8 Remove the Ethernet ID ROM chip from the system module that you removed (see Figure 3–20). Note the position of pin 1 (notched) on the chip. Install the Ethernet ID ROM chip on the new system module.

Figure 3–20 Location of the Ethernet ID ROM Chip on the System Module



9 Make sure that the security switch on the system module is in the secure (up) position. This allows you to enter a password to make the system secure (see Section 1.7.1).

Note *To clear the password, set the security switch to the insecure (down) position while the system is on, and then set it to the secure (up) position.*

3.12 Power Supply Removal

Remove the power supply as follows:

1 Remove the system unit cover (see Section 3.2).

2 Remove the upper drive mounting panel (see Section 3.3).

3 Remove the DHT80 asynchronous module (see Section 3.4).

4 Remove the lower drive mounting panel (see Section 3.5).

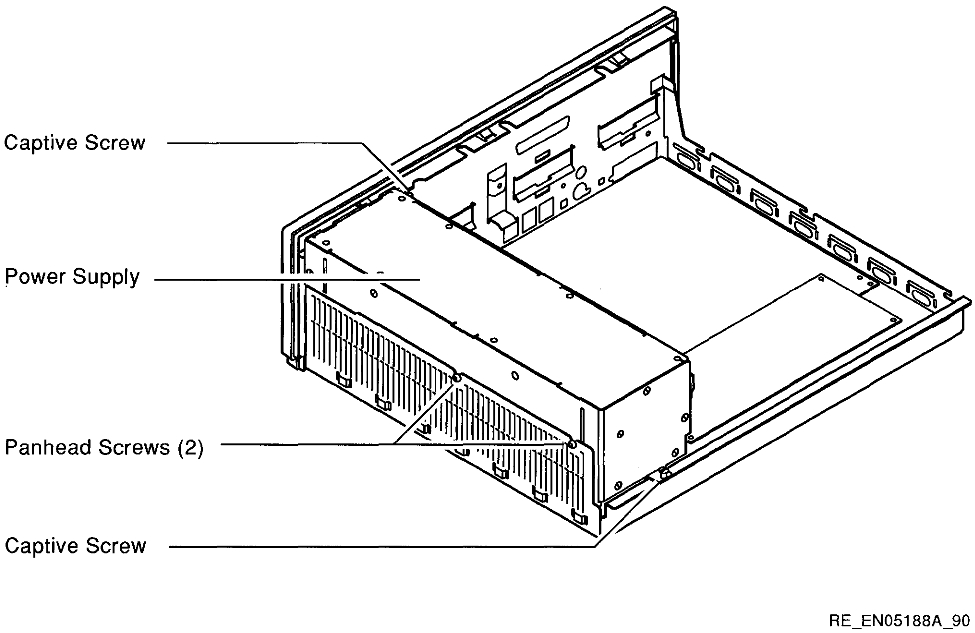
5 Disconnect the power cable from the system module.

6 Loosen the two captive screws and the two panhead screws (see Figure 3–21).

7 Disconnect, from the faulty power supply, the two cables that supply power to the storage devices.

8 Lift the faulty power supply out of the system unit.

Figure 3–21 Power Supply Screw Locations



3.13 Installing Options

There are two system specific options available for the DECsystem 5100 as follows:

- DHT80 asynchronous module
- MS44 memory module

3.13.1 DHT80 Asynchronous Module

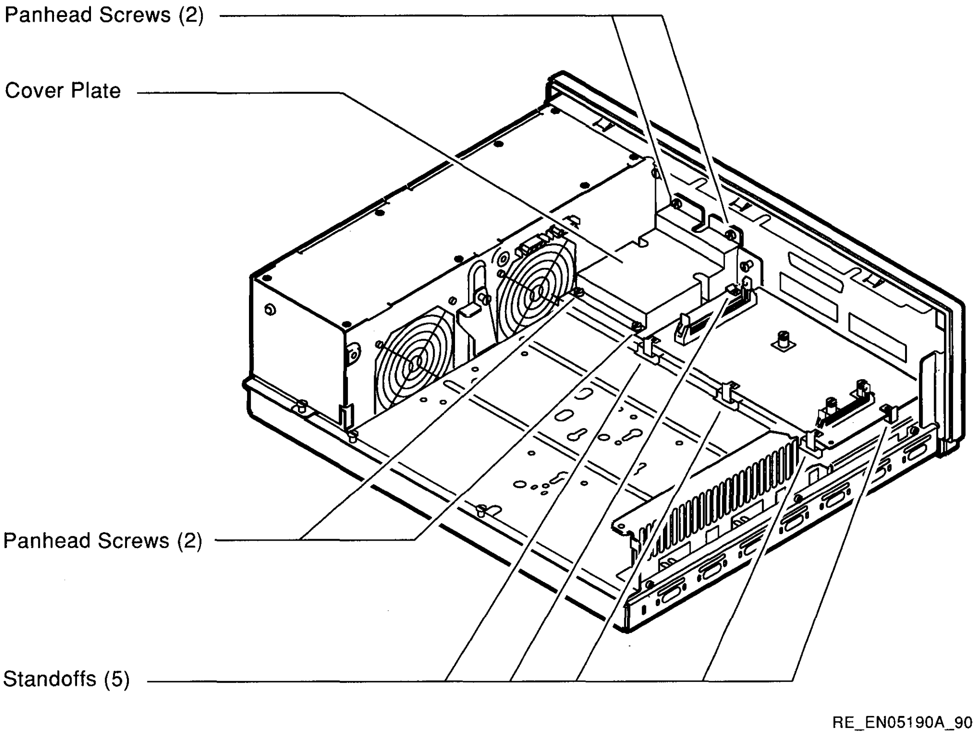
The DHT80 asynchronous module provides seven DEC423 ports and one RS232 full modem port. Install the DHT80 asynchronous module as follows:

1 Remove the system unit cover (see Section 3.2).

2 Remove the upper drive mounting panel (see Section 3.3).

3 Remove the two screws securing the cover plate to the lower drive mounting panel (see Figure 3–22). Remove the two screws securing the cover plate to the back panel of the system unit. Remove the cover plate. Store the screws in a safe place.

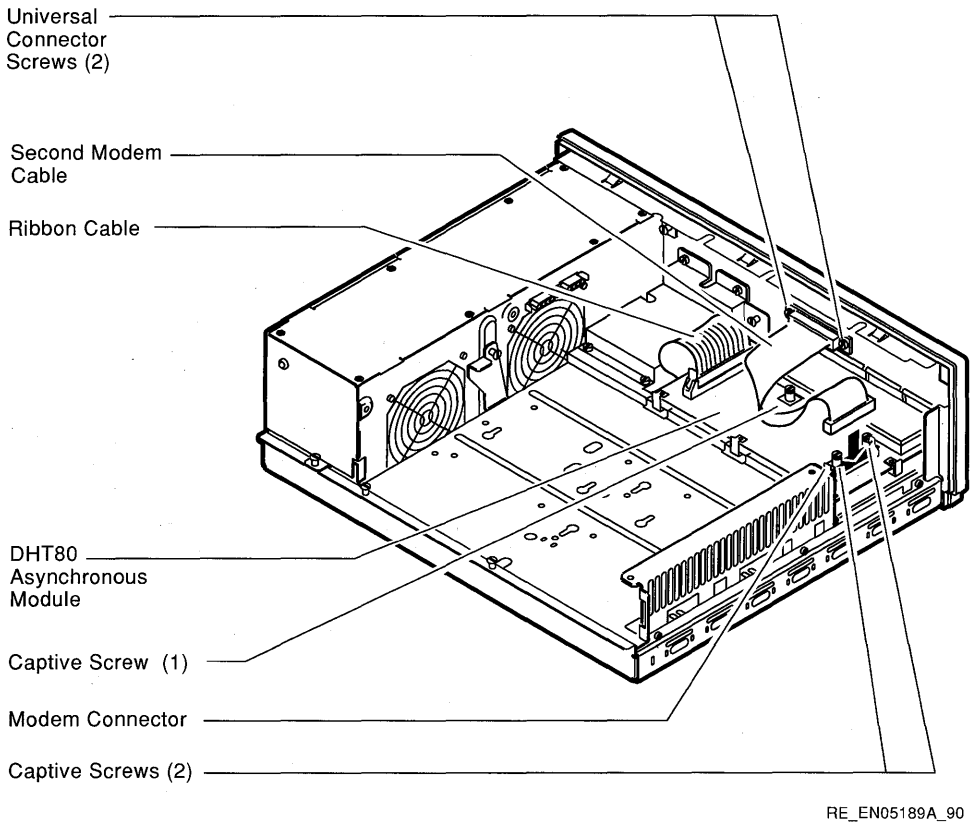
Figure 3–22 Accessing the Asynchronous Connector on the System Module



4 Install the DHT80 asynchronous module onto the five standoffs on the lower drive mounting panel (see Figure 3–22).

5 Tighten the three captive screws on the DHT80 asynchronous module (see Figure 3–23).

Figure 3–23 DHT80 Asynchronous Module Installation



6 Connect one end of the ribbon cable (supplied with the option) to the asynchronous connector on the system module. Lock the connector in place with the connector clips.

7 Connect the other end of the ribbon cable to the DHT80 asynchronous module (see Figure 3–23). Lock the connector in place with the connector clips.

8 Install the cover plate, using the four screws retained in step 3.

9 Connect the second modem cable to the second modem connector on the DHT80 asynchronous module (see Figure 3–23).

10 Align the other cable connector with the cut-out on the back panel of the system unit. Secure the connector to the chassis with the two universal connector screws (see Figure 3–23).

11 Reassemble the system.

12 Run the diagnostic tests (see Chapter 2) to make sure that the option is operating correctly.

3.13.2 MS44 Memory Modules

The system module in the DECsystem 5100 contains eight connectors for MS44 memory modules. These connectors make up four memory banks. You must install two MS44 memory modules to fill a memory bank. Each MS44 memory option contains two MS44 memory modules as follows:

- The MS44-BA memory option contains two 4MB memory modules (MS44-AA).
- The MS44-DA memory option contains two 16MB memory modules (MS44-CA).

You can add memory to your system by installing one of these memory options into one of the memory banks on the system module.

Note *You can install both types of memory option on the system module, but you cannot install a 4MB memory module, and a 16MB memory module, in the same memory bank.*

Note *In systems with mixed memory module types, you must position the higher density memory modules (MS44-DA) in the lowest possible memory banks.*

Table 3–6 shows the possible memory configurations.

Table 3–6 Possible Memory Configurations

Bank 0	Bank 1	Bank 2	Bank 3	Memory Size (MB)
MS44-BA	-	-	-	8
MS44-BA	MS44-BA	-	-	16
MS44-BA	MS44-BA	MS44-BA	-	24
MS44-BA	MS44-BA	MS44-BA	MS44-BA	32
MS44-DA	-	-	-	32
MS44-DA	MS44-BA	-	-	40
MS44-DA	MS44-BA	MS44-BA	-	48
MS44-DA	MS44-BA	MS44-BA	MS44-BA	56
MS44-DA	MS44-DA	-	-	64
MS44-DA	MS44-DA	MS44-BA	-	72
MS44-DA	MS44-DA	MS44-BA	MS44-BA	80
MS44-DA	MS44-DA	MS44-DA	-	96
MS44-DA	MS44-DA	MS44-DA	MS44-BA	104
MS44-DA	MS44-DA	MS44-DA	MS44-DA	128

Install an MS44 memory option as follows:

1 Remove the system unit cover (see Section 3.2).

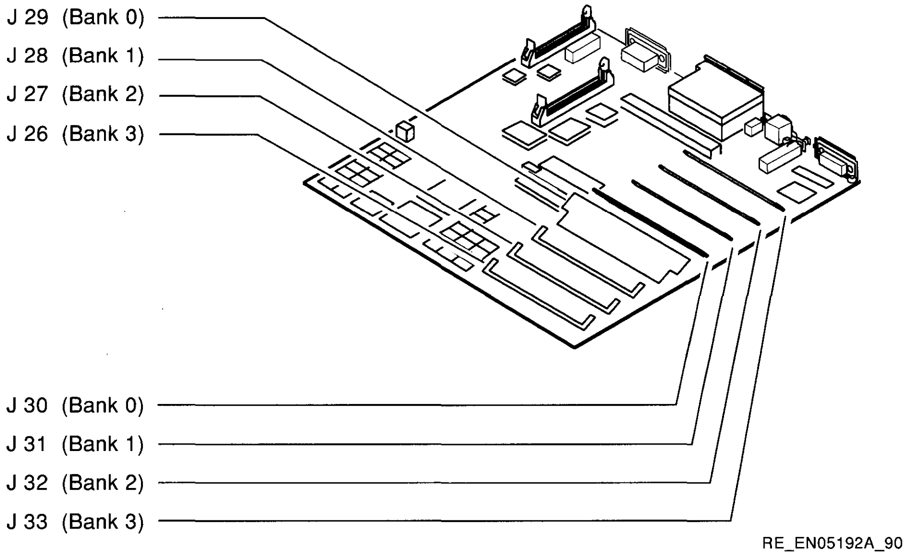
2 Remove the upper drive mounting panel (see Section 3.3).

3 Remove the DHT80 asynchronous module, if installed (see Section 3.4).

4 Remove the lower drive mounting panel (see Section 3.5).

5 Identify the connectors of the memory bank into which you want to install the memory modules (see Figure 3–24 and Table 3–6).

Figure 3–24 Memory Bank Connector Identification



6 Insert the first MS44 memory module, with the side containing the bar code label facing up, into the connector on the system module. Gently press down on the module, until the tabs on the connector snap, locking the module into position.

Caution *The connectors are keyed so that you can install MS44 memory modules with the correct orientation. Do not force the modules into the connectors with an incorrect orientation.*

7 Repeat the procedure in step 6 for the second MS44 memory module, installing it into the other connector of the memory bank.

8 Reassemble the system unit.

9 Run the diagnostic tests (see Chapter 2) to make sure that the option is operating correctly.

A
Console Commands

This appendix describes the console commands that you can enter when the system is in console mode.

Note *If the system is in security mode (that is, the console prompt is S>), you can enter only two valid commands (without options or arguments). The two commands are: boot and passwd.*

Note *The console commands are case sensitive. You must enter lowercase commands on your console terminal in lowercase letters.*

A.1 Boot Command (boot)

This command specifies a file from which the system loads the operating system software. The format of this command is as follows:

boot [-f FILE] [-(s | m)] [-n] [ARG...]

- The -f option followed by the FILE parameter specifies the file you want to use during a boot procedure. If you do not specify the -f option and a FILE parameter, then the system uses the file specified by the environment variable, *bootpath*. See Section A.14 for more information on the *bootpath* variable.

  The FILE parameter has the format:

  dev(controller,unit,lbn)filename

  - dev - specifies the device from which you are booting the operating system software. Typical device types are as follows: hard disk (rz), tape (tz), and network using the MOP protocol (mop) or the BOOTP protocol (tftp).
  - controller - specifies the ID number of the controller.

- unit - specifies the unit number of the device from which you are booting the operating system software.
- lbn - specifies the logical block number that specifies the absolute block number from the beginning of the disk.
- filename - specifies the name of the operating system software file.

Note *When you do not enter values for controller, unit, or lbn, the system uses default values of zero.*

- The -s option specifies that the operating system software file boots in singleuser mode.
- The -m option specifies that the operating system software file boots in multiuser mode.

Note *When you do not specify the -m option or the -s option, the system uses the default option, -m.*

- The -n option specifies that the file loads but does not run.
- The parameter ARG... represents data that you want to pass to the booting operating system file.

A.2 Configuration Command (conf)

This command displays the system configuration. The format of this command is as follows:

conf [-(b | f | m | s | g)]

- The -b option directs the system to display a brief system configuration. Example A–1 shows an example of a brief system configuration display.

Example A–1 Brief System Configuration Display

```
>> conf -b

hardware: revision 1
firmware: revision 1
Ethernet hardware address: 08-00-2b-12-7f-58
option board: Asynch Comm, 8 ports
memory: total size 16MBs
scsi peripherals
  unit type         product              removable/fixed
    0  disk         RZ56      (C) DEC    fixed
    2  cdrom        RRD40      TM DEC    removable
    3  tape         TZK50                removable
    5  tape         TZ30                 removable
    7  host adapter
```

- The -f option directs the system to display a full system configuration table. Example A–2 shows an example of a full system configuration display.

Example A–2 Full System Configuration Display

```
>> conf -f

hardware: revision 1
firmware: revision 1
cpu: revision 2.32
fpu: revision 3.32
security switch: unsecure mode
password: clear
eeprom: valid
Ethernet hardware address: 08-00-2b-12-7f-58
option board: Asynch Comm, 8 ports
memory: total size  16MBs
     bank0   4MB SIMMs  size:  8MBs      0 bad pages
     bank1   4MB SIMMs  size:  8MBs      0 bad pages
scsi peripherals
  unit type         product              removable/fixed    capacity
    0  disk         RZ56      (C) DEC    fixed              634 MBs
    2  cdrom        RRD40      TM DEC    removable          571 MBs
    3  tape         TZK50                removable
    5  tape         TZ30                 removable
    7  host adapter
```

- The -m option directs the system to display the memory configuration. Example A–3 shows an example of a memory configuration display.

Example A–3 Memory Configuration Display

```
>>  conf -m

memory: total size 104MBs
     bank0  16MB SIMMs  size: 32MBs       0 bad pages
     bank1  16MB SIMMs  size: 32MBs       0 bad pages
     bank2  16MB SIMMs  size: 32MBs       0 bad pages
     bank3   4MB SIMMs  size:  8MBs       0 bad pages
```

- The -s option directs the system to display a table of the SCSI devices in the system. Example A–4 shows an example of a SCSI device table.

Example A–4 SCSI Device Table

```
>>  conf -s

scsi peripherals
  unit type         product              removable/fixed    capacity
    0  disk         RZ56     (C) DEC     fixed              634 MBs
    2  cdrom        RRD40     TM DEC     removable          571 MBs
    3  tape         TZK50                removable
    5  tape         TZ30                 removable
    7  host adapter
```

- The -g option directs the system to display general information about the system. Example A–5 shows an example of the general system information display.

Example A–5 General System Information Display

```
>>  conf -g

hardware: revision 1
firmware: revision 1
cpu: revision 2.32
fpu: revision 3.32
security switch: secure mode
password: clear
eeprom: valid
Ethernet hardware address: 08-00-2b-12-7f-58
option board: not present
```

A.3 Continue Command (continue)

This command causes the CPU to begin executing instructions from the address currently stored in the program counter. The format of this command is as follows:

continue

Note *You can use this command to return to the operating system from the console mode. This command works only if you have set the variable bootmode so that you enter console mode by pressing the halt/reset button (see Table A–1).*

A.4 Deposit Command (d)

This command deposits a single byte, halfword or word value at the address that you specify. The format of this command is as follows:

d [[[-(b | h | w)] [ADDR]] | [-H REG]] VAL

- The -b option indicates a single byte.
- The -h option indicates a halfword.
- The -w option indicates a word.

Note *If you do not specify any of these options, the system uses the default option, -w.*

- The parameter ADDR represents a virtual address. For example, to deposit a value at physical address location 0, enter an ADDR value of 0x80000000.

Note *When you do not enter an address, the default address is the address immediately before the last address accessed by the last e (examine), or d (deposit) command.*

- The -H option specifies that the value VAL is to be deposited in one of the system halt state memory locations. These memory locations store internal system register values when the system is halted.
- The parameter REG is used in conjunction with the -H option and specifies the internal system register into which the system loads the value VAL.
- The parameter VAL represents a specific numeric value.

A.5 Disable Command (disable)

This command removes a console device from the current list of enabled console devices.

disable DEV

- The parameter DEV is an ASCII string representing the console device you want to disable. You can enter the following values:
  - tty(0)
  - tty(1)
  - tty(2)
  - tty(3)

If you do not enter a value for DEV, the system displays the current list of enabled console devices.

A.6 Dump Command (dump)

This command shows a formatted display of the contents of memory. The format of this command is as follows:

dump [-H] | [[[[-(b | h | w)] [-(o | d | u | x | c | B)]] | [-I]] RNG]

- The -H option displays the contents of the halt state memory block that contains the values of internal system registers when the system is halted.
- The -b option displays memory in bytes.
- The -h option displays memory in halfwords.
- The -w option displays memory in words.
- The -o option displays memory in octal format.
- The -d option displays memory in decimal format.
- The -u option displays memory in unsigned decimal format.
- The -x option displays memory in hexadecimal format.
- The -c option displays memory in ASCII format.
- The -B option displays memory in binary format.
- The -I option displays memory in R3000 assembly language format (see Example A–6).

Note *When you do not specify any of the options -b, -h , or -w, the system uses the default option, -w.*

The parameter RNG indicates a range of memory contents that the system displays. You can specify the memory range in three different ways:

– ADDR - displays the contents of a single address location specified by the parameter ADDR.

- ADDR#CNT - displays the contents of a number of address locations. The parameter ADDR specifies the address of the first location that the system displays. The parameter CNT specifies the number of address locations that the system displays after the starting address.
- ADDR1:ADDR2 - displays the contents of the address locations between the two addresses ADDR1 and ADDR2.

Example A–6 Example of Assembly Language Format Display

```
>> dump I 0x80030200:0x80030220

0x80030200:    c048228    jal      0x801208a0
0x80030204:       2021    addu     a0,zero,zero
0x80030208:   8fbf0014    lw       ra,0x14(sp)
0x8003020c:   27bd0018    addiu    sp,0x18
0x80030210:    3e00008    jr       ra
0x80030214:          0    nop
0x80030218:   27bdffe8    addiu    sp,0xffe8
0x8003021c:   afbf0014    sw       ra,0x14(sp)
```

A.7 Examine Command (e)

This command displays the byte, halfword, or word of the address you specify. The format of this command is as follows:

e [-(b | h | w)] [ADDR]

- The -b option indicates a single byte.
- The -h option indicates a halfword.
- The -w option indicates a word.

Note *When you do not specify any of the options -b, -h, or -w, the system uses the default option, -w.*

- The parameter ADDR represents a virtual address. For example, when you want to examine the contents of physical address location 0, enter an ADDR value of 0x80000000.

A.8 Enable Command (enable)

This command adds a console device to the current list of enabled console devices.

enable DEV

- The parameter DEV is an ASCII string representing the console device you want to enable. You can enter the following values:
  - tty(0)
  - tty(1)
  - tty(2)
  - tty(3)

If you do not enter a value for DEV, the system displays the current list of enabled console devices.

A.9 Fill Command (fill)

This command places the value that you specify in the range of memory locations that you specify. When you do not specify a value, the system puts zeros in the range of memory locations that you specify. The format of this command is as follows:

fill [-(b | h | w)] [-v VAL] RNG

- The -b option indicates a single byte.
- The -h option indicates a halfword.
- The -w option indicates a word.

Note *When you do not specify any of the options -b, -h, or -w, the system uses the default option, -w.*

- The -v option specifies that you are putting the numeric value, represented by the parameter VAL, into the memory locations that you specify.
- The parameter RNG indicates the range of memory into which the system places the value represented by the parameter VAL. You can specify the memory range in three different ways:
  - ADDR - specifies a single address location.
  - ADDR#CNT - specifies a range of address locations. The parameter ADDR specifies the first address location of the range. The parameter CNT specifies the number of address locations in the range.

- ADDR1:ADDR2 - specifies a range of address locations. The parameter ADDR1 specifies the first address of the range. The parameter ADDR2 specifies the last address of the range.

A.10 Go Command (go)

This command transfers program control to the address you specify. The format of this command is as follows:

go [PC]

The parameter PC is the entry point address to which you want to transfer control.

When you do not specify an entry point address, the system uses the entry point address of the program module that the system has most recently loaded. If the system has not loaded a program module, it uses address 0 as the entry point address.

A.11 Help Command (help) (?)

This command displays the correct format of the command you specify. The format of this command is as follows:

help [CMD]

or,

? [CMD]

The parameter CMD represents the command for which you want information. When you do not specify a command, the system displays the complete console menu. Example A–7 shows the console menu.

Example A–7 Console Menu

```
CMD:
  boot [-f FILE] [-(s|m)] [-n] [ARG...]
  conf [-(b|f|m|s|g)]
  continue
  d [[[-b|h|w)] [ADDR]] | [(-H REG)]] VAL
  disable DEV
  dump [-H] | [[[[-(b|h|w)] [-(o|d|u|x|c|B)]] | [-I]] RNG]
  e [-(b|h|w)] [ADDR]
  enable DEV
  fill [-(b|h|w)] [-v VAL] RNG
  go [PC]
  help [CMD]
  init
  passwd [-(c|s|u)]
  printenv [EVAR...]
  setenv EVAR STR
  scsi [?] | [cmd [unit] [parm]]
  test [?] | [[-v] [-(f|h)] [-r[REPS]] [-s] TNUM [parm1 parm2 parm3..
  unsetenv EVAR
  ? [CMD]
RNG:
  ADDR#CNT
  ADDR:ADDR
```

A.12 Init Command (init)

This command performs a full system initialization. The format of this command is as follows:

init

The init command performs the same initialization procedure that is performed when you turn on the system unit, or when you press the halt/reset button. However, the system does not execute the power-up self-test.

A.13 Password Command (passwd)

This command allows you to:

- Enter privileged mode
- Set a new password
- Clear the currently stored password
- Exit privileged mode

Note *If the system is in secure mode and you do not know the password, you must set the security switch on the system module to the insecure (down) position, and then to the secure (up) position while the system is on. This action resets the password to zero. You can now enter a new password and make the system secure, using the passwd command. See Section 1.7.1 for more information on system security.*

The format of the command is as follows:

passwd [-(c | s | u)]

When you do not specify any of the options in the command, the system prompts you for the system password. Enter the password.

Note *The system does not display the password as you enter it.*

When the password you enter matches the current system password, the system assigns you a privileged status.

When the password you enter does not match the current system password, the system assigns you an unprivileged status. Also, the system maintains a record of the number of incorrect passwords entered.

- The -c option allows you to clear the system password. This is equivalent to disabling system security.
- The -s option allows you to set the system password. The system prompts you for a password twice. When you enter the same password each time, the system accepts the password you enter as the new system password. On the next system power-up, the console prompt is S> and you must enter the correct password.
- The -u option assigns you an unprivileged status.

A.14 Print Environment Command (printenv)

This command displays the current value of the specified environment variable. The format of this command is as follows:

printenv [EVAR]

The parameter EVAR represents the variable, the value of which, you want to display. When you do not specify a variable, the system displays a table showing the values of all the environment variables. Example A–8 is a typical environment variable table.

Example A–8 Environment Variable Table

```
bootpath=rz()vmunix
bootmode=a
console=0
scsiid0=7
iooption=0x0
baud0=9600
systype=0x820c0101
inetaddr=0
baud1=9600
baud2=9600
baud3=9600
bitmap=0xa07ff800
bitmaplen=0x200
```

The system puts the environment variables into classes according to the type of memory in which they reside as follows:

- Volatile - the system stores variables in memory that is lost when you switch the power off
- Nonvolatile - the system stores variables in memory that is not lost when you switch the power off
- Initialized - the console program automatically initializes the memory that stores the values of these variables.

Table A–1 describes the types of default environment variables.

Table A–1 Default Environment Variables

Variable	Type	Description
baud0	Nonvolatile	Baud rate of the tty(0) terminal line. The allowed values are as follows: 75, 110, 134, 150, 300, 600, 1200, 2400, 4800, 9600 (default). The system enables this terminal line at power-up.
baud1	Initialized	Baud rate of the tty(1) terminal line. The allowed values are as follows: 75, 110, 134, 150, 300, 600, 1200, 2400, 4800, 9600 (default). The system disables this terminal line at power-up.
baud2	Initialized	Baud rate of the tty(2) terminal line. The allowed values are as follows: 75, 110, 134, 150, 300, 600, 1200, 2400, 4800, 9600 (default). The system disables this terminal line at power-up.

(continued on next page)

Table A–1 (Cont.) Default Environment Variables

Variable	Type	Description
baud3	Initialized	Baud rate of the tty(3) terminal line. The allowed values are as follows: 75, 110, 134, 150, 300, 600, 1200, 2400, 4800, 9600 (default). The system disables this terminal line at power-up.
bootpath	Nonvolatile	A string containing the complete boot path specification. The boot path has two fields: the boot device and the boot file (see Section A.1.)
bootmode	Nonvolatile	A one character control code that specifies the action taken by the console program on power-up or when you press the halt/reset button. The allowed control characters are as follows: ■ * - causes no specific action. This is the default value. ■ a - automatically boots the system from the device and file specified in the *bootpath* variable ■ d - halts the system before running the power-up diagnostics ■ h - enables the halt interrupt mechanism
bitmap	Initialized	The hexadecimal address of the memory bitmap table. The memory bitmap table is a vector of words. Each bit in each word corresponds to a page in memory. If the bit is set to 1, the memory page is good and available to the system. If the bit is set to 0, the page is bad.
bitmaplen	Initialized	The length of the memory bitmap in words. Do not change the value of this variable.
iooption	Nonvolatile	Specifies the type of Input/Output Option present.
inetaddr	Initialized	Specifies the internet address that the BOOTP protocol uses. The default value is zero.
console	Nonvolatile	Always selects tty (0).
scsiid0	Nonvolatile	Specifies the SCSI ID address assigned to the SCSI bus adapter. The default value is 7.

(continued on next page)

Table A–1 (Cont.) Default Environment Variables

Variable	Type	Description
systype	Initialized	Provides information identifying the CPU type, the firmware revision level, and the hardware revision level.

A.15 Set Environment Command (setenv)

This command assigns a new value to the specified environment variable. The format of this command is as follows:

setenv EVAR STR

- The parameter EVAR is the variable that you want to set.
- The parameter STR is the string value, to which you want to set the variable.

Table A–1 provides descriptions of the default environment variables that the system sets up. You can add your own environment variables but these variables are stored in volatile memory. The environment variables table can contain up to 16 variables, a total of 256 characters.

A.16 SCSI Command (scsi)

This command allows you to inquire, reset, and test devices on the SCSI bus. The format of this command is as follows:

scsi [?] | [cmd [unit] [parm]]

Enter the command scsi ? and the system then displays a summary of the scsi commands that you can enter. Example A–9 shows the scsi command summary that the system displays.

Example A–9 SCSI Command Summary

```
HELP menu for scsi command

scsi  cmd    unit    parm

      rs                     Reset the SCSI bus
      ri                     Reset the sii
      st                     Dump the sii status registers
      du                     Dump all sii registers
      cd     unit    [r]     Read/write test for SCSI hard drives
      ct     unit    [r]     Read/write test for TZ30 tape drive
      cr     unit    [r]     Read only self test for RRD40 ROM disk drive
      fm     unit            Format fixed disk using default parameters
      iq     unit            Show inquiry response from <UNIT>
      ms     unit            Show mode sense response from <UNIT>
      ry     unit            Show ready status from <UNIT>
      sn     unit            Show request sense response from <UNIT>
      sp     unit            Stop <UNIT>
      sr     unit            Start <UNIT>
      su     unit            Setup <UNIT>, wait for ready status
```

A.17 Test Command (test)

This command allows you to run the ROM-based diagnostic test that you specify by entering the test number. The format of this command is as follows:

test [?] | [[-v] [-(f | h)] [-r[REPS]] [-s] TNUM [parm1 parm2 parm3 ....]]

- The ? option displays a list of the tests and test scripts (groups of tests) that the system can run.
- The -v option activates the diagnostic report mode for the duration of test execution.
- The -f option forces the test to continue even if an error is detected. In general, the default is to stop the test on error detection.
- The -h option forces any diagnostic test or diagnostic script to halt as soon as it encounters an error.
- The -r option allows you to repeat a test or test script. The parameter REPS defines the number of times the test repeats. If you do not specify a value for REPS, the test repeats continuously. Press Ctrl/C to stop a repeating test.
- The -s option allows you to create and execute a script of tests. When you specify this option, the system prompts you to enter each test number of the script, one line at a time. End the script by pressing Return twice.

- The parameter TNUM is the number of the test that you want to run. You must enter this number in hexadecimal format.
- The parameters parm1, parm2, and parm3 and so on are the parameters that you want to pass to the test. See Appendix E for more information on test parameters.

Chapter 2 provides more information about the tests that you can perform.

A.18 Unset Environment Command (unsetenv)

This command removes the specified variable from the environment variables table. The format of this command is as follows:

unsetenv EVAR

The parameter EVAR represents the variable that you want to remove. See Table A–1 for a description of the environment variables that the system sets up by default.

Note *The unsetenv command has no effect on environment variables that are stored in nonvolatile memory.*

B

System Specifications

Table B–1 System Specifications

Subject	Description
Processor	KN230 (20 MHz)
EPROM	256KB
EEPROM	32KB
Instruction Cache RAM	64KB
Data Cache RAM	64KB
DRAM memory	8MB, expandable to 32MB or 128MB
Hard disk	RZ23 (104MB) or RZ24 (209MB), 5 devices maximum [1]
Tape drive	TZ30 [1]
Diskette drive	RX23[1]
Terminals	Supports VT series terminals
Interfaces	1 SCSI port, 1 ThinWire Ethernet port[2], 1 Standard Ethernet port[2], 4 asynchronous lines provided by the system module (1 asynchronous line has full modem control) 8 asynchronous lines provided by the optional DHT80 asynchronous module (1 asynchronous line has full modem control)
Input voltage	Automatically adjusting ac input. Range: 100-120 Vac to 220-240 Vac

[1]Depends on configuration

[2]You cannot use both Ethernet types simultaneously

(continued on next page)

Table B–1 (Cont.) System Specifications

Subject	Description
Input current	Typically 2.83 A in a 110 Vac circuit; 1.55 A in a 220 Vac circuit
Power	Typically 170 W
Frequency	47 to 63 Hz

Table B–2 System Unit Metrics

Weight[1]	Height	Width	Depth
20.5 kg	14.99 cm	46.38 cm	40.00 cm
45 lb	5.90 in	18.26 in	15.75 in

[1]Depends on configuration

Table B–3 System Storage Conditions

Temperature range	5°C to 50°C (41°F to 122°F)
Relative humidity	10% to 95% at 66°C (noncondensing)
Altitude	0 to 2400 m (0 to 8000 ft)
Maximum wet bulb temperature	32°C (90°F)
Minimum dew point	2°C (36°F)

Table B–4 System Operating Conditions and Nonoperating Conditions

Operating Conditions	
Temperature range	10°C (50°F) to 32°C (90°F) with TZ30 tape drive; otherwise 10°C (50°F) to 40°C (104°F)
Temperature change rate	11°C (20°F) degree per hour maximum
Relative humidity	10% to 90% noncondensing
Maximum wet bulb temperature	28°C (82°F)
Minimum dew point	2°C (36°F)
Altitude	2400 m (8000 ft) at 36°C (96°F)

(continued on next page)

Table B–4 (Cont.) System Operating Conditions and Nonoperating Conditions

Nonoperating Conditions	
Temperature range	–40°C (–40°F) to 66°C (151°F)
Relative humidity	10% to 95% at 66°C (151°F)
Altitude	4900 m (16,000 ft)
Maximum wet bulb temperature	28°C (82°F)
Minimum dew point	2°C (36°F)

Table B–5 TZ30 Tape Drive Specifications

Subject	Description
Mode of operation	Streaming
Media	12.77 mm (½ in) unformatted magnetic tape
Bit density	2624 b/cm (6667 b/in)
Number of tracks	22
Transfer rate (at host)	62.5KB/s
Tape speed	190 cm/s (75 in/s)
Track format	Multiple track, serpentine recording
Cartridge capacity	95MB, formatted (approximately)

Table B–6 RZ23 and RZ24 Hard Disk Drive Specifications

Formatted Storage Capacity	RZ23	RZ24
Per drive	104MB	209MB
Per surface	13MB	26.2MB
Bytes per track	16,896	19,456
Bytes per block	512	512
Blocks per track	33	38 and 1 spare
Blocks per drive	204,864	409,792
Spare blocks per track	1	-
Spare tracks	-	0
Spare blocks per drive	6,208	10,944

Performance	RZ23	RZ24
Transfer rate to/from media	1.25MB/sec	1.5MB/sec
Transfer rate to/from buffer (asynchronous)	1.5MB/sec	3MB/sec
Transfer rate to/from buffer (synchronous)	1.5MB/sec	4MB/sec
Seek-time track to track	$\leq$ 8 msec	$\leq$ 5 msec
Seek-time average	$\leq$ 25 msec	$\leq$ 16 msec
Seek-time maximum (full stroke)	$\leq$ 45 msec	$\leq$ 35 msec
Average latency	8.4 msec	8.5 msec
Rotational speed	3575 RPM $\pm$0.1%	3497 RPM $\pm$1%
Start time (maximum)	20 sec	20 sec
Stop time (maximum)	20 sec	20 sec
Interleave	1:1	1:1

Functional Specifications	RZ23	RZ24
Recording density (bpi)	23,441	31,800
Flux density (fci)	15,627	21,200
Track density (tpi)	1150	1700
Tracks/surface	776	1348
R/W heads	8	8
Disks	4	4
Time-to-process ECC (512 B)	<100 msec	<100 msec

Table B–7 RX23 Diskette Drive Specifications

Subject	Description
Diskette size	9 cm (3.5 in)
Diskettes/diskette drive	1
Data capacity	1.4MB (RX23K)
Track density	135 TPI
Storage capacity (high density)	600KB

C

Recommended Spares List

Table C–1 DECsystem 5100 FRUs

Part Number	Description	Quantity
54-20420-01	DECsystem 5100 system module	1
54-20428-01	DHT80 asynchronous module	1
MS44-AA	4MB memory module	2
MS44-CA	16MB memory module	2
RZ23-E	104MB SCSI disk drive with logic module	1
29-27240-01	RZ23 module/frame assembly	1
29-28144-01	RZ24 logic module PCB	1
29-28145-01	RZ24 head/disk assembly	1
TZ30-AX	TZ30 95MB/256MB tape drive	1
RX23-E	RX23 diskette drive	1
H7822-00	Power supply	1
17-02295-02	Cable from system module to DHT80 asynchronous module	1
17-02908-01	Second modem port cable (DHT80)	1
17-02907-01	Internal SCSI cable	1
17-02219-01	Power cable for upper drive mounting panel devices	1
17-02464-01	Power cable for lower drive mounting panel devices	1

(continued on next page)

Table C–1 (Cont.) DECsystem 5100 FRUs

Part Number	Description	Quantity
[1]17-00083-43	System power cord (USA)	1
12-25869-01	ThinWire Ethernet T-connector	1
12-26318-01	ThinWire Ethernet cable 50-ohm terminator	2
12-30552-01	50-pin SCSI terminator	1

[1]For 120 Vac US/Canada/Japan orders only. All 240 Vac country specific power cords are a line item on the order.

Table C–2 Miscellaneous Parts

Part Number	Description	Quantity
12-22196-01	Standard Ethernet loopback	1
12-25083-01	MMJ loopback connector (H3103)	4
17-00811-03	BC16E-25 DECconnect office cable (25 feet)	2
17-00811-04	BC16E-50 DECconnect office cable (50 feet)	1
30-25145-05	RX23 blank media	1
12-32442-01	25-pin passive adapter (H8575-A)	1

D
Status LED Display

This appendix describes the significance of the status LED display on the back of the system unit. The status LED display comprises eight LEDs. These LEDs provide system status information during the power-up and extended self-test diagnostics. Table D–1 describes the functions of the individual LEDs.

Table D–1 Status LED Display Interpretation

LED Number † 3210 7654	Significance
1XXX XXXX	Indicates that the system cannot write to the EEPROM on the system module
0XXX XXXX	Indicates that the system can write to the EEPROM on the system module
XX1X XXXX	Indicates that there is a 32MB memory option in memory bank 0
XX0X XXXX	Indicates that there is an 8MB memory option in memory bank 0
X1XX XXXX ‡	Indicates that the maximum baud rate for the serial ports is 9600 baud
X0XX XXXX ‡	Indicates that the maximum baud rate for the serial ports is 19.2 kbaud or 38.4 kbaud

†1 indicates the LED is on, 0 indicates the LED is off, and X indicates a don't care state.

‡Function of LED 2 during normal system operation. LED 2 has a different significance during the diagnostic tests.

(continued on next page)

Table D–1 (Cont.) Status LED Display Interpretation

LED Number † 3210 7654	Significance
XXX1 XXXX	Indicates that reset is enabled and halt disabled
XXX0 XXXX	Indicates that halt is enabled and reset disabled
X1XX 1111	Initial state at power-up, no code has executed
X1XX 1110	Entered ROM, some instructions have executed
X1XX 1101	Stack tested and set
X1XX 1100	NXM taken
X1XX 1011	Security initialization
X1XX 1010	DZ initialization
X1XX 1001	Exception tests
X1XX 1000	FPU test
X1XX 0111	Write buffer test
X1XX 0101	Data cache tag test
X1XX 0110	Instruction cache tag test
X1XX 0100	TLB test
X1XX 0011	Data cache test
X1XX 0010	Instruction cache test
X1XX 0001	Data cache i-stream test
X1XX 0000	Instruction cache i-stream test
X0XX 1111	Memory bitmap test
X0XX 1110	Memory address test
X0XX 1101	Memory data test
X0XX 1100	Memory moving inversion test
X0XX 1011	Memory data shorts test
X0XX 1010	RTC tests
X0XX 1001	DZ tests
X0XX 1000	SII tests
X0XX 0111	LANCE tests

†1 indicates the LED is on, 0 indicates the LED is off, and X indicates a don't care state.

(continued on next page)

Table D–1 (Cont.) Status LED Display Interpretation

LED Number † 3210 7654	Significance
X0XX 0101	EEPROM test
X0XX 0110	Option card test
X0XX 0100	Reserved
X0XX 0011	Console I/O mode
X0XX 0010	Primary boot operation
X0XX 0001	Secondary boot operation
X0XX 0000	Operating system running

†1 indicates the LED is on, 0 indicates the LED is off, and X indicates a don't care state.

E

Parameters Returned by Diagnostic Tests

Certain diagnostic tests use parameters. For each test that uses parameters, a table in this appendix describes the significance of the parameters.

Note *In the tables following, parameter values marked NA are not applicable.*

Table E–1 Exception Test (t 0x1) Parameters

No.	Name	Min	Max	Default	Description
P1	actual	NA	NA	NA	The actual exception code taken
P2	expected	NA	NA	NA	The exception code that should have been taken

Table E–2 Write Buffer Test (t 0x3) Parameters

No.	Name	Min	Max	Default	Description
P1	actual	NA	NA	NA	The data pattern read back from the write buffer address location under test
P2	expected	NA	NA	NA	The data pattern written to the write buffer address location under test
P3	address	NA	NA	NA	The write buffer address location under test

Table E–3 Real Time Clock Test (t 0x4) Parameters

No.	Name	Min	Max	Default	Description
P1	actual	NA	NA	NA	The data pattern read from the address location under test
P2	expected	NA	NA	NA	The data pattern written to the address location under test
P3	address	NA	NA	NA	The address location under test

Table E–4 DZ Test (t 0x5) Parameters

No.	Name	Min	Max	Default	Description
P1	loopback	0	1	0	0 = Internal loopback mode, 1 = External loopback mode
P2	line	1	12	0	Serial line number to test
P3	iteration	1	999	0	Iteration count - specifies the number of times the test executes
P4	xmit	-	-	-	Data transmitted on a given line
P5	rcvd	-	-	-	Data received on a given line
P6	line	-	-	-	The line on which an error was detected

Table E–5 SCSI Test (t 0x6) Parameters

No.	Name	Min	Max	Default	Description
P1	actual	NA	NA	NA	The data pattern read from the SCSI controller chip or buffer
P2	expected	NA	NA	NA	The data pattern the CPU expects to read from the SCSI controller chip or buffer
P3	address	NA	NA	NA	The address of the location that failed to store the data properly

Table E–6 EEPROM Test (t 0x8) Parameters

No.	Name	Min	Max	Default	Description
P1	xsum_was	NA	NA	NA	Calculated checksum of EEPROM
P2	xsum_ should_ be	NA	NA	NA	Checksum stored on the EEPROM

Table E–7 Data Cache Test (t 0x15, t 0x16, t 0x17, t 0x18, t 0x19, t 0x1a) Parameters

No.	Name	Min	Max	Default	Description
P1	actual	NA	NA	NA	The data pattern read back from the data cache RAM address location under test
P2	expected	NA	NA	NA	The data pattern written to the data cache RAM address location under test
P3	address	NA	NA	NA	The data cache RAM address location under test

Table E–8 Instruction Cache Test (t 0x1b, t 0x1c, t 0x1d, t 0x1e, t 0x1f, t 0x20) Parameters

No.	Name	Min	Max	Default	Description
P1	actual	NA	NA	NA	The data pattern read back from the instruction cache RAM address location under test
P2	expected	NA	NA	NA	The data pattern written to the instruction cache RAM address location under test
P3	address	NA	NA	NA	The instruction cache RAM address location under test

Table E–9 Memory Test (t 0x30, t 0x31, t 0x32, t 0x33, t 0x34) Parameters

No.	Name	Min	Max	Default	Description
P1	start_addr	0xA0000000	0xA8000000	0xA0010000	The first address of memory to test
P2	end_addr	0xA0000000	0xA8000000	0xA0010000	The last address of memory to test
P3	offset	0x1	0x10000000	0x4	Offset in longwords to next address of memory to test
P4	actual	NA	NA	NA	The actual data read from memory
P5	expected	NA	NA	NA	The data that the CPU expected to read from memory
P6	address	NA	NA	NA	The address of the failed memory location

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ader's Comments

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ity (easy to understand)	☐	☐	☐	☐
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