Sun StorEdge™ D2 Array Best Practices Guide

Sun Microsystems, Inc.
4150 Network Circle
Santa Clara, CA 95054 U.S.A.
650-960-1300

Part No. 816-3311-10
January 2002, Revision A

Send comments about this document to: docfeedback@sun.com

Please
Recycle

Adobe PostScript

Contents

Figures

Tables

Preface

The *Sun StorEdge D2 Array Best Practices Guide* is intended for use by experienced Sun™ engineering personnel (FE, SE, SSE, and CTE). It is not intended to replace the existing documentation set, but rather to serve as a single point of reference that provides some answers to questions relating to common installation and service tasks. Further, it serves as a roadmap to more detailed information already provided in the current documentation set and on Sun web sites.

Before You Read This Book

To fully use the information in this document, you must have thorough knowledge of the topics discussed in all of the documents listed in “Related Documentation” on page xiii.

How This Book Is Organized

This manual is organized as follows:

Chapter 1 introduces the Sun StorEdge D2 array features, including an overview of hardware and software.

Chapter 2 provides information, guidelines, and tips relating to the installation and configuration of hardware.

Chapter 3 provides a functional description of the Sun StorEdge D2 Environment Services Module (ESM).

Chapter 4 describes the Sun StorEdge D2 ESM switches and options.

Chapter 5 provides supplemental maintenance and service information.

Chapter 6 describes the SCSI Accessed Fault-Tolerant Enclosures (SAF-TE) commands.

Chapter 7 provides information on downloadable images for array VPD settings and factory defaults.

Appendix A lists sense codes used by the Sun StorEdge D2 ESM.

Using UNIX Commands

This document may not contain information on basic UNIX® commands and procedures such as shutting down the system, booting the system, and configuring devices.

See one or more of the following for this information:

- *Solaris Handbook for Sun Peripherals*
- AnswerBook2™ online documentation for the Solaris™ software environment
- Other software documentation that you received with your system

Shell Prompts

Shell	Prompt
C shell	*machine_name*%
C shell superuser	*machine_name*#
Bourne shell and Korn shell	$
Bourne shell and Korn shell superuser	#

Typographic Conventions

Typeface or Symbol	Meaning	Examples
`AaBbCc123`	The names of commands, files, and directories; on-screen computer output	Edit your `.login` file. Use `ls -a` to list all files. `% You have mail.`
`AaBbCc123`	What you type, when contrasted with on-screen computer output	`% su` `Password:`
AaBbCc123	Book titles, new words or terms, words to be emphasized	Read Chapter 6 in the *User's Guide.* These are called *class* options. You *must* be superuser to do this.
	Command-line variable; replace with a real name or value	To delete a file, type `rm` *filename.*

Related Documentation

Application	Title	Part Number
Latest updates	*Sun StorEdge D2 Array Release Notes*	816-1718
Installation	*Sun StorEdge A2 and D2 Arrays Cabinet Installation Guide*	816-1696
Installation and Service	*Sun StorEdge D2 Array Installation, Operation, and Service Manual*	816-2578
CD-ROM Installation	*Sun StorEdge D2 Array CD Insert*	804-7982

Accessing Sun Documentation Online

The docs.sun.com℠ web site enables you to access a select group of Sun technical documentation on the Web. You can browse the docs.sun.com archive or search for a specific book title or subject at:

```
http://docs.sun.com
```

A broad selection of Sun system documentation is located at:

```
http://www.sun.com/products-n-solutions/hardware/docs
```

Sun Welcomes Your Comments

Sun is interested in improving its documentation and welcomes your comments and suggestions. You can email your comments to Sun at:

```
docfeedback@sun.com
```

Please include the part number (816-3311-10) of your document in the subject line of your email.

CHAPTER 1

Introduction

This document describes the features of the Sun StorEdge™ D2 Environmental Services Module (ESM).

Note – For the latest information on software and firmware requirements, patch numbers, and supported hardware, refer to the *Sun StorEdge D2 Array Release Notes*.

1.1 Features

The Sun StorEdge D2 ESM is intended as a SCSI attachment to an LVD SCSI JBOD subsystem. It provides two electrically isolated SCSI LVD Ultra3 drive channels with bus isolation, bus repeater functionality, and environmental monitoring through the SCSI Accessed Fault-Tolerant Enclosures (SAF-TE) protocol.

- Board Size = 15.11 cm. x 30.97 cm. (5.95 in. x 12.2 in.)
- Host SCSI Connect
  - 53C180 SCSI chip
  - 8/16 Bit LVD/SE (multimode) host connect
  - Ultra3 SCSI transfer support with 160 MB/sec maximum transfer rate
  - Connection through 68-pin VHDCI SCSI connectors
- Array SCSI Connect
  - Two 53C180 SCSI chips
  - 8/16 Bit LVD
  - Ultra3 SCSI transfer support with 160 MB/sec maximum transfer rate
  - Connection through 290 pin 2 mm. hard metric connector

- SCSI drive IDs set for 0-5, 8-13 (single bus) or 8-13 (split bus). SCSI ID for the 53C040 chip is fixed at 15 (Fh)

- SAF-TE Subsystem Support
- A 53C040 SAF-TE chip - supporting:
  - 2 power supply in-place and fault
  - 1 user option signal
  - 2 fan unit in-place, 4 fan fault, and 4 fan tach signals
  - 12 drive in-place and faults
  - 2 stage temperature monitoring
  - 1 subsystem fault / warning
  - 3.3V, 5V, and 12V levels
- Subsystem Options
  - Dual ESM / Single ESM selector switch
  - Board module ID switch selectable 0-9
  - Fan RPM monitoring for four fans and fan fault outputs

1.2 Web Sites

The internal and external web sites listed in TABLE 1-1 provide quick access to a wide variety of Sun StorEdge D2 related information.

TABLE 1-1 Web Sites

Web Site Name	URL
A1000 / A3*x*00 / A3*x*00FC (Sonoma) Engineering	`http://webhome.ebay/A3x00`
D2 Engineering	`http://webhome.east/workgroupserverstorage/carmel`
Network Storage	`http://webhome.ebay/networkstorage`
Network Storage Test & Engineering (formerly QAST) Group	`http://webhome.ebay/nste`
OneStop Sun Storage Products	`http://onestop.eng/storage`
Enterprise Services Storage ACES	`http://service.central/ACES`

TABLE 1-1 Web Sites *(Continued)*

Web Site Name	URL
LSI Logic	`http://www.lsil.com`
Escalation Web Interface	`http://sdn.sfbay/tools/escweb/EscWeb.html`
CTE Group Europe	`http://cte-www.uk`

Note – The Enterprise Services Storage ACES web page requires a login / password for access to certain areas. The home page includes information on how to obtain a login account.

1.3 Firmware Overview

The SYM53C040 ESM SAF-TE firmware for the Sun StorEdge D2 ESM is a customization of the SYM53C040 firmware. Using the SAF-TE protocol, it monitors and reports the status of the drive slots, fans, temperature sensors, and power supplies on the ESM card. The following is a list of the standard SCSI and SAF-TE commands and messages supported in the firmware.

1. SCSI commands:
   a. INQUIRY (SCSI 2)
   b. READ BUFFER (SCSI 2)
   c. RECEIVE DIAGNOSTIC RESULTS (SCSI 3)
   d. REQUEST SENSE (SCSI 2)
   e. SEND DIAGNOSTIC (SCSI 3)
   f. TEST UNIT READY (SCSI 2)
   g. WRITE BUFFER (SCSI 2)

2. SCSI Messages
   a. COMMAND COMPLETE (00h)
   b. INITIATOR PARITY ERROR Message (05H)
   c. ABORT Message (06h)

d. MESSAGE REJECT Message (07h)

e. NO OPERATION Message (08h)

f. MESSAGE PARITY ERROR Message (09H)

g. BUS DEVICE RESET Message (0Ch)

h. IDENTIFY (80h -FFh)

3. SAF-TE Read Buffer Commands

   a. READ ENCLOSURE CONFIGURATION (00h)

   b. READ ENCLOSURE STATUS (01h)

   c. READ DEVICE SLOT STATUS (04h)

4. SAF-TE Write buffer Commands

   a. WRITE DEVICE SLOT STATUS (10h)

   b. PERFORM SLOT OPERATION (12h)

   c. SEND GLOBAL COMMAND (15h)

1.4 Hardware Overview

Refer to FIGURE 1-1, ESM Block Diagram.

The Sun StorEdge D2 ESM has two host Ultra3 SCSI connections (host 1 and host 2) and two back-end drive Ultra3 SCSI connections (array 1 and array 2). A single 53C040 on the Sun StorEdge D2 ESM reports enclosure status and controls indicators through the SAF-TE command interface. The D2 enclosure supports one or two D2 ESMs (the “0” and “1” ESM, described in Chapter 2).

In single bus mode (and with the ESM in the “0” slot), both host connections communicate with both back-end drive connections. Array 1 maps to SCSI IDs 0-5 and Array 2 maps to SCSI IDs 8-13. In split-bus mode, the connection to Array 2 is disabled for the ESM in the “0” slot and the connection to Array 1 is disabled for the ESM in the “1” slot. Thus the host 1 and host 2 connections on ESM 0 communicate with Array 1 (mapped to SCSI IDs 8-13) and the host 1 and host 2 connections on ESM 1 communicate with Array 2 (mapped to SCSI IDs 8-13).

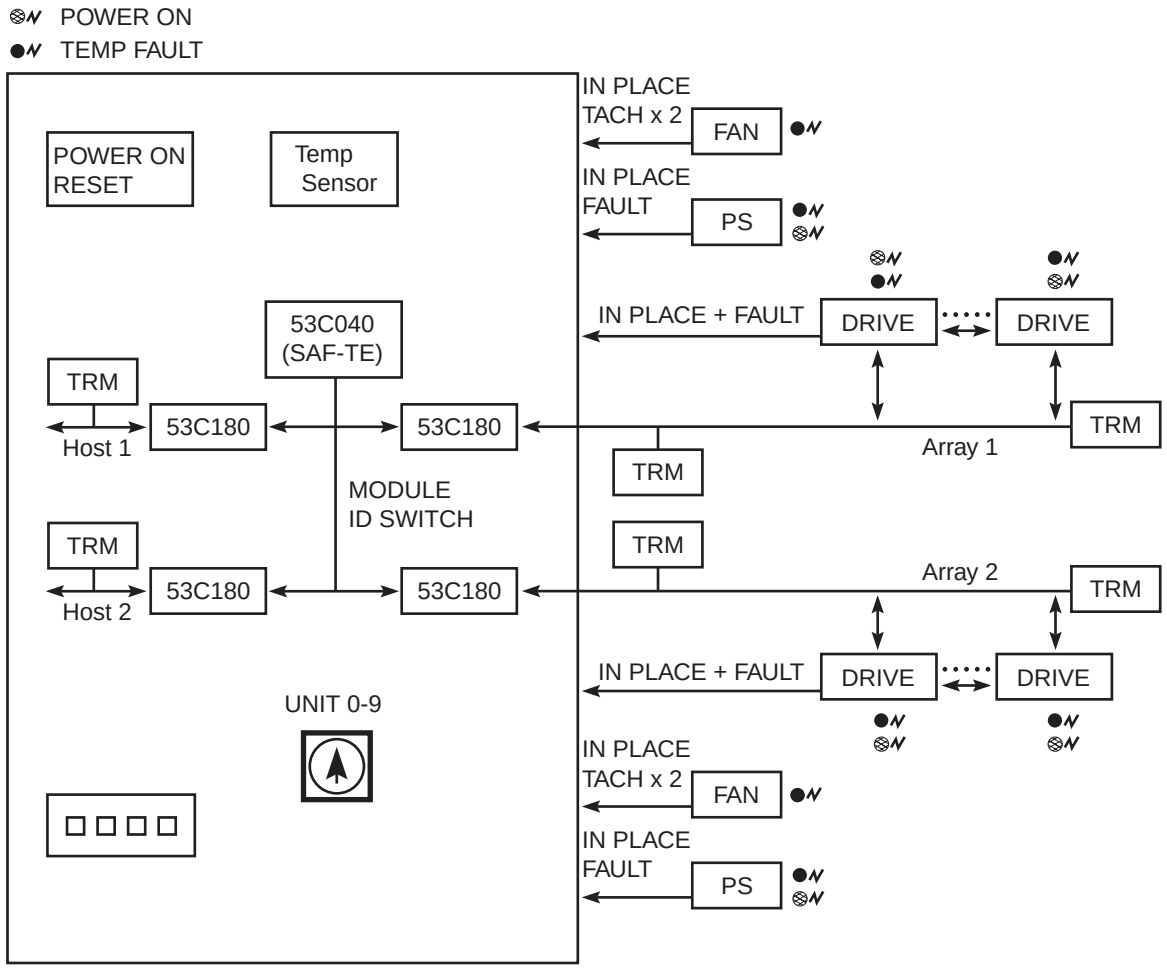

FIGURE 1-1 ESM Block Diagram

CHAPTER 2

Hardware Installation and Configuration

This chapter provides some additional information, guidelines, and tips relating to the installation and configuration of Sun StorEdge D2 hardware.

This chapter contains the following sections:

2.1 New Installation

Note – Refer to the *Sun StorEdge D2 Array Installation, Operation, and Service Manual* for detailed instructions and information on installing an array.

This section contains the following topics:

2.1.1 Power Cables

For information and guidelines for connecting the AC power cables, refer to the *Sun StorEdge D2 Installation, Operations, and Service Manual*. It is important that you follow the guidelines in this document.

2.1.2 SCSI Cables

The maximum SCSI bus length is 12 meters (472 inches). Exceeding this length can cause SCSI or data errors. When calculating the maximum SCSI bus length in a particular configuration, remember to include the internal SCSI bus of each Sun StorEdge D2 device, which is 0.1 meter.

Note – For the most recent listing of supported SCSI cables, sizes, and part numbers, refer to the *Sun StorEdge D2 Array Release Notes*.

2.2 Cluster and Multi-Initiator Configurations

This section contains the following topics:

2.2.1 Cluster Information

Note – Sun Cluster 3.0 software support for the Sun StorEdge D2 array is currently under qualification and anticipated for availability in Q402. Sun Cluster 2.2 software is not supported for the Sun StorEdge D2 array.

The Sun Cluster home page is located on the following web site:

```
http://suncluster.eng/index.html
```

For detailed cluster configuration information, refer to the *Sun Enterprise Cluster System Hardware Site Preparation, Planning, and Installation Guide*. You can find this document on the following web site:

```
http://suncluster.eng.sun.com/engineering
```

Refer to the following document for specific information on clustering arrays: *Sun Cluster 3.0 Hardware Guide*, 806-1420, chapter 7 “Installing, Configuring, and Maintaining a Sun StorEdge Disk Array.”

2.2.2 Multi-Initiator Information

The Sun StorEdge D2 array is supported in a two-node cluster configuration.

Note – To use the Sun StorEdge D2 array in a multi-initiator environment, you must use clustering software. Sun Cluster 3.0 software support for the Sun StorEdge D2 array is currently under qualification and anticipated for availability in Q402.

In a multi-initiator (aka multi-host) connection, both nodes need to be Sun SPARC servers. Only a multi-initiator configuration that runs Sun Cluster is supported by Sun. This applies to Sun StorEdge A2 arrays.

Refer to the following web site for details regarding a cluster support matrix:

```
http://suncluster.eng/support-matrix
```

Also refer to the following cluster FAQ web site:

```
http://suncluster.eng/sales/faq/#storage
```

2.3 Supported Configurations

This section contains the following topics:

2.3.1 Qualified Platforms

The Sun StorEdge D2 array is supported on the following platforms:

- Ultra™ 5 workstation (on-board attachment only)
- Ultra 10 workstation (on-board attachment only)
- Ultra 60 workstation (on-board attachment only)
- Ultra 80 workstation (on-board attachment only)
- Sun Blade™ 100 workstations (on-board attachment only)
- Sun Fire™ 280R server
- Sun Fire V880 server
- Sun Enterprise™ 220R server
- Sun Enterprise 250 server

- Sun Enterprise 420R server
- Sun Enterprise 450 server

Note – Refer to the *Sun StorEdge D2 Array Release Notes* for the most recent listing of supported platforms.

2.3.2 Disk Drive Support Matrix

The following table provides support information for all hard disk drives that are used in the Sun StorEdge D2 array.

TABLE 2-1 Disk Drive Support Matrix for the Sun StorEdge D2 Array

Capacity	Option Part No.	FRU Part No.	Vendor	Device Part No.	Speed	Model No.	Current F/W Patch
18 GB	X5248A	F540-4910-01	Fujitsu	390-0066-02	10K RPM	MAN3184MC	1502
18 GB	X5248A	F540-4910-01	Seagate	390-0085-02	10K RPM	ST318305LC	0340
36 GB	X5250A	F540-4521-01	Fujitsu	390-0065-02	10K RPM	MAN3367MC	1502
36 GB	X5250A	F540-4521-01	Seagate	390-0069-02	10K RPM	ST336605LC	0238

2.3.3 Supported Sun StorEdge D2 Configurations

The Sun StorEdge D2 array can be configured in either a single-bus (FIGURE 2-1) or split-bus (FIGURE 2-2) configuration.

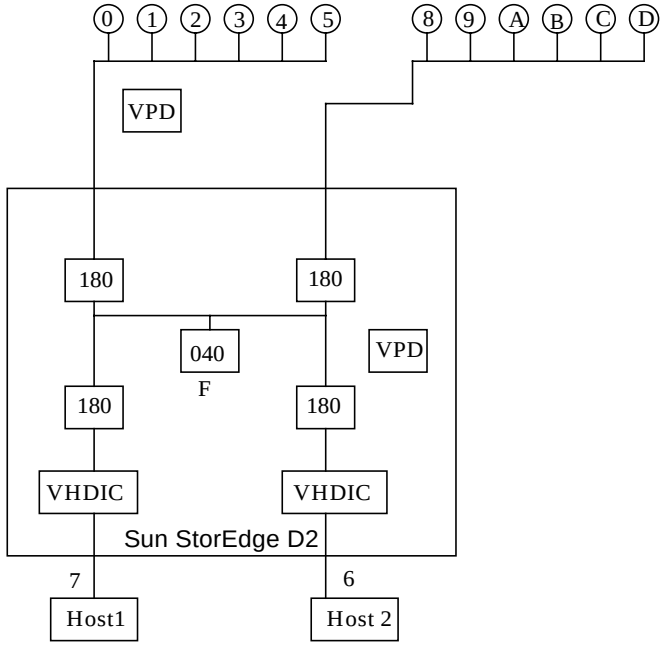

FIGURE 2-1 Sun StorEdge D2 Single Bus Configuration (Logical View)

In a *single-bus* configuration, the Sun StorEdge D2 in the “0” position (the left ESM slot as viewed from the rear of the enclosure) communicates with all 12 drive slots, and two hosts can be connected to the ESM. The 12 drive slots are mapped to SCSI IDs 0-5 and 8-13. The physical drive slot position corresponding to these SCSI IDs is illustrated in FIGURE 2-3. Note in FIGURE 2-1 that each ESM has two front-end and two back-end SCSI bus expanders, the “180s.” The two back-end SCSI bus expanders enable the back-end SCSI bus to be isolated into two separate busses in *split-bus* mode (see FIGURE 2-2).

In single-bus configuration, both host 1 and host 2 can communicate with all 12 drives. The numbers “6” and “7” next to the two host connections represent the SCSI IDs that are assigned to the initiator in each host. The “F” next to the box with the “040,” the SAF-TE processor, is the SCSI ID of the SAF-TE processor.

FIGURE 2-2 shows the ESM in a split bus configuration.

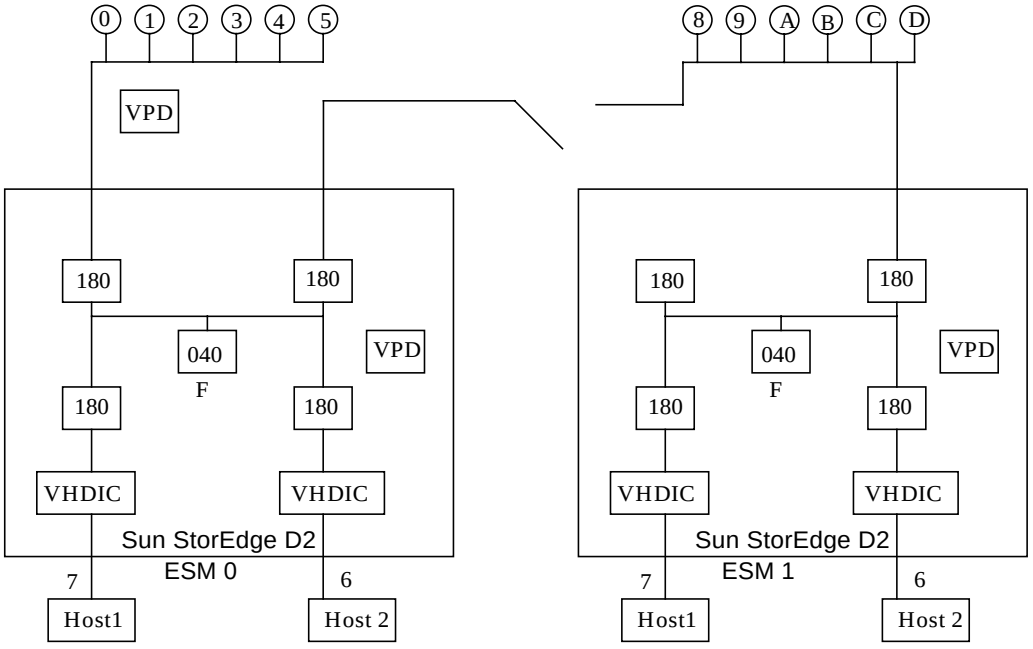

FIGURE 2-2 Dual Sun StorEdge D2 With Split Bus (Logical View)

In a *split-bus* configuration, both the ESM in the “0” and “1” positions are populated, and the ESM in the “0” position has option switch 1 off (dual bus). In a split-bus configuration, the Sun StorEdge D2 enclosure becomes two independent storage subsystems. The ESM in the “0” position communicates with only one set of six drives while the ESM in the “1” position communicates with the other set of six drives. (However, environmental information on the status of the fans and power supplies can be read through the SAF-TE interface of either ESM.)

Note – In the split-bus configuration, each ESM talks to six drives. But the ESMs talk to the drives on the appropriate side of the enclosure. That means the ESM on the left talks to the six drives on the right side. This is important to remember when replacing an ESM.

Both sets of six drives are mapped to SCSI IDs 8 through 13. The physical drive slot position corresponding to these SCSI IDs is illustrated in FIGURE 2-4. Note that the six drives communicating with the ESM in the “0” position are on the left of the enclosure (as viewed from the front), while the six drives communicating with the ESM in the “1” position are on the right of the enclosure. Note also that the slot

numbers, used by the SAF-TE commands to communicate with the drive slots, are 0-5 for ESM 0 and 0-5 for ESM 1 (in the split-bus configuration SAF-TE commands issued through an ESM communicate with only the six drives associated with that ESM). Two hosts can be attached to ESM 0 and to ESM 1.

The split-bus configuration forms the basis for a high-availability storage configuration with no single point of failure in a single Sun StorEdge D2 enclosure. This high-availability configuration is created by using independent host adapters to communicate with each ESM and mirroring data between the two independent busses.

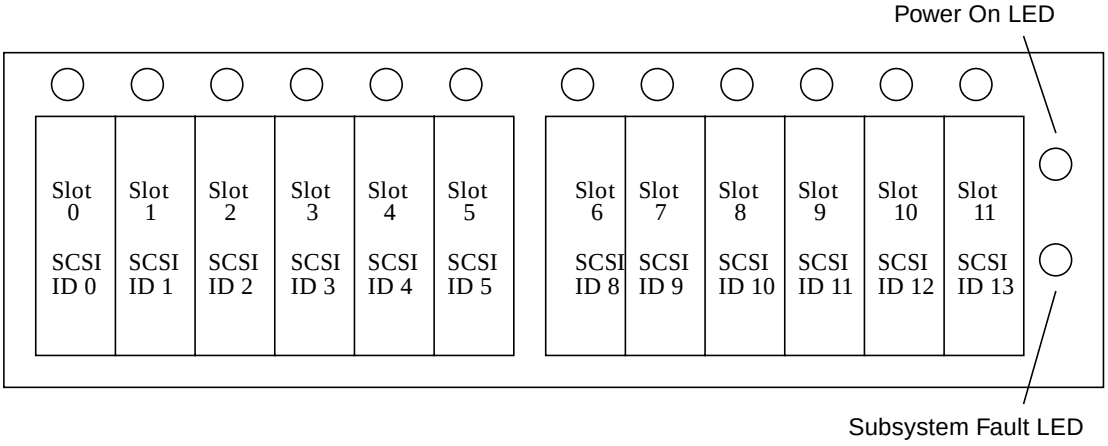

FIGURE 2-3 Sun StorEdge D2 Single ESM Front View (Single Bus)

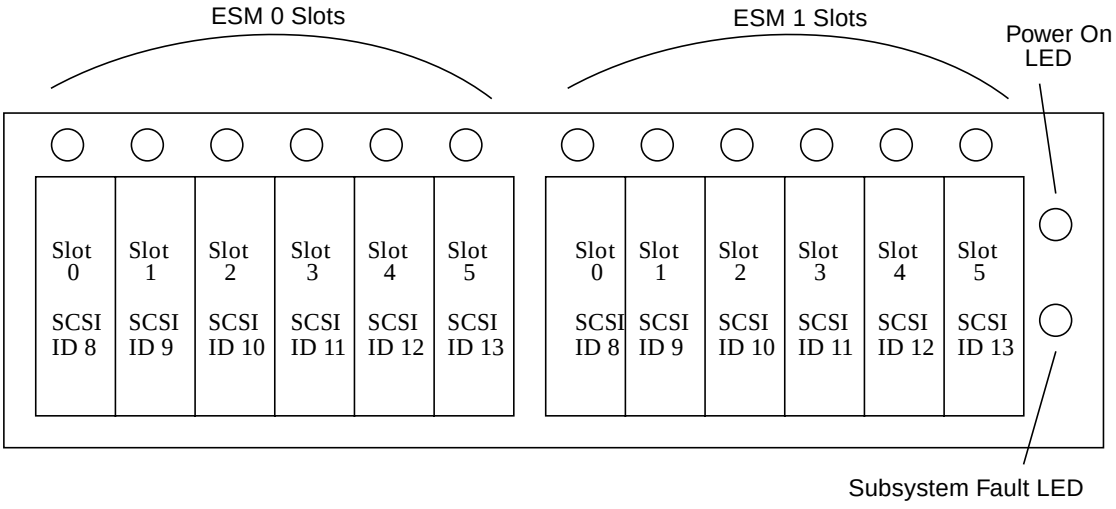

FIGURE 2-4 Sun StorEdge D2 Dual ESM Front View (Split Bus)

CHAPTER 3

Sun StorEdge D2 ESM Functional Description

3.1 Host SCSI

Two (population option) VHDCI 68-pin high density “D” shell connectors provide connectivity for the host. Host multimode termination is provided on the ESM card.

3.2 Host SCSI Termination Power

Host termination power is not provided by the ESM.

3.3 Host SCSI Disable With No Termination Power

The SCSI host channel senses termination power. If termination power goes below 3 volts, the interface chip will be disabled. This prevents data transfers if termination power is lost from the host.

3.4 Host SCSI Reset with Change in Termination Power

When a change of termination power is sensed by the ESM (for example, if the SCSI cable is disconnected), a SCSI bus reset is generated to the host bus followed by an ESM hardware reset. This feature allows for hot plugging and removal of inactive host SCSI connections.

In a dual ESM configuration, a SCSI bus reset is generated to the host busses connected to both ESMs. However, only the ESM which detected the change in termination power will be reset. A SCSI bus reset will also be generated on all host busses when an ESM is plugged or unplugged.

3.5 Array SCSI

Two LVD drive side SCSI channel connections are provided through the J1-J3 connectors. The ESM back panel provides LVD mode termination on both channels. Note that this implies that only LVD drives are supported.

3.6 SAF-TE Interface

The ESM board implements SAF-TE through one LSI LOGIC 53C040 chip. The operation of this chip is firmware-controlled. The software specification gives the implementation details.

3.7 SAF-TE Subsystem Interface

The SAF-TE circuit monitors and controls several ESM subsystem signals. The following signals are directly monitored by the 53C040 chip.

- Host Enable
- Module_ID

- 2 power supply in-place and faults signals
- 2 fan unit in-place signals
- 4 fan fault signals—two for each fan CRU
- 12 drive in place and 12 drive fault signals
- 1 Subsystem Fault/warning
- SCSI ID of the 53C040 chip is 15 (Fh)

The following information is monitored by the 53C040 chip by way of the DS1780E devices.

- Over-temp conditions (1 warning signal driven by either 53C040 chip when ambient temperature surrounding the ESM subsystem exceeds 48˚C). Each DS1780E independently monitors temperature. The 53C040 firmware reports 2-stage temperature monitoring, targeting external ambient levels of 48˚C and 56˚C. An over-48˚C status bit is contained in the Read Enclosure Status Bytes and an over-56˚C status bit is contained in the Vendor Unique Pass-Through Byte. Refer to the SAF-TE Interface Specification for more information on the Read Enclosure Status Bytes.
- 4 fan tach signals - two for each fan unit
- Number of drives
- Controller Position
- Option Switch Positions (Option, 040 Disable, Single/Dual Bus)

CHAPTER 4

Sun StorEdge D2 Array ESM Switches

This chapter describes the two Sun StorEdge D2 array ESM switches.

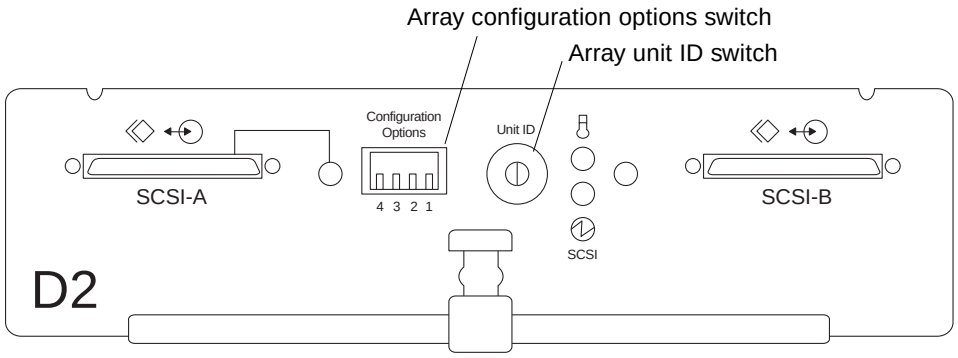

FIGURE 4-1 Sun StorEdge D2 Array Switch Locations

4.1 Array Configuration Options Switch

The array configuration options switch (SW1) is a 4 position, piano style switch that sets ESM options as defined in TABLE 4-1.

TABLE 4-1 Array Configuration Options Switch Settings

Position/ Pin No.	Function	Meaning
1	Single Bus	When the switch is on (position - up), it sets the array to a single bus. In this mode, the ESM card in Slot 0 controls both drive array busses and both 53C180s that connect to the drive array buses, ARRAY_1 and ARRAY_2, are enabled. One 53C180 will control the drive ARRAY_1 bus with drive IDs numbered 0 – 5, the second 53C180 will control the drive ARRAY_2 bus with drive IDs numbered 8 - 13, and the bus SAF-TE will be at 15 (Fh). When the switch is off (dual bus), the ESM card in Slot 0 will control the drives connected to the drive ARRAY_1 bus. The ESM card in Slot 1 will control the drives connected to drive ARRAY_2 bus. The drives on both buses will be numbered 8 – 13 to prevent possible conflicts with SCSI host ID settings, and the SAF-TE device will be at 15 (Fh). NOTE: In a dual bus configuration, both ESMs must have the switch set to dual bus mode (position - down).
2	040 Disable	Setting this switch to on (position - up) disables all SAF-TE chip services. When this switch is off (position - down), all SAF-TE functions will operate as required.
3	Power Off Reset Enable	Not implemented.
4	Option	A user defined switch.

4.2 Array Unit ID Switch

The array unit ID switch is a 10-position switch that sets a unique identification for each ESM board. The INQUIRY, READ ENCLOSURE STATUS, and READ DEVICE SLOT STATUS commands in the Vendor Unique Byte read this ID.

Note – If there are two ESMs in an array, set this switch to the same number for both ESMs because the ID applies to the array as a whole unit.

CHAPTER 5

Maintenance and Service

This chapter provides supplemental service information to the information contained in the *Sun StorEdge D2 Installation, Operation, and Service Manual*. Refer to the Installation, Operation, and Service Manual for replacing FRUs and using diagnostic tools.

This chapter contains information on the following topics:

5.1 Verifying Hardware Functionality

This section describes how to verify the following hardware functionality:

5.1.1 Array Unit

For information on troubleshooting and diagnosing issues with the array and its FRUs, refer to the “Monitoring and Troubleshooting the Sun StorEdge D2 Array” chapter in the *Sun StorEdge D2 Array Installation, Operation, and Service Manual*.

5.1.2 SCSI Cables

The most common problem involving SCSI cables is with bent pins on the connectors. This usually occurs during a system installation. A typical indication of a defective SCSI cable is an error message indicating SCSI parity errors and the SCSI transfer rate has been reduced or has switched from wide to narrow SCSI. A SCSI cable that has failed on the host side usually results in a data path failure indication. If the problem is with a failed SCSI cable on the drive side, the result is usually in the form of a drive side channel failure indication. Currently there are no procedures for testing a SCSI cable for failure other than to replace it with a new or known good cable. Also, ensure that the SCSI bus length is within the recommended maximum of 12 meters (see Section 2.1.2, "SCSI Cables" on page 2-2).

5.2 FRU Replacement

This section contains replacement information on the following FRUs:

- Section 5.2.1, "Host Adapter" on page 5-2
- Section 5.2.2, "Interconnect Cables" on page 5-3

Refer to the *Sun StorEdge D2 Installation, Operations, and Service Manual* for detailed instructions on removing and replacing FRUs.

5.2.1 Host Adapter

If the host server does not support hot swapping of the I/O boards, you will need to shut down the host to replace a host adapter. You should read the manual that ships with the host adapter and become familiar with the installation procedure.

Note – There are several sections in the *Sun Enterprise Cluster System Hardware Service Manual* that provide detailed procedures on how to disconnect a host and to remove and replace an host adapter.

Currently, the Sun PCI Dual Ultra3 SCSI host adapter is the only host adapter that supports the Sun StorEdge D2 array.

5.2.2 Interconnect Cables

- Host SCSI cables

  Stop all I/O activities to the corresponding data path before replacing a host SCSI cable.

- SCSI cables
- Drive side SCSI cables

  You should stop all I/O activities to the controller module and power down the controller module before replacing the drive side SCSI cables. If the failure caused a disk tray to lose communication to the controllers, you will need to power cycle the controller module to re-establish communication with the disk tray.

5.3 LEDs

Refer to FIGURE 5-1 through FIGURE 5-4 for the location of LEDs described in this section.

5.3.1 Subsystem Fault LED

The firmware turns the Subsystem Fault LED (FIGURE 5-3) amber if a drive, fan, power supply, or temperature error condition occurs. Otherwise, the Subsystem Fault LED is green. The Subsystem Fault LED is not turned off, even if the Global Failure Indication and Global Warning Indication Flags are cleared by the SEND GLOBAL FLAGS command issued by the initiator, until all the error conditions are cleared.

A SEND GLOBAL FLAGS command will set the Subsystem Fault LED solid amber when the “Global Failure” flag (byte 1, bit 1) is set. The Subsystem Fault LED will be flashing amber when the “Global Warning” (byte 1, bit 2) is set.

5.3.2 Drive Slot *n* LED

A multifunction LED is associated with each of the 12 array drive slots (FIGURE 5-3). This table lists the colors it turns and the conditions indicated.

TABLE 5-1 Drive Slot Multifunction LED Colors and Indicated Conditions

Color/s	Condition/s
green	Drive is ready
flashing green	Drive is active
blinking amber/green	Slot is identifying itself as a result of the Identify Slot flag (byte 2, bit 2) being set through the PREPARE SLOT OPERATION command.
amber	Drive is faulted if its Device Faulty Flag (byte 0, bit 1 of the device Slot Status) is set to 1 by the initiator with a WRITE DEVICE SLOT STATUS command. Consequently, the Drive Fault and the Subsystem Fault LEDs are turned on. If a faulted drive is no longer inserted, the Drive Fault and Subsystem Fault LEDs are turned off (if there are no other error conditions).

5.3.3 Fan Fault LED *n*

If a fan's rotation RPM is less than the Fan Low Trip Point value specified in the Factory Defaults, it is faulted. In this case, the Fan Fault (FIGURE 5-1) and Subsystem Fault LEDs are set to amber.

Each Sun StorEdge D2 fan CRU contains two fans and two fan fault LEDs. The Subsystem Fault LED is also turned on if one of the fans is not installed. When either fan in the fan CRU is faulty, a READ ENCLOSURE STATUS command returns a "Fan is malfunctioning" status for the associated fan CRU.

5.3.4 Power Fault *n* LED

The Power Fault LED (FIGURE 5-1) turns amber if the power supply is turned off or malfunctioning. In addition, the Subsystem Fault LED turns on if either of the two power supplies is turned off or malfunctioning. The Subsystem Fault LED is not turned on if one of the power supplies is not installed. When a power supply is faulty, a READ ENCLOSURE STATUS command returns a "Power Supply is malfunctioning" status for the associated power supply.

5.3.5 ESM Over-Temp/Code Download LED

The ESM Over-Temp/Code Download LED (FIGURE 5-2) is a multifunction LED.

Yellow: Temperature warning. This occurs if the temperature exceeds the Temperature Warning Level specified in the Factory Defaults. A temperature warning condition will also turn on the Subsystem Fault LED. In addition, the ETA bit (byte 18, bit 7) will be set when a READ ENCLOSURE STATUS command is executed.

A temperature failure condition occurs if the temperature exceeds the Temperature Failure Level specified in the Factory Defaults. When this condition occurs, the Temperature Failure bit (bit 7) is set by the Vendor Unique Byte. The Vendor Unique byte is read through an INQUIRY, READ ENCLOSURE STATUS, or READ DEVICE SLOT STATUS command.

Blinking: A code download is in progress.

5.3.6 Power On/SCSI Active LED

The Power On/SCSI Active LED (FIGURE 5-2) is a multifunction LED.

Green: Power is applied.

Flashing: SCSI activity through the D2 ESM.

5.3.7 Host *n* Term Power LED

See FIGURE 5-2 for the location of the Host *n* Term Power LED.

Green: Termination power is applied to the associated connector.

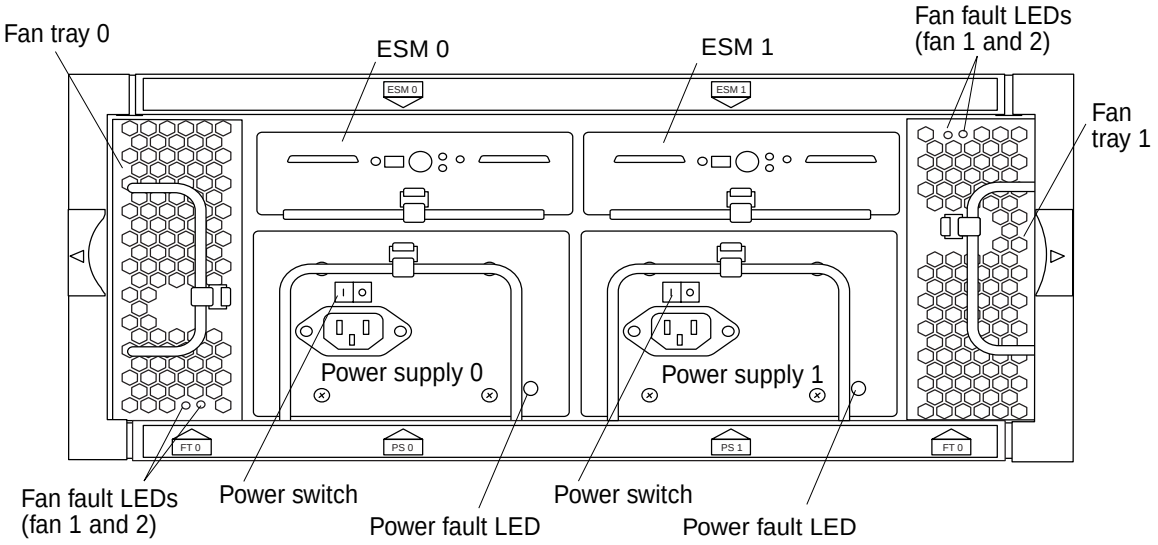

FIGURE 5-1 Sun StorEdge D2 Rear View

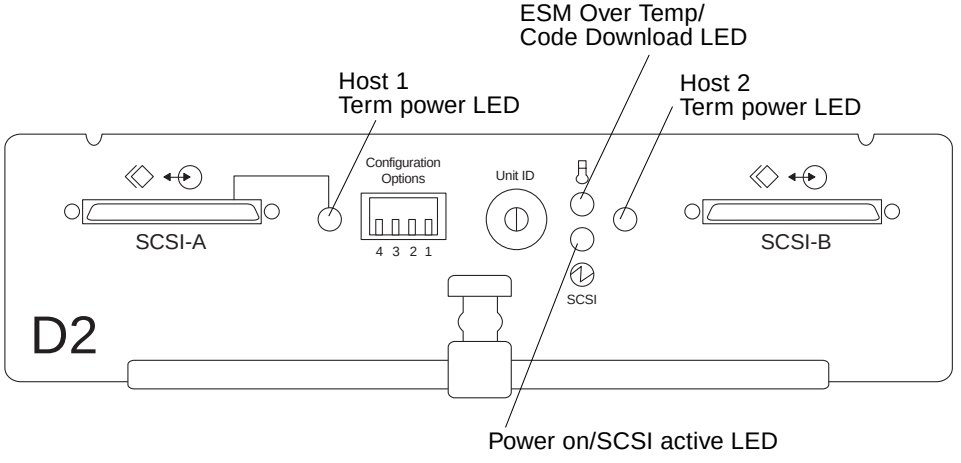

FIGURE 5-2 Sun StorEdge D2 ESM

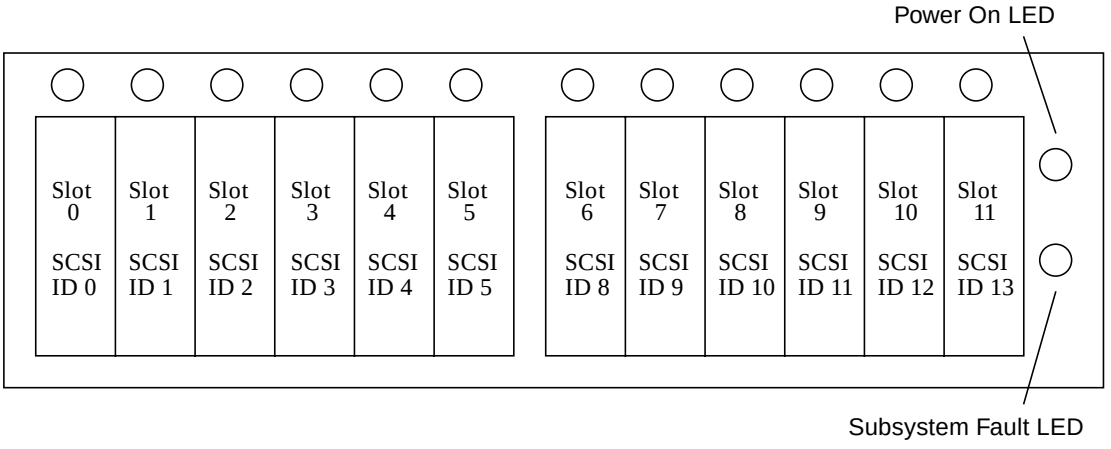

FIGURE 5-3 Sun StorEdge D2 Single ESM Front View (Single Bus)

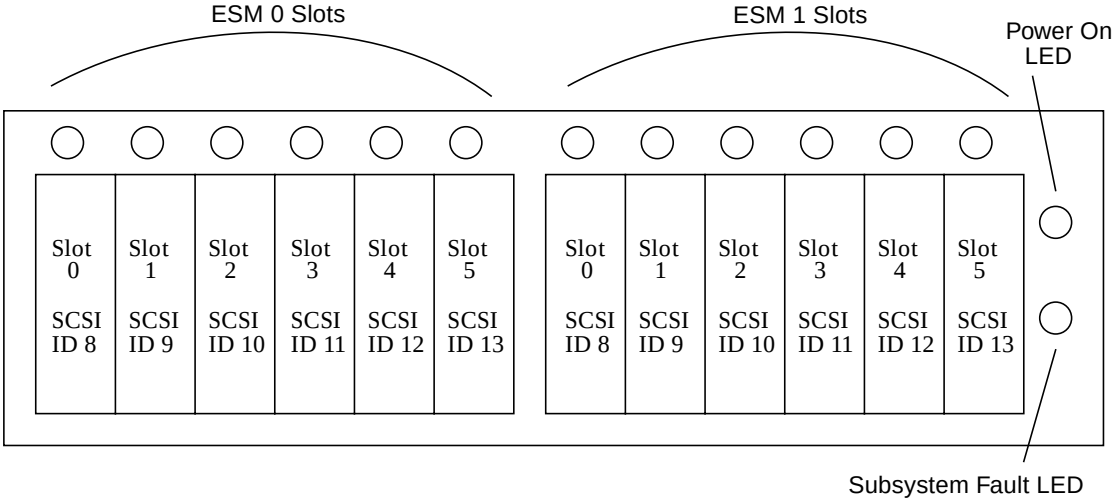

FIGURE 5-4 Sun StorEdge D2 Dual ESM Front View (Split Bus)

CHAPTER 6

SAF-TE Command Implementation

SCSI Accessed Fault-Tolerant Enclosures (SAF-TE) support six SCSI commands including `WRITE BUFFER`, `READ BUFFER`, `INQUIRY`, `TEST UNIT READY`, `SEND DIAGNOSTIC`, and `REQUEST SENSE`. These commands are detailed in the following sections:

6.1 Inquiry command

The host uses the INQUIRY command to request parameter information from the enclosure. The table below shows the response data format from the INQUIRY command.

TABLE 6-1 INQUIRY Data

Byte	Bit	Description	Returned Value/ Notes
0	7-5	Peripheral Qualifier	000b if LUN 0 (the only valid) is selected 011 if LUN 0 is not selected
	4-0	Peripheral Qualifier	03h (SCSI Processor Device) if LUN 0 (the only valid LUN) is selected 1Fh (No device type) if LUN 0 is not selected
1	7-0	00h	Returns 00h
2	7-3	0	0

	2-0	ANSI Approved Version	02h – Compliance with ANSI SCSI-2 specification
3	7-4	0	0
	3-0	Response Data Format	02h – Format defined in ANSI SCSI-2 specification
4	7-0	Additional length	36h = 54 bytes
5	7-0	Reserved	Returns 00h
6	7-0	Bit 6 =0	Returns 00h
7	7-0	00h	Returns 00h
8-15	7-0	Vendor Identification	8-byte ASCII string: “SUN “
16-31	7-0	Product Identification	16-byte ASCII string “D2 “
32-35	7-0	Firmware Revision Level	Returns a four-byte ASCII string representing the current SAF-TE firmware revision level.
36-42	7-0	Enclosure Unique Identifier	Returns a seven-byte ASCII ID number as defined in the configuration program
43	7-0	Channel Identifier	Returns a single ASCII character as a defined in the configuration program
44-49	7-0	SAF-TE Interface Identification string	ASCII string of *SAF-TE*
50-53	7-0	SAF-TE Specification Revision Level	ASCII string of *1.00*
54		Vendor Unique Byte	See TABLE 6-2 for description.

The bit definition of the Vendor Unique Byte is shown in TABLE 6-2.

TABLE 6-2 Vendor Unique Byte Definition

Bit	Meaning	Value
7	Not used	Not used

6	Too Hot	0 => ESM temperature exceeds the temperature failure threshold. 1 => Normal condition
5	LVD/SE	1=> LVD 0=> SE
4	Card ID	0 = ESM A 1 = ESM B
3...0	Rotary Dial	0 through 9

6.2 SAF-TE Read Buffer Commands

This section provides detailed information about the READ ENCLOSURE CONFIGURATION, READ ENCLOSED STATUS, READ DEVICE SLOT STATUS, and READ GLOBAL FLAGS commands.

6.2.1 Read Enclosure Configuration (00h)

The application agent sends this command to the LSI53c040 to inquire about the number and type of system components in the enclosure. The LSI53C040 determines and returns the information based on the enclosure settings.

TABLE 6-3 READ ENCLOSURE CONFIGURATION Return Values

Byte	Bits	Field Description	Value
0	7-0	Number of Fans	2
1	7-0	Number of Power Supplies	2
2	7-0	Number of Device Slots	12 for single-bus 6 for split-bus
3	7-0	Door Lock Installed	0
4	7-0	Number of Temperature Sensors	0
5	7-0	Audible Alarm	0
6	7	Celsius/Fahrenheit	
	6-4	Reserved	
	3-0	Number of Thermostats	00

7-62	7-0	Reserved	00
63	7-0	Number of Vendor Specific Bytes (v)	00
64 - xx	7-0	Vendor specific	Not Supported

6.2.1.1 Number of Fans

This field contains the binary representation of the number of fans in the enclosure. This information reserves the appropriate number of bytes in the READ ENCLOSURE STATUS field.

For D2, this value is reported as 2. Note that this represents the number of Fan CRUs. Each fan CRU contains two fans.

6.2.1.2 Power Supplies

This field contains the binary representation of the number of power supplies in the enclosure. This information reserves the appropriate number of bytes in the READ ENCLOSURE STATUS field.

For D2, there are two power supplies.

6.2.1.3 Device Slots

This field contains the binary representation of the number of available device slots in the enclosure. This information reserves the appropriate number of bytes in the READ ENCLOSURE STATUS field.

For D2, there are 12 device slots seen by the ESM in a single-bus configuration and 6 device slots seen by the ESM in a split-bus configuration.

6.2.1.4 Number of Temperature Sensors

This field contains the binary representation of the number of integer temperature sensors. This information reserves the appropriate number of bytes in the READ ENCLOSURE STATUS field. This type of sensor will be connected to one of the TWS busses to transfer this integer value to the LSI5C040. The DS1621 is one example.

For D2, there are no external temperature sensors in the enclosure; the value returned is 0 (there is a temperature sensor on each D2 ESM).

6.2.1.5 Audible Alarm

This field indicates whether the enclosure has a speaker. If there is no speaker, this field is 0. If a speaker is present, this field is 1**.**

D2 has no audible alarm and returns a value of 0.

6.2.1.6 6.2.1.8 Celsius / Fahrenheit

This field indicates whether the integer temperatures (if any) are reported in degrees Fahrenheit or Celsius. A value of 1 indicates Celsius and a value of 0 indicates Fahrenheit.

D2 returns a value of 0.

6.2.1.7 Number of Thermostats

This field indicates the number of binary temperature monitors.

D2 returns a value of 0.

6.2.2 Read Enclosure Status (01h)

The LSI53C040 processor returns the operational status of the components in the enclosure:

1. Fans
2. Power supplies
3. Slot SCSI IDs
4. Door locks
5. Speakers
6. Integer temperatures
7. Binary temperatures

TABLE 6-4 READ ENCLOSURE STATUS Return Values

Byte	Field Description	Notes
0	Fan B Status	Returns either: 00h Fan is operational 01h Fan is malfunctioning 02h Fan is not installed 80h unknown status, or status not reportable
1	Fan A status	Same as above
2	Power Supply A Status	Returns either: 00h Power Supply is operational and on 10h Power Supply is malfunctioning 80h unknown status, status is not reportable
3	Power Supply B Status	Same as above
4	Device Slot 0 SCSI ID	Returned binary encoded value of SCSI ID of Slot 0 of the D2 enclosure (0 for single-bus, 8 for split-bus)
5-15 (see note below)	Device Slot 1 - 11 SCSI ID's	Returns SCSI ID of Slots 1-11 of the D2 enclosure
16	Door Lock Status	01h door lock not installed
17	Speaker Status	00h no speaker installed
18	Temperature Out of Range Flags 1	Sets the ETA (bit 7) if temperature alert or 0 if no alert.
19	Temperature Out of Range Flags 2	00h
20	Number of Vendor Specific Bytes	01h
21	Vendor Unique Byte	See description under INQUIRY command

Note – In a split-bus configuration, each ESM communicates with six drive slots, 0 – 5. Thus bytes 5 – 9 will contain Device Slot SCSI IDs; bytes 10 – 15 contain the balance of the READ ENCLOSURE STATUS return values.

6.2.3 Read Device Slot Status (04h)

This command returns information on the current state of each device/slot. There are four bytes reserved for each of the 12 array device slots.

TABLE 6-5 READ DEVICE SLOT STATUS Command Return Data

Byte \ Bit	7	6	5	4	3	2	1	0
0	Slot 0 Byte 0							
1	Slot 0 Byte 1							
2	Slot 0 Byte 2							
3	Slot 0 Byte 3							
	:							
40 (see note below)	Slot 11 Byte 0							
41	Slot 11 Byte 1							
42	Slot 11 Byte 2							
43	Slot 11 Byte 3							
44	Vendor Unique Byte (see description under Inquiry command)							

Note – In a split-bus configuration, the Device Slot Status of the six devices the ESM communicates is returned.

The following table shows the values returned for each device slot following a power-up, or drive removal or insertion following a power-up.

TABLE 6-6 READ DEVICE SLOT STATUS Command Default Values

Value	Description
00 00 00 00h	No drive is inserted.
80 00 00 01h	Drive is inserted after power up.
80 00 00 04h	Drive is removed after power up.
80 00 00 05h	Drive is inserted.

The following table defines the bits in each of the four bytes for each device slot.

TABLE 6-7 READ DEVICE SLOT STATUS Command Return Values

Byte	Bit	Description	Notes
0	0 1 2 3 4 5 6 7	No Error Flag	Returns value as set by WRITE DEVICE SLOT STATUS
		Device Faulty Flag	Returns value as set by WRITE DEVICE SLOT STATUS
		Device Rebuilding Flag	Returns value as set by WRITE DEVICE SLOT STATUS
		N / A	Returns value as set by WRITE DEVICE SLOT STATUS
		N / A	Returns value as set by WRITE DEVICE SLOT STATUS
		N / A	Returns value as set by WRITE DEVICE SLOT STATUS
		N / A	Returns value as set by WRITE DEVICE SLOT STATUS
		No Drive flag	Returns value as set by WRITE DEVICE SLOT STATUS
1	0 1 2-7	N / A	Returns value as set by WRITE DEVICE SLOT STATUS
		N / A	Returns value as set by WRITE DEVICE SLOT STATUS
		Reserved	Returns 00h

2	0-7	Reserved	Returns 00h
3	0	(Slot) Device Inserted Flag	Returns either: 0 – no device inserted in slot 1 – device inserted in slot
	1	(Slot) Prepared for Insertion / Removal Flag	Not supported
	2	(Slot) Prepared for operation Flag	Returns either: 0-device power is off (slot not prepared for operation) 1-device power is on (slot prepared for operation)
	3-7	Reserved	Returns 00h

6.3 SAF-TE Write Buffer Commands

This section provides detailed information about the WRITE DEVICE SLOT STATUS, PERFORM SLOT OPERATION and SEND GLOBAL FLAGS commands.

6.3.1 Write Device Slot Status (10h)

This command informs the LSI53C040 of the state of each slot and activates device status LEDs. In general, the WRITE DEVICE SLOT STATUS is set by the RAID controller or host since it knows the status of the devices in each slot. Three bytes are associated with each device slot. Byte 1, 2, and 3 contain the desired state for the device in slot 0; Bytes 4, 5, and 6 contain the desired state for the device in slot 1, and so on.

TABLE 6-8 WRITE DEVICE SLOT STATUS Flag Bytes

Byte	Bit	Bit Description
0		Operation code (10h)
1	0	No Error Flag for slot 0 (turn off device fault LED for slot 0)
	1	Device Faulty Flag (turn on device fault LED for slot 0)
	2	Rebuilding Flag (no action except bit is returned by READ DEVICE SLOT STATUS command)
	3 -7	Not supported

2	0-7	Not supported
3	0-7	Not supported
.	.	.
.	.	.
.	.	.
.	.	.
(N*3) + 1	0	No Error Flag for slot N (turn off device fault LED for slot N)
	1	Device Faulty Flag for slot N (turn on device fault LED for slot N)
	2-7	Not supported
(N*3) + 2	0-7	Not supported
(N*3) + 3	0-7	Not supported

Note – Byte numbers for the WRITE DEVICE SLOT STATUS flags are determined by using "N" = device slot number. Therefore, the above information repeats for each device slot specified. For a single-bus configuration, N = 11. For a split-bus configuration, N = 5

6.3.2 Perform Slot Operation (12h)

This command performs specific operation on an intended device slot. In compliance with the SAF-TE specification, only one of these bits should be set at a time.

TABLE 6-9 PERFORM SLOT OPERATION Flags

Byte	Bit	Bit Description	Action
0		Operation Code (12h)	
1		Slot number	
2	0	Prepare for Operation Flag	Not supported
	1	Prepare for Insertion/Removal Flag	Not supported
	2	Identify Flag	Drive slot LED blinks amber / green

	3-7	Reserved	
3-63		Reserved	

6.3.3 Send Global Flags Command (15h)

This command is used to send commands that apply to the enclosure. The READ GLOBAL FLAGS command reads the current state of the global flags sent with this command.

TABLE 6-10 SEND GLOBAL FLAGS Command Bytes

Byte	Bit	Global Bit Description	Action
0		Operation Code (15h)	
Byte 1 (Global Flag 1)	0	Audible Alarm Control	Not Implemented
	1	Global Failure Indication	Subsystem Fault LED solid amber
	2	Global Warning Indication	Subsystem Fault LED blinking amber
	3	Enclosure Power	Not Implemented
	4	Cooling Failure	Not Implemented
	5	Power Failure	Not Implemented
	6	Drive Failure	Not Implemented
	7	Drive warning	Not Implemented
Byte 2 (Global Flag 2)	0	Array Failure	Not Implemented
	1	Array Warning	Not Implemented
	2	Enclosure Lock	Not Implemented
	3	Identify Enclosure	Not Implemented
	4-7	Reserved	
Byte 3 (Global Flag 3)	0-7	Reserved	

CHAPTER 7

Sun StorEdge D2 VPD settings and Factory Defaults

Refer to the SYM53C040 ESM SAF-TE Firmware Changes Design Note for the procedure to load the VPD and factory defaults.

7.1 D2 Factory Default Downloadable Image

TABLE 7-1 Sun StorEdge D2 Factory Default Downloadable Image

BYTE ORDER	OFFSET	BYTE COUNT	MEANING	Value
0…3	0x00	4		
4…11	0x04	8	Inquiry response data, SES page 01h: Vendor Identification (8 bytes ASCII)	SUN
12…27	0x0C	16	Inquiry: response data, SES page 01h: Product Identification (16 bytes ASCII)	D2
28…47	0x1C	20	Inquiry: Vendor-specific (Not Supported)	0xFF
48…49	0x30	2	Voltage 1: nominal (Not Supported)	0xFF
50…51	0x32	2	Voltage 2: nominal (Not Supported)	0xFF
52…53	0x34	2	Voltage 3: nominal (Not Supported)	0xFF
54…55	0x36	2	Voltage 4: nominal (Not Supported)	0xFF
56…59	0x38	4	Voltage 1: Threshold Data (Not Supported)	0xFF
60…63	0x3C	4	Voltage 2: Threshold Data (Not Supported)	0xFF

64…67	0x40	4	Voltage 3: Threshold Data (Not Supported)	0xFF
68…71	0x44	4	Voltage 4: Threshold Data (Not Supported)	0xFF
72	0x48	1	Over-Temperature Failure Level	0x4C
73	0x49	1	Over-Temperature Warning Level	0x44
74	0x4A	1	Under-Temperature Warning (Not Supported)	0x00
75	0x4B	1	Under-Temperature Failure (Not Supported)	0x00
76…77	0x4C	2	Fan Parameter – Low Trip Point (RPM)	0x384
78…79	0x4E	2	Fan Parameter – Reporting (Not Supported)	0x01F4
80…83	0x50	4	Diagnostic Parameters – RQST FAIL Reporting (Not Supported)	0xFF
84	0x54	1	SCSI ID Mapping	0x02
85…86	0x55	2	Configuration Parameters	0xFF
87	0x57	1	0	0
88…131	0x58	44	Reserved	0xFF

SCSI ID Mapping This field determines the configuration used to assign SCSI IDs to the drive slots. The D2 default is set to 0x02 and is the only supported value. This value indicates a 12-drive configuration. If a value other than 0x02 is downloaded to this field, a CHECK CONDITION is generated with sense information indicating ILLEGAL REQUEST- INVALID SEP COMMAND IN WRITE BUFFER DATA PACKET. (Sense key = 05h, ASC = 26, ASCQ = 02).

ENCSER (Enclosure Service) (D2 default bit is clear) This bit defines the value of the Enclosure Service bit (ENCSER) in the standard INQUIRY command response data (byte 6, bit 6). If set to 1, it indicates that the target returns Enclosure Services Information (ESI) as a result of a RECEIVE DIAGNOSTIC COMMAND. If set to 0x00 and a RECEIVE DIAGNOSTIC RESULTS is issued requesting a supported SES Diagnostic page, the requested page is returned without any error condition.

BKD (Backpanel VPD) - (D2 default bit is set) If it is set to 1, VPD page 1 (Midplane VPD data) is supported.

7.2 Midplane VPD

TABLE 7-2 Midplane VPD Downloadable Image

BYTE ORDER	OFFSET	BYTE COUNT	MEANING
0…3	0x00	4	Magic Number (0x104a5100) ".JQ."
4…6	0x04	3	ASCII header "PN"
7…18	0x07	12	ASCII FRU Part Number "375-3049-01"
19	0x13	1	00h
20…22	0x14	3	ASCII header "SN "
23…34	0x17	12	ASCII serial number
35	0x23	1	00h
36…38	0x24	3	ASCII header "VN"
39…46	0x27	8	ASCII vendor name "SUN"
47	0x2F	1	00h
48…50	0x30	3	ASCII header "DT "
51…58	0x33	8	ASCII Date *xx/yyyy* (where *xx* is month, *yyyy* is year)
59	0x3B	1	00h
60…62	0x3C	3	ASCII header "FT "
63…70	0x3F	8	ASCII FRU Type "MIDPLANE"
71	0x47	1	00h

The **Serial Number** and **Date** fields cannot be updated unless the current value of all the fields is all 0xFFs, or if the downloadable image is all 0xFFs (except for the Magic Number). Otherwise, all the other fields are updated and the downloadable values for these two fields are ignored without an error condition.

7.3 ESM Card VPD

Note – Reference documentation is incorrect. Please refer to the following paragraph for the correct buffer id.

ESM Card VPD is downloaded to both flash memory devices on the ESM board using a WRITE BUFFER command with a mode of 02h and a buffer id of 56h W.

TABLE 7-3 ESM Card VPD Downloadable Image

BYTE ORDER	OFFSET	BYTE ORDER	BYTE COUNT	MEANING/Value
0…3	0x00	0…3	4	Magic Number (0x45534D00) “ESM.”
4…6	0x04	4…6	3	ASCII header “PN “
7…18	0x07	7…18	12	ASCII FRU Part Number “540-5016-01”
19	0x13	19	1	00h
20…22	0x14	20…22	3	ASCII header “SN “
23…34	0x17	23…34	12	ASCII serial number[1]
35	0x23	35	1	00h
36…38	0x24	36…38	3	ASCII header “VN “
39…46	0x27	39…46	8	ASCII vendor name “SUN”
47	0x2F	47	1	00h
48…50	0x30	48…50	3	ASCII header “DT “
51…58	0x33	51…58	8	ASCII Date “xx/yyyy “(where xx is month, yyyy is year)
59	0x3B	59	1	00h
60…62	0x3C	60…62	3	ASCII header “FT “
63…70	0x3F	63…70	8	ASCII FRU Type “ESM_CARD”
71	0x47	71	1	00h

1. The last 8 consecutive meaningful characters of the serial number field are returned in the standard INQUIRY command Enclosure Unique Identifier field.

The **Serial Number** and **Date** fields cannot be updated unless the current value of all the fields is all 0xFFs, or if the downloadable image is all 0xFFs (except for the Magic Number). Otherwise, all the other fields will be updated and the downloadable values for these two fields will be ignored without an error condition.

APPENDIX **A**

Sense Codes

The Sun StorEdge D2 ESM can return the following two unique Sense Codes.

SK	ASC	ASCQ	
04	40	82	EEPROM sum check failed
04	40	83	Unable to Read/Write EEPROM

Index

T

U

V

W