



HSZ70 Array Controller HSOF Version 7.3

EK-HSZ70-SV. B01

Compaq Computer Corporation
Houston, Texas

Service Manual

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This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the manuals, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Restrictions apply to the use of the local-connection port on this series of controllers; failure to observe these restrictions may result in harmful interference. Always disconnect this port as soon as possible after completing the setup operation. Any changes or modifications made to this equipment may void the user's authority to operate the equipment.

Warning!

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

Achtung!

Dieses ist ein Gerät der Funkstörgrenzwertklasse A. In Wohnbereichen können bei Betrieb dieses Gerätes Rundfunkstörungen auftreten, in welchen Fällen der Benutzer für entsprechende Gegenmaßnahmen verantwortlich ist.

Avertissement!

Cet appareil est un appareil de Classe A. Dans un environnement résidentiel cet appareil peut provoquer des brouillages radioélectriques. Dans ce cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.

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Preface

This book provides information and guidance for troubleshooting and servicing the HSZ70 array controller running HSOE Version 7.3. It also provides information and guidance for troubleshooting and servicing the cache module and external cache battery that support the controller's operation in a storage subsystem.

This book does not contain information about the operating environments to which the controller might be connected, or detailed information about subsystem enclosures or their components. See the documentation that accompanied these peripherals for information about them.

Precautions

Use the precautions described in the following paragraphs when you are carrying out any servicing procedures:

- Electrostatic Discharge Precautions, page xi
- VHDCI Cable Precautions, page xii
- Local-Connection Maintenance Port Precautions, page xii

Electrostatic Discharge Precautions

Static electricity collects on all nonconducting material, such as paper, cloth, and plastic. An electrostatic discharge (ESD) can easily damage a controller or other subsystem component even though you may not see or feel the discharge.

Follow these precautions whenever servicing a subsystem or one of its components:

- Always use an ESD wrist strap when servicing the controller or other components in the subsystem. Ensure that the strap contacts bare skin and fits snugly, and that its grounding lead is attached to a bus that is a verified earth ground.
- Before touching any circuit board or component, always touch a verifiable earth ground to discharge any static electricity that may be present in your clothing.

- Always keep circuit boards and components away from nonconducting material.
- Always keep clothing away from circuit boards and components.
- Always use antistatic bags and grounding mats for storing circuit boards or components during replacement procedures.
- Always keep the ESD cover over the program card when the card is in the controller. If you remove the card, put it in its original carrying case. Never touch the contacts or twist or bend the card while handling it.
- Do not touch the connector pins of a cable when it is attached to a component or host.

VHDCI Cable Precautions

All of the cables to the controller, cache module, and external cache battery use very high density cable interconnect connectors (VHDCI). These connectors have small mating surfaces that can be adversely affected by dust and movement.

Use the following precautions when connecting cables that use VHDCI connectors:

- Clean the mating surfaces with a blast of clean air.
- Mate the connectors by hand, then tighten the retaining screws to 1.5 inch-pounds—approximately 1/4 additional turn after the connectors have fully mated.
- Test the assembly by gently pulling on the cable, which should not produce visible separation.

Local-Connection Maintenance Port Precautions

The local-connection maintenance port generates, uses, and radiates radio frequency energy through cables that are connected to it. This energy might interfere with radio and television reception. Do not leave a cable connected to this port when not communicating with the controller.

Conventions

This book adheres to the typographical conventions and special notices found in the paragraphs that follow to help you find what you're looking for.

Typographical Conventions

Convention	Meaning
ALLCAPS BOLD	Command syntax that must be entered exactly as shown, for example: SET FAILOVER COPY=OTHER_CONTROLLER
ALLCAPS	Command discussed within text, for example: “Use the SHOW SPARESET command to show the contents of the spareset.”
Monospaced	Screen display.
<i>Sans serif italic</i>	Command variable or numeric value that you supply, for example: SHOW <i>RAIDset-name</i> (when being described within the text) or set this_controller id=(<i>n,n,n,n</i> ,) when showing how to enter the command syntax.
<i>italic</i>	Reference to other books, for example: “See <i>HSZ70 Array Controller HSOF Version 7.3 Configuration Manual</i> for details.”
. : .	Indicates that a portion of an example or figure has been omitted, for example: ADD RAIDSET RAID1 DISK10000 DISK20000 INITIALIZE RAID1 . : . SHOW RAID1
“this controller”	The controller serving your current CLI session through a local or remote terminal.
“other controller”	The controller in a dual-redundant pair that’s connected to the controller serving your current CLI session.

Special Notices

This book does not contain detailed descriptions of standard safety procedures. However, it does contain warnings for procedures that could cause personal injury and cautions for procedures that could

damage the controller or its related components. Look for these symbols when you're carrying out the procedures in this book:



Warning A warning indicates the presence of a hazard that can cause personal injury if you do not avoid the hazard.



Caution A caution indicates the presence of a hazard that might damage hardware, corrupt software, or cause a loss of data.

In addition, there are two other notices to aid you in your understanding of the subject matter being read:



Tip A tip provides alternative methods or procedures that may not be immediately obvious. A tip may also alert prior customers that the controller behavior being discussed is different from prior software or hardware versions.

Note A note provides additional information that's important to the completion of an instruction or procedure.

Required Tools

The following tools are needed for servicing the controller, cache module, and external cache battery:

- A small screwdriver for loosening and tightening the cable-retaining screws.
- An antistatic wrist strap.
- An antistatic mat on which to place modules during servicing.
- An SBB Extractor for removing StorageWorks building blocks. This tool is not required, but it will enable you to provide more efficient service.

Related Publications

The following table lists some of the documents related to the use of the controller, cache module, and external cache battery.

Document Title	Part Number
<i>HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual</i>	EK-CLI70-RM. A01
<i>HSZ70 Array Controller HSOF Version 7.3 Configuration Manual</i>	EK-HSZ70-CG. A01
<i>HSZ70 Array Controller HSOF Version 7.3 Service Manual</i>	EK-HSZ70-SV. A01
<i>HSZ70 Family Array Controller Operating Software (HSOF) Version 7.3 Software Product Description</i>	SPD xx.xx. 00
<i>Getting Started—HSZ70 Solutions Software Version 7.3 for DIGITAL UNIX</i>	AA-R60KD-TE
<i>Getting Started—HSZ70 Solutions Software Version 7.3 for OpenVMS</i>	AA-R8A7D-TE
<i>Polycenter Console Manager</i>	See the <i>Getting Started</i> guide for the platform-specific order number
<i>StorageWorks Array Controller HSZ70 Array Controller Operating Software HSOF Version 7.3 Release Notes</i>	EK-HSZ70-RN. B01
<i>StorageWorks Getting Started with Command Console, Version 2.1</i>	AA-R0HJC-TE
<i>DIGITAL StorageWorks Ultra SCSI RAID Cabinet Subsystem (SW600) Installation and User's Guide</i>	EK-SW600-UG
<i>DIGITAL StorageWorks Ultra SCSI RAID Enclosure (BA370-Series) User's Guide</i>	EK-BA370-UG
<i>The RAIDBOOK—A Source for RAID Technology</i>	RAID Advisory Board

Revision History

The current revisions of this document include:

EK-HSC70-SV.B01	HSOF V7.3	January 1999
EK-HSC70-SV.A01	HSOF V7.0	July 1997

CHAPTER 1

General Description

This chapter describes in general terms, the HSZ70 Array Controller and the modules that support its operation. The following lists the contents of this chapter:

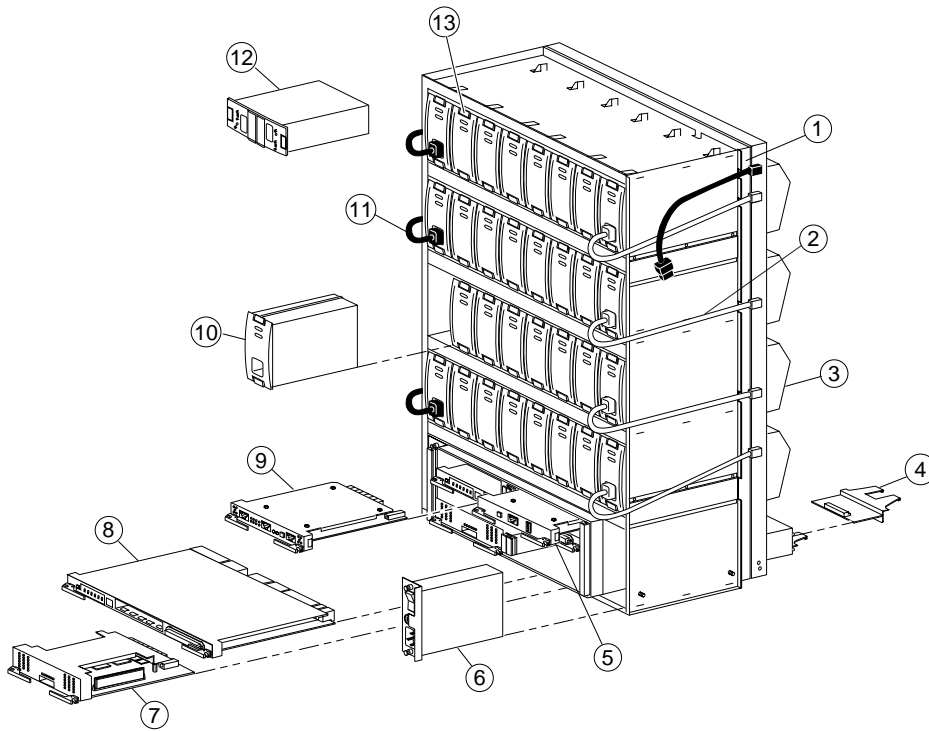
- "Subsystem Typical Installation" on page 1-1
- "Controller Physical Description" on page 1-3
 - "Architecture" on page 1-5
 - "HSOF Software" on page 1-11
- "Cache Module" on page 1-18
- "External Cache Battery," page 1-19
- "Array Controllers and Hot Swapping," page 1-21
- "Host Cabling" on page 1-22

Subsystem Typical Installation

Figure 1-1 shows an example subsystem using a DS-BA370 rack-mountable enclosure:

- HSZ70 controller—Quantity 1 or 2; each supported by a cache module.
- External cache battery (ECB)—Quantity 1 or 2; provides backup power to the cache module in the event of a power failure.
- Environmental monitoring unit (EMU)—monitors the conditions within the storage subsystem and alerts the controller of potential dangers or failures that could be caused by an abnormal environment (see your associated subsystem enclosure manual for more information on the EMU).
- Power verification and addressing module (PVA)—provides a unique address for each enclosure in an extended (more than one enclosure) subsystem.

Figure 1-1 Typical Installation of an HSZ70



CXO6702A

Table 1-1 Key to Figure 1-1

Item	Description	Part No.
1	BA370 rack-mountable enclosure	DS-BA370-AA
2	Power cable kit (white)	17-03718-09
3	Cooling fans; 8 (2 per shelf)	DS-BA35X-MK
4	I/O module; 6	DS-BA35X-MN
5	PVA module (provides a unique address to each enclosure in an extended subsystem).	DS-BA35X-EC

Table 1-1 Key to Figure 1-1 (Continued)

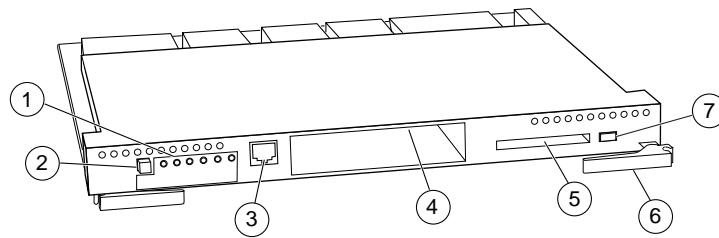
Item	Description	Part No.
6	AC input module	DS-BA35X-HE
7	Cache module; 1 or 2	70-33256-01
8	SC-5650HSZ70 array controller; 1 or 2	DS-HSZ70-AH
9	Environmental monitoring unit (EMU) The EMU monitors the subsystem environment alerting the controller of equipment failures that could cause an abnormal environment.	DS-BA35X-EB
10	180-watt power supply; 8 (2 per shelf)	DS-BA35X-HH
11	Power cable kit (black)	17-03718-10
12	<ul style="list-style-type: none"> ■ External cache battery (ECB), single ■ External cache battery (ECB), dual (two ECBs in one Storage Building Block (SBB), which provide backup power to the cache modules during a primary power failure. 	DS-HS35X-BC DS-HS35X-BD
13	Subsystem Building Block (SBB) - a tape or disk drive unit inside a standard case .	See release notes for qualified disk/tape drive numbers

Controller Physical Description

The HSZ70 controller provides its host processor with high performance, high-availability access to SCSI-2 storage devices. See the product-specific release notes that accompanied the HSOF software release for the most recent list of supported devices and operating systems.

Take a few moments to familiarize yourself with the controller physical layout as shown in Figure 1-2.

Figure 1-2 HSZ70 Physical Layout



CXO5503D

Table 1-2 Key to Figure 1-2

Item	Description
①	Operator Control Panel (OCP)
②	Reset Button
③	Local Connection Port
④	Host Port Cable Slot
⑤	Program Card Slot
⑥	Module Locking/Release Levers (2)
⑦	Program Card Eject Button

From the perspective of the host, the controller is a SCSI-2 device connected to one of its I/O buses. Consequently, the host sends I/O requests to the controller as it would to any SCSI-2 device.

From the subsystem perspective, the controller receives the I/O requests and directs them to the devices in the subsystem. Because the controller processes the I/O requests, the host is not burdened by the processing that's typically associated with reading and writing data to multiple storage devices.

The controller also provides the ability to combine several disk drives into a single, high performance storage unit called a storageset. Storagesets are implementations of RAID technology (Redundant Array of Independent Disks). This technology ensure that every

unpartitioned storage set, whether it uses two disk drives or ten, appears as a single storage unit to the host. See the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual* for more information about storage sets and how to configure them.

The components accessed by the user are conveniently located on the front panel, such as the local connection port and the operator control panel (OCP). The host port and program card slot are also located on the front panel, making it easy to update the HSOF software or to connect the controller to a different host.

Architecture

The HSZ70 controller architecture includes the components shown in the block diagram in Figure 1–3. Each of the components are described in the paragraphs that follow.

Policy Processor

The policy processor is an Intel® 80960CF i960 microprocessor and coordinates, controls, and executes the HSOF software for the controller. The i960 executes the software contained on the Program Card and provides an instruction execution rate of 25MHz from its internal clock. The i960 controls all but low-level device and host-port operations.

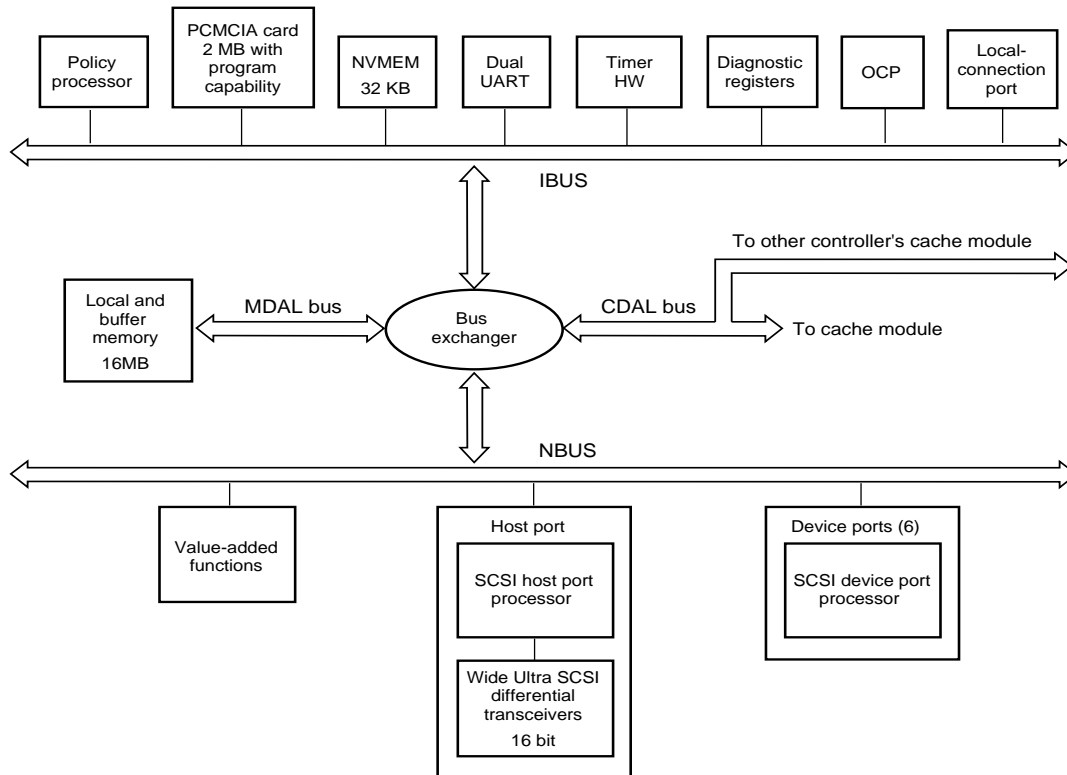
The i960 internal cache is augmented by a separate 32KB instruction/data (I/D) cache. This static RAM cache provides the i960 nearly immediate access to the instructions and variables that it needs to operate.

Program Card

The HSOF software is stored on a 2MB PCMCIA program card. The policy processor loads the software from the program card to the local memory during controller initialization.

Note The PCMCIA card must remain inserted at all times. The HSZ70 Controller will not operate without this card in place.

Figure 1-3 HSZ70 Architecture



CXO5569A

Nonvolatile Memory

The controller has 32KB of nonvolatile memory (NVMEM) with which to store the following data:

- Controller configuration parameters (such as its SCSI target IDs, preferred IDs, prompt text, transfer rate, and failover status).
- Subsystem configuration, such as:
 - Name and location of disk drives.
 - Manner in which disk drives are combined into storagesets (or used in the spareset).
 - Unit numbers assigned to the storagesets.
- Previous four “last failure” and “memory-system failure” entries received from the fault manager.

NVMEM is preserved by an internal battery that provides power in the event of a power failure.

Dual UART

The dual UART (Universal Asynchronous Receiver/Transmitter) provides two functions to the HSZ70:

- Supports serial communication for a local connection to the Maintenance Port.
- Provides a serial communication link between the two controllers in a dual-redundant configuration.

The UART allows the two controllers to communicate independently of the CDAL buses. The UART is the failover communication port, informing the other controller of its present state and configuration.

Timer

The i960 processor controls and interrupts the timer at programmed intervals to track timeouts, interrupts, LED flashing frequencies, and so forth.

Diagnostic Registers

The controller has two write and two read diagnostic registers. Diagnostic and functional software use the write diagnostic registers to control the devices and the controller. For example, some bits in the registers activate test modes for forcing errors in the controller; other bits control the operator control panel LEDs. The policy processor uses the read diagnostic registers to determine the cause of an interrupt when one occurs.

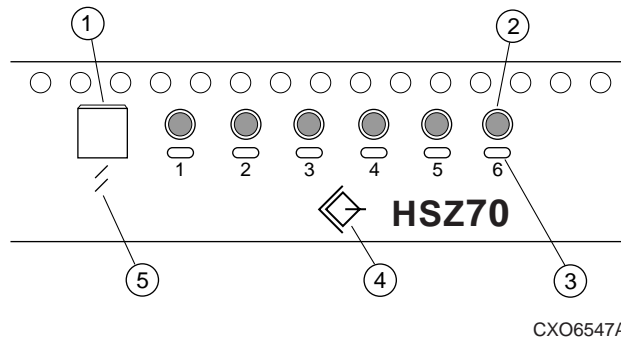
Operator Control Panel

The operator control panel (OCP; see Figure 1-4) contains a reset button, six port quiesce buttons, and six LEDs:

- The Reset button (①) normally flashes at a once per second rate indicating that the controller is functioning properly.
- The Port quiesce buttons (②) are used to turn off the I/O activity on the controller device ports. To quiesce a port, push its port button and hold until the corresponding port LED remains lit. Push the port button again to resume I/O activity on the port.

- The six LEDs (③) correspond to the six controller device ports and remain off during normal operation. If an error occurs, the reset button and LEDs illuminate in a solid or flashing pattern to help you diagnose the problem (see Appendix A, “Operator Control Panel LED Description” for the list of codes and patterns).

Figure 1-4 OCP



In addition, there are two international symbols placed on the front of the OCP:

- The SCSI standard symbol for differential SCSI bus (④) identifies the HSZ70 Array Controller as a SCSI-2 differential device to the host.
- The ISO 7000 Standard for “reset” or “initialization” (⑤) is placed just below the controller reset button.

Maintenance Connection Port

The maintenance connection port provides the location to connect a maintenance terminal, laptop, or PC to the controller so that you can upgrade the software, configure or troubleshoot the controller. This port accepts a standard RS-232 jack from any EIA-423 compatible terminal or a PC with a terminal-emulation program. The port supports serial communications up to 19200 baud using 8 data bits, 1 stop bit, and no parity (see the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*, "Establishing a Local Connection to the Controller" on page 4-2).

Local Memory

The local memory loads and stores the HSOF software from the program card each time the controller initializes. As a result, the local memory contains instructions for the i960, the software variables, and the data structures (which include the i960 look-up table). This single-point of storage ensures that the data structures and buffers remain consistent during the controller operation.

The local memory consists of:

- Dynamic RAM controller
- Arbitration engine
- Gate array controller
- 16MB of dynamic RAM

Parity-protected 9-bit error detection and correction code improves error detection and data recovery. All controller buses have access to the local memory through the bus exchanger and the MDAL bus.

Buses

The HSZ70 controller architecture includes the following buses:

- IBUS—I960 bus; conveys data to and from the i960 processor and the other components on the IBUS. The bus conveys code and text from the program card, code and data from the i960 I/D cache, and configuration information to the NVMEM.
- MDAL—Memory Data and Address Lines; conveys memory data and address information to and from the local buffer memory that originate from the IBUS or NBUS.
- CDAL—Cache Data and Address Lines; conveys cache data and address information to and from either cache module. Addresses may originate from the IBUS or NBUS of either controller in a dual-redundant configuration. The CDAL conveys information to the surviving controller in the event of a failover.
- NBUS—conveys data to and from any of the components on the NBUS (for example, host ports, device ports, and the value-added functions chip). These components may access each other, the local buffer memory, and either cache module.

Bus Exchanger

The bus exchanger facilitates high-speed communication between local memory and the devices on the IBUS, MDAL bus, CDAL bus, and

NBUS. The bus exchanger operates as a four-way cross-point switch that coordinates addresses and data between any two ports on the exchanger.

Value-Added Functions Chip

This chip generates the RAID 5 parity on the first write of the data. Upon detection of a RAIDset failure, this chip regenerates the parity to recover the data that was stored on a failed RAIDset member. This action is accomplished by performing an XOR of the parity data on the surviving RAIDset members. The value-added functions circuit acts as an accelerator for this RAID XOR operation as well as assisting with device compare operations.

This chip is also programmed to conduct large-block read and writes from failed controller cache module to the surviving controller cache module in event of a failover.

Host Port

The host port is made up of an:

- NCR 53C770 Wide Ultra-SCSI processor,
- Wide Ultra-SCSI differential transceiver, and
- VHDCI SCSI connector.

The controller connects to a host bus through a SCSI-2 tralink connector attached to the VHDCI SCSI connector. If the controller is at the end of the host bus, an external terminator is required.

The Wide Ultra-SCSI processor reads and executes scripts from the local memory to perform command and DMA operations. The policy processor sets and maintains the operation of the Wide Ultra-SCSI processor.

Device Ports

The controller communicates with the devices and modules in the subsystem through three backplane connectors. Each connector contains two ports to give the controller access to the six SCSI-2 single-ended buses available in the enclosure. Each device port is made up of an NCR 53C770 Wide Ultra-SCSI processor to support Wide Ultra, single-ended SCSI communication to the devices in the

subsystem. Like the host port, the policy processor sets and maintains the operation of the Wide Ultra processor.

Based on SCSI-2 standards, each bus connected to a device port can support up to 16 IDs (targets plus initiators). However, the practical considerations of StorageWorks packaging limit the use to 12 target IDs and two initiator IDs per bus.

HSOF Software

The HSOF software (loaded into local memory when the controller initializes), provides the following functions:

- Initialization Diagnostics
- Executive Functions
- Host Interconnect Functions
- User-Interface Functions
- Subsystem Management Functions
- Device Services
- Value-Added Functions

Each of these are described in the following paragraphs.

Initialization Diagnostics

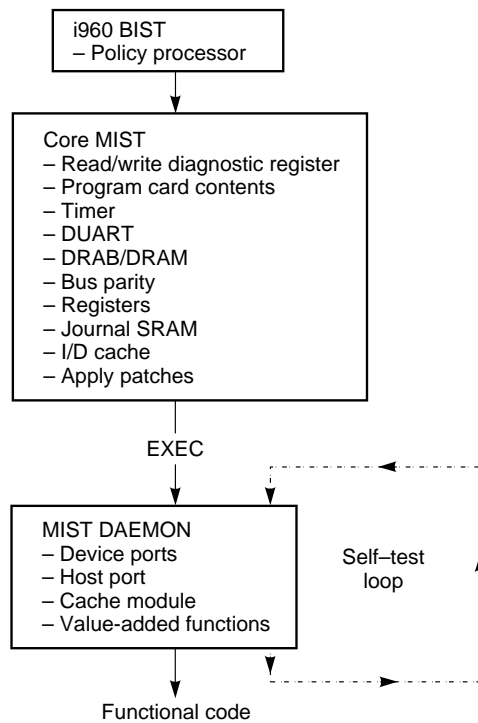
When the controller initializes, it performs the following “go–no go” tests to detect hardware and software faults:

- Policy Processor Built-In Self-Test
- Core Module Integrity Self-Test
- DAEMON Tests

These tests verify the integrity of the controller architecture as well as many of the components that support the controller in its enclosure.

Figure 1-5 contains a block diagram of the initialization diagnostics.

Figure 1-5 Initialization Diagnostics



CXO3697C

Policy Processor Built-In Self-Test

The controller begins the initialization process by executing its internal built-in self-test (BIST; an integral test of the i960 processor):

- BIST fail—the controller reset button will be lit continuously (port LEDs off).
- BIST pass—the RESET button flashes at an approximate once per second rate.



Tip One of the more common causes of a BIST failure is a faulty or improperly seated program card.

Core Module Integrity Self-Test

When BIST completes successfully, the controller reads the initial boot record (IBR) to determine the address of the hardware setup parameters and process control information. The software on the program card is then initialized to the IBR parameters. The initialization routines and diagnostics now begin to test the controller module itself. These tests (part of the HSOF software) are collectively known as the core module integrity self-tests (core MIST).

If a fault occurs during core MIST, the OCP displays an LED code (“Operator Control Panel LED Description,” page A–1) and the register contents may be displayed on the local terminal.

Core MIST performs the following functions in order:

1. Sets the initial state of the read/write diagnostic register.
2. Validates the contents of the program card by reading each memory location, computing an error detection code (EDC), then comparing the EDCs against preset EDCs.
3. Checks the controller internal buses and components attached to them: IBUS parity, I/D cache, diagnostic registers, DUART, the local memory, and so on.

To check these components, the core MIST:

- Selects a device, then checks whether the bus selected that device.
 - Verifies legal transfer sizes work and illegal transfer sizes don't.
 - Writes to and reads back from all legal addresses.
 - Checks write/read boundaries by attempting to access nonexistent addresses.
4. Loads the software into the first two megabytes of local memory. Core MIST uses the EDC compare method to validate the memory contents with the program card to confirm a successful download.
 5. Applies memory-resident code patches and updates the free memory list accordingly.
 6. Initializes the i960 microprocessor with the IBR parameters.
 7. Passes control to EXEC when the core MIST tests are complete.

DAEMON Tests

The Executive functions (EXEC) calls the diagnostic and execution monitor (DAEMON) to test the:

- Device ports.
- Host port.
- Cache module.
- Value-added software functions.



Tip You may re-run the controller DAEMON tests (also called the self-test loop as shown in Figure 1-3) as a troubleshooting aid. See "Self Test Run Procedure" on page 2-33.

- To test the host and device ports, DAEMON checks each NCR 53C770 microprocessor:
 - DAEMON passes the hardware if \geq one device port is OK.
 - DAEMON fails the hardware if:
 - * All device ports fail, or
 - * The DUART fails the core MIST and the host port fails the DAEMON test.
- To test the cache module, DAEMON checks for unwritten data:
 - No data exists. DAEMON tests the DRAB memory controller and the ECB batteries. If they pass, DAEMON passes control to the functional code. The cache manager continues to test the cache memory.

Note At least the first megabyte of the memory must test OK, or the cache module is failed.

- Unwritten data exists—DAEMON tests only the batteries, and postpones other tests. The cache manager flushes the unwritten data after testing the DRAB and memory.

If cache is locked by the other controller in dual-redundant configurations, then all cache DAEMON diagnostics are postponed. During functional code, when the cache manager determines that the cache is unlocked, the cache manager tests the DRAB, batteries, and memory.

DAEMON handles all interrupts and errors received during cache module testing. If DAEMON receives an interrupt, it stops initialization and displays the error as an LED code on the OCP.

- Finally, to ensure RAIDset functionality, DAEMON tests the XOR operations of the value-added hardware and its associated buffer memory. Initialization stops if the XOR operation test fails.

Executive Functions

The executive functions (EXEC) controls the interrupts, thread, queuing support, timers, and so forth to ensure a non-preemptive interrupt-driven environment.

Host Interconnect Functions

The host interconnect functions support the SCSI-2 protocol with the following features:

- SCSI passthrough software to the CLI.
- Tagged-command queuing on the host and device side.
- Mode select/sense support for SCSI.

User-Interface Functions

The command line interpreter (CLI) provides a direct, command line interface to the controller. Issue CLI commands via a local terminal connected to the controller maintenance port or the host via HSZterm.

The CLI provides two kinds of commands:

- SET/SHOW commands for setting and showing the controller ID, name, path controls, and other configuration information.
- ADD/DELETE commands for adding and deleting devices, storagesets, and logical units.

See the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for detailed information about each of the CLI commands. See the *System Manager's Guide for HSZterm* for more information about installing and using HSZterm.

Subsystem Management Functions

The HSOF software contains the following utilities for managing the subsystem:

- Fault Management Utility (FMU)

- Virtual Terminal Display (VTDPY)
- Disk Inline Exerciser (DILX)
- Field Replacement Utility (FRUTIL)
- Configuration Utility (CONFIG)
- HSUTIL
- Code Load/Code Patch Utility (CLCP)
- Configuration menu (CFMENU)
- Clone

Each of these is described in the following paragraphs.

Fault Management Utility (FMU)

Use the FMU to control the display of spontaneous events and failure messages that the fault management software reports to the local terminal. See "Checking Failure Entries," page 2-10 for information on how to use FMU.

Virtual Terminal Display (VTDPY)

Use VTDPY to display performance data about the controller and other subsystem components. Use VTDPY to investigate processor utilization, host port activity and status, device state, logical unit state, and cache and I/O performance. See "VTDPY Run Procedures" on page 2-17 for more information.

Disk Inline Exerciser (DILX)

Use DILX to test and verify operation of the controller and its attached SCSI-2 disk drives. DILX generates intense read/write loads to selected disk drives while monitoring their performance and status. See "DILX Run Procedure" on page 2-29, for more information about this exerciser.

Field Replacement Utility (FRUTIL)

Use FRUTIL to assist in the replacement of a failed controller (in a dual-redundant configuration) without shutting down the subsystem. You can also use this menu-driven utility to replace cache modules and external cache batteries. Most of the procedures beginning on page 3-13, "Dual-Redundant Controller Configuration", explain how to use FRUTIL.

Configuration Utility (CONFIG)

Use CONFIG to add one or more storage devices to the subsystem. See the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual* for more information about using the CONFIG utility.

HSUTIL

Use this utility program to upgrade the firmware on the disk or tape drives on the subsystem. See "Upgrading Device Firmware" on page 4-9 for more information about this utility.

Code Load/Code Patch Utility (CLCP)

Use the CLCP utility to upgrade or patch controller software. See "Firmware Upgrade Procedure," page 4-10 for more information on how to use this utility.

Configuration menu (CFMENU)

Use CFMENU to configure the storagesets in the subsystem. See the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual* for more information about using CFMENU.

Clone

Use the Clone utility to duplicate the data on any unpartitioned single disk unit, stripeset, or mirrorset. You can then backup the cloned data while the original storageset remains online. See the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual* for more information about using the clone utility.

Device Services

The SCSI-2 device service software provides the following functions:

- Device port drivers
- Addressing, access, and tagged-command queuing for qualified SCSI-2 devices
- Device warm swap
- Shelf and SBB observation and control
- Device error recovery

Value-Added Functions

The HSOF software provides the following value-added functions to enhance the availability, performance, subsystem management, and connectivity features of the controller:

- RAID functions to support the creation and operation of RAIDsets, stripesets, mirrorsets, striped mirrorsets, and host-based volume shadowing. See the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual* for more information about storage sets.
- Failover functions to support dual-redundant and multiple-bus failover configurations. In either of these configurations, two controllers exchange status signals and configuration information. If one controller fails, the surviving controller takes over the failed controller's devices and units. See the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual* for more information about these redundant configurations.
- Cache manager functions that control the caching of up to 128MB of data to enhance the subsystem throughput.

Cache Module

Figure 1-6 shows a cache module with its ECB "Y" cable inserted. Figure 1-1 shows its placement in the subsystem; Figure 1-7 shows the ECB.

Figure 1-6 Cache Module and ECB "Y" Cable

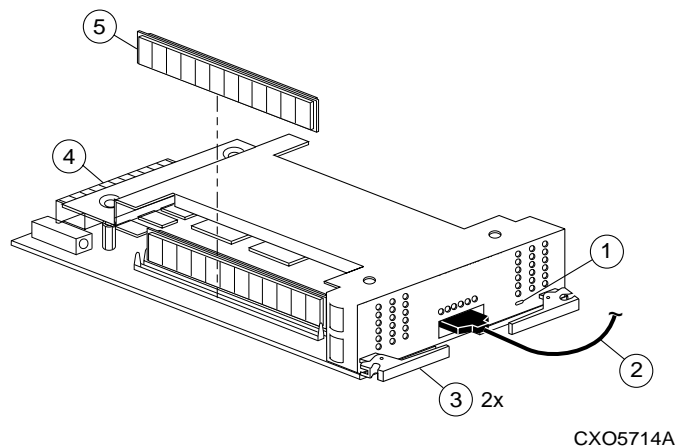


Table 1-3 Key to Figure 1-6

Item	Description	Part No.
①	Cache-memory power LED	N/A
②	ECB “Y” cable (to ECB)	70-33268-01
③	Retaining/Locking lever (2)	N/A
④	Backplane connector	N/A
⑤	■ SIMM (2 or 4)	54-23391-01
	■ SIMM 64 MB pack	DS-HSSIM-AB

The cache module increases the controller I/O performance by caching read and write data.

- Read data—the controller can often satisfy a host read request immediately from the cached data rather than having to access one or more disk drives to obtain the data.
- Write data—the controller avoids the latencies associated with writing data to a disk drive.

To further ensure the availability of write data, mirror two cache modules in a dual-redundant configuration. If one cache module fails, the other one takes over until the failed module is replaced.

Note Mirroring the cache modules cuts the amount of memory available for each controller in half.

Caching techniques and policies are described in the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*.

External Cache Battery

A cache module might contain up to 128MB of power-protected memory. The external cache battery (ECB; Figure 1-7) provides standby power in the event of a conventional power failure. When fully

charged, the batteries in the ECB preserve 128MB of cache memory for 24 hours; 64MB for 48 hours; and 32MB for 96 hours.

It is recommended that you replace the ECB every two years as a preventive measure.

Figure 1-7 External Cache Battery

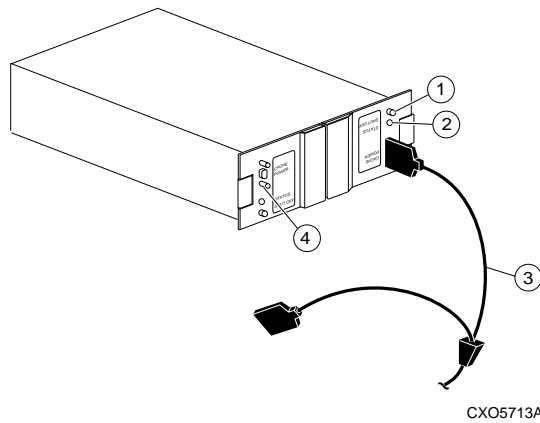


Table 1-4 Key to Figure 1-7

Item	Description	Part No.
	ECB for dual-redundant controller config ECB for single controller configuration	DS-HS35X-BD DS-HS35X-BC
①	Shut off button	N/A
②	Status LED	N/A
③	ECB “Y” Cable (to Cache module) ¹	70-33268-01
④	VHDCI male port for 2nd battery connection	N/A

¹The spare end of the “Y” cable is used to plug in the replacement battery until the battery is fully charged. At that time, the original battery may be disconnected.

Whenever the controller is initialized, the internal diagnostic routines automatically check the charge in the ECB batteries:

- If the batteries are fully charged, the controller reports them as “good” and rechecks them every twenty-four hours after that.
- If the batteries are low at initialization time, the controller reports them as “low” and rechecks them every four minutes for a ten hour period (the ten hour period reflects the maximum time that the batteries should take to completely charge).
 - If the batteries have not come up to full charge in the ten hours, then the controller declares them to be “failed”.
 - If the batteries come to a complete charge within that period of time, the controller reports them as “good”.

Note The batteries could or fail to re-charge in between the 24-hour battery checks. This is why it is important to record the installation date on the battery and replace the batteries every two years.

If a uninterruptable power supply (UPS) is used for backup power, the controller does **not** check for a battery charge. Use the `CACHE_UPS` and `NOCACHE_UPS` commands to set the backup power source for the cache module (see the *HSZ70 Array Controller HSOE Version 7.3 CLI Reference Manual* for information about these commands).

Array Controllers and Hot Swapping

Asynchronous Drive Hot Swap (ADHS) is supported on the HSZ70. ADHS is defined as the removal or insertion of a drive without quiescing the bus:

- ADHS is supported with the following restrictions:
 - Applies to disk drives only (wait 90 sec. after return of power before enabling the bus, issuing CLI commands to the controller, and initiating controller activity).
 - Disks may be imported into slots configured as disks which are members of higher level containers (such as RAIDsets, mirrorsets, spareset, and so on). AUTOSPARING is used for these types of configurations.
- ADHS is not supported under the following operating conditions:
 - During failover.
 - During failback.

- During controller initialization/reboot (until the CLI prompt appears).
- During the running of a local program (DILX, CLCP, and so on).
- To perform a physical move of a device from one location to another (new port or target).
- To perform more than one drive removal/insertion at a time

Note 50 seconds of time is required for the controller to complete the process of recognizing/processing the drive insertion/removal.

Note When power cycling entire shelves during servicing, ensure all controller-based Mirror/RAID drives have not been moved to the Failedset or are faulted.

Host Cabling

HSZ70 Controller-to-Host cabling is described in this section with regards to:

- Single controller configurations (Figure 1-8).
- Dual-redundant controller configurations (Figure 1-9).
- Dual-redundant with multiple bus failover configurations (Figure 1-10).

See the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual* for instructions about configuring your controller.

Figure 1-8 Host Cabling for Single Configuration

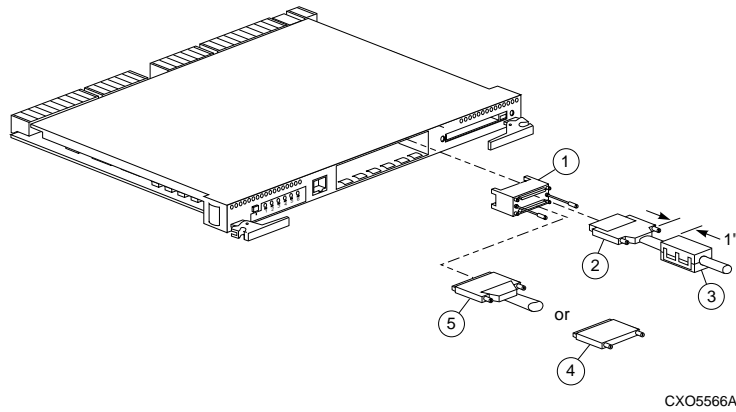
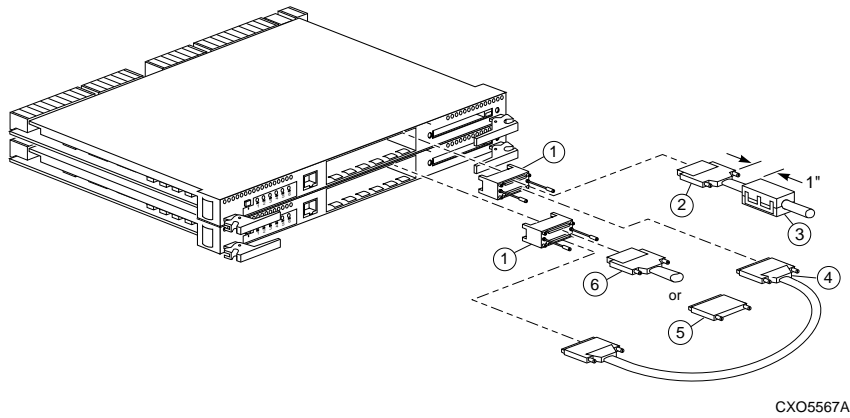


Table 1-5 Key to Figure 1-8

Part	Description	Part No.
①	Trilink connector	12-39921-01H8861-AA
②	Cable from host processor to controller; the last two digits of the Part No. represent the cable length (in meters). An "E" represents one-half meter.	DS-BN37A-1 DS-BN37A-1E DS-BN37A-02 DS-BN37A-2E DS-BN37A-03 DS-BN37A-05 DS-BN37A-10 DS-BN37A-15 DS-BN37A-20 DS-BN37A-25
③	Ferrite Bead	16-25105-18
④	VHDCI Ultra-SCSI Differential Terminator required if controller is at the end of the host bus	H8863-AA
⑤	Cable to other devices on host bus	(same as Part 2)

Figure 1-9 Host Cabling for Transparent Failover Configurations



CXO5567A

Table 1-6 Key to Figure 1-9

Part	Description	Part No.
①	Trilink connector	H8861-AA
②	Cable from host processor to controller; the last two digits of the Part No. represent the cable length (in meters). An "E" represents one-half meter.	DS-BN37A-1 DS-BN37A-1E DS-BN37A-02 DS-BN37A-2E DS-BN37A-03 DS-BN37A-05 DS-BN37A-10 DS-BN37A-15 DS-BN37A-20 DS-BN37A-25
③	Ferrite Bead	16-25105-18
④	Dual-controller cable from controller "A" to controller "B".	DS-BN37A-0E
⑤	VHDCI Ultra-SCSI Differential Terminator required if controller is at the end of the host bus	H8863-AA
⑥	Cable to other devices on host bus from controller "B"	(same as Part 2)

Figure 1-10 Host Cabling for Multiple Bus Failover Configurations

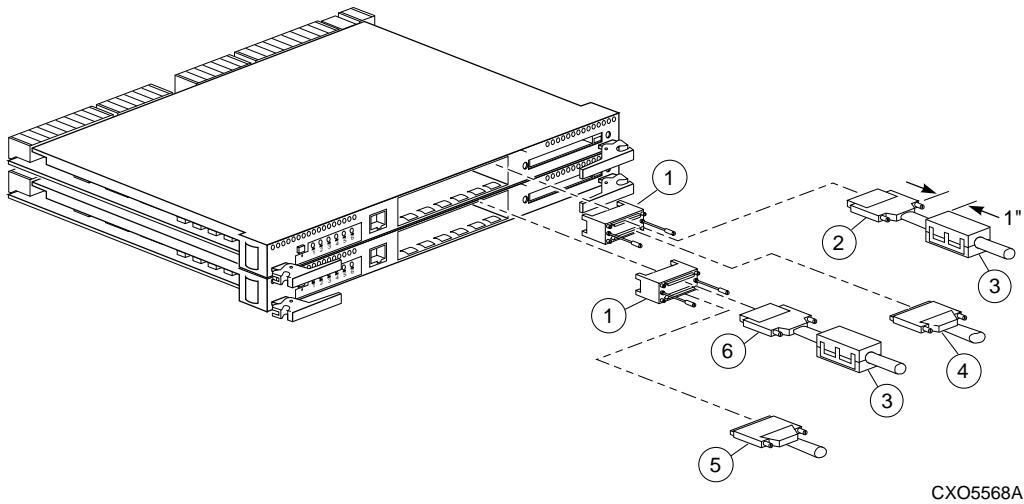


Table 1-7 Key to Figure 1-10

Part	Description	Part No.
①	Trilink connector	H8861-AA
②	Cable from host processor to controller; the last two digits of the Part No. represent the cable length (in meters). An "E" represents one-half meter.	DS-BN37A-1 DS-BN37A-1E DS-BN37A-02 DS-BN37A-2E DS-BN37A-03 DS-BN37A-05 DS-BN37A-10 DS-BN37A-15 DS-BN37A-20 DS-BN37A-25
③	Ferrite Bead	16-25105-18
④	VHDCI Ultra-SCSI Differential Terminator or cable to other devices on host bus.	H8863-AA or same as item 2
⑤	VHDCI Ultra-SCSI Differential Terminator or cable to other devices on host bus.	H8863-AA or same as item 2
⑥	Cable to controller "B" from host processor	(same as 2)

CHAPTER 2

Troubleshooting

This chapter provides guidelines for troubleshooting the controller, cache module, and external cache battery. It also describes the utilities and exercisers that aid in troubleshooting these components. See "Appendix A" for a list of LEDs codes and "Appendix B" for a description of the event codes. See the documentation that accompanied the enclosure for troubleshooting enclosure hardware (power supplies, cooling fans, environmental monitoring unit, and so on).

The following is a list of topics contained within this section:

- "Troubleshooting Checklist," page 2-1
- "Troubleshooting Procedures," page 2-4
- "Checking Failure Entries," page 2-10
- "Checking for Communication Problems," page 2-17
- "Checking for Disk-Drive Problems," page 2-27
- "Running the Controller Self Test," page 2-32
- "Shutting Down and Restarting the Subsystem," page 2-33

Troubleshooting Checklist

Table 2-1 provides a troubleshooting checklist for use in diagnosing the controller and its supporting modules. By using this checklist, you will be able to identify many of the problems that occur during a typical installation. After identifying the problem, use Table 2-2 to confirm the diagnosis and fix the problem.

If the initial diagnosis points to several possible causes, use the tools described later in this chapter to further refine the diagnosis. If the

problem cannot be diagnosed in the field, call customer service for additional support.

Table 2-1 Troubleshooting Checklist

Step	Action	Follow-up
1	Check the power to the cabinet and its components.	<ul style="list-style-type: none"> ■ Are the cords connected properly? ■ Is the power within specifications?
2	Check the component cables.	<ul style="list-style-type: none"> ■ Are the bus cables to the controllers connected properly? ■ Are the external cache battery (ECB) cables connected properly?
3	Check the program cards to ensure both are fully seated.	<ul style="list-style-type: none"> ■ Are the cards seated properly?
4	Check the operator control panel and devices for LED codes.	<ul style="list-style-type: none"> ■ Any LED Codes present? If so, refer to "Appendix A".
5	Connect a local terminal to the controller and check its configuration with the following command: SHOW THIS_CONTROLLER FULL	<ul style="list-style-type: none"> ■ Ensure that the HSOFT software version is correct and that pertinent patches have been installed. ■ Check the status of the cache module and its ECB.
6	Using the FMU, check for last failure or memory-system failure entries.	<ul style="list-style-type: none"> ■ Show these codes and translate the last failure codes they contain (see "Checking Failure Entries," page 2-10). ■ If the controller failed to the extent it cannot support a local terminal for the FMU, check the host error log for the instance or last-failure codes (see "Appendix B" to interpret the event codes).
7	Check the status of the devices with the following command: SHOW DEVICES FULL	<ul style="list-style-type: none"> ■ Look for errors such as "<i>misconfigured device</i>" or "<i>No device at this PTL.</i>" ■ If a device reports misconfigured or missing, check its status with the following command: SHOW device-name

Table 2-1 Troubleshooting Checklist (Continued)

Step	Action	Follow-up
8	Check the status of the storagesets with the following command: SHOW STORAGESETS FULL	<ul style="list-style-type: none"> ■ Ensure that all storagesets are “normal” (or “normalizing” if it’s a RAIDset or mirrorset). ■ Check again for misconfigured or missing devices.
9	Check the status of the units with the following command: SHOW UNITS FULL	<ul style="list-style-type: none"> ■ Ensure that all of the units are “available” or “online.” ■ If the controller reports that a unit is unavailable or offline, re-check the storageset it belongs to with the following command: SHOW storageset-name ■ If the controller reports that a unit has “lost data” or is “unwriteable,” recheck the status of the devices that make up the storageset: <ul style="list-style-type: none"> – If the devices are OK, recheck the status of the cache module. – If the unit reports a “media format error,” recheck the status of the storageset and its devices.

Troubleshooting Procedures

Use Table 2-1 to find a symptom, then use this table to verify and fix the problem.

Table 2-2 Troubleshooting Procedures (sheet 1 of 7)

Symptom	Possible Cause	Investigation	Remedy
Reset button not lit	No power to subsystem	Check power to subsystem and power supplies on controller shelf	Replace cord or AC input power module
		Ensure all cooling fans are installed. The EMU shuts down the subsystem if one fan is missing/inoperative for more than 8 minutes,	Turn off power switch on AC input power module. Replace cooling fan. Restore power to subsystem.
	Failed controller	If the previous check fails to produce a remedy, see “Operator Control Panel LED Description,” page A-1	Replace controller
Reset button lit steadily; other LEDs also lit	Various		Follow repair action
Cannot set failover to create dual-redundant configuration	Incorrect command syntax	See the <i>HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual</i> for the SET FAILOVER command	Use correct command syntax
	Different software versions on controllers	Check software versions on both controllers.	Update one or both controllers so that both controllers are using the same software version
	Incompatible hardware	Check hardware versions	Upgrade controllers so that they are using compatible hardware

Table 2-2 Troubleshooting Procedures (sheet 2 of 7)

Symptom	Possible Cause	Investigation	Remedy
Cannot set failover to create dual-redundant configuration (Continued)	Controller previously set for failover	Ensure that neither controller is configured for failover	SET NOFAILOVER on both controllers, then reset “this” controller for failover
	Failed controller	If the previous checks fail to produce a remedy, check for OCP LED codes	Follow repair action
Unmirrored cache; controller reports failed SIMM	Improperly installed SIMM	Remove cache module and ensure that SIMM is fully seated in its slot. See Figure 3-9 to determine which cache module contains the failed SIMM.	Reseat SIMM
	Failed SIMM	If the previous check fails to produce a remedy	Replace SIMM
Mirrored cache; “this controller” reports SIMM 1 or 2 failed.	Improperly installed SIMM in cache module for “this controller”.	Remove cache module and ensure that SIMMs are installed properly. See “Replacing SIMMs,” page 3-40.	Reseat SIMM
	Failed SIMM in cache module for “this controller”	If the previous check fails to produce a remedy	Replace SIMM in the cache module for “this controller”
Mirrored cache; “this controller” reports SIMM 3 or 4 failed.	Improperly installed SIMM in cache module for “other controller”.	Remove cache module and ensure that SIMMs are installed properly. See “Replacing SIMMs,” page 3-40.	Reseat SIMM
	Failed SIMM in cache module for “other controller”	If the previous check fails to produce a remedy	Replace SIMM in the cache module for “other controller”

Table 2-2 Troubleshooting Procedures (sheet 3 of 7)

Symptom	Possible Cause	Investigation	Remedy
Mirrored cache; controller reports battery not present	Cache module was installed before it was connected to an ECB	ECB cable not connected to cache module	Connect ECB cable to cache module, then restart both controllers by pushing their reset buttons simultaneously
Mirrored cache; controller reports cache or mirrored cache has failed	Primary data and its mirrored copy data are not identical.	<p>SHOW THIS_CONTROLLER indicates that the cache or mirrored cache has failed. Spontaneous FMU message indicates:</p> <ul style="list-style-type: none"> ■ Primary cache declared failed - data inconsistent with mirror, or ■ Mirrored cache declared failed - data inconsistent with primary. 	Enter SHUTDOWN command on controllers that report the problem. (This command flushes the contents of cache to synchronize its primary and mirrored data.) Restart the controllers that you shut down.

Table 2-2 Troubleshooting Procedures (sheet 4 of 7)

Symptom	Possible Cause	Investigation	Remedy
Invalid cache	<p>Mirrored cache mode discrepancy.</p> <p>This could occur after installing a new controller. Its existing cache module is set for mirrored caching, but the new controller is set for unmirrored caching.</p> <p>It could also occur if the new controller is set for mirrored caching but its existing cache module is not.</p>	<p>SHOW THIS CONTROLLER indicates “invalid cache.”</p> <p>Spontaneous FMU message indicates: Cache modules inconsistent with mirror mode.</p>	<p>Connect a local terminal to controller reporting the error and clear the error with the following command (all on one line):</p> <p>CLEAR_ERRORS THIS_CONTROLLER NODESTROY INVALID_CACHE</p>
	<p>Cache module may contain unflushed write-back data.</p> <p>This could occur after installing a new controller. Its existing cache module could indicate that it contains unflushed write-back data, but the new controller expects to find no data in the existing cache module.</p> <p>This error might also occur if installing a new cache module for a controller that expects write-back data in the cache.</p>	<p>SHOW THIS CONTROLLER indicates “invalid cache.”</p> <p>No spontaneous FMU message.</p>	<p>Connect a local terminal to controller reporting the error and clear the error with the following command (all on one line):</p> <p>CLEAR_ERRORS THIS_CONTROLLER DESTROY INVALID_CACHE</p>

Table 2-2 Troubleshooting Procedures (sheet 5 of 7)

Symptom	Possible Cause	Investigation	Remedy
Cannot add device	Illegal device	See product-specific release notes that accompanied the software release for the most recent list of supported devices	Replace device
	Device not properly installed in shelf	Check that SBB is fully seated	Firmly press SBB into slot
	Failed device	Check for presence of device LEDs	Follow repair action in the documentation provided with the enclosure or device
	Failed power supplies	Check for presence of power supply LEDs	Follow repair action in the documentation provided with the enclosure or power supply
	Failed bus to device	If the previous checks fail to produce a remedy	Replace enclosure or shelf
Cannot configure storage sets	Incorrect command syntax	See the <i>HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual</i> for the ADD storage set command	Reconfigure storage set with correct command syntax
	Exceeded maximum number of storage sets	Use CFMENU or the SHOW command to count the number of storage sets configured on controller	Delete unused storage sets
	Failed battery on ECB. (An ECB or UPS is required for RAID sets and mirror sets.)	Use the SHOW command to check the ECB's battery status	Replace ECB if required

Table 2-2 Troubleshooting Procedures (sheet 6 of 7)

Symptom	Possible Cause	Investigation	Remedy
Cannot assign unit number to storageset	Incorrect command syntax	See the <i>HSZ70 Array Controller HSOF Version 7.3 Configuration Manual</i> for correct syntax	Reassign unit number with correct syntax
	Incorrect SCSI target ID numbers set for controller that accesses desired unit (first number of unit number must be one of the SCSI target ID numbers for the controller).	Use the SHOW command to check the controller SCSI target ID numbers	Reset controller SCSI target ID numbers or assign new unit number
Unit is available but not online	This is normal. Units are “available” until the host accesses them, at which point their status is changed to “online.”	None	None
Host cannot access unit	Host files or device drivers not properly installed or configured	Check for the required device special files	Configure device special files as described in the <i>Getting Started Manual</i> that accompanied the software release.

Table 2-2 Troubleshooting Procedures (sheet 7 of 7)

Symptom	Possible Cause	Investigation	Remedy
Host log file indicates that a forced error occurred when the controller was reconstructing a RAIDset or mirrorset	Unrecoverable read errors may have occurred when controller was reconstructing the storageset. Errors occur if another member fails while the controller is reconstructing the storageset.	Conduct a read scan of the storageset using the appropriate utility from the host's operating system, such as the "dd" utility for a DIGITAL UNIX host.	Rebuild the storageset, then restore its data from a backup source. While the controller is reconstructing the storageset, monitor the activity with FMU for any unrecoverable errors. If unrecoverable errors persist, note the device on which they occurred and replace the device before proceeding.
	Host requested data from a normalizing storageset that didn't contain the data		Wait for normalizing members to become normal, then resume I/O to it

Checking Failure Entries

The controller fault-management software reports significant events and failures that occur during the controller's operation. This information is derived from the sense data, which the controller sends in response to a Request Sense command. This command is described in the SCSI-2 specifications: *Information technology, Small Computer System Interface, X3T9.2, 375R Rev. 10k, 10-Mar-93*.

The Fault Management Utility (FMU) provides a limited interface to the controller fault-management software. Use the FMU to:

- Display the last-failure and memory-system-failure entries that the fault-management software stores in the controller's non-volatile memory.

- Translate many of the event messages that are contained in the entries related to the significant events and failures. For example, entries may contain codes that indicate the cause of the event, the software component that reported the event, the repair action, and so on.
- Set the display characteristics of spontaneous events and failures that the fault-management system sends to the local terminal.

Displaying Failure Entries

The controller stores the four most recent last-failure and memory-system failure reports as entries in its non-volatile memory (NVMEM). The occurrence of any failure event terminates the controller on which it occurred. To display the last-failure and memory-system failure entries:

1. Connect a local terminal to the controller.
2. Start FMU with the following command:
RUN FMU
3. Show one or more of the entries with the following command:
SHOW *event_type* *entry#* *FULL*
where:
 - *event_type* is LAST_FAIL or MEMORY_SYSTEM_FAIL
 - *entry#* is ALL, MOST_RECENT, or 1 through 4
 - *FULL* displays additional information, such as the i960 processor stack and hardware component register sets (for example, memory controller, FX, host port, and device ports).
4. Exit FMU with the following command:
EXIT

Example 2-1 Last-Failure Entry

The following example shows a last-failure entry. The Informational Report—the lower half of the entry—contains the instance code, reporting component, and so forth, which you can translate with FMU to learn more about the event.

```
Last Failure Entry: 1. Flags: 000FF301
Template: 1.(01) Description: Last Failure Event
Occurred on 06-DEC-1996 at 09:21:44
Controller Model:
Serial Number: ZG51909900 Hardware Version: 0000(00)
```

Controller Identifier:
Unique Device Number: 01519090 Model: 40.(28) Class: 1.(01)
Firmware Version: v7.0a
Node Name: "HSZ01"

Informational Report

Instance, Code: 01010302 Description:
An unrecoverable hardware detected fault occurred.
Reporting Component: 1.(01) Description:
Executive Services
Reporting component's event number: 1.(01)
Event Threshold: 2.(02) Classification:
HARD. Failure of a component that affects controller performance or precludes access to a device connected to the controller is indicated.
Last Failure Code: 018800A0 (No Last Failure Parameters)
Last Failure Code: 018800A0 Description:
A processor interrupt was generated with an indication that the program card was removed.
Reporting Component: 1.(01) Description:
Executive Services
Reporting component's event number: 136.(88)
Restart Type: 2.(02) Description: Automatic hardware restart

Translating Event Codes

Use the following procedure to translate any event codes reported by the fault-management reports for spontaneous events and failures:

1. Connect a local terminal to the controller.
2. Start FMU with the following command:
RUN FMU
3. Show one or more of the entries with the following command:
DESCRIBE *code_type* *code#*

where *code_type* is one of those listed in Table 2-3 and *code#* is the alpha-numeric value displayed in the entry (code types marked with an asterisk (*) require multiple code numbers).

Table 2-3 Event Code Types

Event-Code Type	Where Found
restart_type	"Restart Code," page B-9
sense_key	Table B-2, Table B-3, Table B-4, Table B-5, Table B-6, Table B-7, Table B-8, Table B-9, Table B-10
memory_system_failure	Table B-7
device services non-transfer errors	Table B-8
device_type	Table B-9, Table B-10
SCSI_command_operation*	Table B-9, Table B-10
sense_data_qualifiers*	Table B-9, Table B-10
instance	Table B-11
last_failure	Table B-12
repair_action	Table B-13
component identifier	Table B-14
event_threshold	Table B-15
ASC_ASCQ*	Table B-16

Example 2-1 Last Failure Code

The following example shows the FMU translation of a last-failure code.

```

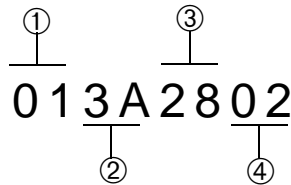
Last Failure Code: 206C0020 Description:
  Controller was forced to restart in order for
  new controller code image to take effect.
Reporting Component: 32.(20) Description:
  Command Line Interpreter
Reporting component's event number: 108.(6C)
Restart Type: 2.(02) Description: Automatic hardware restart
    
```

Instance Codes and Last Failure Codes

Instance codes identify and accompany significant events that do not cause the controller to terminate operation. Last failure codes identify and accompany failure events that cause the controller to stop operating. Last failure codes are sent to the host only after the affected controller is restarted successfully.

You can translate an instance or last failure code if you understand their structure. Figure 2-1 shows an example instance code of **013A2802** (see Table B-11).

Figure 2-1 Structure of an Instance or Last-Failure Code



- ①—The component ID number identifies the software component that detected the event. See Component Identifier Codes in Table B-14.
- ②—The event number indicates the event that the component detected. When combined with the component ID, this number uniquely identifies the event (two different components can use the same event number to report different events).
- ③—The repair action indicates the action that should be taken when the event threshold is reached. See Repair Action Codes in Table B-13.
- ④—The event threshold is reported for instance codes only and indicates:
 - The severity of the event and
 - When the repair action should be taken.

See Appendix B, “Event Reporting: Templates and Codes”.

- The parameter count (reported for last-failure codes only) indicates the number of fields in the event template that contain other important information about the failure.

Controlling the Display of Significant Events and Failures

The FMU SET command can be used to control how the fault-management software displays significant events and failures. Table 2-4 describes the SET commands that may be entered while you're running the FMU. These commands remain in effect only as long as the current FMU session remains active unless you enter the PERMANENT qualifier—the last entry in Table 2-4.

Table 2-4 FMU SET Commands (sheet 1 of 3)

Command	Result
SET EVENT_LOGGING SET NOEVENT_LOGGING	<p>Enable and disable the spontaneous display of significant device events to the local terminal and host (default = disabled).</p> <p>When enabled, the controller spontaneously displays information about the events on the local terminal. These events are preceded with “%EVL” to identify them.</p> <p>Because the events are spontaneous, logs are not stored by the controller. The spontaneous event logging is suspended during execution of CLI commands and while running utilities on the local terminal.</p>
SET LAST_FAILURE_LOGGING SET NOLAST_FAILURE_LOGGING	<p>Enable and disable the spontaneous display of failure events (default = enabled).</p> <p>When enabled, the controller spontaneously displays information relevant to the sudden termination of the controller on the local terminal. These last-failure events are preceded with “%LFL” to identify them.</p> <p>In cases of automatic hardware reset (for example, power failure or pressing the controller reset button), the last-failure log display is inhibited (automatic resets don't allow sufficient time to complete the display).</p>
SET LOG_TYPE REPAIR_ACTION SET LOG_TYPE NOREPAIR_ACTION	<p>Enable and disable the inclusion of repair action information for event logging or last-failure logging (default = disabled).</p> <p>When enabled, the controller displays all of the recommended repair actions associated with the event.</p>

Table 2-4 FMU SET Commands (sheet 2 of 3)

Command	Result
SET LOG_TYPE VERBOSE SET LOG_TYPE NOVERBOSE	<p>Enable and disable the descriptive text of event codes that are contained in event logs or last-failure logs (default =disabled).</p> <p>See “Translating Event Codes,” page 2-12 for instructions to translate these codes manually.</p>
SET PROMPT SET NOPROMPT	<p>Enable and disable the display of the CLI prompt string following the log identifiers %EVL or %LFL (default = disabled).</p> <p>This command is useful if you use the CLI prompt string to identify the controllers in a dual-redundant configuration (see the <i>HSZ70 Array Controller HSOF Version 7.3 Configuration Manual</i> for instructions to set the CLI command string for a controller).</p> <p>When enabled, the identification may be made of which controller sent the log to the local terminal.</p>
SET TIMESTAMP SET NOTIMESTAMP	<p>Enable and disable the display of the current date and time in the first line of an event or last-failure log. (default= disabled).</p>
SET FMU REPAIR_ACTION SET FMU NOREPAIR_ACTION	<p>Enable and disable the inclusion of repair actions when you enter <code>SHOW LAST_FAILURE</code> and <code>SHOW MEMORY_SYSTEM_FAILURE</code> commands (default = disabled).</p> <p>When enabled, the command outputs display all of the recommended repair actions associated with the instance codes or last-failure codes that are used to describe an event.</p>
SET FMU_VERBOSE SET FMU_NOVERBOSE	<p>Enable and disable descriptive text when you enter the <code>SHOW LAST_FAILURE</code> and <code>SHOW MEMORY_SYSTEM_FAILURE</code> commands (default = disabled).</p> <p>When enabled, it identifies the fields and their numeric content that comprise an event or last-failure entry.</p>

Table 2-4 FMU SET Commands (sheet 3 of 3)

Command	Result
SET CLI_EVENT_REPORTING SET NOCLI_EVENT_REPORTING	Enable and disable the asynchronous errors reported at the CLI prompt, such as “swap signals disabled” or “shelf has a bad power supply” (default = enabled). When enabled, these errors must be cleared with the CLEAR ERRORS_CLI command (these errors are preceded with “%CER” for identification).
SHOW PARAMETERS	This command displays the current settings associated with the SET command.
SET COMMAND PERMANENT	This qualifier preserves the SET command across controller resets.

Checking for Communication Problems

Use the virtual terminal display (VTDPY) utility to obtain information about the:

- Communication between the controller and its hosts,
- Communication between the controller and the devices in the subsystem, and
- State and I/O activity of the logical units, devices, and device ports in the subsystem.

VTDPY Run Procedures

Use the following procedures to run VTDPY:

1. Connect a local terminal to the controller. The terminal must support ANSI control sequences.
2. Set the terminal to NOWRAP mode to prevent the top line of the display from scrolling off of the screen.
3. Start VTDPY with the following command:

RUN VTDPY

Use the following key sequences and commands shown in Table 2-5 to control VTDPY.

Table 2-5 VTDPY Key Sequences and Commands

Command	Action
Ctrl/C	Enables command mode; after entering Ctrl/C, enter one of the following commands and press Return: DISPLAY CACHE DISPLAY DEFAULT DISPLAY DEVICE DISPLAY STATUS HELP INTERVAL <i>seconds</i> (to change update interval)
Ctrl/G	Updates screen
Ctrl/O	Pauses (and resumes) screen updates
Ctrl/R	Refreshes current screen display
Ctrl/Y	Exits VTDPY

The commands may be abbreviated to the minimum number of characters necessary to identify the command. Enter a question mark (?) after a partial command to see the values that can follow the supplied command. For example, if you enter `DISP ?`, the utility will list `CACHE`, `DEFAULT`, and so forth (separate “DISP” and “?” with a space). Upon successfully executing a command—other than `HELP`—VTDPY exits command mode. Pressing Enter (Return) without a command also causes VTDPY to exit command mode.

Checking Controller-to-Host Communications

Use the transfer-rate region of the default display (Figure 2-2) to see how or if the controller is communicating with the host.

Figure 2-2 Xfer Rate Region of the Default Display

```

VTDPY> DISPLAY DEFAULT

                S/N: ZG64100176 SW: v7.0 HW: CX-02
                65% I/D Hit 99.8% Idle      0 KB/S      0 Rq/S      Up: 0 5:14.53
Pr  Name  Stk/Max Typ Sta CPU% Xfer Rate      Target      Unit  ASWC KB/S Rd% Wr%
Cm% HT%
0   NULL  0/ 0      Rn 99.8 T W I   Mhz      111111 P0300 o
1   FCTRL 1/ 1 FNC Bl 0.0 03W 6 10.00 0123456789012345 D0303 o^ b
2   RECON 10/ 1 FNC Bl 0.0      P1      hH      PDD D0304 o^ b
3   HP_MAIN 40/ 3 FNC Bl 0.0      o2      hH      DD D P0400
4   HP_TIM 10/ 1 FNC Bl 0.0      r3      ???hH      P0401
7   VTDPY 20/ 12 DUP Rn 0.0      t4      hH DDD      D0402 x^ b
13  MDATAIO 10/ 4 FNC Bl 0.0      5      P      hH
15  SVANVUP 10/ 2 FNC Bl 0.0      6 DDD hH
16  MDATA 10/ 4 FNC Bl 0.0
    
```

Table 2-6 describes the contents for each column of the Xfer Rate region of Figure 2-2.

Table 2-6 Xfer Rate Column Descriptions

Column	Contents
T	SCSI target ID
W	Transfer width: W for 16-bit; blank for 8-bit.
I	Initiator that negotiated synchronous communication.
MHz	Synchronous data rate negotiated by the initiator at the specified SCSI ID number. Async indicates that no communication has been established between the initiator (controller or host) and the SCSI target.

Checking Controller-to-Device Communications

Use the device display (Figure 2-3) to see how or if the controller is communicating with the devices in the subsystem. This display contains three important regions:

- ❶—Device map region (upper left)
- ❷—Device status region (upper right)
- ❸—Device-port status (lower left)

Figure 2-3 Regions on the Device Display

```

VTDPY>DISPLAY DEVICE

S/N: ZG64100176 SW: v7.0 HW: CX-02
67% I/D Hit 99.9% Idle 0 KB/S 0 Rq/S Up: 0 5:17.54
①Target ② P TL ASWF Rq/S RdKB/S WrKB/S Que Tg CR BR TR
      111111 P1120 A^ 0 0 0 0 0 0 0
0123456789012345 D1130 A^ 0 0 0 0 0 0 0
P1 hH PDD D1140 A^ 0 0 0 0 0 0 0
o2 hH DD D D2120 A^ 0 0 0 0 0 0 0
r3 ???hH D2130 A^ 0 0 0 0 0 0 0
t4 hH DDD D2150 a^ 0 0 0 0 0 0 0
5 P hH ?3020 ^ F 0 0 0 0 0 0 0
6 DDD hH ?3030 ^ F 0 0 0 0 0 0 0
      ?3040 ^ F 0 0 0 0 0 0 0
      ?3050 ^ F 0 0 0 0 0 0 0
      D4090 A^ 0 0 0 0 0 0 0
      D4100 A^ 0 0 0 0 0 0 0
③ Port Rq/S RdKB/S WrKB/S CR BR TR D4110 A^ 0 0 0 0 0 0
1 0 0 0 0 0 0 P5030 A^ 0 0 0 0 0 0
2 0 0 0 0 0 0 D6010 A^ 0 0 0 0 0 0
3 0 0 0 0 0 0 D6020 A^ 0 0 0 0 0 0
4 0 0 0 0 0 0 D6030 A^ 0 0 0 0 0 0
5 0 0 0 0 0 0
6 0 0 0 0 0 0
    
```

Checking Device Type and Location

The device map region of the device display (①upper left) shows all of the devices that the controller recognizes through its device ports. Table 2-7 describes the contents for each column of the device map region.

Table 2-7 Device Map Column Descriptions

Column	Contents
Port	SCSI ports 1 through 6.
Target	SCSI targets 0 through 15. Single controllers occupy 7; dual-redundant controllers occupy 6 and 7. D = disk drive or CD-ROM drive F = foreign device
	H = this controller h = other controller in dual-redundant configurations P = passthrough device ? = unknown device type = no device at this port/target location

Checking Device Status and I/O Activity

The device status region of the device display (② upper right) shows the name and I/O characteristics for all of the devices that the controller recognizes. Table 2-8 describes the contents for each column of the device status region.

Table 2-8 Device Status Column Descriptions

Column	Contents
PTL	Kind of device and its port-target-lun (PTL) location: D = disk drive P = passthrough device ? = unknown device type = no device at this port/target location
A	Availability of the device: A = available to this controller a = available to other controller U = unavailable, but configured on this controller u = unavailable, but configured on other controller = unknown availability state
S	Spindle state of the device: ^ = disk is spinning at correct speed; tape is loaded > = disk is spinning up < = disk is spinning down v = disk is not spinning = unknown spindle state
W	Write-protection state of the device. For disk drives, a W in this column indicates that the device is hardware write protected. This column is blank for other kinds of devices.
F	Fault state of the device. An F in this column indicates an unrecoverable device fault. If this field is set, the device fault LED should also be lit.
Rq/S	Average request rate for the device during the last update interval. Requests can be up to 32K and generated by host or cache activity.
RdKB/S	Average data transfer rate from the device (reads) during the last update interval.

Table 2-8 Device Status Column Descriptions (Continued)

Column	Contents
<i>WrKB/S</i>	Average data transfer rate to the device (writes) during the last update interval.
<i>Que</i>	Maximum number of I/O requests waiting to be transferred to the device during the last update interval.
<i>Tg</i>	Maximum number of requests queued to the device during the last update interval. If the device does not support tagged queuing, the maximum value is 1.
<i>CR</i>	Number of SCSI command resets that occurred since VTDPY was started.
<i>BR</i>	Number of SCSI bus resets that occurred since VTDPY was started.
<i>TR</i>	Number of SCSI target resets that occurred since VTDPY was started.

Checking Device-Port Status and I/O Activity

The device-port status region of the device display (Ⓣ lower left) shows the I/O characteristics for the controller device ports. Table 2-9 describes the contents for each column of the device-port status region.

Table 2-9 Device-Port Status Column Descriptions

Column	Contents
Port	SCSI device ports 1 through 6.
Rq/S	Average request rate for the port during the last update interval. Requests can be up to 32K and generated by host or cache activity.
RdKB/S	Average data transfer rate from the devices on the port (reads) during the last update interval.
WrKB/S	Average data transfer rate to the devices on the port (writes) during the last update interval.
CR	Number of SCSI command resets that occurred since VTDPY was started.
BR	Number of SCSI bus resets that occurred since VTDPY was started.
TR	Number of SCSI target resets that occurred since VTDPY was started.

Checking Unit Status and I/O Activity

Use the cache display (Figure 2-4) to see the status and I/O activity for the logical units configured on the controller.

Figure 2-4 Unit Status on the Cache Display

```

VTDPY> DISPLAY CACHE

S/N: ZG64100176 SW: v7.0 HW: CX-02
66% I/D Hit 99.8% Idle 0 KB/S 0 Rq/S Up: 0 5:16.42
Unit ASWC KB/S Rd% Wr% Cm% HT% PH% MS% Purge BlChd BlHit
P0300 o 0 0 0 0 0 0 0 0 0 0 0
D0303 o^ b 0 0 0 0 0 0 0 0 0 0 0
D0304 o^ b 0 0 0 0 0 0 0 0 0 0 0
P0400 0 0 0 0 0 0 0 0 0 0 0
P0401 0 0 0 0 0 0 0 0 0 0 0
D0402 x^ b 0 0 0 0 0 0 0 0 0 0 0
    
```

Table 2-10 describes the contents for each column of the unit status region.

Table 2-10 Unit Status Column Descriptions

Column	Contents
Unit	Kind of unit (and its unit number): D = disk drive or CD-ROM drive P = passthrough device ? = unknown device type
A	Availability of the unit: a = available to other controller d = disabled for servicing. Offline. e = mounted for exclusive access by a user f = media format error i = inoperative m = maintenance mode for diagnostic purposes o = online. Host may access this unit through “this controller.” r = rundown with the SET NORUN command v = no volume mounted due to lack of media x = online. Host may access this unit through “other controller.” = unknown availability
S	Spindle state of the device: ^ = disk is spinning at correct speed; tape is loaded > = disk is spinning up; tape is loading < = disk is spinning down; tape is unloading v = disk is not spinning; tape is unloaded
	= unknown spindle state

Table 2-10 Unit Status Column Descriptions (Continued)

Column	Contents
W	Write-protection state. For disk drives, a W in this column indicates that the device is hardware write protected. This column is blank for units that comprise other kinds of devices.
C	Caching state of the device: b = read and write-back caching enabled r = read caching only = caching disabled
KB/S	Average amount of data transferred to and from the unit during the last update interval in 1000-byte increments.
Rd%	Percentage of data transferred between the host and the unit that were read from the unit.
Wr%	Percentage of data transferred between the host and the unit that were written to the unit.
CM%	Percentage of data transferred between the host and the unit were compared. A compare operation can accompany a read or a write operation, so this column is not the sum of columns Rd% and Wr%.
HT%	Cache-hit percentage for data transferred between the host and the unit.
PH%	Partial cache-hit percentage for data transferred between the host and the unit.
MS%	Cache-miss percentage for data transferred between the host and the unit.
Purge	Number of blocks purged from the cache during the last update interval.
BlChd	Number of blocks added to the cache during the last update interval.
BlHit	Number of blocks hit during the last update interval.

Checking for Disk-Drive Problems

Use the disk inline exerciser (DILX) to check the data-transfer capability of disk drives. DILX generates intense read/write loads to the disk drive while monitoring the drive performance and status. Run DILX on as many disk drives as you would like but, because this utility creates substantial I/O loads on the controller, it is recommended that you stop host-based I/O during the test. You may also use DILX to exercise the read capability of CD-ROM drives.

Finding a Disk Drive in the Subsystem

Follow these steps to find a disk drive or device in the subsystem:

1. Connect a local terminal to the controller.
2. Show the devices that are configured on the controller with the following command:
SHOW DEVICES
3. Find the device in the enclosure with the following command:

LOCATE *device-name*

This command causes the found device's LED to blink continuously.

Enter the following command to turn off the LED:

LOCATE CANCEL

Testing the Read Capability of a Disk Drive

Test the read capability of a disk drive by performing the following procedure:

1. From a host console, dismount logical unit that contains the disk drive you want to test.
2. Connect a local terminal to the controller that accesses the disk drive you want to test.
3. Run DILX with the following command:
RUN DILX
4. Decline the Auto-configure option so that you can specify the disk drive to test.
5. Accept the default test settings and run the test in read-only mode.

6. Enter the unit number of the disk drive you want to test. For example, to test D107, enter the number 107.
7. Testing more than one disk drive?
 - Yes—enter their unit numbers when prompted
 - No—enter “n” to start the test.

Use the control sequence found in Table 2-11 to control DILX during the test:

Table 2-11 DILX Control Sequences

Command	Action
Ctrl/C	Terminates the test
Ctrl/G	Displays the performance summary for the current test and continue testing
Ctrl/Y	Terminates the test and exits DILX

Testing the Read and Write Capabilities of a Disk Drive

Run a DILX Basic Function test to test the read and write capability of a disk drive. During the Basic Function test, DILX runs the four tests shown in Table 2-12.

Note DILX repeats the last three tests until the time established in step 6 of the procedure expires.

Table 2-12 DILX Tests

Test Name	Description	Length of Time to Complete
Write	Writes specific patterns of data to the disk drive (see Table 2-13 on page 2-31). DILX does not repeat this test.	
Random I/O	Simulates typical I/O activity by issuing read, write, access, and erase commands to randomly chosen logical block numbers (LBNs). You can set the ratio of these commands, as well as the percentage of read and write data that are compared throughout this test.	6 minutes
Data Transfer	Tests throughput by starting at an LBN and transferring data to the next LBN that has not been written to.	2 minutes
Seek	Stimulates head motion on the disk drive by issuing single-sector erase and access commands. Each I/O uses a different track on each subsequent transfer. You can set the ratio of access and erase commands.	2 minutes

DILX Run Procedure

Use the following procedure to run DILX *n* (a specific disk drive):

1. From a host console, dismount the logical unit that contains the disk drive you want to test.
2. Connect a local terminal to the controller that accesses the disk drive you want to test.
3. Run DILX with the following command:
RUN DILX
4. Decline the auto-configure option so that you can specify the disk drive to test.



Tip Use the auto-configure option if you want to test the read and write capabilities of every disk drive in the subsystem.

5. Decline the default settings.
6. Enter the number of minutes you want to run the DILX Basic Function test.

Note To ensure that DILX accesses the entire disk space, you should enter 120 or more.)

7. Enter the number of minutes between the display of performance summaries.
8. Choose to include performance statistics in the summary.
9. Choose to display both hard and soft errors.
10. Choose to display the hex dump.
11. Accept the hard-error limit default.
12. Accept the soft-error limit default.
13. Accept the queue depth default.
14. Choose option 1 to run a Basic Function test.
15. Enable phase 1, the write test.
16. Accept the default percentage of requests that DILX issues as read requests during phase 2, the random I/O test. DILX issues the balance as write requests.
17. Choose ALL for the data patterns that DILX issues for write requests.
18. Perform the initial write pass.
19. Allow DILX to compare the read and write data.
20. Accept the default percentage of reads and writes that DILX compares.
21. Enter the unit number of the disk drive you want to test. For example, if you want to test D107, you'd enter the number 107.
22. Testing more than one disk drive?
 - Yes—enter their unit numbers when prompted.
 - No—enter “n” to start the test.

Use the control sequences shown in Table 2-11 to control the write test. Table 2-13 shows the disk write data for each test pattern.

Table 2-13 Data Patterns for Phase 1: Write Test

Pattern	Data Written (in Hexadecimal)
1	0000
2	8B8B
3	3333
4	3091
5	0001, 0003, 0007, 000F, 001F, 003F, 007F, 00FF, 01FF, 03FF, 07FF, 0FFF, 1FFF, 3FFF, 7FFF
6	FIE, FFFC, FFFC, FFFC, FFE0, FFE0, FFE0, FFE0, FE00, FC00, F800, F000, F000, C000, 8000, 0000
7	0000, 0000, 0000, FFFF, FFFF, FFFF, 0000, 0000, FFFF, FFFF, 0000, FFFF, 0000, FFFF, 0000, FFFF
8	B6D9
9	5555, 5555, 5555, AAAA, AAAA, AAAA, 5555, 5555, AAAA, AAAA, 5555, AAAA, 5555, AAAA, 5555, AAAA, 5555
10	DB6C
11	2D2D, 2D2D, 2D2D, D2D2, D2D2, D2D2, 2D2D, 2D2D, D2D2, D2D2, 2D2D, D2D2, 2D2D, D2D2, 2D2D, D2D2
12	6DB6
13	0001, 0002, 0004, 0008, 0010, 0020, 0040, 0080, 0100, 0200, 0400, 0800, 1000, 2000, 4000, 8000
14	FIE, FFFD, FFFB, FFF7, FFEF, FFDF, FFBF, FF7F, FEFF, FDFF, FBFF, F7FF, EFFF, BFFF, DFFF, 7FFF
15	DB6D, B6DB, 6DB6, DB6D, B6DB, 6DB6, DB6D, B6DB, 6DB6, DB6D, B6DB, 6DB6, DB6D
16	3333, 3333, 3333, 1999, 9999, 9999, B6D9, B6D9, B6D9, B6D9, FFFF, FFFF, 0000, 0000, DB6C, DB6C
17	9999, 1999, 699C, E99C, 9921, 9921, 1921, 699C, 699C, 0747, 0747, 0747, 699C, E99C, 9999, 9999
18	FFFF

DILX Error Codes

Table 2-14 describes the error codes that DILX may display during and after testing. Contact your service representative to interpret the end-message fields.

Table 2-14 DILX Error Codes

Error Code	Explanation
1	Illegal Data Pattern Number found in data pattern header. DILX read data from the disk and discovered that the data did not conform to the pattern in which it was previously written.
2	No write buffers correspond to data pattern. DILX read a legal data pattern from the disk but because no write buffers correspond to the pattern, the data must be considered corrupt.
3	Read data does not match write buffer. DILX compared the read and write data and discovered that they didn't correspond.

Running the Controller Self Test

During start up, the controller runs a self test (also known as the DAEMON tests). These tests automatically test the device ports, host port, cache module, and value-added functions. If you are experiencing intermittent problems with one of these components, you can manually run the self test in a continuous loop rather than restarting the controller over and over again.

See "DAEMON Tests," page 1-14, for more information about these tests.

Self Test Run Procedure

Use the following procedure to run the controller self test:

1. Connect a local terminal to the controller.
2. Start the self test with one of the following commands:

```
SELFTEST THIS CONTROLLER  
SELFTEST OTHER_CONTROLLER
```

The self test runs until it detects an error or until you press the controller reset button.

If the self test detects an error, it saves information about the error and produces an OCP LED code for a “DAEMON hard error” (Table A-1 on page A-2).

Restart the controller to write the error information to the host error log, then check the log for a “built-in self-test failure” event report. This report will contain an instance code, located at offset 32 through 35, that you can use to determine the cause of the error. See “Translating Event Codes,” page 2-12 for help on translating instance codes. Instance codes are found in Table B-11 on page B-23.

Shutting Down and Restarting the Subsystem

This section contains procedures to shut down and restart a subsystem.

Shut Down Procedure

Follow these steps to shut down a subsystem:

1. From a host console, dismount the logical units in the subsystem.
2. Connect a maintenance terminal to one of the controllers in your subsystem.

3. Shut down the controllers. In single configurations, you only need to shut down “this controller.” In dual-redundant configurations, shut down the “other controller” first, then shut down “this controller” with the following commands:

SHUTDOWN OTHER_CONTROLLER
SHUTDOWN THIS_CONTROLLER

When the controllers shut down, their reset buttons and their first three LEDs are lit continuously. This may take several minutes, depending on the amount of data that needs to be flushed from the cache modules.

4. Turn off the power to the subsystem.
5. Unplug the subsystem power cord.
6. Disable the ECBs by pressing their shut off buttons until their status lights stops blinking—about two seconds.

Restart Procedure

Follow these steps to restart a subsystem:

1. Plug in the subsystem power cord.
2. Turn on the subsystem. The controllers automatically restart and the ECB automatically re-enable themselves to provide backup power to the cache modules.

CHAPTER 3

Replacement Procedures

This chapter describes the removal and replacement procedures for the components of the HSZ70 Array Controller subsystem with the exception of the power supplies, cooling fans, and cables. For these components, please refer to the enclosure documentation. Chapter 3 contents:

- “Single Controller Configuration,” page 3-2
 - “Replacing the Controller,” page 3-2
 - “Replacing the Cache Module,” page 3-7
 - “Replacing the ECB,” page 3-9
 - “Installing a New Program Card,” page 3-12
- “Dual-Redundant Controller Configuration,” page 3-13
 - “Replacing a Controller Module,” page 3-14
 - “Replacing a Cache Module,” page 3-19
 - “Program Card Replacement,” page 3-24
 - “Replacing the ECB,” page 3-29
- “Replacing a PVA Module,” page 3-31
 - “Replacing the PVA in the Master Enclosure (ID 0),” page 3-31
 - “Replacing the PVA in the First (ID 2) or Second (ID 3) Expansion Enclosure,” page 3-33
- “Replacing an I/O Module,” page 3-36
- “Replacing an Environmental Monitoring Unit,” page 3-39
- “Replacing SIMMs,” page 3-40
- “Replacing a Failed Storageset Member,” page 3-43

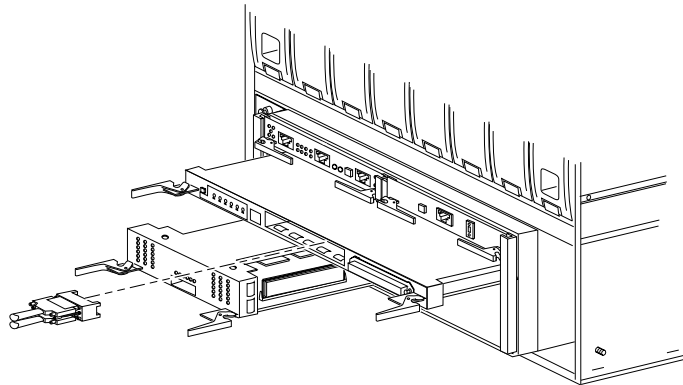
Single Controller Configuration

Follow the instructions in this section to replace modules in a single controller configuration (Figure 3-1).

If you are replacing modules in a dual-redundant controller configuration, see “Dual-Redundant Controller Configuration,” page 3-13.

To upgrade a single controller to a dual-redundant controller configuration, see “Upgrading to a Dual-Redundant Configuration,” page 4-14.

Figure 3-1 Single Controller Configuration



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Caution You must shut down the subsystem before removing or replacing any modules. If you remove the controller or any other module without first shutting down the subsystem, data loss may occur.

Replacing the Controller

Use the steps outlined in “Controller Removal Procedures” and “Controller Installation Procedures” to replace a controller.

Controller Removal Procedures

Use the following steps to remove the HSZ70 controller:

1. From the host console, dismount the logical units in the subsystem.
2. Last Failure Codes desired?
 - Yes—connect a PC or terminal to the controller maintenance port to obtain the last failure codes (see *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for details).

Note The HSZ70 Controller must be operational to complete this step. If not operational, go to step 7.

- No—go to step 7.
3. Start the FMU to obtain the last failure codes:
RUN FMU
 4. Display the instance and last failure codes:
SHOW LAST_FAILURE ALL
 5. Record the codes in the order that they appear.
 6. Exit FMU:

EXIT

Note If the container was initialized with the INITIALIZE command *SAVE_CONFIGURATION* switch (see *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual*), the controller loads the subsystem configuration from that device.

If the *SAVE_CONFIGURATION* switch was not used, you will have to manually configure the new controller as described in *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*



Caution The cache module may contain data if the controller crashed and you weren't able to shut it down with the **SHUTDOWN THIS_CONTROLLER** command.

7. Shut down the controller with the following command:

SHUTDOWN THIS_CONTROLLER

When the controller shuts down, its reset button and the first three LEDs are lit continuously.

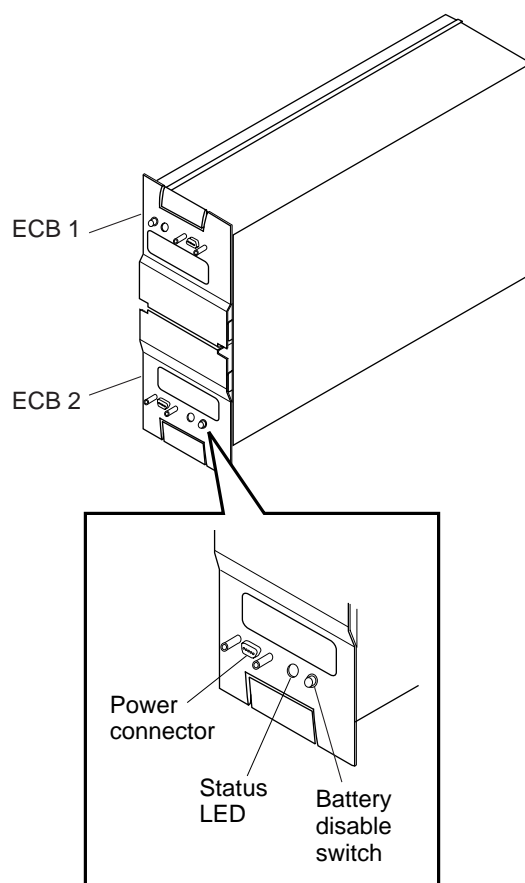


Caution ESD can easily damage a controller. Wear a snug-fitting, grounded ESD wrist strap.

Note If it is anticipated that the system will be shutdown for more than a few minutes, for example, waiting an hour for the part to arrive, then you should also disable the cache batteries to avoid a deep discharge of the battery (which will extend its life).

8. Is power to the subsystem going to be off for more than an hour?
 - Yes—Press the battery-disable switch (see Figure 3-2) until the status light stops blinking (about 5 seconds).
 - No—go to step 9.
9. Turn off power to the subsystem
10. Remove the program card ESD cover and program card (save them for the replacement controller).
11. Remove the tralink connectors, but do not disconnect the host bus cables (or terminators) from the tralink connectors.

Note Disabling the cache batteries prevent the batteries from performing a deep-discharge when the power is anticipated to be off for an extended period of time. This will extend the over-all life of the batteries.

Figure 3-2 Battery Disable Switch Location

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Note One or two trilink connectors may be attached, depending on the configuration.

12. If connected, disconnect the PC or terminal from the controller maintenance port.
13. Disengage both retaining levers and remove the controller, then place the controller into an antistatic bag or onto a grounded antistatic mat.

Controller Installation Procedures

Use the following steps to install a new controller or to re-install the current controller:



Caution ESD can easily damage a controller. Wear a snug-fitting, grounded ESD wrist strap.

Make sure you align the controller in the appropriate guide rails. If you do not align the module correctly, damage to the backplane can occur.

1. Insert the new controller into its slot, and engage its retaining levers.
 2. Connect the trilink connectors (with the host bus cables attached) to the new controller.
-

Note One or two trilink connectors may be attached, depending on the configuration.

3. Restore power to the subsystem.
4. Connect a PC or terminal to the controller maintenance port.
5. Hold the reset button while inserting the program card into the new controller. Release the reset button and replace the ESD cover.
6. When the CLI prompt reappears, display details about the configuration of the controller:

SHOW THIS_CONTROLLER FULL

See the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for detailed information about using this command.

7. Perform one of the following:
 - Configure the controller (refer to the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*).

Note If the controller you're installing was previously used in another subsystem, it will need to be purged of the old configuration (see CONFIGURATION RESET in the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual*).

- Restore the configuration saved with the INITIALIZE *SAVE_CONFIGURATION* switch by holding button 6 while releasing the reset button.
8. Using CLCP, install any patches that you had installed on the previous controller (see “Software Patch Installation Procedure,” page 4–5).
 9. Mount the logical units on the host.
 10. Set the subsystem date and time with the following command:
SET THIS_CONTROLLER TIME=dd-mmm-yyyy:hh:mm:ss
 11. Disconnect the PC or terminal from the controller maintenance port.

Replacing the Cache Module

Use the following steps described in “Cache Module Removal Procedures” and “Cache Module Installation Procedures” to replace the cache module.

Cache Module Removal Procedures

Use the following steps to remove the cache module:

1. From the host console, dismount the logical units in the subsystem. If you are using a Windows NT platform, shut down the server.
2. Last Failure Codes desired?
 - Yes—connect a PC or terminal to the controller maintenance port to obtain the last failure codes (see *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for details).

Note Controller must be operational to complete this step. If not operational, go directly to step 7.

- No—go to step 7.
3. Start the FMU to obtain the last failure codes:
RUN FMU
 4. Display the instance and last failure codes:
SHOW LAST_FAILURE ALL
 5. Record the codes in the order that they appear.

6. Exit FMU:

EXIT

Note If the container was initialized with the INITIALIZE command *SAVE_CONFIGURATION* switch (see *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual*), the controller loads the subsystem configuration from that device.

If the *SAVE_CONFIGURATION* switch was not used, you will have to manually configure the new controller as described in *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*



Caution The cache module may contain data if the controller crashed and you weren't able to shut it down with the SHUTDOWN THIS_CONTROLLER command.

7. Shut down the controller with the following command:

SHUTDOWN THIS_CONTROLLER

When the controller shuts down, its reset button and the first three LEDs are lit continuously.

8. Turn off power to the subsystem.



Caution ESD can easily damage a cache module. Wear a snug-fitting, grounded ESD wrist strap.

9. Disable the ECB by pressing the battery disable switch until the status light stops blinking—about five seconds.



Caution The ECB must be disabled—the status light is not lit or is not blinking—before disconnecting the ECB cable from the cache module. Failure to disable the ECB could result in cache module damage.

10. Disconnect the ECB cable from the cache module.

11. Disengage both retaining levers, remove the cache module, and place the cache module into an antistatic bag or onto a grounded antistatic mat.

Cache Module Installation Procedures

Use the following steps to install the cache module:



Caution ESD can easily damage a cache module. Wear a snug-fitting, grounded ESD wrist strap.

Make sure you align the cache module in the appropriate guide rails. If you do not align the cache module correctly, damage to the backplane can occur.

1. Insert the new cache module into its slot and engage its retaining levers.



Caution The ECB must be disabled—the status light is not lit or is not blinking—before connecting the ECB cable to the cache module. Failure to disable the ECB could result in ECB damage.

2. Connect the ECB cable to the new cache module (follow the VHDCI cable precautions).
3. If not already connected, connect a PC or terminal to the controller maintenance port.
4. Restore power to the subsystem. The ECB automatically re-enables itself to provide backup power to the cache module. The controller restarts with the configuration that resides in NVRAM.
5. Mount the logical units on the host. If you are using a Windows NT platform, restart the server.
6. Set the subsystem date and time with the following command:
SET THIS_CONTROLLER TIME=dd-mmm-yyyy:hh:mm:ss
7. Disconnect the PC or terminal from the controller maintenance port.

Replacing the ECB

Use the procedure outlined to turn the cabinet power off, remove, and then replace the ECB.

1. If the controller and cache module are not operating, go to step 4. Otherwise, go to the next step.
2. Connect a PC or terminal to the controller maintenance port. The controller to which you're connected is "this controller."
3. Shut down the controller with the following command:
`SHUTDOWN THIS_CONTROLLER`

When the controller shuts down, its reset button and first three LEDs are lit continuously. This may take several minutes, depending on the amount of data that needs to be flushed from the cache modules.

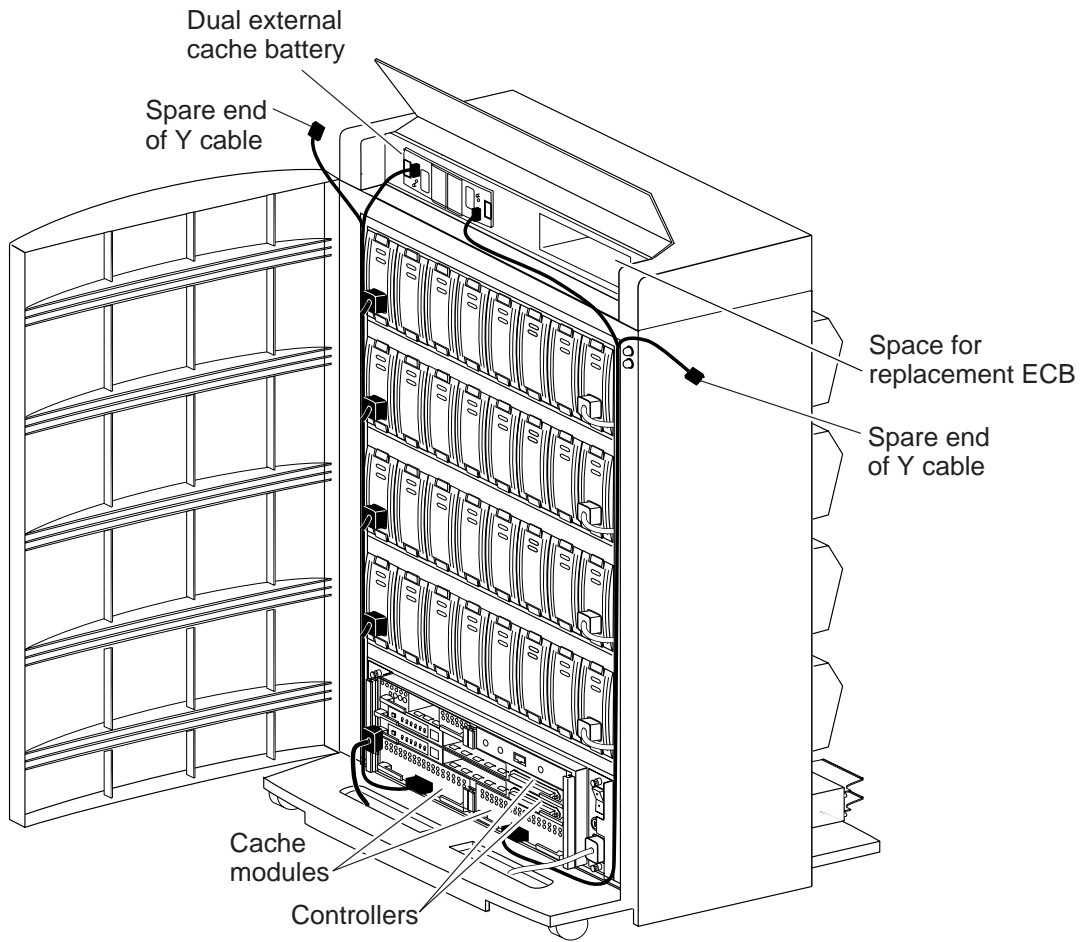
4. Turn off the power to the subsystem.
5. Insert the new ECB into its slot (leaving the old ECB in place until the batteries on the new ECB are fully charged; see Figure 3-3).



Caution The ECB cable has a 12-volt and a 5-volt pin. Improper handling or misalignment when connecting or disconnecting could cause these pins to contact ground, resulting in cache module damage.

6. Connect the open end of the ECB Y cable to the new ECB.
7. Restore power to the subsystem. The controller automatically restarts.
8. New ECB fully charged?
 - Yes—Disconnect the ECB cable from the old ECB.
 - No—Wait until ECB is fully charged.

Figure 3-3 ECB Replacement Cabling



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Note A continuously lit ECB status light indicates the batteries are fully charged whereas a blinking status light indicates that the batteries are charging.

9. Remove the old ECB.
10. Disconnect the PC or terminal from the controller maintenance port.

Installing a New Program Card

Note Before installing the software, ensure that all applicable software patches, if any, are installed (on the one controller, or both controllers if a dual-redundant configuration). The installation may not work properly if the applicable software patches are not installed prior to installing the major release (this applies to reverting to an older code release as well as upgrading the software).

Refer to “Software Patch Installation Procedure,” page 4-5 for a description of software patch installation procedure.

You must shut down and restart the controller during this upgrade (storage devices will then be unavailable to the host system). Use the following procedure to install a new program card with software:

1. Halt all host I/O activity to the controller and prepare the host system for a controller shutdown using the appropriate procedures for your operating system.
2. Establish a local connection to the controller through the maintenance port of the controller.
3. Shut down “this controller” by using the following command:

SHUTDOWN THIS_CONTROLLER



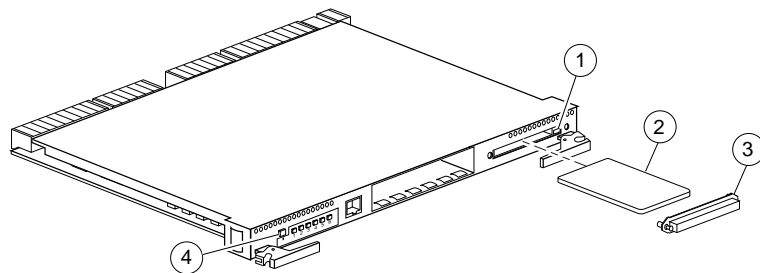
Caution Ensure that you wait until the Rest button stops flashing and stays lit continuously. This indicates that unwritten data is flushed from the cache module.

4. Remove the PCMCIA program card ESD cover (③ on Figure 3-4).
 5. See Figure 3-4: Press and hold the HSZ70 Controller reset button (④ on Figure 3-4) while pushing the eject button (① on Figure 3-4) to eject the old program card (release the button after the card is ejected).
 6. Press and hold the Reset button while inserting the new program card (② on Figure 3-4). Release the button after the card is inserted.
-

Note The controller will initialize and the Reset button will flash at an approximate once per second rate when ready for operation.

7. Replace the ESD cover and push the locking pins locking the card into place.
8. Mount the storage units on the host.

Figure 3-4 Replacing a Program Card

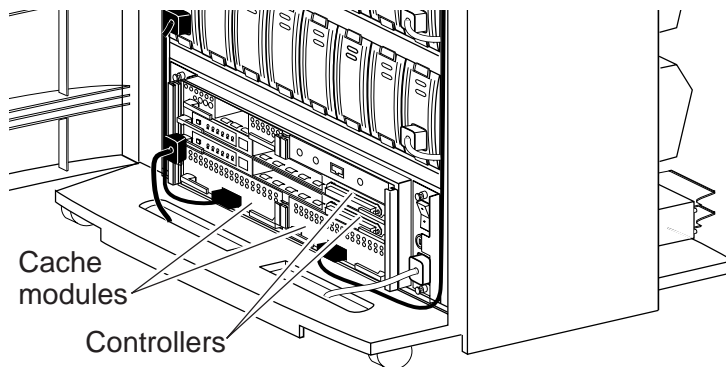


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Dual-Redundant Controller Configuration

Follow the instructions in this section to replace modules in a dual-redundant controller configuration (refer to Figure 3-5). If you're replacing modules in a single controller configuration, see "Single Controller Configuration," page 3-2.

Figure 3-5 Dual-Redundant Controller Configuration



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The following paragraphs in this section contain procedures for replacing

- The controller and cache modules,
- Only the controller, or
- The cache module.

Please observe the following pointers before starting:

- The new controller hardware must be compatible with the functioning controller hardware. See the product-specific release notes that accompanied the software release for information regarding hardware compatibility.
- The software versions and patch levels must be the same on both controllers. See “Software Patch Installation Procedure,” page 4–5, to install software patches on a newly installed controller.
- The new cache module must contain the same memory configuration as the module it is replacing.

Replacing a Controller Module

Use the following steps in “Controller Removal Procedures” and “Controller Installation Procedures” to replace a controller.

Controller Removal Procedures

Use the following steps to remove a controller:

1. Connect a PC or terminal to the operational controller maintenance port. The controller to which you’re connected is “this controller;” the controller that you’re removing is the “other controller.”
2. Disable failover and take the controllers out of their dual-redundant configuration with the following command:
SET NOFAILOVER
3. Start FRUTIL with the following command:
RUN FRUTIL
4. FRUTIL displays the FRUTIL Main menu:

FRUTIL Main Menu:

1. Replace or remove a controller or cache module
2. Install a controller or cache module
3. Replace a PVA module
4. Replace an I/O module

5. Exit
Enter choice: 1, 2, 3, 4, or 5 ->

5. Enter option 1 from the FRUTIL Main menu. FRUTIL displays the Replace or Remove Options menu:

Replace or remove Options:
1. Other controller and cache module
2. Other controller module
3. Other cache module
4. Exit
Enter choice: 1, 2, 3, or 4 ->

6. Enter option 2 from the Replace or Remove Options menu.



Caution The device ports must quiesce before removing the controller. Failure to allow the ports to quiesce may result in data loss. Quiescing may take several minutes.

ESD can easily damage a controller. Wear a snug-fitting, grounded ESD wrist strap.

Note A countdown timer allows a total of two minutes to remove the controller. If you exceed two minutes, “this controller” exits FRUTIL and resumes operations.

7. Remove the tralink connectors from the “other controller,” but don’t disconnect the host bus cables (or terminators) from the tralink connectors.

Note One or two tralink connectors may be attached, depending on the configuration.

8. Disengage both retaining levers and remove the “other controller,” then place this controller into an antistatic bag or onto a grounded antistatic mat.
9. Once the controller is removed, FRUTIL displays the following:

```
Restarting all device ports. Please wait...  
Device Port 1 restarted.  
Device Port 2 restarted.
```

```
Device Port 3 restarted.  
Device Port 4 restarted.  
Device Port 5 restarted.  
Device Port 6 restarted.
```

Do you have a replacement controller? Y/N

- Enter N(o) if you don't have a replacement controller; disconnect the PC or terminal from the controller maintenance port.
- Enter Y(es) if you have a replacement controller and want to install it now. FRUTIL displays the following:

```
Insert the slot A [or B] controller? Y/N
```

Note If you entered Y(es) go to step 6 in the “Controller Installation Procedures”.

10. Remove the program card ESD cover and program card from the “other controller.” Save them for the replacement controller.

Note If it is anticipated that the power to both controllers will be shut off for any extended period of time, then the ECB batteries should also be disabled to avoid a deep cycle discharge (shortening the life of the batteries). If this is the case, follow the steps outlined in step 8 on page 3-4 before continuing.

Controller Installation Procedures

Use the following steps to install a controller:

1. Connect a PC or terminal to the operational controller maintenance port. The controller to which you're connected is “this controller;” the controller that you are installing is the “other controller.”

2. Start FRUTIL with the following command:

RUN FRUTIL

3. FRUTIL displays the FRUTIL Main menu:

```
FRUTIL Main Menu:
```

1. Replace or remove a controller or cache module
2. Install a controller or cache module
3. Replace a PVA module
4. Replace an I/O module
5. Exit

Enter choice: 1, 2, 3, 4, or 5 ->

4. Enter option 2 from the FRUTIL Main menu. FRUTIL displays the Install Options menu:

Install Options:

1. Other controller and cache module
2. Other controller module
3. Other cache module
4. Exit

Enter choice: 1, 2, 3, or 4 ->

5. Enter option 2 from the Install Options menu. FRUTIL display the following:

Insert the slot A [or B] controller? Y/N

6. Enter Y(es) and press **Enter**.

Note A countdown timer allows a total of two minutes to install the controller. If you exceed two minutes, “this controller” will exit FRUTIL and resume operations.



Caution ESD can easily damage a controller. Wear a snug-fitting, grounded ESD wrist strap.

Make sure you align the controller in the appropriate guide rails. If you do not align the controller correctly, damage to the backplane can occur.

7. Ensure that the program card is not already installed in the new controller and insert the new controller into its slot. Engage its retaining levers.

FRUTIL displays the following:

The configuration has two controllers.

To restart the other controller:

1. Type 'restart other_controller'.
2. Press and hold the reset button while inserting the program card on the slot A [or B] controller, then release the reset button.

The controller will restart.

Field Replacement Utility terminated.

Note If the controller you're installing was previously used in another subsystem, it will need to be purged of the controller's previous configuration (see CREATE_PARTITION in the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual*).

Note FRUTIL may display the following message:
%CER--18-NOV-1998 10:39:01--Other controller not responding
- RESET-signal asserted

This is not an error message. Please continue with controller replacement procedure.

8. Wait for FRUTIL to terminate, then connect the trilink connectors to the new controller.

Note One or two trilink connectors may be attached, depending on the configuration.

9. To allow the "other controller" to restart, type the following command:

RESTART OTHER _CONTROLLER

10. Hold the reset button while inserting the program card into the new controller. Release the reset button and replace the ESD cover. The controller will restart.
11. Refer to the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*, to configure the controller.
12. Re-establish the dual-redundant controller configuration with one of the following commands:

SET FAILOVER COPY=THIS_CONTROLLER

SET MULTIBUS_FAILOVER COPY=THIS_CONTROLLER

Refer to the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for proper use of these CLI commands.

13. Disconnect the PC or terminal from the controller maintenance port.

Replacing a Cache Module

Use the following steps in “Cache Module Removal Procedures” and “Cache Module Installation Procedures” to replace a cache module.

Note The new cache module must contain the same memory configuration as the module it is replacing.

Cache Module Removal Procedures

Use the following steps to remove a cache module:

1. Connect a PC or terminal to the operational controller maintenance port. The controller to which you’re connected is “this controller”; the controller whose cache module you’re replacing is the “other controller.”

2. Disable failover and take the controllers out of their dual-redundant configuration with the following command:

```
SET NOFAILOVER
```

3. Start FRUTIL with the following command:

```
RUN FRUTIL
```

4. FRUTIL displays the following:

```
FRUTIL Main Menu:
```

1. Replace or remove a controller or cache module
2. Install a controller or cache module
3. Replace a PVA module
4. Replace an I/O module
5. Exit

```
Enter choice: 1, 2, 3, 4, or 5 ->
```

5. Enter option 1 from the FRUTIL Main menu. FRUTIL displays the Replace or Remove Options menu:

```
Replace or remove Options:
```

1. Other controller and cache module
2. Other controller module
3. Other cache module
4. Exit

```
Enter choice: 1, 2, 3, or 4 ->
```

6. Enter option 3 from the Replace or Remove Options menu.

7. Enter Y(es) and press **Enter**. FRUTIL displays the following:

Remove the slot A (or B) cache module? Y/N

8. Enter Y(es) and press **Enter**. Wait for FRUTIL to quiesce the device ports. After the ports have been quiesced (this may take several minutes), FRUTIL displays the following:

All device ports quiesced;
Remove the slot B cache module within x minutes,
xx seconds. Then disconnect the external battery,
if in use, from the cache module.



Caution The device ports must quiesce before removing the cache module. Failure to allow the ports to quiesce may result in data loss.



Caution ESD can easily damage the cache module. Wear a snug-fitting, grounded ESD wrist strap.

Note A countdown timer allows a total of two minutes to remove the cache module. If you exceed two minutes, “this controller” will exit FRUTIL and resume operations.

9. Disengage both retaining levers and partially remove the “other controller” cache module—about half way.
10. Disable the ECB by pressing the battery disable switch until the status light stops blinking—about five seconds.



Caution The ECB must be disabled—the status light is not lit or blinking—before disconnecting the ECB cable from the cache module. Failure to disable the ECB could result in cache module damage.

11. Disconnect the ECB cable from the “other controller” cache module, remove the cache module, and place it onto a grounded antistatic mat or into an antistatic bag.

Once the cache module is removed, FRUTIL displays the following:

Restarting all device ports. Please wait...


```
Device Port 1 restarted.  
Device Port 2 restarted.  
Device Port 3 restarted.  
Device Port 4 restarted.  
Device Port 5 restarted.  
Device Port 6 restarted.  
Do you have a replacement cache module? Y/N
```

12. Enter one of the following:

- N(o) if you don't have a replacement cache module, and disconnect the PC or terminal from the controller maintenance port.
- Y(es) if you have a replacement cache module and want to install it now. FRUTIL displays the following:

```
Insert the slot A [or B] cache module? Y/N
```

Note If you entered Y(es) go to step 7 of the "Cache Module Installation Procedures".

Cache Module Installation Procedures

Use the following steps to install a cache module:

Note Go to step 5 if you selected Y(es) in step 12 of the removal procedure (continuous removal and installation).

1. Connect a PC or terminal to the operational controller. The controller to which you're connected is "this controller"; the controller whose cache module you're installing is the "other controller."
2. Start FRUTIL with the following command:

RUN FRUTIL

3. FRUTIL displays the following:

```
FRUTIL Main Menu:
```

1. Replace or remove a controller or cache module
2. Install a controller or cache module
3. Replace a PVA module
4. Replace an I/O module
5. Exit

```
Enter choice: 1, 2, 3, 4, or 5 ->
```

4. Enter option 2 from the FRUTIL Main menu. FRUTIL displays the Install Options menu:

```
Install Options:
  1. Other controller and cache module
  2. Other controller module
  3. Other cache module
  4. Exit
Enter choice: 1, 2, 3, or 4 ->
```

5. Enter option 3 from the Install Options menu. FRUTIL display the following:

```
Insert the slot A [or B] cache module? Y/N
```

6. Enter Y(es) and press **Enter**. FRUTIL displays the following:

```
Quiescing all device ports. Please wait...
Device Port 1 quiesced.
Device Port 2 quiesced.
Device Port 3 quiesced.
Device Port 4 quiesced.
Device Port 5 quiesced.
Device Port 6 quiesced.
All device ports quiesced.
.
.
.
```

Perform the following steps:

1. Turn off the battery for the new cache module by pressing the battery's shut off button for five seconds
2. Connect the battery to the new cache module.
3. Insert the new cache module in slot A [or B] within 2 minutes.

Note A countdown timer allows a total of two minutes to install the cache module. If you exceed two minutes, "this controller" will exit FRUTIL and resume operations.



Caution ESD can easily damage a cache module. Wear a snug-fitting, grounded ESD wrist strap.

Make sure you align the cache module in the appropriate guide rails. If you do not align the cache module correctly, damage to the backplane can occur.

7. Disable the ECB to which you're connecting the new cache module by pressing the battery disable switch until the status light stops blinking—about five seconds.
-



Caution The ECB must be disabled—the status light is not lit or is not blinking—before connecting the ECB cable to the cache module. Failure to disable the ECB could result in ECB damage.

8. Connect the ECB cable to the new cache module (follow the VHDCI Cable Precautions).
 9. Insert the new cache module into its slot and engage its retaining levers.
-

Note In mirrored mode, FRUTIL will initialize the mirrored portion of the new cache module, check for old data on the cache module, and then restart all device ports. After the device ports have been restarted, FRUTIL will test the cache module and the ECB.

After the test completes, the device ports will quiesce and a mirror copy of the cache module data will be created on the newly installed cache module.

FRUTIL displays the following:

```
The configuration has two controllers.
```

```
To restart the other controller:
```

1. Type 'restart other_controller'.
2. Press and hold the reset button while inserting the program card on the slot A [or B] controller, then release the reset button.

```
The controller will restart.
```

```
Field Replacement Utility terminated.
```

10. To allow the “other controller” to restart, type the following command:

```
RESTART OTHER_CONTROLLER
```

11. Hold the reset button while inserting the program card into the controller. Release the reset button and replace the ESD cover. The controller will restart.
12. Re-establish the dual-redundant controller configuration with one of the following commands:
SET FAILOVER COPY=THIS_CONTROLLER
SET MUTIBUS_FAILOVER COPY=THIS_CONTROLLER
Refer to the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for proper use of these commands.
13. Disconnect the PC or terminal from the controller maintenance port.

Program Card Replacement

The PCMCIA Program Card may be replaced by shutting down both controllers (shutdown upgrade) or by shutting down only one of the controllers at a time (rolling upgrade). A shutdown upgrade is one in which the storage devices are taken off-line for the period of time that the software is being installed.

If access to the storage devices is needed during the period of time the software is being installed, then use the “Rolling Upgrade,” page 3-25.

Shutdown Upgrade

Use the following procedure to install the new software in a shutdown upgrade manner:

1. Halt all host I/O activity to the controller and prepare the host system for a controller shutdown using the appropriate procedures for your operating system.
2. Establish a local connection to the controller through the maintenance port of the controller.
3. Shutdown both controllers with the following commands:
SHUTDOWN OTHER_CONTROLLER
SHUTDOWN THIS_CONTROLLER



Caution Before continuing, wait until the Reset buttons on both controllers stop flashing (lit continuously). This indicates that unwritten data is flushed from the cache module.

4. See Figure 3–4: Remove the PCMCIA program card ESD covers (③) from both controllers.
5. Press and hold the controller Reset button (④) while ejecting (①) the old program card (②). Release the button after the card is ejected and repeat for other controller.

Note The controller will initialize and the Reset button will flash at an approximate once per second rate when ready for operation.

6. Press and hold the reset button while inserting the new program card (release the button after the new card is inserted); repeat for other controller.

Note The controllers initialize and their reset buttons will flash at an approximate once per second rate when ready for operation.

7. Replace the ESD covers on both controllers, pushing their locking pins to secure them in place.
8. Mount the storage units on the host.

Note You can identify the version of the HSOF software that is currently loaded in the controller by entering a `SHOW THIS_CONTROLLER` command at the CLI prompt.

Rolling Upgrade

A “rolling” upgrade procedure is one in which the storage devices do not have to be placed offline to upgrade the software. Using the failover capabilities of the controllers, only one controller at a time need be shutdown, allowing the host system to have storage device activity from the subsystem being upgraded.

Use the following procedure to install the new program card with its software:

1. Establish a local connection to the controller through the maintenance port of one of the controllers (“this controller”).

2. Remove the preferred target IDs from the “other controller” by using the following command:

SET OTHER_CONTROLLER NOPREFERRED

Note Ensure you have the preferred target IDs written down before clearing them out with the **SET OTHER_CONTROLLER NOPREFERRED** command. This will speed up the process at the end of the installation procedure.

3. Wait for the CLI prompt, and then shut down “other controller” by using the following command:

SHUTDOWN OTHER_CONTROLLER

Note If the EMU alarm is turned on, then the alarm will “sound” when the controller is shut down. The alarm may be turned off by pressing the lit EMU “fault” button.



Caution See Figure 3-4: Before continuing, wait until the Reset button (④) stops flashing and stays lit continuously. This indicates that unwritten data is flushed from the cache module.

4. Remove the program card ESD cover (③) from “other controller”.
 5. Press and hold the controller Reset button (④) while ejecting (①) the old program card (②). Release the button after the card is ejected.
 6. Press and hold the Reset button while inserting the new program card in “other controller” (release the button after the new card is inserted).
-

Note Wait for the following to happen before continuing: 1) The Reset button flashes at an approximate once per second rate and 2) the maintenance terminal displays a message that finishes with:
`other controller restarted.`

7. Read the status of “other controller” by issuing the following command:

SHOW OTHER_CONTROLLER

Note When the `SHOW OTHER_CONTROLLER` command verifies that the `other controller restarted`, it is safe to continue.

8. Replace the ESD cover on “other controller” and push the locking pins to secure it.
9. First pass through this procedure?
 - YES—Move the maintenance port cable from “this controller” to “other controller” maintenance port and repeat procedure from step 3 to step 8 to replace the other program card.

Note “Other controller” switches with “this controller”—the controller that the maintenance port cable was plugged into originally— (“this controller”) becomes “other controller” for the second pass through steps 2–8.

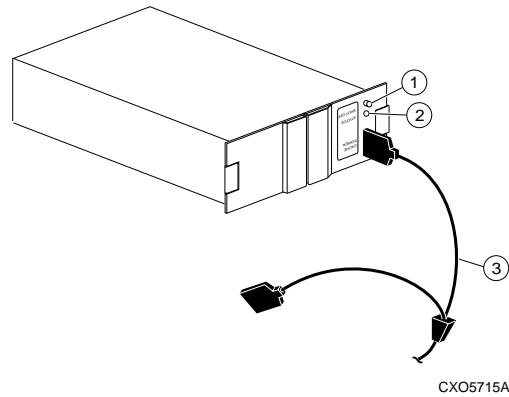
- NO—Go to step 10
10. Re-establish the preferred target ID list in the two controllers by issuing the following commands:

```
SET OTHER_CONTROLLER PREFERRED_ID=n,n,...
SET THIS_CONTROLLER PREFERRED_ID=n,n,...
```

Replacing an External Cache Battery

Use the procedure described in “Replacing the ECB” to remove, and then replace an External Cache Battery (ECB) in the HSZ70. A single-battery ECB is shown in Figure 3-6 and a dual-battery ECB is shown in Figure 3-7.

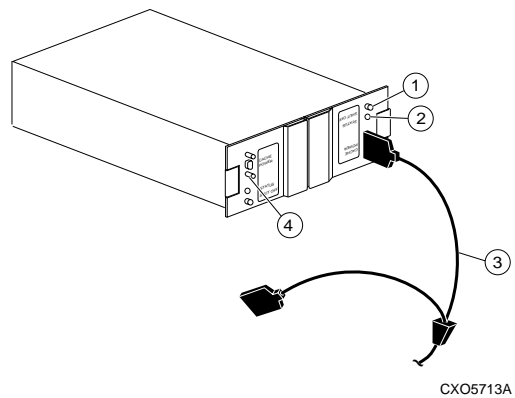
Figure 3-6 Single-Battery ECB SSB Configuration



CXO5715A

①	Battery disable switch
②	Status LED
③	ECB Y cable

Figure 3-7 Dual-Battery ECB SBB Configuration



CXO5713A

①	Battery disable switch
②	Status LED
③	ECB Y cable
④	Faceplate and controls for second battery

Replacing the ECB

Use the following steps to replace the ECB SSB with the cabinet powered on:



Caution Do not disconnect the old ECB until the batteries in the new ECB are fully charged.

Note The procedure for a dual-redundant controller configuration assumes that a single ECB SBB with a dual battery is installed and an empty slot is available for the replacement ECB SBB. If an empty slot is not available, place the new ECB SBB on the top of the enclosure. After the old ECB SBB has been removed, carefully insert the new ECB SBB into the empty slot.

1. Connect a PC or terminal to the controller with the operational ECB. The controller to which you're connected is "this controller"; the controller whose ECB you are replacing is the "other controller".
2. Disable failover and take the controllers out of their dual-redundant configuration with the following command:
SET NOFAILOVER
3. Start FRUTIL with the following command:
RUN FRUTIL
4. Choose Option 3 from the FRUTIL Main menu:
FRUTIL Main Menu:
 1. Replace or remove a controller or cache module
 2. Install a controller or cache module
 3. Replace other cache module battery
 4. Replace a PVA module
 5. Replace an I/O module
 6. Exit
Enter choice: 1, 2, 3, 4, or 5 ->
5. Confirm that you have a new dual-battery replacement ECB. FRUTIL displays the following:
Do you have a NEW replacement battery? Y/N



Caution The ECB cable has a 12-volt and a 5-volt pin. Improper handling or misalignment when connecting or disconnecting could cause these pins to contact ground, resulting in cache module damage.

6. Enter Y(es) and press **Enter**.
7. Confirm that you want to install a replacement ECG. FRUTIL displays the following:

```
Replace the battery for the cache module in slot  
A (or B)? Y/N
```
8. Enter Y(es) and press **Enter**.
9. Insert the new ECB SBB into the empty battery slot.

Note If an empty slot is not available, place the new ECB SBB on the top of the enclosure.

10. Connect the new battery to the unused end of the Y cable attached to cache A [or B].



Caution Do not disconnect the old ECB until the batteries in the new ECB are fully charged. The new ECB's status light will be lit continuously to indicate that its batteries are fully charged. A blinking status light indicates that its batteries are charging. You may operate the subsystem regardless of the old ECB's status.

11. Wait until the new ECB's status light is on continuously, then disconnect the old battery.
12. Re-establish the dual-redundant controller configuration with one of the following commands:

```
SET FAILOVER COPY=THIS_CONTROLLER  
SET MULTIBUS_FAILOVER COPY=THIS_CONTROLLER
```

Refer to the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for proper use of these CLI commands.
13. Disconnect the terminal for the controller.

14. To connect the other cache module to the new ECB, repeat the appropriate steps for the remaining controller and cache module.
15. Remove the old ECB.

Note If an empty slot was not available, and the new ECB was placed on top of the enclosure, carefully insert it into the empty slot now.

Replacing a PVA Module

Use the following instructions in this section to replace a PVA module:

- “Replacing the PVA in the Master Enclosure (ID 0),” page 3-31.
- “Replacing the PVA in the First (ID 2) or Second (ID 3) Expansion Enclosure,” page 3-33.

Note This procedure is not applicable for the DS-350/356-Mx shelf. The HSZ70 controller can support up to three enclosures: the master enclosure (ID 0), the first expansion enclosure (ID 1), and the second expansion enclosure (ID 2).

A PVA can be replaced in either a single or a dual-redundant controller configuration using this procedure.

Replacing the PVA in the Master Enclosure (ID 0)

Use the following steps to replace the PVA in the master enclosure:

1. Connect a PC or terminal to the controller maintenance port.
2. In a dual-redundant controller configuration, disable failover with the following command:
SET NOFAILOVER
3. In a dual-redundant controller configuration, remove the program card ESD cover and program card from the “other controller.” Save them for reinstallation.
4. Start FRUTIL with the following command:
RUN FRUTIL

FRUTIL displays the following:

Do you intend to replace this controller's cache battery? Y/N

5. Enter N(o). FRUTIL displays the FRUTIL Main menu:

FRUTIL Main Menu:

1. Replace or remove a controller or cache module
2. Install a controller or cache module
3. Replace a PVA module
4. Replace an I/O module
5. Exit

Enter choice: 1, 2, 3, 4, or 5 ->

6. Enter option 3 from the FRUTIL Main menu. FRUTIL displays the PVA Replacement menu:

FRUTIL PVA Replacement Menu:

1. Master Enclosure (ID 0)
2. First Expansion Enclosure (ID 2)
3. Second Expansion Enclosure (ID 3)
4. Exit

Enter Choice: 1, 2, 3, or 4 ->

Note The FRUTIL PVA Replacement Menu has options for three enclosures regardless of how many enclosures are physically configured.

7. Enter option 1 from the FRUTIL PVA Replacement Menu. FRUTIL displays the following:

Do you have a replacement PVA module? Y/N

8. Enter Y(es) and press **Enter**. FRUTIL displays the following:

Ensure the replacement PVA's address is set to zero.
Press return to quiesce device port activity.

9. Set the replacement PVA address to zero.

10. Press **Enter** and wait for FRUTIL to quiesce the device ports. This may take several minutes. FRUTIL displays the following:

All device ports quiesced.
Replace the PVA in the master cabinet.

11. Remove the old PVA and install the new PVA. FRUTIL displays the following:

Press return to resume device port activity.

12. Press **Enter** to resume device port activity (this may take several minutes). When all port activity has restarted, FRUTIL displays the following:

```
PVA replacement complete.
```

In a dual-redundant configuration, FRUTIL also displays:

```
The configuration has two controllers.
```

```
To restart the other controller:
```

1. Type 'restart other_controller'.
2. Press and hold the reset button while inserting the program card on the slot A [or B] controller, then release the reset button.

```
The controller will restart.
```

```
Field Replacement Utility terminated.
```

13. To allow the “other controller” to restart, type the following command:

```
RESTART OTHER_CONTROLLER
```

14. Hold the reset button while inserting the program card into the controller. Release the reset button and replace the ESD cover. The controller will restart.
15. Re-establish the dual-redundant controller configuration with one of the following commands:

```
SET FAILOVER COPY=THIS_CONTROLLER
```

```
SET MULTIBUS_FAILOVER COPY=THIS_CONTROLLER
```

Refer to the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for proper use of these CLI commands

16. Disconnect the PC or terminal from the controller maintenance port.

Replacing the PVA in the First (ID 2) or Second (ID 3) Expansion Enclosure

Use the following steps to replace the PVA in the first expansion (ID 2) or second expansion (ID 3) enclosure:

1. Connect a PC or terminal to the controller maintenance port.
2. In a dual-redundant controller configuration, disable failover with the following command:

```
SET NOFAILOVER
```

3. In a dual-redundant controller configuration, remove the program card ESD cover and program card from the “other controller.” Save them for reinstallation.
4. Start FRUTIL with the following command:

RUN FRUTIL

FRUTIL displays the following:

Do you intend to replace this controller’s cache battery? Y/N

5. Enter N(o). FRUTIL displays the FRUTIL Main menu:

FRUTIL Main Menu:

1. Replace or remove a controller or cache module
2. Install a controller or cache module
3. Replace a PVA module
4. Replace an I/O module
5. Exit

Enter choice: 1, 2, 3, 4, or 5 ->

6. Enter option 3 from the FRUTIL Main menu. FRUTIL displays the PVA Replacement menu:

FRUTIL PVA Replacement Menu:

1. Master Enclosure (ID 0)
2. First Expansion Enclosure (ID 2)
3. Second Expansion Enclosure (ID 3)
4. Exit

Enter Choice: 1, 2, 3, or 4 ->

Note The HSZ70 controller can support up to three enclosures. The FRUTIL PVA Replacement menu has options for three enclosures regardless of how many enclosures are connected.

7. Enter one of the following from the FRUTIL PVA Replacement menu:

- Option 2 to replace the PVA in the first expansion enclosure.
- Option 3 to replace the PVA in the second expansion enclosure.

FRUTIL displays the following:

Do you have a replacement PVA module? Y/N

8. Enter Y(es) and press **Enter**. FRUTIL displays the following:

Ensure the replacement PVA’s address is set to 2 [or 3].
Press return to quiesce device port activity.

9. Set the replacement PVA address to one of the following:
 - 2 for the first expansion enclosure
 - 3 for the second expansion enclosure
10. Press **Enter** and wait for FRUTIL to quiesce the device ports. This may take several minutes. FRUTIL displays the following:

```
All device ports quiesced.  
Using the power switch, power down expansion cabinet #2 [or  
#3] and replace the PVA.
```
11. Power down the appropriate expansion cabinet.
12. Remove the old PVA and install the new PVA.
13. Power on the appropriate expansion cabinet. FRUTIL displays the following:

```
Press return to resume device port activity.
```
14. Press **Enter** to resume device port activity. This may take several minutes. When all port activity has restarted, FRUTIL displays the following:

```
PVA replacement complete.
```

In a dual-redundant configuration, FRUTIL also displays:

```
The configuration has two controllers.  
To restart the other controller:  
1. Type 'restart other_controller'.  
2. Press and hold the reset button while inserting the  
   program card on the slot B controller, then release the  
   reset button.  
   The controller will restart.
```

```
Field Replacement Utility terminated.
```
15. To allow the “other controller” to restart, type the following command:
RESTART OTHER_CONTROLLER
16. Hold the reset button while inserting the program card into the new controller. Release the reset button and replace the ESD cover. The controller will restart.

17. Re-establish the dual-redundant controller configuration with one of the following commands:

SET FAILOVER COPY=THIS_CONTROLLER

SET MULTIBUS_FAILOVER COPY=THIS_CONTROLLER

Refer to the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for proper use of these CLI commands.

18. Disconnect the PC or terminal from the controller maintenance port.

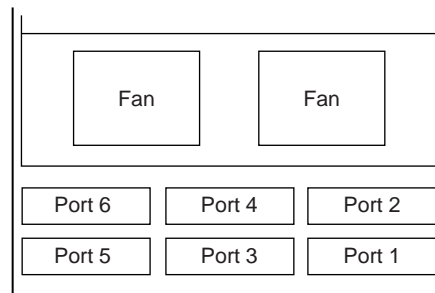
Replacing an I/O Module

Figure 3-8 shows a rear view of the BA370 enclosure and the location of the six I/O modules (also referred to as ports). Use the following steps to replace an I/O module:

Note This procedure is only applicable to the BA370 enclosure.

An I/O module can be replaced in either a single-controller or a dual-redundant controller configuration using this procedure.

Figure 3-8 I/O Module Locations in a BA370 Enclosure



Rear view

CXO6289A

Note The controller can function with one failed I/O module.

1. Connect a PC or terminal to the controller maintenance port.

2. In a dual-redundant controller configuration, disable failover with the following command:

```
SET NOFAILOVER
```

3. In a dual-redundant controller configuration, remove the program card ESD cover and program card from the other controller. Save them for reinstallation.
4. Start FRUTIL with the following command:

```
RUN FRUTIL
```

5. FRUTIL displays the FRUTIL Main menu:

```
FRUTIL Main Menu:
  1. Replace or remove a controller or cache module
  2. Install a controller or cache module
  3. Replace a PVA module
  4. Replace an I/O module
  5. Exit
Enter choice: 1, 2, 3, 4, or 5 ->
```

Note The FRUTIL display of I/O status shows the status of three enclosures regardless of how many are configured.

6. Enter option 4 from the FRUTIL Main menu.

The I/O Module status as displayed by FRUTIL shows the following possible states:

- Single Ended – OK
- Differential – OK
- Termination only – OK
- Missing or bad
- Unknown or bad
- N/A (cabinet is not present).

In the following FRUTIL example, cabinet 0, port 5 is missing or bad:

```
I/O Module Status:
      Cabinet 0          Cabinet 2          Cabinet 3
-----
Port 1: Single Ended - OK      N/A              N/A
Port 2: Single Ended - OK      N/A              N/A
Port 3: Single Ended - OK      N/A              N/A
```

```
Port 4: Single Ended - OK      N/A      N/A
Port 5: Missing or bad        N/A      N/A
Port 6: Single Ended - OK      N/A      N/A
```

Is the replacement I/O module available? Y/N

7. Enter Y(es) and press **Enter**.
8. Wait for FRUTIL to quiesce the device ports. After the ports have been quiesced (this may take several minutes), FRUTIL displays the following:

```
All device ports quiesced.
```



Caution If you remove the incorrect module, the controller will crash.

9. Disconnect the cables (there may be one or two) from the appropriate I/O module.
10. Remove the failed I/O module.
11. Install a new I/O module.
12. Connect the cables (there may be one or two) to the I/O module.
13. Press **Enter** to resume device port activity. When all port activity has restarted, FRUTIL displays the following:

```
I/O module replacement complete.
```

In a dual-redundant configuration, FRUTIL also displays:

```
The configuration has two controllers.
```

```
To restart the other controller:
```

1. Type 'restart other_controller'.
2. Press and hold the reset button while inserting the program card on the slot A [or B] controller, then release the reset button.
The controller will restart.

```
Field Replacement Utility terminated.
```

14. To allow the "other controller" to restart, type the following command:
RESTART OTHER_CONTROLLER
15. Hold the reset button while inserting the program card into the new controller. Release the reset button and replace the ESD cover. The controller will restart.

16. Re-establish the dual-redundant controller configuration with one of the following commands:

SET FAILOVER COPY=THIS_CONTROLLER

SET MULTIBUS_FAILOVER COPY=THIS_CONTROLLER

Refer to the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for proper use of these CLI commands.

17. Disconnect the PC or terminal from the controller maintenance port.

Replacing an Environmental Monitoring Unit

Use the following steps in “Removing an EMU” and “Installing an EMU” to replace the Environmental Monitoring Unit (see Figure 1-1 on page 1-2 for the location of the EMU).

Removing an EMU

1. From a host console, stop all host activity and dismount the logical units in the subsystem.
2. Connect a PC or terminal to the maintenance port of one of the controllers in your subsystem.
3. Shut down the controllers. In single controller configurations, you only need to shut down “this controller.” In dual-redundant controller configurations, shut down the “other controller” first, then shut down “this controller” with the following commands:

SHUTDOWN OTHER_CONTROLLER

SHUTDOWN THIS_CONTROLLER

When the controllers shut down, their reset buttons and their first three LEDs are lit continuously. This may take several minutes, depending on the amount of data that needs to be flushed from the cache modules.

4. Turn off all the ac input boxes for each expansion enclosure.



Caution ESD can easily damage an EMU. Wear a snug-fitting, grounded ESD wrist strap.

5. Disengage both retaining levers and remove the EMU.

Installing an EMU



Caution ESD can easily damage an EMU. Wear a snug-fitting, grounded ESD wrist strap.

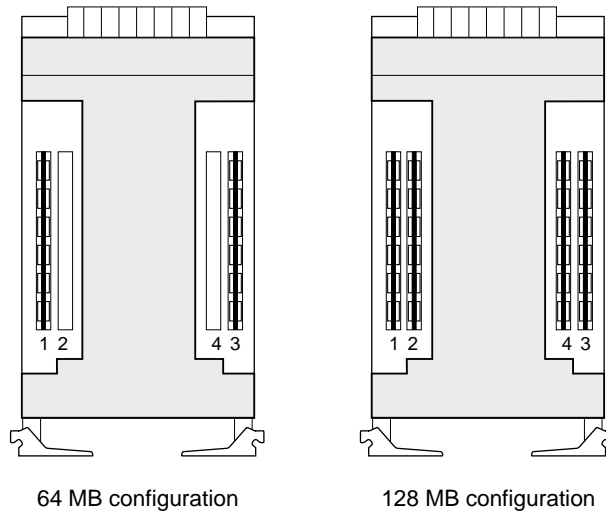
Make sure you align the EMU in the appropriate guide rails. If you do not align the EMU correctly, damage to the backplane can occur.

1. Align the EMU in the top, left-hand slot and insert it.
2. Insert the EMU into its slot until the extractor latches engage the enclosure, then Engage its retaining levers to secure the EMU.
3. Expansion enclosures present?
 - Yes—turn on all the ac input boxes for each expansion enclosure.
 - No—go to step 6.
4. Turn on all the ac input boxes for the master enclosure.
5. If not already connected, connect a PC or terminal to the controller maintenance port.
6. Mount the logical units on the host. If you are using a Windows NT platform, restart the server.
7. Set the subsystem date and time with the following command:
SET THIS_CONTROLLER TIME=DD-MMM-YYYY:HH:MM:SS
8. Disconnect the PC or terminal from the controller's maintenance port.

Replacing SIMMs

Use the following steps in “SIMM Removal Procedure” and “SIMM Installation Procedure” to replace one or more SIMMs in a cache module. The cache module may be configured as shown in Figure 3-9 and Table 3-1.

Figure 3-9 Cache-Module Memory Configurations



CXO5609A

Table 3-1 Cache Module Memory Configurations

Configuration	Quantity	SIMM type	Location
64 MB	2	32 MB	1 and 3
128 MB	4	32 MB	1, 2, 3, and 4

Note If a SIMM fails, note which SIMM you need to replace based on the diagram that displays on the console.



Caution ESD can easily damage a cache module or a SIMM. Wear a snug-fitting, grounded ESD wrist strap.

SIMM Removal Procedure

Use the following steps to remove a SIMM from a cache module:

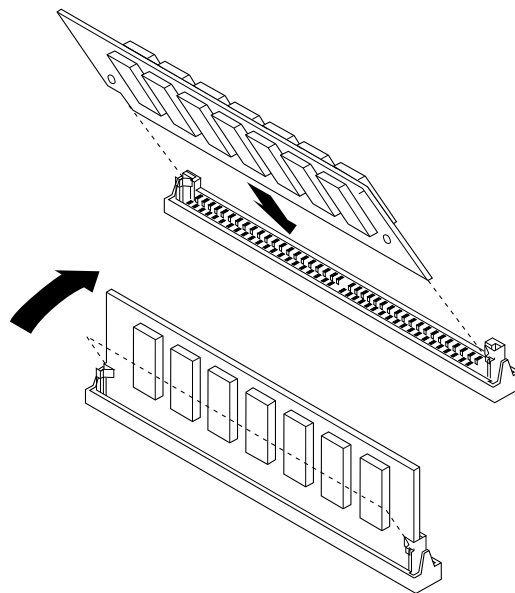
1. Remove the cache module using the steps in “Cache Module Removal Procedures,” page 3-7.
2. Press down on the SIMM retaining levers at either end of the SIMM you want to remove.
3. Grasp the SIMM and gently remove it from the SIMM slot.

SIMM Installation Procedure

Use the following steps to install a SIMM in a cache module:

1. Insert the SIMM at a 45 degree angle as shown in Figure 3-10.

Figure 3-10 Installing a SIMM



CX05743A

2. Rock the SIMM gently until it is seated in the socket.
3. Tip the SIMM upright until both retaining clips engage the SIMM.



Caution Both cache modules must have the same amount of memory. Populate sockets one and three for 64 MB of memory, or all four sockets for 128 MB as shown in Figure 3-9.

4. Install the cache module using the steps in either “Cache Module Installation Procedures,” page 3-9, or “Cache Module Installation Procedures,” page 3-21.

Replacing a Failed StorageSet Member

Replacing a failed storageSet member means putting a satisfactory drive into the spareSet. If a disk drive fails in a RAIDSet or mirrorSet, the controller automatically places it into the failedSet:

- If the spareSet contains a replacement drive that satisfies the storageSet replacement policy, the controller replaces the failed member with the replacement drive.
- If the spareSet is empty or does not contain a satisfactory drive, the controller reduces the storageSet so that it can operate without one of its members.

The storageSet remains in this reduced state until the spareSet contains a satisfactory drive. When the controller senses a satisfactory drive in the spareSet, it automatically places the drive into the storageSet and restores the storageSet to normal.

Failed RAIDSet or MirrorSet Member Removal Procedure

Use the following steps to remove a failed RAIDSet/mirrorSet member:

1. Connect a PC or terminal to the maintenance port of the a controller that accesses the reduced RAIDSet or mirrorSet.
2. Enable AUTOSPARE with the following command:

```
SET FAILEDSET AUTOSPARE
```

With AUTOSPARE enabled, any new disk drive that you insert into the PTL location of a failed disk drive is automatically initialized and placed into the spareSet.

3. Remove the failed disk drive.

RAIDSet or MirrorSet Member Installation Procedure

Insert a new disk drive that satisfies the replacement policy of the reduced storageSet into the PTL location of the failed disk drive.

Note The controller initializes the new disk drive placing it into the spareset. When the new drive becomes a member of the spareset, the controller uses it to restore the reduced RAIDset or mirrorset. If initialization fails, the new disk drive is placed into the failedset.

CHAPTER 4

Upgrading the Subsystem

This chapter provides instructions for upgrading subsystems that use the controller, cache module, and external cache battery:

- “Upgrading Controller Software,” page 4-2
 - “Downloading New Software Images,” page 4-2
 - “Using CLCP to Install, and Delete, and List Software Patches,” page 4-5
- “Upgrading Device Firmware,” page 4-9
 - “Key Points in Upgrading Firmware,” page 4-10
 - “Firmware Upgrade Procedure,” page 4-10
 - “HSUTIL Messages,” page 4-12
- “Upgrading to a Dual-Redundant Configuration,” page 4-14
 - “Installing a New Controller, Cache Module, and ECB,” page 4-15
- “Upgrading to a Multiple-Bus Failover Configuration,” page 4-18
 - “Installing a New Controller, Cache Module, and ECB,” page 4-20

Upgrading Controller Software

You can upgrade the controller software two ways:

- Install a new PCMCIA program card that contains the new software.
- Download a new software image and use the menu-driven Code Load/Code Patch utility (CLCP) to write it onto the existing program card. You may also use this utility to list, install, and delete patches to the controller software.

Installing a New PCMCIA Program Card

Use the procedure found in Chapter 3, “Replacement Procedures” to replace a failed PCMCIA program card. The procedure is the same as “Upgrading Controller Software”.



Caution Ensure that the two PCMCIA program cards are at the same revision level when completed.

Downloading New Software Images

Use CLCP to download new software to the program card with the card installed in the controller:

1. Obtain the new software image file from a customer service representative.

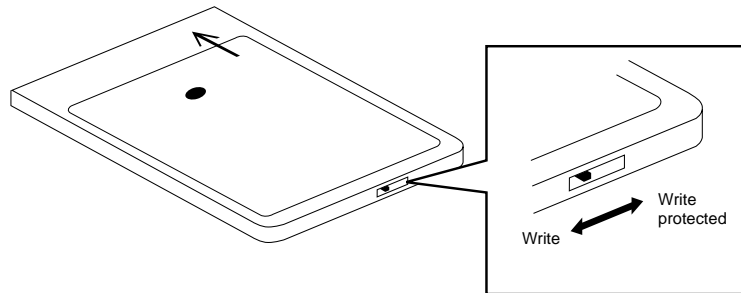
Note The image file can also be loaded by using the StorageWorks Command Console (SWCC); instructions may be found in the SWCC documentation.

2. Load the image onto a PC or workstation using its file-transfer or network-transfer capabilities.
3. From a host console, quiesce all port activity and dismount the storage units in the subsystem.

Note Do not remove the PCMCIA program card.

4. Remove the ESD cover. If your program card is equipped with a write-protection switch, disable write-protection by sliding the switch to the left (Figure 4-1).
5. Connect a PC or terminal to the controller maintenance port.

Figure 4-1 Location of Write-Protection Switch



CXO5873A

6. Start CLCP with the following command:

RUN CLCP

```
CLCP displays the following:
Select an option from the following list:
Code Load & Patch local program Main Menu
0: Exit
1: Enter Code LOAD local program
2: Enter Code PATCH local program
3: Enter EMU Code LOAD Utility
Enter option number (0..3) [0] ?
```

Enter 1 from the CLCP Main menu to start the Code LOAD local program. CLCP displays the following:

You have selected the Code Load Utility. This utility is used to load a new software image into the program card currently inserted in the controller.

Type ^Y or ^C (then RETURN) at any time to abort code load. The code image may be loaded using SCSI Write Buffer commands through the SCSI Host Port, or using KERMIT through the maintenance terminal port.

```
0: Exit
1: Use the SCSI Host Port
2: Use the Maintenance Terminal Port
```

Enter option number (0..2) [0] ?

Note You can use either the SCSI host port (if your operating system supports it) or the maintenance port. To use the SCSI host port, go to step 7. To use the maintenance port, go to step 9.

7. Enter 1 from the menu. CLCP displays the following:

```
WARNING: proceeding with Controller Code Load will overwrite
         the current Controller code image with a new image.
         Do you want to continue (y/n) [n]: ?
```

8. Enter Y(es) and the download starts. When the download is complete, CLCP writes the new image to the program card and restarts the controller. This process takes one to three minutes. Go to step 14.

9. Enter 2 from the menu. CLCP displays the following:

```
Perform the following steps before continuing:
* get new image file on serial line host computer
* configure KERMIT with the following parameters:
  terminal speed 19200 baud, eight bit, no parity, 1 stop bit

It will take approximately 35 to 45 minutes to perform the
code load operation.

WARNING: proceeding with Controller Code Load will overwrite
         the current Controller code image with a new image.
         Do you want to continue (y/n) [n]: ?
```

10. Enter Y(es) and CLCP displays:

```
Start KERMIT now...
```

11. Connect the PC to the controller maintenance port (for detailed information on how to connect the PC to the controller maintenance port, see Chapter 2 in the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*).
12. Configure the KERMIT transfer protocol on the PC to 19200 baud, eight bits, no parity, and one stop bit.
13. Use KERMIT to transfer the binary image from the PC to the controller.
When the download is complete, CLCP automatically writes the new image to the program card and restarts the controller.
14. Verify that the controller is running the new software version with the following command:

SHOW THIS CONTROLLER

15. Re-enable PCMCIA Program Card write-protection by sliding the switch to the right (if applicable).
16. Replace the program card ESD cover.
17. Repeat the procedure to upgrade the other controller in dual-redundant subsystems.
18. Mount the storage units in the subsystem.

Using CLCP to Install, and Delete, and List Software Patches

Use CLCP to manage software patches. Software patches are small programming changes placed into the controller's non-volatile memory and become active as soon you restart the controller. There is space for about ten patches (depending upon the size of the patches).

Keep the following points in mind while installing or deleting patches:

- Patches are associated with specific software versions. CLCP verifies the patch against the currently installed version.
- Patches are sequential: patch one must be entered before patch two, and so on.
- Deleting one patch also deletes all higher-numbered patches. For example, if you delete patch two, you'll automatically delete patches three, four, and so on.
- Controllers in a dual-redundant configuration must have the same patches. You must install patches into each controller separately.

Software Patch Installation Procedure

Use the following steps to install a software patch:

1. Obtain the patch file from a customer service representative or via the Internet at: <http://www.storage.digital.com>. Select "support" and then "array controllers" to display the web page that contains the patch descriptions and procedures for downloading the appropriate patch(es).
2. Connect a PC or terminal to the controller maintenance port (for detailed information on how to connect the PC to the controller maintenance port, see Chapter 2 in the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*).
3. From the host console, quiesce all port activity.
4. Start CLCP with the following command:

RUN CLCP

CLCP displays the following:

```
Select an option from the following list:
Code Load & Patch local program Main Menu
0: Exit
1: Enter Code LOAD local program
2: Enter Code PATCH local program
3: Enter EMU Code LOAD utility
Enter option number (0..3) [0] ?
```

5. Enter 2. CLCP displays the following:

```
You have selected the Code Patch local program. This program
is used to manage software code patches. Select an option
from the following list:
Type ^Y or ^C (then RETURN) at any time to abort Code Patch.
Code Patch Main Menu
    0: Exit
    1: Enter a Patch
    2: Delete Patches
    3: List Patches
Enter option number (0..3) [0] ?
```

6. Enter 1 to install a patch. CLCP displays the following:

This is the Enter a Code Patch option. The program prompts you for the patch information, one line at time. Be careful to enter the information exactly as it appears on the patch release. Patches may be installed for any version of software; however, patches entered for software versions other than XXXXX are not applied until the matching version of software is installed.

To enter any patch, you must first install all patches with lower patch numbers than the patch you are entering, beginning with patch number 1, for a specific software version. If you incorrectly enter the patch information, you are given the option to review the patch one line at a time.

```
Type ^Y or ^C (then RETURN) at any time to abort Code Patch.
Do you wish to continue (y/n) [y] ?
```

7. Enter Y(es) and follow the on-screen prompts.

8. After the patch is installed, press the reset button on “this controller” to restart the controller.

Software Patch Deletion Procedure

Use the following steps to delete a software patch:

1. From a host console, quiesce all port activity.
2. Connect a PC or terminal to the controller maintenance port (for detailed information on how to connect the PC to the controller maintenance port, see Chapter 2 in the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*).
3. Start CLCP with the following command:

RUN CLCP

CLCP displays the following:

```
Select an option from the following list:
Code Load & Patch local program Main Menu
0: Exit
1: Enter Code LOAD local program
2: Enter Code PATCH local program
3: Enter EMU Code LOAD utility
Enter option number (0..3) [0] ?
```

4. Enter 2. CLCP displays the following:

```
You have selected the Code Patch local program. This program
is used to manage software code patches. Select an option
from the following list:
Type ^Y or ^C (then RETURN) at any time to abort Code Patch.
Code Patch Main Menu
  0: Exit
  1: Enter a Patch
  2: Delete Patches
  3: List Patches
Enter option number (0..3) [0] ?
```

5. Enter 2 to delete patches. CLCP displays the following:

```
This is the Delete Patches option. The program prompts you
for the software version and patch number you wish to delete.
If you select a patch for deletion that is required for
another patch, all dependent patches are also selected for
deletion. The program lists your deletion selections and asks
if you wish to continue.
Type ^Y or ^C (then RETURN) at any time to abort Code Patch.
The following patches are currently stored in the patch area:
  Software Version - Patch number(s)
```

```

      xxxx          xxxx
Currently, xx% of the patch area is free.
Software Version of patch to delete ?

```

6. Enter the software version of the patch to delete and press return. CLCP displays the following:

```
Patch Number to delete ?
```

7. Enter the patch number to delete and press return. CLCP displays the following:

```

The following patches have been selected for deletion:
  Software Version - Patch #
  xxxx          xxxx
Do you wish to continue (y/n) [n] ?

```

8. Enter **y(es)** and the patches are deleted. CLCP displays the following:

```

Code Patch Main Menu
  0: Exit
  1: Enter a Patch
  2: Delete Patches
  3: List Patches
Enter option number (0..3) [0] ?

```

9. Enter **0** to exit.
10. Press the reset button on “this controller” to restart the controller.

Software Patches Listing Procedure

Use the following steps to list software patches:

1. Connect a PC or terminal to the controller maintenance port (for detailed information on how to connect the PC to the controller maintenance port, see Chapter 2 in the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*).
2. Start CLCP with the following command:

RUN CLCP

CLCP displays the following:

```

Select an option from the following list:
Code Load & Patch local program Main Menu
0: Exit
1: Enter Code LOAD local program
2: Enter Code PATCH local program

```


- ```
3: Enter EMU Code LOAD utility
Enter option number (0..3) [0] ?
```
3. Enter 2. CLCP displays the following:
- ```
You have selected the Code Patch local program. This program
is used to manage software code patches. Select an option
from the following list:
Type ^Y or ^C (then RETURN) at any time to abort Code Patch.
Code Patch Main Menu
  0: Exit
  1: Enter a Patch
  2: Delete Patches
  3: List Patches
Enter option number (0..3) [0] ?
```
4. Enter 3 to list patches. CLCP displays the following:
- ```
The following patches are currently stored in the patch area:
 Software Version - Patch number(s)
 xxxxx xxxxx
Code Patch Main Menu
 0: Exit
 1: Enter a Patch
 2: Delete Patches
 3: List Patches
Enter option number (0..3) [0] ?
Enter 0 to exit.
```

## Upgrading Device Firmware

Use HSUTIL to upgrade the firmware in a storage device. The new firmware should be located in contiguous blocks at a specific LBN on a source disk drive configured as a unit on the same controller.

Upgrading firmware on a disk or tape drive is a two-step process:

- Copy the new firmware from your host to a disk drive configured as a unit in your subsystem
- Use HSUTIL to load the firmware onto the devices in the subsystem.

## Key Points in Upgrading Firmware

Keep the following points in mind while using HSUTIL to upgrade firmware on a device:

- Do not install firmware on an unsupported device. HSUTIL has been tested only with the devices listed in the product-specific release notes that accompanied the software release. Installation of the firmware made on an unsupported device may cause the upgrade to fail rendering the device unusable. This action will require the attention of the manufacturer to correct.
- The storage device may become unusable if the power fails or the bus is reset while HSUTIL is installing the new firmware. To minimize this possibility, we recommend that you secure a reliable power source and suspend all I/O to the bus that services the device being upgraded.
- HSUTIL may only be used on storage devices that cannot be accessed by the host. Devices that are configured as containers or members of containers must be first removed from the container. If firmware is to be installed on a device that has previously been configured in a container, you'll have to delete the unit number and storageset name associated with it.
- During the installation, the source disk drive is not available for other subsystem operations.
- Some devices may not reflect the new firmware version number when viewed from the "other" controller in a dual-redundant configuration. If you experience this, enter the following CLI command: `CLEAR_ERRORS device-name UNKNOWN`.
- Do not issue any CLI commands that access or inspect devices that are being formatted.

## Firmware Upgrade Procedure

Use the following procedure to upgrade firmware with HSUTIL:

1. Connect a local terminal to the controller that accesses the device you want to upgrade.
2. Configure a single-disk unit.

---

**Note** In the steps that follow, you will copy the firmware image to this unit, then use HSUTIL to distribute it to the devices you are upgrading. This unit must be a newly initialized disk with no label or file structure to ensure that the firmware image resides in contiguous blocks starting from LBN 0 or another known LBN.

Additionally, write-back caching must be disabled (see *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual*).

---

See the *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual* for instructions on configuring a single-disk unit.

3. Copy the firmware image to the single-disk unit that you configured in step 2. The firmware image must begin at a known LBN (usually 0) and must be contiguous. See the documentation that accompanied your host's operating system for instructions on copying firmware images to a disk drive.



**Caution** You must quiesce the host load before running HSUTIL or damage to the storage device can occur.

---

4. Start HSUTIL with the following command:

**RUN HSUTIL**

HSUTIL displays the following:

```
HSUTIL Main Menu:
```

```
0. Exit
1. Disk Format
2. Disk Device Code Load
3. Tape Device Code Load
4. Disaster Tolerance Backend Controller Code Load
```

```
Enter function number: (0:4) [0]?
```

5. Enter 2 from the HSUTIL menu.
6. Choose the single-disk unit as the source disk for the download.
7. Enter the starting LBN of the firmware image—usually LBN 0.

8. Enter the product ID of the device you want to upgrade. This ID corresponds to the product information that's reported in the "Type" column when you issue the SHOW DISK FULL command.

HSUTIL lists all devices that correspond to the product ID you entered.

9. Enter the disk or tape name of the device you want to upgrade.
10. Confirm or enter the byte count of the firmware image.
11. Confirm the download.
12. Some disk firmware releases require that you reformat the disk after upgrading its firmware. See the documentation that accompanied the firmware to determine if you need to reformat the device.
13. When HSUTIL finishes downloading the firmware, it displays the new firmware revision for the disk drive.

## HSUTIL Messages

HSUTIL may produce one or more of the following messages shown in Table 4-1 while you are formatting disk drives or installing new firmware. Many of the self-explanatory messages have been omitted from Table 4-1.

**Table 4-1 HSUTIL Messages and Inquiries**

| Message                                                 | Description                                                                                                                                                                         |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Insufficient resources                                  | HSUTIL cannot find or perform the operation because internal controller resources are not available.                                                                                |
| Unable to change operation mode to maintenance for unit | HSUTIL was unable to put the source single disk drive unit into maintenance mode to enable formatting or code load.                                                                 |
| Unit successfully allocated                             | HSUTIL has allocated the single disk drive unit for code load operation.<br><br>At this point, the unit and its associated device are not available for other subsystem operations. |
| Unable to allocate unit                                 | HSUTIL could not allocate the single disk drive unit. An accompanying message explains the reason.                                                                                  |
| Unit is owned by another sysop                          | Device cannot be allocated because it is being used by another subsystem function or local program.                                                                                 |
| Unit is in maintenance mode                             | Device cannot be formatted or code loaded because it is being used by another subsystem function or local program.                                                                  |

**Table 4-1 HSUTIL Messages and Inquiries (Continued)**

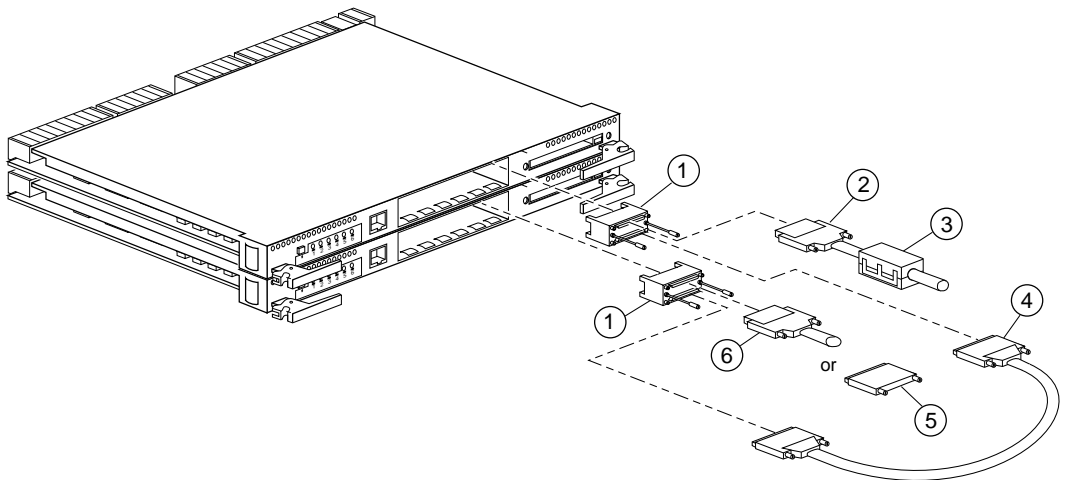
| Message                                                                         | Description                                                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Exclusive access is declared for unit                                           | Another subsystem function has reserved the unit shown.                                                                                                                                                                                                                                                                                                                                                         |
| The other controller has exclusive access declared for unit                     | The “other controller” has locked out “this controller” from accessing the unit shown.                                                                                                                                                                                                                                                                                                                          |
| The RUNSTOP_SWITCH is set to RUN_DISABLED for unit                              | The RUN\NORUN unit indicator for the unit shown is set to NORUN; the disk cannot spin up.                                                                                                                                                                                                                                                                                                                       |
| What BUFFER SIZE, (in BYTES), does the drive require (2048, 4096, 8192) [8192]? | <p>HSUTIL detects that an unsupported device has been selected as the target device and the firmware image requires multiple SCSI Write Buffer commands.</p> <p>You must specify the number of bytes to be sent in each Write Buffer command. The default buffer size is 8192 bytes. A firmware image of 256 KB, for example, can be code loaded in 32 Write Buffer commands, each transferring 8192 bytes.</p> |
| What is the TOTAL SIZE of the code image in BYTES [ <i>device default</i> ]?    | <p>HSUTIL detects that an unsupported device has been selected as the target device.</p> <p>You must enter the total number of bytes of data to be sent in the code load operation.</p>                                                                                                                                                                                                                         |
| Does the target device support only the download microcode and save?            | <p>HSUTIL detects that an unsupported device has been selected as the target device.</p> <p>You must specify whether the device supports the SCSI Write Buffer command’s download and save function.</p>                                                                                                                                                                                                        |
| Should the code be downloaded with a single write buffer command?               | <p>HSUTIL detects that an unsupported device has been selected as the target device.</p> <p>You must indicate whether to download the firmware image to the device in one or more contiguous blocks, each corresponding to one SCSI Write Buffer command.</p>                                                                                                                                                   |

## Upgrading to a Dual-Redundant Configuration

Use the steps in the following procedure to upgrade a single-configuration subsystem to a dual-redundant (transparent failover) configuration subsystem. To replace components, refer to Chapter 3, “Replacement Procedures”. Before you complete this procedure, you’ll need the following items:

- New HSZ70 Controller with the same software version and patch level that is installed on the current single controller.
- New cache module with the same memory configuration that is installed in the current single cache module.
- New External Cache Battery (ECB) suitable for a dual-redundant configuration.
- New ECB cable.
- Dual-controller cable from controller “A” to controller “B” (shown in Figure 4-2 as ④).

**Figure 4-2 Connecting Dual-Redundant Controllers to the Host**



CXO5612B

Table 4-2 Key to Figure 4-2

| Part | Description                                                                                                                            | Part No.                                                                                                                                          |
|------|----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| ①    | Trilink connector                                                                                                                      | H8861-AA                                                                                                                                          |
| ②    | Cable from host processor to controller; the last two digits represent the cable length (in meters). An "E" represents one-half meter. | DS-BN37A-1<br>DS-BN37A-1E<br>DS-BN37A-02<br>DS-BN37A-2E<br>DS-BN37A-03<br>DS-BN37A-05<br>DS-BN37A-10<br>DS-BN37A-15<br>DS-BN37A-20<br>DS-BN37A-25 |
| ③    | Ferrite Bead                                                                                                                           | 16-25105-18                                                                                                                                       |
| ④    | Dual-controller cable from controller "A" to controller "B".                                                                           | DS-BN37A-0E                                                                                                                                       |
| ⑤    | VHDCI Ultra-SCSI Differential Terminator required if controller is at the end of the host bus                                          | H8863-AA                                                                                                                                          |
| ⑥    | Cable to other devices on host bus from controller "B"                                                                                 | (same as Part 2)                                                                                                                                  |

### Installing a New Controller, Cache Module, and ECB

Use the following steps to install a new controller, cache module and ECB:

1. Connect a PC or terminal to the controller maintenance port. The controller to which you're connected is "this controller"; the controller that you're installing is the "other controller."

2. Start FRUTIL with the following command:

```
RUN FRUTIL
```

FRUTIL displays the following:

```
Do you intend to replace this controller's cache battery? Y/N
```

3. Enter N(O). FRUTIL displays the FRUTIL Main menu:

```
FRUTIL Main Menu:
```

1. Replace or remove a controller or cache module
2. Install a controller or cache module

```
3. Replace a PVA module
4. Replace an I/O module
5. Exit
Enter choice: 1, 2, 3, 4, or 5 ->
```

4. Enter 2 from the FRUTIL Main menu. FRUTIL displays the Install Options menu:

```
Install Options:
1. Other controller and cache module
2. Other controller module
3. Other cache module
4. Exit
Enter choice: 1, 2, 3, or 4 ->
```

5. Enter 1 from the Install Options menu. FRUTIL display the following:

```
Insert the both the slot B controller and cache module? Y/N
```

6. Enter Y(es) and press return. FRUTIL displays the following:

```
Quiescing all device ports. Please wait...
Device Port 1 quiesced.
Device Port 2 quiesced.
Device Port 3 quiesced.
Device Port 4 quiesced.
Device Port 5 quiesced.
Device Port 6 quiesced.
All device ports quiesced.
.
.
.
Perform the following steps:
1. Turn off the battery for the new cache module by pressing
 the battery's shut off button for five seconds.
2. Connect the battery to the new cache module.
3. Insert the new cache module in slot B within 4 minutes.
```

---

**Note** A countdown timer allows a total of four minutes to install the cache module and controller. If you exceed four minutes, “this controller” will exit FRUTIL and resume operations.

---





---

**Caution** ESD can easily damage a cache module or controller. Wear a snug-fitting, grounded ESD wrist strap.

---

7. Insert the new ECB SBB into an empty slot.
8. Disable the ECB to which you're connecting the new cache module by pressing the battery disable switch until the status light stops blinking—about five seconds.



---

**Caution** The ECB must be disabled—the status light is not lit or is not blinking—before connecting the ECB cable to the cache module. Failure to disable the ECB could result in ECB damage.

Make sure you align the cache module and controller in the appropriate guide rails. If you do not align the modules correctly, damage to the backplane can occur.

---

9. Connect the ECB cable to the new cache module.
10. Insert the new cache module into its slot and engage its retaining levers. FRUTIL displays the following:  

```
Insert the controller module, without its program card, in
slot B within x minutes, xx seconds.
```
11. Ensure that the program card is not in the new controller and insert the new controller into its slot. Engage its retaining levers.

---

**Note** In mirrored mode, FRUTIL will initialize the mirrored portion of the new cache module, check for old data on the cache module, and then restart all device ports. After the device ports have been restarted, FRUTIL will test the cache module and the ECB. After the test completes, the device ports will quiesce and a mirror copy of the cache module data will be created on the newly installed cache module.

---

FRUTIL displays the following:

The configuration has two controllers.

To restart the other controller:

1. Type 'restart other\_controller'.
2. Press and hold the reset button while inserting the

program card on the slot B controller, then release the reset button.  
The controller will restart.

Field Replacement Utility terminated.

---

**Note** If the controller being installed was previously used in another subsystem, it will need to be purged of the controller's old configuration.

---

12. Wait for FRUTIL to terminate and connect the tralink connectors to the new controller.

---

**Note** One or two tralink connectors may be attached, depending on the configuration.

---

13. To allow the "other controller" to restart, type the following command:

**RESTART OTHER \_CONTROLLER**

14. Hold the reset button while inserting the program card into the controller. Release the reset button and replace the ESD cover. The controller will restart.
15. See *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*, to configure the controller.
16. Re-establish the dual-redundant controller configuration with the following command:

**SET FAILOVER COPY=THIS\_CONTROLLER**

Refer to the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for proper use of this CLI command.

17. Disconnect the PC or terminal from the controller maintenance port.

## Upgrading to a Multiple-Bus Failover Configuration

Use the steps in the following procedure to upgrade a single-configuration subsystem to a multiple-bus failover configuration subsystem. To replace components, refer to Chapter 3, "Replacement

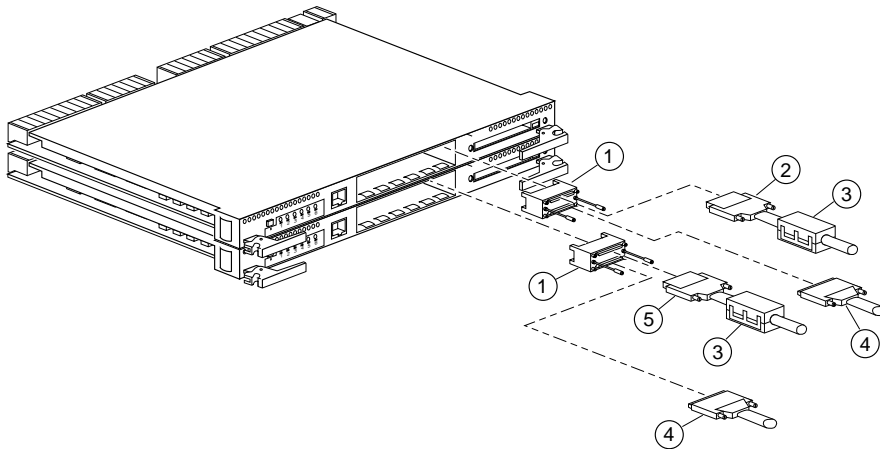
Procedures”. Before you complete this procedure, you’ll need the following items:

- New HSZ70 Controller with the same software version and patch level that is installed on the current single controller.
- New cache module with the same memory configuration that is installed in the current single cache module.
- New External Cache Battery (ECB) suitable for a dual-redundant configuration.
- New ECB cable.
- Dual-controller cable from controller “A” to controller “B” (shown in Figure 4-2 as ④).

To connect a pair of multiple-bus failover dual-redundant controllers to the host:

1. Stop all I/O from the host to its devices on the bus to which you are connecting the controllers.
2. Refer to Figure 4-3 for the balance of these steps: Remove the trilink connectors (① 12-39921-01) from both controllers. These connectors are 68-pin Y-adapters that maintain bus continuity even when they are disconnected from their controller.
3. Connect a bus cable ② from the host to one of the connectors on the front of each trilink connector.
4. If you are connecting a host to a controller in a BA370 enclosure that will reside in an SW600 cabinet, snap a ferrite bead ③ on each bus cable within one inch of the controller.

If you are connecting a host to a controller in any other enclosure or cabinet, skip to step 5.

**Figure 4-3 Connecting Multiple Bus Failover, Dual-Redundant Controllers to the Host**

CXO5613B

5. Perform one of the following:
  - If the controllers are at the end of the bus, connect a terminator ④ to the open connectors on the front of each tralink connector.
  - If the controllers are not at the end of the bus, connect a cable ⑤ that continues to the next device on each bus and install the terminator at the end of the bus.
6. Reconnect the tralink connectors to host ports on the controllers. Do not disconnect the host cables from the tralink connectors.
7. Route and tie the cables as desired.
8. Restart the I/O from the host. Some operating systems may require you to restart the host to see the devices attached to the new controller.

### Installing a New Controller, Cache Module, and ECB

Use the following steps to install a new controller, cache module and ECB:

1. Connect a PC or terminal to the controller maintenance port. The controller to which you're connected is "this controller"; the controller that you're installing is the "other controller."
2. Start FRUTIL with the following command:

**RUN FRUTIL**

FRUTIL displays the following:

Do you intend to replace this controller's cache battery? Y/N

3. Enter **N(o)**. FRUTIL displays the FRUTIL Main menu:

FRUTIL Main Menu:

1. Replace or remove a controller or cache module
2. Install a controller or cache module
3. Replace a PVA module
4. Replace an I/O module
5. Exit

Enter choice: 1, 2, 3, 4, or 5 ->

4. Enter **2** from the FRUTIL Main menu. FRUTIL displays the Install Options menu:

Install Options:

1. Other controller and cache module
2. Other controller module
3. Other cache module
4. Exit

Enter choice: 1, 2, 3, or 4 ->

5. Enter **1** from the Install Options menu. FRUTIL display the following:

Insert the both the slot B controller and cache module? Y/N

6. Enter **Y(es)** and press return. FRUTIL displays the following:

Quiescing all device ports. Please wait...

Device Port 1 quiesced.  
Device Port 2 quiesced.  
Device Port 3 quiesced.  
Device Port 4 quiesced.  
Device Port 5 quiesced.  
Device Port 6 quiesced.  
All device ports quiesced.

.

.

.

Perform the following steps:

1. Turn off the battery for the new cache module by pressing the battery's shut off button for five seconds.
2. Connect the battery to the new cache module.
3. Insert the new cache module in slot B within 4 minutes.

---

**Note** A countdown timer allows a total of four minutes to install the cache module and controller. If you exceed four minutes, “this controller” will exit FRUTIL and resume operations.

---



**Caution** ESD can easily damage a cache module or controller. Wear a snug-fitting, grounded ESD wrist strap.

---

7. Insert the new ECB SBB into an empty slot.
8. Disable the ECB to which you’re connecting the new cache module by pressing the battery disable switch until the status light stops blinking—about five seconds.



**Caution** The ECB must be disabled—the status light is not lit or is not blinking—before connecting the ECB cable to the cache module. Failure to disable the ECB could result in ECB damage.

Make sure you align the cache module and controller in the appropriate guide rails. If you do not align the modules correctly, damage to the backplane can occur.

---

9. Connect the ECB cable to the new cache module.
10. Insert the new cache module into its slot and engage its retaining levers. FRUTIL displays the following:  

```
Insert the controller module, without its program card, in
slot B within x minutes, xx seconds.
```
11. Ensure that the program card is not in the new controller and insert the new controller into its slot. Engage its retaining levers.

---

**Note** In mirrored mode, FRUTIL will initialize the mirrored portion of the new cache module, check for old data on the cache module, and then restart all device ports. After the device ports have been restarted, FRUTIL will test the cache module and the ECB. After the test completes, the device ports will quiesce and a mirror copy of the cache module data will be created on the newly installed cache module.

---

FRUTIL displays the following:

The configuration has two controllers.

To restart the other controller:

1. Type 'restart other\_controller'.
2. Press and hold the reset button while inserting the program card on the slot B controller, then release the reset button.  
The controller will restart.

Field Replacement Utility terminated.

---

**Note** If the controller being installed was previously used in another subsystem, it will need to be purged of the controller's old configuration.

---

12. Wait for FRUTIL to terminate and connect the tralink connectors to the new controller.

---

**Note** One or two tralink connectors may be attached, depending on the configuration.

---

13. To allow the "other controller" to restart, type the following command:

**RESTART OTHER \_CONTROLLER**

14. Hold the reset button while inserting the program card into the controller. Release the reset button and replace the ESD cover. The controller will restart.
15. See *HSZ70 Array Controller HSOF Version 7.3 Configuration Manual*, to configure the controller.
16. Re-establish the dual-redundant controller configuration with the following command:

**SET MULTIBUS\_FAILOVER COPY=THIS\_CONTROLLER**

Refer to the *HSZ70 Array Controller HSOF Version 7.3 CLI Reference Manual* for proper use of this CLI commands.

17. Disconnect the PC or terminal from the controller maintenance port.





## APPENDIX A

## LED Codes

This appendix describes the LED codes that may be encountered while servicing the controller, cache module, and external cache battery:

- “Operator Control Panel LED Description,” page A-1
- “Solid OCP Patterns,” page A-2
- “Flashing OCP Patterns,” page A-6

## Operator Control Panel LED Description

Use Table A-1 to interpret solid OCP patterns and Table A-2 to interpret flashing OCP patterns. Use this legend for both of these tables:

- = Reset button on
- = Reset button off
- = LED on
- = LED off

---

**Note** If the reset button is flashing and an LED is lit continuously, either the devices on that LED bus don't match the controller configuration, or an error has occurred in one of the devices on that bus.

---

## Solid OCP Patterns

Table A-1 Solid OCP Patterns (sheet 1 of 4)

| Pattern  | Error                                                                                                                                                              | Repair Action                                                                                 |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| ■●●●●●●● | DAEMON diagnostic failed hard in non-fault tolerant mode.<br><br>DAEMON diagnostic detected critical hardware component failure; controller can no longer operate. | Verify that cache module is present and operating. If the error persists, replace controller. |
| ■●●●●●○  | Recursive firmware bugcheck.                                                                                                                                       | Replace the controller.                                                                       |
| ■●●●●○●  | NVMEM version mismatch.                                                                                                                                            | Replace the program card with one that contains the latest software version.                  |
| ■●●●●○   | NVMEM write error.                                                                                                                                                 | Replace the controller.                                                                       |
| ■●●●○●●  | NVPM read error.                                                                                                                                                   | Replace the controller.                                                                       |
| ■●●●○●○  | An unexpected Non-Maskable Interrupt (NMI) error occurred during firmware bugcheck.                                                                                | Reset the controller.                                                                         |
| ■●●●○●●  | NVMEM configuration inconsistent.                                                                                                                                  | Reset the controller.                                                                         |
| ■●●●○    | Bugcheck with no restart.                                                                                                                                          | Reset the controller.                                                                         |
| ■●●○●●●  | Software-induced controller reset failed to occur.                                                                                                                 | Replace the controller.                                                                       |
| ■●●○●●○  | Hardware-induced controller reset failed to occur.                                                                                                                 | Replace the controller.                                                                       |
| ■●●○●●●  | Bugcheck within bugcheck controller.                                                                                                                               | Reset the controller.                                                                         |

Table A-1 Solid OCP Patterns (sheet 2 of 4)

| Pattern  | Error                                                                                                                                                            | Repair Action                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ■●●○○●●  | NVMEM structure revision too low.<br>NVMEM structure revision number is less than the one that can be handled by the software version attempting to be executed. | Verify that the program card contains the latest software version. If the error persists, replace the controller.                                                                                                                                                                                                                                                                                                                                                   |
| ■●●○○●○  | Program card write fail.                                                                                                                                         | Replace the program card.                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| ■●●○○○●  | ILF\$INIT unable to allocate memory.                                                                                                                             | Replace the controller.                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| ■●●○○○○  | An unexpected bugcheck occurred before subsystem initialization completed.                                                                                       | Reinsert the controller. If that does not correct the problem, reset the controller. If the error persists, try resetting the controller again, and replace it if no change occurs.                                                                                                                                                                                                                                                                                 |
| ■●○○●●●● | Cache module has illegal SIMM configuration.                                                                                                                     | Verify that the SIMMs are installed as shown in Table 3-1 on page 3-41.                                                                                                                                                                                                                                                                                                                                                                                             |
| ■●○○●●●○ | More than one cabinet have the same SCSI (PVA) ID in an extended subsystem.                                                                                      | <p>Reconfigure the PVA ID to uniquely identify each cabinet in the subsystem:</p> <ul style="list-style-type: none"> <li>■ The cabinet with the controllers must be set to PVA ID 0</li> <li>■ Additional cabinets must use PVA IDs 2 and 3</li> </ul> <p>If the error continues after PVA settings are unique:</p> <ul style="list-style-type: none"> <li>■ Replace each PVA module one at a time.</li> <li>■ Check the cabinet if the problem remains.</li> </ul> |

**Table A-1 Solid OCP Patterns (sheet 3 of 4)**

| Pattern         | Error                                                                                                                                                          | Repair Action                                                                                                                                                                                                                                                                                                 |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>■●○●●○●●</p> | <p>The cabinet with the controllers is not configured to PVA ID 0.</p>                                                                                         | <p>Set the PVA ID to 0 for the cabinet with the controllers.</p> <p>If the problem persists, try the following repair actions:</p> <ol style="list-style-type: none"> <li>1. Replace the PVA module.</li> <li>2. Replace the EMU.</li> <li>3. Remove all devices.</li> <li>4. Replace the cabinet.</li> </ol> |
| <p>■●○●●○●○</p> | <p>Termination power for one or more of the cabinet's device SCSI buses is absent or unacceptable.</p>                                                         | <p>Ensure that all of the cabinet's device SCSI buses have an I/O module.</p> <p>If the problem persists, replace the failed I/O module.</p>                                                                                                                                                                  |
| <p>■●○●○●●●</p> | <p>Jumpers are installed on the backplane instead of terminators.</p> <p>One or more SCSI bus terminators are either missing from the backplane or broken.</p> | <p>Ensure that the cabinet SCSI bus terminators are installed and that there are no jumpers.</p> <p>Replace the failed terminator if the problem continues.</p>                                                                                                                                               |
| <p>■●○●○●○●</p> | <p>All cabinet I/O modules are not of the same type.</p> <p>Cabinet I/O modules are a combination of single-sided and differential.</p>                        | <p>Ensure that the I/O modules in an extended subsystem are either all single-ended or all differential, but not both.</p>                                                                                                                                                                                    |

Table A-1 Solid OCP Patterns (sheet 4 of 4)

| Pattern  | Error                                                                | Repair Action                                                                                                                                                                                                                                          |
|----------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ■●○○●○○● | EMU protocol version incompatible with controller software version.  | Upgrade either the EMU microcode or the software (refer to the Release Notes that accompanied the controller software).                                                                                                                                |
| ■○○○○○○○ | No program card detected.<br>Controller unable to read program card. | Ensure that the program card is properly seated while resetting the controller.<br><br>If the error persists, try the card with another controller; or replace the card.<br><br>If the error persists, replace the controller that reported the error. |
| □○○○○○○○ | Catastrophic controller or power failure.                            | Check the power. If good, reset controller. If the problem persists, reseal controller module and reset controller. If the problem is still evident, replace controller module.                                                                        |

## Flashing OCP Patterns

Table A-2 Flashing OCP Patterns (sheet 1 of 4)

| Pattern | Error                                                                                | Repair Action             |
|---------|--------------------------------------------------------------------------------------|---------------------------|
| ■○○○○○● | Program card EDC error.                                                              | Replace the program card. |
| ■○○○●○○ | Timer zero in the timer chip runs when disabled.                                     | Replace the controller.   |
| ■○○○●●● | Timer zero in the timer chip decrements incorrectly.                                 | Replace the controller.   |
| ■○○○●●○ | Timer zero in the timer chip did not interrupt the processor when requested.         | Replace the controller.   |
| ■○○○●●● | Timer one in the timer chip decrements incorrectly.                                  | Replace the controller.   |
| ■○○●○○○ | Timer one in the timer chip did not interrupt the processor when requested.          | Replace the controller.   |
| ■○○●○○● | Timer two in the timer chip decrements incorrectly                                   | Replace the controller.   |
| ■○○●○○○ | Timer two in the timer chip did not interrupt the processor when requested.          | Replace the controller.   |
| ■○○●○○● | Memory failure in the I/D cache.                                                     | Replace the controller.   |
| ■○○●●○○ | No hit or miss to the I/D cache when expected.                                       | Replace the controller.   |
| ■○○●●●● | One or more bits in the diagnostic registers did not match the expected reset value. | Replace the controller.   |
| ■○○●●●○ | Memory error in the nonvolatile journal SRAM.                                        | Replace the controller.   |
| ■○○●●●● | Wrong image seen on program card                                                     | Replace the program card. |
| ■○●○○○○ | At least one register in the controller DRAB does not read as written.               | Replace the controller.   |

Table A-2 Flashing OCP Patterns (sheet 2 of 4)

| Pattern | Error                                                                                                                                 | Repair Action           |
|---------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| ■○○○○●  | Main memory is fragmented into too many sections for the number of entries in the good memory list.                                   | Replace the controller. |
| ■○○○○○  | The controller DRAB chip does not arbitrate correctly.                                                                                | Replace the controller. |
| ■○○○○●  | The controller DRAB chip failed to detect forced parity, or detected parity when not forced.                                          | Replace the controller. |
| ■○○●○○  | The controller DRAB chip failed to verify the EDC correctly.                                                                          | Replace the controller. |
| ■○○●○○  | The controller DRAB chip failed to report forced ECC.                                                                                 | Replace the controller. |
| ■○○●●○○ | The controller DRAB chip failed some operation in the reporting, validating, and testing of the multi-bit ECC memory error.           | Replace the controller. |
| ■○○●●●● | The controller DRAB chip failed some operation in the reporting, validating, and testing of the multiple single-bit ECC memory error. | Replace the controller. |
| ■○○●○○○ | The controller main memory did not write correctly in one or more sized memory transfers.                                             | Replace the controller. |
| ■○○●○○● | The controller did not cause an I-to-N bus timeout when accessing a “reset” host port chip.                                           | Replace the controller. |
| ■○○●○○○ | The controller DRAB chip did not report an I-to-N us timeout when accessing a “reset” host port chip.                                 | Replace the controller. |
| ■○○●○○● | The controller DRAB chip did not interrupt the controller processor when expected.                                                    | Replace the controller. |

Table A-2 Flashing OCP Patterns (sheet 3 of 4)

| Pattern  | Error                                                                                                                | Repair Action                                  |
|----------|----------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| ■○○●●○○○ | The controller DRAB chip did not report an NXM error when an attempt to access non-existent memory was made.         | Replace the controller.                        |
| ■○○●●●○○ | The controller DRAB chip did not report an address parity error when one was forced.                                 | Replace the controller.                        |
| ■○○●●●○○ | There was an unexpected nonmaskable interrupt from the controller DRAB chip during the DRAB memory test.             | Replace the controller.                        |
| ■○○●●●●● | Diagnostic register indicates there is no cache module, but an interrupt exists from the non-existent cache module.  | Replace the controller.                        |
| ■●○○○○○○ | The required amount of memory available for the code image to be loaded from the program card is insufficient.       | Replace the controller.                        |
| ■●○○○○●● | The required amount of memory available in the pool area is insufficient for the controller to run.                  | Replace the controller.                        |
| ■●○○○○●○ | The required amount of memory in the buffer area is insufficient for the internal debugger to run.                   | Replace the controller.                        |
| ■●○○○○●● | The required amount of memory available in the buffer area is insufficient for the controller to run.                | Replace the controller.                        |
| ■●○○●○○○ | The code image was not the same as the image on the card after the contents were copied to memory.                   | Replace the controller.                        |
| ■●○○●●○○ | Diagnostic register indicates that the cache module does not exist, but access to that cache module caused an error. | Replace the backplane of the controller shelf. |



Table A-2 Flashing OCP Patterns (sheet 4 of 4)

| Pattern | Error                                                                                                                       | Repair Action                                  |
|---------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
| ■●○○●●○ | Diagnostic register indicates that the cache module does not exist, but access to that cache module did not cause an error. | Replace the backplane of the controller shelf. |
| ■●○○○○● | Non-existent memory regions were not trapped as required.                                                                   | Replace the controller.                        |
| ■●●○○○○ | The journal SRAM battery is bad.                                                                                            | Replace the controller.                        |
| ■●●●○○○ | There was an unexpected interrupt from a read cache or the “present” and “lock” bits are not working correctly.             | Replace the controller.                        |
| ■●●●○●● | There is an interrupt pending on the controller’s policy processor when there should be none.                               | Replace the controller.                        |
| ■●●●●○○ | There was an unexpected fault during initialization.                                                                        | Replace the controller.                        |
| ■●●●●○● | There was an unexpected maskable interrupt received during initialization                                                   | Replace the controller.                        |
| ■●●●●●○ | There was an unexpected non-maskable interrupt received during initialization.                                              | Replace the controller.                        |
| ■●●●●●● | An illegal process was activated during initialization.                                                                     | Replace the controller.                        |



## APPENDIX B

# Event Reporting: Templates and Codes

This appendix contains descriptions of the event codes that the fault-management software generates for spontaneous events and last-failure events.

The HSZ70 controller uses various codes to report different types of events, and these codes are presented in template displays:

- Instance codes (unique codes that identify events).
- ASC and ASCQ codes (explain the cause of the events).
- Last failure codes (unrecoverable conditions that may occur in the controller).

This appendix contains the following sections:

- Template and Code Descriptions:
  - “Last Failure Event Sense Data Response,” on page B-3
  - “Multiple-Bus Failover Event Sense Data Response,” on page B-3
  - “Nonvolatile Parameter Memory Component Event Sense Data Response,” on page B-4
  - “Backup Battery Failure Event Sense Data Response,” on page B-4
  - “Subsystem Built-In Self Test Failure Event Sense Data Response,” on page B-4
  - “Memory System Failure Event Sense Data Response,” on page B-4
  - “Device Services Non-Transfer Error Event Sense Data Response,” on page B-5
  - “Disk Transfer Error Event Sense Data Response,” on page B-5
  - “ASC/ASCQ Codes,” on page B-7
  - “Event Threshold Codes,” on page B-7

- “Recommended Repair Action Codes,” on page B-7
- “Last Failure Codes,” on page B-8
- **Template and Code Tables:**
  - Table B-1, “Template 01: Last Failure Event Sense Data Response Format” on page B-11
  - Table B-2, “Template 04: Multiple-Bus Failover Event Sense Data Response Format” on page B-12
  - Table B-3, “Template 05: Failover Event Sense Data Response Format” on page B-13
  - Table B-4, “Template 11: Nonvolatile Parameter Memory Component Event Sense Data Response Format” on page B-14
  - Table B-5, “Template 12: Backup Battery Failure Event Sense Data Response Format” on page B-15
  - Table B-6, “Template 13: Subsystem Built-in Self Test Failure Event Sense Data Response Format” on page B-16
  - Table B-7, “Template 14: Memory System Failure Event Sense Data Response Format” on page B-17
  - Table B-8, “Template 41: Device Services Non-Transfer Error Event Sense Data Response Format” on page B-18
  - Table B-9, “Template 51a: Disk Transfer Error Event Sense Data Response Format (sheet 1 of 2)” on page B-19
  - Table B-10, “Template 51b: Passthrough Device Reset Event Sense Data Response Format (sheet 1 of 2)” on page B-21
  - Table B-11, “Instance Codes (sheet 1 of 31)” on page B-23
  - Table B-12, “Last Failure Codes (sheet 1 of 28)” on page B-54
  - Table B-13, “Repair Action Codes (sheet 1 of 10)” on page B-82
  - Table B-14, “Component Identifier Codes” on page B-92
  - Table B-15, “Event Notification/Recovery Threshold Classifications” on page B-93
  - Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93

## Template and Code Descriptions

### Last Failure Event Sense Data Response

Unrecoverable conditions detected by either software or hardware and certain operator-initiated conditions result in the termination of HSZ70 controller operation. In most cases, following such a termination, the controller attempts to restart (reboot) with hardware components and software data structures initialized to the states necessary to perform normal operations (Table B-1).

- Instance Codes (byte offset 8-11) are described in Table B-11, “Instance Codes (sheet 1 of 31)” on page B-23.
- Last Failure Codes (byte offset 104-107) are described in Table B-12, “Last Failure Codes (sheet 1 of 28)” on page B-54.
- ASC and ASCQ codes (byte offsets 12 and 13) are described in Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93.

### Multiple-Bus Failover Event Sense Data Response

The SCSI Host Interconnect Services software component reports Multiple Bus Failover events via the Multiple Bus Failover Event Sense Data Response (Table B-2).

- Instance Codes (byte offset 8-11) are described in Table B-11, “Instance Codes (sheet 1 of 31)” on page B-23.
- ASC and ASCQ codes (byte offsets 12 and 13) are described in Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93.

### Failover Event Sense Data Response

The Failover Control software component reports errors and other conditions encountered during redundant controller communications and failover operation via the Failover Event Sense Data Response (Table B-3).

- Instance Codes (byte offset 8-11) are described in Table B-11, “Instance Codes (sheet 1 of 31)” on page B-23.
- Last Failure Codes (byte offset 104-107) are described in Table B-12, “Last Failure Codes (sheet 1 of 28)” on page B-54.
- ASC and ASCQ codes (byte offsets 12 and 13) are described in Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93.

### **Nonvolatile Parameter Memory Component Event Sense Data Response**

The Executive software component reports errors detected while accessing a Nonvolatile Parameter Memory Component via the Nonvolatile Parameter Memory Component Event Sense Data Response (Table B-4).

- Instance Codes (byte offset 8-11) are described in Table B-11, “Instance Codes (sheet 1 of 31)” on page B-23.
- ASC and ASCQ codes (byte offsets 12 and 13) are described in Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93.

### **Backup Battery Failure Event Sense Data Response**

The Value Added Services software component reports backup battery failure conditions for the various hardware components that use a battery to maintain state during power failures via the Backup Battery Failure Event Sense Data Response (Table B-5).

- Instance Codes (byte offset 8-11) are described in Table B-11, “Instance Codes (sheet 1 of 31)” on page B-23.
- ASC and ASCQ codes (byte offsets 12 and 13) are described in Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93.

### **Subsystem Built-In Self Test Failure Event Sense Data Response**

The Subsystem Built-In Self Tests software component reports errors detected during test execution via the Subsystem Built-In Self Test Failure Event Sense Data Response (Table B-6).

- Instance Codes (byte offset 8-11) are described in Figure B-11, “Instance Codes (sheet 1 of 31)” on page B-23.
- ASC and ASCQ codes (byte offsets 12 and 13) are described in Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93.

### **Memory System Failure Event Sense Data Response**

The Memory Controller Event Analyzer software component and the Cache Manager, report the occurrence of memory errors via the Memory System Failure Event Sense Data Response (Table B-7).

- Instance Codes (byte offset 8-11) are described in Table B-11, “Instance Codes (sheet 1 of 31)” on page B-23.
- ASC and ASCQ codes (byte offsets 12 and 13) are described in Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93.

### Device Services Non-Transfer Error Event Sense Data Response

The Device Services software component reports errors detected while performing non-transfer work related to disk (including CD-ROM and optical memory) device operations via the Device Services Non-Transfer Event Sense Data Response (Table B-8).

- Instance Codes (byte offset 8-11) are described in Table B-11, “Instance Codes (sheet 1 of 31)” on page B-23.
- ASC and ASCQ codes (byte offsets 12 and 13) are described in Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93.

### Disk Transfer Error Event Sense Data Response

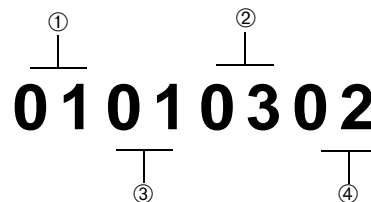
The Device Services and Value Added Services software components report errors detected while performing work related to disk, CD-ROM, or optical memory device transfer operations via the Disk Transfer Error Event Sense Data Response (Table B-9).

- Instance Codes (byte offset 8-11) are described in Table B-11, “Instance Codes (sheet 1 of 31)” on page B-23.
- ASC and ASCQ codes (byte offsets 12 and 13) are described in Table B-16, “ASC and ASCQ Codes (sheet 1 of 3)” on page B-93.

### Instance Codes

An Instance Code is a number that uniquely identifies the event being reported. Figure B-1 outlines the structure of an instance code. By understanding its structure, you will be able to translate it yourself and bypass the fault management utility (FMU).

**Figure B-1** Structure of an Instance Code



| Callout | Description         |
|---------|---------------------|
| ①       | Component ID Number |
| ②       | Repair Action       |
| ③       | Event Number        |
| ④       | Event Threshold     |

### Instance Codes Format

The format of an Instance Code as it appears in Sense Data Responses is shown in the table that follows. The descriptions of the instance code format are contained in the paragraphs that follow the table.

| off    | bit<br>→ | 7             | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------|----------|---------------|---|---|---|---|---|---|---|
| {8}32  |          | NR Threshold  |   |   |   |   |   |   |   |
| {9}33  |          | Repair Action |   |   |   |   |   |   |   |
| {10}34 |          | Error Number  |   |   |   |   |   |   |   |
| {11}35 |          | Component ID  |   |   |   |   |   |   |   |

**Note** The offset values enclosed in braces ({} ) apply only to the passthrough device reset event sense data response format (Table B-10). The nonbraced offset values apply only to the logical device event sense data response formats shown in the templates that begin with Table B-1 on page B-11.

#### *NR Threshold*

Located at byte offset {8}32, the NR Threshold is the notification/recovery threshold assigned to the event. This value is used during Symptom-Directed Diagnosis procedures to determine when notification/recovery action should be taken.

#### *Repair Action*

Located at byte offset {9}33, the Repair Action code identifies the recommended repair action assigned to the event. This value is used during Symptom-Directed Diagnosis procedures to determine what



notification/recovery action should be taken when the NR Threshold is reached. For more details about recommended repair actions, see “Repair Action Codes (sheet 1 of 10),” page B-82.

#### *Event Number*

Located at byte offset {10}34, the Event Number, when combined with the value contained in the Component ID field, uniquely identifies the reported event.

#### *Component ID*

Component Identifier Codes are embedded in Instance and Last Failure codes. A component ID is a number that uniquely identifies the software component that detected the event and is found at byte offset {11}35 (Table B-14, “Component Identifier Codes” on page B-92).

### **Instance Codes Listing**

Table B-11 contains a listing of the instance codes, their descriptions, and the applicable template used.

### **ASC/ASCQ Codes**

Table B-16 lists HSZ70-specific SCSI Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) codes. These codes are Template-specific and appear at byte offsets 12 and 13.

Additional codes that are common to all SCSI devices can be found in the SCSI specification.

### **Event Threshold Codes**

Table B-15 lists the classifications for event notification and recovery threshold values.

### **Recommended Repair Action Codes**

Recommended Repair Action Codes are embedded in Instance and Last Failure codes. Refer to “Instance Codes,” page B-5, and “Last Failure Codes,” page B-8, for a more detailed description of the relationship between these codes.

Table B-13 contains the repair action codes assigned to each significant event in the system.

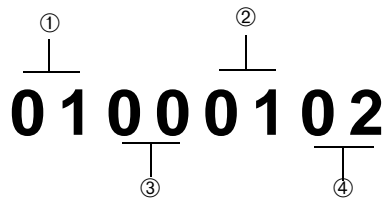
## Last Failure Codes

A Last Failure Code is a number that uniquely-describes an unrecoverable condition. It is found at byte offset 104 to 107 and appears in:

- Table B-1, “Template 01: Last Failure Event Sense Data Response Format” on page B-11, and
- Table B-3, “Template 05: Failover Event Sense Data Response Format” on page B-13.

Figure B-2 shows the structure of a Last Failure Code. By understanding its structure, you will be able to translate it, bypassing the FMU.

**Figure B-2 Structure of a Last Failure Code**



| Callout | Description         |
|---------|---------------------|
| ①       | Component ID Number |
| ②       | Repair Action       |
| ③       | Event Number        |
| ④       | Parameter Count     |

### Last Failure Codes Format

The format of a Last Failure Code is shown in the table that follows. The table codes are described in the following paragraphs.

| offset | bit<br>→ | 7             | 6            | 5 | 4 | 3              | 2 | 1 | 0 |
|--------|----------|---------------|--------------|---|---|----------------|---|---|---|
| 104    |          | HW            | Restart Code |   |   | Parameter Code |   |   |   |
| 105    |          | Repair Action |              |   |   |                |   |   |   |
| 106    |          | Error Number  |              |   |   |                |   |   |   |
| 107    |          | Component ID  |              |   |   |                |   |   |   |

**Note** Do not confuse the Last Failure Code with the Instance Code. They appear at different byte offsets and convey different information.

#### *HW*

This hardware/software flag is located at byte offset 104, bit 7:

- Bit = 1—The unrecoverable condition is due to a hardware-detected fault.
- Bit = 0—The unrecoverable condition is due to an inconsistency with the software, or an intentional restart or shutdown of the controller was requested.

#### *Restart Code*

Located at byte offset 104, bits 4-6, the Restart Code describes the actions taken to restart the controller after the unrecoverable condition was detected. The three restart codes are described in the following table:

| Restart Code | Description                |
|--------------|----------------------------|
| 0            | Full software restart      |
| 1            | No restart                 |
| 2            | Automatic hardware restart |

#### *Parameter Count*

The Parameter Count, located at byte offset 104, bits 0-3, indicates the number of Last Failure Parameters containing supplemental information supplied.

*Repair Action*

The Repair Action found at byte offset 105 indicates the recommended repair action code assigned to the event. This value is used during Symptom-Directed Diagnosis procedures to determine what notification/recovery action should be taken. For more details, see “Repair Action,” page B-6.

*Error Numbers*

Located at byte offset 106, the Error Number, when combined with the value contained in the Component ID field, uniquely-identifies the condition detected.

*Component IDs*

A component ID uniquely identifies the software component that detected the event and is found at byte offset {11}35 (see “Component Identifier Codes,” page B-92).

Table B-12 contains the last failure codes that can be issued by the controller fault-management software.

## Template and Code Tables

**Table B-1 Template 01: Last Failure Event Sense Data Response Format**

| offset  | bit<br>→ | 7                                      | 6          | 5 | 4 | 3         | 2 | 1 | 0 |
|---------|----------|----------------------------------------|------------|---|---|-----------|---|---|---|
| 0       |          | Unused                                 | Error Code |   |   |           |   |   |   |
| 1       |          | Unused                                 |            |   |   |           |   |   |   |
| 2       |          | Unused                                 |            |   |   | Sense Key |   |   |   |
| 3-6     |          | Unused                                 |            |   |   |           |   |   |   |
| 7       |          | Additional Sense Length                |            |   |   |           |   |   |   |
| 8-11    |          | Unused                                 |            |   |   |           |   |   |   |
| 12      |          | Additional Sense Code (ASC)            |            |   |   |           |   |   |   |
| 13      |          | Additional Sense Code Qualifier (ASCQ) |            |   |   |           |   |   |   |
| 14      |          | Unused                                 |            |   |   |           |   |   |   |
| 15-17   |          | Unused                                 |            |   |   |           |   |   |   |
| 18-31   |          | Reserved                               |            |   |   |           |   |   |   |
| 32-35   |          | Instance Code                          |            |   |   |           |   |   |   |
| 36      |          | Template                               |            |   |   |           |   |   |   |
| 37      |          | Template Flags                         |            |   |   |           |   |   |   |
| 38-53   |          | Reserved                               |            |   |   |           |   |   |   |
| 54-69   |          | Controller Board Serial Number         |            |   |   |           |   |   |   |
| 70-73   |          | Controller Software Revision Level     |            |   |   |           |   |   |   |
| 74-75   |          | Reserved                               |            |   |   |           |   |   |   |
| 76      |          | LUN Status                             |            |   |   |           |   |   |   |
| 77-103  |          | Reserved                               |            |   |   |           |   |   |   |
| 104-107 |          | Last Failure Code                      |            |   |   |           |   |   |   |
| 108-111 |          | Last Failure Parameter (0)             |            |   |   |           |   |   |   |
| 112-115 |          | Last Failure Parameter (1)             |            |   |   |           |   |   |   |
| 116-119 |          | Last Failure Parameter (2)             |            |   |   |           |   |   |   |
| 120-123 |          | Last Failure Parameter (3)             |            |   |   |           |   |   |   |
| 124-127 |          | Last Failure Parameter (4)             |            |   |   |           |   |   |   |
| 128-131 |          | Last Failure Parameter (5)             |            |   |   |           |   |   |   |
| 132-135 |          | Last Failure Parameter (6)             |            |   |   |           |   |   |   |
| 136-139 |          | Last Failure Parameter (7)             |            |   |   |           |   |   |   |
| 140-159 |          | Reserved                               |            |   |   |           |   |   |   |

Controller Level Sense Data Format

**Table B-2 Template 04: Multiple-Bus Failover Event Sense Data Response Format**

|                                    | offset | bit<br>→ | 7                                      | 6          | 5 | 4 | 3         | 2 | 1 | 0 |  |
|------------------------------------|--------|----------|----------------------------------------|------------|---|---|-----------|---|---|---|--|
| Controller Level Sense Data Format | 0      |          | Unused                                 | Error Code |   |   |           |   |   |   |  |
|                                    | 1      |          | Unused                                 |            |   |   |           |   |   |   |  |
|                                    | 2      |          | Unused                                 |            |   |   | Sense Key |   |   |   |  |
|                                    | 3-6    |          | Unused                                 |            |   |   |           |   |   |   |  |
|                                    | 7      |          | Additional Sense Length                |            |   |   |           |   |   |   |  |
|                                    | 8-11   |          | Unused                                 |            |   |   |           |   |   |   |  |
|                                    | 12     |          | Additional Sense Code (ASC)            |            |   |   |           |   |   |   |  |
|                                    | 13     |          | Additional Sense Code Qualifier (ASCQ) |            |   |   |           |   |   |   |  |
|                                    | 14-17  |          | Unused                                 |            |   |   |           |   |   |   |  |
|                                    | 18-26  |          | Reserved                               |            |   |   |           |   |   |   |  |
|                                    | 27     |          | Failed Controller Target Number        |            |   |   |           |   |   |   |  |
|                                    | 28-31  |          | Affected LUNs                          |            |   |   |           |   |   |   |  |
|                                    | 32-35  |          | Instance Code                          |            |   |   |           |   |   |   |  |
|                                    | 36     |          | Template                               |            |   |   |           |   |   |   |  |
|                                    | 37     |          | Template Flags                         |            |   |   |           |   |   |   |  |
|                                    | 38-53  |          | Other Controller Board Serial Number   |            |   |   |           |   |   |   |  |
|                                    | 54-69  |          | Controller Board Serial Number         |            |   |   |           |   |   |   |  |
|                                    | 70-73  |          | Controller Software Revision Level     |            |   |   |           |   |   |   |  |
|                                    | 74-75  |          | Reserved                               |            |   |   |           |   |   |   |  |
|                                    | 76     |          | LUN Status                             |            |   |   |           |   |   |   |  |
| 77-159                             |        | Reserved |                                        |            |   |   |           |   |   |   |  |

**Table B-3 Template 05: Failover Event Sense Data Response Format**

|                                    | offset  | bit<br>→                   | 7                                      | 6          | 5 | 4 | 3         | 2 | 1 | 0 |
|------------------------------------|---------|----------------------------|----------------------------------------|------------|---|---|-----------|---|---|---|
| Controller Level Sense Data Format | 0       |                            | Unused                                 | Error Code |   |   |           |   |   |   |
|                                    | 1       |                            | Unused                                 |            |   |   |           |   |   |   |
|                                    | 2       |                            | Unused                                 |            |   |   | Sense Key |   |   |   |
|                                    | 3-6     |                            | Unused                                 |            |   |   |           |   |   |   |
|                                    | 7       |                            | Additional Sense Length                |            |   |   |           |   |   |   |
|                                    | 8-11    |                            | Unused                                 |            |   |   |           |   |   |   |
|                                    | 12      |                            | Additional Sense Code (ASC)            |            |   |   |           |   |   |   |
|                                    | 13      |                            | Additional Sense Code Qualifier (ASCQ) |            |   |   |           |   |   |   |
|                                    | 14      |                            | Unused                                 |            |   |   |           |   |   |   |
|                                    | 15-17   |                            | Unused                                 |            |   |   |           |   |   |   |
|                                    | 18-31   |                            | Reserved                               |            |   |   |           |   |   |   |
|                                    | 32-35   |                            | Instance Code                          |            |   |   |           |   |   |   |
|                                    | 36      |                            | Template                               |            |   |   |           |   |   |   |
|                                    | 37      |                            | Template Flags                         |            |   |   |           |   |   |   |
|                                    | 38-53   |                            | Reserved                               |            |   |   |           |   |   |   |
|                                    | 54-69   |                            | Controller Board Serial Number         |            |   |   |           |   |   |   |
|                                    | 70-73   |                            | Controller Software Revision Level     |            |   |   |           |   |   |   |
|                                    | 74-75   |                            | Reserved                               |            |   |   |           |   |   |   |
|                                    | 76      |                            | LUN Status                             |            |   |   |           |   |   |   |
|                                    | 77-103  |                            | Reserved                               |            |   |   |           |   |   |   |
|                                    | 104-107 |                            | Last Failure Code                      |            |   |   |           |   |   |   |
|                                    | 108-111 |                            | Last Failure Parameter (0)             |            |   |   |           |   |   |   |
|                                    | 112-115 |                            | Last Failure Parameter (1)             |            |   |   |           |   |   |   |
|                                    | 116-119 |                            | Last Failure Parameter (2)             |            |   |   |           |   |   |   |
|                                    | 120-123 |                            | Last Failure Parameter (3)             |            |   |   |           |   |   |   |
|                                    | 124-127 |                            | Last Failure Parameter (4)             |            |   |   |           |   |   |   |
|                                    | 128-131 |                            | Last Failure Parameter (5)             |            |   |   |           |   |   |   |
|                                    | 132-135 |                            | Last Failure Parameter (6)             |            |   |   |           |   |   |   |
| 136-139                            |         | Last Failure Parameter (7) |                                        |            |   |   |           |   |   |   |
| 140-159                            |         | Reserved                   |                                        |            |   |   |           |   |   |   |

**Table B-4 Template 11: Nonvolatile Parameter Memory Component Event Sense Data Response Format**

| offset  | bit<br>→ | 7                                      | 6          | 5 | 4 | 3         | 2 | 1 | 0 |
|---------|----------|----------------------------------------|------------|---|---|-----------|---|---|---|
| 0       |          | Unused                                 | Error Code |   |   |           |   |   |   |
| 1       |          | Unused                                 |            |   |   |           |   |   |   |
| 2       |          | Unused                                 |            |   |   | Sense Key |   |   |   |
| 3-6     |          | Unused                                 |            |   |   |           |   |   |   |
| 7       |          | Additional Sense Length                |            |   |   |           |   |   |   |
| 8-11    |          | Unused                                 |            |   |   |           |   |   |   |
| 12      |          | Additional Sense Code (ASC)            |            |   |   |           |   |   |   |
| 13      |          | Additional Sense Code Qualifier (ASCQ) |            |   |   |           |   |   |   |
| 14      |          | Unused                                 |            |   |   |           |   |   |   |
| 15-17   |          | Unused                                 |            |   |   |           |   |   |   |
| 18-31   |          | Reserved                               |            |   |   |           |   |   |   |
| 32-35   |          | Instance Code                          |            |   |   |           |   |   |   |
| 36      |          | Template                               |            |   |   |           |   |   |   |
| 37      |          | Template Flags                         |            |   |   |           |   |   |   |
| 38-53   |          | Reserved                               |            |   |   |           |   |   |   |
| 54-69   |          | Controller Board Serial Number         |            |   |   |           |   |   |   |
| 70-73   |          | Controller Software Revision Level     |            |   |   |           |   |   |   |
| 74-75   |          | Reserved                               |            |   |   |           |   |   |   |
| 76      |          | LUN Status                             |            |   |   |           |   |   |   |
| 77-103  |          | Reserved                               |            |   |   |           |   |   |   |
| 104-107 |          | Memory Address                         |            |   |   |           |   |   |   |
| 108-111 |          | Byte Count                             |            |   |   |           |   |   |   |
| 112-114 |          | Number of Times Written                |            |   |   |           |   |   |   |
| 115     |          | Undefined                              |            |   |   |           |   |   |   |
| 116-159 |          | Reserved                               |            |   |   |           |   |   |   |

Controller Level Sense Data Format



**Table B-5 Template 12: Backup Battery Failure Event Sense Data Response Format**

|                             | offset | bit<br>→       | 7                                      | 6          | 5 | 4 | 3         | 2 | 1 | 0 |
|-----------------------------|--------|----------------|----------------------------------------|------------|---|---|-----------|---|---|---|
| Controller Level Sense Data | 0      |                | Unused                                 | Error Code |   |   |           |   |   |   |
|                             | 1      |                | Unused                                 |            |   |   |           |   |   |   |
|                             | 2      |                | Unused                                 |            |   |   | Sense Key |   |   |   |
|                             | 3-6    |                | Unused                                 |            |   |   |           |   |   |   |
|                             | 7      |                | Additional Sense Length                |            |   |   |           |   |   |   |
|                             | 8-11   |                | Unused                                 |            |   |   |           |   |   |   |
|                             | 12     |                | Additional Sense Code (ASC)            |            |   |   |           |   |   |   |
|                             | 13     |                | Additional Sense Code Qualifier (ASCQ) |            |   |   |           |   |   |   |
|                             | 14     |                | Unused                                 |            |   |   |           |   |   |   |
|                             | 15-17  |                | Unused                                 |            |   |   |           |   |   |   |
|                             | 18-31  |                | Reserved                               |            |   |   |           |   |   |   |
|                             | 32-35  |                | Instance Code                          |            |   |   |           |   |   |   |
|                             | 36     |                | Template                               |            |   |   |           |   |   |   |
|                             | 37     |                | Template Flags                         |            |   |   |           |   |   |   |
|                             | 38-53  |                | Reserved                               |            |   |   |           |   |   |   |
|                             | 54-69  |                | Controller Board Serial Number         |            |   |   |           |   |   |   |
|                             | 70-73  |                | Controller Software Revision Level     |            |   |   |           |   |   |   |
|                             | 74-75  |                | Reserved                               |            |   |   |           |   |   |   |
|                             | 76     |                | LUN Status                             |            |   |   |           |   |   |   |
|                             | 77-103 |                | Reserved                               |            |   |   |           |   |   |   |
| 104-107                     |        | Memory Address |                                        |            |   |   |           |   |   |   |
| 108-159                     |        | Reserved       |                                        |            |   |   |           |   |   |   |

**Table B-6 Template 13: Subsystem Built-in Self Test Failure Event Sense Data Response Format**

|                                    | offset  | bit<br>→       | 7                                      | 6          | 5 | 4 | 3         | 2 | 1 | 0 |
|------------------------------------|---------|----------------|----------------------------------------|------------|---|---|-----------|---|---|---|
| Controller Level Sense Data Format | 0       |                | Unused                                 | Error Code |   |   |           |   |   |   |
|                                    | 1       |                | Unused                                 |            |   |   |           |   |   |   |
|                                    | 2       |                | Unused                                 |            |   |   | Sense Key |   |   |   |
|                                    | 3-6     |                | Unused                                 |            |   |   |           |   |   |   |
|                                    | 7       |                | Additional Sense Length                |            |   |   |           |   |   |   |
|                                    | 8-11    |                | Unused                                 |            |   |   |           |   |   |   |
|                                    | 12      |                | Additional Sense Code (ASC)            |            |   |   |           |   |   |   |
|                                    | 13      |                | Additional Sense Code Qualifier (ASCQ) |            |   |   |           |   |   |   |
|                                    | 14      |                | Unused                                 |            |   |   |           |   |   |   |
|                                    | 15-17   |                | Unused                                 |            |   |   |           |   |   |   |
|                                    | 18-31   |                | Reserved                               |            |   |   |           |   |   |   |
|                                    | 32-35   |                | Instance Code                          |            |   |   |           |   |   |   |
|                                    | 36      |                | Template                               |            |   |   |           |   |   |   |
|                                    | 37      |                | Template Flags                         |            |   |   |           |   |   |   |
|                                    | 38-53   |                | Reserved                               |            |   |   |           |   |   |   |
|                                    | 54-69   |                | Controller Board Serial Number         |            |   |   |           |   |   |   |
|                                    | 70-73   |                | Controller Software Revision Level     |            |   |   |           |   |   |   |
|                                    | 74-75   |                | Reserved                               |            |   |   |           |   |   |   |
|                                    | 76      |                | LUN Status                             |            |   |   |           |   |   |   |
|                                    | 77-103  |                | Reserved                               |            |   |   |           |   |   |   |
|                                    | 105-105 |                | Undefined                              |            |   |   |           |   |   |   |
|                                    | 106     |                | Header Type                            |            |   |   |           |   |   |   |
|                                    | 107     |                | Header Flags                           |            |   |   |           |   |   |   |
|                                    | 108     |                | TE                                     |            |   |   |           |   |   |   |
|                                    | 109     |                | Test Number                            |            |   |   |           |   |   |   |
|                                    | 110     |                | Test Command                           |            |   |   |           |   |   |   |
|                                    | 111     |                | Test Flags                             |            |   |   |           |   |   |   |
|                                    | 112-113 |                | Error Code                             |            |   |   |           |   |   |   |
|                                    | 114-115 |                | Return Code                            |            |   |   |           |   |   |   |
|                                    | 116-119 |                | Address of Error                       |            |   |   |           |   |   |   |
|                                    | 120-123 |                | Expected Error Data                    |            |   |   |           |   |   |   |
|                                    | 124-127 |                | Actual Error Data                      |            |   |   |           |   |   |   |
| 128-131                            |         | Extra Status 1 |                                        |            |   |   |           |   |   |   |
| 132-135                            |         | Extra Status 2 |                                        |            |   |   |           |   |   |   |
| 136-139                            |         | Extra Status 3 |                                        |            |   |   |           |   |   |   |
| 140-159                            |         | Reserved       |                                        |            |   |   |           |   |   |   |

**Table B-7 Template 14: Memory System Failure Event Sense Data Response Format**

|                                    | offset  | bit<br>→ | 7                                      | 6          | 5 | 4 | 3         | 2 | 1 | 0 |
|------------------------------------|---------|----------|----------------------------------------|------------|---|---|-----------|---|---|---|
| Controller Level Sense Data Format | 0       |          | Unused                                 | Error Code |   |   |           |   |   |   |
|                                    | 1       |          | Unused                                 |            |   |   |           |   |   |   |
|                                    | 2       |          | Unused                                 |            |   |   | Sense Key |   |   |   |
|                                    | 3-6     |          | Unused                                 |            |   |   |           |   |   |   |
|                                    | 7       |          | Additional Sense Length                |            |   |   |           |   |   |   |
|                                    | 8-11    |          | Unused                                 |            |   |   |           |   |   |   |
|                                    | 12      |          | Additional Sense Code (ASC)            |            |   |   |           |   |   |   |
|                                    | 13      |          | Additional Sense Code Qualifier (ASCQ) |            |   |   |           |   |   |   |
|                                    | 14-17   |          | Unused                                 |            |   |   |           |   |   |   |
|                                    | 18-31   |          | Reserved                               |            |   |   |           |   |   |   |
|                                    | 32-35   |          | Instance Code                          |            |   |   |           |   |   |   |
|                                    | 36      |          | Template                               |            |   |   |           |   |   |   |
|                                    | 37      |          | Template Flags                         |            |   |   |           |   |   |   |
|                                    | 38-53   |          | Reserved                               |            |   |   |           |   |   |   |
|                                    | 54-69   |          | Controller Board Serial Number         |            |   |   |           |   |   |   |
|                                    | 70-73   |          | Controller Software Revision Level     |            |   |   |           |   |   |   |
|                                    | 74-75   |          | Reserved                               |            |   |   |           |   |   |   |
|                                    | 76      |          | LUN Status                             |            |   |   |           |   |   |   |
|                                    | 77-103  |          | Reserved                               |            |   |   |           |   |   |   |
|                                    | 104-107 |          | Memory Address                         |            |   |   |           |   |   |   |
|                                    | 108-111 |          | Byte Count                             |            |   |   |           |   |   |   |
|                                    | 112-115 |          | DSR                                    |            |   |   |           |   |   |   |
|                                    | 116-119 |          | CSR                                    |            |   |   |           |   |   |   |
|                                    | 120-123 |          | DCSR                                   |            |   |   |           |   |   |   |
|                                    | 124-127 |          | DER                                    |            |   |   |           |   |   |   |
|                                    | 128-131 |          | EAR                                    |            |   |   |           |   |   |   |
|                                    | 132-135 |          | EDR                                    |            |   |   |           |   |   |   |
|                                    | 136-139 |          | ERR                                    |            |   |   |           |   |   |   |
|                                    | 140-143 |          | RSR                                    |            |   |   |           |   |   |   |
|                                    | 144-147 |          | RDR0                                   |            |   |   |           |   |   |   |
|                                    | 148-151 |          | RDR1                                   |            |   |   |           |   |   |   |
|                                    | 152-155 |          | WDR0                                   |            |   |   |           |   |   |   |
| 156-159                            |         | WDR1     |                                        |            |   |   |           |   |   |   |

**Table B-8 Template 41: Device Services Non-Transfer Error Event Sense Data Response Format**

|                             | offset | bit<br>→       | 7                                      | 6          | 5 | 4 | 3         | 2 | 1 | 0 |  |
|-----------------------------|--------|----------------|----------------------------------------|------------|---|---|-----------|---|---|---|--|
| Controller Level Sense Data | 0      |                | Unused                                 | Error Code |   |   |           |   |   |   |  |
|                             | 1      |                | Unused                                 |            |   |   |           |   |   |   |  |
|                             | 2      |                | Unused                                 |            |   |   | Sense Key |   |   |   |  |
|                             | 3-6    |                | Unused                                 |            |   |   |           |   |   |   |  |
|                             | 7      |                | Additional Sense Length                |            |   |   |           |   |   |   |  |
|                             | 8-11   |                | Unused                                 |            |   |   |           |   |   |   |  |
|                             | 12     |                | Additional Sense Code (ASC)            |            |   |   |           |   |   |   |  |
|                             | 13     |                | Additional Sense Code Qualifier (ASCQ) |            |   |   |           |   |   |   |  |
|                             | 14     |                | Unused                                 |            |   |   |           |   |   |   |  |
|                             | 15-17  |                | Unused                                 |            |   |   |           |   |   |   |  |
|                             | 18-31  |                | Reserved                               |            |   |   |           |   |   |   |  |
|                             | 32-35  |                | Instance Code                          |            |   |   |           |   |   |   |  |
|                             | 36     |                | Template                               |            |   |   |           |   |   |   |  |
|                             | 37     |                | Template Flags                         |            |   |   |           |   |   |   |  |
|                             | 38-53  |                | Reserved                               |            |   |   |           |   |   |   |  |
|                             | 54-69  |                | Controller Board Serial Number         |            |   |   |           |   |   |   |  |
|                             | 70-73  |                | Controller Software Revision Level     |            |   |   |           |   |   |   |  |
|                             | 74-75  |                | Reserved                               |            |   |   |           |   |   |   |  |
|                             | 76     |                | LUN Status                             |            |   |   |           |   |   |   |  |
|                             | 77-103 |                | Reserved                               |            |   |   |           |   |   |   |  |
| 104-107                     |        | Memory Address |                                        |            |   |   |           |   |   |   |  |
| 108-159                     |        | Reserved       |                                        |            |   |   |           |   |   |   |  |

Table B-9 Template 51a: Disk Transfer Error Event Sense Data Response Format (sheet 1 of 2)

|                                | offset | bit<br>→                                             | 7                                      | 6          | 5   | 4    | 3         | 2 | 1 | 0   |
|--------------------------------|--------|------------------------------------------------------|----------------------------------------|------------|-----|------|-----------|---|---|-----|
| Standard SCSI Sense Data Field | 0      |                                                      | Valid                                  | Error Code |     |      |           |   |   |     |
|                                | 1      |                                                      | Segment                                |            |     |      |           |   |   |     |
|                                | 2      |                                                      | FM                                     | EOM        | ILI | Rsvd | Sense Key |   |   |     |
|                                | 3-6    |                                                      | Information                            |            |     |      |           |   |   |     |
|                                | 7      |                                                      | Additional Sense Length                |            |     |      |           |   |   |     |
|                                | 8-11   |                                                      | Command Specific Information           |            |     |      |           |   |   |     |
|                                | 12     |                                                      | Additional Sense Code (ASC)            |            |     |      |           |   |   |     |
|                                | 13     |                                                      | Additional Sense Code Qualifier (ASCQ) |            |     |      |           |   |   |     |
|                                | 14     |                                                      | Field Replaceable Unit Code            |            |     |      |           |   |   |     |
|                                | 15     |                                                      | SKSV                                   |            |     |      |           |   |   |     |
|                                | 16     |                                                      | Sense Key Specific                     |            |     |      |           |   |   |     |
|                                | 17     |                                                      |                                        |            |     |      |           |   |   |     |
|                                | 18-19  |                                                      | Reserved                               |            |     |      |           |   |   |     |
|                                | 20     |                                                      | Total Number of Errors                 |            |     |      |           |   |   |     |
| ASC/ASCQ Stack                 | 21     |                                                      | Total Retry Count                      |            |     |      |           |   |   |     |
|                                | 22     |                                                      | Most Recent ASC                        |            |     |      |           |   |   |     |
|                                | 23     |                                                      | Most Recent ASCQ                       |            |     |      |           |   |   |     |
|                                | 24     |                                                      | Next Most Recent ASC                   |            |     |      |           |   |   |     |
| Device Locator Field           | 25     |                                                      | Next Most Recent ASCQ                  |            |     |      |           |   |   |     |
|                                | 26     |                                                      | Port Address                           |            |     |      |           |   |   |     |
|                                | 27     |                                                      | Target Address                         |            |     |      |           |   |   |     |
|                                | 28     |                                                      | Logical Unit Number (LUN)              |            |     |      |           |   |   |     |
|                                | 29-31  |                                                      | Reserved                               |            |     |      |           |   |   |     |
|                                | 32-35  |                                                      | Instance Code                          |            |     |      |           |   |   |     |
|                                | 36     |                                                      | Template                               |            |     |      |           |   |   |     |
|                                | 37     |                                                      | TMO                                    | Rsvd       |     |      |           |   |   | HCE |
|                                | 38     |                                                      | Reserved                               |            |     |      |           |   |   |     |
|                                | 39     |                                                      | Command OPcode                         |            |     |      |           |   |   |     |
| 40                             |        | Sense Data Qualifier                                 |                                        |            |     |      |           |   |   |     |
| 41-50                          |        | Original Command Descriptor Block (CDB) <sup>1</sup> |                                        |            |     |      |           |   |   |     |
| 51                             |        | Host ID <sup>2</sup>                                 |                                        |            |     |      |           |   |   |     |
| 52-53                          |        | Reserved                                             |                                        |            |     |      |           |   |   |     |
| 54-69                          |        | Controller Board Serial Number                       |                                        |            |     |      |           |   |   |     |

**Table B-9 Template 51a: Disk Transfer Error Event Sense Data Response Format (sheet 2 of 2)**

| offset                  | bit<br>→                           | 7                                      | 6          | 5   | 4    | 3         | 2 | 1 | 0 |  |
|-------------------------|------------------------------------|----------------------------------------|------------|-----|------|-----------|---|---|---|--|
| 70-73                   | Controller Software Revision Level |                                        |            |     |      |           |   |   |   |  |
| 74-75                   | Reserved                           |                                        |            |     |      |           |   |   |   |  |
| 76                      | LUN Status                         |                                        |            |     |      |           |   |   |   |  |
| 77-78                   | Reserved                           |                                        |            |     |      |           |   |   |   |  |
| 79-82                   | Device Software Revision Level     |                                        |            |     |      |           |   |   |   |  |
| 83-98                   | Device Product ID                  |                                        |            |     |      |           |   |   |   |  |
| 99-100                  | Reserved                           |                                        |            |     |      |           |   |   |   |  |
| 101                     | Device Type                        |                                        |            |     |      |           |   |   |   |  |
| 102-103                 | Reserved                           |                                        |            |     |      |           |   |   |   |  |
| Device Sense Data Field | 104                                | Valid                                  | Error Code |     |      |           |   |   |   |  |
|                         | 105                                | Segment                                |            |     |      |           |   |   |   |  |
|                         | 106                                | FM                                     | EOM        | ILI | Rsvd | Sense Key |   |   |   |  |
|                         | 107-110                            | Information                            |            |     |      |           |   |   |   |  |
|                         | 111                                | Additional Sense Length                |            |     |      |           |   |   |   |  |
|                         | 112-115                            | Command Specific Information           |            |     |      |           |   |   |   |  |
|                         | 116                                | Additional Sense Code (ASC)            |            |     |      |           |   |   |   |  |
|                         | 117                                | Additional Sense Code Qualifier (ASCQ) |            |     |      |           |   |   |   |  |
|                         | 118                                | Field Replaceable Unit Code            |            |     |      |           |   |   |   |  |
|                         | 119                                | SKSV                                   |            |     |      |           |   |   |   |  |
|                         | 120                                | Sense Key Specific                     |            |     |      |           |   |   |   |  |
|                         | 121                                |                                        |            |     |      |           |   |   |   |  |
| 122-159                 | Reserved                           |                                        |            |     |      |           |   |   |   |  |

- <sup>1</sup> Host ID Field: If the HCE (offset 37, Bit 0) field is set to one, then the SCSI ID of the host appears here; If the HCE field is set to zero, then this field is undefined.
- <sup>2</sup> CDB Field: If the HCE (offset 37, Bit 0) field is set to one, then the original command descriptor block appears here; If the HCE field is set to zero, then this field is undefined.

**Table B-10 Template 51b: Passthrough Device Reset Event Sense Data Response Format**  
(sheet 1 of 2)

|                                     | offset         | bit<br>→                                             | 7                                      | 6                     | 5   | 4    | 3         | 2 | 1 | 0   |  |
|-------------------------------------|----------------|------------------------------------------------------|----------------------------------------|-----------------------|-----|------|-----------|---|---|-----|--|
| Passthrough Device Sense Data Field | 0              |                                                      | Valid                                  | Error Code            |     |      |           |   |   |     |  |
|                                     | 1              |                                                      | Segment                                |                       |     |      |           |   |   |     |  |
|                                     | 2              |                                                      | FM                                     | EOM                   | ILI | Rsvd | Sense Key |   |   |     |  |
|                                     | 3-6            |                                                      | Information                            |                       |     |      |           |   |   |     |  |
|                                     | 7              |                                                      | Additional Sense Length                |                       |     |      |           |   |   |     |  |
|                                     | 8-11           |                                                      | Instance Code                          |                       |     |      |           |   |   |     |  |
|                                     | 12             |                                                      | Additional Sense Code (ASC)            |                       |     |      |           |   |   |     |  |
|                                     | 13             |                                                      | Additional Sense Code Qualifier (ASCQ) |                       |     |      |           |   |   |     |  |
|                                     | 14             |                                                      | Field Replaceable Unit Code            |                       |     |      |           |   |   |     |  |
|                                     | 15             |                                                      | SKSV                                   |                       |     |      |           |   |   |     |  |
|                                     | 16             |                                                      | Sense Key Specific <sup>3</sup>        |                       |     |      |           |   |   |     |  |
|                                     | 17             |                                                      |                                        |                       |     |      |           |   |   |     |  |
|                                     | 18-19          |                                                      | Reserved                               |                       |     |      |           |   |   |     |  |
|                                     | 20             |                                                      | Total Number of Errors                 |                       |     |      |           |   |   |     |  |
|                                     | 21             |                                                      | Total Retry Count                      |                       |     |      |           |   |   |     |  |
|                                     | ASC/ASCQ Stack | 22                                                   |                                        | Most Recent ASC       |     |      |           |   |   |     |  |
|                                     |                | 23                                                   |                                        | Most Recent ASCQ      |     |      |           |   |   |     |  |
|                                     |                | 24                                                   |                                        | Next Most Recent ASC  |     |      |           |   |   |     |  |
|                                     |                | 25                                                   |                                        | Next Most Recent ASCQ |     |      |           |   |   |     |  |
| Device Locator Field                | 26             |                                                      | Port Address                           |                       |     |      |           |   |   |     |  |
|                                     | 27             |                                                      | Target Address                         |                       |     |      |           |   |   |     |  |
|                                     | 28             |                                                      | Logical Unit Number (LUN)              |                       |     |      |           |   |   |     |  |
|                                     | 29-31          |                                                      | Reserved                               |                       |     |      |           |   |   |     |  |
|                                     | 32-35          |                                                      | Instance Code                          |                       |     |      |           |   |   |     |  |
|                                     | 36             |                                                      | Template                               |                       |     |      |           |   |   |     |  |
|                                     | 37             |                                                      | TM0                                    | Rsvd                  |     |      |           |   |   | HCE |  |
|                                     | 38             |                                                      | Reserved                               |                       |     |      |           |   |   |     |  |
|                                     | 39             |                                                      | Command OPcode                         |                       |     |      |           |   |   |     |  |
|                                     | 40             |                                                      | Sense Data Qualifier                   |                       |     |      |           |   |   |     |  |
| 41-50                               |                | Original Command Descriptor Block (CDB) <sup>1</sup> |                                        |                       |     |      |           |   |   |     |  |
| 51                                  |                | Host ID <sup>2</sup>                                 |                                        |                       |     |      |           |   |   |     |  |
| 52-53                               |                | Reserved                                             |                                        |                       |     |      |           |   |   |     |  |

**Table B-10 Template 51b: Passthrough Device Reset Event Sense Data Response Format (sheet 2 of 2)**

| offset                  | bit<br>→                           | 7                                      | 6          | 5   | 4    | 3         | 2 | 1 | 0 |  |
|-------------------------|------------------------------------|----------------------------------------|------------|-----|------|-----------|---|---|---|--|
| 54-69                   | Controller Board Serial Number     |                                        |            |     |      |           |   |   |   |  |
| 70-73                   | Controller Software Revision level |                                        |            |     |      |           |   |   |   |  |
| 74-75                   | Reserved                           |                                        |            |     |      |           |   |   |   |  |
| 76                      | LUN Status                         |                                        |            |     |      |           |   |   |   |  |
| 77-78                   | Reserved                           |                                        |            |     |      |           |   |   |   |  |
| 79-82                   | Device Software Revision Level     |                                        |            |     |      |           |   |   |   |  |
| 83-98                   | Device Product ID                  |                                        |            |     |      |           |   |   |   |  |
| 99-100                  | Reserved                           |                                        |            |     |      |           |   |   |   |  |
| 101                     | Device Type                        |                                        |            |     |      |           |   |   |   |  |
| 102-103                 | Reserved                           |                                        |            |     |      |           |   |   |   |  |
| Device Sense Data Field | 104                                | Valid                                  | Error Code |     |      |           |   |   |   |  |
|                         | 105                                | Segment                                |            |     |      |           |   |   |   |  |
|                         | 106                                | FM                                     | EOM        | ILI | Rsvd | Sense Key |   |   |   |  |
|                         | 107-110                            | Information                            |            |     |      |           |   |   |   |  |
|                         | 111                                | Additional Sense Length                |            |     |      |           |   |   |   |  |
|                         | 112-115                            | Command Specific Information           |            |     |      |           |   |   |   |  |
|                         | 116                                | Additional Sense Code (ASC)            |            |     |      |           |   |   |   |  |
|                         | 117                                | Additional Sense Code Qualifier (ASCQ) |            |     |      |           |   |   |   |  |
|                         | 118                                | Field Replaceable Unit Code            |            |     |      |           |   |   |   |  |
|                         | 119                                | SKSV                                   |            |     |      |           |   |   |   |  |
|                         | 120                                | Sense Key Specific                     |            |     |      |           |   |   |   |  |
|                         | 121                                |                                        |            |     |      |           |   |   |   |  |
|                         | 122-159                            | Reserved                               |            |     |      |           |   |   |   |  |

- <sup>1</sup> CDB Field: If the HCE (offset 37, Bit 0) field is set to one, then the original command descriptor block appears here; If the HCE field is set to zero, then this field is undefined.
- <sup>2</sup> Host ID Field: If the HCE (offset 37, Bit 0) field is set to one, then the SCSI ID of the host appears here; If the HCE field is set to zero, then this field is undefined.
- <sup>3</sup> Events reported by passthrough devices during host/device operations are conveyed directly to the host system without intervention or interpretation by the HSZ70controller, with the exception of device sense data that is truncated to 160 bytes when it exceeds 160 bytes.



**Table B-11 Instance Codes (sheet 1 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                         | <b>Template</b> |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 01010302             | An unrecoverable hardware fault occurred.                                                                                                                                                                                                                                                  | 01              |
| 0102030A             | An unrecoverable firmware inconsistency was detected or an intentional restart or shutdown of controller operation was requested.                                                                                                                                                          | 01              |
| 01032002             | An EDC check failed in the Nonvolatile parameter memory component; content of the component reset to default settings.                                                                                                                                                                     | 11              |
| 0121370A             | Memory System Error Analysis is indicated in the information preserved during a previous last failure:<br><ul style="list-style-type: none"> <li>■ No error conditions are indicated in the available DRAB registers.</li> <li>■ The Master DRAB registers content is supplied.</li> </ul> | 14              |
| 0122330A             | An error condition detected by one of the CACHE DRABs that requires supplemental information has been reported in another event report.<br><br>This event report contains the Master DRAB and Diagnostic registers content associated with that initial event report.                      | 14              |
| 01292602             | The Master DRAB detected a Cache Timeout condition during an access attempt to a CACHEA0, CACHEA1, CACHEB0, or CACHEB1 DRAB registers region or memory region. The addressed region failed to respond.                                                                                     | 14              |
| 012A3702             | The CACHEA0 DRAB unexpectedly reported a Cache Timeout condition.                                                                                                                                                                                                                          | 14              |
| 012B3702             | The CACHEA1 DRAB unexpectedly reported a Cache Timeout condition.                                                                                                                                                                                                                          | 14              |
| 012C3702             | The CACHEB0 DRAB unexpectedly reported a Cache Timeout condition.                                                                                                                                                                                                                          | 14              |
| 012D3702             | The CACHEB1 DRAB unexpectedly reported a Cache Timeout condition.                                                                                                                                                                                                                          | 14              |
| 012E2702             | The Master DRAB detected an Nbus Transfer Error Acknowledge (TEA) condition – the TEA signal was asserted by an Nbus device during an i960 to Nbus device transaction.                                                                                                                     | 14              |
| 012F3702             | The Master DRAB unexpectedly reported an Nbus Transfer Error Acknowledge condition.                                                                                                                                                                                                        | 14              |
| 01303702             | The CACHEA0 DRAB unexpectedly reported an Nbus Transfer Error Acknowledge condition.                                                                                                                                                                                                       | 14              |
| 01313702             | The CACHEA1 DRAB unexpectedly reported an Nbus Transfer Error Acknowledge condition.                                                                                                                                                                                                       | 14              |
| 01323702             | The CACHEB0 DRAB unexpectedly reported an Nbus Transfer Error Acknowledge condition.                                                                                                                                                                                                       | 14              |
| 01333702             | The CACHEB1 DRAB unexpectedly reported an Nbus Transfer Error Acknowledge condition.                                                                                                                                                                                                       | 14              |

**Table B-11 Instance Codes (sheet 2 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                      | <b>Template</b> |
|----------------------|---------------------------------------------------------------------------------------------------------|-----------------|
| 01342802             | A Multiple-bit ECC error was detected during a memory refresh attempt by the Master DRAB.               | 14              |
| 01352902             | A Multiple-bit ECC error was detected during a memory refresh attempt by the CACHEA0 DRAB.              | 14              |
| 01362902             | A Multiple-bit ECC error was detected during a memory refresh attempt by the CACHEA1 DRAB.              | 14              |
| 01372A02             | A Multiple-bit ECC error was detected during a memory refresh attempt by the CACHEB0 DRAB.              | 14              |
| 01382A02             | A Multiple-bit ECC error was detected during a memory refresh attempt by the CACHEB1 DRAB.              | 14              |
| 01392802             | The Master DRAB detected a Multiple-bit ECC error during an FX attempt to read buffer memory.           | 14              |
| 013A2802             | The Master DRAB detected a Multiple-bit ECC error during a Host Port attempt to read buffer memory.     | 14              |
| 013B2802             | The Master DRAB detected a Multiple-bit ECC error during a Device Port attempt to read buffer memory.   | 14              |
| 013C2802             | The Master DRAB detected a Multiple-bit ECC error during an i960 attempt to read buffer memory.         | 14              |
| 013D2902             | The CACHEA0 DRAB detected a Multiple-bit ECC error during an FX attempt to read CACHEA0 memory.         | 14              |
| 013E2902             | The CACHEA0 DRAB detected a Multiple-bit ECC error during a Host Port attempt to read CACHEA0 memory.   | 14              |
| 013F2902             | The CACHEA0 DRAB detected a Multiple-bit ECC error during a Device Port attempt to read CACHEA0 memory. | 14              |
| 01402902             | The CACHEA0 DRAB detected a Multiple-bit ECC error during an i960 attempt to read CACHEA0 memory.       | 14              |
| 01412902             | The CACHEA1 DRAB detected a Multiple-bit ECC error during an FX attempt to read CACHEA1 memory.         | 14              |
| 01422902             | The CACHEA1 DRAB detected a Multiple-bit ECC error during a Host Port attempt to read CACHEA1 memory.   | 14              |
| 01432902             | The CACHEA1 DRAB detected a Multiple-bit ECC error during a Device Port attempt to read CACHEA1 memory. | 14              |
| 01442902             | The CACHEA1 DRAB detected a Multiple-bit ECC error during an i960 attempt to read CACHEA1 memory.       | 14              |

**Table B-11 Instance Codes (sheet 3 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                                        | <b>Template</b> |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 01452A02             | The CACHEB0 DRAB detected a Multiple-bit ECC error during an FX attempt to read CACHEB0 memory.                                           | 14              |
| 01462A02             | The CACHEB0 DRAB detected a Multiple-bit ECC error during a Host Port attempt to read CACHEB0 memory.                                     | 14              |
| 01472A02             | The CACHEB0 DRAB detected a Multiple-bit ECC error during a Device Port attempt to read CACHEB0 memory.                                   | 14              |
| 01482A02             | The CACHEB0 DRAB detected a Multiple-bit ECC error during an i960 attempt to read CACHEB0 memory.                                         | 14              |
| 01492A02             | The CACHEB1 DRAB detected a Multiple-bit ECC error during an FX attempt to read CACHEB1 memory.                                           | 14              |
| 014A2A02             | The CACHEB1 DRAB detected a Multiple-bit ECC error during a Host Port attempt to read CACHEB1 memory.                                     | 14              |
| 014B2A02             | The CACHEB1 DRAB detected a Multiple-bit ECC error during a Device Port attempt to read CACHEB1 memory.                                   | 14              |
| 014C2A02             | The CACHEB1 DRAB detected a Multiple-bit ECC error during an i960 attempt to read CACHEB1 memory.                                         | 14              |
| 014D3702             | The Master DRAB unexpectedly reported a Multiple-bit ECC error.                                                                           | 14              |
| 014E3702             | The CACHEA0 DRAB unexpectedly reported a Multiple-bit ECC error.                                                                          | 14              |
| 014F3702             | The CACHEA1 DRAB unexpectedly reported a Multiple-bit ECC error.                                                                          | 14              |
| 01503702             | The CACHEB0 DRAB unexpectedly reported a Multiple-bit ECC error.                                                                          | 14              |
| 01513702             | The CACHEB1 DRAB unexpectedly reported a Multiple-bit ECC error.                                                                          | 14              |
| 01522B02             | The Master DRAB detected an Ibus to Nbus Timeout condition during an i960 to Nbus device transaction (the Nbus device failed to respond). | 14              |
| 01533702             | The CACHEA0 DRAB unexpectedly reported an Ibus to Nbus Timeout condition.                                                                 | 14              |
| 01543702             | The CACHEA1 DRAB unexpectedly reported an Ibus to Nbus Timeout condition.                                                                 | 14              |
| 01553702             | The CACHEB0 DRAB unexpectedly reported an Ibus to Nbus Timeout condition.                                                                 | 14              |
| 01563702             | The CACHEB1 DRAB unexpectedly reported an Ibus to Nbus Timeout condition.                                                                 | 14              |
| 01572C02             | The Master DRAB detected a Nonexistent Memory Error condition during an FX attempt to write buffer memory.                                | 14              |

**Table B-11 Instance Codes (sheet 4 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                           | <b>Template</b> |
|----------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 01582C02             | The Master DRAB detected a Nonexistent Memory Error condition during an FX attempt to write a byte to buffer memory.         | 14              |
| 01592C02             | The Master DRAB detected a Nonexistent Memory Error condition during an FX attempt to read buffer memory.                    | 14              |
| 015A2C02             | The Master DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write buffer memory.             | 14              |
| 015B2C02             | The Master DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write a byte to buffer memory.   | 14              |
| 015C2C02             | The Master DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to read buffer memory.              | 14              |
| 015D2C02             | The Master DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write buffer memory.           | 14              |
| 015E2C02             | The Master DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write a byte to buffer memory. | 14              |
| 015F2C02             | The Master DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to read buffer memory.            | 14              |
| 01602C02             | The Master DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write buffer memory.                 | 14              |
| 01612C02             | The Master DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write a byte to buffer memory.       | 14              |
| 01622C02             | The Master DRAB detected a Nonexistent Memory Error condition during an i960 attempt to read buffer memory.                  | 14              |
| 01632D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during an FX attempt to write CACHEA0 memory.                 | 14              |
| 01642D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during an FX attempt to write a byte to CACHEA0 memory.       | 14              |
| 01652D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during an FX attempt to read CACHEA0 memory.                  | 14              |
| 01662D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write CACHEA0 memory.           | 14              |
| 01672D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write a byte to CACHEA0 memory. | 14              |
| 01682D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to read CACHEA0 memory.            | 14              |

**Table B-11 Instance Codes (sheet 5 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                             | <b>Template</b> |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 01692D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write CACHEA0 memory.           | 14              |
| 016A2D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write a byte to CACHEA0 memory. | 14              |
| 016B2D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to read CACHEA0 memory.            | 14              |
| 016C2D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write CACHEA0 memory.                 | 14              |
| 016D2D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write a byte to CACHEA0 memory.       | 14              |
| 016E2D02             | The CACHEA0 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to read CACHEA0 memory.                  | 14              |
| 016F2D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during an FX attempt to write CACHEA1 memory.                   | 14              |
| 01702D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during an FX attempt to write a byte to CACHEA1 memory.         | 14              |
| 01712D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during an FX attempt to read CACHEA1 memory.                    | 14              |
| 01722D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write CACHEA1 memory.             | 14              |
| 01732D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write a byte to CACHEA1 memory.   | 14              |
| 01742D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to read CACHEA1 memory.              | 14              |
| 01752D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write CACHEA1 memory.           | 14              |
| 01762D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write a byte to CACHEA1 memory. | 14              |
| 01772D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to read CACHEA1 memory.            | 14              |
| 01782D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write CACHEA1 memory.                 | 14              |
| 01792D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write a byte to CACHEA1 memory.       | 14              |

**Table B-11 Instance Codes (sheet 6 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                             | <b>Template</b> |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 017A2D02             | The CACHEA1 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to read CACHEA1 memory.                  | 14              |
| 017B2E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during an FX attempt to write CACHEB0 memory.                   | 14              |
| 017C2E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during an FX attempt to write a byte to CACHEB0 memory.         | 14              |
| 017D2E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during an FX attempt to read CACHEB0 memory.                    | 14              |
| 017E2E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write CACHEB0 memory.             | 14              |
| 017F2E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write a byte to CACHEB0 memory.   | 14              |
| 01802E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to read CACHEB0 memory.              | 14              |
| 01812E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write CACHEB0 memory.           | 14              |
| 01822E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write a byte to CACHEB0 memory. | 14              |
| 01832E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to read CACHEB0 memory.            | 14              |
| 01842E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write CACHEB0 memory.                 | 14              |
| 01852E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write a byte to CACHEB0 memory.       | 14              |
| 01862E02             | The CACHEB0 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to read CACHEB0 memory.                  | 14              |
| 01872E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during an FX attempt to write CACHEB1 memory.                   | 14              |
| 01882E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during an FX attempt to write a byte to CACHEB1 memory.         | 14              |
| 01892E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during an FX attempt to read CACHEB1 memory.                    | 14              |
| 018A2E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write CACHEB1 memory.             | 14              |

**Table B-11 Instance Codes (sheet 7 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                             | <b>Template</b> |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 018B2E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to write a byte to CACHEB1 memory.   | 14              |
| 018C2E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during a Host Port attempt to read CACHEB1 memory.              | 14              |
| 018D2E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write CACHEB1 memory.           | 14              |
| 018E2E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to write a byte to CACHEB1 memory. | 14              |
| 018F2E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during a Device Port attempt to read CACHEB1 memory.            | 14              |
| 01902E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write CACHEB1 memory.                 | 14              |
| 01912E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to write a byte to CACHEB1 memory.       | 14              |
| 01922E02             | The CACHEB1 DRAB detected a Nonexistent Memory Error condition during an i960 attempt to read CACHEB1 memory.                  | 14              |
| 01933702             | The Master DRAB unexpectedly reported a Nonexistent Memory Error condition.                                                    | 14              |
| 01943702             | The CACHEA0 DRAB unexpectedly reported a Nonexistent Memory Error condition.                                                   | 14              |
| 01953702             | The CACHEA1 DRAB unexpectedly reported a Nonexistent Memory Error condition.                                                   | 14              |
| 01963702             | The CACHEB0 DRAB unexpectedly reported a Nonexistent Memory Error condition.                                                   | 14              |
| 01973702             | The CACHEB1 DRAB unexpectedly reported a Nonexistent Memory Error condition.                                                   | 14              |
| 01982F02             | An Address Parity error was detected during a memory refresh attempt by the Master DRAB.                                       | 14              |
| 01993002             | An Address Parity error was detected during a memory refresh attempt by the CACHEA0 DRAB.                                      | 14              |
| 019A3002             | An Address Parity error was detected during a memory refresh attempt by the CACHEA1 DRAB.                                      | 14              |
| 019B3102             | An Address Parity error was detected during a memory refresh attempt by the CACHEB0 DRAB.                                      | 14              |

**Table B-11 Instance Codes (sheet 8 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                     | <b>Template</b> |
|----------------------|--------------------------------------------------------------------------------------------------------|-----------------|
| 019C3102             | An Address Parity error was detected during a memory refresh attempt by the CACHEB1 DRAB.              | 14              |
| 019D2F02             | The Master DRAB detected an Address Parity error during an FX attempt to read buffer memory.           | 14              |
| 019E2F02             | The Master DRAB detected an Address Parity error during a Host Port attempt to read buffer memory.     | 14              |
| 019F2F02             | The Master DRAB detected an Address Parity error during a Device Port attempt to read buffer memory.   | 14              |
| 01A02F02             | The Master DRAB detected an Address Parity error during an i960 attempt to read buffer memory.         | 14              |
| 01A13002             | The CACHEA0 DRAB detected an Address Parity error during an FX attempt to read CACHEA0 memory.         | 14              |
| 01A23002             | The CACHEA0 DRAB detected an Address Parity error during a Host Port attempt to read CACHEA0 memory.   | 14              |
| 01A33002             | The CACHEA0 DRAB detected an Address Parity error during a Device Port attempt to read CACHEA0 memory. | 14              |
| 01A43002             | The CACHEA0 DRAB detected an Address Parity error during an i960 attempt to read CACHEA0 memory.       | 14              |
| 01A53002             | The CACHEA1 DRAB detected an Address Parity error during an FX attempt to read CACHEA1 memory.         | 14              |
| 01A63002             | The CACHEA1 DRAB detected an Address Parity error during a Host Port attempt to read CACHEA1 memory.   | 14              |
| 01A73002             | The CACHEA1 DRAB detected an Address Parity error during a Device Port attempt to read CACHEA1 memory. | 14              |
| 01A83002             | The CACHEA1 DRAB detected an Address Parity error during an i960 attempt to read CACHEA1 memory.       | 14              |
| 01A93102             | The CACHEB0 DRAB detected an Address Parity error during an FX attempt to read CACHEB0 memory.         | 14              |
| 01AA3102             | The CACHEB0 DRAB detected an Address Parity error during a Host Port attempt to read CACHEB0 memory.   | 14              |
| 01AB3102             | The CACHEB0 DRAB detected an Address Parity error during a Device Port attempt to read CACHEB0 memory. | 14              |
| 01AC3102             | The CACHEB0 DRAB detected an Address Parity error during an i960 attempt to read CACHEB0 memory.       | 14              |



**Table B-11 Instance Codes (sheet 9 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                                                             | <b>Template</b> |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 01AD3102             | The CACHEB1 DRAB detected an Address Parity error during an FX attempt to read CACHEB1 memory.                                                                 | 14              |
| 01AE3102             | The CACHEB1 DRAB detected an Address Parity error during a Host Port attempt to read CACHEB1 memory.                                                           | 14              |
| 01AF3102             | The CACHEB1 DRAB detected an Address Parity error during a Device Port attempt to read CACHEB1 memory.                                                         | 14              |
| 01B03102             | The CACHEB1 DRAB detected an Address Parity error during an i960 attempt to read CACHEB1 memory.                                                               | 14              |
| 01B13702             | The Master DRAB unexpectedly reported an Address Parity error.                                                                                                 | 14              |
| 01B23702             | The CACHEA0 DRAB unexpectedly reported an Address Parity error.                                                                                                | 14              |
| 01B33702             | The CACHEA1 DRAB unexpectedly reported an Address Parity error.                                                                                                | 14              |
| 01B43702             | The CACHEB0 DRAB unexpectedly reported an Address Parity error.                                                                                                | 14              |
| 01B53702             | The CACHEB1 DRAB unexpectedly reported an Address Parity error.                                                                                                | 14              |
| 01B63202             | The Master DRAB detected an Ibus Parity Error during an i960 ID/Cache access attempt.                                                                          | 14              |
| 01B73202             | The Master DRAB detected an Ibus Parity Error during an i960 buffer memory access attempt.                                                                     | 14              |
| 01B83202             | The Master DRAB detected an Ibus Parity Error during an i960 buffer memory access attempt with a simultaneous but unrelated CACHExn memory access.             | 14              |
| 01B93202             | The Master DRAB detected an Ibus Parity Error during an i960 CACHEA memory access with a simultaneous but unrelated buffer memory access.                      | 14              |
| 01BA3202             | The Master DRAB detected an Ibus Parity Error during an i960 CACHEB memory access with a simultaneous but unrelated buffer memory access.                      | 14              |
| 01BB3202             | The Master DRAB detected an Ibus Parity Error during an i960 CACHEA Control and Status Register access with a simultaneous but unrelated buffer memory access. | 14              |
| 01BC3202             | The Master DRAB detected an Ibus Parity Error during an i960 CACHEB Control and Status Register access with a simultaneous but unrelated buffer memory access. | 14              |
| 01BD3702             | The Master DRAB unexpectedly reported an Ibus Parity error.                                                                                                    | 14              |
| 01BE3702             | The CACHEA0 DRAB unexpectedly reported an Ibus Parity error.                                                                                                   | 14              |
| 01BF3702             | The CACHEA1 DRAB unexpectedly reported an Ibus Parity error.                                                                                                   | 14              |

**Table B-11 Instance Codes (sheet 10 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                  | <b>Template</b> |
|----------------------|---------------------------------------------------------------------------------------------------------------------|-----------------|
| 01C03702             | The CACHEB0 DRAB unexpectedly reported an Ibus Parity error.                                                        | 14              |
| 01C13702             | The CACHEB1 DRAB unexpectedly reported an Ibus Parity error.                                                        | 14              |
| 01C22F02             | The Master DRAB detected a Write Data Parity error during an FX attempt to write buffer memory.                     | 14              |
| 01C32F02             | The Master DRAB detected a Write Data Parity error during an FX attempt to write a byte to buffer memory.           | 14              |
| 01C42F02             | The Master DRAB detected a Write Data Parity error during a Host Port attempt to write buffer memory.               | 14              |
| 01C52F02             | The Master DRAB detected a Write Data Parity error during a Host Port attempt to write a byte to buffer memory.     | 14              |
| 01C62F02             | The Master DRAB detected a Write Data Parity error during a Device Port attempt to write buffer memory.             | 14              |
| 01C72F02             | The Master DRAB detected a Write Data Parity error during a Device Port attempt to write a byte to buffer memory.   | 14              |
| 01C82F02             | The Master DRAB detected a Write Data Parity error during an i960 attempt to write buffer memory.                   | 14              |
| 01C92F02             | The Master DRAB detected a Write Data Parity error during an i960 attempt to write a byte to buffer memory.         | 14              |
| 01CA3002             | The CACHEA0 DRAB detected a Write Data Parity error during an FX attempt to write CACHEA0 memory.                   | 14              |
| 01CB3002             | The CACHEA0 DRAB detected a Write Data Parity error during an FX attempt to write a byte to CACHEA0 memory.         | 14              |
| 01CC3002             | The CACHEA0 DRAB detected a Write Data Parity error during a Host Port attempt to write CACHEA0 memory.             | 14              |
| 01CD3002             | The CACHEA0 DRAB detected a Write Data Parity error during a Host Port attempt to write a byte to CACHEA0 memory.   | 14              |
| 01CE3002             | The CACHEA0 DRAB detected a Write Data Parity error during a Device Port attempt to write CACHEA0 memory.           | 14              |
| 01CF3002             | The CACHEA0 DRAB detected a Write Data Parity error during a Device Port attempt to write a byte to CACHEA0 memory. | 14              |
| 01D03002             | The CACHEA0 DRAB detected a Write Data Parity error during an i960 attempt to write CACHEA0 memory.                 | 14              |
| 01D13002             | The CACHEA0 DRAB detected a Write Data Parity error during an i960 attempt to write a byte to CACHEA0 memory.       | 14              |

**Table B-11 Instance Codes (sheet 11 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                  | <b>Template</b> |
|----------------------|---------------------------------------------------------------------------------------------------------------------|-----------------|
| 01D23002             | The CACHEA1 DRAB detected a Write Data Parity error during an FX attempt to write CACHEA1 memory.                   | 14              |
| 01D33002             | The CACHEA1 DRAB detected a Write Data Parity error during an FX attempt to write a byte to CACHEA1 memory.         | 14              |
| 01D43002             | The CACHEA1 DRAB detected a Write Data Parity error during a Host Port attempt to write CACHEA1 memory.             | 14              |
| 01D53002             | The CACHEA1 DRAB detected a Write Data Parity error during a Host Port attempt to write a byte to CACHEA1 memory.   | 14              |
| 01D63002             | The CACHEA1 DRAB detected a Write Data Parity error during a Device Port attempt to write CACHEA1 memory.           | 14              |
| 01D73002             | The CACHEA1 DRAB detected a Write Data Parity error during a Device Port attempt to write a byte to CACHEA1 memory. | 14              |
| 01D83002             | The CACHEA1 DRAB detected a Write Data Parity error during an i960 attempt to write CACHEA1 memory.                 | 14              |
| 01D93002             | The CACHEA1 DRAB detected a Write Data Parity error during an i960 attempt to write a byte to CACHEA1 memory.       | 14              |
| 01DA3102             | The CACHEB0 DRAB detected a Write Data Parity error during an FX attempt to write CACHEB0 memory.                   | 14              |
| 01DB3102             | The CACHEB0 DRAB detected a Write Data Parity error during an FX attempt to write a byte to CACHEB0 memory.         | 14              |
| 01DC3102             | The CACHEB0 DRAB detected a Write Data Parity error during a Host Port attempt to write CACHEB0 memory.             | 14              |
| 01DD3102             | The CACHEB0 DRAB detected a Write Data Parity error during a Host Port attempt to write a byte to CACHEB0 memory.   | 14              |
| 01DE3102             | The CACHEB0 DRAB detected a Write Data Parity error during a Device Port attempt to write CACHEB0 memory.           | 14              |
| 01DF3102             | The CACHEB0 DRAB detected a Write Data Parity error during a Device Port attempt to write a byte to CACHEB0 memory. | 14              |
| 01E03102             | The CACHEB0 DRAB detected a Write Data Parity error during an i960 attempt to write CACHEB0 memory.                 | 14              |
| 01E13102             | The CACHEB0 DRAB detected a Write Data Parity error during an i960 attempt to write a byte to CACHEB0 memory.       | 14              |
| 01E23102             | The CACHEB1 DRAB detected a Write Data Parity error during an FX attempt to write CACHEB1 memory.                   | 14              |

**Table B-11 Instance Codes (sheet 12 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                          | <b>Template</b> |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 01E33102             | The CACHEB1 DRAB detected a Write Data Parity error during an FX attempt to write a byte to CACHEB1 memory.                                                                                                                                                                                                                                 | 14              |
| 01E43102             | The CACHEB1 DRAB detected a Write Data Parity error during a Host Port attempt to write CACHEB1 memory.                                                                                                                                                                                                                                     | 14              |
| 01E53102             | The CACHEB1 DRAB detected a Write Data Parity error during a Host Port attempt to write a byte to CACHEB1 memory.                                                                                                                                                                                                                           | 14              |
| 01E63102             | The CACHEB1 DRAB detected a Write Data Parity error during a Device Port attempt to write CACHEB1 memory.                                                                                                                                                                                                                                   | 14              |
| 01E73102             | The CACHEB1 DRAB detected a Write Data Parity error during a Device Port attempt to write a byte to CACHEB1 memory.                                                                                                                                                                                                                         | 14              |
| 01E83102             | The CACHEB1 DRAB detected a Write Data Parity error during an i960 attempt to write CACHEB1 memory.                                                                                                                                                                                                                                         | 14              |
| 01E93102             | The CACHEB1 DRAB detected a Write Data Parity error during an i960 attempt to write a byte to CACHEB1 memory.                                                                                                                                                                                                                               | 14              |
| 01EA3702             | The Master DRAB unexpectedly reported a Write Data Parity error.                                                                                                                                                                                                                                                                            | 14              |
| 01EB3702             | The CACHEA0 DRAB unexpectedly reported a Write Data Parity error.                                                                                                                                                                                                                                                                           | 14              |
| 01EC3702             | The CACHEA1 DRAB unexpectedly reported a Write Data Parity error.                                                                                                                                                                                                                                                                           | 14              |
| 01ED3702             | The CACHEB0 DRAB unexpectedly reported a Write Data Parity error.                                                                                                                                                                                                                                                                           | 14              |
| 01EE3702             | The CACHEB1 DRAB unexpectedly reported a Write Data Parity error.                                                                                                                                                                                                                                                                           | 14              |
| 02020064             | A Disk Bad Block Replacement attempt was completed for a write operation within the user data area of the disk.<br><br>Information on the actual replacement blocks is not available to the controller and is therefore not included in the event report due to the manner in which Bad Block Replacement is performed on SCSI disk drives. | 51              |
| 02032001             | A journal SRAM backup battery failure was detected during a system restart.<br><br>The Memory Address field contains the starting physical address of the Journal SRAM.                                                                                                                                                                     | 12              |
| 02042001             | A journal SRAM backup battery failure was detected during a periodic check.<br><br>The Memory Address field contains the starting physical address of the Journal SRAM.                                                                                                                                                                     | 12              |

**Table B-11 Instance Codes (sheet 13 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                  | Template |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 02052301      | <p>A processor interrupt was generated by the CACHE Dynamic Ram controller and ArBitration engine (DRAB) with an indication that the CACHE backup battery has failed or is low (needs charging).</p> <p>The Memory Address field contains the starting physical address of the CACHEA0 memory.</p>                           | 12       |
| 02062301      | <p>The CACHE backup battery has been declared bad.</p> <p>Either it failed testing performed by the Cache Diagnostics during system start-up or it was low (insufficiently charged) for longer than the expected duration.</p> <p>The Memory Address field contains the starting physical address of the CACHEA0 memory.</p> | 12       |
| 02072201      | <p>The CACHE Dynamic Ram controller and ArBitration engine 0 (DRAB0) failed testing performed by the Cache Diagnostics.</p> <p>The Memory Address field contains the starting physical address of the CACHEA0 memory.</p>                                                                                                    | 14       |
| 02082201      | <p>The CACHE Dynamic Ram controller and ArBitration engine 1 (DRAB1) failed testing performed by the Cache Diagnostics.</p> <p>The Memory Address field contains the starting physical address of the CACHEA1 memory.</p>                                                                                                    | 14       |
| 02090064      | <p>A data compare error was detected during the execution of a compare modified READ or WRITE command.</p>                                                                                                                                                                                                                   | 51       |
| 020B2201      | <p>Failed read test of a write-back metadata page residing in cache.</p> <p>Dirty write-back cached data exists and cannot be flushed to media (the dirty data is lost).</p> <p>The Memory Address field contains the starting physical address of the CACHEA0 memory.</p>                                                   | 14       |
| 020C2201      | <p>Cache Diagnostics have declared the cache bad during testing.</p> <p>The Memory Address field contains the starting physical address of the CACHEA0 memory.</p>                                                                                                                                                           | 14       |
| 020D2401      | <p>The wrong write cache module is configured.</p> <p>The serial numbers do not match. Either the existing or the expected cache contains dirty write-back cached data.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                              | 14       |

**Table B-11 Instance Codes (sheet 14 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                                                  | Template |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 020E2401      | <p>The write cache module is missing.</p> <p>A cache is expected to be configured and contains dirty write-back cached data.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                                                                                                         | 14       |
| 020F2401      | <p>The write cache modules are not configured properly for a dual-redundant configuration.</p> <p>One of the write cache modules is not present to perform cache failover of dirty write-back cached data.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                           | 14       |
| 02102401      | <p>The write cache modules are not configured properly for a dual-redundant configuration.</p> <p>One of the cache modules is not the same size to perform cache failover of dirty write-back cached data.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                           | 14       |
| 02110064      | <p>Disk Bad Block Replacement attempt completed for a read within the user data area of the disk.</p> <p>Information on the actual replacement blocks is not available to the controller and is therefore not included in the event report due to the manner in which Bad Block Replacement is performed on SCSI disk drives.</p>                            | 51       |
| 02192401      | <p>The cache modules are not configured properly for a dual-redundant configuration.</p> <p>One of the cache modules is not the same type (both write cache) to perform cache failover of dirty write-back cached data.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                              | 14       |
| 021A0064      | <p>Disk Bad Block Replacement attempt completed for a write of controller metadata to a location outside the user data area of the disk.</p> <p>Information on the actual replacement blocks is not available to the controller and is therefore not included in the event report due to the way Bad Block Replacement is performed on SCSI disk drives.</p> | 41       |

**Table B-11 Instance Codes (sheet 15 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                                                     | Template |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 021B0064      | <p>Disk Bad Block Replacement attempt completed for a read of controller metadata from a location outside the user data area of the disk.</p> <p>Information on the actual replacement blocks is not available to the controller and is therefore not included in the event report due to the way Bad Block Replacement is performed on SCSI disk drives.</p>   | 41       |
| 021D0064      | <p>Unable to lock the other controller's cache in a write-cache failover attempt.</p> <p>Either a latent error could not be cleared on the cache or the other controller did not release its cache.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                                     | 14       |
| 021E0064      | <p>The device specified in the Device Locator field has been added to the RAIDset associated with the logical unit.</p> <p>The RAIDset is now in Reconstructing state.</p>                                                                                                                                                                                      | 51       |
| 02280064      | <p>The device specified in the Device Locator field has been added to the Mirrorset associated with the logical unit.</p> <p>The new Mirrorset member is now in Copying state.</p>                                                                                                                                                                              | 51       |
| 022C0064      | <p>The device specified in the Device Locator has transitioned from Copying or Normalizing state to Normal state.</p>                                                                                                                                                                                                                                           | 51       |
| 022E0064      | <p>The device specified in the Device Locator field has been converted to a Mirrorset associated with the logical unit.</p>                                                                                                                                                                                                                                     | 51       |
| 022F0064      | <p>The mirrored device specified in the Device Locator field has been converted to a single device associated with the logical unit.</p>                                                                                                                                                                                                                        | 51       |
| 02382201      | <p>The Cache Dynamic Ram Controller and Arbitration Engine 1 (DRAB1), which resides on the other cache module, failed testing performed by the cache diagnostics.</p> <p>This is the mirrored cache DRAB. The Memory Address field contains the starting physical address of the CACHEB0 memory.</p>                                                            | 14       |
| 02392201      | <p>Both the Cache Dynamic Ram Controller and Arbitration Engine 0 (DRAB0) and 1 (DRAB1), which resides on the other cache module, failed testing performed by the cache diagnostics.</p> <p>Data cannot be accessed in the primary cache or the mirror cache.</p> <p>The Memory Address field contains the starting physical address of the CACHEA0 memory.</p> | 14       |

**Table B-11 Instance Codes (sheet 16 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                                              | Template |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 023E2401      | <p>Metadata residing on the two cache modules disagree as to the mirror mode.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                                                                                                                                                    | 14       |
| 023F2301      | <p>The CACHE B backup battery covering the mirror cache is insufficiently charged.</p> <p>The Memory Address field contains the starting physical address of the CACHEB1 memory</p>                                                                                                                                                                      | 12       |
| 02402301      | <p>The CACHE B backup battery covering the mirror cache has been declared bad.</p> <p>Either it failed testing performed by the Cache Diagnostics during system start-up or it was low (insufficiently charged) for longer than the expected duration.</p> <p>The Memory Address field contains the starting physical address of the CACHEB1 memory.</p> | 12       |
| 02412401      | <p>Mirrored cache writes have been disabled.</p> <p>Either the primary or the mirror cache has been declared bad or invalid and will not be used.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                                                                                | 14       |
| 02422464      | <p>Cache failover attempt failed because the other cache was illegally configured with SIMMs.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                                                                                                                                    | 14       |
| 02432201      | <p>The Cache Dynamic Ram controller and Arbitration Engine 0 (DRAB0) failed Cache Diagnostics testing performed on Cache B (other cache) during a cache failover attempt.</p> <p>The Memory Address field contains the starting physical address of the CACHEB0 memory.</p>                                                                              | 14       |
| 02442201      | <p>The Cache Dynamic Ram controller and Arbitration Engine 1 (DRAB1) failed Cache Diagnostics testing performed on Cache B (other cache) during a cache failover attempt.</p> <p>The Memory Address field contains the starting physical address of the CACHEB1 memory.</p>                                                                              | 14       |



**Table B-11 Instance Codes (sheet 17 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                  | Template |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 02452201      | <p>The Cache Dynamic Ram controller and Arbitration Engine 0 and 1(DRAB0 and DRAB1) failed Cache Diagnostics testing performed on Cache B (other cache) during a cache failover attempt.</p> <p>The Memory Address field contains the starting physical address of the CACHEB0 memory.</p>                                   | 14       |
| 02492401      | <p>The write cache module which is the mirror for the primary cache is not present (missing).</p> <p>A cache is expected to be configured and it may contain dirty write cached data.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                | 14       |
| 024A2401      | <p>Mirroring is enabled and the primary write cache module is not present (missing).</p> <p>A cache is expected to be configured and it may contain dirty write cached data.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                         | 14       |
| 024B2401      | <p>Write-back caching has been disabled either due to a cache or battery-related problem.</p> <p>The exact nature of the problem is reported by other instance codes.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p>                                                | 14       |
| 024F2401      | <p>This cache module is populated with SIMMs incorrectly.</p> <p>Cache metadata resident in the cache module indicates that unflushed write cache data exists for a cache size different than what is found present.</p> <p>The Memory Address, Byte Count, DRAB register, and Diagnostic register fields are undefined.</p> | 14       |
| 0251000A      | <p>This command failed because the target unit is not online to the controller.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                             | 51       |

**Table B-11 Instance Codes (sheet 18 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                                                  | Template |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 0252000A      | <p>The last block of data returned contains a forced error.</p> <p>A forced error occurs when a disk block is successfully reassigned, but the data in that block is lost. Re-writing the disk block will clear the forced error condition.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p> | 51       |
| 0253000A      | <p>The data supplied from the host for a data compare operation differs from the data on the disk in the specified block.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                   | 51       |
| 0254000A      | <p>The command failed due to a host data transfer failure.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                                                  | 51       |
| 0255000A      | <p>The controller was unable to successfully transfer data to the target unit.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                              | 51       |
| 0256000A      | <p>The write operation failed because the unit is Data Safety Write Protected.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                              | 51       |
| 0257000A      | <p>An attempt to reassign a bad disk block failed.</p> <p>The contents of the disk block is lost. The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                  | 51       |
| 0258000A      | <p>This command was aborted prior to completion.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                                                            | 51       |
| 0259000A      | <p>The write operation failed because the unit is hardware write protected.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                                 | 51       |
| 025A000A      | <p>The command failed because the unit became inoperative prior to command completion.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                      | 51       |

**Table B-11 Instance Codes (sheet 19 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Template |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 025B000A      | <p>The command failed because the unit became unknown to the controller prior to command completion.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                                                                                                                                                                | 51       |
| 025C000A      | <p>The command failed because of a unit media format error.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                                                                                                                                                                                                         | 51       |
| 025D000A      | <p>The command failed for an unknown reason.</p> <p>The Information field of the Device Sense Data contains the block number of the first block in error.</p>                                                                                                                                                                                                                                                                                                                                                        | 51       |
| 025F2201      | <p>Memory diagnostics performed during controller initialization detected an excessive number of memory errors (512 pages or more) detected on the primary cache memory.</p> <p>Diagnostics have not declared the cache failed, due to the isolated bad memory regions, but this is a warning to replace the cache as soon as possible in case of further degradation.</p> <p>The firmware performed the necessary error recovery as appropriate.</p> <p>The Memory Address and Byte Count fields are undefined.</p> | 14       |
| 02602201      | <p>Memory diagnostics performed during controller initialization detected an excessive number of memory errors (512 pages or more) detected on mirrored cache memory.</p> <p>Diagnostics has not declared the cache failed, due to the isolated bad memory regions, but this is a warning to replace the cache as soon as possible in case of further degradation.</p> <p>The firmware performed the necessary error recovery as appropriate.</p> <p>The Memory Address, Byte Count fields are undefined.</p>        | 14       |
| 02613801      | <p>Memory diagnostics performed during controller initialization detected that the SIMM in location 1 failed on the cache module.</p> <p>The Byte Count field is undefined.</p>                                                                                                                                                                                                                                                                                                                                      | 14       |
| 02623801      | <p>Memory diagnostics performed during controller initialization detected that the SIMM in location 2 failed on the cache module.</p> <p>The Byte Count field is undefined.</p>                                                                                                                                                                                                                                                                                                                                      | 14       |

**Table B-11 Instance Codes (sheet 20 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                                      | <b>Template</b> |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 02633801             | Memory diagnostics performed during controller initialization detected that the SIMM in location 3 failed on the cache module.<br><br>The Byte Count field is undefined.                                                                                                                                | 14              |
| 02643801             | Memory diagnostics performed during controller initialization detected that the SIMM in location 4 failed on the cache module.<br><br>The Byte Count field is undefined.                                                                                                                                | 14              |
| 02653801             | Memory diagnostics performed during controller initialization detected that the SIMM in location 3 on the "other controller" cache module (on mirrored cache) failed:<br><ul style="list-style-type: none"> <li>■ Mirroring has been disabled.</li> <li>■ The Byte Count field is undefined.</li> </ul> | 14              |
| 02663801             | Memory diagnostics performed during controller initialization detected that the SIMM in location 4 on the "other controller" cache module (on mirrored cache) failed:<br><ul style="list-style-type: none"> <li>■ Mirroring has been disabled.</li> <li>■ The Byte Count field is undefined.</li> </ul> | 14              |
| 02675201             | The device specified in the Device Locator field has been removed from the RAIDset associated with the logical unit:<br><ul style="list-style-type: none"> <li>■ The removed device is now in the failedset.</li> <li>■ The RAIDset is now in Reduced state.</li> </ul>                                 | 51              |
| 0268530A             | The device specified in the Device Locator field failed to be added to the RAIDset associated with the logical unit.<br><br>The device remains in the Spareset.                                                                                                                                         | 51              |
| 02695401             | The device specified in the Device Locator field failed to be added to the RAIDset associated with the logical unit.<br><br>The failed device has been moved to the Failedset.                                                                                                                          | 51              |
| 026A5001             | The RAIDset associated with the logical unit has gone inoperative.                                                                                                                                                                                                                                      | 51              |
| 026B0064             | The RAIDset associated with the logical unit has transitioned from the Normal state to the Reconstructing state.                                                                                                                                                                                        | 51              |
| 026C0064             | The RAIDset associated with the logical unit has transitioned from the Reconstructing state to the Normal state.                                                                                                                                                                                        | 51              |
| 026D5201             | The device specified in the Device Locator field has been removed from the Mirrorset associated with the logical unit.<br><br>The removed device is now in the Failedset.                                                                                                                               | 51              |

**Table B-11 Instance Codes (sheet 21 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                               | Template |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 026E0001      | <p>The device specified in the Device Locator field has been reduced from the Mirrorset associated with the logical unit:</p> <ul style="list-style-type: none"> <li>■ The nominal number of members in the mirrorset decreased by one.</li> <li>■ The reduced device is now available for use.</li> </ul>                | 51       |
| 026F530A      | <p>The device specified in the Device Locator field failed to be added to the mirrorset associated with the logical unit.</p> <p>The device remains in the spareset.</p>                                                                                                                                                  | 51       |
| 02705401      | <p>The device specified in the Device Locator field failed to be added to the mirrorset associated with the logical unit.</p> <p>The failed device was moved to the Failedset.</p>                                                                                                                                        | 51       |
| 02710064      | <p>The mirrorset associated with the logical unit has had its nominal membership changed.</p> <p>The new nominal number of members for the mirrorset is specified in the Device Sense Data Information field.</p>                                                                                                         | 51       |
| 02725101      | <p>The Mirrorset associated with the logical unit has gone inoperative.</p>                                                                                                                                                                                                                                               | 51       |
| 02730001      | <p>The device specified in the Device Locator field had a read error which has been repaired with data from another mirrorset member.</p>                                                                                                                                                                                 | 51       |
| 02745A0A      | <p>The device specified in the Device Locator field had a read error.</p> <p>Attempts to repair the error with data from another mirrorset member failed due to lack of alternate error-free data source.</p>                                                                                                             | 51       |
| 02755601      | <p>The device specified in the Device Locator field had a read error:</p> <ul style="list-style-type: none"> <li>■ Attempts to repair the error with data from another mirrorset member failed due to a write error on the original device.</li> <li>■ The original device will be removed from the mirrorset.</li> </ul> | 51       |
| 03010101      | <p>No command control structures are available for a disk operation.</p> <p>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p>                                                                                                                                            | 41       |
| 03022002      | <p>A SCSI interface chip command timeout occurred during a disk operation.</p> <p>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p>                                                                                                                                      | 41       |
| 03034002      | <p>A byte transfer timeout occurred during a disk operation.</p> <p>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p>                                                                                                                                                    | 41       |

**Table B-11 Instance Codes (sheet 22 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                                                                                               | <b>Template</b> |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 03044402             | SCSI bus errors were detected during a disk operation.<br>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.                                         | 41              |
| 03052002             | The device port SCSI chip reported a gross error during a disk operation.<br>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.                      | 41              |
| 03062002             | A non-SCSI bus parity error occurred during a disk operation.<br>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.                                  | 41              |
| 03070101             | A source driver programming error was encountered during a disk operation.<br>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.                     | 41              |
| 03080101             | A miscellaneous SCSI Port Driver coding error was detected during a disk operation.<br>The Associated Additional Sense Code and Associated Additional Sense Code Qualifier fields are undefined. | 41              |
| 03094002             | An unrecoverable disk drive error was encountered while performing work related to disk unit operations.                                                                                         | 51              |
| 030C4002             | A Drive failed because a Test Unit Ready command or a Read Capacity command failed.                                                                                                              | 51              |
| 030D000A             | Drive was failed by a Mode Select command received from the host.                                                                                                                                | 51              |
| 030E4002             | Drive failed due to a deferred error reported by drive.                                                                                                                                          | 51              |
| 030F4002             | Unrecovered Read or Write error.                                                                                                                                                                 | 51              |
| 03104002             | No response from one or more drives.                                                                                                                                                             | 51              |
| 0311430A             | Nonvolatile memory and drive metadata indicate conflicting drive configurations.                                                                                                                 | 51              |
| 0312430A             | The Synchronous Transfer Value differs between drives in the same storageset.                                                                                                                    | 51              |
| 03134002             | The Maximum number of errors for this data transfer operation was exceeded.                                                                                                                      | 51              |
| 03144002             | Drive reported recovered error without transferring all data.                                                                                                                                    | 51              |
| 03154002             | Data returned from drive is invalid.                                                                                                                                                             | 51              |

**Table B-11 Instance Codes (sheet 23 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                                                                                               | <b>Template</b> |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 03164002             | Request Sense command to drive failed.                                                                                                                                                           | 51              |
| 03170064             | Illegal command for pass-through mode.                                                                                                                                                           | 51              |
| 03180064             | Data transfer request error.                                                                                                                                                                     | 51              |
| 03194002             | Premature completion of a drive command.                                                                                                                                                         | 51              |
| 031A4002             | Command timeout.                                                                                                                                                                                 | 51              |
| 031B0101             | Watchdog timer timeout.                                                                                                                                                                          | 51              |
| 031C4002             | Disconnect timeout.                                                                                                                                                                              | 51              |
| 031D4002             | Unexpected bus phase.                                                                                                                                                                            | 51              |
| 031E4002             | Disconnect expected.                                                                                                                                                                             | 51              |
| 031F4002             | ID Message not sent by drive.                                                                                                                                                                    | 51              |
| 03204002             | Synchronous negotiation error.                                                                                                                                                                   | 51              |
| 03214002             | The drive unexpectedly disconnected from the SCSI bus.                                                                                                                                           | 51              |
| 03224002             | Unexpected message.                                                                                                                                                                              | 51              |
| 03234002             | Unexpected Tag message.                                                                                                                                                                          | 51              |
| 03244002             | Channel busy.                                                                                                                                                                                    | 51              |
| 03254002             | A Message Reject was received on a valid message.                                                                                                                                                | 51              |
| 0326450A             | The disk device reported Vendor Unique SCSI Sense Data.                                                                                                                                          | 51              |
| 03270101             | A disk-related error code was reported which was unknown to the Fault Management firmware.<br><br>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined. | 41              |
| 0328450A             | The disk device reported standard SCSI Sense Data.                                                                                                                                               | 51              |
| 03324002             | SCSI bus selection timeout.                                                                                                                                                                      |                 |
| 03330002             | Device power on reset.                                                                                                                                                                           |                 |
| 03344002             | A target assertion of REQ occurred after a WAIT DISCONNECT.                                                                                                                                      |                 |
| 03354002             | A Test Unit Ready command or a Read Capacity command to the device failed during device initialization.                                                                                          |                 |
| 03364002             | The device reported a deferred error during device initialization.                                                                                                                               |                 |

**Table B-11 Instance Codes (sheet 24 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                                                                                                                    | <b>Template</b> |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 03374002             | The maximum number of errors for a data transfer operation was exceeded during device initialization.                                                                                                                 |                 |
| 03384002             | A Request Sense command to the device failed.                                                                                                                                                                         |                 |
| 03394002             | A command timeout occurred.                                                                                                                                                                                           |                 |
| 033A4002             | A disconnect timeout occurred.                                                                                                                                                                                        |                 |
| 033B4002             | Unexpected bus phase.                                                                                                                                                                                                 |                 |
| 033C4002             | The device unexpectedly disconnected from the SCSI bus.                                                                                                                                                               |                 |
| 033D4002             | Unexpected message.                                                                                                                                                                                                   |                 |
| 033E4002             | A Message Reject was received on a valid message.                                                                                                                                                                     |                 |
| 033F0101             | No command control structures are available for passthrough device operation.                                                                                                                                         |                 |
| 03402002             | The device port SCSI chip reported a gross error.                                                                                                                                                                     |                 |
| 03410101             | The miscellaneous SCSI Port Driver encountered a coding error.                                                                                                                                                        |                 |
| 03420101             | A passthrough device-related internal error code was reported which is not recognized by the Fault Management firmware.                                                                                               |                 |
| 03434002             | During device initialization, the device reported unexpected standard SCSI Sense Data.                                                                                                                                |                 |
| 03C80101             | No command control structures are available for operation to a device which is unknown to the controller.<br><br>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.       | 41              |
| 03C92002             | A SCSI interface chip command timeout occurred during operation to a device which is unknown to the controller.<br><br>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined. | 41              |
| 03CA4002             | A byte transfer timeout occurred during operation to a device which is unknown to the controller.<br><br>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.               | 41              |



**Table B-11 Instance Codes (sheet 25 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                         | Template |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 03CB0101      | <p>A miscellaneous SCSI Port Driver coding error was detected during operation to a device which is unknown to the controller.</p> <p>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p>                            | 41       |
| 03CC0101      | <p>An error code was reported which was unknown to the Fault Management firmware.</p> <p>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p>                                                                         | 41       |
| 03CD2002      | <p>The device port SCSI chip reported a gross error during operation to a device which is unknown to the controller.</p> <p>The Associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p>                                      | 41       |
| 03CE2002      | <p>A Non-SCSI bus parity error was detected during operation to a device which is unknown to the controller.</p> <p>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p>                                              | 41       |
| 03CF0101      | <p>A source driver programming error was encountered during operation to a device which is unknown to the controller.</p> <p>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p>                                     | 41       |
| 03D04002      | <p>A failure occurred while attempting a SCSI Test Unit Ready or Read Capacity command to a device (the actual device type is unknown to the controller).</p> <p>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p> | 41       |
| 03D14002      | <p>The identification of a device does not match the organization information (the actual device type is unknown to the controller).</p> <p>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.</p>             | 41       |
| 03D24402      | <p>SCSI bus errors were detected during device operation. The device type is unknown to the controller.</p> <p>The associated Additional Sense Code and Additional Sense Code Qualifier fields are undefined.</p>                                                   | 41       |

**Table B-11 Instance Codes (sheet 26 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                | Template |
|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 03D3450A      | <p>During device initialization, the device reported the SCSI Sense Key NO SENSE.</p> <p>This indicates that there is no specific sense key information to be reported for the designated logical unit—this would be the case for a successful command or a command that received CHECK CONDITION or COMMAND TERMINATED status because one of the FM, EOM, or ILI bits is set to one in the sense data flags field.</p>                                    | 41       |
| 03D4450A      | <p>During device initialization, the device reported the SCSI Sense Key RECOVERED ERROR.</p> <p>This indicates the last command completed successfully with some recovery action performed by the target.</p>                                                                                                                                                                                                                                              | 41       |
| 03D5450A      | <p>During device initialization, the device reported the SCSI Sense Key NOT READY.</p> <p>This indicates that:</p> <ul style="list-style-type: none"> <li>■ The logical unit addressed cannot be accessed.</li> <li>■ Operator intervention may be required to correct this condition.</li> </ul>                                                                                                                                                          | 41       |
| 03D6450A      | <p>During device initialization, the device reported the SCSI Sense Key MEDIUM ERROR.</p> <p>This indicates that the command terminated with a non-recovered error condition that was probably caused by a flaw in the medium or an error in the recorded data.</p> <p>The MEDIUM ERROR sense key may also be returned if the target is unable to distinguish between a flaw in the medium and a specific hardware failure (HARDWARE ERROR sense key).</p> | 41       |
| 03D7450A      | <p>During device initialization, the device reported the SCSI Sense Key HARDWARE ERROR.</p> <p>This indicates that the target detected a non-recoverable hardware failure (for example, controller failure, device failure, parity error, etc.) while performing the command or during a self test.</p>                                                                                                                                                    | 41       |

**Table B-11 Instance Codes (sheet 27 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Template |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 03D8450A      | <p>During device initialization, the device reported the SCSI Sense Key ILLEGAL REQUEST.</p> <p>This indicates that:</p> <ul style="list-style-type: none"> <li>■ There was an illegal parameter in the command descriptor block, or</li> <li>■ There was an illegal parameter in the additional parameters supplied as data for some commands (FORMAT UNIT, SEARCH DATA, etc.).</li> </ul> <p>If the target detects an invalid parameter in the command descriptor block, then it terminates the command without altering the medium.</p> <p>If the target detects an invalid parameter in the additional parameters supplied as data, then the target may have already altered the medium.</p> <p>This sense key may also indicate that an invalid IDENTIFY message was received.</p> | 41       |
| 03D9450A      | <p>During device initialization, the device reported the SCSI Sense Key UNIT ATTENTION. This indicates that the removable medium may have been changed or the target has been reset.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 41       |
| 03DA450A      | <p>During device initialization, the device reported the SCSI Sense Key DATA PROTECT.</p> <p>This indicates that:</p> <ul style="list-style-type: none"> <li>■ A command that reads or writes the medium was attempted on a block that is protected from this operation.</li> <li>■ The read or write operation is not performed.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                            | 41       |
| 03DB450A      | <p>During device initialization, the device reported the SCSI Sense Key BLANK CHECK.</p> <p>This indicates that:</p> <ul style="list-style-type: none"> <li>■ A write-once device encountered blank medium, or</li> <li>■ Format-defined end-of-data indication while reading, or</li> <li>■ A write-once device encountered a non-blank medium while writing.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                               | 41       |
| 03DC450A      | <p>During device initialization, the device reported a SCSI Vendor Specific Sense Key. This sense key is available for reporting vendor specific conditions.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 41       |
| 03DD450A      | <p>During device initialization, the device reported the SCSI Sense Key COPY ABORTED (a COPY, COMPARE, or COPY AND VERIFY command was aborted due to an error condition on the source device, the destination device, or both).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 41       |

**Table B-11 Instance Codes (sheet 28 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Template |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 03DE450A      | During device initialization, the device reported the SCSI Sense Key ABORTED COMMAND: <ul style="list-style-type: none"> <li>■ The target aborted the command.</li> <li>■ The initiator may be able to recover by trying the command again.</li> </ul>                                                                                                                                                                                                                                                                    | 41       |
| 03DF450A      | During device initialization, the device reported the SCSI Sense Key EQUAL (a SEARCH DATA command has satisfied an equal comparison).                                                                                                                                                                                                                                                                                                                                                                                     | 41       |
| 03E0450A      | During device initialization, the device reported the SCSI Sense Key VOLUME OVERFLOW: <ul style="list-style-type: none"> <li>■ A buffered peripheral device has reached the end-of-partition</li> <li>■ Data may remain in the buffer that has not been written to the medium.</li> <li>■ A RECOVER BUFFERED DATA command(s) may be issued to read the unwritten data from the buffer.</li> </ul>                                                                                                                         | 41       |
| 03E1450A      | During device initialization, the device reported the SCSI Sense Key MISCOMPARE (the source data did not match the data read from the medium).                                                                                                                                                                                                                                                                                                                                                                            | 41       |
| 03E2450A      | During device initialization, the device reported a reserved SCSI Sense Key.                                                                                                                                                                                                                                                                                                                                                                                                                                              | 41       |
| 03EE0064      | The EMU for the cabinet indicated by the Associated Port field has become available.<br><br>The associated Target, Additional Sense Code, and the Additional Sense Code Qualifier fields are undefined.                                                                                                                                                                                                                                                                                                                   | 41       |
| 03EF8301      | The EMU for the cabinet indicated by the Associated Port field has become unavailable.<br><br>The associated Target, Additional Sense Code, and the Additional Sense Code Qualifier fields are undefined.                                                                                                                                                                                                                                                                                                                 | 41       |
| 03F10502      | The SWAP interrupt from the device port indicated by the Associated Port field can not be cleared: <ul style="list-style-type: none"> <li>■ All SWAP interrupts from all ports are disabled until corrective action is taken.</li> <li>■ When SWAP interrupts are disabled, both controller front panel button presses and removal/insertion of devices are not detected by the controller.</li> <li>■ The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.</li> </ul> | 41       |
| 03F20064      | The SWAP interrupts have been cleared and re-enabled for all device ports.<br><br>The associated Port, Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.                                                                                                                                                                                                                                                                                                                           | 41       |

**Table B-11 Instance Codes (sheet 29 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                        | Template |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 03F30064      | <p>An asynchronous SWAP interrupt was detected by the controller for the device port indicated by the Associated Port field. Possible reasons for this occurrence include:</p> <ul style="list-style-type: none"> <li>■ Device insertion or removal</li> <li>■ Shelf power failure</li> <li>■ SWAP interrupts re-enabled</li> </ul> <p>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.</p> | 41       |
| 03F40064      | <p>Device services had to reset the port to clear a bad condition.</p> <p>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.</p>                                                                                                                                                                                                                                                              | 41       |
| 03F60402      | <p>The controller shelf is reporting a problem. This could mean one or both of the following:</p> <ul style="list-style-type: none"> <li>■ One of the dual power supplies has failed.</li> <li>■ One of the shelf cooling fans has failed.</li> </ul> <p>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.</p>                                                                               | 41       |
| 03F70401      | <p>The shelf indicated by the Associated Port field is reporting a problem. This could mean one or both of the following:</p> <ul style="list-style-type: none"> <li>■ One of the dual power supplies has failed.</li> <li>■ One of the shelf cooling fans has failed.</li> </ul> <p>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.</p>                                                   | 41       |
| 03F80701      | <p>The EMU has detected one or more bad power supplies.</p> <p>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.</p>                                                                                                                                                                                                                                                                         | 41       |
| 03F90601      | <p>The EMU has detected one or more bad fans.</p> <p>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.</p>                                                                                                                                                                                                                                                                                   | 41       |
| 03FA0D01      | <p>The EMU has detected an elevated temperature condition.</p> <p>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.</p>                                                                                                                                                                                                                                                                      | 41       |

**Table B-11 Instance Codes (sheet 30 of 31)**

| <b>Instance Code</b> | <b>Description</b>                                                                                                                                                                                                                         | <b>Template</b> |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 03FB0E01             | The EMU has detected an external air sense fault.<br>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.                                                                               | 41              |
| 03FC0F01             | The EMU-detected power supply fault is now fixed.<br>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.                                                                               | 41              |
| 03FD0F01             | The EMU-detected bad-fan fault is now fixed.<br>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.                                                                                    | 41              |
| 03FE0F01             | The EMU-detected elevated temperature fault is now fixed.<br>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.                                                                       | 41              |
| 03FF0F01             | The EMU-detected external air sense fault is now fixed.<br>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.                                                                         | 41              |
| 03EF8301             | The EMU for the cabinet indicated by the Associated Port field has become available.<br>The associated Target, Additional Sense Code, and Additional Sense Code Qualifier fields are undefined.                                            | 41              |
| 07030B0A             | Failover Control detected a receive packet sequence number mismatch. The controllers are out of synchronization with each other and are unable to communicate.<br>The Last Failure Code and Last Failure Parameters fields are undefined.  | 05              |
| 07040B0A             | Failover Control detected a transmit packet sequence number mismatch. The controllers are out of synchronization with each other and are unable to communicate.<br>The Last Failure Code and Last Failure Parameters fields are undefined. | 05              |
| 07050064             | Failover Control received a Last Gasp message from the "other controller".<br>The "other controller" is expected to restart itself within a given time period. If it does not, it will be held reset with the "Kill" line.                 | 05              |

**Table B-11 Instance Codes (sheet 31 of 31)**

| Instance Code | Description                                                                                                                                                                                                                                                                                                                | Template |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| 07060C01      | Failover Control detected that both controllers are using the identification of SCSI ID 6. It is unknown which controller is the real SCSI ID 6 (IDs are determined by hardware).<br><br>The Last Failure Code and Last Failure Parameters fields are undefined.                                                           | 05       |
| 07070C01      | Failover Control detected that both controllers are using the identification of SCSI ID 7. It is unknown which controller is the real SCSI ID 7 (IDs are determined by hardware).<br><br>The Last Failure Code and Last Failure Parameters fields are undefined.                                                           | 05       |
| 07080B0A      | Failover Control was unable to send keepalive communication to the other controller—It is assumed that the other controller is hung or not started.<br><br>The Last Failure Code and Last Failure Parameters fields are undefined.                                                                                         | 05       |
| 43010064      | Host Port Protocol component has detected that the “other controller” has failed and that “this controller” has taken over the units specified in the extended sense data.                                                                                                                                                 | 04       |
| 43020064      | Host Port Protocol component has detected that “this controller” has taken over (failed back) the units specified in the extended sense data.                                                                                                                                                                              | 04       |
| 82012002      | An unrecoverable error was detected during execution of the Device Port Subsystem Built-In Self Test:<br><ul style="list-style-type: none"> <li>■ One or more of the device ports on the controller module has failed.</li> <li>■ Some/all of the attached storage is no longer accessible via this controller.</li> </ul> | 13       |
| 82042002      | A spurious interrupt was detected during the execution of a Subsystem Built-In Self Test.                                                                                                                                                                                                                                  | 13       |
| 82052002      | An unrecoverable error was detected during execution of the HOST PORT Subsystem Test—the system will not be able to communicate with the host.                                                                                                                                                                             | 13       |
| 82062002      | An unrecoverable error was detected during execution of the UART/DUART Subsystem Test:<br><ul style="list-style-type: none"> <li>■ The console is unusable.</li> <li>■ Failover communications fail.</li> </ul>                                                                                                            | 13       |
| 82072002      | An unrecoverable error was detected during execution of the FX Subsystem Test.                                                                                                                                                                                                                                             | 13       |
| 82082002      | An unrecoverable error was detected during execution of the Nbus init test.                                                                                                                                                                                                                                                | 13       |

**Table B-12 Last Failure Codes (sheet 1 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01000100    | Memory allocation failure during executive initialization.                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 01010100    | An interrupt without any handler was triggered.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 01020100    | Entry on timer queue was not of type AQ or BQ.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 01030100    | Memory allocation for a facility lock failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 01040100    | Memory initialization called with invalid memory type.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 01050104    | The i960 reported a fault where: <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PC value.</li> <li>■ Last Failure Parameter[1] contains the AC value.</li> <li>■ Last Failure Parameter[2] contains the fault type and subtype values.</li> <li>■ Last Failure Parameter[3] contains the address of the faulting instruction.</li> </ul>                                                                                                                      |
| 01070100    | Timer chip setup failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 01082004    | The core diagnostics reported a fault where: <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the error code value (OCP LEDs error code).</li> <li>■ Last Failure Parameter[1] contains the address of the fault.</li> <li>■ Last Failure Parameter[2] contains the actual data value.</li> <li>■ Last Failure Parameter[3] contains the expected data value.</li> </ul>                                                                                            |
| 01090105    | An NMI occurred during EXEC\$BUGCHECK processing where: <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the executive flags value.</li> <li>■ Last Failure Parameter[1] contains the RIP from the NMI stack.</li> <li>■ Last Failure Parameter[2] contains the read diagnostic register 0 value.</li> <li>■ Last Failure Parameter[3] contains the Master DRAB CSR value.</li> <li>■ Last Failure Parameter[4] contains the SIP last failure code value</li> </ul> |
| 010A2080    | A single bit or a multi-single bit ECC error was detected.<br><br>To prevent data corruption, the controller was reset.<br><br>If this event occurs frequently, the controller module should be replaced.                                                                                                                                                                                                                                                                                      |
| 010B2380    | A processor interrupt was generated by the CACHEA Dynamic Ram controller and ArBitration engine (DRAB).<br><br>The indication is that the CACHE backup battery has failed or is low (needs charging).                                                                                                                                                                                                                                                                                          |
| 010C2380    | A processor interrupt was generated by the CACHEB Dynamic Ram controller and ArBitration engine (DRAB).<br><br>The indication is that the CACHE backup battery has failed or is low (needs charging).                                                                                                                                                                                                                                                                                          |



**Table B-12 Last Failure Codes (sheet 2 of 28)**

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 010D0110 | <p>The System Information structure within the System Information Page has been reset to default settings.</p> <p>The only known cause for this event is an i960 processor hang caused by a reference to a memory region that is not implemented. When such a hang occurs, controller modules equipped with inactivity watchdog timer circuitry will spontaneously reboot after the watchdog timer expires (within seconds of the hang).</p> <p>Controller modules not so equipped will just hang as indicated by the green LED on the OCP remaining in a steady state.</p>                                                              |
| 010E0110 | <p>All structures contained in the System Information Page (SIP) and the Last Failure entries have been reset to their default settings.</p> <p>This is a normal occurrence for the first boot following manufacture of the controller module and during the transition from one firmware version to another if and only if the format of the SIP is different between the two versions.</p> <p>If this event is reported at any other time, follow the recommended repair action associated with this Last Failure code.</p>                                                                                                            |
| 010F0110 | <p>All structures contained in the System Information Page and the Last Failure entries have been reset to their default settings as the result of certain controller manufacturing configuration activities.</p> <p>If this event is reported at any other time, follow the recommended repair action associated with this Last Failure code.</p>                                                                                                                                                                                                                                                                                       |
| 01100100 | <p>Non-maskable interrupt (NMI) was entered, but no Non-maskable interrupt is pending.</p> <p>This is typically caused by an indirect call to address 0.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 01110106 | <p>A bugcheck occurred during EXEC\$BUGCHECK processing where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains the executive flags value.</li> <li>■ Last Failure Parameter [1] contains the RIP from the bugcheck call stack.</li> <li>■ Last Failure Parameter [2] contains the first SIP last failure parameter value.</li> <li>■ Last Failure Parameter [3] contains the second SIP last failure.</li> <li>■ Last Failure Parameter [4] contains the SIP last failure code value.</li> <li>■ Last Failure Parameter [5] contains the EXEC\$BUGCHECK call last failure code value.</li> </ul>        |
| 01150106 | <p>A bugcheck occurred before subsystem initialization completed where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains the executive flags value</li> <li>■ Last Failure Parameter [1] contains the RIP from the bugcheck call stack.</li> <li>■ Last Failure Parameter [2] contains the first SIP last failure parameter value.</li> <li>■ Last Failure Parameter [3] contains the second SIP last failure</li> <li>■ Last Failure Parameter [4] contains the SIP last failure code value.</li> <li>■ Last Failure Parameter [5] contains the EXEC\$BUGCHECK call last failure code value.</li> </ul> |

**Table B-12 Last Failure Codes (sheet 3 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                               |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 018000A0    | A powerfail interrupt was detected.                                                                                                                                                                                                                                                                                                                              |
| 018600A0    | A processor interrupt was generated with an indication that the other controller in a dual controller configuration asserted the KILL line to disable this controller.                                                                                                                                                                                           |
| 018700A0    | A processor interrupt was generated with an indication that the RESET button (//) on the controller module was depressed.                                                                                                                                                                                                                                        |
| 018800A0    | A processor interrupt was generated with an indication that the program card was removed.                                                                                                                                                                                                                                                                        |
| 018900A0    | A processor interrupt was generated with an indication that the controller inactivity watch dog timer expired.                                                                                                                                                                                                                                                   |
| 018C2580    | A DRAB_INT interrupt was generated with an indication that a memory system problem occurred.                                                                                                                                                                                                                                                                     |
| 018D2580    | The memory address range for which buffer SYSCOM was linked is not available                                                                                                                                                                                                                                                                                     |
| 018E2582    | An NMI interrupt was generated with an indication that a memory system problem occurred where: <ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains the memory controller register address which encountered the error.</li> <li>■ Last Failure Parameter [1] contains the memory controller's Command Status Register value.</li> </ul> |
| 02000100    | Initialization code was unable to allocate enough memory to setup the receive data descriptors.                                                                                                                                                                                                                                                                  |
| 02010100    | Initialization code was unable to allocate enough memory to setup the send data descriptors.                                                                                                                                                                                                                                                                     |
| 02040100    | Unable to allocate memory necessary for data buffers.                                                                                                                                                                                                                                                                                                            |
| 02050100    | Unable to allocate memory for the Free Buffer Array.                                                                                                                                                                                                                                                                                                             |
| 02080100    | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when populating the disk read DWD stack.                                                                                                                                                                                                                                                             |
| 02090100    | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when populating the disk write DWD stack.                                                                                                                                                                                                                                                            |
| 020A0100    | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when populating the tape read DWD stack.                                                                                                                                                                                                                                                             |
| 020B0100    | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when populating the tape write DWD stack.                                                                                                                                                                                                                                                            |
| 020C0100    | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when populating the miscellaneous DWD stack.                                                                                                                                                                                                                                                         |

**Table B-12 Last Failure Codes (sheet 4 of 28)**

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02100100 | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when creating the device services state table.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 02170100 | Unable to allocate memory for the Free Node Array.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 021D0100 | Unable to allocate memory for the Free Buffer Array.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 021F0100 | Unable to allocate memory for WARPs and RMDs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 02210100 | Invalid parameters in CACHE\$OFFER_META call.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 02220100 | No buffer found for CACHE\$MARK_META_DIRTY call.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 02270104 | <p>A callback from DS on a transfer request has returned a bad or illegal DWD status where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains the DWD Status.</li> <li>■ Last Failure Parameter [1] contains the DWD address.</li> <li>■ Last Failure Parameter [2] contains the PUB address.</li> <li>■ Last Failure Parameter [3] contains the Device Port.</li> </ul>                                                                                                                                                                          |
| 022C0100 | A READ_LONG operation was requested for a Local Buffer Transfer (READ_LONG is not supported for Local Buffer Transfers).                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 022D0100 | A WRITE_LONG operation was requested for a Local Buffer Transfer (WRITE_LONG is not supported for Local Buffer Transfers).                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 022E0102 | <p>An invalid mapping type was specified for a logical unit where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the USB address.</li> <li>■ Last Failure Parameter[1] contains the Unit Mapping Type.</li> </ul>                                                                                                                                                                                                                                                                                                                              |
| 02392084 | <p>A processor interrupt was generated by the controller's XOR engine (FX), with no bits set in the CSR to indicate a reason for the interrupt where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the FX Control and Status Register (CSR).</li> <li>■ Last Failure Parameter[1] contains the FX DMA Indirect List Pointer register (DILP).</li> <li>■ Last Failure Parameter[2] contains the FX DMA Page Address register (DADDR).</li> <li>■ Last Failure Parameter[3] contains the FX DMA Command and control register (DCMD).</li> </ul> |
| 023A2084 | <p>A processor interrupt was generated by the controller XOR engine (FX), indicating an unrecoverable error condition where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the FX Control and Status Register (CSR).</li> <li>■ Last Failure Parameter[1] contains the FX DMA Indirect List Pointer register (DILP).</li> <li>■ Last Failure Parameter[2] contains the FX DMA Page Address register (DADDR).</li> <li>■ Last Failure Parameter[3] contains the FX DMA Command and control register (DCMD).</li> </ul>                          |

**Table B-12 Last Failure Codes (sheet 5 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                                                              |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02440100    | The logical unit mapping type was detected invalid in va_set_disk_geometry()                                                                                                                                                                                    |
| 02530102    | An invalid status was returned from CACHE\$LOOKUP_LOCK() where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the DD address.</li> <li>■ Last Failure Parameter[1] contains the invalid status.</li> </ul>                     |
| 02560102    | An invalid status was returned from CACHE\$LOOKUP_LOCK() where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the DD address.</li> <li>■ Last Failure Parameter[1] contains the invalid status.</li> </ul>                     |
| 02570102    | An invalid status was returned from VA\$XFER() during a operation where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the DD address.</li> <li>■ Last Failure Parameter[1] contains the invalid status.</li> </ul>            |
| 025A0102    | An invalid status was returned from CACHE\$LOOKUP_LOCK() where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the DD address.</li> <li>■ Last Failure Parameter[1] contains the invalid status.</li> </ul>                     |
| 025B0102    | An invalid mapping type was specified for a logical unit where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the USB address.</li> <li>■ Last Failure Parameter[1] contains the Unit Mapping Type.</li> </ul>                 |
| 02620102    | An invalid status was returned from CACHE\$LOOKUP_LOCK() where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the DD address.</li> <li>■ Last Failure Parameter[1] contains the invalid status.</li> </ul>                     |
| 02690102    | An invalid status was returned from CACHE\$OFFER_WRITE_DATA() where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the DD address.</li> <li>■ Last Failure Parameter[1] contains the invalid status.</li> </ul>                |
| 02790102    | An invalid status was returned from VA\$XFER() in a complex read operation where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the DD address.</li> <li>■ Last Failure Parameter[1] contains the invalid status.</li> </ul>   |
| 027B0102    | An invalid status was returned from VA\$XFER() in a complex ACCESS operation where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the DD address.</li> <li>■ Last Failure Parameter[1] contains the invalid status.</li> </ul> |
| 027D0100    | Unable to allocate memory for a Failover Control Block.                                                                                                                                                                                                         |
| 027E0100    | Unable to allocate memory for a Failover Control Block.                                                                                                                                                                                                         |
| 027F0100    | Unable to allocate memory for a Failover Control Block.                                                                                                                                                                                                         |
| 02800100    | Unable to allocate memory for a Failover Control Block.                                                                                                                                                                                                         |
| 02840100    | Unable to allocate memory for the XNode Array.                                                                                                                                                                                                                  |

**Table B-12 Last Failure Codes (sheet 6 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                      |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02860100    | Unable to allocate memory for the Fault Management Event Information Packet used by the Cache Manager in generating error logs to the host.                                             |
| 02880100    | Invalid FOC Message in cmfoc_snd_cmd.                                                                                                                                                   |
| 02890100    | Invalid FOC Message in cmfoc_rcv_cmd.                                                                                                                                                   |
| 028A0100    | Invalid return status from DIAG\$CACHE_MEMORY_TEST.                                                                                                                                     |
| 028B0100    | Invalid return status from DIAG\$CACHE_MEMORY_TEST.                                                                                                                                     |
| 028C0100    | Invalid error status given to cache_fail.                                                                                                                                               |
| 028E0100    | Invalid DCA state detected in init_crashover.                                                                                                                                           |
| 02910100    | Invalid metadata combination detected in build_raid_node.                                                                                                                               |
| 02920100    | Unable to handle that many bad dirty pages (exceeded MAX_BAD_DIRTY). Cache memory is bad.                                                                                               |
| 02930100    | There was no free or freeable buffer to convert bad metadata or to borrow a buffer during failover of bad dirty.                                                                        |
| 02940100    | A free Device Correlation Array entry could not be found during write-back cache failover.                                                                                              |
| 02950100    | Invalid DCA state detected in start_crashover.                                                                                                                                          |
| 02960100    | Invalid DCA state detected in start_failover.                                                                                                                                           |
| 02970100    | Invalid DCA state detected in init_failover.                                                                                                                                            |
| 02990100    | A free RAID Correlation Array entry could not be found during write-back cache failover.                                                                                                |
| 029A0100    | Invalid cache buffer metadata detected while scanning the Buffer Metadata Array.<br>Found a page containing dirty data but the corresponding Device Correlation Array entry does exist. |
| 029D0100    | Invalid metadata combination detected in build_bad_raid_node.                                                                                                                           |
| 029F0100    | The Cache Manager software has insufficient resources to handle a buffer request pending.                                                                                               |
| 02A00100    | VA change state is trying to change device affinity and the cache has data for this device.                                                                                             |
| 02A10100    | Pubs not one when transportable                                                                                                                                                         |
| 02A20100    | Pubs not one when transportable                                                                                                                                                         |

**Table B-12 Last Failure Codes (sheet 7 of 28)**

| Code     | Description                                                                                                                                                                                          |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02A30100 | No available data buffers.<br><br>If the cache module exists then this is true after testing the whole cache. Otherwise there were no buffers allocated from BUFFER memory on the controller module. |
| 02A40100 | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when allocating VAXDs.                                                                                                                   |
| 02A50100 | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when allocating DILPs.                                                                                                                   |
| 02A60100 | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when allocating Change State Work Items.                                                                                                 |
| 02A70100 | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when allocating VA Request Items.                                                                                                        |
| 02A90100 | Too many pending FOC\$SEND requests by the Cache Manager.<br><br>Code is not designed to handle more than one FOC\$SEND to be pending because there's no reason to expect more than one pending.     |
| 02AA0100 | An invalid call was made to CACHE\$DEALLOCATE_CLD.<br><br>Either that device had dirty data or it was bound to a RAIDset.                                                                            |
| 02AB0100 | An invalid call was made to CACHE\$DEALLOCATE_SLD.<br><br>A RAIDset member either had dirty data or write-back already turned on.                                                                    |
| 02AC0100 | An invalid call was made to CACHE\$DEALLOCATE_SLD.<br><br>The RAIDset still has data (strip nodes).                                                                                                  |
| 02AD0180 | The FX detected a compare error for data that was identical.<br><br>This error has always previously occurred due to a hardware problem.                                                             |
| 02AE0100 | The mirrorset member count and individual member states are inconsistent.<br><br>Discovered during a mirrorset write or erase.                                                                       |
| 02AF0102 | An invalid status was returned from vA\$XFER() in a write operation where:<br>■ Last Failure Parameter[0] contains the DD address.<br>■ Last Failure Parameter[1] contains the invalid status.       |
| 02B10100 | A mirrorset read operation was received and the round robin selection algorithm found no normal members in the mirrorset. Internal inconsistency.                                                    |

**Table B-12 Last Failure Codes (sheet 8 of 28)**

| Code     | Description                                                                                                                                                                                                                                                            |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02B20102 | An invalid status was returned from CACHE\$LOCK_READ during a mirror copy operation where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the DD address.</li> <li>■ Last Failure Parameter[1] contains the invalid status.</li> </ul> |
| 02B30100 | The CACHE\$CHANGE_MIRROR_MODE was invoked illegally (cache bad, dirty data still resident in the cache.)                                                                                                                                                               |
| 02B52200 | Cache A was declared bad during memory diagnostic testing of the metadata while in mirrored mode.<br><br>A reboot is necessary to recover any dirty data from the mirror.                                                                                              |
| 02B72200 | Cache B which contains the mirror for Cache A was declared bad during memory diagnostic testing of the metadata while in mirrored mode.<br><br>A reboot is necessary to recover any dirty data from the primary cache.                                                 |
| 02B90100 | Invalid code loop count attempting to find the Cache ID Blocks.                                                                                                                                                                                                        |
| 02BC0100 | A mirrorset read operation was received and the preferred member selection algorithm found no normal members in the mirrorset.<br><br>Internal inconsistency.                                                                                                          |
| 02BD0100 | A mirrorset metadata online operation found no normal members in the mirrorset.<br>Internal inconsistency.                                                                                                                                                             |
| 02BE0100 | No free pages in the other cache.<br><br>In performing mirror cache failover, a bad page was found and an attempt was made to recover the data from the good copy (primary/mirror), but no free good page was found on the other cache to copy the data to.            |
| 02BF0100 | Report_error routine encountered an unexpected failure status returned from DIAG\$LOCK_AND_TEST_CACHE_B.                                                                                                                                                               |
| 02C00100 | Copy_buff_on_this routine expected the given page to be marked bad and it wasn't.                                                                                                                                                                                      |
| 02C10100 | Copy_buff_on_other routine expected the given page to be marked bad and it wasn't.                                                                                                                                                                                     |
| 02C30100 | CACHE\$CREATE_MIRROR was invoked by C_SWAP under unexpected conditions (other controller not dead, bad lock state).                                                                                                                                                    |
| 02C42200 | Cache A was declared bad during memory diagnostic testing of the metadata while in mirrored mode.<br><br>A reboot is necessary to recover any dirty data from the mirror.                                                                                              |

**Table B-12 Last Failure Codes (sheet 9 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                 |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02C52200    | Cache B which contains the mirror for Cache A was declared bad during memory diagnostic testing of the metadata while in mirrored mode.<br>A reboot is necessary to recover any dirty data from the primary cache. |
| 02C60100    | Mirroring transfer found CLD with writeback state OFF.                                                                                                                                                             |
| 02C70100    | Bad BBR offsets for active shadowset, detected on write.                                                                                                                                                           |
| 02C80100    | Bad BBR offsets for active shadowset, detected on read.                                                                                                                                                            |
| 02C90100    | Illegal call made to CACHE\$PURGE_META when the storageset wasn't quiesced.                                                                                                                                        |
| 02CA0100    | Illegal call made to VA\$RAID5_META_READ when another read (of metadata) is already in progress on the same strip.                                                                                                 |
| 02CB0000    | A restore of the configuration has been done.<br>This cleans up and restarts with the new configuration.                                                                                                           |
| 02CC0100    | No freeable cache node was found on an attempt to allocate a cache node (which is not allowed to fail).                                                                                                            |
| 02CE1010    | Serial number mismatch was detected during an attempt to restore saved configuration information.                                                                                                                  |
| 02CF0100    | An unsupported message type or terminal request was received by the VA_SAVE_CONFIG virtual terminal code from the CLI.                                                                                             |
| 02D00100    | Not all alter_device requests from VA_SAVE_CONFIG completed within the timeout interval.                                                                                                                           |
| 02D30100    | The controller has insufficient memory to allocate enough data structures used to manage metadata operations.                                                                                                      |
| 02D50100    | No resources are available to handle a new metadata work request.                                                                                                                                                  |
| 02D60100    | An invalid storage set type was specified for metadata initialization.                                                                                                                                             |
| 02D72390    | Forced failover of devices due to a cache battery failure.<br>This was initiated because the dual partner was operational with a good battery and there is no host failover assistance.                            |
| 02D80100    | Unable to allocate memory for Fast Buffers.<br>Code bug suspected rather than low buffer memory, because the code just checked for sufficient buffer memory.                                                       |
| 02D90100    | Bad CLD pointer passed setwb routine.                                                                                                                                                                              |
| 02DA0100    | A fatal logic error occurred while trying to restart a stalled data transfer stream.                                                                                                                               |



Table B-12 Last Failure Codes (sheet 10 of 28)

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02DB0100 | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when populating the disk read PCX DWD stack.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 02DC0100 | A call to EXEC\$ALLOCATE_MEM_ZEROED failed to return memory when populating the disk write PCX DWD stack.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 02DD0100 | The VA state change deadman timer expired, and at least one VSI was still interlocked. Last Failure Parameter [0] contains the nv_index.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 02DE0100 | An attempt to allocate memory for a null pub failed to get the memory.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 02DF0100 | License identified in Last Failure Parameter [0] was not forced valid.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 02E00180 | Mirror functionality is broken.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 02E11016 | <p>While attempting to restore a saved configuration, information was encountered for two unrelated controllers.</p> <p>The restore code is unable to determine which disk contains the correct information. The PTL information for the two disks is contained in the Last Failure Parameter list:</p> <ul style="list-style-type: none"> <li>■ Parameters 0, 1, and 2 contain the first disk's P, T, and L respectively.</li> <li>■ Parameters 3, 4, and 5 contain the second disk's P, T, and L respectively.</li> </ul> <p>Remove the disk that contains the incorrect configuration, restart the controller, then enter the SET THIS_CONTROLLER INITIAL_CONFIGURATION command.</p> <p>When the controller restarts, it will load the correct configuration from the disk.</p> |
| 02E20100 | An attempt to allocate a va_cs_work item from the S_va_free_cs_work_queue failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 02E30100 | An attempt to allocate a free VAR failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 02E40100 | An attempt to allocate a free VAR failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 02E50100 | An attempt to allocate a free VAR failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 02E60100 | An attempt to allocate a free VAR failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 02E70100 | An attempt to allocate a free VAR failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 02E80100 | An attempt to allocate a free VAR failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 02E90100 | An attempt to allocate a free VAR failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 02EA0100 | An attempt to allocate a free VAR failed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 02EE0102 | A CLD is already allocated when it should be free. The Last Failure Parameter 0 contains the requesting entity; parameter 1 contains the CLD index.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 02EF0102 | A CLD is free when it should be allocated. The Last Failure Parameter 0 contains the requesting entity; parameter 1 contains the CLD index.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**Table B-12 Last Failure Codes (sheet 11 of 28)**

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02F60103 | <p>An invalid modification to the no_interlock VSI flag was attempted where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter 0 = the nv_index of the configuration on which the problem was found.</li> <li>■ Last Failure Parameter 1 = the modification flag:</li> <li>■ Modification flag = 1, then an attempt was made to set the no_interlock flag, which was not clear at the time.</li> <li>■ Modification flag = 0, then an attempt was made to clear the no_interlock flag, which was clear (==1) at the time.</li> <li>■ Last Failure Parameter 2 = the current value of the no_interlock flag.</li> </ul> |
| 02F70100 | <p>Initialization diagnostics found one or more failed device ports</p> <p>The diagnostics may occasionally fail a good port. Restart the controller to ensure that the device ports were not falsely declared to be failed. If the port is actually failed, the diagnostics contain logic that will halt the controller during restart.</p>                                                                                                                                                                                                                                                                                             |
| 03010100 | Failed request for port-specific scripts memory allocation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 03020101 | <p>Invalid SCSI direct-access device opcode in misc command DWD.</p> <p>Last Failure Parameter[0] contains the SCSI command opcode.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 03040101 | <p>Invalid SCSI CDROM device opcode in misc command DWD.</p> <p>Last Failure Parameter[0] contains the SCSI command opcode.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 03060101 | Invalid SCSI device type in PUB.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 03070101 | <p>Invalid CDB Group Code detected during create of misc cmd DWD where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the SCSI device type.</li> <li>■ Last Failure Parameter[0] contains the SCSI command opcode.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                          |
| 03080101 | <p>Invalid SCSI OPTICAL MEMORY device opcode in misc command DWD.</p> <p>Last Failure Parameter[0] contains the SCSI command opcode.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 030A0100 | Error DWD not found in port in_proc_q.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

**Table B-12 Last Failure Codes (sheet 12 of 28)**

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 030B0188 | <p>A dip error was detected when pcb_busy was set where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB port_ptr value.</li> <li>■ Last Failure Parameter[1] contains the new info NULL - SSTAT0 - DSTAT - ISTAT.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPTS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul>                |
| 03150100 | More DBDs than allowed for in mask.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 031E0100 | Can't find in_error dwd on in-process queue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 031F0100 | Either DWD_ptr is null or bad value in dsps.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 03280100 | SCSI CDB contains an invalid group code for a transfer command.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 03290100 | The required Event Information Packet (EIP) or device work descriptor (DWD) were not supplied to the Device Services error logging code.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 032B0100 | A Device Work Descriptor (DWD) was supplied with a NULL Physical Unit Block (PUB) pointer.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 03320101 | <p>An invalid code was passed to the error recovery thread in the error_stat field of the PCB.</p> <p>Last Failure Parameter[0] contains the PCB error_stat code.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 03330188 | <p>A parity error was detected by a device port while sending data out onto the SCSI bus where</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB port_ptr value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPTS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul> |

Table B-12 Last Failure Codes (sheet 13 of 28)

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 03350188 | <p>The TEA (bus fault) signal was asserted into a device port where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB <code>port_ptr</code> value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port TEMP register.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul> |
| 03360188 | <p>A device port host bus watchdog timer expired where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB <code>port_ptr</code> value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port TEMP register.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul>              |
| 03370108 | <p>A device port detected an illegal script instruction where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB <code>port_ptr</code> value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port  TEMP register.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul>      |

Table B-12 Last Failure Codes (sheet 14 of 28)

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 03380188 | <p>A device port DSTAT register contains multiple asserted bits, or an invalidly asserted bit, or both where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB <code>port_ptr</code> value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port TEMP register.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul> |
| 03390108 | <p>An unknown interrupt code was found in a device port DSPS register where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB <code>port_ptr</code> value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port TEMP register.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port Last Failure Parameter[5] contains the PCB copy of the device port DSPS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul>                                                           |
| 033C0101 | <p>An invalid code was seen by the error recovery thread in the <code>er_funct_step</code> field of the PCB.</p> <p>Last Failure Parameter[0] contains the PCB <code>er_funct_step</code> code.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Table B-12 Last Failure Codes (sheet 15 of 28)**

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 033E0108 | <p>An attempt was made to restart a device port at the SDP DBD:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB port_ptr value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port TEMP register.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul>                            |
| 033F0108 | <p>An EDC error was detected on a read of a soft-sectored device-path not yet implemented:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB port_ptr value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port TEMP register.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul> |
| 03410101 | <p>Invalid SCSI device type in PUB.<br/>Last Failure Parameter[0] contains the PUB SCSI device type.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

**Table B-12 Last Failure Codes (sheet 16 of 28)**

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 03420188 | <p>A UDC interrupt could not be associated with either a DWD or the non-callable scripts where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB port_ptr value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port TEMP register.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul> |
| 03440188 | <p>A Host Parity Error was detected by a port where:</p> <ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the PCB port_ptr value.</li> <li>■ Last Failure Parameter[1] contains the PCB copy of the device port TEMP register.</li> <li>■ Last Failure Parameter[2] contains the PCB copy of the device port DBC register.</li> <li>■ Last Failure Parameter[3] contains the PCB copy of the device port DNAD register.</li> <li>■ Last Failure Parameter[4] contains the PCB copy of the device port DSP register.</li> <li>■ Last Failure Parameter[5] contains the PCB copy of the device port DSPS register.</li> <li>■ Last Failure Parameter[6] contains the PCB copies of the device port SSTAT2/SSTAT1/SSTAT0/DSTAT registers.</li> <li>■ Last Failure Parameter[7] contains the PCB copies of the device port LCRC/RESERVED/ISTAT/DFIFO registers.</li> </ul>                                            |
| 03470100 | Insufficient memory available for target block allocation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 03480100 | Insufficient memory available for device port info block allocation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 03490100 | Insufficient memory available for autoconfig buffer allocation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 034A0100 | Insufficient memory available for PUB allocation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 034B0100 | Insufficient memory available for DS init buffer allocation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 034C0100 | Insufficient memory available for static structure allocation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 034D0100 | DS init DWDs exhausted.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 034E2080 | Diagnostics report all device ports are broken.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 03500100 | Insufficient memory available for command disk allocation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 03520100 | A failure resulted when an attempt was made to allocate a DWD for use by DS CDI.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

**Table B-12 Last Failure Codes (sheet 17 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 035A0100    | Invalid SCSI message byte passed to DS.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 035B0100    | Insufficient DWD resources available for SCSI message passthrough.                                                                                                                                                                                                                                                                                                                                                                                                     |
| 03640100    | Processing run_switch disabled for LOGDISK associated with the other controller.                                                                                                                                                                                                                                                                                                                                                                                       |
| 03650100    | Processing pub unblock for LOGDISK associated with the other controller.                                                                                                                                                                                                                                                                                                                                                                                               |
| 03660100    | No memory available to allocate pub to tell the other controller of reset to one if its LUNs                                                                                                                                                                                                                                                                                                                                                                           |
| 03670100    | No memory available to allocate pub to tell the other controller of a BDR to one if its LUNs                                                                                                                                                                                                                                                                                                                                                                           |
| 04010101    | The requester id component of the instance code passed to FM\$REPORT_EVENT is larger than the maximum allowed for this environment.<br><br>Last Failure Parameter[0] contains the instance code value.                                                                                                                                                                                                                                                                 |
| 04020102    | The requester's error table index passed to FM\$REPORT_EVENT is larger than the maximum allowed for this requester where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the instance code value.</li> <li>■ Last Failure Parameter[1] contains the requester error table index value.</li> </ul>                                                                                                                                      |
| 04030102    | The USB index supplied in the Event Information Packet (EIP) is larger than the maximum number of USBs where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the instance code value.</li> <li>■ Last Failure Parameter[1] contains the USB index value.</li> </ul>                                                                                                                                                                    |
| 04040103    | The event log format found in V_fm_template_table is not supported by the Fault Manager. The bad format was discovered while trying to fill in a supplied Event Information Packet (EIP):<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the instance code value.</li> <li>■ Last Failure Parameter[1] contains the format code value.</li> <li>■ Last Failure Parameter[2] contains the requester error table index value.</li> </ul> |
| 04050100    | The Fault Manager could not allocate memory for its Event Information Packet (EIP) buffers.                                                                                                                                                                                                                                                                                                                                                                            |
| 040A0100    | The caller of FM\$CANCEL SCSI_DE_NOTIFICATION passed an address of a deferred error notification routine which doesn't match the address of any routines for which deferred error notification is enabled.                                                                                                                                                                                                                                                             |
| 040E0100    | FM\$ENABLE_DE_NOTIFICATION was called to enable deferred error notification but the specified routine was already enabled to receive deferred error notification.                                                                                                                                                                                                                                                                                                      |
| 040F0102    | The Event Information Packet (EIP)→generic.mscp1.flgs field of the EIP passed to FM\$REPORT_EVENT contains an invalid flag where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter[0] contains the instance code value.</li> <li>■ Last Failure Parameter[1] contains the value supplied in the Event Information Packet (EIP)→generic.mscp1.flgs field.</li> </ul>                                                                                  |



**Table B-12 Last Failure Codes (sheet 18 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 04100101    | Unexpected template type found during fmu_display_errlog processing.<br>Last Failure Parameter[0] contains the unexpected template value.                                                                                                                                                                                                                                                                                                                |
| 04110101    | Unexpected instance code found during fmu_memerr_report processing.<br>Last Failure Parameter[0] contains the unexpected instance code value.                                                                                                                                                                                                                                                                                                            |
| 04120101    | CLIB\$SDD_FAO call failed.<br>Last Failure Parameter[0] contains the failure status code value.                                                                                                                                                                                                                                                                                                                                                          |
| 04130103    | The event log format found in the eip is not supported by the Fault Manager.<br>The bad format was discovered while trying to fill in the DLI of the supplied eip where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains the instance code value.</li> <li>■ Last Failure Parameter [1] contains the format code value.</li> <li>■ Last Failure Parameter [2] contains the requester error table index value.</li> </ul> |
| 04140103    | The template value found in the eip is not supported by the Fault Manager.<br>The bad template value was discovered while trying to build an esd where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains the instance code value.</li> <li>■ Last Failure Parameter [1] contains the format code value.</li> <li>■ Last Failure Parameter [2] contains the requester error table index value.</li> </ul>                  |
| 05010100    | In recursive_nonconflict could not get enough memory for scanning the keyword tables for configuration name conflicts.                                                                                                                                                                                                                                                                                                                                   |
| 06010100    | The DUART was unable to allocate enough memory to establish a connection to the CLI.                                                                                                                                                                                                                                                                                                                                                                     |
| 06020100    | A port other than terminal port A was referred to by a set terminal characteristics command. This is illegal.                                                                                                                                                                                                                                                                                                                                            |
| 06030100    | A DUP question or default question message type was passed to the DUART driver, but the pointer to the input area to receive the response to the question was NULL.                                                                                                                                                                                                                                                                                      |
| 06040100    | Attempted to detach unattached maintenance terminal.                                                                                                                                                                                                                                                                                                                                                                                                     |
| 06050100    | Attempted output to unattached maintenance terminal.                                                                                                                                                                                                                                                                                                                                                                                                     |
| 06060100    | Attempted input from output only maintenance terminal service.                                                                                                                                                                                                                                                                                                                                                                                           |
| 06070100    | The DUART was unable to allocate enough memory for its input buffers                                                                                                                                                                                                                                                                                                                                                                                     |
| 06080000    | Controller was forced to restart due to entry of a CNTRL-K character on the maintenance terminal.                                                                                                                                                                                                                                                                                                                                                        |
| 07010100    | All available slots in the FOC notify table are filled.                                                                                                                                                                                                                                                                                                                                                                                                  |

**Table B-12 Last Failure Codes (sheet 19 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                 |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 07020100    | FOC\$CANCEL_NOTIFY() was called to disable notification for a rtn that did not have notification enabled.                                                          |
| 07030100    | Unable to start the Failover Control Timer before main loop.                                                                                                       |
| 07040100    | Unable to restart the Failover Control Timer.                                                                                                                      |
| 07050100    | Unable to allocate flush buffer.                                                                                                                                   |
| 07060100    | Unable to allocate active receive fcb.                                                                                                                             |
| 07070100    | The other controller killed this, but could not assert the kill line because nindy on or in debug. So it killed this now.                                          |
| 07080000    | The other controller crashed, so this one must crash too.                                                                                                          |
| 08010101    | A remote state change was received from the FOC thread that NVFOC does not recognize.<br>Last Failure Parameter[0] contains the unrecognized state value.          |
| 08020100    | No memory could be allocated for a NVFOC information packet.                                                                                                       |
| 08030101    | Work received on the S_nvfoc_bque did not have a NVFOC work id.<br>Last Failure Parameter[0] contains the id type value that was received on the NVFOC work queue. |
| 08040101    | Unknown work value received by the S_nvfoc_bque.<br>Last Failure Parameter[0] contains the unknown work value.                                                     |
| 08060100    | A write command was received when the NV memory was not locked.                                                                                                    |
| 08070100    | A write to NV memory was received while not locked.                                                                                                                |
| 08080000    | The other controller requested this controller to restart.                                                                                                         |
| 08090010    | The other controller requested this controller to shutdown.                                                                                                        |
| 080A0000    | The other controller requested this controller to selftest.                                                                                                        |
| 080B0100    | Could not get enough memory to build a FCB to send to the remote routines on the other controller.                                                                 |
| 080C0100    | Could not get enough memory for FCBs to receive information from the other controller.                                                                             |
| 080D0100    | Could not get enough memory to build a FCB to reply to a request from the other controller.                                                                        |

**Table B-12 Last Failure Codes (sheet 20 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                    |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 080E0101    | An out-of-range receiver ID was received by the NVFOC communication utility (master send to slave send ACK).<br>Last Failure Parameter[0] contains the bad id value.  |
| 080F0101    | An out-of-range receiver ID was received by the NVFOC communication utility (received by master).<br>Last Failure Parameter[0] contains the bad id value.             |
| 08100101    | A call to NVFOC\$TRANSACTION had a from field (id) that was out of range for the NVFOC communication utility.<br>Last Failure Parameter[0] contains the bad id value. |
| 08110101    | NVFOC tried to defer more than one FOC send.<br>Last Failure Parameter[0] contains the master ID of the connection that had the multiple delays.                      |
| 08140100    | Could not allocate memory to build a workblock to queue to the NVFOC thread.                                                                                          |
| 08160100    | A request to clear the remote configuration was received but the memory was not locked.                                                                               |
| 08170100    | A request to read the next configuration was received but the memory was not locked.                                                                                  |
| 08180100    | Could not get enough memory for FLS FCBs to receive information from the other controller.                                                                            |
| 08190100    | An unlock command was received when the NV memory was not locked.                                                                                                     |
| 081A0100    | Unable to allocate memory for remote work.                                                                                                                            |
| 081B0101    | Bad remote work received on remote work queue.<br>Last Failure Parameter[0] contains the id type value that was received on the NVFOC remote work queue.              |
| 081C0101    | Bad member management work received.<br>Last Failure Parameter[0] contains the bad member management value that was detected.                                         |
| 081D0000    | In order to go into mirrored cache mode, the controllers must be restarted.                                                                                           |
| 081E0000    | In order to go into nonmirrored cache mode, the controllers must be restarted.                                                                                        |
| 081F0000    | An FLM\$INSUFFICIENT_RESOURCES error was returned from a FLM lock or unlock call.                                                                                     |
| 08200000    | Expected restart so the write_instance may recover from a configuration mismatch.                                                                                     |
| 08210100    | Unable to allocate memory to setup NVFOC lock/unlock notification routines.                                                                                           |

**Table B-12 Last Failure Codes (sheet 21 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                        |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 09010100    | Unable to acquire memory to initialize the FLM structures.                                                                                                                                                                                                                                |
| 09640101    | Work that was not FLM work was found on the FLM queue.<br>Bad format detected or the formatted string overflows the output buffer.<br>Last Failure Parameter [0] contains the work found.                                                                                                 |
| 09650101    | Work that was not FLM work was found on the FLM queue.<br>Last Failure Parameter [0] contains the structure found.                                                                                                                                                                        |
| 09670101    | Local FLM detected an invalid facility to act upon.<br>Last Failure Parameter [0] contains the facility found.                                                                                                                                                                            |
| 09680101    | Remote FLM detected an error and requested the local controller to restart.<br>Last Failure Parameter [0] contains the reason for the request.                                                                                                                                            |
| 09C80101    | Remote FLM detected an error and requested an invalid facility to act upon.<br>Last Failure Parameter [0] contains the facility found.                                                                                                                                                    |
| 09C90101    | Remote FLM detected an invalid work type.<br>Last Failure Parameter [0] contains the work type found.                                                                                                                                                                                     |
| 09CA0101    | Remote FLM detected an invalid work type.<br>Last Failure Parameter [0] contains the work type found.                                                                                                                                                                                     |
| 09CB0012    | Remote FLM detected that the other controller has a facility lock manager at an incompatible revision level with this controller where:<br>■ Last Failure Parameter [0] contains the controller FLM revision.<br>■ Last Failure Parameter [1] contains the other controller FLM revision. |
| 0A010100    | CACHE\$FIND_LOG_BUFFERS returned continuation handle→0.                                                                                                                                                                                                                                   |
| 0A020100    | ILF\$CACHE_READY unable to allocate necessary DWDs.                                                                                                                                                                                                                                       |
| 0A030100    | ILF\$CACHE_READY buffers_obtained → non-zero stack entry count.                                                                                                                                                                                                                           |
| 0A040100    | ILF\$CACHE_READY DWD overrun.                                                                                                                                                                                                                                                             |
| 0A050100    | ILF\$CACHE_READY DWD underrun.                                                                                                                                                                                                                                                            |
| 0A080100    | Not processing a bugcheck.                                                                                                                                                                                                                                                                |
| 0A090100    | No active DWD.                                                                                                                                                                                                                                                                            |
| 0A0A0100    | Current entry pointer is not properly aligned.                                                                                                                                                                                                                                            |

**Table B-12 Last Failure Codes (sheet 22 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                                                |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0A0B0100    | Next entry pointer is not properly aligned.                                                                                                                                                                                                       |
| 0A0C0100    | Next entry was partially loaded.                                                                                                                                                                                                                  |
| 0A0D0100    | Another free DWD is not queued as expected.                                                                                                                                                                                                       |
| 0A0E0100    | Active DWD is not a DISK WRITE DWD as expected.                                                                                                                                                                                                   |
| 0A0F0100    | New active DWD is not a DISK WRITE DWD as expected.                                                                                                                                                                                               |
| 0A100100    | Data buffer pointer is not properly aligned.                                                                                                                                                                                                      |
| 0A110100    | DWD count was wrong and a free DWD actually exists.                                                                                                                                                                                               |
| 0A120100    | Data buffer pointer is not properly aligned.                                                                                                                                                                                                      |
| 0A130100    | Data buffer pointer is not properly aligned.                                                                                                                                                                                                      |
| 0A140100    | New entry pointer is not properly aligned.                                                                                                                                                                                                        |
| 0A150100    | New entry record type is out of range.                                                                                                                                                                                                            |
| 0A160102    | ilf_issue_log_write marker entry page guard check failed where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter 0 contains the DWD address value.</li> <li>■ Last Failure Parameter 1 contains the buffer address.</li> </ul>  |
| 0A170102    | ilf_get_new_dwd first page guard check failed where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter 0 contains the DWD address value.</li> <li>■ Last Failure Parameter 1 contains the buffer address.</li> </ul>             |
| 0A180102    | ilf_distribute_cache_DWDs first page guard check failed where<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter 0 contains the DWD address value.</li> <li>■ Last Failure Parameter 1 contains the buffer address.</li> </ul>    |
| 0A190102    | ilf_depopulate_DWD_to_cache first page guard check failed where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter 0 contains the DWD address value.</li> <li>■ Last Failure Parameter 1 contains the buffer address.</li> </ul> |
| 0A1A0102    | ilf_io_success page guard check failed where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter 0 contains the DWD address value.</li> <li>■ Last Failure Parameter 1 contains the buffer address.</li> </ul>                    |
| 0A1B0102    | ilf_io_success page guard check failed where<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter 0 contains the DWD address value.</li> <li>■ Last Failure Parameter 1 contains the buffer address.</li> </ul>                     |
| 0A1C0102    | ILF\$LOG_ENTRY page guard check failed where<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter 0 contains the DWD address value.</li> <li>■ Last Failure Parameter 1 contains the buffer address.</li> </ul>                     |

**Table B-12 Last Failure Codes (sheet 23 of 28)**

| Code     | Description                                                                                                                                                                                                           |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0A1D0102 | ILF\$LOG_ENTRY page guard check failed where:<br>■ Last Failure Parameter 0 contains the DWD address value.<br>■ Last Failure Parameter 1 contains the buffer address.                                                |
| 0A1E0102 | ILF\$LOG_ENTRY page guard check failed where:<br>■ Last Failure Parameter 0 contains the DWD address value.<br>■ Last Failure Parameter 1 contains the buffer address.                                                |
| 0A1F0100 | ilf_rebind_cache_buffs_to_DWDs found duplicate buffer for current DWD.                                                                                                                                                |
| 0A200101 | Unknown bugcheck code passed to ilf_cache_interface_crash.<br>Last Failure Parameter 0 contains the unknown bugcheck code value.                                                                                      |
| 0A210100 | ilf_rebind_cache_buffs_to_DWDs found buffer type not IDX_ILF.                                                                                                                                                         |
| 0A220100 | ilf_rebind_cache_buffs_to_DWDs found buffer DBD index too big.                                                                                                                                                        |
| 20010100 | The action for work on the CLI queue should be:<br>■ CLI_CONNECT<br>■ CLI_COMMAND_IN<br>■ CLI_PROMPT<br>If it isn't one of these three, this bugcheck will result.                                                    |
| 20020100 | The FAO returned a non-successful response.<br>This will only happen if a bad format is detected or the formatted string overflows the output buffer.                                                                 |
| 20030100 | The type of work received on the CLI work queue wasn't of type CLI.                                                                                                                                                   |
| 20060100 | A work item of an unknown type was placed on the CLI SCSI Virtual Terminal thread work queue by the CLI.                                                                                                              |
| 20080000 | This controller requested this controller to restart.                                                                                                                                                                 |
| 20090010 | This controller requested this controller to shutdown.                                                                                                                                                                |
| 200A0000 | This controller requested this controller to selftest.                                                                                                                                                                |
| 200B0100 | Could not get enough memory for FCBs to receive information from the other controller.                                                                                                                                |
| 200D0101 | After many calls to DS\$PORT_BLOCKED, the FALSE status back signal (which signals that nothing is blocked) was never received.<br>Last Failure Parameter[0] contains the port number (1 - <i>n</i> ) to be unblocked. |

**Table B-12 Last Failure Codes (sheet 24 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                      |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 200E0101    | While traversing the structure of a unit, a config_info node was discovered with an unrecognized structure type.<br>Last Failure Parameter[0] contains the structure type number that was unrecognized. |
| 200F0101    | A config_info node was discovered with an unrecognized structure type.<br>Last Failure Parameter[0] contains the structure type number that was unrecognized.                                           |
| 20100101    | A config_node of type VA_MA_DEVICE had an unrecognized SCSI device type.<br>Last Failure Parameter[0] contains the SCSI device type number that was unrecognized.                                       |
| 20110100    | An attempt to allocate memory so the CLI prompt messages could be deleted failed.                                                                                                                       |
| 20120101    | While traversing the structure of a unit, a config_info node was discovered with an unrecognized structure type.<br>Last Failure Parameter[0] contains the structure type number that was unrecognized. |
| 20130101    | While traversing the structure of a unit, the device was of an unrecognized type.<br>Last Failure Parameter[0] contains the SCSI device type that was unrecognized.                                     |
| 20150100    | On failover, both controllers must be restarted for failover to take effect.<br>This is how this controller is restarted in <i>COPY=OTHER</i> .                                                         |
| 20160000    | In order to go into mirrored cache mode, the controllers must be restarted.                                                                                                                             |
| 20160100    | Unable to allocate resources needed for the CLI local program.                                                                                                                                          |
| 20170000    | In order to go into unmirrored cache mode, the controllers must be restarted.                                                                                                                           |
| 20180010    | User requested the parameters of "this controller" to be set to initial configuration state.                                                                                                            |
| 20190010    | A cache state of a unit remains WRITE_CACHE_UNWRITTEN_DATA. The unit is not ONLINE, thus this state would only be valid for a very short period of time.                                                |
| 201A0100    | An attempt to allocate memory so a CLI prompt message could be reformatted failed.                                                                                                                      |
| 201B0100    | Insufficient resources to get memory to lock CLI.                                                                                                                                                       |
| 201C0100    | Insufficient resources to get memory to unlock CLI.                                                                                                                                                     |
| 20640000    | Nindy was turned on.                                                                                                                                                                                    |
| 20650000    | Nindy was turned off.                                                                                                                                                                                   |
| 20692010    | To enter dual-redundant mode, both controllers must be of the same type.                                                                                                                                |
| 206A0000    | Controller restart forced by DEBUG CRASH REBOOT command.                                                                                                                                                |

**Table B-12 Last Failure Codes (sheet 25 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 206B0100    | Controller restart forced by DEBUG CRASH NOREBOOT command.                                                                                                                                                                                                                                                                                                                                                   |
| 206C0020    | Controller was forced to restart in order for new controller code image to take effect.                                                                                                                                                                                                                                                                                                                      |
| 206D0000    | Controller code load was not completed because the controller could not rundown all units.                                                                                                                                                                                                                                                                                                                   |
| 43000100    | Encountered an unexpected structure type on S_shis_ctl.scsi_q.                                                                                                                                                                                                                                                                                                                                               |
| 43030100    | Unable to allocate the necessary number of large Sense Data buckets in HPP_init().                                                                                                                                                                                                                                                                                                                           |
| 43100100    | Encountered a NULL completion routine pointer in a DD.                                                                                                                                                                                                                                                                                                                                                       |
| 43130100    | Could not allocate a large sense bucket.                                                                                                                                                                                                                                                                                                                                                                     |
| 43160100    | A sense data bucket of unknown type (neither LARGE or SMALL) was passed to deallocate_SDB().                                                                                                                                                                                                                                                                                                                 |
| 43170100    | Call to VA\$ENABLE_NOTIFICATION() failed due to INSUFFICIENT_RESOURCES.                                                                                                                                                                                                                                                                                                                                      |
| 43190100    | Unable to allocate necessary memory in HPP_int().                                                                                                                                                                                                                                                                                                                                                            |
| 431A0100    | Unable to allocate necessary timer memory in HPP_int().                                                                                                                                                                                                                                                                                                                                                      |
| 43210101    | HPP detected unknown error indicated by HPT.<br>Last Failure Parameter [0] contains the error value.                                                                                                                                                                                                                                                                                                         |
| 44000104    | Interrupt from SCSI host port chip indicated condition that is not handled (unexpected):<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains ISTAT Register.</li> <li>■ Last Failure Parameter [1] contains DSTAT Register.</li> <li>■ Last Failure Parameter [2] contains SIEN/SIST Registers.</li> <li>■ Last Failure Parameter [3] contains Chip Register Base.</li> </ul>    |
| 44010104    | Interrupt from SCSI host port chip indicated ATN condition at unexpected script location where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains ISTAT Register.</li> <li>■ Last Failure Parameter [1] contains DSTAT Register.</li> <li>■ Last Failure Parameter [2] contains Script PC (DSP).</li> <li>■ Last Failure Parameter [3] contains Chip Register Base.</li> </ul> |
| 44020104    | Interrupt from SCSI host port chip indicated interrupt with an unexpected reason (pass value) where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains ISTAT Register.</li> <li>■ Last Failure Parameter [1] contains DSTAT Register.</li> <li>■ Last Failure Parameter [2] contains Pass Value.</li> <li>■ Last Failure Parameter [3] contains Chip Register Base.</li> </ul> |



**Table B-12 Last Failure Codes (sheet 26 of 28)**

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 44030104 | Interrupt from SCSI host port chip indicated interrupt with an unexpected reason but invalid conditions where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains ISTAT Register.</li> <li>■ Last Failure Parameter [1] contains DSP Register.</li> <li>■ Last Failure Parameter [2] contains Code (Condition).</li> <li>■ Last Failure Parameter [3] contains Chip Register Base.</li> </ul>  |
| 44040104 | Interrupt from SCSI host port chip indicated interrupt with an unexpected reason but invalid conditions where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains ISTAT Register.</li> <li>■ Last Failure Parameter [1] contains DSTAT Register.</li> <li>■ Last Failure Parameter [2] contains Script PC (DSP).</li> <li>■ Last Failure Parameter [3] contains Chip Register Base.</li> </ul> |
| 44050104 | Interrupt from SCSI host port chip indicated STO condition at unexpected script location where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains ISTAT Register.</li> <li>■ Last Failure Parameter [1] contains DSTAT Register.</li> <li>■ Last Failure Parameter [2] contains Script PC (DSP).</li> <li>■ Last Failure Parameter [3] contains Chip Register Base.</li> </ul>                |
| 44060104 | Interrupt from SCSI host port chip indicated HTH condition at unexpected script location where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains ISTAT Register.</li> <li>■ Last Failure Parameter [1] contains DSTAT Register.</li> <li>■ Last Failure Parameter [2] contains Script PC (DSP).</li> <li>■ Last Failure Parameter [3] contains Chip Register Base.</li> </ul>                |
| 44070100 | Unable to locate the IDENTIFY msg in HTB.                                                                                                                                                                                                                                                                                                                                                                                   |
| 44090100 | Encountered an unknown MESSAGE OUT message.                                                                                                                                                                                                                                                                                                                                                                                 |
| 440A0104 | Interrupt from SCSI host port chip indicated parity error at unexpected script location where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains ISTAT Register.</li> <li>■ Last Failure Parameter [1] contains DSTAT Register.</li> <li>■ Last Failure Parameter [2] contains Script PC (DSP).</li> <li>■ Last Failure Parameter [3] contains Chip Register Base.</li> </ul>                 |
| 440B0100 | Encountered unknown structure on port queue in HPT\$ABORT_HTB.                                                                                                                                                                                                                                                                                                                                                              |
| 440C0100 | No available Abort Records to process abort request.                                                                                                                                                                                                                                                                                                                                                                        |
| 440D0100 | No available FOR Records to process Failover request.                                                                                                                                                                                                                                                                                                                                                                       |
| 440E0100 | Unable to allocate the necessary number of HTBS in hpt_init().                                                                                                                                                                                                                                                                                                                                                              |

**Table B-12 Last Failure Codes (sheet 27 of 28)**

| Code     | Description                                                                                                                                                                                                                                                                                                                                                                                                                |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 440F0104 | Interrupt from SCSI host port chip indicated interrupt with an unexpected reason but invalid conditions where:<br><ul style="list-style-type: none"> <li>■ Last Failure Parameter [0] contains ISTAT Register.</li> <li>■ Last Failure Parameter [1] contains DSP Register.</li> <li>■ Last Failure Parameter [2] contains Code (Condition).</li> <li>■ Last Failure Parameter [3] contains Chip Register Base.</li> </ul> |
| 44100100 | Unable to allocate the necessary memory for scripts in hpt_init().                                                                                                                                                                                                                                                                                                                                                         |
| 44110100 | Unable to allocate the necessary memory for abort records in hpt_init().                                                                                                                                                                                                                                                                                                                                                   |
| 44120100 | Unable to allocate the necessary memory for tables in hpt_init().                                                                                                                                                                                                                                                                                                                                                          |
| 64000100 | Insufficient buffer memory to allocate data structures needed to propagate SCSI Mode Select changes to other controller.                                                                                                                                                                                                                                                                                                   |
| 64010100 | During an initialization of LUN specific mode pages, an unexpected device type was encountered.                                                                                                                                                                                                                                                                                                                            |
| 80010100 | An HTB was not available to issue an I/O when it should have been.                                                                                                                                                                                                                                                                                                                                                         |
| 80030100 | DILX tried to release a facility that wasn't reserved by DILX.                                                                                                                                                                                                                                                                                                                                                             |
| 80040100 | DILX tried to change the unit state from MAINTENANCE_MODE to NORMAL but was rejected because of insufficient resources.                                                                                                                                                                                                                                                                                                    |
| 80050100 | DILX tried to change the usb unit state from MAINTENANCE_MODE to NORMAL but DILX never received notification of a successful state change.                                                                                                                                                                                                                                                                                 |
| 80060100 | DILX tried to switch the unit state from MAINTENANCE_MODE to NORMAL but was not successful.                                                                                                                                                                                                                                                                                                                                |
| 80070100 | DILX aborted all cmds via va\$d_abort() but the HTBS haven't been returned.                                                                                                                                                                                                                                                                                                                                                |
| 80090100 | DILX received an end msg which corresponds to an op code not supported by DILX.                                                                                                                                                                                                                                                                                                                                            |
| 800A0100 | DILX was not able to restart his timer.                                                                                                                                                                                                                                                                                                                                                                                    |
| 800B0100 | DILX tried to issue an I/O for an opcode not supported.                                                                                                                                                                                                                                                                                                                                                                    |
| 800C0100 | DILX tried to issue a oneshot I/O for an opcode not supported.                                                                                                                                                                                                                                                                                                                                                             |
| 800D0100 | A DILX device control block contains an unsupported unit_state.                                                                                                                                                                                                                                                                                                                                                            |
| 800F0100 | A DILX cmd completed with a sense key that DILX does not support.                                                                                                                                                                                                                                                                                                                                                          |
| 80100100 | DILX could not compare buffers because no memory was available from EXEC\$ALLOCATE_MEM_ZEROED.                                                                                                                                                                                                                                                                                                                             |
| 80110100 | While DILX was deallocating his deferred error buffers, at least one could not be found.                                                                                                                                                                                                                                                                                                                                   |


**Table B-12 Last Failure Codes (sheet 28 of 28)**

| <b>Code</b> | <b>Description</b>                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 80120100    | DILX expected an Event Information Packet (EIP) to be on the receive EIP queue but no EIPs were there.                                                                                                                                                                                                                                                                                           |
| 80130100    | DILX was asked to fill a data buffer with an unsupported data pattern.                                                                                                                                                                                                                                                                                                                           |
| 80140100    | DILX could not process an unsupported answer in dx\$reuse_params().                                                                                                                                                                                                                                                                                                                              |
| 80150100    | A deferred error was received with an unsupported template.                                                                                                                                                                                                                                                                                                                                      |
| 83020100    | An unsupported message type or terminal request was received by the CONFIG virtual terminal code from the CLI.                                                                                                                                                                                                                                                                                   |
| 83030100    | Not all alter_device requests from the CONFIG utility completed within the timeout interval.                                                                                                                                                                                                                                                                                                     |
| 83050100    | An unsupported message type or terminal request was received by the CFMENU utility code from the CLI.                                                                                                                                                                                                                                                                                            |
| 83060100    | Not all alter_device requests from the CFMENU utility completed within the timeout interval.                                                                                                                                                                                                                                                                                                     |
| 84010100    | An unsupported message type or terminal request was received by the CLONE virtual terminal code from the CLI.                                                                                                                                                                                                                                                                                    |
| 85010100    | HSUTIL tried to release a facility that wasn't reserved by HSUTIL.                                                                                                                                                                                                                                                                                                                               |
| 85020100    | HSUTIL tried to change the unit state from MAINTENANCE_MODE to NORMAL but was rejected because of insufficient resources.                                                                                                                                                                                                                                                                        |
| 85030100    | HSUTIL tried to change the usb unit state from MAINTENANCE_MODE to NORMAL but HSUTIL never received notification of a successful state change.                                                                                                                                                                                                                                                   |
| 85040100    | HSUTIL tried to switch the unit state from MAINTENANCE_MODE to NORMAL but was not successful.                                                                                                                                                                                                                                                                                                    |
| 86000020    | Controller was forced to restart in order for new code load or patch to take effect.                                                                                                                                                                                                                                                                                                             |
| 86000020    | Controller was forced to restart due to execution of the CRASH utility.                                                                                                                                                                                                                                                                                                                          |
| 86010010    | The controller code load function is about to update the program card.<br><br>This requires controller activity to cease. This code is used to inform the other controller this controller will stop responding to inter-controller communications during card update. An automatic restart of the controller at the end of the program card update causes normal controller activity to resume. |
| 8A020080    | A memory error was encountered on the new cache module.<br><br>The controller has been automatically restarted to clear the error.                                                                                                                                                                                                                                                               |

**Table B-13 Repair Action Codes (sheet 1 of 10)**

| Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 00   | No action necessary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 01   | An unrecoverable hardware detected fault occurred or an unrecoverable firmware inconsistency was detected.<br><br>Proceed with controller support avenues. Contact your local field service representative.                                                                                                                                                                                                                                                                                                   |
| 03   | Follow the recommended repair action contained as indicated in the Last Failure Code.                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 04   | Two possible problem sources are indicated:<br><ul style="list-style-type: none"> <li>■ One of the dual power supplies has failed. Follow repair action 07 for the power supply with the Power LED out.</li> <li>■ One of the shelf blowers has failed. Follow repair action 06.</li> </ul>                                                                                                                                                                                                                   |
| 05   | Four possible problem sources are indicated:<br><ul style="list-style-type: none"> <li>■ Total power supply failure on a shelf. Follow repair action 09.</li> <li>■ A device inserted into a shelf that has a broken internal SBB connector. Follow repair action 0A.</li> <li>■ A standalone device is connected to the controller with an incorrect cable. Follow repair action 08.</li> <li>■ A controller hardware failure. Follow repair action 20.</li> </ul>                                           |
| 06   | Determine which blower has failed and replace it.                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 07   | Replace power supply.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 08   | Replace the cable. Refer to the specific device documentation.                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 09   | Determine power failure cause.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 0A   | Determine which SBB has a failed connector and replace it.                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 0B   | The "other controller" in a dual-redundant configuration has been reset with the "Kill" line by the controller that reported the event.<br><br>To restart the "Killed" controller:<br><ul style="list-style-type: none"> <li>■ Enter the CLI command <b>RESTART OTHER</b> on the "Surviving" controller.</li> <li>■ Depress the RESET button (//) on the "Killed" controller.</li> </ul><br>If the "other controller" is repeatedly being "Killed" for the same or a similar reason, follow repair action 20. |

**Table B-13 Repair Action Codes (sheet 2 of 10)**

| Code                                                                                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0C                                                                                  | <p>Both controllers in a dual-redundant configuration are attempting to use the same SCSI ID (either 6 or 7 as indicated in the event report).</p> <p>Note that the other controller of the dual-redundant pair has been reset with the "Kill" line by the controller that reported the event.</p> <p>Two possible problem sources are indicated:</p> <ul style="list-style-type: none"> <li>■ A controller hardware failure.</li> <li>■ A controller backplane failure.</li> <li>■ First, follow repair action 20 for the "Killed" controller.</li> <li>■ If the problem persists follow repair action 20 for the "Surviving" controller.</li> <li>■ If the problem still persists replace the controller backplane.</li> </ul> |
| 0D                                                                                  | <p>The Environmental Monitor Unit has detected an elevated temperature condition.</p> <p>Check the shelf and its components for the cause of the fault.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 0E                                                                                  | <p>The Environmental Monitor Unit has detected an external air-sense fault.</p> <p>Check components outside of the shelf for the cause of the fault.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 0F                                                                                  | <p>An environmental fault previously detected by the Environmental Monitor Unit is now fixed.</p> <p>This event report is notification that the repair was successful.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 10                                                                                  | Restore on-disk configuration information to original state.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 20                                                                                  | Replace the controller module.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 22                                                                                  | Replace the indicated cache module or the appropriate memory SIMMs on the indicated cache module.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 23                                                                                  | Replace the indicated write cache battery.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|  | <hr/> <p><b>Warning</b> Battery Replacement May Cause Injury.</p> <hr/>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

**Table B-13 Repair Action Codes (sheet 3 of 10)**

| Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24   | <p>Check for the following invalid write cache configurations:</p> <ul style="list-style-type: none"> <li>■ Wrong write cache module installed—replace with the matching module or clear the invalid cache error via the CLI.</li> <li>■ Write cache module is missing (single controller configuration)—reseat cache if it is physically present, or add the missing cache module, or clear the invalid cache error via the CLI.</li> <li>■ Write cache module is missing (dual-redundant configuration)—match write cache boards with both controllers.</li> <li>■ Write cache modules are not the same type (dual-redundant configuration)—replace a cache module to assure both are compatible with each other.</li> <li>■ Write cache modules are not the same size (dual-redundant configuration)—replace a cache module to assure both are compatible with each other.</li> <li>■ Cache module is populated with memory SIMMs in an illegal configuration—reconfigure according to guidelines.</li> </ul> |
| 25   | <p>An unrecoverable Memory System failure occurred.</p> <p>Upon restart the controller will generate one or more Memory System Failure Event Sense Data Responses; follow the repair action(s) contained therein.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 26   | <p>The Master DRAB detected a Cache Timeout condition.</p> <p>The cache regions in effect are identified in the Master DRAB RSR register where:</p> <ul style="list-style-type: none"> <li>■ Bits 8 through 11 identify the CACHEA memory region.</li> <li>■ Bits 12 through 15 identify the CACHEB memory region.</li> <li>■ Bits 20 through 23 the CACHEA DRAB registers region.</li> <li>■ Bits 24 through 27 identify the CACHEB DRAB registers region.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT. Follow repair action 36.</li> </ul>                                                                                                                                                                                                                                                                                                                   |
| 27   | <p>The Master DRAB detected an Nbus Transfer Error Acknowledge (TEA) condition where:</p> <ul style="list-style-type: none"> <li>■ Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT (follow repair action 36).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

**Table B-13 Repair Action Codes (sheet 4 of 10)**

| Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 28   | <p>A Multiple Bit ECC error was detected by the Master DRAB where:</p> <ul style="list-style-type: none"> <li>■ The Master DRAB DER register bits 0 through 6 contain the syndrome value.</li> <li>■ The Master DRAB EAR register combined with Master DRAB ERR bits 0 through 3 (address region) yields the affected memory address.</li> <li>■ The Master DRAB EDR register contains the error data.</li> <li>■ If the failure involved a Device Port, the Master DRAB CSR register bits 10 through 12 identify that Device Port.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT (follow repair action 34).</li> </ul>                                   |
| 29   | <p>A Multiple Bit ECC error was detected by the CACHEA0 or CACHEA1 DRAB where:</p> <ul style="list-style-type: none"> <li>■ The CACHEAn DRAB DER register bits 0 through 6 contain the syndrome value.</li> <li>■ The CACHEAn DRAB EAR register combined with the Master DRAB RSR register bits 8 through 11 (CACHEA memory region) yields the affected memory address.</li> <li>■ The CACHEAn DRAB EDR register contains the error data.</li> <li>■ If the failure involved a Device Port, the Master DRAB CSR register bits 10 through 12 identify that Device Port.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT. Follow repair action 34.</li> </ul> |
| 2A   | <p>A Multiple Bit ECC error was detected by the CACHEB0 or CACHEB1 DRAB where</p> <ul style="list-style-type: none"> <li>■ The CACHEBn DRAB DER register bits 0 through 6 contain the syndrome value.</li> <li>■ The CACHEBn DRAB EAR register combined with the Master DRAB RSR register bits 12 through 15 (CACHEB memory region) yields the affected memory address.</li> <li>■ The CACHEBn DRAB EDR register contains the error data.</li> <li>■ If the failure involved a Device Port, the Master DRAB CSR register bits 10 through 12 identify that Device Port.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT. Follow repair action 34.</li> </ul> |

**Table B-13 Repair Action Codes (sheet 5 of 10)**

| Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2B   | <p>The Master DRAB detected an Ibus to Nbus Timeout condition.</p> <p>For each of the following conditions, a firmware fault is indicated; follow repair action 01. Otherwise, follow repair action 36:</p> <ul style="list-style-type: none"> <li>■ Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT.</li> <li>■ Master DRAB CSR register bits 10 through 12 contains the value 1 and WDR1 register bit 26 is clear.</li> <li>■ Master DRAB CSR register bits 10 through 12 contains the value 2 and WDR1 register bit 27 is clear.</li> <li>■ Master DRAB CSR register bits 10 through 12 contains the value 3 and WDR1 register bit 28 is clear.</li> <li>■ Master DRAB CSR register bits 10 through 12 contains the value 4 and WDR1 register bit 29 is clear.</li> <li>■ Master DRAB CSR register bits 10 through 12 contains the value 5 and WDR1 register bit 30 is clear.</li> <li>■ Master DRAB CSR register bits 10 through 12 contains the value 6 and WDR1 register bit 31 is clear.</li> </ul> |
| 2C   | <p>The Master DRAB detected a Nonexistent Memory Error condition where:</p> <ul style="list-style-type: none"> <li>■ The Master DRAB EAR register combined with Master DRAB ERR bits 0 through 3 (address region) yields the affected memory address.</li> <li>■ The Master DRAB EDR register contains the error data.</li> <li>■ If the failure involved a Device Port, the Master DRAB CSR register bits 10 through 12 identify that Device Port.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT. Follow repair action 36.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 2D   | <p>The CACHEA0 or CACHEA1 DRAB detected a Nonexistent Memory Error condition where:</p> <ul style="list-style-type: none"> <li>■ The CACHEAn DRAB EAR register combined with the Master DRAB RSR register bits 8 through 11 (CACHEA memory region) yields the affected memory address.</li> <li>■ The CACHEAn DRAB EDR register contains the error data.</li> <li>■ If the failure involved a Device Port, the Master DRAB CSR register bits 10 through 12 identify that Device Port.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT. Follow repair action 36.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                |



**Table B-13 Repair Action Codes (sheet 6 of 10)**

| Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2E   | <p>The CACHEB0 or CACHEB1 DRAB detected a Nonexistent Memory Error condition where:</p> <ul style="list-style-type: none"> <li>■ The CACHEBn DRAB EAR register combined with the Master DRAB RSR register bits 12 through 15 (CACHEB memory region) yields the affected memory address.</li> <li>■ The CACHEBn DRAB EDR register contains the error data.</li> <li>■ If the failure involved a Device Port, the Master DRAB CSR register bits 10 through 12 identify that Device Port.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT. Follow repair action 36.</li> </ul>                                                                                                                                                                                                                                          |
| 2F   | <p>The Master DRAB detected an Address Parity Error or a Write Data Parity Error condition where:</p> <ul style="list-style-type: none"> <li>■ The Master DRAB EAR register combined with Master DRAB ERR bits 0 through 3 (address region) yields the affected memory address.</li> <li>■ The Master DRAB EDR register contains the error data.</li> <li>■ If the failure involved a Device Port, the Master DRAB CSR register bits 10 through 12 identify that Device Port.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT.</li> <li>■ For Write Data Parity Error conditions, Bits 0—3 of the Master DRAB CSR register identify the byte in error.</li> <li>■ For Address Parity Error conditions follow repair action 34.</li> <li>■ For Write Data Parity Error conditions follow repair action 35.</li> </ul> |

**Table B-13 Repair Action Codes (sheet 7 of 10)**

| Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 30   | <p>The CACHEA0 or CACHEA1 DRAB detected an Address Parity Error or a Write Data Parity Error condition where:</p> <ul style="list-style-type: none"> <li>■ If the failure occurred during a memory refresh attempt, the CACHEAn DRAB EAR register combined with the Master DRAB RSR register bits 8 through 11 (CACHEA memory region) yields the affected memory address.</li> <li>■ If the failure occurred during a memory access attempt, the CACHEA0 DRAB EAR register combined with the Master DRAB RSR register bits 8 through 11 (CACHEA memory region) or bits 20 through 23 (CACHEA DRAB register region) yields the affected memory address.</li> </ul> <p>No other information is available to distinguish a memory region access from a DRAB register region access.</p> <ul style="list-style-type: none"> <li>■ The CACHEAn DRAB EDR register contains the error data.</li> <li>■ If the failure involved a Device Port, the Master DRAB CSR register bits 10 through 12 identify that Device Port.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the DRAB_INT.</li> <li>■ For Write Data Parity Error conditions bits 0 through 3 of the CACHEAn DRAB CSR register identify the byte in error.</li> <li>■ For Address Parity Error conditions follow repair action 34. For Write Data Parity Error conditions follow repair action 35.</li> </ul> |

**Table B-13 Repair Action Codes (sheet 8 of 10)**

| Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 31   | <p>The CACHEB0 or CACHEB1 DRAB detected an Address Parity Error or a Write Data Parity Error condition:</p> <ul style="list-style-type: none"> <li>■ If the failure occurred during a memory refresh attempt, the CACHEBn DRAB EAR register combined with the Master DRAB RSR register bits 8 through 11 (CACHEB memory region) yields the affected memory address.</li> <li>■ If the failure occurred during a memory access attempt, the CACHEB0 DRAB EAR register combined with the Master DRAB RSR register bits 8 through 11 (CACHEB memory region) or bits 20 through 23 (CACHEB DRAB register region) yields the affected memory address.</li> </ul> <p>No other information is available to distinguish a memory region access from a DRAB register region access.</p> <ul style="list-style-type: none"> <li>■ The CACHEBn DRAB EDR register contains the error data.</li> <li>■ If the failure involved a Device Port, the Master DRAB CSR register bits 10 through 12 identify that Device Port.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT.</li> <li>■ For Write Data Parity Error conditions bits 0 through 3 of the CACHEBn DRAB CSR register identify the byte in error.</li> <li>■ For Address Parity Error conditions, follow repair action 34.</li> <li>■ For Write Data Parity Error conditions, follow repair action 35.</li> </ul> |
| 32   | <p>The Master DRAB detected an Ibus Parity Error condition where:</p> <ul style="list-style-type: none"> <li>■ The Master DRAB EAR register combined with the Master DRAB ERR bits 4 through 7 (address region) yields the affected memory address.</li> <li>■ The Master DRAB EDR register contains the error data.</li> <li>■ If Master DRAB DSR register bit 14 is set, the failure was reported via the NMI.</li> <li>■ If Master DRAB DSR register bit 14 is clear, the failure was reported via the DRAB_INT.</li> <li>■ If bits 20 through 23 of the Master DRAB DCSR register contain a nonzero value, a firmware fault is indicated; follow repair action 01; otherwise, follow repair action 36.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 33   | <p>This event report contains supplemental information related to a Memory System Failure event report delivered earlier. Use the Instance Code contained in the Memory Address field of this event report to correlate this event report with the other event report.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 34   | <p>If Bit 31 of the DCSR register of the DRAB that detected the failure is set, a firmware fault is indicated; follow repair action 01; otherwise, follow repair action 36.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 35   | <p>If bits 20 through 23 of the WDR1 register contain a nonzero value, a firmware fault is indicated; follow repair action 01. Otherwise, follow repair action 36.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |

**Table B-13 Repair Action Codes (sheet 9 of 10)**

| Code | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 36   | Use the following sequence to find the cause of this error: <ul style="list-style-type: none"> <li>■ If the Master DRAB detected the failure, follow repair action 20.</li> <li>■ If the CACHEAn or CACHEBn DRAB detected the failure, follow repair action 22.</li> <li>■ If the problem persists, follow repair action 01.</li> </ul>                                                                                                                                                                                                   |
| 37   | The Memory System Failure translator could not determine the failure cause.<br>Follow repair action 01.                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 38   | Replace the indicated cache memory SIMM.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 40   | <ul style="list-style-type: none"> <li>■ If the Sense Data FRU field is non-zero follow repair action 41.</li> <li>■ If the Sense Data FRU field is zero, replace the appropriate FRU associated with the device SCSI interface or the entire device.</li> </ul>                                                                                                                                                                                                                                                                          |
| 41   | Consult the device maintenance manual for guidance on replacing the indicated device FRU.                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 43   | Update the configuration data to correct the problem.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 44   | Replace the SCSI cable for the failing SCSI bus.<br><br>If the problem persists, replace the <ul style="list-style-type: none"> <li>■ Controller backplane,</li> <li>■ Drive backplane, or</li> <li>■ Controller module.</li> </ul>                                                                                                                                                                                                                                                                                                       |
| 45   | Interpreting the device supplied Sense Data is beyond the scope of the controller firmware. See the device service manual to determine the appropriate repair action, if any.                                                                                                                                                                                                                                                                                                                                                             |
| 50   | The RAIDset is inoperative for one or more of the following reasons: <ul style="list-style-type: none"> <li>■ More than one member malfunctioned—perform repair action 55.</li> <li>■ More than one member is missing—perform repair action 58.</li> <li>■ Before reconstruction of a previously replaced member completes another member becomes missing or malfunctions—perform repair action 59.</li> <li>■ The members have been moved around and the consistency checks show mismatched members—perform repair action 58.</li> </ul> |
| 51   | The mirrorset is inoperative for one or more of the following reasons: <ul style="list-style-type: none"> <li>■ The last NORMAL member has malfunctioned—perform repair actions 55 and 59.</li> <li>■ The last NORMAL member is missing—perform repair action 58.</li> <li>■ The members have been moved around and the consistency checks show mismatched members—perform repair action 58.</li> </ul>                                                                                                                                   |
| 52   | The indicated Stageset member was removed for one of the following reasons:<br>The member malfunctioned—perform repair action 56.<br>By operator command—perform repair action 57.                                                                                                                                                                                                                                                                                                                                                        |

**Table B-13 Repair Action Codes (sheet 10 of 10)**

| Code | Description                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 53   | The storageset may be in a state that prevents the adding of a replacement member.<br>Check the state of the storageset and its associated unit and resolve the problems found before adding the replacement member.                                                                                                                                                                                                  |
| 54   | The device may be in a state that prevents adding it as a replacement member or may not be large enough for the storageset.<br>Use another device for the ADD action and perform repair action 57 for the device that failed to be added.                                                                                                                                                                             |
| 55   | Perform the repair actions indicated in any and all event reports found for the devices that are members of the storageset.                                                                                                                                                                                                                                                                                           |
| 56   | Perform the repair actions indicated in any and all event reports found for the member device that was removed from the storageset. Then perform repair action 57.                                                                                                                                                                                                                                                    |
| 57   | Delete the device from the failedset and redeploy (perhaps by adding it to the spareset so it will be available to be used to replace another failing device).                                                                                                                                                                                                                                                        |
| 58   | Install the physical devices that are members of the storageset in the proper port, target, and LUN locations.                                                                                                                                                                                                                                                                                                        |
| 59   | Delete the storageset, recreate it with the appropriate ADD, INITIALIZE, and ADD UNIT commands and reload its contents from backup storage.                                                                                                                                                                                                                                                                           |
| 5A   | Restore the mirrorset data from backup storage.                                                                                                                                                                                                                                                                                                                                                                       |
| 69   | An unrecoverable fault occurred at the host port:<br><ul style="list-style-type: none"> <li>■ There may be more than one entity attempting to use the same SCSI ID number, or</li> <li>■ Some other bus-configuration error may have occurred, such as improper termination.</li> </ul> If you don't find any SCSI host bus configuration problems, follow repair action 01.                                          |
| 80   | An EMU fault has occurred.                                                                                                                                                                                                                                                                                                                                                                                            |
| 81   | The EMU reported terminator power out of range. Replace the indicated I/O modules.                                                                                                                                                                                                                                                                                                                                    |
| 83   | An EMU has become unavailable:<br><ul style="list-style-type: none"> <li>■ If the EMU and its enclosure have been removed from the subsystem, no action is required.</li> <li>■ If the enclosure has lost power, restore power to the enclosure.</li> <li>■ If the EMU-to-EMU cable has been disconnected or is broken, reconnect or replace the cable.</li> <li>■ If the EMU has failed, replace the EMU.</li> </ul> |

**Table B-14 Component Identifier Codes**

| <b>Code</b> | <b>Description</b>                                                |
|-------------|-------------------------------------------------------------------|
| 01          | Executive Services                                                |
| 02          | Value Added Services                                              |
| 03          | Device Services                                                   |
| 04          | Fault Manager                                                     |
| 05          | Common Library Routines                                           |
| 06          | Dual Universal Asynchronous Receiver/Transmitter Services (DUART) |
| 07          | Failover Control                                                  |
| 08          | Nonvolatile Parameter Memory Failover Control                     |
| 09          | Facility Lock Manager                                             |
| 0A          | Integrated Logging Facility                                       |
| 20          | Command Line Interpreter                                          |
| 43          | Host Port Protocol Layer                                          |
| 44          | Host Port Transport Layer                                         |
| 64          | SCSI Host Value Added Services                                    |
| 80          | Disk Inline Exercise (DILX)                                       |
| 82          | Subsystem Built-In Self Tests (BIST)                              |
| 83          | Device Configuration Utilities (CONFIG/CFMENU)                    |
| 84          | Clone Unit Utility (CLONE)                                        |
| 85          | Format and Device Code Load Utility (HSUTIL)                      |
| 86          | Code Load/Code Patch Utility (CLCP)                               |
| 8A          | Field Replacement Utility (FRUTIL)                                |

**Table B-15 Event Notification/Recovery Threshold Classifications**

| Threshold Value | Classification | Description                                                                                                                                                                                                                                                                                                                                           |
|-----------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01              | IMMEDIATE      | Failure or potential failure of a component critical to proper controller operation is indicated; immediate attention is required.                                                                                                                                                                                                                    |
| 02              | HARD           | Failure of a component that affects controller performance or precludes access to a device connected to the controller is indicated.                                                                                                                                                                                                                  |
| 0A              | SOFT           | An unexpected condition detected by one of the following: <ul style="list-style-type: none"> <li>■ A controller firmware component (e.g., protocol violations, host buffer access errors, internal inconsistencies, uninterpreted device errors, etc.)</li> <li>■ An intentional restart or shutdown of controller operation is indicated.</li> </ul> |
| 64              | INFORMATIONAL  | An event having little or no effect on proper controller or device operation is indicated.                                                                                                                                                                                                                                                            |

**Table B-16 ASC and ASCQ Codes (sheet 1 of 3)**

| ASC Code | ASCQ Code | Description                                                             |
|----------|-----------|-------------------------------------------------------------------------|
| 3F       | 85        | Test Unit Ready or Read Capacity Command failed                         |
| 3F       | 87        | Drive failed by a Host Mode Select command.                             |
| 3F       | 88        | Drive failed due to a deferred error reported by drive.                 |
| 3F       | 90        | Unrecovered Read/Write error.                                           |
| 3F       | C0        | No response from one or more drives.                                    |
| 3F       | C2        | NV memory and drive metadata indicate conflicting drive configurations. |
| 3F       | D2        | Synchronous Transfer Value differences between drives.                  |
| 80       | 00        | Forced error on Read                                                    |
| 82       | 01        | No Command control structures available.                                |
| 84       | 04        | Command failed - SCSI ID verification failed.                           |
| 85       | 05        | Data returned from drive is invalid.                                    |
| 89       | 00        | Request Sense command to drive failed.                                  |

**Table B-16 ASC and ASCQ Codes (sheet 2 of 3)**

| <b>ASC Code</b> | <b>ASCQ Code</b> | <b>Description</b>                                   |
|-----------------|------------------|------------------------------------------------------|
| 8A              | 00               | Illegal command for pass through mode.               |
| 8C              | 04               | Data transfer request error.                         |
| 8F              | 00               | Premature completion of a drive command.             |
| 93              | 00               | Drive returned vendor unique sense data.             |
| A0              | 00               | Last failure event report.                           |
| A0              | 01               | Nonvolatile parameter memory component event report. |
| A0              | 02               | Backup battery failure event report.                 |
| A0              | 03               | Subsystem built-in self test failure event report.   |
| A0              | 04               | Memory system failure event report.                  |
| A0              | 05               | Failover event report.                               |
| A0              | 07               | RAID membership event report.                        |
| A0              | 08               | Multiple Bus failover event.                         |
| A0              | 09               | Multiple Bus failback event.                         |
| A1              | 00               | Shelf OK is not properly asserted.                   |
| A1              | 01               | Unable to clear SWAP interrupt. Interrupt disabled.  |
| A1              | 02               | Swap interrupt re-enabled.                           |
| A1              | 03               | Asynchronous SWAP detected.                          |
| A1              | 04               | Controller shelf OK is not properly asserted.        |
| A1              | 0A               | EMU fault: Power Supplies not OK.                    |
| A1              | 0B               | EMU fault: Fans not OK.                              |
| A1              | 0C               | EMU fault: Temperature not OK.                       |
| A1              | 0D               | EMU fault: External Air Sense not OK.                |
| A1              | 10               | Power supply fault is now fixed.                     |
| A1              | 11               | Fans fault is now fixed.                             |
| A1              | 12               | Temperature fault is now fixed.                      |
| A1              | 13               | External Air Sense fault is now fixed.               |
| A1              | 14               | Controller vendor specific                           |



**Table B-16 ASC and ASCQ Codes (sheet 3 of 3)**

| ASC Code | ASCQ Code | Description                                                   |
|----------|-----------|---------------------------------------------------------------|
| A1       | 15        | Controller vendor specific                                    |
| B0       | 00        | Command timeout.                                              |
| B0       | 01        | Watchdog timer timeout.                                       |
| D0       | 01        | Disconnect timeout.                                           |
| D0       | 02        | Chip command timeout.                                         |
| D0       | 03        | Byte transfer timeout.                                        |
| D1       | 00        | Bus errors.                                                   |
| D1       | 02        | Unexpected bus phase.                                         |
| D1       | 03        | Disconnect expected.                                          |
| D1       | 04        | ID Message not sent.                                          |
| D1       | 05        | Synchronous negotiation error.                                |
| D1       | 07        | Unexpected disconnect.                                        |
| D1       | 08        | Unexpected message.                                           |
| D1       | 09        | Unexpected tag message.                                       |
| D1       | 0A        | Channel busy.                                                 |
| D1       | 0B        | Device initialization failure. Device sense data available.   |
| D2       | 00        | Miscellaneous SCSI driver error.                              |
| D2       | 03        | Device services had to reset the bus.                         |
| D3       | 00        | Drive SCSI chip reported gross error.                         |
| D4       | 00        | Non-SCSI bus parity error.                                    |
| D5       | 02        | Message Reject received on a valid message.                   |
| D7       | 00        | Source driver programming error.                              |
| E0       | 03        | Fault Manager detected an unknown error code.                 |
| E0       | 06        | Maximum number of errors for this I/O exceeded.               |
| E0       | 07        | Drive reported recovered error without transferring all data. |



# Glossary

|                   |                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Adapter</b>    | A device that converts the protocol and hardware-interface of one bus type into that of another without changing the functionality of the bus.                                                                                                                                                                                                                                                                                            |
| <b>BBR</b>        | Bad block replacement. The procedure used to locate a replacement block, mark the bad block as replaced, and move the data from the bad block to the replacement block.                                                                                                                                                                                                                                                                   |
| <b>BBU</b>        | Battery backup unit. A StorageWorks SBB option that extends power availability after the loss of primary ac power or a power supply to protect against the corruption or loss of data.                                                                                                                                                                                                                                                    |
| <b>Block</b>      | The smallest data unit addressable on a disk. Also called a sector. In integrated storage elements, a block contains 512 bytes of data, EDC, ECC, flags, and the block's address header.                                                                                                                                                                                                                                                  |
| <b>CDU</b>        | Cable distribution unit. The power entry device for StorageWorks cabinets. The unit provides the connections necessary to distribute ac power to cabinet shelves and fans.                                                                                                                                                                                                                                                                |
| <b>CLI</b>        | Command line interpreter. Operator command line interface for the HS family controller firmware.                                                                                                                                                                                                                                                                                                                                          |
| <b>Container</b>  | <p>A term given to:</p> <ul style="list-style-type: none"><li>■ Any entity that is capable of storing data, whether it is a physical device or a group of physical devices.</li><li>■ A virtual, internal, controller structure representing either a single disk or a group of disk drives linked as a storageset.</li></ul> <p>Stripesets and mirrorsets are examples of storageset containers the controller uses to create units.</p> |
| <b>Controller</b> | A hardware/software device that facilitates communications between a host and one or more devices organized in an array. The HSZ70 controller is an example of an array controller.                                                                                                                                                                                                                                                       |

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Controller shelf</b>             | A StorageWorks shelf designed to contain controller and cache modules.                                                                                                                                                                                                                                                                                                                                                 |
| <b>Data center cabinet</b>          | A generic reference to the large cabinets, such as the SW800-series, in which StorageWorks components can be mounted.                                                                                                                                                                                                                                                                                                  |
| <b>Differential SCSI bus</b>        | A signal's level is determined by the potential difference between two wires. A differential bus is more robust and less subject to electrical noise than is a single-ended bus.                                                                                                                                                                                                                                       |
| <b>DILX</b>                         | Disk inline exerciser. Diagnostic firmware used to test the data transfer capabilities of disk drives in a way that simulates a high level of user activity.                                                                                                                                                                                                                                                           |
| <b>Dual-redundant configuration</b> | Two controllers in one controller shelf providing the ability for one controller to take over the work of the other controller in the event of a failure of the other controller.                                                                                                                                                                                                                                      |
| <b>DUART</b>                        | Dual universal asynchronous receiver/transmitter. An integrated circuit containing two serial, asynchronous transceiver circuits.                                                                                                                                                                                                                                                                                      |
| <b>DWZZA, B, C</b>                  | StorageWorks compatible SCSI bus signal converters: <ul style="list-style-type: none"><li>■ DWZZA is a SCSI-2 compliant single-ended to differential bus converter (8-bit).</li><li>■ DWZZB is a SCSI-2 compliant single-ended to differential bus converter (16-bit).</li><li>■ DWZZC is an UltraSCSI compliant single-ended to single-ended extender, as well as a differential-to-single-ended converter.</li></ul> |
| <b>ECB</b>                          | External cache battery.                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>ECC</b>                          | Error correction code. One or more cyclic redundancy check (CRC) words that allow detection of a mismatch between transmitted and received data in a communications system, or between stored and retrieved data in a storage system. The ECC allows for location and correction of an error in the received/retrieved data. All ECCs have limited correction power.                                                   |

|                           |                                                                                                                                                                                                                                                                                       |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EDC</b>                | Error detection code. One or more checksum words that allow detection of a mismatch between transmitted and received data in a communications system, or between stored and retrieved data in a storage system. The EDC has no data correction capability.                            |
| <b>ESD</b>                | Electrostatic discharge. The discharge of a potentially harmful static electric voltage as a result of improper grounding.                                                                                                                                                            |
| <b>Failback</b>           | The process of restoring data access to the newly-restored controller in a dual-redundant controller configuration (see Failover).                                                                                                                                                    |
| <b>Failedset</b>          | A group of disk drives that have been removed from RAIDsets due to a failure or a manual removal. Disk drives in the failedset should be considered defective and should be tested, repaired, and then placed into the spareset.                                                      |
| <b>Failover</b>           | The process that takes place when one controller in a dual-redundant configuration assumes the workload of a failed controller.                                                                                                                                                       |
| <b>Flush</b>              | The act of writing data from the cache module to the media.                                                                                                                                                                                                                           |
| <b>FRU</b>                | Field replaceable unit. A hardware component that can be replaced.                                                                                                                                                                                                                    |
| <b>FWD SCSI</b>           | Fast, wide, differential SCSI. The differential SCSI bus with a 16-bit parallel data path that yields a transfer rate of up to 20 MB/s.                                                                                                                                               |
| <b>Half-height device</b> | A device that occupies half of a 5.25 inch SBB carrier. Two half-height devices can be mounted in a 5.25 inch SBB carrier. The first half-height device is normally mounted in the lower part of the carrier. The second device is normally mounted in the upper part of the carrier. |
| <b>HBVS</b>               | Host-based volume shadowing. Also known as Phase 2 volume shadowing.                                                                                                                                                                                                                  |
| <b>HSOF</b>               | Hierarchical storage operating firmware. Software contained on a program card that provides the logic for the HS array controllers.                                                                                                                                                   |
| <b>HIS</b>                | Host interconnect services. The firmware in the HS array controller that communicates with the host.                                                                                                                                                                                  |
| <b>Host</b>               | Any computer to which a storage subsystem can be attached.                                                                                                                                                                                                                            |

|                                    |                                                                                                                                                                                                                                                                                                                        |
|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Hot swap</b>                    | A method of replacing a device whereby the system that contains the device remains online and active during replacement. The device being replaced is the only device that cannot perform operations during a hot swap.                                                                                                |
| <b>Initiator</b>                   | A SCSI device that requests an I/O process to be performed by another SCSI device (a target). This is always the controller.                                                                                                                                                                                           |
| <b>Local terminal</b>              | Any EIA-423 compatible terminal plugged into the controller maintenance port. This terminal may be used to identify the controller, enable host paths, define the initial configuration, and check controller status. It is not required for normal operations. It is sometimes referred to as a maintenance terminal. |
| <b>Logical unit</b>                | The physical device or storage unit seen by the host. Often these logical units are spread across more than one physical device, especially in RAID implementations. This is not the same as a logical unit number (LUN).                                                                                              |
| <b>Logical Unit Number</b>         | See LUN.                                                                                                                                                                                                                                                                                                               |
| <b>LRU</b>                         | Least recently used. Cache terminology for the block replacement policy for the read cache.                                                                                                                                                                                                                            |
| <b>LUN</b>                         | A logical unit number is a physical or virtual peripheral device addressable through a target. LUNs use their target's bus connection to communicate on the SCSI bus.                                                                                                                                                  |
| <b>Metadata</b>                    | Data written on the physical disk that is not visible to the host/customer that allows the HS array controller to maintain a high integrity of customer data.                                                                                                                                                          |
| <b>Mirrorset</b>                   | Two or more physical disks configured to present one highly reliable virtual unit to the host.                                                                                                                                                                                                                         |
| <b>Non-redundant configuration</b> | A single controller configuration. A controller configuration which does not include an second backup controller permitting failover in the event of a failure.                                                                                                                                                        |
| <b>Normal member</b>               | A mirrorset member whose entire contents is guaranteed to be the same as all other NORMAL members. All NORMAL members are exactly equivalent.                                                                                                                                                                          |

|                           |                                                                                                                                                                                                                                                                                   |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Normalizing member</b> | A mirrorset member whose contents is the same as all other NORMAL and NORMALIZING members for data that has been written since the mirrorset was created or lost cache data was cleared. Data that has never been written may differ among NORMALIZING members.                   |
| <b>NVMEM</b>              | Nonvolatile memory. A term used to describe memory that can retain data during a power loss to the controller.                                                                                                                                                                    |
| <b>Partition</b>          | A percentage of a storageset or single-disk unit that may be presented to the host as a storage unit.                                                                                                                                                                             |
| <b>Partitioning</b>       | Device partitioning is the process of dividing up a single large container into a number of smaller containers.                                                                                                                                                                   |
| <b>Port</b>               | The hardware and software used to connect a host controller to a communication bus, such as CI, DSSI, or SCSI bus. This term also is used to describe the connection between the controller and its SCSI storage devices.                                                         |
| <b>PTL</b>                | <b>Port-Target-LUN</b> —a method of device notation where: <ul style="list-style-type: none"><li>■ P = the controller's device port (1-6).</li><li>■ T = the target ID of the device (0-5).</li><li>■ L = the LUN of the device (0-7).</li></ul>                                  |
| <b>Qualified device</b>   | A device that has been fully tested in an approved StorageWorks configuration, (that is, shelf, cabinet, power supply, cabling, and so forth) and is in complete compliance with country-specific standards (for example, FCC, TUV, and so forth) and with all Digital standards. |
| <b>Quiesce</b>            | To make a device bus (port) inactive or dormant. For example, the operator must <i>quiesce</i> SCSI bus operations during a device warm swap.                                                                                                                                     |
| <b>RAID</b>               | <b>Redundant array of independent disks.</b> The multiple storage access methods devised for performance (RAID 0, striping) and/or various cost levels of availability (RAID 1 through RAID 5).                                                                                   |
| <b>RAIDset</b>            | Three or more physical disks that are configured to present an array of disks as a single virtual unit to the host.                                                                                                                                                               |

|                                        |                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Read cache</b>                      | The cache used to accelerate read operations by retaining data which has been previously read, written, or erased, based on a prediction that it will be reread.                                                                                                                                                                                             |
| <b>Replacement policy</b>              | The method by which a spare disk is selected to replace a disk that has failed in a RAIDset.                                                                                                                                                                                                                                                                 |
| <b>SBB</b>                             | StorageWorks <b>B</b> uilding <b>B</b> lock. A modular carrier plus the individual mechanical and electromechanical interface required to mount the device into a standard StorageWorks shelf. Any device conforming to shelf mechanical and electrical standards is considered an SBB.                                                                      |
| <b>SBB shelf</b>                       | A StorageWorks shelf, such as the DS-BA350--Sx, designed to house plug-in SBB modules.                                                                                                                                                                                                                                                                       |
| <b>SCSI</b>                            | <b>S</b> mall <b>C</b> omputer <b>S</b> ystem <b>I</b> nterface. An ANSI interface defining the physical and electrical parameters of a parallel I/O bus used to connect a maximum of 15 devices. The StorageWorks device interface is implemented according to SCSI-2 standard, allowing the synchronous transfer of 16-bit data at rates of up to 40 MB/s. |
| <b>SCSI device</b>                     | A host computer adapter, a peripheral controller, or a storage element that can be attached to the SCSI bus.                                                                                                                                                                                                                                                 |
| <b>SCSI device ID</b>                  | The bit-significant representation of the SCSI addressing that refers to one of the signal lines numbered 0 through 15. Also referred to as a target ID.                                                                                                                                                                                                     |
| <b>SCSI-A cable</b>                    | A 50-conductor (25 twisted pair) cable used for single-ended, SCSI bus connectors.                                                                                                                                                                                                                                                                           |
| <b>SCSI-P cable</b>                    | A 68-conductor (34 twisted pair) cable used for differential bus connectors.                                                                                                                                                                                                                                                                                 |
| <b>Small Computer System Interface</b> | See SCSI.                                                                                                                                                                                                                                                                                                                                                    |
| <b>Spareset</b>                        | A pool of disk drives used by the controller to replace failed members of a RAIDset or mirrorset.                                                                                                                                                                                                                                                            |
| <b>SPD</b>                             | <b>S</b> oftware <b>P</b> roduct <b>D</b> escription. A document that contains the legal description of a product.                                                                                                                                                                                                                                           |



|                                    |                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Storage set</b>                 | Any collection of containers, such as partitions, stripesets, RAIDsets, the spareset, and the failedset, that make up a container.                                                                                                                                                                                                                |
| <b>Storage unit</b>                | The general term that refers to storage sets, single disk units, and all other storage devices that can be installed in your subsystem and accessed by a host. A storage unit can be any entity that is capable of storing data, whether it is a physical device or a group of physical devices (see Container).                                  |
| <b>StorageWorks</b>                | A family of Compaq Computer Corporation's modular data storage products that allows customers to design and configure their own storage subsystems. Components include power, packaging, cabling, devices, controllers, and software. Customers can integrate devices and array controllers in StorageWorks enclosure to form storage subsystems. |
| <b>StorageWorks Building Block</b> | See SBB.                                                                                                                                                                                                                                                                                                                                          |
| <b>Stripeset</b>                   | A virtual disk drive with its physical data spread across multiple physical disks. Stripeset configurations do not include a data recovery mechanism.                                                                                                                                                                                             |
| <b>Striped mirrorset</b>           | Stripesets whose members have been mirrored.                                                                                                                                                                                                                                                                                                      |
| <b>Tagged command queuing</b>      | A SCSI feature that allows a device to have multiple I/O requests outstanding to it at one time.                                                                                                                                                                                                                                                  |
| <b>Target</b>                      | A SCSI device that performs an operation requested by an initiator. The target number is determined by the device's address on its SCSI bus.                                                                                                                                                                                                      |
| <b>Unit</b>                        | The host view of a container on an HSxxx array controller. A unit may be made up of simply a physical disk or tape drive, or a more complex container such as a RAIDset.                                                                                                                                                                          |
| <b>Unwritten cached data</b>       | Data in the write-back cache which has not yet been written to the physical device, but the user has been notified that the data has been written.                                                                                                                                                                                                |
| <b>VCS</b>                         | VAXcluster console system.                                                                                                                                                                                                                                                                                                                        |

|                            |                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Virtual terminal</b>    | A software path from an operator terminal on the host to the controller's CLI. The path can be established via the host port on the controller (using DUP) or via the maintenance port through an intermediary host (VCS). A virtual terminal is also sometimes called a host console.                                                                                                           |
| <b>Warm swap</b>           | A method for adding or replacing a device whereby the system remains online, but all activity on the device bus must be halted for the duration of the swap.                                                                                                                                                                                                                                     |
| <b>Write-back caching</b>  | A caching strategy that writes data to the cache memory, then flushes the data to the intended device at some future time. From the user perspective, the write operation is complete when the data is stored in the cache memory. This strategy avoids unnecessary access of the devices.                                                                                                       |
| <b>Write hole</b>          | Undetectable RAID level 1 or 5 data corruption. A write hole is caused by the successful writing of some, but not all, of the storage set members. Write holes occur under conditions such as power outages, where the writing of multiple members can be abruptly interrupted. A battery backed-up cache design eliminates the write hole, because data is preserved and writes can be retried. |
| <b>Write-through cache</b> | A cache write strategy in which the destination of the write data is the primary storage media. This operation may update, invalidate, or delete data from the cache memory accordingly, to ensure that the cache does not contain obsolete data. The user sees the operation as complete only after the backup storage device has been updated.                                                 |

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