StorageWorks™ Array Controllers

HS Family of Array Controllers Service Manual

Order Number: EK–HSFAM–SV. B01

This manual contains necessary servicing information for the HS family of array controllers. Information included pertains to configuration, normal operating procedures, troubleshooting and error analysis, field replaceable units, and removal and replacement procedures.

Digital Equipment Corporation
Maynard, Massachusetts

April 1994

NOTE: This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

Any changes or modifications made to this equipment may void the user's authority to operate the equipment.

Operation of this equipment in a residential area may cause interference, in which case the user at his own expense will be required to take whatever measures may be needed to correct the interference.

The postpaid READER'S COMMENTS card requests the user's critical evaluation to assist in preparing future documentation.

This document was prepared using VAX DOCUMENT Version 2.1.

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Preface

This manual describes how to maintain and service the HS family of array controllers. The manual details configuration, controls and indicators, normal operating procedures, error reporting, troubleshooting and fault analysis, field replaceable units (FRUs), and removal and replacement procedures.

Intended Audience

This manual is intended for Digital™ Mutlivendor Services Personnel and customers who need assistance in operating and maintaining the HS array controllers.

Familiarity with the *StorageWorks Array Controllers HS Family of Array Controllers User's Guide* is assumed.

Structure

This manual contains the following chapters:

Chapter 1	Provides an overview of the HS controllers.
Chapter 2	Provides a technical explanation of HS controller hardware and firmware.
Chapter 3	Defines physical configuration rules for the HS controller subsystem.
Chapter 4	Provides operation and configuration instructions.
Chapter 5	Discusses how to translate error information and perform initial fault analysis.
Chapter 6	Details the diagnostics, inline exercisers, and utilities for the HS controllers.
Chapter 7	Provides procedures for the removal and replacement of FRUs.
Appendix A	Lists the HS controller FRUs, including part numbers and related FRUs.
Appendix B	Provides complete details for CLI commands and their usage.
Appendix C	Describes HSJ-series controller error logging.
Appendix D	Describes HSD-series controller error logging.
Appendix E	Describes HSZ-series controller error logging.
Glossary	Lists acronyms and terms specific to the HS controllers.

Related Documentation

Table 1 lists documents containing information related to this product.

Table 1 Related Documentation

Document Title	Order Number
HSJxx Array Controller Software Product Description (SPD47.26.04)	AE–PYTGA–TE
HSD30 Array Controller Software Product Description (SPD53.53.00)	AE–Q6HKA–TE
HSZ40 Array Controller Software Product Description (SPD53.54.00)	AE–Q6HMA–TE
StorageWorks Array Controllers HS Family of Array Controllers Pocket Service Guide	EK–HSFAM–PS
StorageWorks Array Controllers HS Family of Array Controllers User's Guide	EK–HSFAM–UG
StorageWorks Array Controllers HSJ40 and HSJ30 Array Controller Operating Firmware Release Notes	EK–HSFAM–RN
StorageWorks Array Controllers HSD30 Array Controller Operating Firmware Release Notes	EK–HSD30–RN
StorageWorks Array Controllers HSZ40 Array Controller Operating Firmware Release Notes	EK–HSZ40–RN
StorageWorks Solutions Building Block User's Guide	EK–SBB35–UG
StorageWorks Solutions Controller Shelf User's Guide	EK–350MA–UG
StorageWorks Solutions Configuration Guide	EK–BA350–CG
StorageWorks Solutions Shelf and SBB User's Guide	EK–BA350–UG
StorageWorks Solutions Shelf Metric Mounting Kit User's Guide	EK–35XRD–IG
StorageWorks Solutions SW800-Series Data Center Cabinet Installation and User's Guide	EK–SW800–IG
StorageWorks Solutions SW800-Series Data Center Cabinet Cable Distribution Unit Installation Sheet	EK–SWCDU–IS
StorageWorks Solutions SW500-Series Cabinet Installation and User's Guide	EK–SW500–IG
StorageWorks Solutions SW500-Series Cabinet Cable Distribution Unit Installation Sheet	EK–SW5CU–IS
The Digital Guide to RAID Storage Technology	EC–B1960–45
VAXcluster Console System User's Guide	AA–GV45D–TE
VAXcluster Systems Guidelines for VAXcluster System Configurations	EK–VAXCS–CG

Documentation Conventions

The following conventions are used in this manual:

boldface type	Boldface type in examples indicates user input. Boldface type in text indicates the first instance of terms defined in either the text, the glossary, or both.
italic type	Italic type indicates emphasis, variables in command strings, and complete manual titles.
UPPERCASE	Words in uppercase text indicate a command, the name of a file, or an abbreviation for a system privilege.
Ctrl/*x*	CTRL/*x* indicates that you hold down the Ctrl key while you press another key, indicated by *x*. For DILX and TILX, the caret symbol (^) is equivalent to the Ctrl key and these same instructions apply.
CDROM	This refers to both a command and a hardware device. The proper usage of CD–ROM with a hyphen is not used to avoid reader confusion.
HSJ-series	This refers to all CI-based controllers covered in this manual, as listed in Table 1–1.
HSD-series	This refers to all DSSI-based controllers covered in this manual, as listed in Table 1–1.
HSZ-series	This refers to all SCSI-based controllers covered in this manual, as listed in Table 1–1.

Manufacturer’s Declarations

CAUTION

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 die Benutzer für entsprechende Gegenmaßnahmen verantwortlich sind.

ATTENTION !

Ceci est un produit de Classe A. Dans un environment domestique, ce produit risque de créer des interférences radiélectriques, il appartiendra alors à l´utilisateur de prendre les mesures spécifiques appropriées.

Für Bundesrepublik Deutschland
For Federal Republic of Germany
Pour la République féderale d’Allemagne

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1 General Information and Subsystem Overview

This chapter contains general information and technical overview information on the hierarchial storage (HS) controller. For purposes of this manual, "HS controller" refers to several models, as shown in Table 1–1:

Table 1–1 HS Controller Models

Type	Model
HSJ™-series	HSJ40 HSJ30
HSD-series	HSD30™
HSZ™-series	HSZ40

Controllers *not* covered in this manual
Any HSC™ controller
HSD05™
HSZ1*x*

1.1 Technical Overview

The HS controllers are an integral part of Digital's family of **array controllers**. The controllers connect Small Computer System Interface generation 2 (SCSI–2) storage devices to a variety of host interfaces, including CI™, DSSI™, and SCSI.

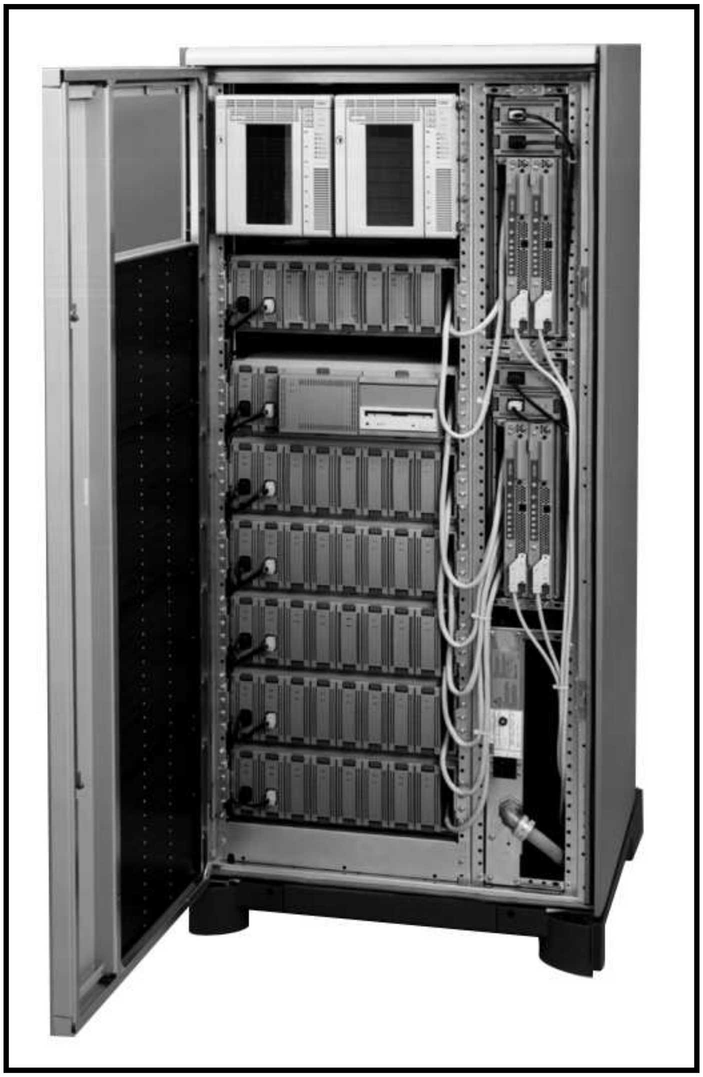
Each HS controller consists of the following:

- A controller module
- A read cache module (optional)

The two modules are housed together in a BA350–MA controller shelf. The controller shelf can be inserted in different StorageWorks™ cabinets. The cabinets are shown in Figures 1–1 and 1–2.

Firmware that controls the HS controllers (hierarchial storage operating firmware) resides on a Personal Computer Memory Card Industry Association (PCMCIA) **program card**. The card plugs into the controller module. To receive the most current controller and device support, Digital recommends replacing this card with the latest firmware as each new version is released.

Figure 1–1 SW800-Series Data Center Cabinet



CXO-3658B-PH

The HSJ- and HSD-series controllers can be configured alone (**nonredundant**), or in conjunction with a second controller of the same model (**dual-redundant**) for improved availability. Dual-redundant configurations support 6 SCSI–2 devices per port (for example, 36 devices on an HSJ40 controller). Nonredundant, low availability configurations support up to 7 devices per SCSI–2 port, but this setup sacrifices a convenient upgrade to high availability and redundant/backup power options.

Note

The HSZ-series controllers can only be configured alone (nonredundant).

Digital recommends the dual-redundant configuration for the HSJ- and HSD-series controllers, to support up to six SCSI–2 storage devices per port.

Figure 1–2 SW500-Series Cabinet

CXO-4138A-PH

Refer to the appropriate *StorageWorks Array Controller Operating Firmware Release Notes* and *StorageWorks Firmware Array Controller Software Product Description* for supported devices.

Note

In the dual-redundant configuration, make sure that both controller's cache modules have the same number of megabytes, and that both firmware versions are identical. If there is a mismatch, neither controller can access any devices.

Table 1–2 summarizes the main features of each HS controller.

Table 1–2 Summary of HS Controller Product Features

Feature	HSJ40	HSJ30	HSD30	HSZ40
Host system bus	CI™	CI	DSSI	SCSI–2
Host protocol	SCS, MSCP™, TMSCP™	SCS, MSCP, TMSCP	SCS, MSCP, TMSCP	SCSI–2
Storage device protocol	SCSI–2	SCSI–2	SCSI–2	SCSI–2
Number of SCSI–2 ports	6	3	3	6
Number of SCSI–2 devices per port	6 (or 7)†	6 (or 7)†	6 (or 7)†	6 (or 7)
Maximum number of SCSI–2 devices	36 (or 42)†	18 (or 21)†	18 (or 21)†	36 (or 42)
Shared memory (nonvolatile memory)	32 KB	32 KB	32 KB	32 KB
Read cache module	16- or 32-MB	16- or 32-MB	16- or 32-MB	16- or 32-MB
RAID levels supported	RAID 0/1a	RAID 0/1a	RAID 0/1a	RAID 0/1a
Mixed disk and tape support‡	Yes	Yes	Yes	No tapes
Tape drive media loader support	Sequential access device	Sequential access device	Sequential access device	N/A
Dual-redundant configurations	Yes	Yes	Yes	No
Program card firmware update	Yes	Yes	Yes	Yes
Error detection code (EDC)	Validation of program card firmware	Validation of program card firmware	Validation of program card firmware	Validation of program card firmware
Error correction code (ECC) on cache and shared memory	Yes	Yes	Yes	Yes
Power fail write nonvolatile journal	Yes	Yes	Yes	Yes
Data integrity and byte parity (all buses/memory)	Yes	Yes	Yes	Yes

†The dual-redundant controller configuration supports up to six devices per port. Nonredundant configurations support up to seven devices per port, but this sacrifices a convenient upgrade to high availability and redundant/backup power options.

‡On the same or different ports

1.2 Maintenance Strategy

Maintain the HS controller subsystem by removing and replacing field replaceable units (FRUs) as necessary. Chapter 7 contains FRU removal and replacement procedures. See Appendix A for a list of FRUs and FRU part numbers.

Note

Do not attempt to replace or repair components within field replaceable units (FRUs). Use the controller internal diagnostics and error logs to isolate FRU-level failures.

1.3 Maintenance Features

The HS controllers have the following features to aid in troubleshooting and maintenance:

- **Initialization diagnostics**

  Various levels of initialization diagnostics execute on the controller. These tests ensure that the subsystem is ready to come on line after it has been reset, powered on, and so forth. You can elect to rerun many of the diagnostics even after initialization completes, in order to test the controller operation. See Chapter 6 for more information about the controller initialization diagnostics.

- **Utilities**

  You can run the VTDPY utility to display current controller state and performance data, including processor utilization, host port activity and status, device state, logical unit state, and cache and I/O performance. See Chapter 6 for detailed information on this utility.

  The configuration utility checks the SCSI device ports for any device not previously added. This utility will add and name these devices. See Chapter 6 for more information on the configuration utility.

- **Exercisers**

  The controller can run both the disk exerciser (DILX) and the tape exerciser (TILX). These exercisers simulate high levels of user activity, so running them provides performance information you may use to determine the health of the controller and the devices attached to it. See Chapter 6 for more information about the exercisers.

- **Terminal access**

  You can use a virtual (host) terminal or a maintenance terminal to check status and set operating parameters. The terminal connection provides access to the following:

  – Command Line Interpreter (CLI) (See Chapter 4, Appendix B)

  – Error messages (See Chapter 5)

  – Error logs (See Chapter 5, Appendices C through E)

- **Controller warm swap (HSJ-series controller)**

  You can efficiently remove and replace, or warm swap, one controller in a dual-redundant configuration. When you warm swap a controller, you are changing out a controller in the most transparent method available to the HS controller subsystem. Warm swapping a controller has minimal system and device impact. For more information on warm swapping, see Chapter 7.

- **Operator control panel**

  The operator control panel (OCP) on the front of the controller has seven buttons and LEDs. The buttons and LEDs serve different functions with respect to controlling the SCSI ports and/or reporting fault and normal conditions. See Chapter 5 for a complete description of the OCP.

1.4 Precautions

This section describes necessary precautions and procedures for properly maintaining and servicing HS controllers.

1.4.1 Electrostatic Discharge Protection

Electrostatic discharge (ESD) is a common problem for any electronic device and may cause data loss, system down time, and other problems. The most common source of static electricity is the movement of people in contact with carpets and clothing. Low humidity also increases the amount of static electricity. You must discharge all static electricity prior to touching electronic equipment.

In general, you should follow routine ESD protection procedures when handling controller modules and cache modules and when working around the cabinet and shelf that houses the modules.

Follow these guidelines to further minimize ESD problems:

- Maintain more than 40-percent humidity in the room where the equipment is installed.
- Place the subsystem cabinet away from heavy traffic paths.
- Do not place the subsystem on carpet, if possible. If carpet is necessary, choose antistatic carpet. If the carpet is already in place, place antistatic mats around the subsystem.
- Use ESD wrist straps, antistatic bags, and grounded ESD mats when handling FRUs.[2]
- Obey the module handling guidelines listed in Section 1.4.2.

1.4.2 Module Handling Guidelines

Prior to handling the controller module or cache module, follow these grounding guidelines:

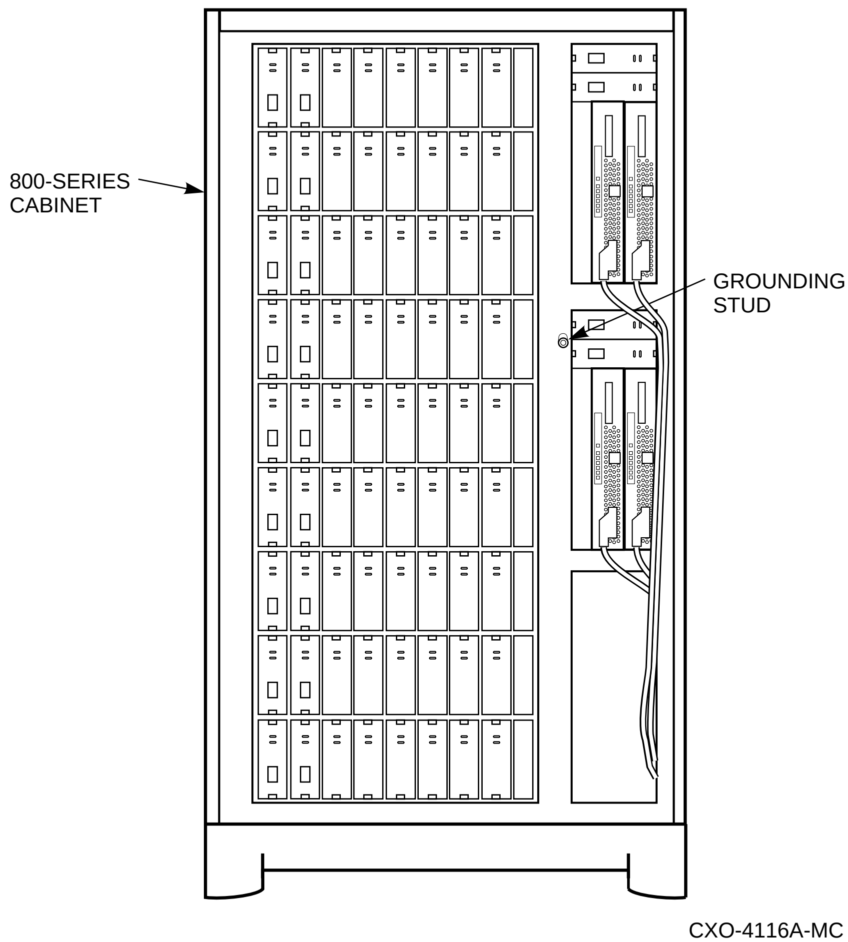
CAUTION

Refer to ESD guidelines in Section 1.4.1 prior to handling the controller module or cache module. Damage to the modules can result if the guidelines are not followed.

- Obtain and wear an ESD wrist strap on your wrist. Make sure the strap fits snugly.
- Plug the ESD strap into the grounding stud located on the vertical rail between the BA350–MA controller shelves and the device shelves. You can find the stud approximately half way down from the top of the rail (Figure 1–3).[3]
- After removing a module from the shelf, place the module into an approved antistatic bag or onto a grounded antistatic mat.

[2] Not required for handling the program card
[3] The grounding stud is moveable, and can be relocated to another part of the cabinet

Figure 1–3 Shelf Grounding Stud



- Remain grounded while installing a replacement module.

1.4.3 Program Card Handling Guidelines

Follow these guidelines when handling the program card:

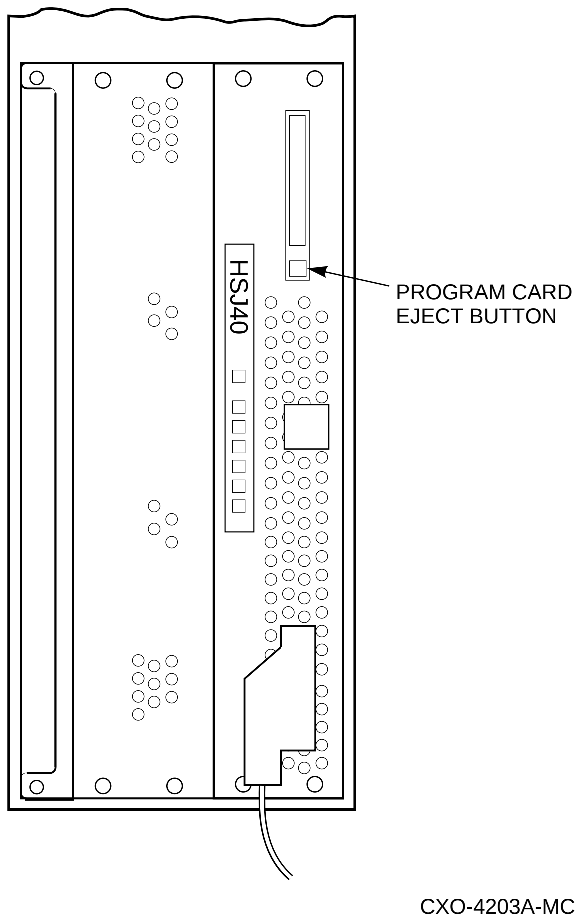
CAUTION

Follow program card guidelines or damage to the program card and firmware may result.

- Keep the program card in its original carrying case when not in use.
- Do not twist or bend the program card.
- Do not touch the card contacts.
- Keep the card out of direct sunlight.
- Do not immerse the card in water or chemicals.

- Always push the program card eject button, shown in Figure 1–4, to remove the card; do not pull on the card.

Figure 1–4 Program Card Eject Button



1.4.4 Cable Handling Guidelines

Use the guidelines presented in the following sections when handling the host interface cables to the controller. See Chapter 7 for host cable removal and replacement instructions.

Note

Always halt activity on the host path to the target controller before servicing its host cables (see Chapter 7).

1.4.4.1 CI Cable

CAUTION

If the internal CI cable connectors should become grounded, damage to the equipment can result.

Never leave external CI cables, terminated or not, attached at the star coupler and disconnected at the internal CI cable connector. This minimizes adverse effects on the cluster and prevents a short circuit between the two ground references.

Always terminate the connections of the star coupler when removing external CI cables.

When handling or moving the internal CI cables, it is very important that the connectors do not become grounded. *No metal* may contact the metal connectors on these cables, other than an external CI host cable connector.

1.4.4.2 DSSI Cable

Turn off all power to HSD-series controllers and all other devices, including the host CPU, on a DSSI bus before removing a DSSI host cable. If you accidentally short DSSI connector pins during aligning and inserting/removing a DSSI connector, you risk blowing the fuses of *all* members on the DSSI bus.

1.4.4.3 SCSI Cable

Always terminate open active SCSI connections to the host CPU when SCSI cables are removed.

1.5 Controller Specifications

Table 1–3 lists the physical and electrical specifications for the HS controllers and their cache modules.

Note

Measurements in Table 1–3 are nominal measurements; tolerances are not listed.

Table 1–3 HS Controller Specifications

Hardware	Length	Width	Power	Current at +5 V	Current at +12 V
HSJ40 controller module	12.5 inches	9.50 inches	40.5 W	6.2 A	670 mA
HSJ30 controller module	12.5 inches	9.50 inches	40.5 W	6.2 A	670 mA
HSD30 controller module	12.5 inches	8.75 inches	20.9 W	3.2 A	10 mA
HSZ40 controller module	12.5 inches	8.75 inches	24.8 W	4.6 A	10 mA
Read cache, 16 MB	12.5 inches	7.75 inches	1.5 W	300 mA	2 mA
Read cache, 32 MB	12.5 inches	7.75 inches	2.0 W	300 mA	2 mA

Refer to the *StorageWorks Solutions Controller Shelf User's Guide* for power requirements for the BA350–MA controller shelf.

1.6 Controller Environmental Specifications

The HS controllers are intended for installation in a Class A computer room environment.

The StorageWorks product line environmental specifications listed in Table 1–4 are the same as for other Digital storage devices.

Table 1–4 Environmental Specifications

Condition	Specification
	Optimum Operating Environment
Temperature	+18° to +24°C (+65° to +75°F)
Rate of change	3°C (5.4°F)
Step change	3°C (5.4°F)
Relative humidity	40% to 60% (noncondensing) with a step change of 10% or less (noncondensing)
Altitude	From sea level to 2400 m (8000 ft)
Air quality	Maximum particle count .5 micron or larger, not to exceed 500,000 particles per cubic ft of air
Inlet air volume	.026 cubic m per second (50 cubic ft per minute)
	Maximum Operating Environment (Range)
Temperature	+10° to +40°C (+50° to +104°F) Derate 1.8°C for each 1000 m (1.0°F for each 1000 ft) of altitude Maximum temperature gradient 11°C/hr (20°F/hr) ±2°C/hr (4°F/hr)
Relative humidity	10% to 90% (noncondensing) Maximum wet bulb temperature: 28°C (82°F) Minimum dew point: 2°C (36°F)
	Maximum Nonoperating Environment (Range)
Temperature	–40° to +66°C (–40° to +151°F) (During transportation and associated short–term storage)
Relative humidity	
Nonoperating	8% to 95% in original shipping container (noncondensing); otherwise, 50% (noncondensing)
Altitude	From –300 m (–1000 ft) to +3600 m (+12,000 ft) MSL†

†Mean sea level

2
Functional Description

This chapter provides a detailed functional description of the HS controller hardware and firmware.

2.1 HS Controller Hardware

The HS controller provides a connection between a host computer and an array of SCSI–2 compatible storage devices. The controller hardware consists of core circuitry common to all models of HS controllers, as follows:

- Policy processor
- Program card
- Diagnostic registers
- Operator control panel
- Maintenance terminal port
- Dual controller port
- Nonvolatile memory (NVMEM)
- Bus exchangers
- Shared memory
- Device ports
- Cache module

Each controller model also has a unique interface tailored to the appropriate host system.

Figure 2–1 shows a block diagram of the HS controller hardware.

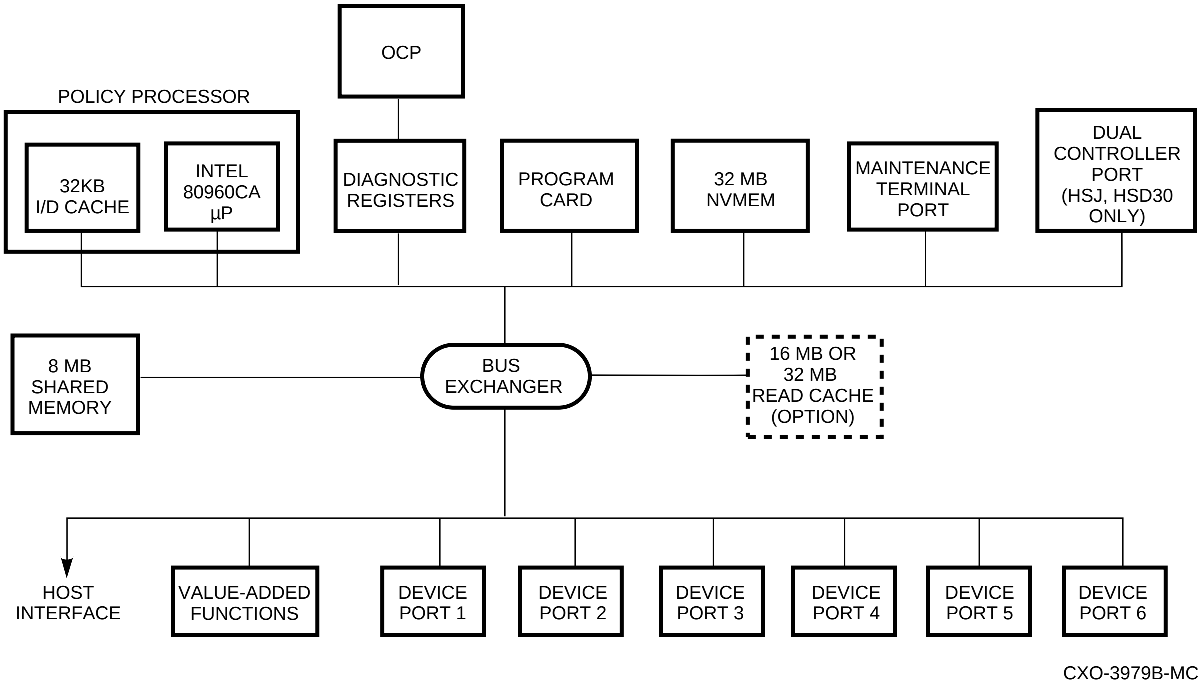
2.1.1 Policy Processor

The policy processor consists of microprocessor hardware necessary for running the HS controller.

2.1.1.1 Intel 80960CA

The heart of the policy processor is an Intel® 80960CA processor chip. This processor chip runs the firmware from the program card and provides a consistent 25 MIPs. The processor chip controls all but low-level device and host port operations.

Figure 2–1 HS Controller Common Hardware Block Diagram



2.1.1.2 Instruction/Data Cache

Although the Intel 80960CA processor chip has an internal cache, the internal cache is not large enough to offset performance degradation caused by shared memory. To compensate for this, a separate Instruction/Data (I/D) cache is part of the policy processor. This 32-KB static RAM (SRAM) cache helps the Intel 80960CA processor chip achieve faster access to instructions and variables. A write-through cache design maintains data coherency in the I/D cache.

2.1.2 Program Card

The program card is a PCMCIA standard program card device containing the firmware for operating the controller. The firmware is validated and then loaded from the program card into shared memory each time the controller is initialized.

2.1.3 Diagnostic Registers

The HS controller has two write and two read diagnostic registers. Diagnostic and functional firmware use the write diagnostic registers to control HS controller and StorageWorks operations. Certain bits in the registers activate test modes for forcing errors in the HS controller. Other bits control the operator control panel (OCP) LEDs. The policy processor reads the read diagnostic registers to determine the cause of an interrupt, when an interrupt occurs.

2.1.4 Operator Control Panel

The OCP includes the following:

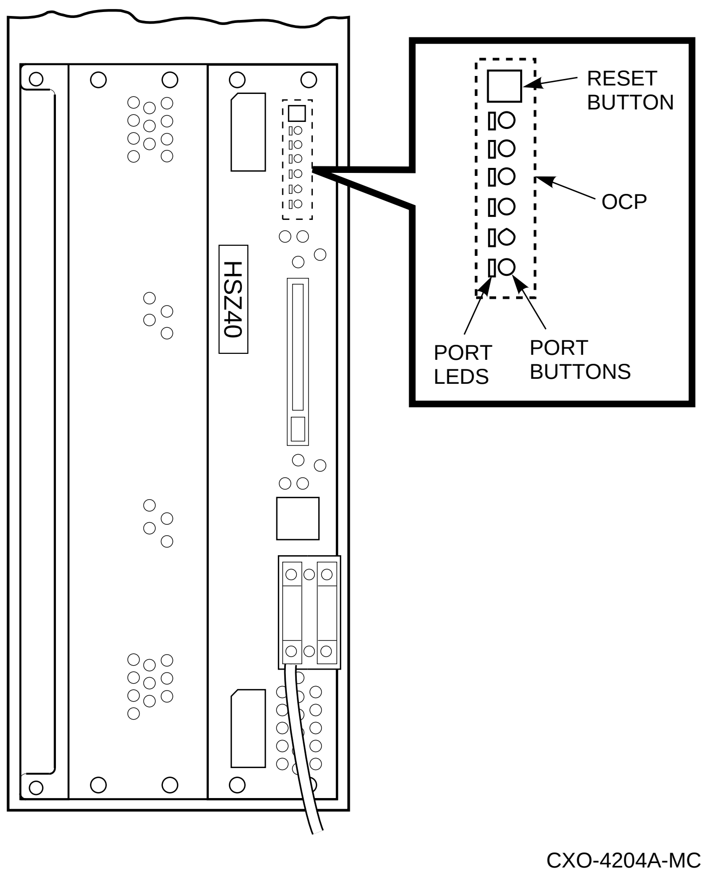
- One reset button with embedded green LED

- One button per SCSI port
- Six amber LEDs[1]

Figure 2–2 shows an example of the OCP from the HSZ40 controller. The buttons and LEDs serve different functions with respect to controlling the SCSI ports and/or reporting fault and normal conditions.

See Chapter 5 for further information on using the OCP.

Figure 2–2 HS Controller Operator Control Panel



2.1.5 Maintenance Terminal Port

Each HS controller has a modified modular jack (MMJ) on its front bezel that can support an EIA–423 compatible maintenance terminal. You must connect the maintenance terminal during controller installation to set initial controller parameters. During normal operation, you may use either the maintenance terminal or a virtual (host) terminal to add devices, and storage sets, or to perform other storage configuration tasks. However, a maintenance terminal is required when a host connection is not available.

[1] The HSJ-series has the amber LEDs embedded in the port buttons.

Note

If you connect a maintenance terminal to one controller in a dual-redundant configuration, and both controllers are functioning, you can communicate with both controllers.

A VAXcluster™ console system (VCS) or serial interface can also be connected to the EIA–423 terminal port for maintenance.

2.1.6 Dual Controller Port

The HSJ-series and HSD-series controllers have an internal serial port for communication with a second controller of the same model. The second controller needs to be mounted in the same controller shelf, with communication passing through the ports and shelf backplane. A dual-redundant configuration allows one controller to take over for another (failed) controller. The takeover process is called **failover**. During failover, the surviving controller supports the SCSI–2 devices linked to the failed controller.

Note

The HSZ-series controller does not support dual-redundant configurations, thus failover cannot occur.

2.1.7 Nonvolatile Memory

The HS controller has 32 KB of nonvolatile memory (NVMEM). NVMEM is implemented using battery backed up SRAM. This memory stores parameter and configuration information such as device and unit number assignments entered by you and by the HS controller firmware.

2.1.8 Bus Exchangers

Bus exchange devices allow high-speed communication between bus devices and shared memory. One bus exchanger handles address lines while the other exchanger handles data lines. The bus exchangers are classified as four-way cross-point switches, which means the bus exchangers allow connections between one port and any other port on the switch.

2.1.9 Shared Memory

Shared memory consists of a dynamic RAM controller and arbitration engine (DRAB) gate array controller and 8 MB of associated dynamic RAM (DRAM). Shared memory uses parity-protected 9-bit error correction code (ECC) and error detection code (EDC) for improved data integrity. The shared memory stores the HS controller firmware and is shared between bus devices for data structures as well as data buffers.

One portion of shared memory contains instructions for the Intel 80960CA processor chip, firmware variables, and data structures, including the look-up table for the Intel 80960CA processor chip. In the absence of the HS controller cache module, another portion of shared memory acts as a cache. Otherwise, this portion contains cache module context for cache look-ups when a cache module is in place.

2.1.10 Device Ports

The HS controller SCSI–2 device ports are a combination of NCR® 53C710 SCSI port processors and SCSI transceivers. The 53C710 processors perform operations in 8-bit, single-ended normal or fast mode. The 53C710 processors execute scripts read from shared memory and under control of the policy processor.

Each SCSI–2 port can have up to six or seven attached devices depending on controller configuration (dual-redundant and nonredundant, respectively). In a dual-redundant configuration, subsystem availability improves because each controller has access to the other controller's devices.

2.1.11 Cache Module

The HS controllers can run with a companion read cache module, available in 16 or 32 MB.

2.1.11.1 Common Cache Functions

The HS controller cache module increases the controller I/O performance. During normal operation, a host read operation accesses data either from the fast memory of the cache module or from an I/O device.

If a host read is a cache "hit" (data already in the cache), the data are supplied to the host immediately, improving I/O performance by reducing latency. If the host read is a cache "miss" (data not in the cache), the HS controller accesses the appropriate disk to satisfy the request. Then the controller reads the data, returns it to the host, and writes it to the cache.

Cache entry sizes are fixed at 64 KB (128 logical blocks) for each logical unit. Read caching is enabled by default but can be optionally disabled using the CLI Logical Unit SET command on a per unit basis (see Appendix B).

The data replacement algorithm is a least recently used (LRU) replacement algorithm. When the cache is full and new data must be written, the LRU algorithm removes the oldest resident cached data with the least number of references and replaces it with the new data.

2.1.11.2 Read Cache Module

During a host write operation using the read cache, data are written to the disk *and* the cache. This is known as **write-through** caching, and it improves the performance of subsequent reads, because often the requested data were previously written to the cache.

The read cache consists of DRAM storage. However, the read cache is volatile. Subsystem power failures will cause the loss of all data in the read cache.

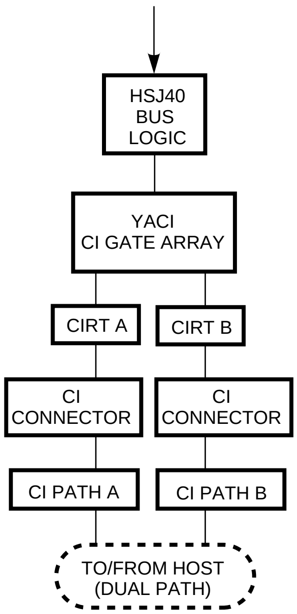
2.1.12 Host Interface

The following sections provide descriptions of the host interface hardware for each series of HS controller.

2.1.12.1 HSJ-Series (CI Interface)

Figure 2–3 shows a block diagram of the HSJ-series to CI host interface hardware.

Figure 2–3 HSJ-Series CI Host Interface Hardware Block Diagram



The CI interface for the HSJ-series controllers consists of a YACI CI gate array and CI receiver/transmit (CIRT) chips for the individual CI ports. The YACI allows direct memory access of data between the host CI port and controller shared memory. Specialized host port firmware running on the policy processor sets up and maintains the CI port.

The HSJ-series controller supports dual data link (DDL) operations on the CI bus. With DDL, the controller can have operations in progress simultaneously on both CI paths (Path A and Path B).

Receive/receive, receive/transmit, or transmit/transmit operations can be active at the same time. The only restriction is that simultaneous transmits and simultaneous receives may not be active on the same virtual circuit. The packets that are simultaneously active can be to any two separate CI nodes, or a transmit/receive operation may be active to the same node if it also supports DDL operation (such as to a CIXCD adapter). Each CI path (Path A and Path B) runs in half duplex. This means the path can either be transmitting or receiving, but not both at the same time.

2.1.12.2 HSD-Series (DSSI Interface)

Figure 2–4 shows a block diagram of the HSD-series to DSSI host interface hardware.

The SCSI to DSSI interface gets implemented with the NCR 53C720 chip plus specific DSSI logic and transceivers. The NCR 53C720 chip reads and runs scripts from controller shared memory to perform command and DMA operations on the DSSI interface. The policy processor sets up and maintains the operation of the NCR 53C720 chip.

Figure 2–4 HSD-Series DSSI Host Interface Hardware Block Diagram

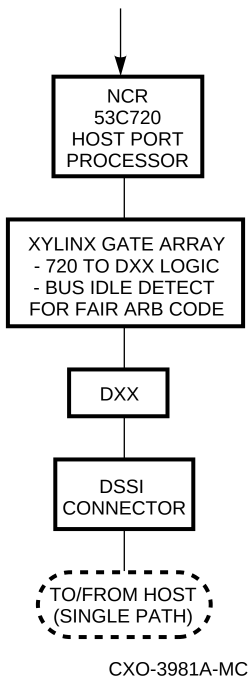
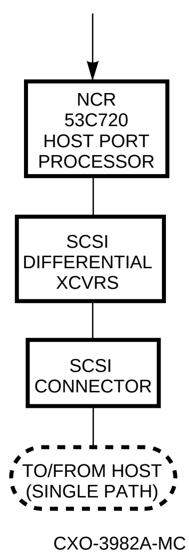


Figure 2–5 HSZ-Series SCSI–2 Host Interface Hardware Block Diagram



2.1.12.3 HSZ-Series (SCSI–2 Interface)

Figure 2–5 shows a block diagram of the HSZ-series to SCSI–2 host interface hardware.

The HSZ-series interfaces with a SCSI–2 Fast-Wide-Differential (FWD) 16-bit host bus or a SCSI–2 8-bit differential bus. The hardware consists of the NCR 53C720 chip and tranceivers, and functions in much the same way as the DSSI interface (refer to Section 2.1.12.2).

CAUTION

Although the HSD-series and HSZ-series interfaces are similar, care should be taken not to accidentally install an HSD-series controller in an HSZ-series system, or vice versa. Equipment damage would result.

2.2 HS Controller Firmware

The HS controller firmware, or hierarchical storage operating firmware, consists of functional code, diagnostics, utilities, and excercisers.

HS operating firmware is stored in a PCMCIA program card. Digital ships the card along with your HS controller. Thereafter, each time HS operating firmware is updated, new cards are manufactured. You can purchase the update cards on a per release basis or through an update service contract.

Once the card is installed in the HS controller, the contents are validated and loaded into shared memory. Any time you reset the controller, this validating and loading process gets repeated. Because of this scheme, when the firmware executes, only part of the controller initialization diagnostics run directly from the program card. The remaining diagnostics, all functional code, and all utilities run from controller shared memory.

Refer to the *StorageWorks Array Controllers HS Family of Array Controllers User's Guide* for information on controller I/O performance using HS operating firmware.

The HS operating firmware consists of five function areas:

- Core functions
- Host interconnect functions
- Operator interface and subsystem management
- Device services
- Value-added functions

These functions are discussed in the following sections.

2.2.1 Core Functions

HS operating firmware provides the following core functions, in the order they are executed following turning on the controller:

1. Tests and diagnostics
2. Executive functions

2.2.1.1 Tests and Diagnostics

HS controller tests and diagnostics are integrated in a controller self-test procedure performed when the controller is switched on. The output of self-test is a simple go/nogo status of the controller subsystem. Self-test includes a test of the cache module. See Chapter 6 for additional self-test information.

2.2.1.2 Executive Functions

Executive functions act as the operating system kernel for the HS controller. The executive functions are common among the different controller models described in this manual. Executive functions control firmware execution with respect to interrupts, thread control, queuing support, timers, and so forth. The executive functions establish the HS controller environment as a non-preemptive interrupt-driven process.

2.2.2 Host Interconnect Functions

The three different host interconnections HS operating firmware supports are CI, DSSI, and SCSI. The following list briefly describes the protocols used for host access of controller storage:

- **CI**—SCS/MSCP™ (and/or TMSCP™) protocol and DUP
- **DSSI**—SCS/MSCP™ (and/or TMSCP™) protocol and DUP
- **SCSI**—SCSI–2 protocol with SCSI pass-through software to the Command Line Interpreter (CLI), tagged command queuing on the host and device side, and mode select/sense support for SCSI

2.2.3 Operator Interface and Subsystem Management Functions

The operator interface and subsystem management functions support the user interface, subsystem management, subsystem verification, and error logging/fault management. These functions are presented in the following sections.

2.2.3.1 Command Line Interpreter

The Command Line Interpreter (CLI) is the primary user interface for HS controllers. The CLI contains firmware for responding to most management functions plus local program execution. Appendix B contains a full description of CLI operation. Briefly, the CLI provides the following two types of commands:

- SET/SHOW commands for the controller itself. This includes setting and showing of controller ID, name, path controls, and other vital information.
- Configuration commands to add/delete devices, storage sets, and logical units.

2.2.3.2 Diagnostic Utility Protocol

Diagnostic Utility Protocol (DUP) from the host is supported over CI and DSSI (HSJ- and HSD-series controllers). DUP allows you to access the CLI and local programs through a host virtual terminal in much the same way as using a maintenance terminal. See Chapter 4 for more information.

2.2.3.3 HSZ-Series Virtual Terminal

A virtual terminal port can be created using a host-based application called HSZUTIL (HSZ-series controller). The HSZUTIL application uses SCSI diagnostic send/receive commands to deliver and receive characters to/from the HSZ-series CLI and local programs. See Chapter 6 for more information on the HSZUTIL application.

2.2.3.4 Local Programs

There are several local utilities available for HS controller subsystem management/verification, as follow:

- **DILX** and **TILX** allow you to test and verify operation of the controller with attached SCSI–2 storage under a high or low I/O load. These utilities place the load on the controller, bypassing the host port. Chapter 6 provides a full description of DILX and TILX.
- **VTDPY** allows the user to display current controller state and performance data, including processor utilization, host port activity and status, device state, logical unit state, and cache and I/O performance. It is similar to the VTDPY for an HSC50 controller. See Chapter 6 for detailed information on this utility.
- **Controller warm swap** (C_SWAP) for HSJ-series controllers efficiently removes and replaces one controller in a dual-redundant configuration. When you warm swap a controller, you are changing out a controller in the most transparent method available to the HS controller subsystem. Warm swapping a controller has minimal system and device impact, as explained in Chapter 7.
- **Configure** (CONFIG) checks the SCSI device ports for any device not previously added. This utility will add and name these devices. See Chapter 6 for more information on the configuration utility.

2.2.3.5 Error Logging and Fault Management

Error Logging and Fault Management is integrated function that collects system errors in a central firmware location to send the error information to the host. See Chapter 5 and Appendices C through E for more information on error logging.

2.2.4 Device Services

SCSI–2 device service firmware includes device port drivers, mixed disk and tape support on one controller, and physical device addressing and access. Device service consists of normal functions such as read and write, plus error recovery code. It also contains firmware for controlling and observing the BA350–SB shelf and StorageWorks building blocks (SBBs), such as LED, power, and blower monitoring. Specific features include the following:

- Normal SCSI–2, 8-bit, single-ended support.
- FAST, synchronous, 8-bit, single-ended device support.
- Tagged queueing for SCSI–2 devices.
- Read and write physical device addressing and access. This is the read and write path to and from devices, and from and to the value-added portion of HS operating firmware.
- Specified device support per HS operating firmware release. Refer to your HS operating firmware release notes to identify specifically supported devices.
- Mixed disk and tape support. You can mix disk and tape storage on one controller. Furthermore, Disks and tapes may be placed together on one of the controller's six SCSI–2 ports.

Note

Tapes are not currently supported for the HSZ-series controller. Refer to your *StorageWorks Array Controller Operating Firmware Release Notes* for specific information and restrictions for tape drives.

- Device warm swap. You can remove and replace devices without taking the subsystem off line (see Chapter 7).
- Device shelf and SBB observation and control. This service monitors SHELF_OK signals and alerts you you of fan and power supply failures. This firmware also controls the fault LEDs on the SBBs for use in warm swap and identifying device failures or configuration mismatches.
- Device error recovery. This service performs error recovery and read and write retries directly, making every attempt to serve data to and from the host before declaring an unrecoverable error or marking a device as failed.
- Controller warm swap (HSJ-series controllers). This service supports this feature under control from a local program running at CLI. Device services must quiesce all the SCSI buses in order to safely allow you to remove and replace a controller (see Chapter 7).

2.2.5 Value-Added Functions

HS operating firmware contains value-added functions to enhance availability, performance, subsystem management and maintenance, and connectivity features of the HS controller subsystem. These value-added functions are presented in the following sections.

2.2.5.1 RAID

HS operating firmware supports levels of Redundant Array of Independent Disks (RAID) storage methods.

- HS operating firmware supports host-based volume shadowing (HBVS) assistance, also referred to as RAID level 1a. With HBVS assistance, shadow copy operations requested by the host between two units under one controller run under direction from the controller. This leaves the host CPU free for other operations.
- HS operating firmware supports RAID level 0 (striping). Striping allows for parallel transfers to all stripeset members. This feature enhances performance in the areas of latency and throughput. Stripesets can be from 2 to 14 members. Striping firmware is tuned to balance the load across devices and not for maximum data transfer bandwidth.

Refer to *The Digital Guide to RAID Storage Technology* for a description of RAID and how the various levels of RAID improve data integrity.

2.2.5.2 Failover

HSJ- and HSD-series controllers: A failover component (FOC) in HS operating firmware links two controllers in a dual-redundant configuration. The controllers exchange status signals and configuration information. When one controller fails, the surviving controller takes over service to the failed controller's units. An HSJ40 controller can execute failover within 15 seconds. Failover also allows for easier system management, because only one terminal connection is required to access both controllers. See Chapter 4 for more information on failover.

2.2.5.3 Caching

Cache firmware within the value added section of HS operating firmware will address the following areas:

- Read caching
- Write-through caching
- Handling of up to 32 MB of cache
- Logical Block Number (LBN) extent locking
- Least Recently Used (LRU) replacement policy (Refer to Section 2.1.11.1 for a description of the LRU algorithm.)
- Read and write-through caching enabled on a per logical unit basis

The Cache policies for the product are as follow:

- Transfer defined extent (TDE) based cache.
- Data caching based on transfer size; maximum read and write size is changed on a per logical unit basis.
- All I/O subject to locking.

2.3 Addressing Storage Within the Subsystem

This section provides an overview about how storage is addressed in a controller subsystem. Storage is seen in two different ways, depending on your perspective and controller model:

- From the controller SCSI device interface—At the physical device level
- From the host interface—At the virtual device level

Following are descriptions of both levels of storage addressing.

2.3.1 Controller Storage Addressing

Note

This section on controller storage applies to *all* controller models.

Figure 2–6 shows a typical physical storage device interface for a controller. Each of the controller's six device ports supports a SCSI bus connected with up to six devices. The devices typically reside in a StorageWorks BA350–SB storage shelf.

The current implementation of all controllers supports only one controller LUN per physical device. LUN 0 is the default controller LUN address for each device.

Controller Port Target LUN Addressing

Controller **Port Target LUN** (PTL) addressing is the process by which the controller selects storage space within a specific, physical, storage device. The process takes place in three steps:

1. The port selection—The controller selects the SCSI bus port connected to a particular device.
2. The target selection—The controller selects the device's SCSI ID (that is, the target) on that port.
3. The LUN selection—The controller selects the desired LUN within that physical device. (In the current implementation, there is only one LUN on each device, and its LUN address is always 0.)

Note that controller PTL addressing is always tied to a physical storage device.

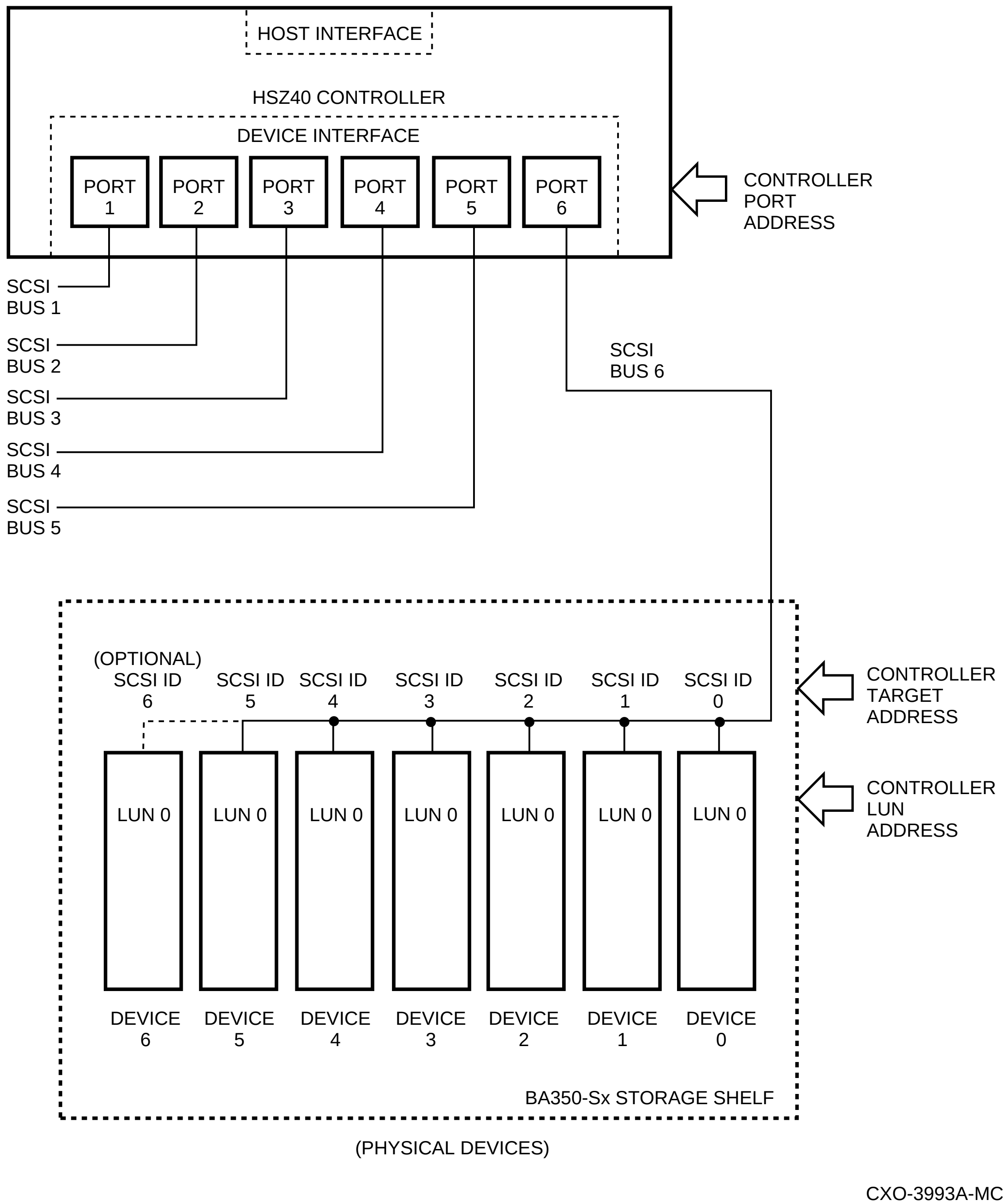
2.3.2 Host Storage Addressing

Note

The information in this section applies to all controllers. However, see Section 2.3.3 for additional, specialized information on how a SCSI host addresses storage.

A typical host device interface consists of a number of host ports each connected to a bus containing devices. From the host perspective, the controller is one of these devices.

Figure 2–6 Controller Storage Addressing



To support certain high-level storage subsystem functions such as RAID, the controller presents the entire *physical* device configuration (from Figure 2–6) to the host as a group of **host logical units**. A host logical unit often consists of storage space (a storage set) distributed throughout more than one physical device. The controller presents these logical units to the host as individually-addressable, virtual devices. You configure host logical units using the CLI.

Note

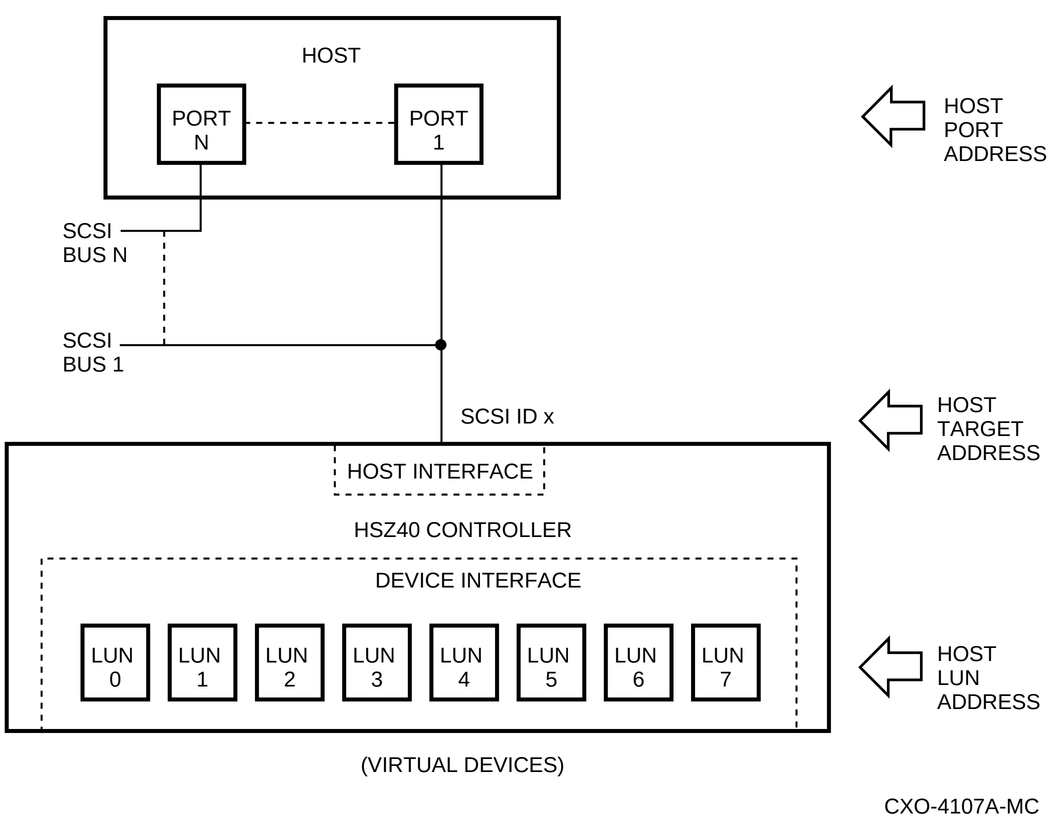
Controller LUNs (devices) and host logical units *may* represent the same structure, but only if you configure the controller devices in a one-to-one unit relationship with the host. This situation may or may not occur under normal operation.

For this reason, host addressing is often tied to a virtual storage device (a storage set).

2.3.3 Host Storage Addressing (HSZ-series)

Figure 2–7 shows a typical connection between an HSZ-series controller and its host. In this case, the SCSI host device interface consists of device ports, each connected to a SCSI bus containing up to eight devices. The HSZ-series controller resides on one of the SCSI buses. The HSZ-series controller can be assigned one or two SCSI IDs on the bus.

Figure 2–7 Host Storage Addressing (HSZ-series)



A SCSI host also sees host logical units through the controller. (However, in SCSI systems there can only be up to eight units per ID. For the HSZ-series controller, this translates as up to 16 units, or eight per each ID) Furthermore, the host addresses each unit by a SCSI logical unit number, *also* called a LUN.

Note

Although they share the same name, controller LUNs and SCSI host LUNs are logical addresses for two different storage structures. Controller LUNs exist on the controller's device interface, and SCSI host LUNs exist on a SCSI host's device interface.

Controller LUNs and SCSI host LUNs *may* represent the same structure, but only if the user configures (up to) eight controller devices in a one-to-one unit relationship with the host. This situation may or may not occur under normal operation.

Host Port Target LUN Addressing (HSZ-series)

Note

Non-SCSI hosts (CI, DSSI), though they access virtual devices, do not use a PTL addressing scheme. Any unit seen by these hosts is simply called a host logical unit (not a LUN).

Host PTL addressing is the process by which a SCSI host selects a logical unit made up of physical devices connected to an HSZ-series controller. The process takes place in three steps:

1. The port selection—The host selects the SCSI bus that has the HSZ-series controller connected to it.
2. The target selection—The host selects the controller's SCSI ID (that is, the target) on that port/bus. The HSZ-series controller may act as one or two target IDs.
3. The LUN selection—The host presents the controller with the LUN of the desired host logical unit. The controller translates the LUN into the physical device addresses required to allow the host access to the virtual device.

3
Configuration Rules and Restrictions

This chapter describes rules and restrictions as they apply to the physical configuration and connection of the following HS controller subsystem hardware:

- Cabinets
- Shelves
- Devices
- Controllers
- Hosts

The information in this chapter describes physical configurations with respect to both standard and nonstandard (customized) subsystems. Further information can be found in the specific StorageWorks cabinet, shelf, and configuration documentation.

Note

Configuration rules and restrictions apply to all controllers unless stated otherwise.

3.1 Ordering Considerations

Digital provides the following configuration approaches for ordering controller subsystems:

- Preconfigured, packaged starter subsystems[1]
- Configured-to-order (CTO) subsystems (custom configurations)
- A combination of preconfigured and CTO subsystems

Refer to the *StorageWorks Array Controllers HS Family of Array Controllers User's Guide* for a list of preconfigured controller subsystem option numbers. Not all controller models have preconfigured subsystem option numbers.

3.2 Cabinets

The following sections present information to keep in mind when loading controller and storage shelves in SW800-series data center cabinets and SW500-series cabinets.

[1] Preconfigured subsystems include a range of solutions for various capacities, performance levels, and availability.

3.2.1 SW800-Series Data Center Cabinet

This section presents the rules to apply to subsystem configurations in SW800-series data center cabinets. Refer to the *StorageWorks Solutions SW800-Series Data Center Cabinet Installation and User's Guide* for more details.

Note

In Figures 3–1 through 3–5 "S" indicates a BA350–SB storage shelf, and "C" indicates a BA350–MA controller shelf.

Figure 3–1 shows the loading sequence for storage and controller shelves in an SW800-series data center cabinet.

Figure 3–2 shows the loading sequence for storage and controller shelves when one or two TZ8xx-series tape devices are installed.

Figure 3–3 shows the loading sequence for storage and controller shelves when three or four TZ8xx-series tape devices are installed.

- Standard shelf configuration

  A standard of three (or four) BA350–MA shelves connected to 18 BA350–SB shelves in a single SW800-series data center cabinet is suggested.

- Two device shelves per port (jumpered pairs)

  Two BA350–SB shelves can be joined on the same controller port with the following restrictions:

  – The SCSI–2 cable to the first BA350–SB storage shelf is 1.0 meter or less.[2]

  – The SCSI–2 cable from the first BA350–SB shelf to the second shelf is 0.5 meters or less. This requires two shelves to be immediately adjacent to each other.

  – The first BA350–SB storage shelf is configured for an unterminated single SCSI cable.

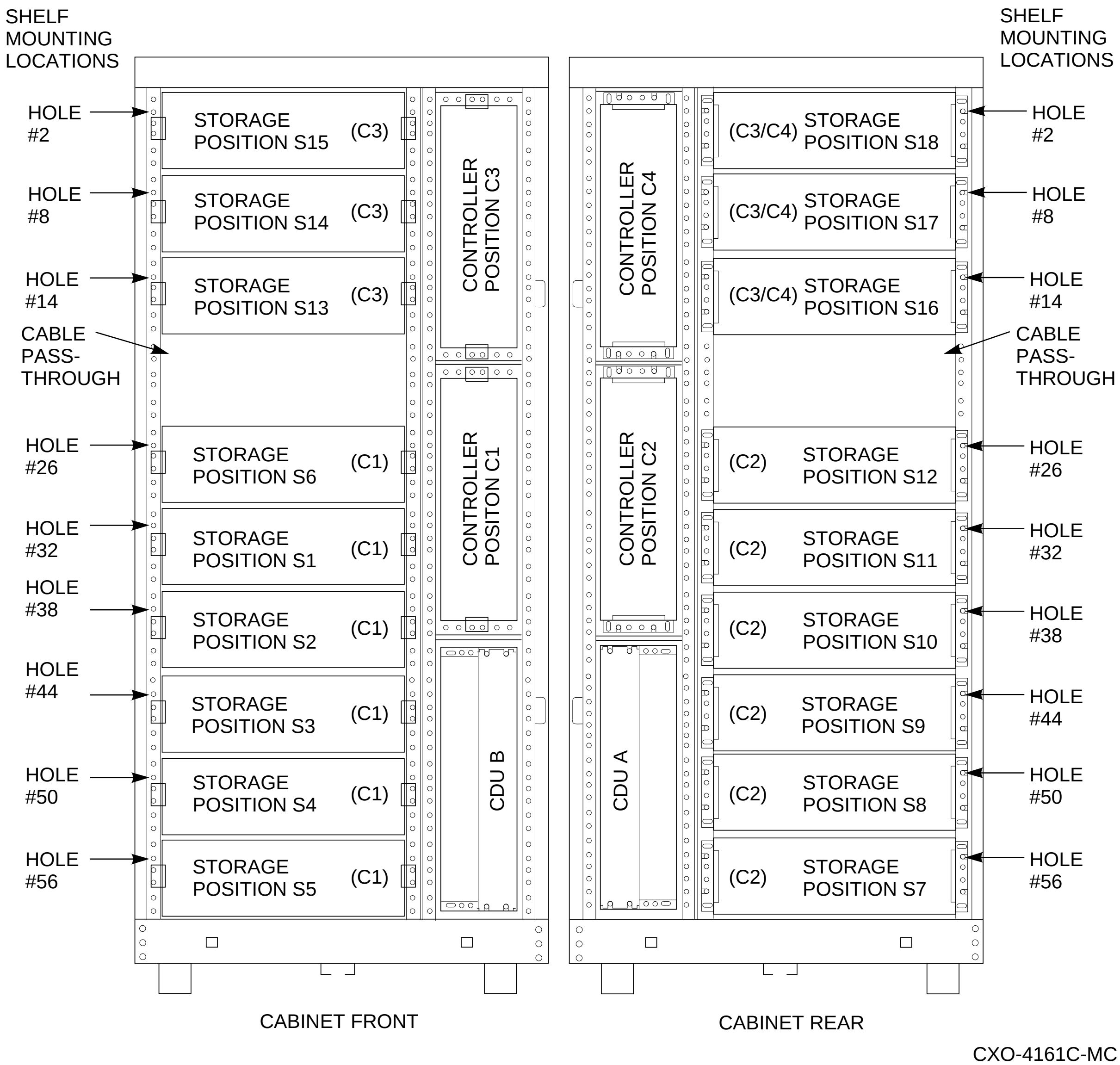
- TZ8x7 half-rack tape loader

  Any TZ8x7 half-rack tape loader device must be located at the top front positions filling two or four top BA350–SB shelf positions (front and back). Note that each tape loader occupies the full cabinet depth.

  Up to four tape drive loader devices can be loaded in an SW800-series data center cabinet, displacing shelves S6 and S12-S18 (leaving 10 BA350–SB shelves remaining).

[2] The associated BA350–MA controller shelf must be located near enough to satisfy this restriction.

Figure 3–1 SW800-Series Data Center Cabinet Loading

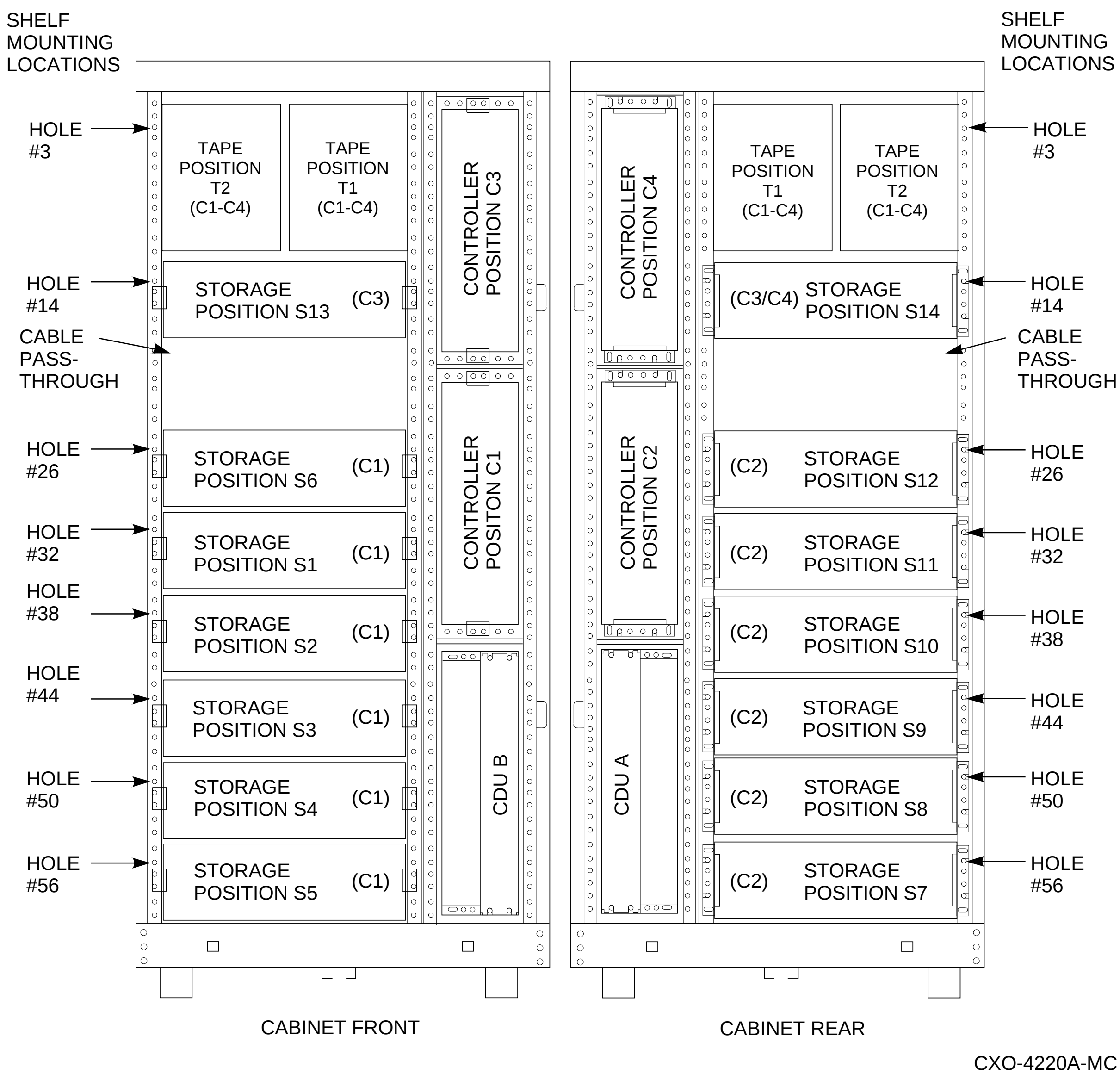


Single (or paired) TZ8x7 devices must be connected with a 0.2 meter (8-inch) SCSI–1-to-StorageWorks transition cable (order number 17–03831–01), then to a 2 meter SCSI–2 cable (order number BN21H–02) that connects to one of the controller SCSI–2 ports.

- Use of an upper controller shelf

  By convention, controller shelf C3 would use (only) the top three (or four) storage shelves in the front of the cabinet; the fourth controller shelf (C4) would use the top three (or four) storage shelves in the back of the cabinet.

Figure 3–2 SW800-Series Data Center Cabinet Controller/Storage/(1–2) Tape Drive Locations



- Number of devices

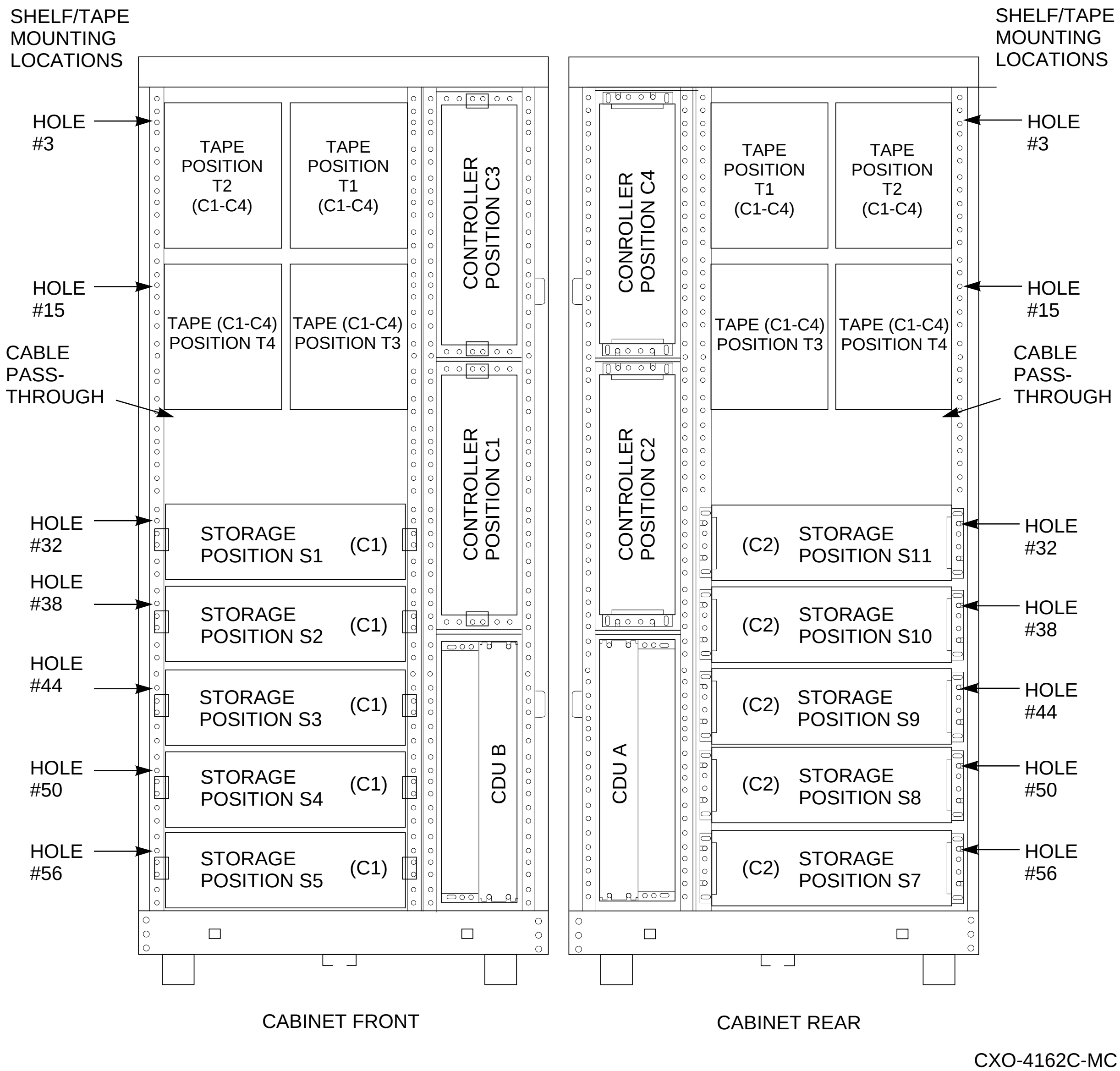
  Up to 42 devices can be attached using 7 3½-inch SBBs in each of 6 BA350–SB shelves attached to controllers with 6 controller ports.[3]

- Maximum number of device shelves

  Up to 18 horizontal BA350–SB device shelves are allowed (16 if one or two TZ8x7 tape loaders are present). An earlier cabinet configuration had a provision for 19 horizontal device shelves, however Digital no longer recommends that configuration.

[3] Redundant power and dual-redundant controllers are not supported when using 42 devices. This is not a recommended configuration.

Figure 3–3 SW800-Series Data Center Cabinet Controller/Storage/(3–4) Tape Drive Locations



- Vertical device shelves

  Vertical shelves are not used for device shelves because some devices require horizontal alignment. If desired, vertical shelf locations can be used for most disk drives. Refer to the device-specific documentation for requirements. (Any of the vertical shelves can be used. However, Digital recommends surrendering controller positions C4, then C3, first for storage shelves. Refer to Figure 3–1.)

3.2.2 SW500-series Cabinets

The rules presented in this section apply to subsystem configurations in SW500-series cabinets. Refer to the *StorageWorks Solutions SW500-Series Cabinet Installation and User's Guide* for more details.

Figure 3–4 shows the loading sequence for storage and controller shelves in an SW500-series cabinet.

Figure 3–4 SW500-Series Cabinet Loading

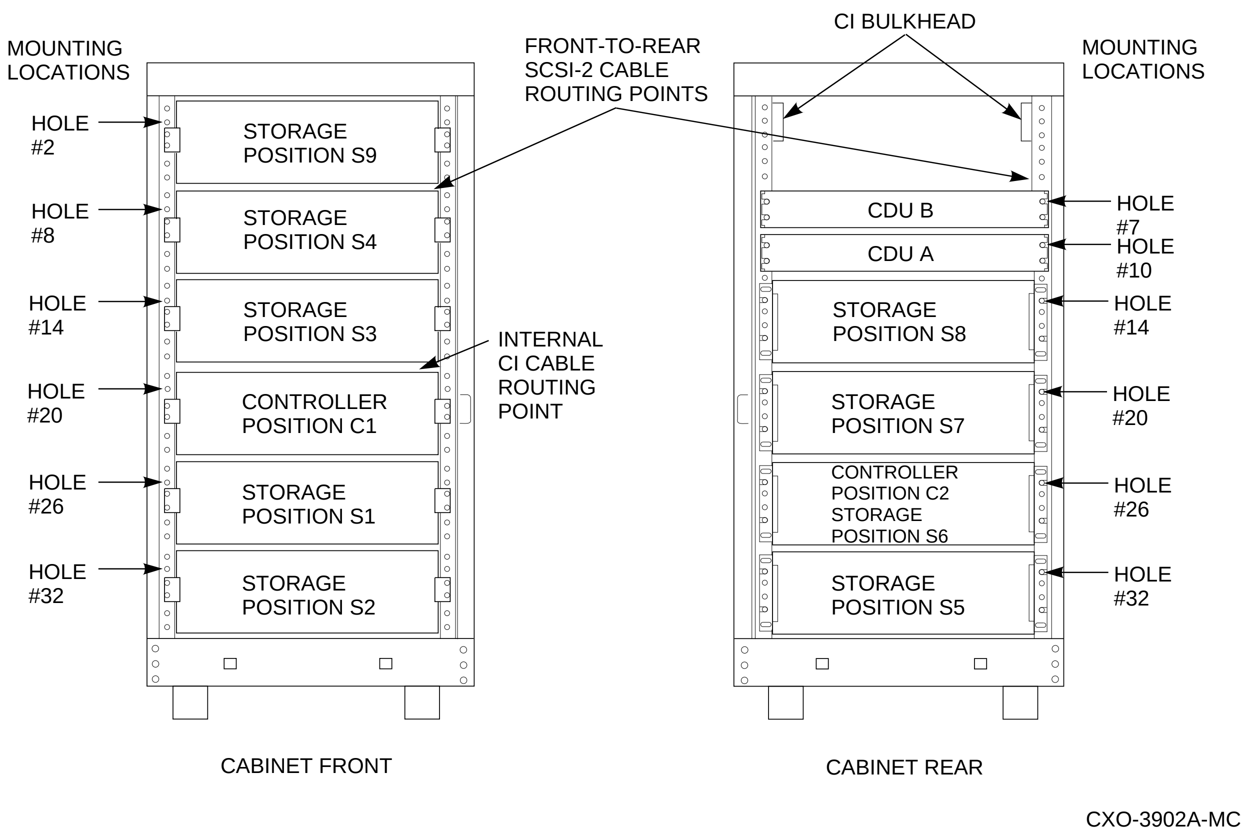


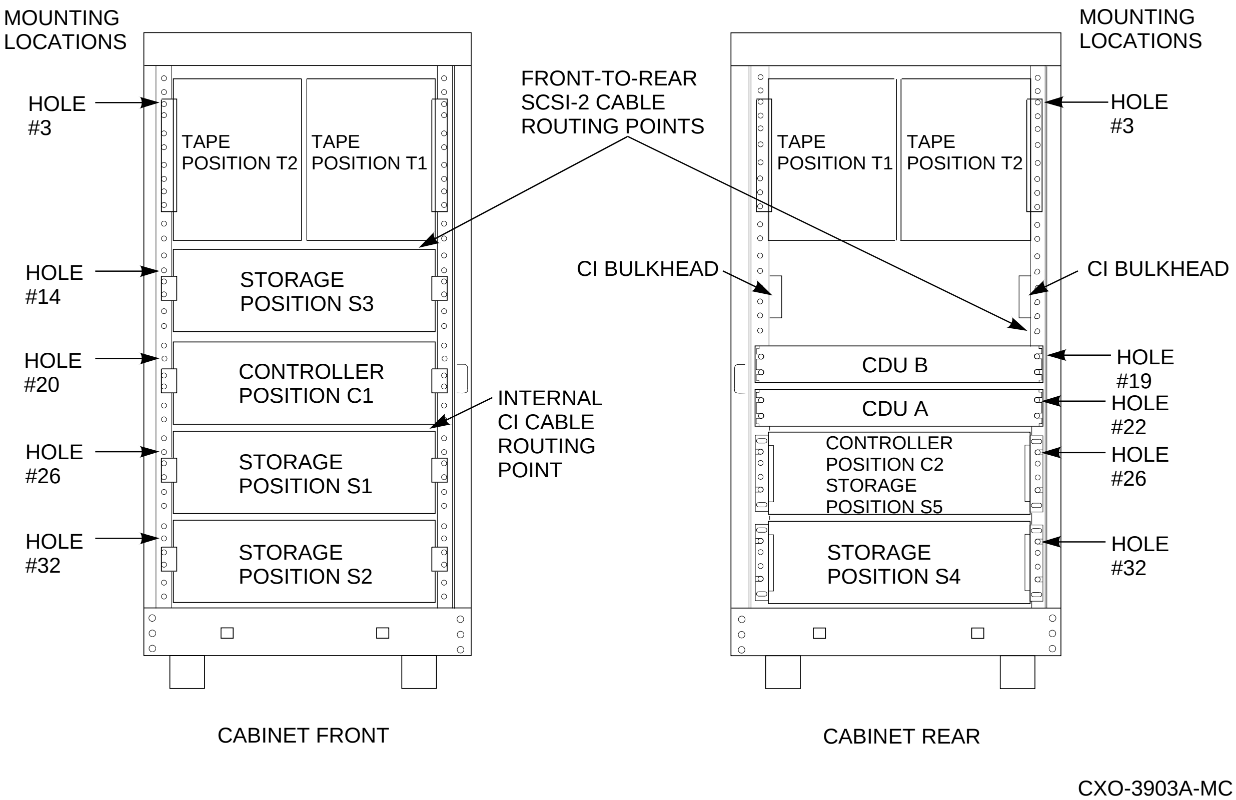
Figure 3–5 shows the loading sequence for storage and controller shelves when TZ8xx-series tape devices are installed.

- Standard shelf configuration

  A standard of one BA350–MA controller shelf connected to six BA350–SB storage shelves in a single SW500-series cabinet is suggested.

- Two BA350–MA shelves can be housed with a maximum of four BA350–SB shelves as two subsystems.

Figure 3–5 SW500-Series Cabinet Controller/Storage/Tape Drive Locations



- Two device shelves per port (jumpered pairs)

  Two BA350–SB shelves can be joined on the same controller port with the following restrictions:

  – The SCSI–2 cable to the first BA350–SB storage shelf is 1.0 meter or less.[4]

  – The SCSI–2 cable from the first BA350–SB shelf to the second shelf is 0.5 meters or less. This requires two shelves to be immediately adjacent to each other.

  – The first BA350–SB storage shelf is configured for unterminated single SCSI.

  – Controller shelf position C1 can be used with the pairs S1-S2 and S3-S4, and controller shelf position C2 can be used with the pair S7-S8, to satisfy these restrictions. A single subsystem (C1) can thus accommodate up to 16 5¼-inch SBBs.

- TZ8x7 half-rack tape loader (Figure 3–5):

  Any TZ8x7 half-rack tape loader must be located at the top front positions filling the two top BA350–SB shelf positions (front and rear). Note that each tape loader occupies the full cabinet depth. Up to two tape drive loader devices can be loaded in an SW500-series cabinet, displacing shelves S4, S9, and S7-S8 (moving the CDUs to shelf location S7). Single (or paired) TZ8x7

[4] The associated BA350–MA controller shelf must be located near enough to satisfy this restriction.

devices must be connected to a controller port, as in the SW800-series data center cabinet.

- Use of a second controller shelf

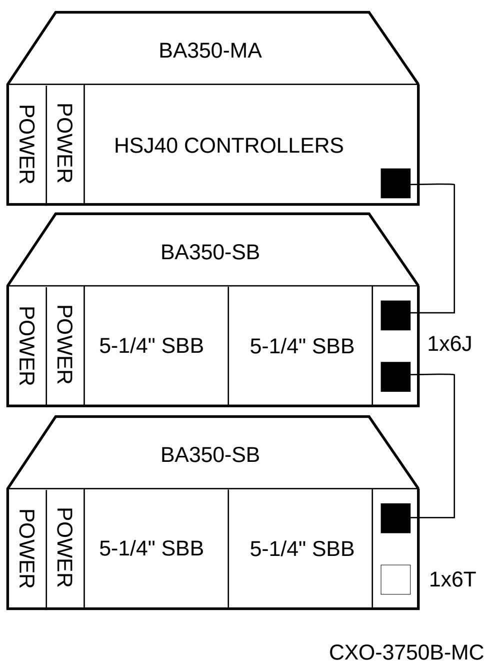
  By convention, the first controller shelf (C1) would use positions S1–S4 and S9; the second controller shelf (C2) would use positions S5, S7, and S8. This permits two subsystems, one with up to 24–28 3½-inch SBB devices (in the front), and the other with 18–21 3½-inch SBB devices (in the rear).

3.3 Shelves

Device shelves can be arranged in any SCSI–2 legal configuration, subject to the following:

- No more than a single extension joining two BA350–SB device shelves is permitted. The two BA350–SB shelves must be physically adjacent to each other. Figure 3–6 shows an example of device shelves in a single extension configuration.

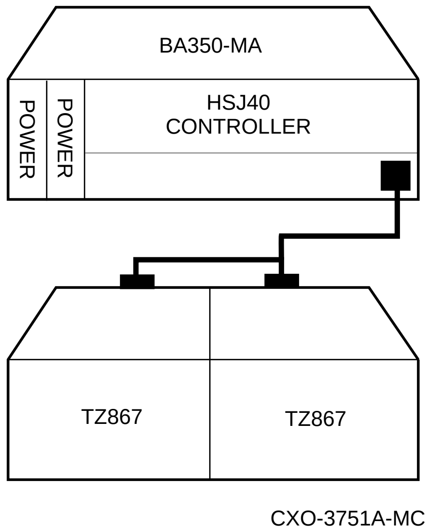
Figure 3–6 Single Extension from Device Shelf to Device Shelf



- Half-rack/full-depth devices, for example all TZ867 tapes, must be on their own port and cannot be connected as an extension from a BA350–SB shelf. Only two such devices (maximum) may be configured per controller port, and those devices must be physically adjacent to each other at the top of a cabinet.

  Figure 3–7 shows two adjacent tape drives attached to a single port of the controller shelf.

Figure 3–7 Adjacent Devices on a Single Port



- Connecting a 1.0 meter cable from a controller shelf to a device shelf allows for device shelf jumpering. Connecting a 2.0 meter cable does *not* permit shelf jumpering. (Required cable length will vary depending on cabinet type, device shelf position, and controller shelf position.)

3.4 Device Placement

The following sections describe recommended device configurations for 3½-inch and 5¼-inch SBBs.

Note

Intermixing disk SBBs and tape SBBs on the same controller port is permitted, provided all other configuration rules in this chapter are also obeyed.

3.4.1 3½-inch SBB Restrictions

There are no restrictions for adding 3½-inch SBBs to a configuration. Refer to your SPD and release notes for a list of specific supported device types.

3.4.2 5¼-inch SBB Restrictions

The following restrictions apply when adding 5¼-inch SBBs to a configuration. Refer to your SPD and release notes for a list of specific supported device types.

- A maximum of two 5¼-inch SBBs are allowed per port (in a single shelf), or four 5¼-inch SBBs per port (in adjacent jumpered shelves).

  No more than four 5¼-inch SBBs are allowed on a single port (that would take three shelves, which cannot be configured within SCSI–2 cable limits).

- Intermixing 5¼-inch and 3½-inch SBBs is permitted using up to six devices per port (maximum of two shelves), with no more than three 5¼-inch SBBs.

  You can use two 5¼-inch SBBs and four 3½-inch SBBs in two BA350–SB shelves, or one 5¼-inch SBB and four 3½-inch SBBs in one BA350–SB shelf.

- When using jumpered shelves, only five jumpered-pair shelves (for a total of ten shelves) can be used within each SW800-series data center cabinet. This leaves the sixth controller port unused. Alternately, four jumpered ports permit two single-shelf connections on the remaining two controller ports, which is preferable.

  This setup is only permitted in the lower front of the cabinet from the C1 controller position. Five such ports can take up to a maximum of ten front shelf locations, with no allowance for cable access to shelves or devices in the rear of the SW800-series cabinet. (Refer to Figure 3–1.)

  A more balanced configuration consists of four 5¼-inch SBBs on each of four ports, and two ports each with two 5¼-inch SBBs.

- When using jumpered shelves, only two jumpered-pair shelves (for a total of four shelves) can be used with an SW500-series cabinet.
- When five ports (SW800) or two ports (SW500) have doubled shelves for 5¼-inch SBBs (4+2), TZ8x7 tapes cannot be connected or even mounted in the cabinet because all or most (front) shelf locations are needed for the 5¼-inch SBBs.

3.4.2.1 Table Conventions

The following describes the designations used in Tables 3–1 through 3–6. The designation shows the possible devices in each shelf and the possible number of devices in similarly configured shelves.

```
(n)mxoT

(n)mxoJ
```

where:
n is the number of device shelves.
m is the number of SCSI–2 connections to a device shelf.
o is the number of devices on each SCSI–2 connection.
T indicates the device shelf is terminated.
J indicates the device shelf is jumpered.

According to the formula:

$m * o$ = possible devices in each shelf.

$n * m * o$ = possible number of devices in similarly configured shelves.

3.4.3 3½-inch SBBs

Tables 3–1 and 3–2 list some recommended configurations for 3½-inch SBBs.

Table 3–1 3½-Inch SBB Configurations, 6-Port Controller

Number of Devices	Number of BA350–SB Shelves*	Configure as**	Available for 3½-inch SBBs***	Ports Used
1–2	1	(1)2x3T	5-4	1–2
3–4	2	(2)2x3T	9-8	3–4
5–18	3	(3)2x3T	13-0	5–6
19–24	4	(2)2x3T	5-0	6
		(2)1x6T		
25–30	5	(1)2x3T	5-0	6
		(4)1x6T		
31–36	6	(6)1x6T	5-0	6
37–42****	6	(6)1x7T	5-0	6

Notes

2x3T: Two (split) SCSI–2 connections, separately terminated in the shelf. The devices appear as IDs 0, 2, 4, and 1, 3, 5.

1x6T: Single path SCSI–2 connection terminated in the shelf. The devices appear as IDs 0 through 5.

1x7T: Single path SCSI–2 connection terminated in the shelf. The devices appear as IDs 0 through 6.

* Consult the *StorageWorks Solutions Shelf User's Guide* for BA350–SB shelf information.
** Each BA350–SB shelf's upper SCSI–2 port connector is cabled to a controller port. The lower SCSI–2 port connector is attached to a controller port for 2x3T configurations and is unused for a 1x6T or 1x7T.
*** Available for future expansion.
**** Nonredundant controller and power (not recommended).

Table 3–2 3½-Inch SBB Configurations, 3-Port Controller

Number of Devices	Number of BA350–SB Shelves*	Configure as**	Available for 3½-inch SBBs***	Ports Used
1–2	1	(1)2x3T	5-4	1–2
3–12	2	(1)2x3T	9-0	3
		(1)1x6T		
13–18	3	(3)1x6T	5-0	3
19–21****	3	(3)1x7T	2-0	3

Notes

2x3T: Two (split) SCSI–2 connections, separately terminated in the shelf. The devices appear as IDs 0, 2, 4, and 1, 3, 5.

1x6T: Single path SCSI–2 connection terminated in the shelf. The devices appear as IDs 0 through 5.

1x7T: Single path SCSI–2 connection terminated in the shelf. The devices appear as IDs 0 through 6.

* Consult the *StorageWorks Solutions Shelf User's Guide* for BA350–SB shelf information.
** Each BA350–SB shelf's upper SCSI–2 port connector is cabled to a controller port. The lower SCSI–2 port connector is attached to a controller port for 2x3T configurations and is unused for a 1x6T or 1x7T.
*** Available for future expansion.
**** Nonredundant controller and power (not recommended).

3.4.4 5¼-inch SBBs

Tables 3–3 and 3–4 list some recommended configurations for 5¼-inch SBBs.

Table 3–3 5¼-Inch SBB Configurations, 6-Port Controller

Number of Devices	Number of BA350–SB Shelves*	Configure as	Available for 5¼-inch SBBs**	Ports Used
1–2	1	(1)2x3T	1-0	1–2
3–4	2	(2)2x3T	1-0	3–4
5–6	3	(3)2x3T	1-0	5–6
7–8	4	(2)1x6T	1-0	6
		(2)2x3T		
9–10	5	(4)1x6T	1-0	6
		(1)2x3T		
11–12	6	(6)1x6T	1-0	6
13–14***	7	(6)1x6T	1-0	6
		(1)1x6J		
15–16***	8	(6)1x6T	1-0	6
		(2)1x6J		
17–18***	9†	(6)1x6T	1-0	6
		(3)1x6J		
19–20***	10†	(6)1x6T	1-0	6
		(4)1x6J		

Notes

Each BA350–SB shelf has its upper connector cable attached to either the adjacent BA350–SB shelf's lower connector (1x6J), or a controller port connector (2x3T or 1x6T).

The lower connector cable is attached to either an adjacent BA350–SB shelf's upper connector (1x6J, as in the first list item), controller port connector (2x3T), or is unused (1x6T).

* Consult the *StorageWorks Solutions Shelf User's Guide* for BA350–SB shelf information.
** Available for additional 5¼-inch device.
*** When used with the controller in the C1 position in an SW800-series or SW500-series cabinet. (Refer to Figures 3–1 and 3–5.)
† Cannot be configured in SW500-series cabinets.

Table 3–4 5¼-Inch SBB Configurations, 3-Port Controller

Number of Devices	Number of BA350–SB Shelves*	Configure as	Available for 5¼-inch SBBs**	Ports Used
1–2	1	(1)2x3T	1-0	1–2
3–4	2	(1)2x3T	1-0	3
		(1)1x6T		
5–6	3	(3)1x6T	1-0	3
7–8	4	(2)1x6T	1-0	3
		(1)1x6J		
9–10	5	(1)1x6T	1-0	3
		(2)1x6J		
11–12	6†	(3)1x6J	1-0	3

Notes

Each BA350–SB shelf has its upper connector cable attached to either the adjacent BA350–SB shelf's lower connector (1x6J), or a controller port connector (2x3T or 1x6T).

The lower connector cable is attached to either an adjacent BA350–SB shelf's upper connector (1x6J, as in the first list item), controller port connector (2x3T), or is unused (1x6T).

* Consult the *StorageWorks Solutions Shelf User's Guide* for BA350–SB shelf information.
** Available for additional 5¼-inch device.
† Cannot be configured in SW500-series cabinets.

3.4.5 Intermixing 5¼-inch and 3½-inch SBBs

Use these guidelines for intermixing 5¼-inch and 3½-inch SBBs:

- Treat each 5¼-inch SBB as three 3½-inch SBBs.
- Each 5¼-inch SBB must have its SCSI–2 ID set manually using the address switch on the rear of the SBB, or by setting the switch to automatic and letting the slot connector dictate the device address. (Refer to the *StorageWorks Solutions Shelf and SBB User's Guide*.)
- A 5¼-inch SBB may be located in the same shelf with three or four 3½-inch SBBs.

3.4.6 Atypical Configurations

By unbalancing the number of devices per controller port, configurations can be devised with a smaller shelf count. This results in lower performance and/or availability. The minimum shelf count for various numbers of 3½-inch SBBs is listed in Tables 3–5 and 3–6.

Table 3–5 Small Shelf Count Configurations, 6-Port Controller

Number of Devices	Number of BA350–SB Shelves*	Configure as
1–6	1	1x6T
7–12	2	1x6T
13–18	3	1x6T
19–24	4	1x6T
25–30	5	1x6T
31–36	6	1x6T
37–42**	6	1x7T

Notes

* Consult the *StorageWorks Solutions Shelf User's Guide* for BA350–SB shelf information.
** Nonredundant controller and power configurations (not recommended).

Table 3–6 Small Shelf Count Configurations, 3-Port Controller

Number of Devices	Number of BA350–SB Shelves*	Configure as
1–6	1	1x6T
7–12	2	1x6T
13–18	3	1x6T
19–21**	3	1x7T

Notes

* Consult the *StorageWorks Solutions Shelf User's Guide* for BA350–SB shelf information.
** Nonredundant controller and power configurations (not recommended).

3.5 Controllers

This section describes specifics of configuring the controllers.

3.5.1 Nonredundant Controllers

The following guidelines apply to nonredundant controllers:

- A single controller must be installed in the slot furthest from the BA350–MA shelf's SCSI connectors. This slot is SCSI ID 7. By using SCSI ID 7, SCSI ID 6 (the other controller slot) is available as an additional ID on the device shelf.
- The maximum recommended controller subsystem configuration is six devices per controller port. This allows for the addition of another controller, and additional power supplies in the storage shelves. A nonredundant controller configuration *can* support seven devices per port. However, Digital still recommends six devices per port to permit the ease of future upgrade.
- (HSZ-series controller) The HSZ-series controller may currently only be configured as nonredundant. Two nonredundant HSZ-series controllers may not be placed in the same BA350–MA controller shelf.

3.5.2 Dual-Redundant Controllers

The following guidelines apply to dual-redundant controllers:

- Only HSJ- and HSD-series controllers may be configured as dual-redundant.
- Dual-redundant controllers are located in the same BA350–MA shelf, and are connected to each other through the shelf backplane. Both controllers have access to all the devices on each other's ports. This setup increases availability and provides for failover when one controller in the pair fails. (The surviving controller takes over service to all devices.)
- Dual-redundant configurations follow the same guidelines as nonredundant configurations, except there is no option to increase to seven devices per port.
- Both controller's cache modules must have the same number of megabytes, and both firmware versions must be identical. If there is a mismatch, neither controller will access any devices.
- Dual-redundant HSJ-series controllers must be on the same star coupler.
- Dual-redundant HSD-series controllers must be on the same DSSI bus.

3.5.3 Optimal Performance Configuration

For optimal performance, configure to the following guidelines:

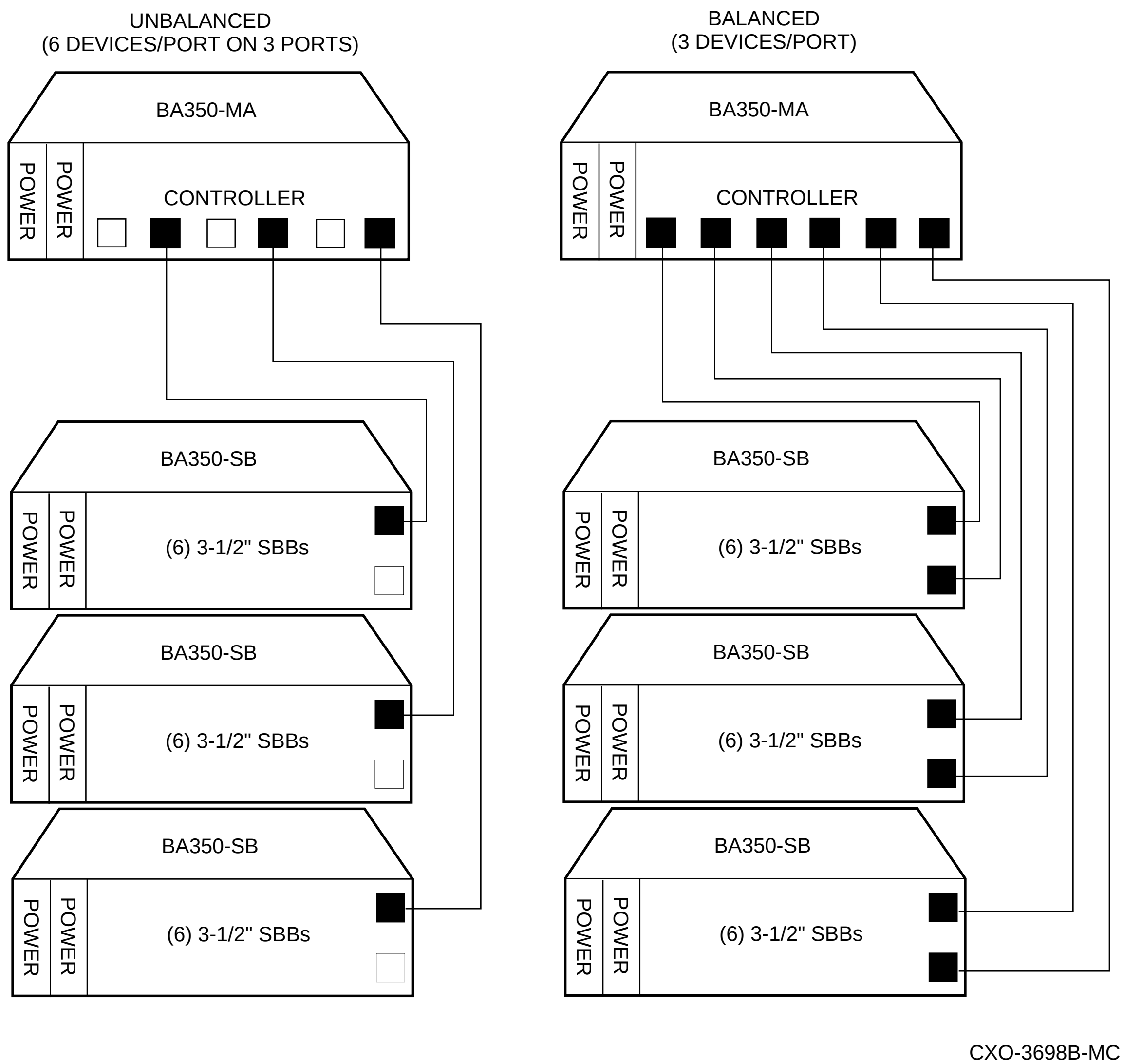
- Balance the number of devices on each port of a controller. For example, for 18 3½-inch SBBs, place 3 devices on each of 6 ports. This permits parallel activity on the controller's available ports to the attached devices. Figure 3–8 is an example of how to balance devices across ports.
- Evenly distribute higher performance devices across separate ports so that higher and lower performance devices are intermixed on the same port. (For example, put multiple solid state disks on separate ports.) This intermixing of higher and lower performance devices on the same port benefits overall performance. Use the guidelines in Table 3–7.

Table 3–7 High-performance Devices per Port

Number of high-performance devices	Number of high-performance devices per port
1–6	1
7–12	2
13–18	3

- Limit the number of devices per controller port to three in dual-redundant configurations. In doing so, both controllers access three devices per *each other's* port, maintaining six SCSI–2 devices total.
- Maximize the amount of cache memory per controller with the 16- or 32-MB cache module option.

Figure 3–8 Balanced Devices Within Device Shelves



Highest Performance

To obtain the highest performance possible, use a dual-redundant configuration and balance the number of devices across the two controllers. Do this through your operating system by ordering how devices are mounted or sequenced and by setting preferred path definitions.

Following this guideline results in approximately half of the devices normally accessed through each controller. Should one controller fail, the surviving controller automatically will assume service to the failed controller's devices.

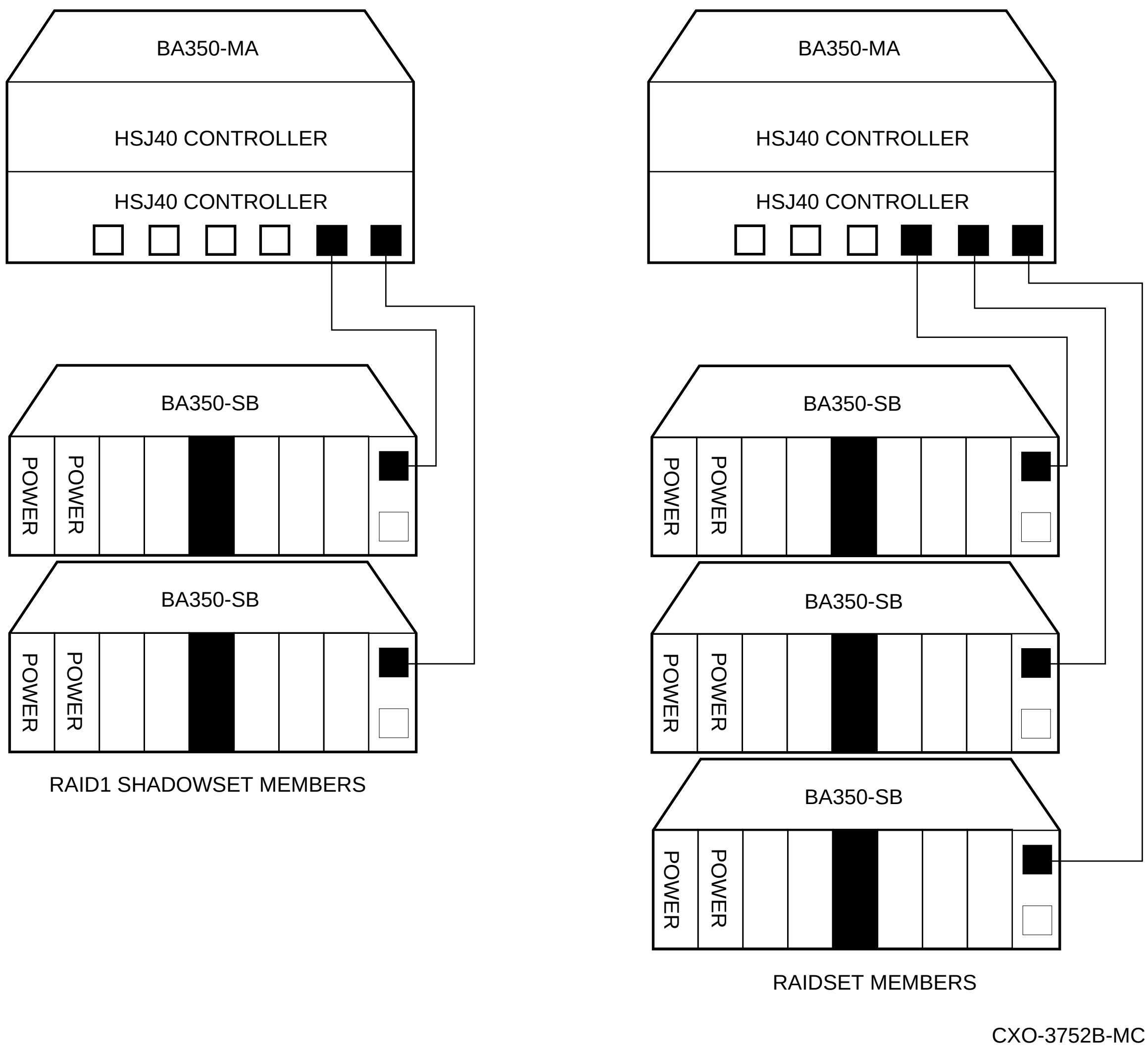
3.5.4 Optimal Availability Configuration

For optimal availability, configure to the following guidelines:

- Use dual-redundant controllers and redundant power supplies in all shelves.
- Place storage set members on different controller ports and different device shelves.
- Use predesignated spares on separate controller ports and device shelves.
- Place storage set members on separate controllers when implementing host-based RAID (for example, HBVS).

Figure 3–9 shows examples of optimal configurations for raidset members and designated spares on separate controller ports.

Figure 3–9 Optimal Availability Configurations



Highest Availability

For highest availability, especially with RAID implementations, follow these guidelines:

- For host-based RAID implementations, split the normal access path between controllers.
- Use redundant power supplies in all shelves.

3.6 Host Considerations

The following sections explain important considerations when configuring the HS controller and subsystem to the host CPU.

3.6.1 Host Cables

Following are special guidelines for configuring host cables/buses to and from the HS controller.

HSD-series controllers

- DSSI cable length between nodes/members on the DSSI bus must be no greater than 16 feet (4.9 meters).
- Total DSSI cable length (end-to-end) on one DSSI bus must be no greater than 60 feet (18.3 meters).

HSZ-series controllers

The maximum length (end-to-end) of fast and slow buses is summarized in Table 3–8:

Table 3–8 SCSI Bus Maximum Lengths

Bus Type	Transfer Rate	Meters	Feet
8-bit, single-ended	5 MB/s	6	19.7
8-bit, single-ended	10 MB/s	3	9.8
16-bit, differential	20 MB/s	25	82.0

3.6.2 Host Adapters

The HSJ-series controllers follow the same CI configuration rules as the HSC controller product family, which supports from 1 to 31 host nodes. Consult your HSJ-series controller software product description (SPD) and firmware release notes for specific restrictions and a current list of supported host adapters.

Also for the HSJ-series controllers, all host adapter CI ports in a CI configuration must have the quiet slot time set to 10. Some older systems may have the quiet slot time set to 7, which will cause incorrect operation of the CI.

The following host adapters currently are supported:

- **HSJ-series controllers**
  - CIXCD (for XMI-based systems)
  - CIBCA–B (for BI-based systems)[5]
  - CI780 (for SBI-based systems)
- **HSD-series controllers**
  - SHAC (for various DEC and VAX systems)
  - D4000 (for DEC 4000 systems)
  - KFMSA (for XMI based systems)
- **HSZ-series controllers**
  - KZTSA[6] (for DEC 3000 systems)
  - KZMSA (for DEC 7000/10000 systems via DWZZA)

Consult your controller SPD and firmware release notes for current lists of supported host adapters.

---

[5] Supersedes CIBCA–A; CIBCA–A is no longer supported.
[6] See the HSZ-series firmware release notes for restrictions.

4
Normal Operation

This chapter describes operating conditions and procedures for the HS controllers. Included is information about both storage and controller configurations.

The “configurations” discussed in this chapter are those set by the operator, employing user interfaces such as the HS operating firmware and/or operating system commands. Refer to Chapter 3 for *physical* configuration of the subsystem hardware.

Also given are cross references to other sections of this manual where more information about controller operation is provided.

4.1 Initialization

The following sections discuss the operating conditions surrounding initialization of the controller and subsystem.

4.1.1 Controller Initialization

The controller will initialize after any of the following conditions:

- Power is turned on.
- The firmware resets the controller.
- The operator presses the green reset (//) button.
- The host clears the controller.

Note

Keep the program card in its slot during controller subsystem operation. If the program card is removed, the controller will reset.

See Chapter 6 for a description of the initialization of both the controller and its cache module. (The process is described in Chapter 6 because some of the initialization diagnostics are available as a controller self-test function for the operator.)

4.1.2 Dual-Redundant Configuration Initialization

The controllers in a dual-redundant configuration run the same initialization sequence that is described in Chapter 6, except they exchange signals during their individual initialization sequences. The first signal occurs after one controller starts initializing. The signal informs the other controller that an initialization is occurring. This way the other controller will not assume that the initializing controller is not functioning and will not attempt to disable it.

4.1.3 Subsystem Initialization

Full StorageWorks subsystem initialization take place when the subsystem is switched on for the first time. In the event of a reset due to one of the following conditions, a subset of the initialization sequence is run:

- A partial or complete power failure
- Equipment failure
- An error condition

A complete StorageWorks subsystem initialization includes the following:

1. When the subsystem is turned on, all shelves in the subsystem are reset. Then, entities in the shelves (including storage devices, controllers, and cache modules) run their initialization and self-test sequences.
2. During initialization, the controller interrogates the entities with which it has connections, including other controllers in the subsystem.
3. When the initialization sequence on all entities is completed, the controller begins data transfer and other operations with the host.

4.2 Operator Control Panel

The operator can use the operator control panel (OCP) to reset the controller, control the SCSI–2 buses attached to the controller, and interpret error conditions that result in LED error codes. The OCP and its use are described in Chapter 5.

4.3 Command Line Interpreter

The Command Line Interpreter (CLI) is the user interface to the controller. The CLI allows you to control storage and controller configurations through commands. The following sections explain how to use the CLI, and how it defines and modifies configurations. A detailed description of CLI commands is provided in Appendix B.

4.3.1 Accessing the CLI

You can access the CLI through a maintenance terminal (see Section 4.5) or through a virtual terminal.

To access the CLI through a maintenance terminal (all controllers), connect the terminal and press the Return key. You must use a maintenance terminal to set the controller initial configuration. This is because the controller arrives with an invalid ID, and its host ports (HSJ-, HSD-series controllers) are initially off.

Thereafter, you may use a virtual (host) terminal to modify the configuration. The method of establishing the virtual terminal connection varies depending on your operating system and interface.

For example, for HSJ- and HSD-series controllers under the OpenVMS operating system for VAX hardware, the following command connects a host terminal to the CLI (the command requires the DIAGNOSE privilege):

Note

The controller SCS node name *must* be specified.

```
$ SET HOST/LOG=CONFIGURATION.INFO/DUP/SERVER=MSCP$DUP/TASK=CLI SCS_nodename
```

Establishing a virtual terminal for HSZ-series controllers requires using the HSZUTIL application, which is described in Chapter 6.

Note

Your CLI> prompt may be factory-set to reflect your controller model, such as HSJ>, HSD>, or HSZ>. Appendix B provides details on how to change the CLI> prompt.

4.3.2 Exiting the CLI

When exiting the CLI, keep the following guidelines in mind:

- If you are using a maintenance terminal, you cannot exit the CLI. Entering the EXIT command merely restarts the CLI and redisplays the copyright notice, controller type, and any last fail error information.
- If you are using the DUP connection/virtual terminal, enter the following command to exit the CLI and return the terminal to the host:

  ```
  CLI> EXIT
  ```

- If you connect a virtual terminal via the OpenVMS VAX operating system, you can specify the qualifier /LOG=CONFIGURATION.INFO on the DCL command line. This qualifier creates a log file of your CLI session. Then, when you exit the CLI, you can open the log file to remember how you configured your subsystem.

4.3.3 Command Sets

The CLI consists of the following six command sets:

- Failover commands
  - Failover commands support dual-redundant controller configurations.
- Controller commands
  - Set and show the basic controller parameters.
  - Set the controller ID (CI or DSSI node number or SCSI target ID),.
  - Set the resident terminal characteristics.
  - Restart the controller.
  - Run resident diagnostics and utilities (see Chapter 6).

- Device commands
  - Device commands specify and show the location of *physical* SCSI–2 devices attached to the controller. Locations of devices are specified using the SCSI Port-Target-LUN (PTL) designation.
  - Only devices that have been defined by the ADD command are seen or used by the controller. Devices that have been placed in a shelf, but have not been added, will *not* be automatically used by the controller. Use the CONFIG utility to quickly add such devices (see Chapter 6).
- Storage set commands
  - Storage set commands add, modify, rename, and show storage sets (such as stripesets).
- Logical unit commands
  - Logical unit commands add, modify, and show logical units built from devices and storage sets.
- Exerciser commands
  - The exerciser commands invoke disk and tape exercisers that test device data transfer capabilities. The exercisers (DILX and TILX) are fully described in Chapter 6.

Note

Remember these two guidelines when using the CLI:

- Not all configuration parameters need to be specified on one line. They can be entered by using multiple SET commands.
- Only enough of each command need be entered to make the command unique (usually three characters). For example, SHO is equivalent to SHOW.

4.3.4 Initial Configuration (Nonredundant Controller)

After installation of a nonredundant controller, use the CLI to define its parameters in the following order (from a maintenance terminal).

CAUTION

Do not install HSJ-series CI host port cables until after setting all parameters listed here. Failure to follow this procedure may result in adverse effects on the host/cluster.

Note

Not all steps are applicable to all controller models. Steps applicable to certain models are designated as such.

1. Enter the following command to set the MAX_NODES (HSJ-series controllers):

   ```
   CLI> SET THIS_CONTROLLER MAX_NODES=n
   ```

   where *n* is 8, 16, or 32.

2. Enter the following command to set a valid controller ID:

   ```
   CLI> SET THIS_CONTROLLER ID=n
   ```

   where *n* is the (HSJ-series controller) CI node number (0 through (MAX_NODES – 1)).

   or *n* is the (HSD-series controller) one-digit DSSI node number (0 through 7). Each controller DSSI node number must be unique on its DSSI interconnect.

   or *n* is the (HSZ-series controller) SCSI target ID(s) (0 through 7).

3. Enter the following command to set the SCS node (HSJ- and HSD-series controllers):

   ```
   CLI> SET THIS_CONTROLLER SCS_NODENAME="xxxxxx"
   ```

   where *xxxxxx* is a one- to six-character alphanumeric name for this node. The node name must be enclosed in quotes with an alphabetic character first. Each SCS node name must be unique within its VMScluster.[1]

4. Enter the following command to set the MSCP allocation class (HSJ- and HSD-series controllers):

   ```
   CLI> SET THIS_CONTROLLER MSCP_ALLOCATION_CLASS=n
   ```

   where *n* is 0 through 255.

5. Enter the following command to set the TMSCP allocation class (HSJ- and HSD-series controllers):

   ```
   CLI> SET THIS_CONTROLLER TMSCP_ALLOCATION_CLASS=n
   ```

   where *n* is 0 through 255.

   Note

   Always restart the controller after setting the ID, SCS node name, or allocation classes.

6. Restart the controller either by pressing the green reset (//) button, or by entering the following command:

   ```
   CLI> RESTART THIS_CONTROLLER
   ```

7. Enter the following command to verify the preceding parameters were set:

   ```
   CLI> SHOW THIS_CONTROLLER
   ```

[1] See Section 4.9.2 for important information about VMS node names.

CAUTION

Do not plug the host port cable into an HSD-series controller while the power is on to *any* devices on the DSSI bus. Doing so risks short circuits that may blow fuses on all the devices.

8. Connect the host port cable to the front of the controller (see Chapter 7).
9. Enter the following commands to enable CI paths A and B to the host (HSJ-series controllers):

```
CLI> SET THIS_CONTROLLER PATH_A
CLI> SET THIS_CONTROLLER PATH_B
```

   Enter the following command to enable the host port path (HSD-series controllers):

```
CLI> SET THIS_CONTROLLER PATH
```

   The host port path for HSZ-series controllers is always on, so no command is needed.

4.3.5 Initial Configuration (Dual-redundant Controllers)

In a dual-redundant configuration, one terminal can set both controller configurations. After installation of both controllers, use the CLI to define their parameters in the following order (from a maintenance terminal connected to one controller):

CAUTION

Do not install HSJ-series CI host port cables until after setting all parameters listed here. Failure to follow this procedure may result in adverse effects on the host/cluster.

Note

Not all steps are applicable to all controller models. Steps applicable to certain models are designated as such.

1. Enter the following command to set the MAX_NODES (HSJ-series controllers):

```
CLI> SET THIS_CONTROLLER MAX_NODES=n
```

   where *n* is 8, 16, or 32.

2. Enter the following command to set a valid controller ID:

```
CLI> SET THIS_CONTROLLER ID=n
```

   where *n* is the (HSJ-series controller) CI node number (0 through (MAX_NODES − 1)).

   or *n* is the (HSD-series controller) one-digit DSSI node number (0 through 7). Each controller DSSI node number must be unique on its DSSI interconnect.

3. Enter the following command to set the SCS node:

```
CLI> SET THIS_CONTROLLER SCS_NODENAME="xxxxxx"
```

where *xxxxxx* is a one- to six-character alphanumeric name for this node. The node name must be enclosed in quotes with an alphabetic character first. Each SCS node name must be unique within its VMScluster.[2]

4. Enter the following command to set the MSCP allocation class:

```
CLI> SET THIS_CONTROLLER MSCP_ALLOCATION_CLASS=n
```

where *n* is 1 through 255.

Digital recommends providing a unique allocation class value for every pair of dual-redundant controllers in the same cluster.

5. Enter the following command to set the TMSCP allocation class:

```
CLI> SET THIS_CONTROLLER TMSCP_ALLOCATION_CLASS=n
```

where *n* is 1 through 255.

CAUTION

The SET FAILOVER command establishes controller-to-controller communication and copies configuration information. Always enter this command on one controller only. COPY=*configuration-source* specifies where the *good* configuration data are located. *Never* blindly specify SET FAILOVER. Know where your good configuration information resides before entering the command.

---

6. Enter the following command to copy parameters to the other controller (the one *not* connected to):

```
CLI> SET FAILOVER COPY=THIS_CONTROLLER
```

Note

Always restart the controllers after setting the ID, SCS node name, or allocation classes.

---

7. Restart both controllers either by pressing the green reset (//) buttons, or by entering the following commands:

```
CLI> RESTART OTHER_CONTROLLER
CLI> RESTART THIS_CONTROLLER
```

[2] See Section 4.9.2 for important information about VMS node names.

8. Enter the following commands to verify the preceding parameters were set.

```
CLI> SHOW THIS_CONTROLLER
CLI> SHOW OTHER_CONTROLLER
```

CAUTION

Do not plug host port cables into an HSD-series controller while the power is on to *any* members on the DSSI bus, including the controller and host. Doing so risks short circuits that may blow fuses on all the members.

9. Connect the host port cables to the front of the controllers (see Chapter 7). Do *not* connect the two controllers in a dual-redundant pair to separate or different star couplers (HSJ-series) or DSSI buses (HSD-series).
10. Enter the following commands to enable CI paths A and B to the host (HSJ-series controllers):

```
CLI> SET THIS_CONTROLLER PATH_A
CLI> SET THIS_CONTROLLER PATH_B
CLI> SET OTHER_CONTROLLER PATH_A
CLI> SET OTHER_CONTROLLER PATH_B
```

Enter the following commands to enable the host port path (HSD-series controllers):

```
CLI> SET THIS_CONTROLLER PATH
CLI> SET OTHER_CONTROLLER PATH
```

4.3.6 Configuring Storage Devices

To automatically configure devices on the controller, use the CONFIG utility described in Chapter 6.

Note

If you use the ADD command to add a removable media device (such as a tape or CDROM) to an HSJ- or HSD-series controller, the host will not be able to access the device until one of the following occurs:

- The media is loaded into the device.
- The controller is reinitialized.
- The host is reinitialized.
- The virtual circuit is broken and reestablished.

For manual configuration, the following steps add devices, storage sets, and logical units. Use the CLI to complete these steps so that the host will recognize the storage device. (These steps can be run from a virtual terminal.)

1. Add the physical devices by using the following command:

   CLI> **ADD *device-type device-name scsi-location***

   For example:

   ```
   CLI> ADD DISK DISK100 1 0 0
   CLI> ADD TAPE TAPE510 5 1 0
   CLI> ADD CDROM CDROM0 6 0 0
   ```

   where:

   device-type is the type of device to be added. This can be DISK, TAPE, or CDROM.

   device-name is the name to refer to that device. The name is referenced when creating units or storage sets.

   SCSI-location is the port, target, and LUN (PTL) for the device. When entering the PTL, at least one space must separate the port, target, and LUN.

2. Add the storage sets for the devices.

   See Appendix B for examples for adding storage sets. (If you do not desire storage sets in your configuration, skip this step.)

CAUTION

The INITIALIZE command destroys all data on a container. See Appendix B for specific information on this command.

3. Enter the following command to initialize the containers (devices, or storage sets, or both) prior to adding logical units to the configuration.

   CLI> **INITIALIZE *container-name***

   where *container-name* is a device or storage set that will become part of a unit.

   When initializing a single-device container:

   - If NOTRANSPORTABLE (the default) was specified when the device was added, a small amount of disk space was made inaccessible to the host and used for metadata. The metadata will now be initialized.
   - If TRANSPORTABLE was specified, any metadata on the device will now be destroyed. See Appendix B for details on metadata and when INITIALIZE is required.

4. Add the units that use either the devices or the storage sets built from the devices by entering the following command:

   CLI> **ADD UNIT *logical-unit-number container-name***

   where:

   logical-unit-number is the unit number the host uses to access the device.

   container-name identifies the device or the storage set.

4.4 Acceptance Test

After you install, set parameters for, and configure your controller, follow the guidelines in this section to acceptance test your subsystem.

1. Turn your system on. This resets all shelves and starts the spin-up cycle on devices within the shelves. This includes the initialization (diagnostics) on the controller(s) and device self-tests.
2. Run DILX using the default answers to the test questions (see Chapter 6). This tests all disk devices in your subsystem.
3. Run TILX using the default answers to the test questions (see Chapter 6). This tests all tape devices in your subsystem.

4.5 Maintenance Terminal

A maintenance terminal is a locally connected EIA–423 compatible terminal (a terminal connected directly to the controller MMJ). You do not need a maintenance terminal for normal operation. However, you must connect a maintenance terminal for initial controller configuration. Thereafter, use either a maintenance terminal or a host (virtual) terminal to communicate with the controller.

Follow this procedure to connect a maintenance terminal:

1. Make sure the power switch on the back of the terminal is off (O).
2. Connect one end of the terminal cable to the back of the terminal.
3. Connect the other end of the terminal cable to the MMJ on the controller.
4. Set your terminal at 9600 baud, 8 data bits, 1 stop bit, and no parity. Refer to your terminal documentation for terminal setup instructions.

4.6 Virtual Terminal (HSJ- and HSD-Series Controllers)

After installation and setting of initial controller parameters through a maintenance terminal, controller functions may be executed from a virtual host terminal through a DUP connection. Refer to Section 4.3.1 for information on making the virtual connection.

Establishing a virtual terminal session under the OpenVMS VAX and OpenVMS AXP operating systems (SET HOST/DUP) requires the FYDRIVER. The following error indicates that the FYDRIVER has not been loaded:

```
%HSCPAD-F-DRVNOTLOAD, FYDRIVER not loaded
-SYSTEM-W-NOSUCHDEV, no such device available
```

If you receive this message, load the FYDRIVER as follows:

- For OpenVMS VAX

```
$ MCR SYSGEN
SYSGEN> LOAD SYS$LOADABLE_IMAGES:FYDRIVER
SYSGEN> CONNECT FYA0 /NOADAPTER
SYSGEN> EXIT
$
```

- For OpenVMS AXP

```
$ MCR SYSMAN
SYSMAN> IO CONNECT FYA0 /NOADAPTER/DRIVER=SYS$FYDRIVER
SYSMAN> EXIT
$
```

Once FYDRIVER is loaded, you may make the virtual terminal connection as follows:

```
$ SET HOST/LOG=CONFIGURATION.INFO/DUP/SERVER=MSCP$DUP/TASK=CLI SCS_nodename
```

4.7 Virtual Terminal (HSZ-series Controllers)

A virtual terminal port can be created through a host-based application called HSZUTIL (HSZ-series controller). This program uses SCSI diagnostic send and receive commands to deliver and receive characters to and from the HSZ-series CLI and local programs. See Chapter 6 for more information on the HSZUTIL application.

4.8 VAXcluster Console System

You can run VAXcluster Console System (VCS) with any HS controller. If you are unfamiliar with VCS, refer to the *VCS Software Manual* for instructions.

Note

VCS can only be used from a terminal connected to a maintenance terminal port.

4.9 Operating Systems

The following sections describe particulars associated with host operating systems which may help in understanding and servicing the HS controllers.

The two primary operating systems that support the HS controllers are the OpenVMS and DEC OSF/1 AXPoperating systems as shown in Table 4–1:

Table 4–1 Operating System Support

Operating System	HSJ-series	HSD-series	HSZ-series
OpenVMS AXP	V1.5[1]	V1.5[1]	N/S[2]
OpenVMS VAX	V5.5–2[1]	V5.5–2	N/S[2]
VAX VMS	V5.5–1[1]	N/S[2]	N/S[2]
DEC OSF/1 AXP	N/S[2]	N/S[2]	V2.0

[1]Supported with limitations.

[2]Not supported at time of printing.

Refer to your firmware release notes for updates to the list of operating system support.

Although certain specifics regarding operating systems are covered here, you should refer to the *StorageWorks Array Controllers HS Family of Array Controllers User's Guide* for complete information on operating system support.

4.9.1 Controller Disks as System Initialization Disks

HSJ-series controllers

HSJ-series controller disks as VAX 7000™ and VAX 10000™ initialization devices—HS operating firmware supports manual and automatic initialization for VAX 7000/10000 systems. For a disk drive connected to an HSJ-series controller to be both a VAX 7000/10000 manual *and* automatic initialization device, the following conditions must be met:

- VAX 7000/10000 console code must be at version V3.2 or higher.
- HS operating firmware must be at version V1.0B or higher.

Note

Contact Digital Multivendor Services if you need to upgrade to V3.2 or greater VAX 7000/10000 console code.

If your VAX 7000/10000 console code version is earlier than V3.2, you are limited to manual initialization. To manually initialize, perform the following steps:

1. Make sure that the disk drives attached to the HSJ-series controller are visible to the initialization driver by entering the SHOW DEVICE command repeatedly (from the virtual terminal) until the disk drives attached to the HSJ-series controller are reported (usually two repetitions are sufficient).
2. Enter the default initialization device string. (Refer to the VAX console instructions in the VAX console documentation.)
3. Enter BOOT.

HSD-series controllers

An HSD-series unit can be an OpenVMS operating system initialization disk.

HSZ-series controllers

An HSZ-series unit can be a DEC OSF/1 AXP operating system initialization disk if the system unit is LUN 0 as seen by the host CPU.[3]

4.9.2 Operating System Nodes (OpenVMS)

Be aware of the following condition for HSJ-series controllers:

- If a controller is already an active member of an OpenVMS cluster and you change its current CI node number but not its CI node name, and then restart the controller with the new node number, access to its devices and overall cluster operation will be adversely affected. This occurs because the OpenVMS operating system makes continuous attempts to establish new virtual circuits with new nodes, and it will find a known node name at a new node address. This operation is a security feature provided by the operating system to prevent one CI node from masquerading as another.

[3] See the HSZ-series firmware release notes for restrictions.

- If the controller CI node number and node name are both changed, and you restart the controller while the OpenVMS cluster remains operational, the operating system will establish communication with the controller using the new CI node address and CI node name. Normal operation will occur, with the exception that the controller's devices will be assigned new device names based on the controller's new node name.
- If it is necessary to change only the controller's CI node number, all CI host CPU nodes must be shut down and then restarted.

4.9.3 AUTOGEN.COM (OpenVMS)

The OpenVMS AUTOGEN.COM file must be edited for HSJ- and HSD-series controller-attached disks to be recognized. If AUTOGEN is run without modification in a system that includes such controller-attached disk drives, the following error message is displayed:

```
"** WARNING ** - unsupported system disk type. Using speed and size
characteristics of an RK07."
```

The AUTOGEN program does not recognize the device types of the controller's attached devices. The OpenVMS DCL lexical F$GETDVI returns the following values:

```
OpenVMS VAX V6.0    VAX VMS V5.5-1
OpenVMS VAX V6.1    OpenVMS VAX V5.5-2
----------------    ------------------
141 - HSX00         35 - unknown device
142 - HSX01         35 - unknown device
```

The AUTOGEN.COM DCL procedure must be modified as follows to support these values:

VAX VMS V5.5–1 and OpenVMS V5.5–2

The AUTOGEN.COM DCL procedure will select a –1 (unsupported device) from the speed list. To circumvent this problem, perform the following steps:

1. Make a copy of the AUTOGEN.COM DCL file in case restoration of the original state is required.
2. The section of AUTOGEN.COM (from OpenVMS software V5.5–2) dealing with devices is shown below. Change one element in the speed list (the –1 shown enclosed in a box) to a 4.

```
$speed_list=" -1, 2, 2, 4, 4, 4, 4, 4, 4, 1, 1,-1,-1, 4,-1, 4,-1,-1, 1, 2"
$speed_list=speed_list + ", 4, 4, 4, 2, 2, 1,-1, 1, 1, 2, 4, 1, 1,-1,-1, -1, -1,-1, 4, 4"
$speed_list=speed_list + ", 1, 1, 1, 4, 4, 1, 4,-1, 4, 4, 4, 4,-1,-1, 4,-1, 4, 4,-1, 4"
$speed_list=speed_list + ", 4, 4,-1,-1, 4, 4, 2,-1,-1,-1, 4,-1, 1,-1, 4, 4, 4, 4, 4, 4"
$speed_list=speed_list + ", 4, 4, 4, 4,-1, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4"
$speed_list=speed_list + ", 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4, 4"
$speed_list=speed_list + ", 4, 4, 4, 4, 4, 4, 4"
$diskspeed=-1
$temp = F$GETDVI("sys$sysdevice","DEVTYPE")
$IF (temp .LE. 126) .AND. (temp .GE. 1) -
THEN diskspeed = F$ELEMENT(temp,",",speed_list)
$disksize = F$GETDVI("sys$sysdevice","MAXBLOCK")
$IF diskspeed .NE. -1 THEN GOTO getdata30
```

3. Run the AUTOGEN program.

Completing this procedure causes the disk drives to be recognized as supported device types.

OpenVMS VAX V6.0

The AUTOGEN.COM DCL procedure does not support device types above 137 although HSX00 and HSX01 are properly defined in the speed list. To circumvent this problem, perform the following steps:

1. Make a copy of the AUTOGEN.COM DCL file in case restoration of the original state is required.
2. Edit the AUTOGEN.COM file. Change the value 137 in the following statement to 142.

```
$IF  (temp  .LE.   137) .AND.  (temp .GE.  1) -
```

3. Run the AUTOGEN program.

This change will allow AUTOGEN to run successfully against the controller-attached disk drives used as system disks.

OpenVMS VAX V6.1

The OpenVMS VAX V6.1 operating system does not require modifications to AUTOGEN.COM as described in the previous sections.

4.9.4 Other Conditions (OpenVMS)

The following conditions and recommendations also apply to controllers running under the OpenVMS operating system:

- MSCP and TMSCP controller timeouts

  The MSCP and TMSCP controller timeouts have been split and the TMSCP timeout has been increased from 200 to 255 seconds. This is to reduce host resets from the TU driver in OpenVMS VAX V5.5–2 that occur when the driver sends multiple position commands to a tape drive with shorter timeouts. This change in HSJ- and HSD-series controller firmware will reduce but not eliminate the rate of these host resets.

- Write history log

  The write history log has been increased from 512 to 2048 entries. The allocation failure entry table has also been increased from 128 to 512 entries. This should eliminate or drastically reduce VMS crashes from entries and tables filling up while the OpenVMS software is using Host-Based Volume Shadowing (HBVS) on the HSJ- or HSD-series controller.

- Increased storage set size

  Fourteen-member RAID 0 storage sets are now supported. Previous versions of HS operating firmware supported only five-member storage sets. The OpenVMS VAX operating system maximum capacity restriction for file-structured volumes, 16,777,216 blocks (about 8.5 gigabytes), remains in effect for operating system versions prior to V6.0.

- The CLUSTER_SIZE qualifier for large devices or storage sets

  Digital recommends that the formula displayed by the OpenVMS HELP DEVICE INIT/CLUSTER_SIZE command be used to determine the proper OpenVMS file system cluster size. Using too small a file system cluster size may prevent some of the device or storage set capacity from being accessed; too large a cluster size usually wastes storage capacity by allocating large blocks of storage for small files.

- Shadow set operation

  In the OpenVMS VAX operating system versions earlier than V6.0, timed-out I/O requests to shadow set members may lead to member disks attached to controllers being dropped from shadow sets. In some cases, this may lead to host crashes.

  To avoid this possibility, Digital recommends changing the value of the SYSGEN parameter SHADOW_MBR_TMO to at least 120 (seconds) for systems running operating system versions earlier than V6.0. (Be aware that your system may temporarily pause during the 120 second interval.) Version 6.0 of the OpenVMS VAX operating system avoids this problem by retrying timed-out operations to shadow set members several times.

- PAPOLLINTERVAL and PANUMPOLL parameters

  Digital recommends that the SYSGEN parameters PAPOLLINTERVAL and PANUMPOLL be set such that all nodes in the cluster are polled within 30 seconds or less. This ensures proper operation of the HSJ-series CI in the event of controller reinitialization. Failure to set this value may result in MSCP command timeouts. The default values are set to poll 16-node clusters every 5 seconds and 32-node clusters every 10 seconds.

4.10 Failover

Failover takes place when one controller fails in a dual-redundant configuration. To support failover, information is shared between the two controllers, such as:

- Physical device PTL configurations
- Storage set names
- Logical unit definitions

Prior to failover, all resources are considered unbound to a particular controller, until a logical unit is brought on line by the host through (one of) the controllers. At this point, all containers used by the logical unit become solely accessible through the one controller.

In a failover configuration, all commands are shared between the two controllers except the following:

SET THIS_CONTROLLER
SET OTHER_CONTROLLER
SHOW THIS_CONTROLLER
SHOW OTHER_CONTROLLER
RESTART THIS_CONTROLLER
RESTART OTHER_CONTROLLER
SHUTDOWN THIS_CONTROLLER
SHUTDOWN OTHER_CONTROLLER

In these cases, the command will be directed to the correct controller:

- THIS_CONTROLLER refers to the controller to which the terminal is connected.
- OTHER_CONTROLLER refers to the other controller in the dual-redundant pair.

4.10.1 Setting Failover

To place two controllers into failover configuration, enter the following command:

```
CLI> SET FAILOVER COPY=configuration-source
```

where *configuration-source* is either THIS_CONTROLLER or OTHER_CONTROLLER, depending on where the “good” copy of device configuration information is found.

CAUTION

Digital recommends that the controllers be set for failover before any device configuration commands are entered. Then, as devices, storage sets, and units are added to one controller’s configuration, they are automatically added to the other controller’s configuration.

Given two controllers, it is possible to fully configure one controller, and then enter the SET FAILOVER command, but if the wrong *configuration-source* is specified, all device configuration information will be lost (overwritten). *Never* blindly specify SET FAILOVER. Know where your good configuration information resides before entering the command. (A considerable amount of work and effort could easily be lost by overwriting good information.)

Note

Due to the amount of information that must be passed between the two controllers, the SET FAILOVER command may take up to one minute to complete.

4.10.2 Exiting Failover

To take two controllers out of the failover configuration, enter the following command:

```
CLI> SET NOFAILOVER
```

This removes the controller from the failover configuration (as well as the other controller, if it is reachable). No device configuration information is lost from either controller.

4.10.3 Failing Over

A failed or unresponsive controller in a dual-redundant configuration is disabled by its companion controller. The functioning controller sends a signal to the other controller to induce failover. The functioning controller assumes control of the storage devices that were on line to the disabled controller. Maintenance can now take place on the failed controller.

Failover should normally complete in 30 seconds or less (15 seconds or less for three-port controllers). If there is no outstanding drive I/O activity at the time of controller failure, failover should require substantially less than 30 seconds. If drive I/O is in progress at the time of failure, the surviving controller must reset any SCSI buses with outstanding I/O. These bus resets can require up to 5 seconds per port to complete.

Whenever you need to revive a controller that was disabled, you must enter the following command from a terminal connected to the functioning controller:

```
CLI> RESTART OTHER_CONTROLLER
```

Then, press the reset (//) button to initialize the controller.

You may test failover by removing the program card from one of the controllers. The other controller will assume service to the dormant controller's devices until you reinsert the program card and reinitialize/restart the controller.

4.10.4 Failover Setup Mismatch

During failover mismatch, one controller will function while the second controller will not recognize any devices. Although it is rare, a failover mismatch may occur during the following scenarios:

- If the controllers initialize at *exactly* the same time, one controller may be set for failover while the other is not.
- If one controller is running (operating normally) while the second controller is initialized, mismatch may occur. For example, this can happen after one controller was undergoing maintenance.

To correct a failover mismatch, stop all processes on the devices for both controllers. Then enter the following commands to determine which controller has the desired, good configuration information:

```
CLI> SHOW UNITS
CLI> SHOW STORAGESETS
CLI> SHOW DEVICES
```

After deciding on one of the two configurations, use the SET FAILOVER command to copy the good information from one controller to the other.

4.11 Moving Devices Between Controllers

The moving of devices from one controller to another is supported under the following conditions:

- **For nontransportable devices**

  Under normal operation, the controller makes a small portion of a disk inaccessible to the host and uses this area to store metadata. Metadata improves error detection and media defect management. Devices utilizing metadata are called **nontransportable**. Initializing a device that is set as nontransportable will place/reset metadata on the device.

  When bringing other HS controller[4] (nontransportable) devices to an HS controller subsystem, simply add the device to your configuration using the ADD command. Do not initialize the device or you will reset/destroy forced error information on the device.

  When adding devices, the controller firmware will verify that metadata is present. If in doubt, try to add the device so that the controller will check for

[4] For purposes of setting transportable/nontransportable devices, the HSC K.scsi controllers may be considered compatible with the HS controllers.

metadata. If an error stating that there is no metadata occurs, initialize the device before adding it.

A nontransportable device is interchangeable with an HSC™ K.scsi module or another HS controller subsystem. Nontransportable devices are MSCP compliant and support forced error.

- **For transportable devices**

  A **transportable** feature is provided for transfer of devices between non-HS controller systems and HS controller arrays. Transportable devices do not have metadata on them, and initializing a device after setting it as transportable will destroy metadata (if any) on the device.

  Before moving devices from an HS controller subsystem to a non-HS controller system, delete the unit associated with the device and set the device as transportable. Then, initialize the device to remove any metadata.

  When bringing non-HS controller devices to an HS controller subsystem, initialize the device after setting it transportable, then copy the data on the device to another, nontransportable, unit. Then, reinitialize the device after setting it nontransportable (thereby putting metadata on the device). You *must* initialize these devices because they may contain intact metadata blocks, which can "fool" the controller into attempting to run with the device.

CAUTION

Do not keep any device set as transportable on an HS controller subsystem. Doing so sacrifices forced error support on all units attached to the device. This is mandatory for HBVS and improving data integrity on the entire array.

A transportable device is interchangeable with any SCSI interface that does not utilize the device metadata (for example, a VAX workstation, an SZ200, or a PC). Transportable devices are not MSCP compliant, do not support forced error, and may not be members of a shadow set. A controller error (see Chapter 5) will occur if the operating system attempts to write forced error information to a transportable device.

Note

Be careful not to confuse the terms "transportable" and "nontransportable" with the commands TRANSPORTABLE and NOTRANSPORTABLE. See Appendix B for more information on these commands.

Transportable/nontransportable device support is summarized in Table 4–2.

Table 4–2 Transportable and Nontransportable Devices

Media Format	VAX or AXP Workstation	HSC K.scsi	HSD05	HS Controller
Transportable	Yes	No	Yes	Yes
Nontransportable	No	Yes	No	Yes

5

Error Analysis and Fault Isolation

This chapter describes the errors, faults, and significant events that may occur during HS controller initialization and normal operation. A translation of the events, and in most cases how to respond to a specific event, is also given.

The error and event descriptions isolate failures to the field replaceable unit (FRU). However, in most cases additional information for diagnosis beyond the FRU is given. This information will help increase your knowledge of controller functions and assist with your report to depot repair personnel.

CAUTION

Do not attempt to replace or repair components within FRUs or equipment damage may result. Use the controller fault indications and error logs to isolate FRU-level failures.

5.1 Special Considerations

Some or all of the situations presented iun the following sections may apply when your controller detects a fault.

5.1.1 Nonredundant Configurations

When a controller (or its cache module, or both) fails in a nonredundant configuration, a short period of system down time is needed to remove the faulty unit and install a replacement. The devices attached to that controller will be off line for the duration of the remove and replace cycle.

5.1.2 Dual-redundant Configurations

When a controller fails in a dual-redundant configuration, fault isolation and corrective actions are similar to a nonredundant configuration. However, failover takes place, so the surviving controller takes over the failed controller's ports and devices.

5.1.3 Cache Module Failures

If a cache module fails, its controller still functions; however, Digital recommends that you replace the cache module as soon as possible.

When a cache module fails in a dual-redundant configuration, cache failover occurs so that the companion cache module can take over all caching operations.

5.2 Types of Error Reporting

The controller can notify you of an error through one or more of the following means:

- The OCP
- Device LEDs
- Error messages at a host virtual terminal, or
  error messages at a maintenance terminal (if attached)
- Host error logs

5.3 Troubleshooting Basics

When an error occurs, use the following steps as top-level guidelines for fault isolation:

1. Make a note of all visual indicators (OCP, device LEDs, or error messages) available to you.
2. Extract and read host error logs (see Section 5.7).
3. Errors can be intermittent; reset the controller to see if the error clears.[1]
4. See if the error indication changes after resetting the controller. If the error remains the same, look up the cause for that error. If the indication changes, look up the cause for the newer error.

   See Sections 5.4 through 5.6 for detailed information about errors and repair actions.

5.4 Operator Control Panel

The operator control panel (OCP) includes the following:

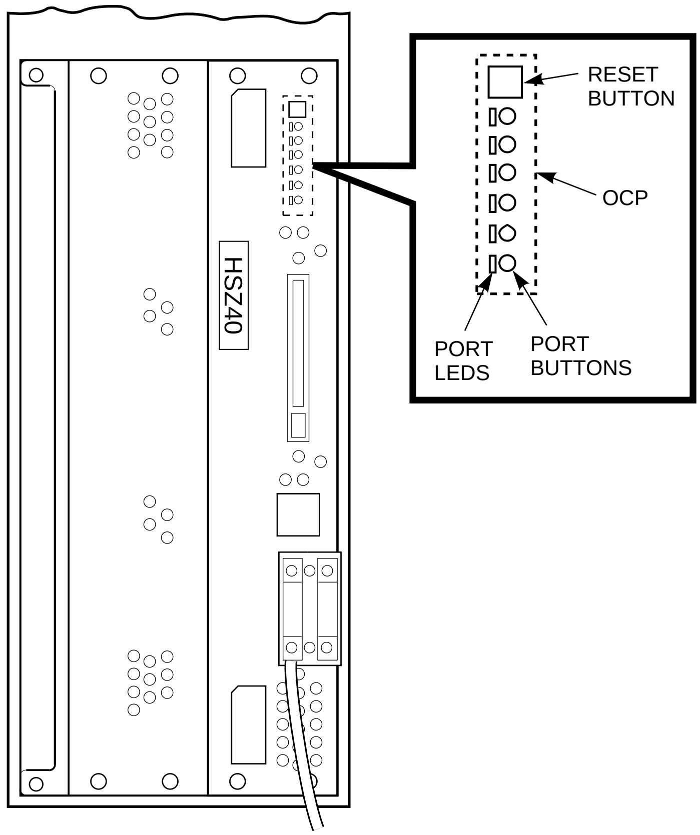
- One reset button with an embedded green LED
- One button per SCSI port
- Six amber LEDs[2]

Figure 5–1 shows the OCP from the HSZ40 controller. The buttons and LEDs serve different functions with respect to controlling the SCSI ports and/or reporting fault and normal conditions. Button and LED functions are discussed in the following sections.

[1] Record which devices have lit/flashing fault LEDs before resetting as a reset may temporarily clear the LED even though the fault remains.

[2] The HSJ-series has the amber LEDs embedded in the port buttons.

Figure 5–1 HS Controller Operator Control Panel



5.4.1 Normal Operation

The green LED (//) reflects the state of the controller and the host interface. Once controller initialization completes and its firmware is functioning, the green button flashes continuously at 1 Hz. Pressing the green button during this normal operation resets the controller.

Under normal operation, the amber LEDs indicate the state of the respective SCSI–2 buses attached to the controller. When the devices on the buses are functioning correctly, the amber LEDs will not be lit or flashing.

Pressing one of the port buttons at this time will light its corresponding amber LED and quiesce its SCSI–2 port. You must quiesce a port to remove or warm swap a device on the SCSI–2 bus for that port. (Once you replace the device, you can press the button again to turn off the LED and reactivate the port.) See Chapter 7 for a detailed description of removing and replacing devices.

5.4.2 Fault Notification

The OCP LEDs display information when the HS controller encounters a problem with a device configuration, a device, or the controller itself.

Should a configuration mismatch or a device fault occur, the amber LED for the affected device's bus will light continuously.

For controller problems, LED codes determined by internal diagnostics and operating firmware will indicate either controller faults or HS operating firmware program card faults. In either case, the single (green) reset (//) LED lights continuously when an error is detected. The remaining (amber) LEDs display the error codes in two different ways:

- The error code will be lit continuously for faults detected by internal diagnostic and initialization routines. See Figure 5–2 to determine what these codes mean.
- The error code will flash at 3 Hz representing faults that occur during normal controller operation. See Figure 5–3 to determine what these codes mean.

Figure 5–2 Solid OCP Codes

Reset	1	2	3	4	5	6	Description of Error	Action
■	■	■	■	■	■	■	00 DAEMON hard error.	Replace controller module.
■	■	■	■	■	■	□	01 Repeated firmware bugcheck.	Replace controller module.
■	■	■	■	■	□	■	02 NVMEM version mismatch.	Replace program card with later version.
■	■	■	■	■	□	□	03 NVMEM write error.	Replace controller module.
■	■	■	■	□	■	■	04 NVMEM read error.	Replace controller module.
■	■	■	■	□	■	□	05 Inconsistent NVMEM structures repaired[1].	RESET (//) the controller.
■	■	■	■	□	□	■	06 NMI error.	Replace controller module.
■	■	■	■	□	□	□	07 Bugcheck with no restart.	RESET (//) the controller.
■	■	■	□	■	■	■	08 NVMEM contents invalid.	Replace controller module.
■	□	□	□	□	□	□	3F No program card seen[2].	Replace controller module.

□ off ■ lit continuously

DAEMON = Diagnostic and Execution Monitor
NVMEM = Nonvolatile Memory
NMI = Nonmaskable Interrupt

[1] A power failure or controller reset during an NVMEM update causes this error. If the error occurs on one controller in a dual-redundant configuration, a configuration mismatch will probably occur upon restart.
[2] Try the card in another module. If the problem moves with the card, replace the card. If the problem does not move with the card, replace the controller module.

Figure 5–3 Flashing OCP Codes

Reset	1	2	3	4	5	6		Description of Error	Action
■	□	□	□	□	□	◪	01	Program card EDC error.	Replace program card.
■	□	□	□	◪	□	□	04	Timer zero in the timer chip will run when disabled.	Replace controller module.
■	□	□	□	◪	□	◪	05	Timer zero in the timer chip decrements incorrectly.	Replace controller module.
■	□	□	□	◪	◪	□	06	Timer zero in the timer chip did not interrupt the processor when requested.	Replace controller module.
■	□	□	□	◪	◪	◪	07	Timer one in the timer chip decrements incorrectly.	Replace controller module.
■	□	□	◪	□	□	□	08	Timer one in the timer chip did not interrupt the processor when requested.	Replace controller module.
■	□	□	◪	□	□	◪	09	Timer two in the timer chip decrements incorrectly.	Replace controller module.
■	□	□	◪	□	◪	□	0A	Timer two in the timer chip did not interrupt the processor when requested.	Replace controller module.
■	□	□	◪	□	◪	◪	0B	Memory failure in the I/D cache.	Replace controller module.
■	□	□	◪	◪	□	□	0C	No hit or miss to the I/D cache when expected.	Replace controller module.
■	□	□	◪	◪	□	◪	0D	One or more bits in the diagnostic registers did not match the expected reset value	Replace controller module.
■	□	□	◪	◪	◪	□	0E	Memory error in the nonvolatile journal SRAM.	Replace controller module.
■	□	□	◪	◪	◪	◪	0F	Wrong image seen on program card.	Replace program card.
■	□	◪	□	□	□	□	10	At least one register in the controller DRAB chip does not read as written.	Replace controller module.
■	□	◪	□	□	□	◪	11	Main memory is fragmented into too many sections for the number of entries in the good memory list.	Replace controller module.
■	□	◪	□	□	◪	□	12	The controller DRAB chip does not arbitrate correctly.	Replace controller module.
■	□	◪	□	□	◪	◪	13	The controller DRAB chip failed to detect forced parity or detected parity when not forced.	Replace controller module.

□ off ■ lit continuously ◪ flashing

I/D = Instruction/Data (cache on the controller module)
DRAB = Dynamic RAM Controller and Arbitration Engine (operates controller shared memory)
ECC = Error Correction Code
EDC = Error Detection Code
SRAM = Static RAM
NXM = Nonexistent Memory

(continued on next page)

Figure 5–3 (Cont.) Flashing OCP Codes

Reset	1	2	3	4	5	6		Description of Error	Action
■	□	◩	□	◩	□	□	14	The controller DRAB chip failed to verify the EDC correctly.	Replace controller module.
■	□	◩	□	◩	□	◩	15	The controller DRAB chip failed to report forced failed ECC.	Replace controller module.
■	□	◩	□	◩	◩	□	16	The controller DRAB chip failed some operation in the reporting, validating, and testing of the multibit ECC memory error.	Replace controller module.
■	□	◩	□	◩	◩	◩	17	The controller DRAB chip failed some operation in the reporting, validating, and testing of the multiple single-bit ECC memory error.	Replace controller module.
■	□	◩	◩	□	□	□	18	The controller main memory did not write correctly in one or more sized memory transfers.	Replace controller module.
■	□	◩	◩	□	□	◩	19	The controller did not cause an I-to-N bus timeout when accessing a “reset” host port chip.	Replace controller module.
■	□	◩	◩	□	◩	□	1A	The controller DRAB chip did not report an I-to-N bus timeout when accessing a “reset” host port chip.	Replace controller module.
■	□	◩	◩	□	◩	◩	1B	The controller DRAB did not interrupt the controller processor when expected.	Replace controller module.
■	□	◩	◩	◩	□	□	1C	The controller DRAB did not report an NXM error when nonexistent memory was accessed.	Replace controller module.
■	□	◩	◩	◩	□	◩	1D	The controller DRAB did not report an address parity error when one was forced.	Replace controller module.
■	□	◩	◩	◩	◩	□	1E	There was an unexpected nonmaskable interrupt from the controller DRAB during the DRAB memory test.	Replace controller module.
■	◩	□	□	□	□	□	20	The required amount of memory available for the code image to be loaded from the program card is insufficient.	Replace controller module.
■	◩	□	□	□	□	◩	21	The required amount of memory available in the pool area is insufficient for the controller to run.	Replace controller module.
■	◩	□	□	□	◩	◩	23	The required amount of memory available in the buffer area is insufficient for the controller to run.	Replace controller module.

□ off ■ lit continuously ◩ flashing

I/D = Instruction/Data (cache on the controller module)
DRAB = Dynamic RAM Controller and Arbitration Engine (operates controller shared memory)
SRAM = Static RAM
ECC = Error Correction Code
EDC = Error Detection Code
NXM = Nonexistent Memory

(continued on next page)

Figure 5–3 (Cont.) Flashing OCP Codes

Reset	1	2	3	4	5	6		Description of Error	Action
■	◪	□	□	◪	□	□	24	The code image was not the same as the image on the card after the contents were copied to memory.	Replace controller module.
■	◪	◪	□	□	□	□	30	The journal SRAM battery is bad.	Replace controller module.
■	◪	◪	◪	□	◪	□	3A	There was an unexpected interrupt from a read cache or the present and lock bit are not working correctly.	Replace controller module.
■	◪	◪	◪	□	◪	◪	3B	There is an interrupt pending to the controller's policy processor when there should be none.	Replace controller module.
■	◪	◪	◪	◪	□	□	3C	There was an unexpected fault during initialization.	Replace controller module.
■	◪	◪	◪	◪	□	◪	3D	There was an unexpected maskable interrupt received during initialization.	Replace controller module.
■	◪	◪	◪	◪	◪	□	3E	There was an unexpected nonmaskable interrupt received during initialization.	Replace controller module.
■	◪	◪	◪	◪	◪	◪	3F	An illegal process was activated during initialization.	Replace controller module.

□ off ■ lit continuously ◪ flashing

I/D = Instruction/Data (cache on the controller module)
DRAB = Dynamic RAM Controller and Arbitration Engine (operates controller shared memory)
SRAM = Static RAM
ECC = Error Correction Code
EDC = Error Detection Code
NXM = Nonexistent Memory

5.5 Device LEDs

The storage devices (SBBs) and their power supplies have LEDs to indicate power and status. You can use these LEDs in conjuction with the OCP indicators to isolate certain faults, as discussed in the following sections.

5.5.1 Storage SBB Status

Device shelves monitor the status of the storage SBBs. When a fault occurs, the fault and the SBB device address (SCSI target ID) are reported to the controller for processing. The SBB internal fault/identity bus controls the fault (lower) LED.

As shown in Figure 5–4, each storage SBB has two LED indicators that display the SBB's status. These LEDs have three states: on, off, and flashing.

- The upper LED (green) is the device activity LED and is on or flashing when the SBB is active.

  CAUTION

  Do not remove a storage SBB when the upper LED is on or flashing. This can cause the loss or corruption of data.

- The lower LED (amber) is the storage SBB fault LED and indicates an error condition when it is either on or flashing. When this LED indicates a fault, the amber controller OCP LED for the device's port will be lit continuously as well. You should record which devices have lit/flashing fault LEDs before resetting the controller as a reset may temporarily clear the LED even though the fault remains.

Figure 5–4 Storage SBB LEDs

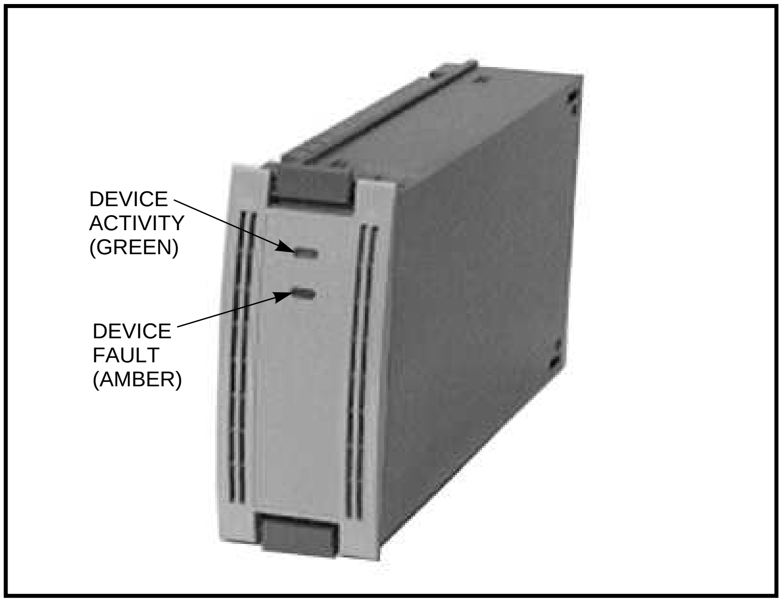


Table 5–1 defines the valid states for these LEDs.

Table 5–1 Storage SBB Status LEDs

LED	Status	Indication
Device activity Device fault	On Off	SBB is operating normally.
Device activity Device fault	Flashing Off	SBB is operating normally.
Device activity Device fault	Off Off	SBB is operating normally. The SBB is inactive, and there is no fault.
Device activity Device fault	On On	Fault status. SBB is probably not responding to control signals. It is recommended that you replace the SBB.
Device activity Device fault	Off On	Fault status. SBB is inactive and spun down. Digital recommends that you replace the SBB.
Device activity Device fault	On Flashing	Fault status. SBB is active and is spinning down because of the fault.

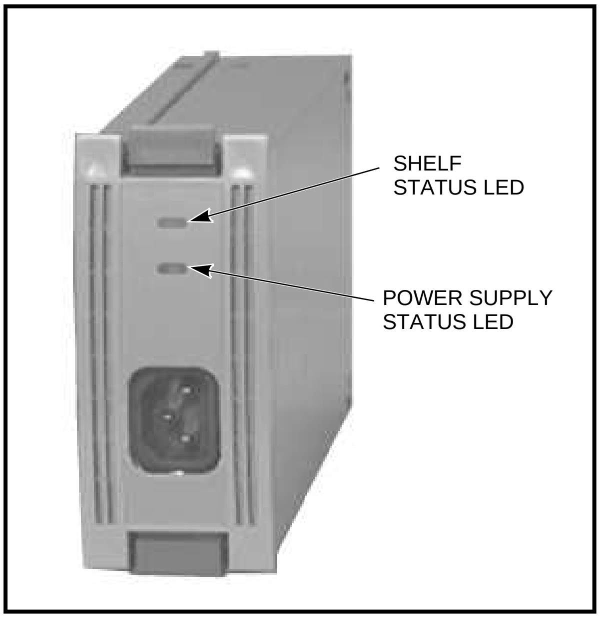
5.5.2 Device Shelf Status and Power Supply Status

The status of both the device shelf blowers and power supplies is displayed on the power supply LEDs, as shown in Figure 5–5. The upper LED displays the shelf status and the lower LED displays the power supply status.

- When the upper LED is on, both the shelf blowers and the power supplies are functioning properly.
- When the upper LED is off, either a shelf blower or a power supply is not functioning properly.

- When the lower LED is off, either there is an input power problem or the power supply is not functioning.

Figure 5–5 Power Supply LEDs



For a detailed explanation of the power supply LED codes, see Tables 5–2 and 5–3.

Table 5–2 Shelf and Single Power Supply Status LEDs

Status LED	State	Indication
Shelf (upper) PS (lower)	On On	System is operating normally.
Shelf (upper) PS (lower)	Off On	Fault status. There is a shelf fault; there is no power supply fault. Replace blower as described in Chapter 7.
Shelf (upper) PS (lower)	Off Off	Fault status. Shelf and power supply fault Replace power supply as described in Chapter 7.

Note

When a shelf has two power supplies, you must observe the LEDs on *both* power supplies to determine the status (see Table 5–3).

Table 5–3 Shelf and Dual Power Supply Status LEDs

Status LED	PS1†	PS2‡	Indication
Shelf (upper) PS (lower)	On On	On On	Normal status. System is operating normally.
Shelf (upper) PS (lower)	Off On	Off On	Fault status. There is a shelf fault; there is no power supply fault. Replace blower as described in Chapter 7.
Shelf (upper) PS (lower)	Off On	Off Off	Fault status. PS1 is operational. Replace PS2 as described in Chapter 7.
Shelf (upper) PS (lower)	Off Off	Off On	Fault status. PS2 is operational. Replace PS1 as described in Chapter 7.
Shelf (upper) PS (lower)	Off Off	Off Off	Fault status. Possible PS1 and PS2 fault or input power problem

† Shelf power supply installed in slot 7.

‡ Redundant power supply installed in slot 6.

5.6 Error Messages

The HS operating firmware is designed to send messages to a virtual terminal and/or maintenance terminal under certain fault conditions. The messages appear on the lines just before the CLI prompt, as shown in the following example:

```
SWAP signal cleared - all SWAP interrupts re-enabled
CLI>
```

You might not have a remote or maintenance terminal connected to display messages. In this case, the HS operating firmware saves messages for you. You need only connect a terminal and press the Return key to see the 15 most recently received error messages.

Often, messages will continue to appear each time Return is pressed. To clear the terminal of the errors, enter the CLEAR_ERRORS command. (You may want to make a note of the errors before clearing them because they cannot be recalled afterwards.)

Note

Because the severity of errors varies, the controller may or may not initialize or operate, or both, even though an error message appears.

For example, if all of the SCSI ports, or the host port and local terminal port fail diagnostics, the controller will not operate.

However, if the cache module fails during normal operation, the controller will continue to operate. You will have to extract the host error log to determine the cause of this error.

The following sections list automatic messages you may encounter. The controller sends these messages when the specific fault is detected, regardless of whether or not you are interactively viewing or using the virtual or maintenance terminal. These messages differ in this respect from the ones listed in Appendix B, which appear based on your inputs to the CLI.

Be aware that not all the error messages listed in this section will pertain to your model of controller. Some messages are specific to the HSJ-, HSD-, or HSZ-series controllers.

5.6.1 Diagnostic Messages

This section contains error messages that may be displayed if a fault occurs during initialization or self-test diagnostics. See Chapter 6 for more information on diagnostics.

Half CACHE FAILED Diagnostics

Explanation: Up to 50% of the cache memory has failed diagnostic tests.

Whole CACHE FAILED Diagnostics

Explanation: The cache module has failed diagnostics tests.

SCSI port *n* FAILED Diagnostics

Explanation: A SCSI–2 port has failed diagnostics. This message can appear even if you do not have a host connection. The variable *n* indicates which port failed.

HOST port FAILED Diagnostics

Explanation: The host port of the controller has failed diagnostics.

CI Path *x* has FAILED external loop-back Diagnostics

Explanation: The CI path named by *x* has failed the loop-back diagnostics. *x* can be A or B.

Local Terminal Port FAILED Diagnostics

Explanation: The maintenance (EIA–423) terminal port has failed diagnostics.

5.6.2 NVPM Messages

The messages listed in this section are displayed because of a problem or fault associated with the nonvolatile parameters in memory (NVPM).

Note

Some NVPM messages will read "NVPM *component-name* component initialized to default settings." For some of these initialization cases, corrective action may only clear the error message until the next time the controller is reset because the error could be caused by a fault in NVPM itself. If the error persists, replace the controller module.

NVPM Revision level updated from *n* to *N*.

Explanation: The format of the NVPM has changed as a result of installing a newer program card (containing updated firmware). However, all subsystem configuration information has been retained.

NVPM Failover Information component initialized to default settings.

Explanation: The identity of the other controller in a dual-redundant pair has been lost. Enter the SET FAILOVER COPY=OTHER_CONTROLLER command to correct this problem.

NVPM Host Interconnect Parameters component initialized to default settings.

Explanation: The SCS node name, CI node number, or Path A, or Path B enable settings for this controller have been lost.

To correct this problem, enter the SHOW THIS_CONTROLLER and SHOW OTHER_CONTROLLER commands to determine the current controller settings. Use the SET THIS_CONTROLLER and SET OTHER_CONTROLLER commands to restore settings.

NVPM Host Protocol Parameters component initialized to default settings.

Explanation: The tape and disk MSCP allocation class settings for this controller have been lost.

To correct this problem, enter the SHOW THIS_CONTROLLER and SHOW OTHER_CONTROLLER commands to determine the current controller settings. Use the SET THIS_CONTROLLER and SET OTHER_CONTROLLER commands to restore settings.

NVPM User Interface Parameters component initialized to default settings.

Explanation: Terminal setting information has been lost.

To correct this problem, enter the SHOW THIS_CONTROLLER and SHOW OTHER_CONTROLLER commands to determine the current terminal settings. Compare the terminal settings with the CONFIGURATION.INFO output information, and use the SET THIS_CONTROLLER and SET OTHER_CONTROLLER commands to restore terminal settings.

The following NVPM Configuration Information component elements
were initialized to default settings: [*n* ....

Explanation: The settings given by *n* have been initialized in connection with another NVPM error. To clear this error, perform the following procedure:

1. Enter the following commands:

   ```
   CLI> SHOW DEVICES
   CLI> SHOW UNITS
   CLI> SHOW STORAGESETS
   ```

2. Compare the information displayed with a printout of the CONFIGURATION.INFO file or with a copy of the most current configuration.

3. Reconfigure the necessary devices, units, or storage sets. (See the CLI commands described in Appendix B.)

CAUTION: Replace the controller immediately if any of the following messages occur. Do not continue to use the controller.

NVPM Controller Characteristics component initialized to default settings.

The following NVPM Manufacturing Failure Information component elements were initialized to default settings: *[...list of component elements*

NVPM Recursive Bugcheck Information component initialized to default settings.

NVPM System Information Page component initialized to default settings.

NVPM Volume Serial Number component initialized to default settings.

All NVPM components initialized to their default settings.

Unknown NVPM Revision Level.

Unknown reformat stage encountered during NVPM Revision Level 1 to 2 reformat.

Controller Characteristics component reformat failed during NVPM Revision Level 1 to 2 reformat.

Host Access Disabled.

5.6.3 CLI Automatic Messages

This section lists the automatic messages displayed by the CLI.

Device and/or Storageset names changed to avoid conflicts

Explanation: Digital adds new CLI keywords at each new HS operating firmware release that can conflict with existing device and/or storage set names. When this happens, HS operating firmware changes your device and/or storage set names and sends this message. The functional operation of your configuration is not changed when this message appears.

Controllers misconfigured. Type SHOW THIS_CONTROLLER

Explanation: If this message appears, examine the SHOW THIS_CONTROLLER display to determine the source of the misconfiguration.

Taken out of failover due to serial number format error

Explanation: An invalid serial number format was entered for the second controller of a dual-redundant pair.

Serial number initialized due to format error

Explanation: An invalid serial number was entered for the second controller of a dual-redundant pair.

Configuration information deleted due to internal inconsistencies

Explanation: This message is displayed if a test of nonvolatile memory shows corruption. The configuration information for the controller is deleted when this message is displayed.

Restart of the other controller required

Explanation: When changing some parameters, you must reinitialize the companion controller in a dual-redundant pair to have the parameter take effect.

Restart of this controller required

Explanation: A changed parameter requires reinitialization of this controller to take effect.

5.6.4 Shelf Messages

This section lists messages displayed by the controller shelf.

Unable to clear SWAP signal on shelf *xx* - all SWAP interrupts disabled

Explanation: The subsystem is unable to clear the swap signal for a swapped device, where *xx* is the shelf number. This could indicate an unsupported SBB or no power to the device shelf.

SWAP signal cleared - all SWAP interrupts re-enabled

Explanation: This message indicates that the swap signal is now cleared.

Shelf *xx* has a bad power supply or fan

Explanation: Troubleshoot the system to isolate and replace the failed component.

Shelf *xx* fixed

Explanation: Shelf number *xx* has been correctly repaired.

5.6.5 Failover Messages

The messages in this section are generated during failover between dual-redundant controllers.

Received LAST GASP message from other controller

Explanation: One controller in a dual-redundant configuration is attempting an automatic restart after failing or undergoing a bugcheck. See Section 5.7 for more information on this message.

Other controller restarted

Explanation: The other controller in a dual-redundant pair has successfully restarted after failing or undergoing a bugcheck. See Section 5.7 for more information on this message.

Other controller not responding - RESET signal asserted

Explanation: One controller in a dual-redundant configuration is locked up, not responding, or the kill line to it is asserted.

SCSI Device and HS*xxx* controller both configured at SCSI address 6

Explanation: This message appears when a device is accidentally configured as SCSI ID 6, and two controllers (SCSI IDs 6 and 7) are in a dual-redundant configuration.

Both HS*xxx* controllers are using SCSI address 6

Explanation: There is a hardware problem with the BA350–MA shelf. This problem probably involves the shelf backplane.

Both HS*xxx* controllers are using SCSI address 7

Explanation: There is a hardware problem with the BA350–MA shelf. This problem probably involves the shelf backplane.

5.6.6 Other CLI Messages

The previous sections detailed automatic messages you may encounter. For a list of other messages you may see during interactive use of the CLI, see Appendix B.

Consult your firmware release notes for updates to the list of error messages.

5.7 Host Error Logs

Events related to controller and device operation are recorded in the host error log. If the OCP, device LEDs, or error messages cannot help you determine the cause of a problem, review the host error logs. They provide the greatest level of detail about the controller and connected devices.

5.7.1 Translation Utilities

OpenVMS systems have the Errorlog Report Formatter (ERF) to aid in error log translation. The tool reads the information from the log and provides the operator with more information about what the log means with respect to controller operation and repair.

ERF provides bit-to-text translation of the (binary) log, so that the operator can read the information. The OpenVMS DCL command ANALYZE/ERROR_LOG invokes ERF. For a description of the VMS Analyze Error Log Utility, including more information about this command and its qualifiers, refer to the *VMS Error Log Utility Reference Manual*, or call Digital Multivendor Services.

DEC OSF/1 AXP systems use the UNIX Errorlog Report Formatter (uerf) to assist in error log translation. This tool also reads information from the log and provides the operator with indications as to what the log means with respect to controller/host operation. Invoke uerf using the uerf -R -o full command.

5.7.2 Host Error Log Translation

The format of transmitted error information varies according to model of HS controller. Consequently, you will find the description of error logs, and how to read the logs, broken into separate appendices for each model. See the following:

- For HSJ-series controllers, see Appendix C.
- For HSD-series controllers, see Appendix D.
- For HSZ-series controllers, see Appendix E.

Note

Host error log translations are correct as of the date of publication of this manual. However, log information may change with firmware updates. Refer to your *StorageWorks Array Controller Operating Firmware Release Notes* for error log information updates.

6 Diagnostics, Exercisers, and Utilities

This chapter discusses the automatic and manual programs available to assist operation and diagnosis of the HS controller subsystem, including the following:

- Initialization and self-test routines
- Disk exerciser (HSJ- and HSD-series controllers)
- Tape exerciser (HSJ- and HSD-series controllers)
- Disk exerciser (HSZ-series controllers)
- VTDPY utility
- CONFIG utility
- HSZUTIL virtual terminal host-resident application

6.1 Initialization

The controller will initialize after any of the following conditions:

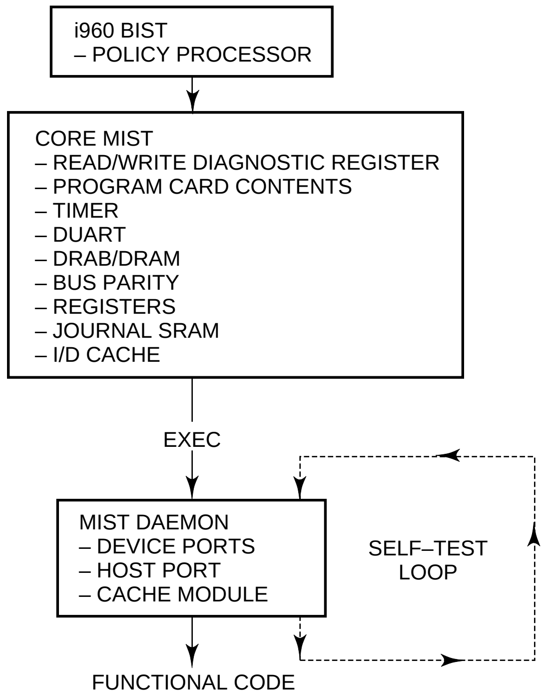
- Power is turned on.
- The firmware resets the controller.
- The operator presses the green reset (//) button.
- The host clears the controller.

Whenever the controller initializes, it steps through a three-phase series of tests designed to detect any hardware or firmware faults. The three test areas are as follow:

- Built-in self-test
- Core module integrity self-test
- Module integrity self-test DAEMON

Initialization time will vary depending on your model of controller and what size and type of cache module, if any, you are running. However, initialization will always complete in under 1 minute. Figure 6–1 shows the initialization process.

Figure 6–1 Controller Initialization



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6.1.1 Built-In Self-Test

The controller begins initialization by executing its policy processor's internal built-in self-test (BIST). BIST always executes upon initialization, because it is an integral part of the Intel 80960CA chip (i960) microcode. BIST runs entirely from the i960 chip and a small portion of the firmware program card. Successful completion of BIST means the i960 chip is functioning properly. If BIST fails, the controller will show no activity, and all port indicators on the OCP will be off. (The green reset LED will be solidly lit.) BIST will fail if an incorrect program card is present.

6.1.2 Core Module Integrity Self-Test

After BIST completes successfully, initialization routines and diagnostics expand to testing of the controller module itself. The tests are part of the program card firmware and are known as core module integrity self-test (core MIST).

Just before beginning core MIST, the controller reads the initial boot record (IBR) to determine the address of hardware setup parameters and process control information. After reading the IBR, the firmware within the program card is initialized to the IBR parameters. Program card firmware then executes core MIST as follows:

1. MIST checks the initial state of the read/write diagnostic register.
2. The test validates program card contents by reading each memory location and computing an error detection code (EDC). The test then compares the computed EDC with a predetermined EDC. The program card contents are valid if both EDCs match.

3. Core MIST then tests and/or checks module hardware attached to the buses:
   - Timer operation
   - DUART operation
   - DRAB/DRAM (shared memory) operation
     - The test writes to and reads all legal addresses. Then, boundaries are checked by attempting to access nonexistent addresses. To pass this test, the first two megabytes of memory must test good. If bad segments are found, the bad segments may divide total memory into no more than 16 good, continuous sections.
     - The test selects a device, then checks whether or not the bus has selected that device.
     - The test verifies that each allowable memory transfer size works, and that illegal transfer sizes do not.
   - Bus parity
   - Registers (The test checks registers for frozen bits.)
   - Journal SRAM (The test writes to and reads all journal SRAM addresses.)
   - I/D cache
4. After core MIST successfully tests the program card and bus hardware, the initialization routine loads the firmware into the first two megabytes of controller shared memory. The initialization routine then uses the EDC method to compare the memory contents with the program card to make sure of a successful download.
5. The policy processor is initialized to the new parameters (the ones read from the IBR). At this time control of initialization passes to the firmware executive (EXEC). EXEC runs from controller shared memory.

   If, at any time, a fault occurs during core MIST, the OCP will display a code. (Refer to Chapter 5.)

6.1.3 Module Integrity Self-Test DAEMON

Once initialization control is passed to EXEC, EXEC calls the diagnostic and execution monitor (DAEMON). DAEMON tests the device port hardware, host port hardware, and cache module.

- To test the device ports, DAEMON checks each NCR 53C710 SCSI processor chip. Initialization continues unless *all* SCSI device ports fail testing. In other words, it is possible for the controller to run with only one functioning device port.
- DAEMON tests the host port hardware for the particular controller model. For HSJ-series controllers, this test focuses primarily on the YACI chip. For the HSD- and HSZ-series controllers, the NCR 53C720 host processor chip is tested. Initialization continues even if the host port tests fail. However, DAEMON stops initialization if the DUART test (from core MIST) *and* the host port tests fail.

- DAEMON tests the cache module as follows:

Note

The controller still functions if the cache module fails its testing. In this case, the controller will use its on-board shared memory for caching operations.

  – DAEMON tests the DRAB (memory controller) on the read cache module. After DAEMON completes, and functional code takes control of the firmware, the cache manager tests the memory on the cache. At least the first megabyte of the memory must test good, or the cache will be declared bad.

    If cache is locked by the other controller (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 will test the DRAB followed by the memory.

  – The tests run by DAEMON and the cache manager are summarized in Table 6–1.

Table 6–1 Cache Module Testing

Test	DAEMON	Cache Manager
DRAB	• All memory is initialized. • Full address test.	• No memory is initialized. • Address test on diagnostic pages only.
Memory	• Never invoked.	• Always invokes all memory tests. • Read only, or read/write.

After successful test completion, DAEMON releases control. At this time, initialization is finished, and functional controller firmware takes over.

DAEMON handles all interrupts and errors received during cache module testing. (If DAEMON receives any interrupt, it stops initialization. DAEMON displays any errors as a code on the OCP.)

6.1.3.1 Self-Test

Self-test is a special function of DAEMON, where you set DAEMON to run in a continuous loop. Self-test allows you to diagnose intermittent hardware failures because the loop will continue until an error is detected.

In addition, self-test checks the controller hardware without affecting devices on any ports. Digital recommends you run self-test from the maintenance terminal because the host port will disconnect once the controller begins self-test.

For self-test to properly execute, you must have a valid configuration and enable the host paths.

To run self-test, enter one of the following commands (which command you need will depend on your configuration, which controller the terminal is connected to, and which controller you wish to test.)

CAUTION

Do not use the OVERRIDE_ONLINE qualifier for the SELFTEST command, as customer data may be overwritten.

```
CLI> SELFTEST THIS_CONTROLLER
```

```
CLI> SELFTEST OTHER_CONTROLLER
```

See Appendix B for more information on the command and its qualifiers.

When you run self-test, all outstanding I/O operations complete. The controller will also attempt to flush the cache. However, even if self-test fails to flush the cache, the program will continue to execute.

Self-test will halt if it detects a fault. Otherwise, the self-test loop continues until you press the reset (//) button or the cycle controller power off and on, after which the controller reinitializes.

6.2 Disk Inline Exerciser (HSJ- and HSD-Series Controllers)

The **disk inline exerciser** (DILX) is a diagnostic tool used to exercise the data transfer capabilities of selected disks connected to an HSJ- or HSD-series controller. DILX exercises disks in a way that simulates a high level of user activity. Using DILX, you can read and write to all customer-available data areas. DILX can also be run on CDROMs, but must be run in *read-only* mode only. Thus, DILX can be used to determine the health of a controller and the disks connected to it and to acquire performance statistics. You can run DILX from a maintenance terminal, virtual terminal, or VCS.

DILX now allows for auto-configuring of drives. This allows for quick configuring and testing of all units at once. Please be aware that *customer data will be lost* by running this test. Digital recommends only using auto-configure during initial installations.

DILX tests logical units that may consist of storage sets of multiple physical devices. Error reports identify the logical units, not the physical devices. Therefore, if errors occur while running against a unit, its storage set should be reconfigured as individual devices, and then DILX run again, against the individual devices.

There are no limitations on the number of units DILX may test at one time. However, Digital recommends only using DILX when no host activity is present. If you must run DILX during a live host connection, you should limit your testing to no more than half of any controller's units at one time. This conserves controller resources and minimizes performance degradation on the live units you are not testing.

DILX and the **tape inline exerciser** (TILX) may run concurrently with one initiated from a maintenance terminal and the other from a virtual terminal connection. Digital recommends, however, that the exercisers *not* be run while normal I/O operations are in progress, as system performance will degrade due to the heavy load the exercisers impose on the controller.

6.2.1 Invoking DILX

Note

Before running DILX, be sure that all units that you wish to test have been dismounted from the host.

The following describes how to invoke DILX from a maintenance terminal at the CLI> prompt or from a VCS, or from a virtual terminal through a DUP connection:

- To invoke DILX from a maintenance terminal, enter the following command at the CLI> prompt:

  ```
  CLI> RUN DILX
  ```

- To invoke DILX from a maintenance terminal using a VCS, enter the following command at the CLI> prompt:

  ```
  CLI> VCS CONNECT node-name
  ```

  where *node name* is the controller's SCS node name.

  Consult the *VAXcluster Console System User's Guide* for complete details on using a VCS.

  Note

  The node name *must* be specified for a VCS.

- To invoke DILX from a virtual terminal using a DUP connection, enter the command (for the OpenVMS operating system):

  ```
  $ SET HOST/DUP/SERVER=MSCP$DUP/TASK=DILX SCS_nodename
  ```

  Specify the controller's *SCS node-name* to indicate where DILX will execute.

6.2.2 Interrupting DILX Execution

Use the following guidelines to interrupt DILX execution:

Note

The symbol "^" is equivalent to the Ctrl key. You must press and hold the Ctrl key and type the character key given.

Note

Do not use Ctrl/G from a VCS because it will cause VCS to terminate. VCS acts on the sequence and the sequence is never sent to DILX. Use Ctrl/T when invoking DILX from a VCS.

- Ctrl/G causes DILX to produce a performance summary. DILX continues normal execution without affecting the runtime parameters.

- Ctrl/C causes DILX to produce a performance summary, stop testing, and asks the “reuse parameters” question.
- Ctrl/Y causes DILX to abort. The “reuse parameters” question is not asked.
- Ctrl/T causes DILX to produce a performance summary. DILX then continues executing normally without affecting any of the runtime parameters.

6.2.3 DILX Tests

There are two DILX tests, as follow:

- The Basic Function test
- The User-Defined test

6.2.3.1 Basic Function Test—DILX

The Basic Function test for DILX executes in three or four phases. The four phases are as follow:

- **Initial Write Pass**—Is the only optional phase and is always executed first (if selected). The initial write pass writes the selected data patterns to the entire specified data space or until the DILX execution time limit has been reached. Once the initial write pass has completed, it is not re-executed no matter how long the DILX execution time is set. The other phases are re-executed on a 10-minute cycle.
- **Random I/O**—Simulates typical I/O activity with random transfers from one byte to the maximum size I/O possible with the memory constraints DILX runs under. Note that the length of all I/Os is in bytes and is evenly divisible by the sector size (512 bytes). Read, write, access and erase commands are issued using random logical block numbers (LBNs).

  In the read/write mode, DILX issues the reads and writes in the ratio specified previously under read/write ratio, and issues access and erase commands in the ratio specified previously under access/erase ratio.

  When read-only mode is chosen, only read and access commands are issued.

  If compares are enabled, compares are performed on write and read commands using the data compare modifier and DILX internal checks. The percentage of compares to perform can be specified. This phase is executed 60 percent of the time. It is the first phase executed after the initial write pass has completed. It is re-executed at 10-minute intervals with each cycle lasting approximately 6 minutes.

  Intervals are broken down into different cycles. The interval is repeated until the user-selected time interval expires.

  ```
  <-----------------------10 min----------------------------------------->
  <------6 min Random I/O----><--2 min Data Inten--><--2 min Seek Inten--->
  ```

- **Data Intensive**—Designed to test disk throughput by selecting a starting LBN and repeating transfers to the next sequential LBN that has not been written to by the previous I/O. The transfer size of each I/O equals the maximum sized I/O that is possible with the memory constraints DILX must run under. This phase continues performing spiraling I/O to sequential tracks.

  Read and write commands are issued in read/write mode. This phase is executed 20 percent of the time after the initial write pass has completed. This phase always executes after the random I/O phase. It is re-executed at 10-minute intervals with each cycle approximately 2 minutes.

- **Seek Intensive**—Is designed to stimulate head motion on the selected disk units. Single sector erase and access commands are issued if the test is write enabled. Each I/O uses a different track on each subsequent transfer. The access and erase commands are issued in the ratio that you selected using the access/erase ratio parameter. This phase is executed 20 percent of the time after the initial write pass has completed. This phase always executes after the data intensive I/O phase. It is re-executed at 10-minute intervals with each cycle approximately 2 minutes.

6.2.3.2 User-Defined Test—DILX

CAUTION

The User-Defined test should be run *only* by very knowledgeable personnel. Otherwise, customer data can be destroyed.

When this test is selected, DILX prompts you for input to define a specific test. In the DILX User-Defined test, a total of 20 or fewer I/O commands can be defined. Once all of the commands are issued, DILX issues the commands again in the same sequence. This is repeated until the selected time limit is reached. As you build the test, DILX collects the following information from you for each command:

- The I/O command name (write, read, access or erase, or quit). Note that quit is not a command; instead it indicates to DILX that you have finished defining the test.
- The starting Logical Block Number (LBN).
- The size of the I/O in 512 byte blocks.
- The MSCP command modifiers.

6.2.4 DILX Test Definition Questions

The following text is displayed when running DILX. The text includes questions that are listed in the approximate order that they are displayed on your terminal. These questions prompt you to define the runtime parameters for DILX.

Note

Defaults for each question are given inside [ ]. If you press the Return key as a response to a question, the default is used as the response.

After DILX has been started, the following message describing the Auto-Configure option is displayed:

```
The Auto-Configure option will automatically select, for testing, half
or all of the disk units configured. It will perform a very thorough
test  with *WRITES* enabled. The user will only be able to select the
run time and performance summary options and whether to test a half or
full  configuration. The user will not be able to specify specific
units to test. The Auto-Configure option is only recommended for
initial installations. It is the first question asked.
```

Do you wish to perform an Auto-Configure (y/n) [n] ?

Explanation: Enter “Y” if you wish to invoke the Auto-Configure option.

DILX next diplays the following information:

```
If you want to test a dual redundant subsystem, it is recommended that
you pick option 2 on the first controller and then option 2 on the
other controller. Auto-Configure options are:

1. Configure all disk units for testing. This is recommended for a
   single controller subsystem.

2. Configure half of all disk units for testing. This is recommended
   for a dual controller subsystem.

3. Exit Auto-Configure and DILX.
```

Enter Auto-Configure option (1:3) [3] ?

Explanation: This is self explanatory.

After you enter the desired Auto-Configure option, DILX will display the following caution statement:

```
 **CAUTION**
All data on the Auto-Configured disks will be destroyed. You *MUST* be sure
of yourself.
```

Are you sure you want to continue (y/n) [n] ?

Explanation: This question is only asked if the Auto-Configure option was selected and if the user selected Auto-Configure option 1 or 2 as described in the last question above.

Use All Defaults and Run in Read Only Mode (y/n)[y]?

Explanation: Enter “Y” to use the defaults for DILX, run in read-only mode, and most of the other DILX questions are not asked. Enter “N” and the defaults are not used. You must then answer each question as it is displayed. The following defaults are assumed for all units selected for testing:

- Execution time limit = 10 minutes.
- Performance summary interval = 10 minutes.
- Displaying hard or soft error Event Information Packets (EIPs) and end messages is disabled.
- The hard error limit = 65535. Testing will stop if the limit is reached.
- A hex dump of the extended error log information is disabled.
- The I/O queue depth = 4. A maximum of 4 I/Os will be outstanding at any time.
- The Selected Test = the Basic Function test.
- Read-only mode.
- All user available LBNs are available for testing.
- Data compares are disabled.

Enter the execution time limit in minutes (1:65535)[10]?

Explanation: Enter the desired time you want DILX to run. The default run time is 10 minutes.

Enter performance summary interval in minutes (1:65535)[10]?

Explanation: Enter a value to set the interval for which a performance summary is displayed. The default is 10 minutes.

Include performance statistics in performance summary (y/n)[n]?

Explanation: Enter “Y” to see a performance summary that includes the performance statistics that include the total count of read, write, access, and erase I/O requests and the kilobytes transferred for each command. Enter “N” and no performance statistics are displayed.

Display hard/soft errors (y/n)[n]?

Explanation: Enter “Y” to enable error reporting, including end messages and EIPs. Enter “N” to disable error reporting, including end messages and EIPs. The default is disabled error reporting.

Display hex dump of Event Information Packet requester specific
Information (y/n)[n]?

Explanation: Enter “Y” to enable the hex dump display of the requester specific information contained in the EIP. Enter “N” to disable the hex dump.

When the hard error limit is reached, the unit will be dropped from testing.
Enter hard error limit (1:65535) [65535] ?

Explanation: Enter a value to specify the hard error limit for all units to test. This question is used to obtain the hard error limit for *all* units under test. If the hard error limit is reached, DILX discontinues testing the unit that reaches the hard error limit. If other units are currently being tested by DILX, testing continues for those units.

When the soft error limit is reached, soft errors will no longer be displayed
but testing will continue for the unit. Enter soft error limit (1:65535) [32] ?

Explanation: Enter a value to specify the soft error limit for *all* units under test. When the soft error limit is reached, soft errors are no longer displayed, but testing continues for the unit.

Enter IO queue depth (1:12) [4]?

Explanation: Enter the maximum number of outstanding I/Os for each unit selected for testing. The default is 4.

Enter unit number to be tested?

Explanation: Enter the unit number for the unit to be tested.

Note

When DILX asks for the unit number, it requires the number designator for the disk, where D117 would be specified as unit number 117.

Unit *x* will be write enabled.
Do you still wish to add this unit (y/n) [n]?

Explanation: This is a reminder of the consequences of testing a unit while it is write enabled. This is the last chance to back out of testing the displayed unit. Enter “Y” to write enable the unit. Enter “N” to back out of testing that unit.

Select another unit (y/n) [n]?

Explanation: Enter “Y” to select another unit for testing. Enter “N” to begin testing the units already selected. The system will display the following test selections:

```
***Available tests are:
1.   Basic Function
2.   User Defined Test

Use the Basic Function 99.9% of the time.  The User Defined
test is for special problems only.
```

Enter test number (1:2) [1]?

Explanation: Enter “1” for the Basic Function test or “2” for the User-Defined test. After selecting a test, the system will then display the following message:

```
* IMPORTANT *  If you answer yes to the next question, user data
WILL BE destroyed.
```

Write enable disk unit (y/n) [n] ?

Explanation: Enter “Y” to write enable the unit. Write commands are enabled for the currently selected test. Data within your selected LBN range will be destroyed. *Be sure of your actions before answering this question.* This question applies to all DILX tests. Enter “N” to enable read only mode, where read and access commands are the only commands enabled.

Perform initial write (y/n) [n] ?

Explanation: Enter “Y” to write to the entire user-selected LBN range with the user-selected data patterns. Enter “N” for no initial write pass.

If you respond with “Y”, the system performs writes starting at the lowest user-selected LBN and issues spiral I/Os with the largest byte count possible. This continues until the specified LBN range has been completely written. Upon completion of the initial write pass, normal functions of the Random I/O phase start. The advantage of selecting the initial write pass is that compare host data commands can then be issued and the data previously written to the media can be verified for accuracy. It makes sure that all LBNs within the selected range are accessed by DILX.

The disadvantage of using the initial write pass is that it may take a long time to complete because a large LBN range was specified. You can bypass this by selecting a smaller LBN range, but this creates another disadvantage in that the entire disk space is not tested. The initial write pass only applies to the Basic Function test.

The write percentage will be set automatically.
Enter read percentage for random IO and data intensive phase (0:100) [67] ?

Explanation: This question is displayed if read/write mode is selected. It allows you to select the read/write ratio to use in the Random I/O and Data Intensive phases. The default read/write ratio is similar to the I/O ratio generated by a typical OpenVMS system.

Enter data pattern number 0=all, 19=user_defined, (0:19) [0] ?

Explanation: The DILX data patterns are used in write commands. This question is displayed when writes are enabled for the Basic Function or User-Defined tests. There are 18 unique data patterns to select from. These patterns were carefully selected as worst case or most likely to produce errors for disks connected to the controller. (See Table 6–2 for a list of data patterns.) The default uses all 18 patterns in a random method. This question also allows you to create a unique data pattern of your own choice.

Enter the 8-digit hexadecimal user defined data pattern [ ] ?

Explanation: This question is only displayed if you choose to use a user-defined data pattern for write commands. The data pattern is represented in a longword and can be specified with eight hexadecimal digits.

Enter start block number (0:highest_lbn_on_the_disk) [0] ?

Explanation: Enter the starting block number of the area on the disk you wish DILX to test. Zero is the default.

Enter end block number (starting_lbn:highest_lbn_on_the_disk) [highest_lbn_on_the_disk] ?

Explanation: Enter the highest block number of the area on the disk you wish DILX to test. The highest block number (of that type of disk) is the default.

Perform data compare (y/n) [n] ?

Explanation: Enter "Y" to enable the use of the compare modifier bit with read and write commands. Enter "N" and no data compare operations are done.

This question only applies to the Basic Function test. If the compare modifier is set on write commands, the data are written to the disk. The data are then read from the disk and compared against the corresponding DILX buffers. On read commands, the data are read from the disk into the DILX buffers, read again, then compared against the corresponding DILX buffers. If a discrepancy is found, an error is reported. If the initial write was chosen for the Basic Function test and you enter "Y" to this question, compare host data commands are then enabled and data previously written to the media are verified for accuracy.

Enter compare percentage (1:100) [5] ?

Explanation: This question is displayed only if you choose to perform data compares. This question allows you to change the percentage of read and write commands that will have a data compare operation performed. Enter a value indicating the compare percentage. The default is 5.

The erase percentage will be set automatically.
Enter access percentage for Seek Intensive Phase (0:100) [90] ?

Explanation: This question only applies to the Seek Intensive phase if writes are enabled. It allows you to select the percentage of access and erase commands to be issued. Enter a value indicating the access percentage.

Enter command number x (read, write, access, erase, quit) [ ] ?

Explanation: This question only applies to the User-Defined test. It allows you to define command *x* as a read, write, access, or erase command. Enter quit to finish defining the test.

Enter starting LBN for this command (0:highest_lbn_on_the_disk) [ ] ?

Explanation: This question only applies to the User-Defined test. It allows you to set the starting LBN for the command currently being defined. Enter the starting LBN for this command.

Enter the IO size in 512 byte blocks for this command (1:size_in_blocks) [ ] ?

Explanation: This question only applies to the User-Defined test. It allows you to set the I/O size in 512-byte blocks for the command currently being defined. Enter values indicating the I/O size for this command.

Enter in HEX, the MSCP Command Modifiers[0] ?

Explanation: This question only applies to the User-Defined test. It allows you to specify the MSCP command modifiers. You must understand the meaning of the MSCP command modifiers before you enter any value other than the default.

Reuse parameters (stop, continue, restart, change_unit) [stop] ?

Explanation: This question is displayed after the DILX execution time limit expires, after the hard error limit is reached for every unit under test, or after you enter Ctrl/C. These options are as follow:

- **Stop**—DILX terminates normally.
- **Continue**—DILX resumes execution without resetting the remaining DILX execution time or any performance statistics. If the DILX execution time limit has expired, or all units have reached their hard error limit, DILX terminates.
- **Restart**—DILX resets all performance statistics and restarts execution so that the test will perform exactly as the one that just completed. However, there is one exception. If the previous test was the Basic Function test with the initial write pass and the initial write pass completed, the initial write pass is not performed when the test is restarted.
- **Change_unit**—DILX allows you to drop or add units to testing. For each unit dropped, another unit must be added, until all units in the configuration have been tested. The unit chosen will be tested with the same parameters that were used for the unit that was dropped from testing. When you have completed dropping and adding units, all performance statistics are initialized and DILX execution resumes with the same parameters as the last run.

Drop unit #x (y/n) [n] ?

Explanation: This question is displayed if you choose to change a unit as an answer to the reuse parameters (previous) question. Enter the unit number that you wish to drop from testing.

The new unit will be write enabled. Do you wish to continue (y/n) [n] ?

Explanation: This question is displayed if you choose to change a unit as an answer to the reuse parameters question. It is only asked if the unit being dropped was write enabled. This question gives you the chance to terminate DILX testing if you do not want data destroyed on the new unit. Enter “N” to terminate DILX.

6.2.5 DILX Output Messages

The following message is displayed when DILX is started:

```
Copyright © Digital Equipment Corporation 1993
Disk Inline Exerciser - version 1.4
```

This message identifies the internal program as DILX and gives the DILX software version number.

Change Unit is not a legal option if Auto-Configure was chosen.

Explanation: This message will be displayed if the user selected the Auto-Configure option and selected the “change unit response” to the “reuse parameters” question. You cannot drop a unit and add a unit if all units were selected for testing.

DILX - Normal Termination.

Explanation: This message is displayed when DILX terminates under normal conditions.

Insufficient resources.

Explanation: Following this line is a second line that gives more information about the problem, which could be one of the following messages:

- Unable to allocate memory.

  DILX was unable to allocate the memory it needed to perform DILX tests. You should run DILX again but choose a lower queue depth and/or choose fewer units to test.

- Cannot perform tests.

  DILX was unable to allocate all of the resources needed to perform DILX tests. You should run DILX again but choose a lower queue depth and/or choose fewer units to test.

- Unable to change operation mode to maintenance.

  DILX tried to change the operation mode from normal to maintenance using the SYSAP$CHANGE_STATE( ) routine but was not successful due to insufficient resources. This problem should not occur. If it does occur, submit a CLD (error report), then reset the controller.

Disk unit *x* does not exist.

Explanation: An attempt was made to allocate a unit for testing that does not exist on the controller.

Unit *x* successfully allocated for testing.

Explanation: All processes that DILX performs to allocate a unit for testing, have been completed. The unit is ready for DILX testing.

Unable to allocate unit.

Explanation: This message should be preceded by a reason why the unit could not be allocated for DILX testing.

DILX detected error, code *x*.

Explanation: The “normal” way DILX recognizes an error on a unit is through the reception of an EIP. This loosely corresponds to an MSCP error log. However, the following are some errors that DILX will detect without the reception of an EIP:

- Illegal Data Pattern Number found in data pattern header. Unit *x*

  This is code 1. DILX read data from the disk and found that the data were not in a pattern that DILX previously wrote to the disk.

- No write buffers correspond to data pattern Unit *x*.

  This is code 2. DILX read a legal data pattern from the disk at a place where DILX wrote to the disk, but DILX does not have any write buffers that correspond to the data pattern. Thus, the data have been corrupted.

- Read data do not match what DILX thought was written to the media. Unit *x*.

  This is code 3. DILX writes data to the disk and then reads it and compares it against what was written to the disk. This indicates a compare failure. More information is displayed to indicate where in the data buffer the compare failed and what the data were and should have been.

- Compare Host Data should have reported a compare error but did not. Unit *x*

  This is code 4. A compare host data compare was issued in a way that DILX expected to receive a compare error but no error was received.

DILX terminated. A termination, a print summary or a reuse parameters request was received but DILX is currently not testing any units.

Explanation: The user entered a Ctrl/Y (termination request), a Ctrl/G (print summary request), or a Ctrl/C (reuse parameters request) before DILX had started to test units. DILX cannot satisfy the second two requests so DILX treats all of these requests as a termination request.

DILX will not change the state of a unit if it is not NORMAL.

Explanation: DILX cannot allocate the unit for testing because it is already in Maintenance mode. (Maintenance mode can only be invoked by the firmware. If another DILX session is in use, the unit is considered in Maintenance mode.)

Unit is not available - if you dismount the unit from the host, it may correct this problem.

Explanation: The unit has been placed on line by another user (or host) or the media is not present. The most common reason for this message is that the unit is mounted on the host.

Soft error reporting disabled. Unit *x*.

Explanation: This message indicates that the soft error limit has been reached and therefore no more soft errors will be displayed for this unit.

Hard error limit reached, unit *x* dropped from testing.

Explanation: This message indicates that the hard error limit has been reached and the unit must be dropped from testing.

Soft error reporting disabled for controller errors.

Explanation: This indicates that the soft error limit has been reached for controller errors. Thus, controller soft error reporting is disabled.

Hard error limit reached for controller errors. All units dropped from testing.

Explanation: This message is self explanatory.

Unit is already allocated for testing.

Explanation: This message is self explanatory.

No drives selected.

Explanation: DILX parameter collection was exited without choosing any units to test.

Maximum number of units are now configured.

Explanation: This message is self explanatory. (Testing will start after this message is displayed.)

Unit is write protected.

Explanation: The user wants to test a unit with a write commands, or erase commands, or both enabled but the unit is write protected.

The unit status and/or the unit device type has changed unexpectedly.
Unit x dropped from testing.

Explanation: The unit status may change if the unit experienced hard errors or if the unit is disconnected. Either way, DILX cannot continue testing the unit.

Last Failure Information follows. This error was NOT produced by running DILX. It represents the reason why the controller crashed on the previous controller run.

Explanation: This message may be displayed while allocating a unit for testing. It does not indicate any reason why the unit is or is not successfully allocated, but rather represents the reason why the controller went down in the previous run. The information that follows this message is the contents of an EIP.

Disk unit numbers on this controller include:

Explanation: After this message is displayed, a list of disk unit numbers on the controller is displayed.

IO to unit *x* has timed out. DILX aborting.

Explanation: One of the DILX I/Os to this unit did not complete within the command timeout interval and when examined, was found not progressing. This indicates a failing controller.

DILX terminated prematurely by user request.

Explanation: A Ctrl/Y was entered. DILX interprets this as a request to terminate. This message is displayed and DILX terminates.

Unit is owned by another sysap.

Explanation: DILX could not allocate the unit specified because the unit is currently allocated by another system application. Terminate the other system application or reset the controller.

Exclusive access is declared for this unit.

Explanation: The unit could not be allocated for testing because exclusive access has been declared for the unit.

The other controller has exclusive access declared for this unit.

Explanation: This message is self explanatory.

This unit is marked inoperative.

Explanation: The unit could not be allocated for testing because the controller internal tables have the unit marked as inoperative.

The unit does not have any media present.

Explanation: The unit could not be allocated for testing because no media is present.

The RUNSTOP_SWITCH is set to RUN_DISABLED.

Explanation: The unit could not be allocated for testing because the RUNSTOP_SWITCH is set to RUN_DISABLED. This is enabled and disabled through the Command Line Interpreter (CLI).

Unable to continue, run time expired.

Explanation: A continue response was given to the “reuse parameters” question. This is not a valid response if the run time has expired. Reinvoke DILX.

When DILX starts to exercise the disk units, the following message is displayed with the current time of day:

```
DILX testing started at: xx:xx:xx
    Test will run for x minutes
    Type ^T(if running DILX through a VCS) or ^G(in all other cases)
      to get a current performance summary
    Type ^C to terminate the DILX test prematurely
    Type ^Y to terminate DILX prematurely
```

6.2.6 DILX End Message Display

To interpret the end message fields correctly, you must contact Digital Multivendor Services. Example 6–1 is an example of a DILX end message display.

Example 6–1 DILX End Message Display

```
Bad Value Added Completion Status for unit x, End message in hex

      Event Code                  x
      Op Code                     x
      Cmd Ref Number              x
      Byte Count                  x
      Error Byte Count            x
      Sequence Number             x
      Flags                       x
```

6.2.7 DILX Event Information Packet Displays

A DILX EIP display may or may not include a hex dump of the Requestor Specific Data. This is an option you can select as a DILX parameter.

The EIP will be in one of the following formats that corresponds to MSCP error log formats:

- Controller Error
- Memory Error
- Disk Transfer Error
- Bad Block Replacement Attempt Error

Examples 6–2 through 6–5 are examples of each display. Each display includes the optional requestor specific information. In all cases, the Instance code, template type, and all requestor specific information correspond to event (error) log device dependent parameters, while everything else has a one-to-one correspondence to error log fields. See Appendices C and D for a translation of these codes.

Example 6–2 Controller Error

```
Error Information Packet in hex

      Cmd Ref Number      x
      Unit Number         x
      Log Sequence        x
      Format              x
      Flags               x
      Event Code          x
      Controller ID       x
      Controller SW ver   x
      Controller HW ver   x
      Multi Unit Code     x
      Instance                   x
      Template Type              x
      Requestor Information Size  x
      Requestor Specific Data bytes 0 7   xx xx xx xx xx xx xx xx
      Requestor Specific Data bytes 8 15   xx xx xx xx xx xx xx xx
        :
        :
      Requestor Specific Data bytes xx xx   xx xx xx xx xx xx xx xx
```

Example 6–3 Memory Error

```
Error Information Packet in hex

      Cmd Ref Number      x
      Unit Number         x
      Log Sequence        x
      Format              x
      Flags               x
      Event Code          x
      Controller ID       x
      Controller SW ver   x
      Controller HW ver   x
      Multi Unit Code     x
      Memory Address      x
      Instance                   x
      Template Type              x
      Requestor Information Size  x
      Requestor Specific Data bytes 0 7   xx xx xx xx xx xx xx xx
      Requestor Specific Data bytes 8 15   xx xx xx xx xx xx xx xx
        :
        :
      Requestor Specific Data bytes xx xx   xx xx xx xx xx xx xx xx
```

Example 6–4 Disk Transfer Error

```
Error Information Packet in hex

      Cmd Ref Number       x
      Unit Number          x
      Log Sequence         x
      Format               x
      Flags                x
      Event Code           x
      Controller ID        x
      Controller SW ver    x
      Controller HW ver    x
      Multi Unit Code      x
      Unit ID[0]           x
      Unit ID[1]           x
      Unit Software Rev    x
      Unit Hardware Rev    x
      Recovery Level       x
      Retry Count          x
      Serial Number        x
      Header Code          x
      Instance                    x
      Template Type               x
      Requestor Information Size  x
      Requestor Specific Data bytes 0 7   xx xx xx xx xx xx xx xx
      Requestor Specific Data bytes 8 15   xx xx xx xx xx xx xx xx
        :
        :
      Requestor Specific Data bytes xx xx   xx xx xx xx xx xx xx xx
```

Example 6–5 Bad Block Replacement Attempt Error

```
Error Information Packet in hex

      Cmd Ref Number       x
      Unit Number          x
      Log Sequence         x
      Format               x
      Flags                x
      Event Code           x
      Controller ID        x
      Controller SW ver    x
      Controller HW ver    x
      Multi Unit Code      x
      Unit ID[0]           x
      Unit ID[1]           x
      Unit Software Rev    x
      Unit Hardware Rev    x
      Replace Flags        x
      Serial Number        x
      Bad LBN              x
      Old RBN              x
      New RBN              x
      Cause                x
      Instance                    x
      Template Type               x
      Requestor Information Size  x
      Requestor Specific Data bytes 0 7   xx xx xx xx xx xx xx xx
      Requestor Specific Data bytes 8 15   xx xx xx xx xx xx xx xx
        :
```

(continued on next page)

Example 6–5 (Cont.) Bad Block Replacement Attempt Error

```
      :
Requestor Specific Data bytes xx xx   xx xx xx xx xx xx xx xx
```

6.2.8 DILX Data Patterns

Table 6–2 defines the data patterns used with the DILX Basic Function or User-Defined tests. There are 18 unique data patterns. These data patterns were selected as worst case, or the ones most likely to produce errors on disks connected to the controller.

Table 6–2 DILX Data Patterns

Pattern Number	Pattern in hex
1	0000
2	8B8B
3	3333
4	3091
5, shifting 1s	0001, 0003, 0007, 000F, 001F, 003F, 007F, 00FF, 01FF, 03FF, 07FF, 0FFF, 1FFF, 3FFF, 7FFF
6, shifting 0s	FIE, FFFC, FFFC, FFFC, FFE0, FFE0, FFE0, FFE0, FE00, FC00, F800, F000, F000, C000, 8000, 0000
7, alternating 1s, 0s	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, ripple 1	0001, 0002, 0004, 0008, 0010, 0020, 0040, 0080, 0100, 0200, 0400, 0800, 1000, 2000, 4000, 8000
14, ripple 0	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
Default—Use all of the above patterns in a random method	

6.2.9 DILX Examples

This section provides DILX examples using different options.

6.2.9.1 DILX Example—Using All Defaults

In Example 6–6, DILX is run using all defaults. DILX is executed in read-only mode. No data on the units under test are destroyed. The entire user-available LBN range on each disk is accessible for DILX testing. DILX was invoked from a maintenance terminal.

Example 6–6 Using All Defaults—DILX

```
HSJ> show disk
Name          Type          Port Targ  LUN                  Used by
------------------------------------------------------------------------------

DISK100       disk             1    0    0                  D10
DISK120       disk             1    2    0                  D12
DISK140       disk             1    4    0                  D14
DISK210       disk             2    1    0                  D21
DISK230       disk             2    3    0                  D23
DISK610       disk             6    1    0                  D61
DISK630       disk             6    3    0                  D63

HSJ> run dilx

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The Auto-Configure option will automatically select, for testing, half or
all of the disk units configured. It will perform a very thorough test with
*WRITES* enabled. The user will only be able to select the run time and
performance summary options and whether or not to test a half or full
configuration. The user will not be able to specify specific units to test.
The Auto-Configure option is only recommended for initial installations.

Do you wish to perform an Auto-Configure (y/n) [n] ?n

Use all defaults and run in read only mode (y/n) [y] ?y
Disk unit numbers on this controller include:
    10
    12
    14
    21
    23
    61
    63
Enter unit number to be tested ?10
Unit 10 successfully allocated for testing
Select another unit (y/n) [n] ?y
Enter unit number to be tested ?12
Unit 12 successfully allocated for testing
Select another unit (y/n) [n] ?n

   DILX testing started at: 13-JAN-1993 04:47:57
    Test will run for 10 minutes
    Type ^T(if running DILX through VCS) or ^G(in all other cases)
      to get a current performance summary
    Type ^C to terminate the DILX test prematurely
    Type ^Y to terminate DILX prematurely

   DILX Summary at 13-JAN-1993 04:49:14
   Test minutes remaining: 9, expired: 1
```

(continued on next page)

Example 6–6 (Cont.) Using All Defaults—DILX

```
Unit 10     Total IO Requests 4530
  No errors detected
Unit 12     Total IO Requests 2930
  No errors detected
Reuse Parameters (stop, continue, restart, change_unit) [stop] ?

DILX - Normal Termination
HSJ>
```

6.2.9.2 DILX Example—Using All Functions

In Example 6–7, all functions are chosen for DILX. DILX was invoked from the virtual terminal using the DUP connection from an OpenVMS system. This is an extensive (long) run because the initial write pass was chosen, and because there was enough time for the initial write pass to complete and for normal testing to continue for a reasonable length of time after the initial write pass.

CAUTION

This test writes to disks. All user data will be destroyed.

Example 6–7 All Functions—DILX

```
$ SHOW CLUSTER/CONTINUOUS

View of Cluster from system ID 9038  node: ENGHRN          7-APR-1993 14:54:01

      SYSTEMS       MEMBERS

  NODE   SOFTWARE   STATUS

 ENGHRN  VMS V5.5  MEMBER
 FORCE   HSC V700
 WODWND  VMS V5.5  MEMBER
 CYMBAL  VMS V5.5  MEMBER
 LUTE    VMS V5.5  MEMBER
 MASS2   HSJ TM4I
 MASS1   HSJ XM4I

(Entered a Ctrl/C here.)

DUP> set host/dup/server=mscp$dup MASS1/task=DILX
%HSCPAD-I-LOCPROGEXE, Local program executing - type ^\ to exit

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The Auto-Configure option will automatically select, for testing, half or
all of the disk units configured. It will perform a very thorough test with
*WRITES* enabled. The user will only be able to select the run time and
performance summary options and whether or not to test a half or full
configuration. The user will not be able to specify specific units to test.
The Auto-Configure option is only recommended for initial installations.

Do you wish to perform an Auto-Configure (y/n) [n] ?
```

(continued on next page)

Example 6–7 (Cont.) All Functions—DILX

```
Use all defaults and run in read only mode (y/n) [y] ?n
Enter execution time limit in minutes (1:65535) [10] ?45
Enter performance summary interval in minutes (1:65535) [10] ?45
Include performance statistics in performance summary (y/n) [n] ?y
Display hard/soft errors (y/n) [n] ?y
Display hex dump of Error Information Packet Requester Specific
information (y/n) [n] ?y
When the hard error limit is reached, the unit will be dropped from testing.
Enter hard error limit (1:65535) [65535] ?
When the soft error limit is reached, soft errors will no longer be
displayed but testing will continue for the unit.
Enter soft error limit (1:65535) [32] ?
Enter IO queue depth (1:20) [4] ?10
  *** Available tests are:
    1. Basic Function
    2. User Defined

Use the Basic Function test 99.9% of the time. The User Defined
test is for special problems only.
Enter test number (1:2) [1] ?1

 **CAUTION**
If you answer yes to the next question, user data WILL BE destroyed.

Write enable disk unit(s) to be tested (y/n) [n] ?y
The write percentage will be set automatically.
Enter read percentage for Random IO and Data Intensive phase (0:100) [67] ?
Enter data pattern number 0=ALL, 19=USER_DEFINED, (0:19) [0] ?
Perform initial write (y/n) [n] ?y
The erase percentage will be set automatically.
Enter access percentage for Seek Intensive phase (0:100) [90] ?
Perform data compare (y/n) [n] ?y
Enter compare percentage (1:100) [5] ?
Disk unit numbers on this controller include:
    10
    12
    14
    21
    23
    61
    63
Enter unit number to be tested ?10
Unit 10 will be write enabled.
Do you still wish to add this unit (y/n) [n] ?y
Enter start block number (0:1664214) [0] ?
Enter end block number (0:1664214) [1664214] ?
Unit 10 successfully allocated for testing
Select another unit (y/n) [n] ?y
Enter unit number to be tested ?12
Unit 12 will be write enabled.
Do you still wish to add this unit (y/n) [n] ?y
Enter start block number (0:832316) [0] ?
Enter end block number (0:832316) [832316] ?
Unit 12 successfully allocated for testing
Select another unit (y/n) [n] ?n

   DILX testing started at: 13-JAN-1993 04:52:26
    Test will run for 45 minutes
    Type ^T(if running DILX through VCS) or ^G(in all other cases)
      to get a current performance summary
    Type ^C to terminate the DILX test prematurely
    Type ^Y to terminate DILX prematurely
```

(continued on next page)

Example 6–7 (Cont.) All Functions—DILX

```
   DILX Summary at 13-JAN-1993 04:56:20
   Test minutes remaining: 42, expired: 3

Unit 10     Total IO Requests 40794
  Read Count 0   Write Count 40793
  Access Count 0   Erase Count 0
  KB xfer   Read 0   Write 326344   Total 326344
  No errors detected
Unit 12     Total IO Requests 13282
  Read Count 0   Write Count 13281
  Access Count 0   Erase Count 0
  KB xfer   Read 0   Write 106248   Total 106248
  No errors detected
Reuse Parameters (stop, continue, restart, change_unit) [stop] ?

DILX - Normal Termination
HSJ>
```

6.2.9.3 DILX Examples—Auto-Configure with All Units

In Example 6–8, DILX is run using the Auto-Configure option with the all units option.

Example 6–8 Auto-Configuration with All Units

```
HSJ> run dilx

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The Auto-Configure option will automatically select, for testing, half or
all of the disk units configured. It will perform a very thorough test with
*WRITES* enabled. The user will only be able to select the run time and
performance summary options and whether or not to test a half or full
configuration. The user will not be able to specify specific units to test.
The Auto-Configure option is only recommended for initial installations.

Do you wish to perform an Auto-Configure (y/n) [n] ?y

 If you want to test a dual redundant subsystem, it is recommended that
 you pick option 2 on the first controller and then option 2 on the
 other controller. Auto-Configure options are:

      1. Configure all disk units for testing. This is recommended for a
           single controller subsystem.
      2. Configure half of all disk units for testing, this is recommended
         for a dual controller subsystem.
      3. Exit Auto-Configure and DILX.

Enter Auto-Configure option (1:3) [3] ?1

     ****  C a u t i o n  ****

All data on the Auto-Configured disks will be destroyed.
You *MUST* be sure of yourself.
```

(continued on next page)

Example 6–8 (Cont.) Auto-Configuration with All Units

```
Are you sure you want to continue (y/n) [n] ?y
Enter execution time limit in minutes (1:65535) [60] ?
Enter performance summary interval in minutes (1:65535) [60] ?
Unit 10 successfully allocated for testing
Unit 12 successfully allocated for testing
Unit 14 successfully allocated for testing
Unit 21 successfully allocated for testing
Unit 23 successfully allocated for testing
Unit 61 successfully allocated for testing
Unit 63 successfully allocated for testing

   DILX testing started at: 13-JAN-1993 04:42:39
    Test will run for 60 minutes
    Type ^T(if running DILX through VCS) or ^G(in all other cases)
      to get a current performance summary
    Type ^C to terminate the DILX test prematurely
    Type ^Y to terminate DILX prematurely

   DILX Summary at 13-JAN-1993 04:44:11
   Test minutes remaining: 59, expired: 1

Unit 10     Total IO Requests 9595
  No errors detected
Unit 12     Total IO Requests 5228
  No errors detected
Unit 14     Total IO Requests 10098
  No errors detected
Unit 21     Total IO Requests 9731
  No errors detected
Unit 23     Total IO Requests 5230
  No errors detected
Unit 61     Total IO Requests 11283
  No errors detected
Unit 63     Total IO Requests 5232
  No errors detected
Reuse Parameters (stop, continue, restart, change_unit) [stop] ?

DILX - Normal Termination
HSJ>
```

In Example 6–9, DILX is run using the Auto-Configure option with the half of all units option.

Example 6–9 Auto-Configuration with Half of All Units

```
HSJ> run dilx

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The Auto-Configure option will automatically select, for testing, half or
all of the disk units configured. It will perform a very thorough test with
*WRITES* enabled. The user will only be able to select the run time and
performance summary options and whether or not to test a half or full
configuration. The user will not be able to specify specific units to test.
The Auto-Configure option is only recommended for initial installations.

Do you wish to perform an Auto-Configure (y/n) [n] ?y
```

(continued on next page)

Example 6–9 (Cont.) Auto-Configuration with Half of All Units

```
 If you want to test a dual redundant subsystem, it is recommended that
 you pick option 2 on the first controller and then option 2 on the
 other controller. Auto-Configure options are:

      1. Configure all disk units for testing. This is recommended for a
           single controller subsystem.
      2. Configure half of all disk units for testing, this is recommended
         for a dual controller subsystem.
      3. Exit Auto-Configure and DILX.

Enter Auto-Configure option (1:3) [3] ?2

     ****  C a u t i o n  ****

All data on the Auto-Configured disks will be destroyed.
You *MUST* be sure of yourself.

Are you sure you want to continue (y/n) [n] ?y
Enter execution time limit in minutes (1:65535) [60] ?
Enter performance summary interval in minutes (1:65535) [60] ?
Unit 12 successfully allocated for testing
Unit 21 successfully allocated for testing
Unit 61 successfully allocated for testing

   DILX testing started at: 13-JAN-1993 04:39:20
    Test will run for 60 minutes
    Type ^T(if running DILX through VCS) or ^G(in all other cases)
      to get a current performance summary
    Type ^C to terminate the DILX test prematurely
    Type ^Y to terminate DILX prematurely


   DILX Summary at 13-JAN-1993 04:41:39
   Test minutes remaining: 58, expired: 2

Unit 12     Total IO Requests 8047
  No errors detected
Unit 21     Total IO Requests 15239
  No errors detected
Unit 61     Total IO Requests 19270
  No errors detected
Reuse Parameters (stop, continue, restart, change_unit) [stop] ?

DILX - Normal Termination
HSJ>
```

6.2.10 Interpreting the DILX Performance Summaries

A DILX performance display is produced under the following conditions:

- When a specified performance summary interval elapses
- When DILX terminates for any conditions except an abort
- When Ctrl/G is entered (or Ctrl/T when running from a VCS)

The performance display has different formats depending on whether or not performance statistics are requested in the user-specified parameters and if errors are detected.

The following is an example of a DILX performance display where performance statistics were not selected and where no errors were detected:

```
   DILX Summary at 18-JUN-1993 06:18:41
   Test minutes remaining: 0, expired: 6

Unit 1     Total IO Requests 482
  No errors detected
Unit 2     Total IO Requests 490
  No errors detected
```

The following is an example of a DILX performance display where performance statistics were selected and no errors were detected:

```
   DILX Summary at 18-JUN-1993 06:18:41
   Test minutes remaining: 0, expired: 6

Unit 1     Total IO Requests 482
  Read Count   292   Write Count 168
  Access Count 21   Erase Count 0
  KB xfer   Read 7223   Write 4981   Total 12204
  No errors detected
```

The following is an example of a DILX performance display where performance statistics were not selected and where errors were detected on a unit under test:

```
     DILX Summary at 18-JUN-1993 06:18:41
     Test minutes remaining: 0, expired: 6

❶ Unit 10     Total IO Requests 153259
           No errors detected
❷ Unit 40     Total IO Requests 2161368
           Err in Hex: IC:031A4002  PTL:04/00/00  Key:04  ASC/Q:B0/00  HC:0  SC:1
           Total Errs   Hard Cnt 0   Soft Cnt 1
❸ Unit 55     Total IO Requests 2017193
           Err in Hex: IC:03094002  PTL:05/05/00  Key:01  ASC/Q:18/89  HC:0  SC:1
           Err in Hex: IC:03094002  PTL:05/05/00  Key:01  ASC/Q:18/86  HC:0  SC:1
❹          Total Errs   Hard Cnt 0   Soft Cnt 2
```

where:

❶ Represents the unit number and the total I/O requests to this unit.

❷ Represents the unit number and total I/O requests to this unit.

All values for the following codes are described in Appendices C and D. This also includes the following items associated with this error, and the total number of hard and soft errors for this unit:

- The HSJ-/HSD-series Instance code (in hex)
- The Port Target LUN (PTL)
- The SCSI Sense Key
- The SCSI ASC and ASQ (ASC/Q) codes
- The total hard and soft count for this error

❸ Represents information about the first two unique errors.

All values for the following codes are described in Appendices C and D. This also includes the following items associated with this error, and the total number of hard and soft errors for this unit:

- The HSJ-/HSD-series Instance code (in hex)
- The Port Target LUN (PTL)
- The SCSI Sense (Key)

- The SCSI ASC and ASQ (ASC/Q) codes
- The total hard and soft count for this error

  A line of this format may be displayed up to three times in a performance summary. There would be a line for each unique error reported to DILX for this unit, up to three errors.

❹ Represents the total hard and soft errors experienced for this unit.

The following is an example of a DILX performance display where performance statistics were not selected and where a controller error was detected:

```
   DILX Summary at 18-JUN-1993 06:18:41
   Test minutes remaining: 0, expired: 6

Cnt err in HEX  IC:07080064  Key:06  ASC/Q:A0/05  HC:1  SC:0
  Total Cntrl Errs   Hard Cnt 1   Soft Cnt 0

Unit 1     Total IO Requests 482
  No errors detected
Unit 2     Total IO Requests 490
  No errors detected
```

For the previous examples, the following definitions apply. These codes are translated in Appendices C and D.

- IC—The HSJ-/HSD-series Instance code
- ASC/Q—The SCSI ASC and ASCQ code associated with this error
- HC—The hard count of this error
- SC—The soft count of this error
- PTL—The location of the unit (Port Target LUN)

The performance displays contain error information for up to three unique errors. Hard errors always have precedence over soft errors. A soft error represented in one display may be replaced with information on a hard error in subsequent performance displays.

6.2.11 DILX Abort Codes

Table 6–3 lists the DILX abort codes and definitions.

Table 6–3 DILX Abort Codes and Definitions

Value	Definition
1	An IO has timed out.
2	dcb_p->htb_used_count reflects an available HTB to test IOs but none could be found.
3	FAO returned either FAO_BAD_FORMAT or FAO_OVERFLOW.
4	TS$SEND_TERMINAL_DATA returned either an ABORTED or INVALID_BYTE_COUNT.
5	TS$READ_TERMINAL_DATA returned either an ABORTED or INVALID_BYTE_COUNT.
6	A timer is in an unexpected expired state that prevents it from being started.
7	The semaphore was set after a oneshot IO was issued but nothing was found in the received HTB que.
8	A termination, a print summary, or a reuse parameters request was received when DILX was not testing any units.
9	User requested an abort via ^Y.

6.2.12 DILX Error Codes

Table 6–4 list the DILX error codes and definitions for DILX-detected errors.

Table 6–4 DILX Error Codes and Definitions

Value	Definition
1	Illegal Data Pattern Number found in data pattern header.
2	No write buffers correspond to data pattern.
3	Read data does not match write buffer.
4	Compare Host Data should have reported a compare error but did not.

6.3 Tape Inline Exerciser (HSJ- and HSD-Series Controllers)

TILX is a diagnostic tool used to exercise the data transfer capabilities of selected tape drives connected to an HSJ- or HSD-series controller. TILX exercises tape drives in a way that simulates a high level of user activity. Thus, TILX can be used to determine the health of the controller and the tape drives connected to it. You can run TILX from a maintenance terminal or from a virtual terminal.

DILX and TILX may run concurrently with one initiated from a maintenance terminal and the other from a virtual terminal connection. Digital recommends, however, that the exercisers *not* be run while normal I/O operations are in progress, as system performance will degrade due to the heavy load the exercisers impose on the controller.

6.3.1 Invoking TILX

Note

Before running TILX, be sure that all units you wish to test have been dismounted from the host.

The following describes how to invoke TILX from a maintenance terminal at the CLI> prompt or a VCS, or from a virtual terminal through the DUP connection.

- To invoke TILX from a maintenance terminal, enter the following command at the CLI> prompt:

  ```
  CLI> RUN TILX
  ```

- To invoke TILX from a maintenance terminal using a VCS, enter the following command at the CLI> prompt:

  ```
  CLI> VCS CONNECT node name
  ```

  where *node name* is the controller's SCS node name.

  Consult the *VAXcluster Console System User's Guide* for complete details on using a VCS.

  Note

  The node name *must* be specified for a VCS.

- To invoke TILX from a virtual terminal, enter the following command (for OpenVMS software):

  ```
  $ SET HOST/DUP/SERVER=MSCP$DUP/TASK=TILX SCS_nodename
  ```

  where *SCS_nodename* indicates where TILX will execute.

6.3.2 Interrupting TILX Execution

Use the following guidelines to interrupt TILX execution:

Note

The symbol "^" is equivalent to the Ctrl key. You must press and hold the Ctrl key and type the character key given.

Note

Do not use Ctrl/G from a VCS because it will cause VCS to terminate. VCS acts on the sequence and the sequence is never sent to TILX. Use Ctrl/T when invoking TILX from a VCS.

- Ctrl/G causes TILX to produce a performance summary. TILX continues normal execution without affecting the runtime parameters.
- Ctrl/C causes TILX to produce a performance summary, stop testing, and asks the "reuse parameters" question.

- Ctrl/Y causes TILX to terminate. The “reuse parameters” question is not asked.
- Ctrl/T causes TILX to produce a performance summary. TILX then continues executing normally without affecting any of the runtime parameters.

6.3.3 TILX Tests

There are three TILX tests, as follow:

- The Basic Function test
- The User-Defined test
- The Read Only test

6.3.3.1 Basic Function Test—TILX

The Basic Function test executes a write pass followed by a read pass. The write pass executes in two phases, as follows:

- **Data Intensive**—The first one third of the records are written in this phase. All records written to the tape have a byte count of 16 kilobytes. With this high byte count and the default queue depth, this phase should test the streaming capability (if supported) of the tape unit.
- **Random**—This test is performed for the remaining two-thirds of the selected record count. It consists of writes with random byte counts. Intermixed is the sequence *write, reposition back one record, read*. This sequence performed three times in a row. Tape mark writing is also intermixed in the test.

The write pass is complete when the selected record count is reached, or if the end of tape (EOT) is reached. The tape is rewound and the read pass is started.

The read pass consists of the following three phases:

- **Data Intensive**—Consists of reads of fixed record sizes with a byte count equal to the expected tape record byte count. When tape marks are encountered, forward position commands are issued.
- **Random**—Begins at the point where random sized records were written to the tape. Most reads are issued with a byte count equal to the expected tape record byte count. Occasionally, reads will be intermixed with a byte count less than or greater than the expected tape record byte count. When tape marks are encountered, forward position commands are issued.
- **Position Intensive**—Begins half way down from the start of the area where random sized records are located. In the Position Intensive phase, reads and position commands are intermixed so that the test gradually proceeds toward the EOT. When tape marks are encountered, forward position commands are issued.

In all phases, if the EOT is detected, the tape is rewound to the beginning of tape (BOT), and the write pass is again entered.

6.3.3.2 User-Defined Test—TILX

CAUTION

The User-Defined test should be run *only* by very knowledgeable personnel. Otherwise, customer data can be destroyed.

When the TILX User-Defined test is selected, TILX prompts you for input to allow a specific test to be defined. In a User-Defined test, a total of 20, or fewer, I/O commands can be defined. Once all of the commands are issued, TILX issues the commands again in the same sequence. This is repeated until the selected time limit is reached. As you build the test, TILX collects the following information for each command:

- The I/O command operation (write, read, reposition record, reposition file, write tape mark, rewind, quit. Note that quit is not a command; instead it indicates to TILX that you have finished defining the test).
- The number of times to repeat the command. (Applies only to write, read, and write tape mark.)
- The number of records or file marks to reposition.
- The data pattern to use.
- The direction of reposition operation (toward EOT or BOT).
- The size of the I/O in bytes.
- The TMSCP command modifiers.

6.3.3.3 Read Only Test—TILX

The Read Only test should only be used to verify that a tape is readable. The Read Only test reads records until the EOT or the selected record count is reached. At that point, the tape is rewound and another read pass proceeds. Tape marks are ignored. This test will most likely issue reads with incorrect record sizes. If there are record size mismatches, they will be ignored. All other errors will be recorded.

6.3.4 TILX Test Definition Questions

The following section lists the questions that TILX asks to collect the parameters needed to perform a TILX test. Each of the following sections discusses specific TILX questions. The test questions are listed in the approximate order that they are displayed on your terminal. These questions prompt you to define the runtime parameters for TILX.

Note

Defaults for each question are given inside [ ]. If you press the Return key as a response to a question, the default is used as the response.

Use all defaults (y/n) [y] ?

Explanation: Enter “Y” to use the defaults for TILX and most of the other TILX questions are not asked. Enter “N” and the defaults are not used. You must then answer each question as it is displayed. The following defaults are assumed for all units selected for testing:

- Execution time limit = 10 minutes.
- Performance summary interval = 10 minutes.

- Displaying performance statistics is disabled.

Note

This does not include total I/O requests.

- Displaying hard/soft EIPs and end messages is disabled.
- Hard error limit = 65535. Testing will stop if the limit is reached.
- Hex dump of extended error log information is disabled.
- I/O queue depth = 4. A maximum of 4 I/Os will be outstanding at one time.
- Selected test = Basic Function test.
- The record count = 4096.
- All data patterns are used.
- Data compares are disabled.

Enter execution time limit in minutes (1:65535) [10] ?

Explanation: Enter the desired time you want TILX to run. The default run time is 10 minutes.

Enter performance summary interval in minutes (1:65535) [10] ?

Explanation: Enter a value to set the interval for which a performance summary is displayed. The default is 10 minutes.

Include performance statistics in performance summary (y/n) [n] ?

Explanation: Enter "Y" to see a performance summary that includes the performance statistics that include the total count of read and write I/O requests and the kilobytes transferred for each command. Enter "N" and no performance statistics are displayed.

Display hard/soft errors (y/n) [n] ?

Explanation: Enter "Y" to enable error reporting, including end messages and EIPs. Enter "N" to disable error reporting, including end messages and EIPs. The default is disabled error reporting.

Display hex dump of Event Information Packet Requester Specific information(y/n) [n] ?

Explanation: Enter "Y" to enable the hex dump display of the requester specific information contained in the EIP. Enter "N" to disable the hex dump.

When the hard error limit is reached, the unit will be dropped from testing. Enter hard error limit (1:65535) [65535] ?

Explanation: Enter a value to specify the hard error limit for all units to test. This question is used to obtain the hard error limit for *all* units under test. If the hard error limit is reached, TILX discontinues testing the unit that reaches the hard error limit. If other units are currently being tested by TILX, testing continues for those units.

When the soft error limit is reached, soft errors will no longer be displayed
but testing will continue for the unit. Enter soft error limit (1:65535) [32] ?

Explanation: Enter a value to specify the soft error limit for all units under test. If the soft error limit is reached for a unit under test, soft error reporting is disabled for that unit only. However, testing continues for that unit.

Enter IO queue depth (1:20) [4] ?

Explanation: Enter the maximum number of outstanding I/Os for each unit selected for testing. The default is 4.

Enter unit number to be tested ?

Explanation: Enter the unit number for the (tape drive) unit to be tested.

Note

When TILX asks for the unit number, it requires the actual number of the tape, where T177 would be specified as unit number 177.

Is a tape loaded and ready, answer Yes when ready ?

Explanation: This question is self explanatory.

Select another unit (y/n) [n] ?

Explanation: Enter "Y" to select another unit to test. Enter "N" to begin testing the units selected. The system will display the following test selections:

```
*** Available tests are:
    1.  Basic Function
    2.  User Defined Test
    3.  Read Only

Use the Basic Function test 99.9% of the time. The User-Defined test
is for special problems only.
```

Enter test number (1:3) [1] ?

Explanation: This question allows you to pick which TILX test you want to run on all selected units. The following questions define the TILX tests.

Enter data pattern number 0=all, 19=user_defined, (0:19) [0] ?

Explanation: The TILX data patterns are used in write commands. This question is displayed for the Basic Function and User-Defined tests. There are 18 unique data patterns from which to select. These patterns were carefully selected as worst case or most likely to produce errors for tapes connected to the controller. (See Table 6–5 for a list of the data patterns.) The default uses all 18 patterns in a random method. This question also allows you to create a unique data pattern of your choice.

Enter record count (1:4294967295) [4096] ?

Explanation: Enter the number of records to write to the tape.

Note

The record count does not include tape marks that are intermixed with the records written to the tape in the Basic Function test.

Enter the 8-digit hexadecimal user defined data pattern [ ] ?

Explanation: This question is only displayed if you choose to use a User-Defined data pattern for write commands. The data pattern is represented in a longword and can be specified with eight hexadecimal digits.

Perform data compare (y/n) [n] ?

Explanation: Enter “Y” to enable the compare modifier bit with the read and write commands. This question only applies to the Basic Function test. If the compare modifier is set on write commands, the data are written to the tape. The data are then read from the tape and compared against the corresponding TILX buffers. On read commands, the data are read from the tape into the TILX buffers, read again, and then compared against the corresponding TILX buffers. If a discrepancy is found, an error is reported. Enter “N” and the compare modifier bit is disabled. The default is to have the bit disabled.

Enter compare percentage (1:100) [2] ?

Explanation: This question is displayed only if you choose to perform data compares. It allows you to enter the percentage of read and write commands that will have a data compare operation performed.

Enter command number *x* (red, wrt, rew, wtm, rpr, rpf, quit) [ ] ?

Explanation: This question only applies to the User-Defined test. It allows you to define command *x* as a read, write, rewind, write tape mark, reposition records, or reposition file marks. Enter quit to finish defining the test.

Reposition towards EOT (y=EOT/n=BOT) [y] ?

Explanation: If you specify the reposition records or reposition file marks command in the User-Defined test, this question is displayed. Enter the direction of the reposition operation you want, either towards the end of tape (EOT) or at the beginning of tape (BOT).

Enter number of records to reposition (1:255) [1] ?

Explanation: If you specify the reposition records command in the User-Defined test, this question is displayed. The question is self explanatory.

Enter number of tape marks to reposition (1:255) [1] ?

Explanation: If you specify the reposition file marks command in the User-Defined test, this question is displayed. The question is self explanatory.

Enter IO size in bytes (1,65535) [ ] ?

Explanation: This question is only asked in the User-Defined test for read or write commands. The question is self explanatory.

Enter in HEX, the TMSCP Command Modifiers [0] ?

Explanation: This question only applies to the User-Defined test. It allows you to specify the TMSCP command modifiers. You **must** understand the meaning of the TMSCP command modifiers before entering any value other than the default. Contact Digital Multivendor Services if you wish to use other than default values.

Reuse Parameters (stop, continue, restart, change_unit) [stop] ?

Explanation: This question is displayed after the TILX execution time limit expires after the hard error limit is reached for every unit under test, or after you enter Ctrl/C. The options are as follow:

- **Stop**—TILX terminates normally.
- **Continue**—TILX resumes execution without resetting the remaining TILX execution time or any performance statistics. If the TILX execution time limit has expired, or all units have reached their hard error limit, TILX terminates.
- **Restart**—TILX resets all performance statistics and restarts execution so that the test will perform exactly as the test that just completed.
- **Change_unit**—If you select this option, TILX allows you to drop a unit from testing and add a unit to testing. For each unit dropped, another unit must be added until all units in the configuration have been tested. The unit chosen will be tested with the same parameters chosen for the unit that was dropped from testing. When you have completed adding and dropping units, all performance statistics are initialized and TILX execution resumes with the same parameters as the last run.

Drop unit #*x* (y/n) [n] ?

Explanation: This question is displayed if you choose to change a unit as an answer to the "reuse parameters" question. It is asked for every unit that was tested. After entering "Y", you are prompted for the unit number. Enter the unit number to drop from testing. Enter "N" if you do not wish to drop a unit from testing.

Note

For each unit dropped from testing, one must be added.

6.3.5 TILX Output Messages

The following message is displayed when TILX is started:

```
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Tape Inline Exerciser - version 1.4
```

This message identifies the internal program as TILX and gives the TILX software version number.

TILX - Normal Termination.

Explanation: This message is displayed when TILX terminates under normal conditions.

Insufficient resources.

Explanation: Following this line is a second line that gives more information about the problem, which could be one of the following messages:

- Unable to allocate memory.

  TILX was unable to allocate the memory needed to perform TILX tests. You should run TILX again but choose a lower queue depth and/or choose fewer units to test.

- Cannot perform tests.

  TILX was unable to allocate all of the resources needed to perform TILX tests. You should run TILX again but choose a lower queue depth and/or choose fewer units to test.

- Unable to change operation mode to maintenance.

  TILX tried to change the operation mode from normal to maintenance using the SYSAP$CHANGE_STATE( ) routine, but was not successful due to insufficient resources. This problem should not occur. If it does occur, submit an error report. Then reset the controller.

Tape unit *x* does not exist.

Explanation: An attempt was made to allocate a unit for testing that does not exist on the controller.

Unit *x* successfully allocated for testing.

Explanation: All processes that TILX performs to allocate a unit for testing have been completed. The unit is ready for TILX testing.

Unable to allocate unit.

Explanation: This message should be preceded by a reason why the unit could not be allocated for TILX testing.

Cannot enable eip notification.

Explanation: This message indicates that TILX was not successful in enabling EIP notification. This should only occur if another copy of TILX is running. Wait for the first copy to finish or terminate the second copy. If there are no copies of TILX running, submit a CLD (error report) and restart the controller.

TILX detected error, code *x*.

Explanation: The "normal" way TILX recognizes an error on a unit is through the reception of an EIP, which loosely corresponds to an error log. However, there are some errors that TILX will detect without the reception of an EIP. These errors are as follow:

- Illegal Data Pattern Number found in data pattern header. Unit x.

  This is code 1. TILX read data from the tape unit and found that the data were not in a pattern that TILX previously wrote to the tape.

- No write buffers correspond to data pattern. Unit x.

  This is code 2. TILX read a legal data pattern from the tape at a place where TILX wrote to the tape, but TILX does not have any write buffers that correspond to the data pattern. Thus, the data have been corrupted.

- Read data do not match what TILX thought was written to the media.

  This is code 3. TILX writes data to the tape and then reads it and compares it against what TILX thought it wrote to the tape. This indicates a compare failure. More information is displayed to indicate where in the data buffer the compare failed, and what the data were and should have been.

- TILX/Tape record size mismatch.

  This is code 4. This error would only be detected on a read pass. Because TILX knows what was written to the tape, TILX expects to encounter the records (of different sizes), tape marks, and the EOT in exactly the same positions as previously written. This error most likely means that the tape unit has a positioning problem.

- A tape mark was detected in a place not expected by TILX.

  This is code 5. This error would only be detected on a read pass. Because TILX knows what was written to the tape, TILX expects to encounter the records, tape marks, and the EOT in exactly the same positions as previously written. This error most likely means that the tape unit has a positioning problem.

- Record Data Truncated not generated.

  This is code 6. This error would only be detected on a read pass. Occasionally, TILX issues a read with a byte count less than what TILX knows was written to the current tape record. Thus, TILX would expect to receive a Record Data Truncated status. If TILX does not receive the Record Data Truncated status when expected, this TILX detected error is reported.

- EOT encountered in unexpected position.

  This is code 7. This error would only be detected on a read pass. Because TILX knows what was written to the tape, TILX expects to encounter the records, tape marks, and the EOT in exactly the same positions as previously written. This error most likely means that the tape unit has a positioning problem.

TILX terminated. A termination, a print summary or a reuse parameters request was received but TILX is currently not testing any units.

Explanation: A Ctrl/Y (termination request), Ctrl/G (print summary request), or a Ctrl/C (reuse parameters request) was entered before TILX started to test units. TILX cannot satisfy the second two requests, so TILX treats all of these requests as a termination request.

TILX will not change the state of a unit if it is not NORMAL.

Explanation: TILX cannot allocate the unit for testing because it is already in Maintenance mode. (Maintenance mode can only be invoked by the firmware. If another TILX session is in use, the unit is considered in Maintenance mode.)

Unit is not available - if you dismount the unit from the host, it may correct this problem.

Explanation: The unit has been placed on line by another user (or host) or the media is not present.

Soft error reporting disabled. Unit *x*.

Explanation: This message indicates that the soft error limit has been reached and that no more soft errors will be printed for this unit.

Hard error limit reached, unit *x* dropped from testing.

Explanation: This message indicates that the hard error limit has been reached and the unit must be dropped from testing.

Soft error reporting disabled for controller errors.

Explanation: This indicates that the soft error limit has been reached for controller errors. Controller soft error reporting is disabled.

Hard error limit reached for controller errors.
All units dropped from testing.

Explanation: This message is self explanatory.

Unit is already allocated for testing.

Explanation: This message is self explanatory.

No drives selected.

Explanation: TILX parameter collection was exited without choosing any units to test.

Maximum number of units are now configured.

Explanation: This message is self explanatory. (Testing will start after this message is displayed.)

Unit is write protected.

Explanation: The user wants to test a unit with write and/or erase commands enabled but the unit is write protected.

The unit status and/or the unit device type has changed unexpectedly.
Unit *x* dropped from testing.

Explanation: The unit status may change if the unit experienced hard errors or if the unit is disconnected. Either way, TILX cannot continue testing the unit.

Last Failure Information follows. This error, was NOT produced by running TILX. It represents the reason why the controller crashed on the previous controller run.

Explanation: This message may be displayed while allocating a unit for testing. It does not indicate any reason why the unit is or is not successfully allocated, but rather represents the reason why the controller went down in the previous run. The information that follows this message is the contents of an EIP.

Tape unit numbers on this controller include:

Explanation: After this message is displayed, a list of tape unit numbers on the controller is displayed.

IO to unit *x* has timed out. TILX aborting.

Explanation: One of the TILX I/Os to this unit did not complete within the command timeout interval and when examined, was found not progressing. This indicates a failing controller.

TILX terminated prematurely by user request.

Explanation: A Ctrl/Y was entered. TILX interprets this as a request to terminate. This message is then displayed and TILX terminates.

Unit is owned by another sysap.

Explanation: TILX could not allocate the unit specified because the unit is currently allocated by another system application. Terminate the other system application or reset the controller.

Exclusive access is declared for this unit.

Explanation: The unit could not be allocated for testing because exclusive access has been declared for the unit.

The other controller has exclusive access declared for this unit.

Explanation: This message is self explanatory.

This unit is marked inoperative.

Explanation: The unit could not be allocated for testing because the controller internal tables have the unit marked as inoperative.

The unit does not have any media present.

Explanation: The unit could not be allocated for testing because no media is present.

The RUNSTOP_SWITCH is set to RUN_DISABLED.

Explanation: The unit could not be allocated for testing because the RUNSTOP_SWITCH is set to RUN_DISABLED. This is enabled and disabled through the Command Line Interpreter (CLI).

Unable to continue, run time expired.

Explanation: A continue response was given to the “reuse parameters” question. This is not a valid response if the run time has expired. Reinvoke TILX.

When TILX starts to exercise the tape units, the following is displayed with the current time of day:

```
TILX testing started at: xx:xx:xx
    Test will run for x minutes
    Type ^T(if running TILX through a VCS) or ^G(in all other cases)
      to get a current performance summary
    Type ^C to terminate the TILX test prematurely
    Type ^Y to terminate TILX prematurely
```

6.3.6 TILX End Message Display

The Value Added Status field corresponds to the TMSCP end message status. Example 6–10 is an example of a TILX end message display.

Example 6–10 TILX End Message Display

```
Bad Value Added Completion Status for unit x, End message in hex

      Event Code                  x
      Op Code                     x
      Cmd Ref Number              x
      End Flags                   x
      Host Xfer Byte Count        x
      Tape Rec Byte Count         x
      Tape Position               x
      Sequence Number             x
```

6.3.7 TILX Error Information Packet Displays

Contact Digital Multivendor Services for assistance in deciphering the EIP fields.

A TILX EIP display may or may not include a hex dump of the Requestor Specific Data. This is an option you can select for TILX selectable parameters.

The EIP will be in one of the following formats that corresponds to MSCP error log formats:

- Controller Error
- Memory Error
- Tape Error

Examples 6–11 through 6–13 are samples of each display. Each display includes the optional requestor specific information. In all cases, the Instance code, template type, and all requestor specific information correspond to event (error) log device dependent parameters, while everything else has a one-to-one correspondence to error log fields. See Appendices C and D for a translation of these codes.

Example 6–11 Controller Error

```
Error Information Packet in hex

      Cmd Ref Number      x
      Unit Number         x
      Log Sequence        x
      Format              x
      Flags               x
      Event Code          x
      Controller ID       x
      Controller SW ver   x
      Controller HW ver   x
      Multi Unit Code     x
      Instance                   x
      Template Type              x
      Requestor Information Size x
      Requestor Specific Data bytes 0 7   xx xx xx xx xx xx xx xx
      Requestor Specific Data bytes 8 15   xx xx xx xx xx xx xx xx
        :
        :
      Requestor Specific Data bytes xx xx   xx xx xx xx xx xx xx xx
```

Example 6–12 Memory Error

```
Error Information Packet in hex

      Cmd Ref Number      x
      Unit Number         x
      Log Sequence        x
      Format              x
      Flags               x
      Event Code          x
      Controller ID       x
      Controller SW ver   x
      Controller HW ver   x
      Multi Unit Code     x
      Memory Address      x
      Instance                   x
      Template Type              x
      Requestor Information Size x
      Requestor Specific Data bytes 0 7   xx xx xx xx xx xx xx xx
      Requestor Specific Data bytes 8 15   xx xx xx xx xx xx xx xx
        :
        :
      Requestor Specific Data bytes xx xx   xx xx xx xx xx xx xx xx
```

Example 6–13 Tape Error

```
Error Information Packet in hex

      Cmd Ref Number      x
      Unit Number         x
      Log Sequence        x
      Format              x
      Flags               x
      Event Code          x
      Controller ID       x
      Controller SW ver   x
      Controller HW ver   x
      Multi Unit Code     x
      Unit ID[0]          x
      Unit ID[1]          x
      Unit Software Rev   x
      Unit Hardware Rev   x
      Recovery Level      x
      Retry Count         x
      Position            x
      Formatter SW version x
      Formatter HW version x
      Instance                   x
      Template Type              x
      Requestor Information Size  x
      Requestor Specific Data bytes 0 7   xx xx xx xx xx xx xx xx
      Requestor Specific Data bytes 8 15   xx xx xx xx xx xx xx xx
        :
        :
      Requestor Specific Data bytes xx xx   xx xx xx xx xx xx xx xx
```

6.3.8 TILX Data Patterns

Table 6–5 defines the data patterns used with the TILX Basic Function or User-Defined tests. There are 18 unique data patterns. These data patterns were selected as worst case, or the ones most likely to produce errors on tapes connected to the controller.

Table 6–5 TILX Data Pattern Definitions

Pattern Number	Pattern in hex
1	0000
2	8B8B
3	3333
4	3091
5, shifting 1s	0001, 0003, 0007, 000F, 001F, 003F, 007F, 00FF, 01FF, 03FF, 07FF, 0FFF, 1FFF, 3FFF, 7FFF
6, shifting 0s	FIE, FFFC, FFFC, FFFC, FFE0, FFE0, FFE0, FFE0, FE00, FC00, F800, F000, E000, C000, 8000, 0000
7, alternating 1s, 0s	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, ripple 1	0001, 0002, 0004, 0008, 0010, 0020, 0040, 0080, 0100, 0200, 0400, 0800, 1000, 2000, 4000, 8000
14, ripple 0	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
Default–Use all of the above patterns in a random method	

6.3.9 TILX Examples

This sections provides some TILX examples with different options chosen.

6.3.9.1 TILX Example—Using All Defaults

In Example 6–14, TILX is run using all defaults. This is a semi-extensive test even though the test only runs for 10 minutes. The only function not performed is data compares. Data compares are a time consuming operation with tapes. TILX is invoked from a maintenance terminal.

CAUTION

TILX should only be run using scratch tapes. This test will write to the tape and destroy any data that exist on the tape.

Example 6–14 Using All Defaults—TILX

```
HSJ> show tape
Name          Type          Port Targ  LUN                  Used by
------------------------------------------------------------------------------

TAPE500       tape             5    0    0                  T50
TAPE520       tape             5    2    0                  T52

HSJ> run tilx

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Use all defaults (y/n) [y] ?
Tape unit numbers on this controller include:
    50
    52
Enter unit number to be tested ?50
Is a tape loaded and ready, answer Yes when ready ?y
Unit 50 successfully allocated for testing
Select another unit (y/n) [n] ?y
Enter unit number to be tested ?52
Is a tape loaded and ready, answer Yes when ready ?y
Unit 52 successfully allocated for testing
Maximum number of units are now configured

   TILX testing started at: 13-JAN-1993 04:35:08
    Test will run for 10 minutes
    Type ^T(if running TILX through VCS) or ^G(in all other cases)
      to get a current performance summary
    Type ^C to terminate the TILX test prematurely
    Type ^Y to terminate TILX prematurely

   TILX Summary at 13-JAN-1993 04:36:24
   Test minutes remaining: 9, expired: 1

Unit 50   Total IO Requests 868
  No errors detected
Unit 52   Total IO Requests 860
  No errors detected
Reuse Parameters (stop, continue, restart, change_unit) [stop] ?

TILX - Normal Termination
HSJ>
```

6.3.9.2 TILX Example—Using All Functions

In Example 6–15, TILX is run using all functions and using a longer run time and higher record count than the default. The performance statistics and a performance summary are displayed every 15 minutes. TILX is invoked from a maintenance terminal. This is an extensive test.

Example 6–15 Using All Functions—TILX

```
HSJ> run tilx

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Tape Inline Exerciser - version 1.4
Enter TILX hex debug flags (0:ffff) [0] ?
```

(continued on next page)

Example 6–15 (Cont.) Using All Functions—TILX

```
Use all defaults (y/n) [y] ?n
Enter execution time limit in minutes (10:65535) [10] ?
Enter performance summary interval in minutes (1:65535) [10] ?
Include performance statistics in performance summary (y/n) [n] ?y
Display hard/soft errors (y/n) [n] ?y
Display hex dump of Error Information Packet requester specific
information (y/n) [n] ?y
When the hard error limit is reached, the unit will be dropped from testing.
Enter hard error limit (1:65535) [32] ?
When the soft error limit is reached, soft errors will no longer be
displayed but testing will continue for the unit.
Enter soft error limit (1:65535) [32] ?
Enter IO queue depth (1:20) [4] ?6
Suppress caching (y,n) [n] ?
  *** Available tests are:
    1. Basic Function
    2. User Defined
    3. Read Only

Use the Basic Function test 99.9% of the time. The User Defined test
is for special problems only.
Enter test number (1:3) [1] ?1
Enter data pattern number 0=ALL, 19=USER_DEFINED, (0:19) [0] ?
Enter record count (1:4294967295) [4096] ?1000
Perform data compare (y/n) [n] ?y
Enter compare percentage (1:100) [2] ?1
Tape unit numbers on this controller include:
    50
    52
Enter unit number to be tested ?50
Is a tape loaded and ready, answer Yes when ready ?y
Unit 50 successfully allocated for testing
Select another unit (y/n) [n] ?y
Enter unit number to be tested ?52
Is a tape loaded and ready, answer Yes when ready ?y
Unit 52 successfully allocated for testing
Maximum number of units are now configured

   TILX testing started at: 13-JAN-1993 04:38:15
    Test will run for 10 minutes
    Type ^T(if running TILX through VCS) or ^G(in all other cases)
      to get a current performance summary
    Type ^C to terminate the TILX test prematurely
    Type ^Y to terminate TILX prematurely

   TILX Summary at 13-JAN-1993 04:40:14
   Test minutes remaining: 9, expired: 1

Unit 50   Total IO Requests 724
  Read Count 3   Write Count 681   Reposition Count 3
  Total KB xfer 6718   Read 10   Write 6707
  No errors detected
Unit 52   Total IO Requests 731
  Read Count 3   Write Count 687   Reposition Count 3
  Total KB xfer 6743   Read 10   Write 6733
  No errors detected
Reuse Parameters (stop, continue, restart, change_unit) [stop] ?

TILX - Normal Termination
HSJ>
```

6.3.10 Interpreting the TILX Performance Summaries

A TILX performance display is produced under the following conditions:

- When the user-selectable performance summary interval elapses
- When TILX terminates for any conditions except an abort
- When Ctrl/G is entered (or Ctrl/T when running from a VCS)

The performance display has different formats depending on whether or not performance statistics were requested in the user-specified parameters and if errors were detected.

The following is an example of a TILX performance display where performance statistics were not selected and where no errors were detected:

```
   TILX Summary at 18-JUN-1993 06:18:41
   Test minutes remaining: 0, expired: 6

Unit 1     Total IO Requests 482
  No errors detected
Unit 2     Total IO Requests 490
  No errors detected
```

The following is an example of a TILX performance display where performance statistics were selected and no errors were detected:

```
   TILX Summary at 18-JUN-1993 06:18:41
   Test minutes remaining: 0, expired: 6

Unit 1     Total IO Requests 482
  Read Count   292   Write Count 168
  Access Count 21   Erase Count 0
  KB xfer   Read 7223   Write 4981   Total 12204
  No errors detected
```

The following is an example of a TILX performance display where errors were detected:

```
     TILX Summary at 18-JUN-1993 06:18:41
     Test minutes remaining: 0, expired: 6

❶ Unit 10     Total IO Requests 153259
    No errors detected
❷ Unit 40     Total IO Requests 2161368
    Err in Hex: IC:031A4002  PTL:04/00/00  Key:04  ASC/Q:B0/00  HC:0  SC:1
    Total Errs   Hard Cnt 0   Soft Cnt 1
❸ Unit 55     Total IO Requests 2017193
    Err in Hex: IC:03094002  PTL:05/05/00  Key:01  ASC/Q:18/89  HC:0  SC:1
    Err in Hex: IC:03094002  PTL:05/05/00  Key:01  ASC/Q:18/86  HC:0  SC:1
    Total Errs   Hard Cnt 0   Soft Cnt 2
```

where:

❶ Represents the unit number and the total I/O requests to this unit.

❷ Represents the unit number and total I/O requests to this unit.

All values for the following codes are described in Appendices C and D. This also includes the items associated with this error and the total number of hard and soft errors for this unit:

- The HSJ-/HSD-series Instance code (in hex)
- The Port Target LUN (PTL)

- The SCSI Sense (Key)
- The SCSI ASC and ASQ (ASC/Q) codes
- The hard and soft count for this error

❸ Represents information about the first two unique errors for this unit.

All values for the following codes are described in Appendices C and D. This also includes the items associated with this error and the total number of hard and soft errors for this unit:

- The HSJ-/HSD-series Instance code (in hex)
- The Port Target LUN (PTL)
- The SCSI Sense (Key)
- The SCSI ASC and ASQ (ASC/Q) codes
- The hard and soft count for this error

A line of this format may be displayed up to three times in a performance summary. There would be a line for each unique error reported to TILX for this unit, up to three errors.

The following is an example of a TILX performance display where performance statistics were not selected and where a controller error error was detected:

```
   TILX Summary at 18-JUN-1993 06:18:41
   Test minutes remaining: 0, expired: 6

Cnt err in HEX  IC:07080064  Key:06  ASC/Q:A0/05  HC:1  SC:0
  Total Cntrl Errs   Hard Cnt 1   Soft Cnt 0

Unit 1     Serial Number 1   Total IO Requests 482
  No errors detected
Unit 2     Serial Number 2   Total IO Requests 490
  No errors detected
```

The performance displays contain error information on up to three unique errors. It should be noted that hard errors always have precedence over soft errors. A soft error represented in one display may be replaced with information on a hard error in subsequent performance displays.

6.3.11 TILX Abort Codes

Table 6–6 list TILX abort codes and definitions.

Table 6–6 TILX Abort Codes and Definitions

Value	Definition
1	An IO has timed out.
2	A HTB was not available to issue an IO when it should have been.
3	FAO returned either FAO_BAD_FORMAT or FAO_OVERFLOW.
4	TS$SEND_TERMINAL_DATA returned either an ABORTED or INVALID_BYTE_COUNT.
5	TS$READ_TERMINAL_DATA returned either an ABORTED or INVALID_BYTE_COUNT.
6	A timer is in an unexpected expired state that prevents it from being started.
7	The semaphore was set after a oneshot IO was issued but nothing was found in the received HTB que.
8	A termination or a print summary or a reuse parameters request was received when TILX was not testing any units.
9	User requested abort via control Y.

6.3.12 TILX Error Codes

Table 6–7 lists TILX defined error codes and definitions for TILX-detected errors.

Table 6–7 TILX Abort Codes and Definitions

Value	Definition
1	Illegal Data Pattern Number found in data pattern header.
2	No write buffers correspond to data pattern.
3	Read data do not match write buffer.
4	TILX/TAPE record size mismatch.
5	A tape mark was detected in a place where it was not expected.
7	EOT encountered in unexpected position.

6.4 Disk Inline Exerciser (HSZ-Series Controllers)

Note

The information on DILX for the HSZ-series controllers is presented separately because the messages and performance summaries differ from those of the HSJ- and HSD-series controllers.

DILX is a diagnostic tool used to exercise the data transfer capabilities of selected disks connected to an HSZ-series controller. DILX exercises disks in a way that simulates a high level of user activity. Using DILX, you can read and write to all customer-available data areas. DILX can also be run on CDROMs, but must be run in *read-only* mode only. Thus, DILX can be used to determine the health of a controller and the disks connected to it and to acquire performance statistics. You can run DILX from a maintenance terminal.

DILX now allows for auto-configuring of drives. This allows for quick configuring and testing of all units at once. Please be aware that *customer data will be lost* by running this test. Digital recommends only using the Auto-Configure option during initial installations.

DILX tests logical units that may consist of storage sets of multiple physical devices. Error reports identify the logical units, not the physical devices. Therefore, if errors occur while running against a unit, its storage set should be reconfigured as individual devices, and then DILX run again, against the individual devices.

There are no limitations on the number of units DILX may test at one time. However, Digital recommends only using DILX when no host activity is present. If you must run DILX during a live host connection, you should limit your testing to no more than half of any controller's units at one time. This conserves controller resources and minimizes performance degradation on the live units you are not testing.

6.4.1 Invoking DILX

To invoke DILX from a maintenance terminal, enter the following command at the CLI> prompt:

```
CLI> RUN DILX
```

6.4.2 Interrupting DILX Execution

Use the following guidelines to interrupt DILX execution.

Note

The symbol "^" is equivalent to the Ctrl key. You must press and hold the Ctrl key and type the character key given.

- Ctrl/G or Ctrl/T causes DILX to produce a performance summary. DILX continues normal execution without affecting the runtime parameters.
- Ctrl/C causes DILX to produce a performance summary, stop testing, and ask the "reuse parameters" question.
- Ctrl/Y causes DILX to abort. The "reuse parameters" question is not asked.

6.4.3 DILX Tests

There are two DILX tests, as follow:

- The Basic Function test
- The User-Defined test

6.4.3.1 Basic Function Test—DILX

The Basic Function test for DILX executes in two or three phases. The three phases are as follow:

- **Initial Write Pass**—Is the only optional phase and is always executed first (if selected). The initial write pass writes the selected data patterns to the entire specified data space or until the DILX execution time limit has been reached. Once the initial write pass has completed, it is not re-executed no matter how long the DILX execution time is set. The other phases are re-executed on a 10-minute cycle.

- **Random I/O**—Simulates typical I/O activity with random transfers from one byte to the maximum size I/O possible with the memory constraints DILX runs under. Note that the length of all I/Os is in bytes and is evenly divisible by the sector size (512 bytes).

  Read and write (if enabled) commands are issued using random logical block numbers (LBNs). In the read/write mode, DILX issues the reads and writes in the ratio specified previously under read/write ratio. When read-only mode is chosen, only read commands are issued.

  If compares are enabled, compares are performed on read commands using DILX internal checks. The percentage of compares to perform can be specified. This phase is executed 80 percent of the time. It is the first phase executed after the initial write pass has completed. It is re-executed at 10-minute intervals with each cycle lasting approximately 8 minutes.

  Intervals are broken down into different cycles. The interval is repeated until the user-selected time interval expires.

  ```
  <-------------------------------10 min---------------------------------->
  <-----------------8 min Random I/O---------------><--2 min Data Inten--->
  ```

- **Data Intensive**—Designed to test disk throughput by selecting a starting LBN and repeating transfers to the next sequential LBN that has not been accessed by the previous I/O. The transfer size of each I/O equals the maximum sized I/O that is possible with the memory constraints DILX must run under. This phase continues performing spiraling I/O to sequential tracks. Read and write commands are issued in read/write mode. This phase is executed 20 percent of the time after the initial write pass has completed. This phase always executes after the random I/O phase. It is re-executed at 10-minute intervals with each cycle approximately 2 minutes.

6.4.3.2 User-Defined Test—DILX

CAUTION

The User-Defined test should be run *only* by very knowledgeable personnel. Otherwise, customer data can be destroyed.

When this test is selected, DILX prompts you for input to define a specific test. In the DILX User-Defined test, a total of 20 or fewer I/O commands can be defined. Once all of the commands are issued, DILX issues the commands again in the same sequence. This is repeated until the selected time limit is reached. As you build the test, DILX collects the following information from you for each command:

- The I/O command name (write, read, or quit). Quit is not a command; instead it indicates to DILX that you have finished defining the test.
- The starting logical block number (LBN).
- The size of the I/O in 512 byte blocks.

6.4.4 DILX Test Definition Questions

The following text is displayed when running DILX. The text includes questions that are listed in the approximate order that they are displayed on your terminal. These questions prompt you to define the runtime parameters for DILX.

Note

Defaults for each question are given inside [ ]. If you press the Return key as a response to a question, the default is used as the response.

After DILX has been started, the following message and prompt is displayed:

```
It is recommended that DILX only be run when there is no host activity
present on the HSZ-series controller. Do you want to continue (y/n) [n] ?
```

The following message describing the Auto-Configure option is displayed:

```
The Auto-Configure option will automatically select, for testing,
all of the disk units configured. It will perform a very thorough
test  with *WRITES* enabled. The user will only be able to select the
run time and performance summary options. The user will not be able
to specify specific units to test. The Auto-Configure option is only
recommended for initial installations. It is the first question asked.
```

Do you wish to perform an Auto-Configure (y/n) [n] ?

Explanation: Enter “Y” if you wish to invoke the Auto-Configure option.

After the Auto-Configure option is selected, DILX will display the following caution statement:

```
 **CAUTION**
All data on the Auto-Configured disks will be destroyed. You *MUST* be sure
of yourself.
```

Are you sure you want to continue (y/n) [n] ?

Explanation: This question is self explanatory.

Use All Defaults and Run in Read Only Mode (y/n)[y]?

Explanation: Enter “Y” to use the defaults for DILX, run in read-only mode, and most of the other DILX questions are not asked. Enter “N” and the defaults are not used. You must then answer each question as it is displayed. The following defaults are assumed for all units selected for testing:

- Execution time limit = 10 minutes.
- Performance summary interval = 10 minutes.
- Displaying sense data for hard or soft errors is disabled.
- The hard error limit = 65535. Testing will stop if the limit is reached.
- The I/O queue depth = 4. A maximum of 4 I/Os will be outstanding at any time.
- The Selected Test = the Basic Function test.
- Read-only mode.
- All user available LBNs are available for testing.

- Data compares are disabled.

Enter the execution time limit in minutes (1:65535)[10]?

Explanation: Enter the desired time you want DILX to run. The default run time is 10 minutes.

Enter performance summary interval in minutes (1:65535)[10]?

Explanation: Enter a value to set the interval for which a performance summary is displayed. The default is 10 minutes.

Include performance statistics in performance summary (y/n)[n]?

Explanation: Enter "Y" to see a performance summary that includes the performance statistics that include the total count of read and write I/O requests and the kilobytes transferred for each command type. Enter "N" and no performance statistics are displayed.

Display hard/soft errors (y/n)[n]?

Explanation: Enter "Y" to enable displays of sense data and deferred errors. Enter "N" to disable error reporting. The default is disabled error reporting.

When the hard error limit is reached, the unit will be dropped from testing.
Enter hard error limit (1:65535) [65535] ?

Explanation: Enter a value to specify the hard error limit for all units to test. This question is used to obtain the hard error limit for *all* units under test. If the hard error limit is reached, DILX discontinues testing the unit that reaches the hard error limit. If other units are currently being tested by DILX, testing continues for those units.

When the soft error limit is reached, soft errors will no longer be displayed
but testing will continue for the unit. Enter soft error limit (1:65535) [32] ?

Explanation: Enter a value to specify the soft error limit for *all* units under test. When the soft error limit is reached, soft errors are no longer displayed, but testing continues for the unit.

Enter IO queue depth (1:12) [4]?

Explanation: Enter the maximum number of outstanding I/Os for each unit selected for testing. The default is 4.

Enter unit number to be tested?

Explanation: Enter the unit number for the unit to be tested.

Note

When DILX asks for the unit number, it requires the number designator for the disk, where D117 would be specified as unit number 117.

Unit *x* will be write enabled.
Do you still wish to add this unit (y/n) [n]?

Explanation: This is a reminder of the consequences of testing a unit while it is write enabled. This is the last chance to back out of testing the displayed unit. Enter "Y" to write enable the unit. Enter "N" to back out of testing that unit.

Select another unit (y/n) [n]?

Explanation: Enter “Y” to select another unit for testing. Enter “N” to begin testing the units already selected. The system will display the following test selections:

```
***Available tests are:
1.   Basic Function
2.   User Defined Test

Use the Basic Function 99.9% of the time.  The User Defined
test is for special problems only.
```

Enter test number (1:2) [1]?

Explanation: Enter “1” for the Basic Function test or “2” for the User-Defined test. After selecting a test, the system will then display the following messages:

```
In the User-Defined test, you may define up to 20 commands.  They will be
executed in the order entered.  The commands will be repeated until the
execution time limit expires.

** CAUTION **
If you define write commands, user data will be destroyed.
```

Enter command number x (read, write, quit) [ ]?

Explanation: This question only applies to the User-Defined test. It allows you to define command *x* as a read or write command. Enter quit to finish defining the test.

After making your command selection(s), the following message is displayed by DILX:

```
* IMPORTANT *  If you answer yes to the next question, user data
WILL BE destroyed.
```

Write enable disk unit (y/n) [n] ?

Explanation: Enter “Y” to write enable the unit. Write commands are enabled for the currently selected test. Data within your selected LBN range will be destroyed. *Be sure of your actions before answering this question.* This question applies to all DILX tests. Enter “N” to enable read only mode, where read and access commands are the only commands enabled.

Perform initial write (y/n) [n] ?

Explanation: Enter “Y” to write to the entire user-selected LBN range with the user-selected data patterns. Enter “N” for no initial write pass.

If you respond with “Y”, the system performs writes starting at the lowest user-selected LBN and issues spiral I/Os with the largest byte count possible. This continues until the specified LBN range has been completely written. Upon completion of the initial write pass, normal functions of the Random I/O phase start. The advantage of selecting the initial write pass is that compare host data commands can then be issued and the data previously written to the media can be verified for accuracy. It makes sure that all LBNs within the selected range are accessed by DILX.

The disadvantage of using the initial write pass is that it may take a long time to complete because a large LBN range was specified. You can bypass this by selecting a smaller LBN range, but this creates another disadvantage in that the entire disk space is not tested. The initial write pass only applies to the Basic Function test.

The write percentage will be set automatically.
Enter read percentage for random IO and data intensive phase (0:100) [67] ?

Explanation: This question is displayed if read/write mode is selected. It allows you to select the read/write ratio to use in the Random I/O and Data Intensive phases. The default read/write ratio is similar to the I/O ratio generated by a typical OpenVMS system.

Enter data pattern number 0=all, 19=user_defined, (0:19) [0] ?

Explanation: The DILX data patterns are used in write commands. This question is displayed when writes are enabled for the Basic Function or User-Defined tests. There are 18 unique data patterns to select from. These patterns were carefully selected as worst case or most likely to produce errors for disks connected to the controller. (See Section 6.4.8 for a list of data patterns.) The default uses all 18 patterns in a random method. This question also allows you to create a unique data pattern of your own choice.

Enter the 8-digit hexadecimal user defined data pattern [ ] ?

Explanation: This question is only displayed if you choose to use a User-Defined data pattern for write commands. The data pattern is represented in a longword and can be specified with eight hexadecimal digits.

Enter start block number (0:highest_lbn_on_the_disk) [0] ?

Explanation: Enter the starting block number of the area on the disk you wish DILX to test. Zero is the default.

Enter end block number (starting_lbn:highest_lbn_on_the_disk)
[highest_lbn_on_the_disk] ?

Explanation: Enter the highest block number of the area on the disk you wish DILX to test. The highest block number (of that type of disk) is the default.

Perform data compare (y/n) [n] ?

Explanation: Enter “Y” to enable data compares. Enter “N” and no data compare operations are done.

This question is only asked if you select the initial write option. Data compares are only performed on reads. This option can be used to test data integrity.

Enter compare percentage (1:100) [5] ?

Explanation: This question is displayed only if you choose to perform data compares. This question allows you to change the percentage of read and write commands that will have a data compare operation performed. Enter a value indicating the compare percentage. The default is 5.

Enter command number x (read, write, quit) [ ] ?

Explanation: This question only applies to the User-Defined test. It allows you to define command *x* as a read, write, access, or erase command. Enter quit to finish defining the test.

Enter starting LBN for this command (0:highest_lbn_on_the_disk) [ ] ?

Explanation: This question only applies to the User-Defined test. It allows you to set the starting LBN for the command currently being defined. Enter the starting LBN for this command.

Enter the IO size in 512 byte blocks for this command (1:size_in_blocks) [ ] ?

Explanation: This question only applies to the User-Defined test. It allows you to set the I/O size in 512-byte blocks for the command currently being defined. Enter values indicating the I/O size for this command.

Reuse parameters (stop, continue, restart, change_unit) [stop] ?

Explanation: This question is displayed after the DILX execution time limit expires, after the hard error limit is reached for every unit under test, or after you enter Ctrl/C. These options are as follow:

- **Stop**—DILX terminates normally.
- **Continue**—DILX resumes execution without resetting the remaining DILX execution time or any performance statistics. If the DILX execution time limit has expired, or all units have reached their hard error limit, DILX terminates.
- **Restart**—DILX resets all performance statistics and restarts execution so that the test will perform exactly as the one that just completed. However, there is one exception. If the previous test was the Basic Function test with the initial write pass and the initial write pass completed, the initial write pass is not performed when the test is restarted.
- **Change_unit**—DILX allows you to drop or add units to testing. For each unit dropped, another unit must be added until all units in the configuration have been tested. The unit chosen will be tested with the same parameters that were used for the unit that was dropped from testing. When you have completed dropping and adding units, all performance statistics are initialized and DILX execution resumes with the same parameters as the last run.

Drop unit #x (y/n) [n] ?

Explanation: This question is displayed if you choose to change a unit as an answer to the “reuse parameters” (previous) question. Enter the unit number that you wish to drop from testing.

The new unit will be write enabled. Do you wish to continue (y/n) [n] ?

Explanation: This question is displayed if you choose to change a unit as an answer to the “reuse parameters” question. It is only asked if the unit being dropped was write enabled. This question gives you the chance to terminate DILX testing if you do not want data destroyed on the new unit. Enter “N” to terminate DILX.

6.4.5 DILX Output Messages

The following message is displayed when DILX is started:

```
Copyright © Digital Equipment Corporation 1993
Disk Inline Exerciser - version 1.4
```

This message identifies the internal program as DILX and gives the DILX software version number.

Change Unit is not a legal option if Auto-Configure was chosen.

Explanation: This message will be displayed if the user selected the Auto-Configure option and selected the "change unit response" to the "reuse parameters" question. You cannot drop a unit and add a unit if all units were selected for testing.

DILX - Normal Termination.

Explanation: This message is displayed when DILX terminates under normal conditions.

Insufficient resources.

Explanation: Following this line is a second line that gives more information about the problem, which could be one of the following messages:

- Unable to allocate memory.

  DILX was unable to allocate the memory it needed to perform DILX tests. You should run DILX again but choose a lower queue depth and/or choose fewer units to test.

- Cannot perform tests.

  DILX was unable to allocate all of the resources needed to perform DILX tests. You should run DILX again but choose a lower queue depth and/or choose fewer units to test.

- Unable to change operation mode to maintenance.

  DILX tried to change the operation mode from normal to maintenance using the SYSAP$CHANGE_STATE( ) routine but was not successful due to insufficient resources. This problem should not occur. If it does occur, submit a CLD (error report), then reset the controller.

Disk unit *x* does not exist.

Explanation: An attempt was made to allocate a unit for testing that does not exist on the controller.

Unit *x* successfully allocated for testing.

Explanation: All processes that DILX performs to allocate a unit for testing, have been completed. The unit is ready for DILX testing.

Unable to allocate unit.

Explanation: This message should be preceded by a reason why the unit could not be allocated for DILX testing.

DILX detected error, code *x*.

Explanation: The “normal” way DILX recognizes an error on a unit is through the reception of SCSI sense data. This loosely corresponds to an MSCP error log. However, the following are some errors that DILX will detect using internal checks without SCSI sense data:

- Illegal Data Pattern Number found in data pattern header. Unit *x*

  This is code 1. DILX read data from the disk and found that the data were not in a pattern that DILX previously wrote to the disk.

- No write buffers correspond to data pattern Unit *x*.

  This is code 2. DILX read a legal data pattern from the disk at a place where DILX wrote to the disk, but DILX does not have any write buffers that correspond to the data pattern. Thus, the data have been corrupted.

- Read data do not match what DILX thought was written to the media. Unit *x*.

  This is code 3. DILX writes data to the disk and then reads it and compares it against what was written to the disk. This indicates a compare failure. More information is displayed to indicate where in the data buffer the compare failed and what the data were and should have been.

DILX terminated. A termination, a print summary or a reuse parameters request was received but DILX is currently not testing any units.

Explanation: You entered a Ctrl/Y (termination request), a Ctrl/G (print summary request) or a Ctrl/C (reuse parameters request) before DILX had started to test units. DILX cannot satisfy the second two requests so DILX treats all of these requests as a termination request.

DILX will not change the state of a unit if it is not NORMAL.

Explanation: DILX cannot allocate the unit for testing because it is already in Maintenance mode. (Maintenance mode can only be invoked by the firmware. If another DILX session is in use, the unit is considered in Maintenance mode.)

Unable to bring unit online.

Explanation: This message is self explanatory.

Soft error reporting disabled. Unit *x*.

Explanation: This message indicates that the soft error limit has been reached and therefore no more soft errors will be displayed for this unit.

Hard error limit reached, unit *x* dropped from testing.

Explanation: This message indicates that the hard error limit has been reached and the unit is dropped from testing.

Soft error reporting disabled for controller errors.

Explanation: This indicates that the soft error limit has been reached for controller errors. Thus, controller soft error reporting is disabled.

Hard error limit reached for controller errors. All units dropped from testing.

Explanation: This message is self explanatory.

Unit is already allocated for testing.

Explanation: This message is self explanatory.

No drives selected.

Explanation: DILX parameter collection was exited without choosing any units to test.

Maximum number of units are now configured.

Explanation: This message is self explanatory. (Testing will start after this message is displayed.)

Unit is write protected.

Explanation: The user wants to test a unit with write and/or erase commands enabled but the unit is write protected.

The unit status and/or the unit device type has changed unexpectedly.
Unit x dropped from testing.

Explanation: The unit status may change if the unit experienced hard errors or if the unit is disconnected. Either way, DILX cannot continue testing the unit.

Last Failure Information follows. This error was NOT produced by running DILX. It represents the reason why the controller crashed on the previous controller run.

Explanation: This message may be displayed while allocating a unit for testing. It does not indicate any reason why the unit is or is not successfully allocated, but rather represents the reason why the controller went down in the previous run. The information that follows this message is the contents of an EIP.

Disk unit numbers on this controller include:

Explanation: After this message is displayed, a list of disk unit numbers on the controller is displayed.

IO to unit *x* has timed out. DILX aborting.

Explanation: One of the DILX I/Os to this unit did not complete within the command timeout interval and when examined, was found not progressing. This indicates a failing controller.

DILX terminated prematurely by user request.

Explanation: A Ctrl/Y was entered. DILX interprets this as a request to terminate. This message is displayed and DILX terminates.

Unit is owned by another sysap.

Explanation: DILX could not allocate the unit specified because the unit is currently allocated by another system application. Terminate the other system application or reset the controller.

This unit is reserved.

Explanation: The unit could not be allocated for testing because a host has reserved the unit.

This unit is marked inoperative.

Explanation: The unit could not be allocated for testing because the controller internal tables have the unit marked as inoperative.

The unit does not have any media present.

Explanation: The unit could not be allocated for testing because no media is present.

The RUNSTOP_SWITCH is set to RUN_DISABLED.

Explanation: The unit could not be allocated for testing because the RUNSTOP_SWITCH is set to RUN_DISABLED. This is enabled and disabled through the Command Line Interpreter (CLI).

Unable to continue, run time expired.

Explanation: A continue response was given to the “reuse parameters” question. This is not a valid response if the run time has expired. Reinvoke DILX.

When DILX starts to exercise the disk units, the following message is displayed with the current time of day:

```
DILX testing started at: xx:xx:xx
    Test will run for x minutes
    Type ^T(if running DILX through a VCS) or ^G(in all other cases)
      to get a current performance summary
    Type ^C to terminate the DILX test prematurely
    Type ^Y to terminate DILX prematurely
```

6.4.6 DILX Sense Data Display

To interpret the sense data fields correctly, refer to SCSI–2 specifications. Example 6–16 is an example of a DILX sense data display.

Example 6–16 DILX Sense Data Display

```
Sense data in hex for unit x

      Sense Key                 x
      Sense ASC                 x
      Sense ASQ                 x
      Instance                  x
```

6.4.7 DILX Deferred Error Display

Example 6–17 is an example of a DILX deferred error display.

Example 6–17 DILX Deferred Error Display

```
Deferred error detected, hard error counted against each unit.

     Sense Key                 x
     Sense ASC                 x
     Sense ASQ                 x
     Instance                  x
```

6.4.8 DILX Data Patterns

Table 6–8 defines the data patterns used with the DILX Basic Function or User-Defined tests. There are 18 unique data patterns. These data patterns were selected as worst case, or the ones most likely to produce errors on disks connected to the controller.

Table 6–8 DILX Data Patterns

Pattern Number	Pattern in hex
1	0000
2	8B8B
3	3333
4	3091
5, shifting 1s	0001, 0003, 0007, 000F, 001F, 003F, 007F, 00FF, 01FF, 03FF, 07FF, 0FFF, 1FFF, 3FFF, 7FFF
6, shifting 0s	FIE, FFFC, FFFC, FFFC, FFE0, FFE0, FFE0, FFE0, FE00, FC00, F800, F000, F000, C000, 8000, 0000
7, alternating 1s, 0s	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, ripple 1	0001, 0002, 0004, 0008, 0010, 0020, 0040, 0080, 0100, 0200, 0400, 0800, 1000, 2000, 4000, 8000
14, ripple 0	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

(continued on next page)

Table 6–8 (Cont.) DILX Data Patterns

Pattern Number	Pattern in hex
18	FFFF
Default—Use all of the above patterns in a random method	

6.4.9 Interpreting the DILX Performance Summaries

A DILX performance display is produced under the following conditions:

- When a specified performance summary interval elapses
- When DILX terminates for any conditions except an abort
- When Ctrl/G or Ctrl/T is entered

The performance display has different formats depending on whether or not performance statistics are requested in the user-specified parameters and if errors are detected.

The following is an example of a DILX performance display where performance statistics were not selected and where no errors were detected:

```
   DILX Summary at 18-JUN-1993 06:18:41
   Test minutes remaining: 0, expired: 6

Unit 1     Total IO Requests 482
  No errors detected
Unit 2     Total IO Requests 490
  No errors detected
```

The following is an example of a DILX performance display where performance statistics were selected and no errors were detected:

```
   DILX Summary at 18-JUN-1993 06:18:41
   Test minutes remaining: 0, expired: 6

Unit 1     Total IO Requests 482
  Read Count   292   Write Count 168
  KB xfer   Read 7223   Write 4981   Total 12204
  No errors detected
```

The following is an example of a DILX performance display where performance statistics were not selected and where errors were detected on a unit under test:

```
     DILX Summary at 18-JUN-1993 06:18:41
     Test minutes remaining: 0, expired: 6

❶ Unit 10    Total IO Requests 153259
          No errors detected
❷ Unit 40    Total IO Requests 2161368
          Err in Hex: IC:031A4002  PTL:04/00/00  Key:04  ASC/Q:B0/00  HC:0  SC:1
          Total Errs   Hard Cnt 0   Soft Cnt 1
❸ Unit 55    Total IO Requests 2017193
          Err in Hex: IC:03094002  PTL:05/05/00  Key:01  ASC/Q:18/89  HC:0  SC:1
          Err in Hex: IC:03094002  PTL:05/05/00  Key:01  ASC/Q:18/86  HC:0  SC:1
❹         Total Errs   Hard Cnt 0   Soft Cnt 2
```

where:

❶ Represents the unit number and the total I/O requests to this unit.

❷ Represents the unit number and total I/O requests to this unit.

All values for the following codes are described in Appendix E. This also includes the following items associated with this error, and the total number of hard and soft errors for this unit:

- The HSZ-series Instance code (in hex)
- The Port Target LUN (PTL)
- The SCSI Sense Key
- The SCSI ASC and ASQ (ASC/Q) codes
- The total hard and soft count for this error

❸ Represents information about the first two unique errors for this unit.

All values for the following codes are described in Appendix E. This also includes the following items associated with this error, and the total number of hard and soft errors for this unit:

- The HSZ-series Instance code (in hex)
- The Port Target LUN (PTL)
- The SCSI Sense (Key)
- The SCSI ASC and ASQ (ASC/Q) codes
- The total hard and soft count for this error

A line of this format may be displayed up to three times in a performance summary. There would be a line for each unique error reported to DILX for up to three errors for each unit.

❹ Represents the total hard and soft errors experienced for this unit.

The following is an example of a DILX performance display where performance statistics were not selected and where a controller error was detected:

```
   DILX Summary at 18-JUN-1993 06:18:41
   Test minutes remaining: 0, expired: 6

Cnt err in HEX  IC:07080064  Key:06  ASC/Q:A0/05  HC:1  SC:0
  Total Cntrl Errs   Hard Cnt 1   Soft Cnt 0

Unit 1     Total IO Requests 482
  No errors detected
Unit 2     Total IO Requests 490
  No errors detected
```

For the previous examples, the following definitions apply. These codes are translated in Appendix E.

- IC—The HSZ-series Instance code.
- ASC/Q—The SCSI ASC and ASCQ code associated with this error.
- HC—The hard count of this error.
- SC—The soft count of this error.
- PTL—The location of the unit (Port Target LUN).

The performance displays contain error information for up to three unique errors. Hard errors always have precedence over soft errors. A soft error represented in one display may be replaced with information on a hard error in subsequent performance displays.

6.4.10 DILX Abort Codes

Table 6–9 lists the DILX abort codes and definitions.

Table 6–9 DILX Abort Codes and Definitions

Value	Definition
1	An IO has timed out.
2	dcb_p->htb_used_count reflects an available HTB to test IOs but none could be found.
3	FAO returned either FAO_BAD_FORMAT or FAO_OVERFLOW.
4	TS$SEND_TERMINAL_DATA returned either an ABORTED or INVALID_BYTE_COUNT.
5	TS$READ_TERMINAL_DATA returned either an ABORTED or INVALID_BYTE_COUNT.
6	A timer is in an unexpected expired state that prevents it from being started.
7	The semaphore was set after a oneshot IO was issued but nothing was found in the received HTB que.
8	A termination, a print summary, or a reuse parameters request was received when DILX was not testing any units.
9	User requested an abort via ^Y.

6.4.11 DILX Error Codes

Table 6–10 list the DILX error codes and definitions for DILX-detected errors.

Table 6–10 DILX Error Codes and Definitions

Value	Definition
1	Illegal Data Pattern Number found in data pattern header.
2	No write buffers correspond to data pattern.
3	Read data do not match write buffer.

6.5 VTDPY Utility

The VTDPY utility gathers and displays system state and performance information for the HS family of modular storage controllers. The information displayed includes processor utilization, host port activity and status, device state, logical unit state, and cache and I/O performance.

The VTDPY utility requires a video terminal that supports ANSI control sequences, such as a VT220, VT320, or VT420 terminal. A graphics display that provides emulation of an ANSI-compatible video terminal also can be used. For DSSI- and CI-based HS controllers, VTDPY can be run on terminals either directly connected to the HS controller, or on terminals connected through a host based DUP connection. For SCSI-based HS controllers, the VTDPY utility can be run only on terminals connected the the HS controller maintenance terminal port.

Note

VCS can only be used from a terminal attached to the EIA–423 terminal port of the controller.

The VTDPY utility is conceptually based on the HSC utility of the same name. Though the information displayed differs from the HSC utility due to system implementation differences, a user familiar with the HSC utility should be able to easily understand this display terminology.

The following sections show how to use the VTDPY utility.

6.5.1 How to Run VTDPY

Only one VTDPY session can be run on each controller at one time.

Note

Prior to running VTDPY, be sure the terminal is set in NOWRAP mode. Otherwise, the top line of the display scrolls off of the screen.

To initiate VTDPY from the maintenance terminal at the CLI> prompt, enter the following command:

```
CLI>RUN VTDPY
```

To initiate VTDPY from a virtual terminal, refer to Chapter 4.

6.5.1.1 Using the VTDPY Control Keys

Use the following control key sequences to work the VTDPY display:

Table 6–11 VTDPY Control Keys

Control Key Sequence	Function
Ctrl/C	Prompts for commands
Ctrl/G	Updates the screen (same as Ctrl/Z)
Ctrl/O	Pauses or resumes screen updates
Ctrl/R	Refreshes current screen display (same as Ctrl/W)
Ctrl/W	Refreshes current screen display (same as Ctrl/R)
Ctrl/Y	Terminates VTDPY and resets screen characteristics
Ctrl/Z	Updates the screen (same as Ctrl/G)

Note

While VTDPY and the maintenance terminal interface support passing all of the listed control characters, some host-based terminal interfaces restrict passing some of the characters. All of the listed characters have equivalent text string commands.

6.5.1.2 Using the VTDPY Command Line

VTDPY contains a command line interpreter that is invoked by entering Ctrl/C any time after the program has begun execution. The command line interpreter is used to modify the characteristics of the VTDPY display. Commands also exist to duplicate the function of the control keys listed in Section 6.5.1.1.

Table 6–12 VTDPY Commands

Command String	Function
DISPLAY CACHE	Uses 132-column unit caching statistics display
DISPLAY DEFAULT	Uses default 132-column system performance display
DISPLAY DEVICE	Uses 132-column device performance display
DISPLAY STATUS	Uses 80-column controller status display
EXIT	Terminates program (same as QUIT)
INTERVAL <seconds>	Changes update interval
HELP	Displays help message text
REFRESH	Refreshes the current display
QUIT	Terminates program (same as EXIT)
UPDATE	Updates screen display

The keywords in the command strings can be abbreviated to the minimum number of characters that are necessary to uniquely identify the keyword. Typing a question mark (?) after a keyword causes the parser to provide a list of keywords or values that may follow the supplied keyword. The CLI is not case sensitive, so keywords may be entered in uppercase, lowercase, or mixed case.

Upon successful execution of a command other than HELP, the CLI is exited and the display is resumed. Entering a carriage return without a command also exits the CLI and resumes the display. If an error occurs in the command, the user prompts for command expansion help, or the HELP command is entered, the CLI prompts for an additional command instead of returning to the display.

6.5.1.3 How to Interpret the VTDPY Display Fields

This section describes the major fields in the VTDPY displays. Examples of the VTDPY screens are shown followed by an explanation of each field of the screens.

Figure 6–2 VTDPY Default Display for CI Controllers

```
HSJ40 S/N: ZG33700938 SW: V14J HW: 00-00 VTDPY Monitor Copyright © 1994, Digital Equipment Corp.          03-FEB-1994 16:52:34
                          92% I/D Hit  90.8% Idle     2656 KB/S       0 Rq/S                                Up:     0  0:24.53
Pr   Name  Stk/Max Typ Sta  CPU% Node HSJA4   Port 25          Unit  ASWC  KB/S  Rd% Wr% Cm% HT% Unit  ASWC  KB/S  Rd% Wr% Cm% HT%
 0    NULL   0/  0      Rn  90.8 SysId 42001019F529            D0410 a^ r     0   0   0   0   0 D0444 a^ r     0   0   0   0   0
 2   RECON  10/  1 FNC  Bl   0.0                               D0411 a^ r     0   0   0   0   0 D0445 a^ r     0   0   0   0   0
 3     HPT  40/  4 FNC  Bl   1.6 Path A Pkts  Pkts/S           D0413 a^ r     0   0   0   0   0 D0450 a^ r     0   0   0   0   0
 9   VTDPY  10/  3 DUP  Rn   0.2 RCV      203     20           D0414 a^ r     0   0   0   0   0 D0451 a^ r     0   0   0   0   0
17  FMTHRD  10/  1 FNC  Bl   0.0 ACK      183     18           D0415 a^ r     0   0   0   0   0 D0452 a^ r     0   0   0   0   0
18   DS_HB  10/  1 FNC  Bl   0.0 NAK        0      0   Target  D0420 o^ r   448   0 100   0   0 D0453 a^ r     0   0   0   0   0
19     DUP  10/  1 FNC  Bl   0.8 NOR       40      4  01234567 D0421 o^ r   435   0 100   0   0 D0454 a^ r     0   0   0   0   0
20     SCS  10/  1 FNC  Bl   0.0                     P1DDFDDDhH D0422 o^ r   435   0 100   0   0 D0455 a^ r     0   0   0   0   0
21    MSCP  20/  1 FNC  Bl   0.0 Path B Pkts  Pkts/S o2DDDDDDhH D0423 o^ r   448   0 100   0   0 D0460 a^ r     0   0   0   0   0
23      VA  10/  1 FNC  Bl   0.0 RCV      187     18 r3DDDDDDhH D0424 o^ r   448   0 100   0   0 D0461 a^ r     0   0   0   0   0
24    DS_1  40/  3 FNC  Rn   6.3 ACK      209     20 t4DDDDDDhH D0425 o^ r   441   0 100   0   0 D0462 a^ r     0   0   0   0   0
25    DS_0  20/  2 FNC  Bl   0.0 NAK        0      0  5DDDDDDhH D0430 a^ r     0   0   0   0   0 D0463 a^ r     0   0   0   0   0
26     HIS  10/  1 FNC  Bl   0.0 NOR       40      4  6DDDDDDhH D0431 a^ r     0   0   0   0   0 D0464 a^ r     0   0   0   0   0
27 CLIMAIN  16/  2 FNC  Bl   0.0                               D0432 a^ r     0   0   0   0   0 D0465 a^ r     0   0   0   0   0
28   NVFOC  10/  1 FNC  Bl   0.0 Connections Path Status       D0433 a^ r     0   0   0   0   0
29  REMOTE  10/  1 FNC  Bl   0.0  0123456789  0123456789       D0434 a^ r     0   0   0   0   0
30     FOC  20/  2 FNC  Bl   0.0 0MVMMM..... 0^^^^^.....       D0435 a^ r     0   0   0   0   0
31   DUART  10/  1 FNC  Bl   0.0 1V.......C. 1^.......^.       D0440 a^ r     0   0   0   0   0
                                 2....V.VV.. 2....^.^^..       D0441 a^ r     0   0   0   0   0
                                 3.V         3.^               D0442 a^ r     0   0   0   0   0
                                                               D0443 a^ r     0   0   0   0   0
```

Figure 6–3 VTDPY Default Display for DSSI Controllers

```
HSD30 S/N: CX40300006 SW: V14D HW: 00-00 VTDPY Monitor Copyright © 1994, Digital Equipment Corp.          03-FEB-1994 16:48:41
                          96% I/D Hit  19.7% Idle       0 KB/S       0 Rq/S                              Up:    0  0:50.27
Pr   Name  Stk/Max Typ Sta  CPU% Node HSDD6   Port  6          Unit  ASWC  KB/S  Rd% Wr% Cm% HT% Unit  ASWC  KB/S  Rd% Wr% Cm% HT%
 0    NULL   0/  0      Rn  19.7 SysId 42001106E115            D2691 o^ r      0   0   0   0   0
 2   RECON  10/  1 FNC  Bl   0.0                               D2692 o^ r      0   0   0   0   0
 3     HPT  40/  8 FNC  Rn   1.2 DSSI   Pkts  Pkts/S           D2693 o^ r      0   0   0   0   0
 8   VTDPY  10/  3 DUP  Rn   0.2 RCV      342     31
17  FMTHRD  10/  1 FNC  Bl   0.0 ACK      343     31
18   DS_HB  10/  1 FNC  Bl   0.0 NAK        0      0    Target
19     DUP  10/  1 FNC  Bl   0.5 NOR        0      0   01234567
20     SCS  10/  1 FNC  Bl   0.0                     P1 DDDDD H
21    MSCP  20/  1 FNC  Bl   0.0                     o2 DDDDD H
23      VA  10/  1 FNC  Bl   0.0                     r3 DDDDD H
24    DS_1  40/ 11 FNC  Rn  77.2                     t
25    DS_0  20/  1 FNC  Bl   1.0
26     HIS  10/  1 FNC  Bl   0.0
27 CLIMAIN  16/  2 FNC  Bl   0.0
28   NVFOC  10/  1 FNC  Bl   0.0 Connections Path Status
29  REMOTE  10/  1 FNC  Bl   0.0  0123456789  0123456789
30     FOC  20/  2 FNC  Bl   0.0 0.......M   0.......^
31   DUART  10/  1 FNC  Bl   0.0 1           1
                                 2           2
                                 3           3
```

Figure 6–4 VTDPY Default Display for SCSI Controllers

```
HSZ40 S/N: ZG33300035 SW: V14Z HW: 00-00 VTDPY Monitor Copyright © 1994, Digital Equipment Corp.
                          91% I/D Hit  14.7% Idle   10074 KB/S     160 Rq/S                            Up:    0  0:07.13
Pr   Name  Stk/Max Typ Sta  CPU% Xfer Rate                      Unit  ASWC  KB/S  Rd% Wr% Cm% HT% Unit  ASWC  KB/S  Rd% Wr% Cm% HT%
 0    NULL   0/  0      Rn  14.7 T W I  Mhz                     D0100 o^ r    647  49  50   0   0
 2   RECON  10/  1 FNC  Bl   0.0 1 W 7 10.00                    D0101 o^ r    641  50  50   0   0
 3    SHIS  40/  2 FNC  Rn  59.3 2 W 7 10.00                    D0102 o^ r    635  49  50   0   0
 8   VTDPY  10/  2 DUP  Rn   0.4                                D0103 o^ r    630  50  50   0   0
18  SCSIVT  10/  1 FNC  Bl   0.0                                D0104 o^ r    630  50  50   0   0
19   DS_HB  10/  1 FNC  Bl   0.0                       Target   D0105 o^ r    618  50  50   0   0
24      VA  10/  1 FNC  Bl   0.0                      01234567  D0106 o^ r    612  50  49   0   0
25    DS_1  40/  3 FNC  Rn  25.3                      P1D D D  H D0107 o^ r    649  50  49   0   0
26    DS_0  20/  1 FNC  Bl   0.0                      o2 D D D H D0200 o^ r    641  50  50   0   0
27 CLIMAIN  16/  2 FNC  Bl   0.0                      r3D D D  H D0201 o^ r    641  50  50   0   0
28   NVFOC  10/  1 FNC  Bl   0.0                      t4 D D DDH D0202 o^ r    635  50  49   0   0
29  REMOTE  10/  1 FNC  Bl   0.0                       5D D D  H D0203 o^ r    618  50  50   0   0
30     FOC  20/  2 FNC  Bl   0.0                       6 D D DDH D0204 o^ r    630  50  50   0   0
31   DUART  10/  1 FNC  Bl   0.0                                D0205 o^ r    624  50  49   0   0
                                                                D0206 o^ r    607  50  50   0   0
                                                                D0207 o^ r    610  49  50   0   0
```

Figure 6–5 VTDPY Device Performance Display

```
HSJ40 S/N: ZG33700938 SW: V14J HW: 00-00 VTDPY Monitor Copyright © 1994, Digital Equipment Corp.          03-FEB-1994 16:53:06
                          89% I/D Hit   0.0% Idle     2389 KB/S      348 Rq/S                               Up:    0  0:25.26
   Target                                PTL ASWF Rq/S RdKB/S WrKB/S Que Tg CR BR TR  PTL ASWF Rq/S RdKB/S WrKB/S Que Tg CR BR TR
  01234567                              D100 A^     0      0      0   0  0  0  0  0 D430 A^     0      0      0   0  0  0  0  0
P1DDFDDDhH                              D200 A^    57      0    396  16 11  0  0  0 D530 A^     0      0      0   0  0  0  0  0
o2DDDDDDhH                              D300 A^     0      0      0   0  0  0  0  0 D630 A^     0      0      0   0  0  0  0  0
r3DDDDDDhH                              D400 A^     0      0      0   0  0  0  0  0 D140 A^     0      0      0   0  0  0  0  0
t4DDDDDDhH                              D500 A^     0      0      0   0  0  0  0  0 D240 A^    60      0    415  16 11  0  0  0
 5DDDDDDhH                              D600 A^     0      0      0   0  0  0  0  0 D340 A^     0      0      0   0  0  0  0  0
 6DDDDDDhH                              D110 A^     0      0      0   0  0  0  0  0 D440 A^     0      0      0   0  0  0  0  0
                                        D210 A^    50      0    340  17 11  0  0  0 D540 A^     0      0      0   0  0  0  0  0
                                        D310 A^     0      0      0   0  0  0  0  0 D640 A^     0      0      0   0  0  0  0  0
                                        D410 A^     0      0      0   0  0  0  0  0 D150 A^     0      0      0   0  0  0  0  0
                                        D510 A^     0      0      0   0  0  0  0  0 D250 A^    45      0    292  16 11  0  0  0
                                        D610 A^     0      0      0   0  0  0  0  0 D350 A^     0      0      0   0  0  0  0  0
Port Rq/S RdKB/S WrKB/S  CR  BR  TR    F120  v F    0      0      0   0  0  0  0  0 D450 A^     0      0      0   0  0  0  0  0
 1      0      0      0   0   0   0    D220 A^    51      0    333  16 11  0  0  0 D550 A^     0      0      0   0  0  0  0  0
 2    348      1   2387   0   0   0    D320 A^     0      0      0   0  0  0  0  0 D650 A^     0      0      0   0  0  0  0  0
 3      0      0      0   0   0   0    D420 A^     0      0      0   0  0  0  0  0
 4      0      0      0   0   0   0    D520 A^     0      0      0   0  0  0  0  0
 5      0      0      0   0   0   0    D620 A^     0      0      0   0  0  0  0  0
 6      0      0      0   0   0   0    D130 A^     0      0      0   0  0  0  0  0
                                       D230 A^    83      0    608  16 11  0  0  0
                                       D330 A^     0      0      0   0  0  0  0  0
```

Figure 6–6 VTDPY Unit Cache Performance Display

```
HSJ40 S/N: ZG33700938 SW: V14J HW: 00-00 VTDPY Monitor Copyright © 1994, Digital Equipment Corp.          03-FEB-1994 16:53:26
                                90% I/D Hit  80.1% Idle     2719 KB/S       23 Rq/S                          Up:    0  0:25.45
Unit  ASWC  KB/S  Rd% Wr% Cm% HT% PH% MS% Purge BlChd BlHit Unit  ASWC  KB/S  Rd% Wr% Cm% HT% PH% MS% Purge BlChd BlHit
D0410 a^ r     0   0   0   0   0   0   0     0     0     0 D0444 a^ r     0   0   0   0   0   0   0     0     0     0
D0411 a^ r     0   0   0   0   0   0   0     0     0     0 D0445 a^ r     0   0   0   0   0   0   0     0     0     0
D0413 a^ r     0   0   0   0   0   0   0     0     0     0 D0450 a^ r     0   0   0   0   0   0   0     0     0     0
D0414 a^ r     0   0   0   0   0   0   0     0     0     0 D0451 a^ r     0   0   0   0   0   0   0     0     0     0
D0415 a^ r     0   0   0   0   0   0   0     0     0     0 D0452 a^ r     0   0   0   0   0   0   0     0     0     0
D0420 o^ r   483   0 100   0   0   0 100     0   132     0 D0453 a^ r     0   0   0   0   0   0   0     0     0     0
D0421 o^ r   483   0 100   0   0   0 100     0   132     0 D0454 a^ r     0   0   0   0   0   0   0     0     0     0
D0422 o^ r   476   0 100   0   0   0 100     0   132     0 D0455 a^ r     0   0   0   0   0   0   0     0     0     0
D0423 o^ r   315   0  99   0   1   0  99     0   159     1 D0460 a^ r     0   0   0   0   0   0   0     0     0     0
D0424 o^ r   483   0 100   0   0   0 100     0   132     0 D0461 a^ r     0   0   0   0   0   0   0     0     0     0
D0425 o^ r   476   0 100   0   0   0 100     0   132     0 D0462 a^ r     0   0   0   0   0   0   0     0     0     0
D0430 a^ r     0   0   0   0   0   0   0     0     0     0 D0463 a^ r     0   0   0   0   0   0   0     0     0     0
D0431 a^ r     0   0   0   0   0   0   0     0     0     0 D0464 a^ r     0   0   0   0   0   0   0     0     0     0
D0432 a^ r     0   0   0   0   0   0   0     0     0     0 D0465 a^ r     0   0   0   0   0   0   0     0     0     0
D0433 a^ r     0   0   0   0   0   0   0     0     0     0
D0434 a^ r     0   0   0   0   0   0   0     0     0     0
D0435 a^ r     0   0   0   0   0   0   0     0     0     0
D0440 a^ r     0   0   0   0   0   0   0     0     0     0
D0441 a^ r     0   0   0   0   0   0   0     0     0     0
D0442 a^ r     0   0   0   0   0   0   0     0     0     0
D0443 a^ r     0   0   0   0   0   0   0     0     0     0
```

Figure 6–7 VTDPY Brief CI Status Display

```
VTDPY Monitor Copyright © 1994, Digital Equipment Corp.    03-FEB-1994 16:52:50
 88% I/D Hit   0.0% Idle     2717 KB/S       0 Rq/
         Up:    0  0:25.09
Pr   Name  Stk/Max Typ Sta  CPU%    Target   Unit  ASWC  KB/S  Unit  ASWC  KB/S
 0    NULL   0/  0      Rn   0.0   01234567  D0410 a^ r     0 D0444 a^ r     0
 2   RECON  10/  1 FNC  Bl   0.0 P1DDFDDDhH  D0411 a^ r     0 D0445 a^ r     0
 3     HPT  40/  4 FNC  Rn 100.0 o2DDDDDDhH  D0413 a^ r     0 D0450 a^ r     0
 9   VTDPY  10/  3 DUP  Rn   0.0 r3DDDDDDhH  D0414 a^ r     0 D0451 a^ r     0
17  FMTHRD  10/  1 FNC  Bl   0.0 t4DDDDDDhH  D0415 a^ r     0 D0452 a^ r     0
18   DS_HB  10/  1 FNC  Bl   0.0  5DDDDDDhH  D0420 o^ r   452 D0453 a^ r     0
19     DUP  10/  1 FNC  Bl   0.0  6DDDDDDhH  D0421 o^ r   452 D0454 a^ r     0
20     SCS  10/  1 FNC  Bl   0.0             D0422 o^ r   452 D0455 a^ r     0
21    MSCP  20/  1 FNC  Bl   0.0 Connections D0423 o^ r   452 D0460 a^ r     0
23      VA  10/  1 FNC  Bl   0.0  0123456789 D0424 o^ r   452 D0461 a^ r     0
24    DS_1  40/  3 FNC  Rn   0.0 0MVMMM..... D0425 o^ r   456 D0462 a^ r     0
25    DS_0  20/  2 FNC  Bl   0.0 1V.......C. D0430 a^ r     0 D0463 a^ r     0
26     HIS  10/  1 FNC  Bl   0.0 2....V.VV.. D0431 a^ r     0 D0464 a^ r     0
27 CLIMAIN  16/  2 FNC  Bl   0.0 3.V         D0432 a^ r     0 D0465 a^ r     0
28   NVFOC  10/  1 FNC  Bl   0.0             D0433 a^ r     0
29  REMOTE  10/  1 FNC  Bl   0.0 Path Status D0434 a^ r     0
30     FOC  20/  2 FNC  Bl   0.0  0123456789 D0435 a^ r     0
31   DUART  10/  1 FNC  Bl   0.0 0^^^^^..... D0440 a^ r     0
                                 1^.......^. D0441 a^ r     0
                                 2....^.^^.. D0442 a^ r     0
                                 3.^         D0443 a^ r     0
```

Figure 6–8 VTDPY Brief DSSI Status Display

```
VTDPY Monitor Copyright © 1994, Digital Equipment Corp.    03-FEB-1994 16:49:04
 87% I/D Hit   0.0% Idle        0 KB/S        0 Rq/S        Up:    0  0:50.50
Pr   Name  Stk/Max Typ Sta  CPU%    Target   Unit  ASWC  KB/S  Unit  ASWC  KB/S
 0    NULL   0/  0      Rn   0.0   01234567  D2691 o^ r     0
 2   RECON  10/  1 FNC  Bl   0.0 P1 DDDDD H  D2692 o^ r     0
 3     HPT  40/  8 FNC  Rn   0.0 o2 DDDDD H  D2693 o^ r     0
 8   VTDPY  10/  3 DUP  Rn 100.0 r3 DDDDD H
17  FMTHRD  10/  1 FNC  Bl   0.0 t
18   DS_HB  10/  1 FNC  Bl   0.0
19     DUP  10/  1 FNC  Bl   0.0
20     SCS  10/  1 FNC  Bl   0.0
21    MSCP  20/  1 FNC  Bl   0.0 Connections
23      VA  10/  1 FNC  Bl   0.0  0123456789
24    DS_1  40/ 11 FNC  Rn   0.0 0.......M
25    DS_0  20/  1 FNC  Rn   0.0 1
26     HIS  10/  1 FNC  Bl   0.0 2
27 CLIMAIN  16/  2 FNC  Bl   0.0 3
28   NVFOC  10/  1 FNC  Bl   0.0
29  REMOTE  10/  1 FNC  Bl   0.0 Path Status
30     FOC  20/  2 FNC  Bl   0.0  0123456789
31   DUART  10/  1 FNC  Bl   0.0 0.......^
                                 1
                                 2
                                 3
```

Figure 6–9 VTDPY Brief SCSI Status Display

```
VTDPY Monitor Copyright © 1994, Digital Equipment Corp.
 88% I/D Hit   0.0% Idle     9520 KB/S      151 Rq/S         Up:    0  0:07.46
Pr   Name  Stk/Max Typ Sta  CPU%    Target   Unit  ASWC  KB/S  Unit  ASWC  KB/S
 0    NULL   0/  0      Rn   0.0   01234567  D0100 o^ r    598
 2   RECON  10/  1 FNC  Bl   0.0 P1D D D  H  D0101 o^ r    606
 3    SHIS  40/  2 FNC  Rn  40.0 o2 D D D H  D0102 o^ r    614
 8   VTDPY  10/  2 DUP  Rn  40.0 r3D D D  H  D0103 o^ r    590
18  SCSIVT  10/  1 FNC  Bl   0.0 t4 D D DDH  D0104 o^ r    590
19   DS_HB  10/  1 FNC  Bl   0.0  5D D D  H  D0105 o^ r    590
24      VA  10/  1 FNC  Bl   0.0  6 D D DDH  D0106 o^ r    590
25    DS_1  40/  3 FNC  Rn  20.0             D0107 o^ r    606
26    DS_0  20/  1 FNC  Bl   0.0 Xfer Rate   D0200 o^ r    606
27 CLIMAIN  16/  2 FNC  Bl   0.0 T W I  Mhz  D0201 o^ r    598
28   NVFOC  10/  1 FNC  Bl   0.0 1 W 7 10.00 D0202 o^ r    590
29  REMOTE  10/  1 FNC  Bl   0.0 2 W 7 10.00 D0203 o^ r    582
30     FOC  20/  2 FNC  Bl   0.0             D0204 o^ r    590
31   DUART  10/  1 FNC  Bl   0.0             D0205 o^ r    582
                                             D0206 o^ r    590
                                             D0207 o^ r    590
```

Display Header

```
    HSJ40 ❶ S/N: CX00000002 ❷ SW: V14J ❸ HW:  A-02 ❹
VTDPY Monitor Copyright © 1994, Digital Equipment Corp.❺
```

Description

This subdisplay provides title information for the display. For 132-column displays, this subdisplay will be spread across one line of the display.

❶ Controller model.

❷ Controller serial number.

❸ Controller firmware version.

❹ Controller hardware version.

❺ Copyright notice.

Date and Time

```
29-JAN-1994 13:46:34 ❶
  Up:    1  3:45.19 ❷
```

Description

This subdisplay provides time information for the display.

❶ System date and time. This information is not displayed for SCSI-based HS controllers.

❷ Time in days, hours, minutes, and seconds since the last controller boot.

Controller Performance Summary

```
88% I/D Hit ❶ 47.2% Idle ❷ 1225 KB/S ❸106 Rq/S ❹
```

Description

This subdisplay provides total system performance information.

❶ Instruction and data cache hit rate.

❷ Policy processor idle rate.

❸ Cumulative data transfer rate in kilobytes per second. When logical units are being displayed, this is the transfer rate between the host and the controller. When physical devices are being displayed, this is the transfer rate between the controller and the devices.

❹ Cumulative unit or device request rate per second. When logical units are being displayed, this is the request rate between the host and the controller. When physical devices are being displayed, this is the request rate between the controller and the devices.

Controller Threads Display

```
Pr❶ Name❷  Stk/Max❸ Typ❹ Sta❺ CPU%❻
 0    NULL    0/  0        Rn   47.2
 3     HPT   40/  7   FNC  Rn   40.3
 8   VTDPY   10/  3   DUP  Rn    0.1
18  FMTHRD   10/  2   FNC  Bl    0.0
19   DS_HB   10/  2   FNC  Bl    0.0
20     DUP   10/  2   FNC  Bl    1.3
21     SCS   10/  2   FNC  Bl    0.0
22    MSCP   20/  6   FNC  Bl    0.0
24      VA   10/  3   FNC  Bl    1.2
25    DS_1   40/  6   FNC  Rn    8.9
26    DS_0   20/  4   FNC  Bl    0.0
27     HIS   10/  2   FNC  Bl    0.0
28 CLIMAIN   16/  6   FNC  Bl    0.0
30     FOC   16/  4   FNC  Bl    0.0
31   DUART   10/  2   FNC  Bl    0.0
```

Description

This display shows the status and characteristics of the active threads in the controller. Threads that are not active, such as DUP Local Program threads, will not be displayed until they become active. If the number of active threads exceeds the available space, not all of them will be displayed.

❶ The **Pr** column lists the thread priority. The higher the number, the higher the priority.

❷ The **Name** column contains the thread name. For DUP Local Program threads, this is the name used to invoke the program.

❸ The **Stk** column lists the allocated stack size in 512-byte pages. The **Max** column lists the number of stack pages actually used.

❹ The **Typ** column lists the thread type. The following thread types may be displayed:

- **FNC**—Functional thread. Those threads that are started when the controller boots and never exit.
- **DUP**—DUP Local Program threads. These threads are only active when run either from a DUP connection or through the command line interpreter's RUN command.
- **NULL**—The NULL thread does not have a thread type because it is a special type of thread that only executes when no other thread is executable.

❺ The **Sta** column lists the current thread state. The following thread states may be displayed:

- **Bl**—The thread is blocked waiting for timer expiration, resources, or a synchronization event.
- **Io**—A DUP Local Program is blocked waiting for terminal I/O completion.
- **Rn**—The thread is currently executable.

❻ The **CPU%** column lists the percentage of execution time credited to each thread since the last screen update. The values may not add up to exactly 100 percent due to both rounding errors and the fact that there may not be enough room to display all of the threads. An unexpected amount of time may be credited to some threads because the controller's firmware architecture allows code from one thread to execute in the context of another thread without a context switch.

Table 6–13 describes the processes that may be displayed in the active thread display.

Note

It is possible that different versions of the controller firmware will have different threads or different names for the threads.

Table 6–13 Thread Description

Thread Name	Description
CLI	A local program that provides an interface to the controller's command line interpreter thread.
CLIMAIN	The command line interpreter (CLI) thread.
CONFIG	A local program that locates and adds devices to an HS array controller configuration.
DILX	A Local Program that exercises disk devices.
DIRECT	A local program that returns a listing of available Local Programs.
DS_0	Device error recovery management thread.
DS_1	The thread that handles successful completion of physical device requests.
DS_HB	The thread that manages the device and controller error indicator lights and port reset buttons.
DUART	The console terminal interface thread.
DUP	The DUP protocol server thread.
FMTHREAD	The thread that performs error log formatting and fault reporting for the controller.
FOC	The thread that manages communication between the controllers in a dual-controller configuration.
HIS	The SCS protocol interface thread for CI and DSSI controllers.
HPT	The thread that handles interaction with the host port logic and PPD protocol for CI and DSSI controllers.
MSCP	The MSCP and TMSCP protocol server thread.
NULL	The process that is scheduled when no other process can be run.
NVFOC	The thread that initiates state change requests for the other controller in a dual-controller configuration.
REMOTE	The thread that manages state changes initiated by the other controller in a dual-controller configuration.
RMGR	The thread that manages the data buffer pool.

(continued on next page)

Table 6–13 (Cont.) Thread Description

Thread Name	Description
SCS	The SCS directory thread.
SCSIVT	A thread that provides a virtual terminal connection to the CLI over the host SCSI bus.
SHIS	The host SCSI protocol interface thread for SCSI controllers.
TILX	A Local Program that exercises tape devices.
VA	The thread that provides host protocol independent logical unit services.
VTDPY	A Local Program thread that provides a dynamic display of controller configuration and performance information.

CI/DSSI Host Port Characteristics

```
Node HSJ501 ❶ Port 13 ❷
SysId 4200100D0720 ❸
```

Description

This subdisplay shows the current host port identification information. This subdisplay is only available for CI- or DSSI-based controllers.

❶ SCS node name.

❷ Port number.

❸ SCS system ID.

SCSI Host Port Characteristics

```
Xfer Rate
T❶W❷I❸Mhz❹
1 W 7 10.00
2 W Async❺
```

Description

This subdisplay shows the current host port SCSI target identification, any initiator that has negotiated synchronous transfers, and the negotiated transfer method currently in use between the controller and the initiators. This subdisplay is only available for SCSI-based HS controllers.

❶ SCSI host port target ID.

❷ Transfer width. **W** indicates 16-bit or wide transfers are being used. A space indicates 8-bit transfers are being used.

❸ The initiator with which synchronous commication has been negotiated.

❹ A numeric value indicates the synchronous data rate that has been negotiated with the initiator at the specified SCSI ID. The value is listed in megahertz (Mhz). In this example, the negotiated synchronous transfer rate is approximately 3.57 Mhz. To convert this number to the nanosecond period, invert and multiply by 1000. The period for this is approximately 280 nanoseconds.

❺ **Async** indicates communication between this target and all initiators is being done in asynchronous mode. This is the default communication mode and will be used unless the initiator successfully negotiates for synchronous communications. If there is no communication with a given target ID, the communication mode will be listed as asynchronous.

CI Performance Display

```
Path A Pkts  Pkts/S
RCV     5710    519 ❶
ACK    11805   1073 ❷
NAK     2073    188 ❸
NOR     1072     97 ❹

Path B Pkts  Pkts/S
RCV     5869    533
ACK    11318   1028
NAK     2164    196
NOR      445     40
```

Description

This display indicates the number of packets sent and received over each CI path and the packet rate. This display is only available on CI-based controllers.

❶ Packets received from a remote node.

❷ Packets sent to a remote node that were acknowledged (ACK).

❸ Packets sent to a remote node that were not acknowledged (NAK).

❹ Packets sent to a remote node for which no response was received.

DSSI Performance Display

```
DSSI   Pkts  Pkts/S
RCV     5710    519 ❶
ACK    11805   1073 ❷
NAK     2073    188 ❸
NOR     1072     97 ❹
```

Description

This display indicates the number of packets sent and received through the DSSI port and the packet rate. This display is only available on DSSI-based controllers.

❶ Packets received from a remote node.

❷ Packets sent to a remote node that were acknowledged (ACK).

❸ Packets sent to a remote node that were not acknowledged (NAK).

❹ Packets sent to a remote node for which no response was received.

CI/DSSI Connection Status

```
Connections
 0123456789 ❶
0........MM ❷
1..C.MV....
2..........
3..
```

Description

This display shows the current status of any connections to a remote CI or DSSI node. This display is available only on CI- and DSSI-based controllers.

❶ Each position in the data field represents one of the possible nodes to which the controller can communicate. To locate the connection status for a given node, use the column on the left to determine the high order digit of the node number and use the second row to determine the low order digit. For CI controllers, the number of nodes displayed is determined by the controllers MAX NODE parameter. The maximum supported value for this parameter is 32. For DSSI controllers, the number of nodes is fixed at 8.

❷ Each location in the grid contains a character to indicate the connection status:

- **C** indicates one connection to that node. In this example, node 12 shows one connection. This usually happens if a host has multiple adaptors and is using more than one adaptor for load balancing.
- **M** indicates multiple connections to that node. Because each host system can make a separate connection to each of the disk, tape, and DUP servers, this field frequently shows multiple connections to a host system. In this example, nodes 8, 9, and 14 show multiple connections.
- **V** indicates that only a virtual circuit is open and no connection is present. This happens prior to establishing a connection. It also will happen when there is another controller on the same network and when there are systems with multiple adaptors connected to the same network. Node 15 demonstrates this principle.
- If a period "." is in a position corresponding to a node, that node does not have any virtual circuits or connections to this controller.
- A space indicates the address is beyond the visible node range for this controller.

CI/DSSI Host Path Status

```
Path Status
 0123456789 ❶
0........^^ ❷
1..A.B^....
2.......X..
3..
```

Description

This display indicates the path status to any system for which a virtual circuit exists. This display is available only on CI- and DSSI-based controllers.

❶ Each position in the data field represents one of the possible nodes to which the controller can communicate. To locate the path status for a given node, use the column on the left to determine the high order digit of the node number and use the second row to determine the low order digit. For CI controllers, the number of nodes displayed is determined by the controllers MAX NODE parameter. The maximum supported value for this parameter is 32. For DSSI controllers, the number of nodes is fixed at 8.

❷ Each location in the grid contains a character to indicate the path status:

- **A** indicates only CI path A is functioning properly. In this example, node 12 demonstrates this. This value will not be displayed for DSSI-based controllers.
- **B** indicates only CI path B is functioning properly. In this example, node 14 demonstrates this. This value will not be displayed for DSSI-based controllers.
- **X** indicates the CI cables are crossed. In this example, node 27 demonstrates this. This value will not be displayed for DSSI-based controllers.
- **^** indicates the single DSSI path or both CI paths are functioning properly. In this example, nodes 8, 9, and 15 demonstrate this.
- If a period "." is in a position corresponding to a node, that node does not have any virtual circuits or connections to this controller so either the path status cannot be determined, or neither path is functioning properly.
- A space indicates the address is beyond the visible node range for this controller.

Device SCSI Status

```
  Target
  01234567 ❶
P1 DDDDFhH ❷
o2TTT T hH
r3DDD   hH
t4DDDDDDhH
 5DDDD  hH
 6      hH
❸
```

Description

This display shows what devices the controller has been able to identify on the device busses.

Note

The controller will not look for devices that are not configured into the nonvolatile memory using the CLI ADD command.

---

❶ The column headings indicate the SCSI target numbers for the devices. SCSI Targets are in the range 0 through 7. Target 7 is always used by a controller. In a dual controller configuration, target 6 is used by the second controller.

❷ The device grid contains a letter signifying the device type in each port/target location where a device has been found:

- **C** indicates a CDROM device.
- **D** indicates a disk device.
- **F** indicates a device type not listed above.
- **H** indicates bus position of this controller.
- **h** indicates bus position of the other controller.
- **L** indicates a media loader.
- **T** indicates a tape device.
- A period "." indicates the device type is unknown.
- A space indicates there is no device configured at this location.

❸ This subdisplay contains a row for each SCSI device port supported by the controller. The subdisplay for a controller that has six SCSI device ports is shown.

Unit Status (abbrievated)

```
Unit❶ ASWC❷ KB/S❸ Rd%❹ Wr%❺ Cm%❻ HT%❼
D0110  a^ r      0     0     0     0     0
D0120  a^ r      0     0     0     0     0
D0130  o^ r    236   100     0     0   100
T0220  av        0     0     0     0     0
T0230  o^      123     0   100     0     0
```

Description

This subdisplay shows the status of the logical units that are known to the controller firmware. It also indicates performance information for the units. Up to 42 units may be displayed in this subdisplay.

❶ The **Unit** column contains a letter indicating the type of unit followed by the unit number of the logical unit. The list is sorted by unit number. There may be duplication of unit numbers between devices of different types. If this happens, the order of these devices is arbitrary. The following device type letters that may be displayed are as follow:

- **D** indicates a disk device.
- **T** indicates a tape device.
- **L** indicates a media loader.
- **C** indicates a CDROM device.
- **F** indicates a device type not listed above.
- **U** indicates the device type is unknown.

❷ The **ASWC** columns indicate respectively the availability, spindle state, write protect state, and cache state of the logical unit.

The availability state is indicated using the following letters:

- **a**—Available. Available to be mounted by a host system.
- **d**—Offline, Disabled by Digital Multivendor Services. The unit has been disabled for service.
- **e**—Online, Exclusive Access. Unit has been mounted for exclusive access by a user.
- **f**—Offline, Media Format Error. The unit cannot be brought available due to a media format inconsistancy.
- **i**—Offline, Inoperative. The unit is inoperative and cannot be brought available by the controller.
- **m**—Offline, Maintenance. The unit has been placed in Maintenance mode for diagnostic or other purposes.
- **o**—Online. Mounted by at least one of the host systems.
- **r**—Offline, Rundown. The CLI SET NORUN command has been issued for this unit.
- **v**—Offline, No Volume Mounted. The device does not contain media.
- **x**—Online to other controller. Not available for use by this controller.

- A space in this column indicates the availability is unknown.

The spindle state is indicated using the following characters:

- **^**—For disks, this symbol indicates the device is at speed. For tapes, it indicates the tape is loaded.
- **>**—For disks, this symbol indicates the device is spinning up. For tapes, it indicates the tape is loading.
- **<**—For disks, this symbol indicates the device is spinning down. For tapes, it indicates the tape is unloading.
- **v**—For disks, this symbol indicates the device is stopped. For tapes, it indicates the tape is unloaded.
- For other types of devices, this column is left blank.

For disks and tapes, a **w** in the write protect column indicates the unit is write protected. This column is left blank for other device types.

The data caching state is indicated using the following letters:

- **r**—Read caching is enabled.
- A space in this column indicates caching is disabled.

❸ **KB/S**—This column indicates the average amount of kilobytes of data transferred to and from the unit in the previous screen update interval. This data is only available for disk and tape units.

❹ **Rd%**—This column indicates what percentage of data transferred between the host and the unit were read from the unit. This data is only contained in the **DEFAULT** display for disk and tape device types.

❺ **Wr%**—This column indicates what percentage of data transferred between the host and the unit were written to the unit. This data is only contained in the **DEFAULT** display for disk and tape device types.

❻ **Cm%**—This column indicates what percentage of data transferred between the host and the unit were compared. A compare operation may be accompanied by either a read or a write operation, so this column is not cumulative with read percentage and write percentage columns. This data is only contained in the **DEFAULT** display for disk and tape device types.

❼ **HT%**—This column indicates the cache hit percentage for data transferred between the host and the unit.

Unit Status (full)

```
Unit❶ ASWC❷  KB/S❸ Rd%❹  Wr%❺ Cm%❻ HT%❼ PH%❽ MS%❾ Purge❿ BlChd⓫ BlHit⓬
D0003  o^ r    382     0   100    0    0    0    0      0   6880      0
D0250  o^ r    382   100     0    0    0    0  100      0   6880      0
D0251  o^ r    284   100     0    0    0    0  100      0   5120      0
D0262  a^ r      0     0     0    0    0    0    0      0      0      0
D0280  o^ r    497    44    55    0    0    0  100      0   9011      0
D0351  a^ r      0     0     0    0    0    0    0      0      0      0
D0911  a^ r      0     0     0    0    0    0    0      0      0      0
D1000  a^ r      0     0     0    0    0    0    0      0      0      0
```

Description

This subdisplay shows the status of the logical units that are known to the controller firmware. It also shows I/O performance information and caching statistics for the units. Up to 42 units may be displayed in this subdisplay.

❶ The **Unit** column contains a letter indicating the type of unit followed by the unit number of the logical unit. The list is sorted by unit number. There may be duplication of unit numbers between devices of different types. If this happens, the order of these devices is arbitrary. The device type letters that may displayed are as follow:

- **D** indicates a disk device.
- **T** indicates a tape device.
- **L** indicates a media loader.
- **C** indicates a CDROM device.
- **F** indicates a device type not listed above.
- **U** indicates the device type is unknown.

❷ The **ASWC** columns indicate the availability, spindle state, write protect state, and cache state respectively of the logical unit.

The availability state is indicated using the following letters:

- **a**—Available. Available to be mounted by a host system.
- **d**—Offline, Disabled by Digital Multivendor Services. The unit has been disabled for service.
- **e**—Online, Exclusive Access. Unit has been mounted for exclusive access by a user.
- **f**—Offline, Media Format Error. The unit cannot be brought available due to a media format inconsistancy.
- **i**—Offline, Inoperative. The unit is inoperative and cannot be brought available by the controller.
- **m**—Offline, Maintenance. The unit has been placed in maintenance mode for diagnostic or other purposes.
- **o**—Online. Mounted by at least one of the host systems.
- **r**—Offline, Rundown. The CLI SET NORUN command has been issued for this unit.

- **v**—Offline, No Volume Mounted. The device does not contain media.
- **x**—On line to other controller. Not available for use by this controller.
- A space in this column indicates the availability is unknown.

The spindle state is indicated using the following characters:

- **^**—For disks, this symbol indicates the device is at speed. For tapes, it indicates the tape is loaded.
- **>**—For disks, this symbol indicates the device is spinning up. For tapes, it indicates the tape is loading.
- **<**—For disks, this symbol indicates the device is spinning down. For tapes, it indicates the tape is unloading.
- **v**—For disks, this symbol indicates the device is stopped. For tapes, it indicates the tape is unloaded.
- For other types of devices, this column is left blank.

For disks and tapes, a **w** in the write protect column indicates the unit is write protected. This column is left blank for other device types.

The data caching state is indicated using the following letters:

- **r**—Read caching is enabled.
- A space in this column indicates caching is disabled.

❸ **KB/S**—This column indicates the average amount of kilobytes of data transferred to and from the unit in the previous screen update interval. This data is only available for disk and tape units.

❹ **Rd%**—This column indicates what percentage of data transferred between the host and the unit were read from the unit. This data is only contained in the **DEFAULT** display for disk and tape device types.

❺ **Wr%**—This column indicates what percentage of data transferred between the host and the unit were written to the unit. This data is only contained in the **DEFAULT** display for disk and tape device types.

❻ **Cm%**—This column indicates what percentage of data transferred between the host and the unit were compared. A compare operation may be accompanied by either a read or a write operation, so this column is not cumulative with read percentage and write percentage columns. This data is only contained in the **DEFAULT** display for disk and tape device types.

❼ **HT%**—This column indicates the cache hit percentage for data transferred between the host and the unit.

❽ **PH%**—This column indicates the partial cache hit percentage for data transferred between the host and the unit.

❾ **MS%**—This column indicates the cache miss percentage for data transferred between the host and the unit.

❿ **Purge**—This column shows the number of blocks purged from the cache in the last update interval.

⓫ **BlChd**—This column shows the number of blocks added to the cache in the last update interval.

⓬ **BlHit**—This column shows the number of cached data blocks "hit" in the last update interval.

Device Status

PTL❶	ASWF❷	Rq/S❸	RdKB/S❹	WrKB/S❺	Que❻	Tg❼	CR❽	BR❾	TR❿
D100	A^	0	0	0	11	0	0	0	0
D120	A^	0	0	0	0	0	0	0	0
D140	A^	0	0	0	0	0	0	0	0
D210	A^	11	93	0	1	1	0	0	0
D230	A^	0	0	0	0	0	0	0	0
D300	A^	11	93	0	2	1	0	0	0
D310	A^	0	0	0	0	0	0	0	0
D320	A^	36	247	0	12	10	0	0	0
D400	A^	11	93	0	2	1	0	0	0
D410	A^	0	0	0	0	0	0	0	0
D420	A^	36	247	0	10	8	0	0	0
D430	A^	0	0	0	0	0	0	0	0
D440	A^	0	0	0	0	0	0	0	0
D450	A^	0	0	0	0	0	0	0	0
D500	A^	11	93	0	1	1	0	0	0
D510	A^	0	0	0	0	0	0	0	0
D520	A^	0	0	0	0	0	0	0	0
D530	A^	47	0	375	6	5	0	0	0

Description

This subdisplay shows the status of the physical storage devices that are known to the controller firmware. It also shows I/O performance information and bus statistics for these devices. Up to 42 devices may be displayed in this subdisplay.

❶ The **PTL** column contains a letter indicating the type of device followed by the SCSI Port, Target, and LUN of the device. The list is sorted by port, target, and LUN. The device type letters that may be displayed are as follow:

- **D** indicates a disk device.
- **T** indicates a tape device.
- **L** indicates a media loader.
- **C** indicates a CDROM device.
- **F** indicates a device type not listed above.
- **U** indicates the device type is unknown.

❷ The **ASWF** columns indicate the allocation, spindle state, write protect state, and fault state respectively of the device.

The availability state is indicated using the following letters:

- **A**—Allocated to this controller.
- **a**—Allocated to the other controller.
- **U**—Unallocated, but owned by this controller.
- **u**—Unallocated, but owned by the other controller.
- A space in this column indicates the allocation is unknown.

The spindle state is indicated using the following characters:

- **^**—For disks, this symbol indicates the device is at speed. For tapes, it indicates the tape is loaded.

- **>**—For disks, this symbol indicates the device is spinning up. For tapes, it indicates the tape is loading.
- **<**—For disks, this symbol indicates the device is spinning down. For tapes, it indicates the tape is unloading.
- **v**—For disks, this symbol indicates the device is stopped. For tapes, it indicates the tape is unloaded.
- For other types of devices, this column is left blank.

For disks and tapes, a **W** in the write protect column indicates the device is hardware write protected. This column is left blank for other device types.

A **F** in the fault column indicates an unrecoverable device fault. If this field is set, the device fault indicator will also be illuminated.

❸ **Rq/S**—This column shows the average I/O request rate for the device during the last update interval. These requests are up to 8 kilobytes long and are either generated by host requests or cache flush activity.

❹ **RdKB/S**—This column shows the average data transfer rate from the device in kilobytes during the previous screen update interval.

❺ **WrKB/S**—This column shows the average data transfer rate to the device in kilobytes during the previous screen update interval.

❻ **Que**—This column shows the maximum number of transfer requests waiting to be transferred to the device during the last screen update interval.

❼ **Tg**—This column shows the maximum number of transfer requests queued to the device during the last screen update interval. If a device does not support tagged queueing, the maximum value will be 1.

❽ **CR**—This column indicates the number of SCSI command resets that occurred since VTDPY was started.

❾ **BR**—This column indicates the number of SCSI bus resets that occurred since VTDPY was started.

❿ **TR**—This column indicates the number of SCSI target resets that occurred since VTDPY was started.

Device SCSI Port Performance

```
Port❶ Rq/S❷ RdKB/S❸ WrKB/S❹ CR❺ BR❻ TR❼
 1       0       0        0   0   0   0
 2      11      93        0   0   0   0
 3      48     341        0   0   0   0
 4      48     340        0   0   0   0
 5      58      93      375   0   0   0
 6       0       0        0   0   0   0
```

Description

This subdisplay shows the accumulated I/O performance values and bus statistics for the SCSI device ports. The subdisplay for a controller that has six SCSI device ports is shown.

❶ The **Port** column indicates the number of the SCSI device port.

❷ **Rq/S**—This column shows the average I/O request rate for the port during the last update interval. These requests are up to 8 kilobytes long and are either generated by host requests or cache flush activity.

❸ **RdKB/S**—This column shows the average data transfer rate from all devices on the SCSI bus in kilobytes during the previous screen update interval.

❹ **WrKB/S**—This column shows the average data transfer rate to all devices on the SCSI bus in kilobytes during the previous screen update interval.

❺ **CR**—This column indicates the number of SCSI command resets that occurred since VTDPY was started.

❻ **BR**—This column indicates the number of SCSI bus resets that occurred since VTDPY was started.

❼ **TR**—This column indicates the number of SCSI target resets that occurred since VTDPY was started.

Help Example

```
VTDPY> HELP

Available VTDPY commands:

^C - Prompt for commands
^G or ^Z - Update screen
^O - Pause/Resume screen updates
^Y - Terminate program
^R or ^W - Refresh screen
DISPLAY CACHE - Use 132 column unit caching statistics display
DISPLAY DEFAULT - Use default 132 column system performance display
DISPLAY DEVICE - Use 132 column device performance display
DISPLAY STATUS - Use 80 column controller status display
EXIT - Terminate program (same as QUIT)
INTERVAL <seconds> - Change update interval
HELP - Display this help message
REFRESH - Refresh the current display
QUIT - Terminate program (same as EXIT)
UPDATE - Update screen display

VTDPY>
```

Description

This is the sample output from executing the HELP command.

6.6 The CONFIG Utility

The CONFIG utility locates and adds devices to the controller. You should run the CONFIG utility whenever new devices are added to the controller.

The CONFIG searches all port/target/LUN device combinations to determine what devices exist on the subsystem. It adds all new devices that are found. The CONFIG utility does not initialize these devices, and it does not add units or storage sets.

If a device somewhere in the cluster already has the PTL that the CONFIG utility plans to assign, the program will assign an alpha character after the numbers. For example, if another device is already called DISK100, the program will assign the name DISK100A to the new device. (The program compares DISK100A to other PTLs in the cluster, and if DISK100A has already been used, the program increments to DISK100B and so forth.) This avoids the assignment of duplicate PTLs in the same cluster.

6.6.1 Running the CONFIG Utility

You can run the CONFIG utility on either a virtual terminal or on a maintenance terminal.

Before running the CONFIG utility, you may use the SHOW DEVICES command to verify the list of devices that are currently configured on the controller, as shown in the following example. The example shows the CONFIG utility as it is run on an HSJ- or HSD-series controller. The text of the prompts may change slightly when run on other controllers in the HS controller family.

```
HSJ> SHOW DEVICES
No devices
HSJ> RUN CONFIG

Copyright © Digital Equipment Corporation 1993
Config Local Program Invoked

Config will search all port/target/LUN combinations to determine what
devices exist on the subsystem. It will then add all disk, tape and cdrom
devices that are found. It will not initialize devices, add units or
storage sets. Do you want to continue (y/n) [y] ? YES

Config is building its tables and determining what devices exist
on the subsystem. Please be patient.

add disk DISK100   1 0 0
add disk DISK120   1 2 0
add disk DISK140   1 4 0
add disk DISK210   2 1 0
add disk DISK230   2 3 0
add disk DISK500   5 0 0
add disk DISK520   5 2 0
add tape TAPE600   6 0 0
add tape TAPE610   6 1 0

Config - Normal Termination
HSJ>
```

```
HSJ> SHOW DEVICES
Name          Type          Port Targ  LUN                   Used by
------------------------------------------------------------------------------

DISK100       disk             1    0    0
DISK120       disk             1    2    0
DISK140       disk             1    4    0
DISK210       disk             2    1    0
DISK230       disk             2    3    0
DISK500       disk             5    0    0
DISK520       disk             5    2    0
TAPE600       tape             6    0    0
TAPE610       tape             6    1    0
HSJ>
```

After you run the CONFIG utility, you may have to initialize your containers using the INITIALIZE command as described in Appendix B.

6.7 HSZUTIL Virtual Maintenance Terminal Application

This section describes the virtual maintenance terminal application, HSZUTIL. The HSZUTIL program is a host-resident user application that provides a virtual maintenance terminal facility for communicating with an HSZ-series controller over its host SCSI bus interface. The virtual maintenance terminal communication protocol was developed explicitly for the HSZ-series controller.

6.7.1 General Implementation Considerations

The HSZUTIL application is written entirely in C language. The portion of the code that is system dependent is contained in separate system-specific modules.

The terminal interface uses portable C I/O functions and therefore does not support asynchronous terminal I/O. This is not a restriction of the virtual maintenance terminal protocol.

SCSI commands used by the HSZUTIL application in communicating with the HSZ-series controller are as follow:

TEST UNIT READY
INQUIRY
SEND DIAGNOSTIC
RECEIVE DIAGNOSTIC RESULTS

6.7.2 Restrictions

There are several restrictions that must be noted before running the HSZUTIL application, as follow:

- Though the programming interface allows access to most SCSI commands, HSZUTIL is not intended to provide functions beyond those required for maintaining a virtual terminal session. The existing code contains code to several additional SCSI functions. This code is currently disabled.
- The HSZUTIL application does not support the RZxx SCSI DUP protocol.

6.7.3 DEC OSF/1 for Alpha AXP Implementations

The DEC OSF/1 AXP version issues SCSI commands through the CAM User Agent interface. The user identifies the HSZ-series controller through its bus, target, and LUN identifiers. The HSZ-series controller, therefore, does not need to be configured into the system prior to accessing it through HSZUTIL. SUPERUSER privilege is required to run the HSZUTIL application on DEC OSF/1 AXP.

6.7.3.1 Running HSZUTIL Under DEC OSF/1 AXP

The HSZUTIL application is installed in the /USR/LOCAL/BIN directory by SETLD. The program is invoked as follows:

```
#HSZUTIL bus target LUN
```

where:
bus is the number of the SCSI bus.
target is the target ID of the HSZ-series controller.
LUN is the logical unit number of one of the devices connected to the HSZ-series controller.

If specified, the parameters must be specified in order. HSZUTIL prompts for missing parameters. The specified device need not be known to the operating system. To exit the program, enter Ctrl/D.

Control characters to be delivered to the HSZ-series controller CLI are entered by typing the "^" character followed by the appropriate letter. For example, Ctrl/G would be entered as "^G".

6.7.4 Description of HSZ-series Controller Virtual Terminal Protocol Diagnostic Pages

Figures 6–10 and 6–11 present the formats of both the send and receive diagnostic page formats.

Figure 6–10 HSZ-series Controller CLI Send Diagnostic Page Format

```
+----+-------------------------------+
| Bit| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|Byte|   |   |   |   |   |   |   |   |
+----+-------------------------------+
|  0 |      Page Code (80h)          |  CLI Data page (vendor specific)
+----+-------------------------------+
|  1 |        Reserved               |
+----+-------------------------------+
|  2 |(MSB)                          |
+----+---   Page Length (n-3)     ---+
|  3 |                          (LSB)|
+----+-------------------------------+
|  4 |       CLI Cmd Code            | INQUIRY (1) or ANSWER (2)
+----+-------------------------------+
|  5 |        Reserved               |
+----+-------------------------------+
|  6 |                               | Used for ANSWER only
+-  -+---      ASCII Text         ---+ (132 bytes maximum)
|  n |                               |
+----+-------------------------------+
```

Figure 6–11 HSZ-series Controller CLI Receive Diagnostic Page Format

```
+----+-------------------------------+
| Bit| 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|Byte|   |   |   |   |   |   |   |   |
+----+-------------------------------+
|  0 |      Page Code (80h)          | CLI Data page (vendor specific)
+----+-------------------------------+
|  1 |        Reserved               |
+----+-------------------------------+
|  2 |(MSB)                          |
+----+---   Page Length (n-3)     ---+
|  3 |                          (LSB)|
+----+-------------------------------+
|  4 |         Status                | SUCCESS (1) or INPUT_REQUESTED (2)
+----+-------------------------------+
|  5 |         Delay                 | 0.10 second delay before next cmd
+----+-------------------------------+
|  6 |                               | (132 bytes maximum)
+-  -+---      ASCII Text         ---+
|  n |                               |
+----+-------------------------------+
```

6.7.5 Virtual Maintenance Terminal Communications Protocol

The following sections describe the communications protocol developed to support the virtual maintenance terminal utility.

6.7.5.1 Protocol Notes

The virtual maintenance terminal protocol allows asynchronous delivery of control characters using the CLI SEND DIAGNOSTIC PAGE command. The CLI Command Code field is set to ANSWER, and the control character is placed in the first byte of the ASCII text buffer. Any other characters in the ASCII text buffer are ignored.

There is no fixed connection made between the host process and the HSZ-series controller. It is therefore possible to implement a host interface that allows a user to exit the host program while a program is running within the HSZ-series controller. The terminal session could be resumed at a later time. This also implies that if multiple users attempt to have simultaneous virtual terminal sessions, the resulting responses from the controller may be unpredictable.

6.7.5.2 Host Virtual Terminal I/O Algorithm

Following is a description of the sequence of events that occurs in the host virtual maintenance terminal I/O algorithm:

1. Obtain the device information.
2. Enter a SCSI INQUIRY command and display the returned INQUIRY information.
3. Make sure the remote device supports the protocol's diagnostic pages by entering a SCSI RECEIVE DIAGNOSTIC RESULTS command for page 0 and comparing the received list with the virtual terminal protocol list. If the diagnostic pages are not supported, then exit.
4. Enter SCSI TEST UNIT READY commands until either the device becomes available or a failure occurs. If a failure occurs, then exit.
5. To start communication, enter Ctrl/C to place the HSZ-series controller CLI into a known state. This is done by entering a SCSI SEND DIAGNOSTIC command for the CLI DATA PAGE, with the CLI Command Code set at ANSWER and a Ctrl/C character in the first byte of the ASCII Text field. If this fails, exit.

6. Process the following code:

```
Do
    If a message was received from the drive, process it.
    If the message length is greater than 2,
 {
 Print the message.
 If we have a log file, log the message.
 If the message was a SCSI_CLI_INPUT_REQUEST,
     {
     Get terminal input
     If we have a log file, log the terminal input.
     If the first character is a '^' the user is trying to send a
       control character, so convert the string into the appropriate
       control character.
     If we got "End of File" on the input string,
  Put a ^C in the input string to abort the program.
     Send the input string to the remote program.
     }
 }
    Else
 {
 This is a keep alive message, so ignore it.
 }
```

7. If the CLI has asked for a polling delay, sleep for the delay period until End Of File is received on the terminal read or until an error occurs while communicating with the HSZ-series controller.

7

Removing and Replacing Field Replaceable Units

This chapter describes how to remove and replace/install the following FRUs in both dual-redundant and nonredundant configurations:

- Controller module (including its mounting bracket, OCP, and bezel)
- Cache module
- Program card
- Internal host cable (CI)
- External host cables (CI)
- Host cable (DSSI and SCSI)
- SCSI device port cables
- Blowers
- Power supplies

CAUTION

Do not attempt to replace or repair components within FRUs or equipment damage may result. Use the controller fault indications and error logs to isolate FRU-level failures.

This chapter also discusses how to **warm swap** controllers and storage devices.

7.1 Controller Module

Servicing a controller module involves several considerations:

- Diagnosing the controller
- Shutting down controllers
- Deciding what to replace
  - A nonredundant controller
  - One dual-redundant controller
  - Both dual-redundant controllers

7.1.1 Diagnosing the Controller

If you are presented with a controller failure, you should be aware of the following.

Generally, if the green OCP reset (//) button is lit continuously, the controller module needs replacing. However, you need to be as familiar as possible with the failure or reason for replacing the module. Be sure you have followed troubleshooting basics:

1. Make a note of all visual indicators (OCP, device LEDs, and/or error messages) available to you.
2. Extract and read host error logs (Chapter 5).
3. Errors can be intermittent. Reset the controller to see if the error clears.[1]
4. See if the error indication changes after resetting the controller. If the error remains the same, look up information for that error. If the indication changes, look up information for the newer error.

   Refer to Chapter 5 for detailed information about errors and repair actions.

Before Proceeding

You should decide exactly what you will be servicing (a nonredundant controller, one dual-redundant controller, or both dual-redundant controllers) before proceeding to the following sections, as each procedure varies and has different consequences.

7.1.2 Shutting Down a Controller

Controller failures are not the only reason to remove and replace a controller module. You may be moving resources, or removing a functioning controller for use as a replacement somewhere else in your system.

Note

If you wish to quickly remove and replace one controller in a *dual-redundant* configuration, you may warm swap (see Section 7.11.2) the controller with a replacement, if you have one. This method provides the fastest, most transparent way of exchanging controllers with minimal system impact and no down time.

Unless you are warm swapping a controller, you *must* shut down a functional controller before removing it.

Use the following guidelines to shut down a controller:

- Always stop all processes on, and dismount, devices attached to a controller you intend to shut down.
- To enter any CLI> SHUTDOWN command, your terminal must be connected to a fully or partially functional controller. A fully functional controller's green OCP reset (//) LED flashes at 1 Hz. A partially functional controller's green LED may flash at 3 Hz.

[1] Record which devices have lit/flashing fault LEDs before resetting, as a reset may temporarily clear the LED even though the fault remains.

- You cannot enter CLI> SHUTDOWN commands from terminals connected to failed controllers (green LED lit continuously).
  - For dual-redundant configurations *only*:

    You may enter the CLI> SHUTDOWN OTHER_CONTROLLER command from a terminal connected to one of the controllers. The other (shutdown) controller's green LED will light continuously when shutdown completes.

    After you shut down one controller in a dual-redundant configuration, the other **surviving controller** takes over service to the shut down controller's devices. This process is called **failover**.
  - For *both* nonredundant and dual-redundant configurations:

    You may enter the CLI> SHUTDOWN THIS_CONTROLLER command from a terminal connected to the controller you want to shut down. The shutdown controller's green LED will light continuously when shutdown completes.

See Appendix B for a complete description of the SHUTDOWN command and its qualifiers. Be sure to understand the consequences to data and devices when using any qualifiers.

7.1.3 Nonredundant Controller

When you replace the controller module in a nonredundant configuration, device service is interrupted for the duration of the service cycle.[2]

(HSZ-series controllers) In effect, following these procedures to remove and replace an HSZ-series controller is "warm swapping" the controller. This is because *other* targets on the host SCSI bus remain unaffected. However, take care not to confuse removing and replacing an HSZ-series controller with the special warm swap procedure for HSJ-series controllers described in Section 7.11.2.

7.1.3.1 Tools Required

You will need the following tools to remove or replace the controller module:

- ESD strap
- 3/32-inch Allen wrench
- 5/32-inch Allen wrench
- Flat-head screwdriver
- Small flat-head screwdriver

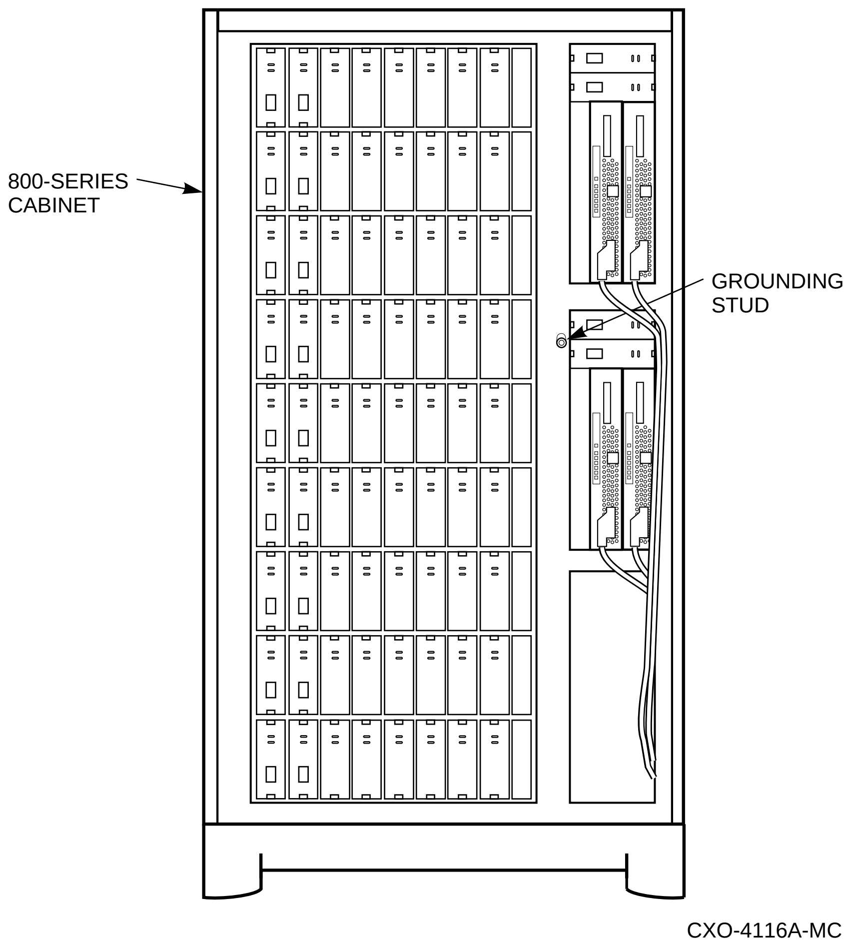
7.1.3.2 Precautions

Refer to Chapter 1 for ESD, grounding, module handling, and program card handling guidelines.

Ground yourself to the cabinet grounding stud, shown in Figure 7–1, before servicing the controller module.

[2] Nonredundant controllers will always be installed in slot (SCSI ID) 7. Slot 7 is the controller shelf slot furthest from the SCSI device cable connectors.

Figure 7–1 Cabinet Grounding Stud



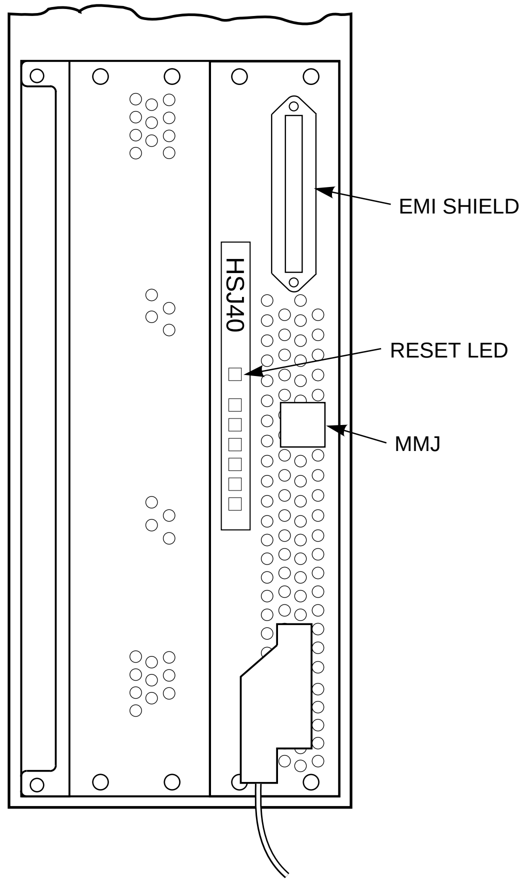
7.1.3.3 Module Removal

Use the following procedure to remove the controller module:

1. If you have not done so already, unlock and open the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
2. Examine the green OCP reset (//) LED, shown in Figure 7–2, on the controller. If the green LED stays lit continuously after troubleshooting (refer to Section 7.1.1), the controller has failed and is already shut down. Proceed to step 6.
3. If the controller is fully or partially functioning (green LED flashing), connect a maintenance terminal to its MMJ, shown in Figure 7–2, and enter the following commands:

```
CLI> SHOW THIS_CONTROLLER FULL
CLI> SHOW DEVICES FULL
CLI> SHOW UNITS FULL
```

Figure 7–2 Reset LED, HSJ40 Controller



4. Record the output from the commands and keep it available for reference.

Note

Never remove a controller while it is still servicing devices.

---

5. Because the controller is still functioning, you must shut down the controller by following the guidelines listed in Section 7.1.2.

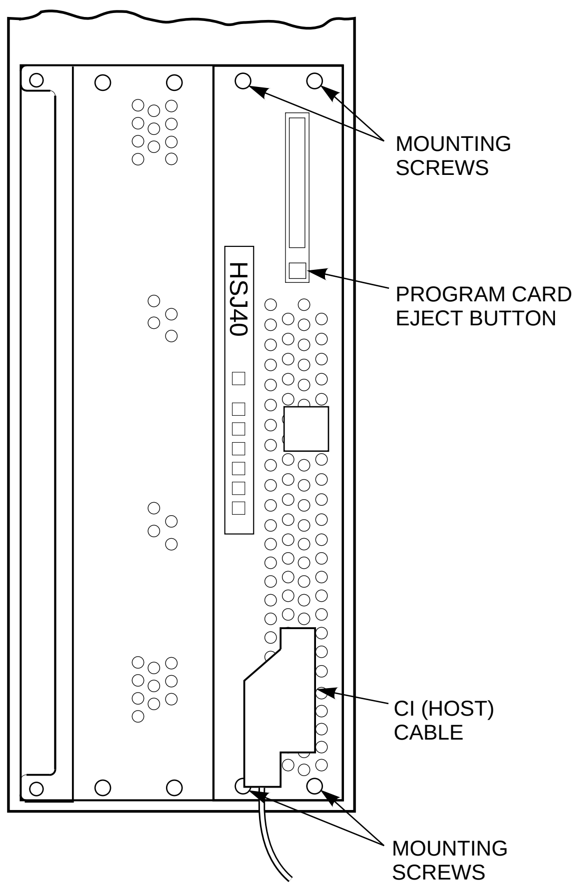
Note

Earlier controller models had a program card EMI shield. This shield may be discarded.

---

6. Unsnap and discard the program card EMI shield (if attached; see Figure 7–2).

Figure 7–3 Eject Button, HSJ40 Controller



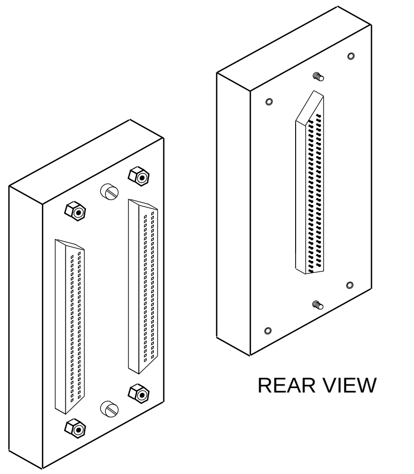
7. Remove the program card by pushing the eject button, shown in Figure 7–3. Pull the card out and save it for use in the replacement controller module.
8. **HSJ-series:** Loosen the captive screws on the CI cable connector, shown in Figure 7–3, with a flat-head screwdriver and remove the cable from the front of the controller module.

CAUTION

Do not remove host port cables from an HSD-series controller while the power is on to *any* members on the DSSI bus, including the controller and host. Doing so risks short circuits that may blow fuses on all the members.

HSD-series: Turn off power to all members on the DSSI bus. Then, with a flat-head screwdriver, loosen the captive screws on the DSSI cable connector and terminator, and remove them from the trilink connector, shown in Figure 7–4.

Figure 7–4 Trilink Connector



HSZ-series: With a small flat-head screwdriver, loosen the captive screws on the trilink connector and remove the trilink from the front of the controller. You will have to work around any SCSI cable or terminator connections when removing the trilink. Do *not* remove cables or terminators from the trilink or you will interrupt the host SCSI bus.

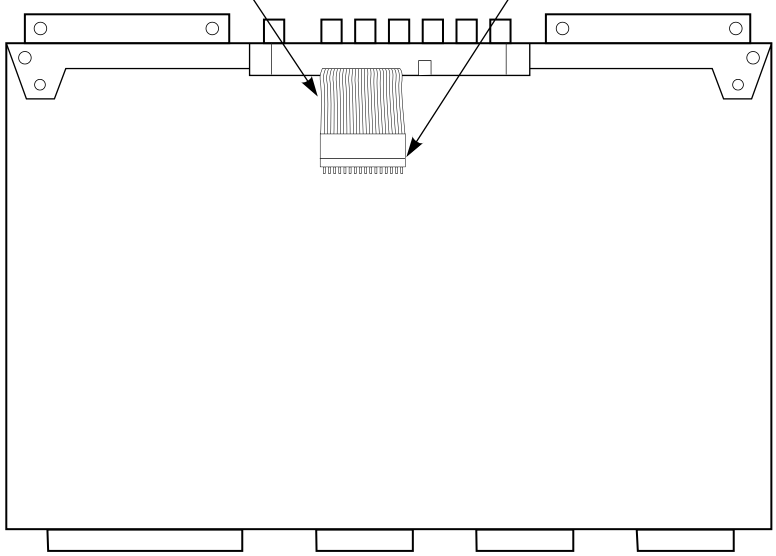
9. Remove the maintenance terminal cable (if attached).
10. Loosen the four mounting screws (refer to Figure 7–3) on each side of the front bezel with a 3/32-inch Allen wrench (HSJ-series controllers) or flat-head screwdriver (HSD- and HSZ-series controllers).
11. Use a gentle up-and-down rocking motion to loosen the module from the shelf backplane.
12. Slide the module out of the shelf (noting which rails the module was seated in) and place on an approved ESD work surface or mat.
13. If necessary, you may now remove the cache module as described in Section 7.2.3.

7.1.3.4 Module Replacement/Installation

Use the following procedure to replace or install the controller module:

1. You should replace the cache module now, if you removed it. See Section 7.2.4 for further information on replacing of installing the cache module.
2. Make sure the OCP cable (HSJ-series only) is correctly plugged into the underside of the module, as shown in Figure 7–5.
3. Slide the controller module into the shelf using its slot's rightmost rails as guides (see Figure 7–6).

Figure 7–5 OCP Cable, HSJ-Series Controller



4. Use a gentle up-and-down rocking motion to help seat the module into the backplane. Press firmly on the module until it is seated. Finally, press firmly once more to make sure the module is seated.
5. Tighten the four screws on the front bezel using a 3/32-inch Allen wrench (HSJ-series controllers) or flat-head screwdriver (HSD- and HSZ-series controllers).
6. Connect a maintenance terminal to the MMJ of the new controller.

Before Proceeding

Set initial controller parameters by following the steps in Section 7.1.3.5.

---

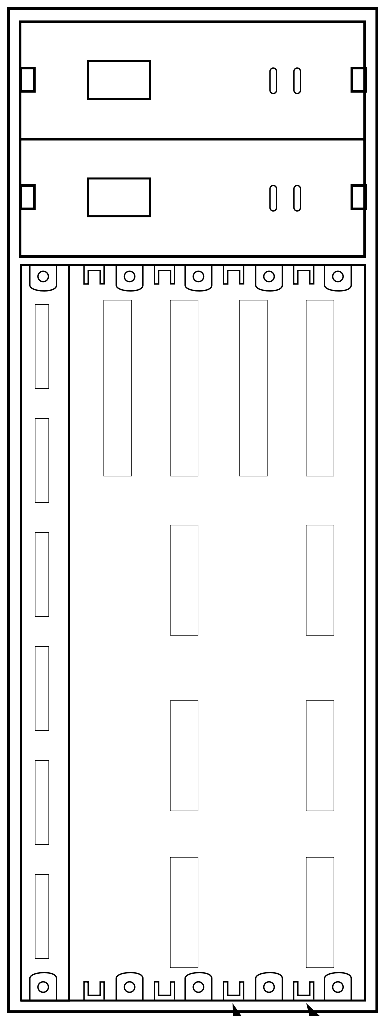
7. Press and hold the controller's green reset (//) button. Then insert the program card into the new controller. The program card eject button will extend when the card is fully inserted.
8. Release the reset button.
9. Enter the following command to initialize the controller:

```
CLI> RESTART THIS_CONTROLLER
```

   If the controller initializes correctly, its green reset LED will begin to flash at 1 Hz. If an error occurs during initialization, the OCP will display a code. Refer to Chapter 5 to analyze the code.

10. If you wish, you may disconnect the maintenance terminal. The terminal is not required for normal controller operation.

Figure 7–6 Controller Shelf Rails



11. Close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.

7.1.3.5 Restoring Initial Parameters

A new controller module has no initial parameters, so you must use the maintenance terminal to enter them. Refer to information in a CONFIGURATION.INFO file or on the configuration sheet packaged with your system, whichever is most current, for parameters. Be sure to use the same parameters from the removed controller when installing a replacement.

After installation of a nonredundant controller, use the CLI to define its parameters in the following order (from a maintenance terminal).

CAUTION

Do not install HSJ-series CI host port cables until after setting all parameters listed here. Failure to follow this procedure may result in adverse effects on the host/cluster.

Note

Not all steps are applicable to all controller models. Steps applicable to certain models are designated as such.

1. (HSD-series controller) Turn the controller on before entering parameters.
2. Enter the following command to set the MAX_NODES (HSJ-series controllers):

   ```
   CLI> SET THIS_CONTROLLER MAX_NODES=n
   ```

   where *n* is 8, 16, or 32.
3. Enter the following command to set a valid controller ID:

   ```
   CLI> SET THIS_CONTROLLER ID=n
   ```

   where *n* is the (HSJ-series controller) CI node number (0 through (MAX_NODES – 1)).

   or *n* is the (HSD-series controller) one-digit DSSI node number (0 through 7). Each controller DSSI node number must be unique on its DSSI interconnect.

   or *n* is the (HSZ-series controller) SCSI target ID(s) (0 through 7).
4. Enter the following command to set the SCS node (HSJ- and HSD-series controllers):

   ```
   CLI> SET THIS_CONTROLLER SCS_NODENAME="xxxxxx"
   ```

   where *xxxxxx* is a one- to six-character alphanumeric name for this node. The node name must be enclosed in quotes with an alphabetic character first. Each SCS node name must be unique within its VMScluster.[3]
5. Enter the following command to set the MSCP allocation class (HSJ- and HSD-series controllers):

   ```
   CLI> SET THIS_CONTROLLER MSCP_ALLOCATION_CLASS=n
   ```

   where *n* is 0 through 255.
6. Enter the following command to set the TMSCP allocation class (HSJ- and HSD-series controllers):

   ```
   CLI> SET THIS_CONTROLLER TMSCP_ALLOCATION_CLASS=n
   ```

[3] Refer to Chapter 4 for important information about VMS node names.

where *n* is 0 through 255.

Note

Always restart the controller after setting the ID, SCS node name, or allocation classes.

7. Restart the controller either by pressing the green reset (//) button, or entering the following command:

```
CLI> RESTART THIS_CONTROLLER
```

8. Enter the following command to verify the preceding parameters were set.

```
CLI> SHOW THIS_CONTROLLER FULL
```

9. Connect the host port cable to the front of the controller.

   HSJ-series: Connect the CI cable and tighten its captive screws with a flat-head screwdriver.

   CAUTION

   Do not connect host port cables to an HSD-series controller while the power is on to *any* members on the DSSI bus, including the controller and host. Doing so risks short circuits that may blow fuses on all the members.

   HSD-series: Disconnect controller power. Then connect the DSSI cable and the terminator to the trilink connector, and tighten their captive screws. Restore power to all members on the DSSI bus.

   HSZ-series: Connect the SCSI cable trilink connector to the front of the controller and tighten its captive screws with a small flat-head screwdriver. You will have to work around any SCSI cable or terminator connections when replacing the trilink. Do *not* remove cables or terminators from the trilink or you will interrupt the host SCSI bus.

10. Enter the following commands to enable CI paths A and B to the host (HSJ-series controllers):

```
CLI> SET THIS_CONTROLLER PATH_A
CLI> SET THIS_CONTROLLER PATH_B
```

   Enter the following command to enable the host port path (HSD-series controllers):

```
CLI> SET THIS_CONTROLLER PATH
```

   The host port path for HSZ-series controllers is always on, so no command is needed.

To automatically configure devices on the controller, use the CONFIG utility described in Chapter 6.

For manual configuration, the following steps add devices, storage sets, and logical units. Use the CLI to complete these steps so that the host will recognize the storage device. (These steps can be run from a virtual terminal.)

1. Add the physical devices by using the following command:

   CLI> **ADD *device-type device-name scsi-location***

   where:
   device-type is the type of device to be added. This can be DISK, TAPE, or CDROM.
   device-name is the name to refer to that device. The name is referenced when creating units or storage sets.
   SCSI-location is the port, target, and LUN (PTL) for the device. When entering the PTL, at least one space must separate the port, target, and LUN.

   For example:

   ```
   CLI> ADD DISK DISK100 1 0 0
   CLI> ADD TAPE TAPE510 5 1 0
   CLI> ADD CDROM CDROM0 6 0 0
   ```

2. Add the storage sets for the devices.

   See Appendix B for examples for adding storage sets. (If you do not desire storage sets in your configuration, proceed to step 3.)

   CAUTION

   The INITIALIZE command destroys all data on a container. See Appendix B for specific information on this command.

3. Enter the following command to initialize the containers (devices and/or storage sets) prior to adding logical units to the configuration.

   CLI> **INITIALIZE *container-name***

   where a *container-name* is a device or storage set that will become part of a unit.

   When initializing a single-device container:

   - If NOTRANSPORTABLE (the default) was specified when the device was added, a small amount of disk space was made inaccessible to the host and used for metadata. The metadata will now be initialized.
   - If TRANSPORTABLE was specified, any metadata on the device will now be destroyed. Refer to Chapter 4 for details on metadata and when INITIALIZE is required.

4. Add the units that use either the devices or the storage sets built from the devices by entering the following command:

   CLI> **ADD UNIT *logical-unit-number container-name***

   where:

   logical-unit-number is the unit number the host uses to access the device.

   container-name identifies the device or the storage set.

5. Use the following commands to verify that your configuration matches the earlier, printed configuration:

```
CLI> SHOW DEVICES FULL
CLI> SHOW UNITS FULL
```

7.1.4 One Dual-Redundant Controller

CAUTION

To perform the procedures in this section, at least one controller must be functioning.

To replace one controller in a dual-redundant configuration (or one at a time), use the second controller to service devices while the first controller is absent. This procedure causes no service outage, but system performance will decrease slightly while one controller does the work of two.

Note

HSD-series controllers: You cannot effectively remove the HSD-series controller in slot (SCSI ID) 7 because of interference from the trilink connector attached to the companion controller. Remove the companion's trilink connector first in this case.

7.1.4.1 Tools Required

You will need the following tools to remove or replace the controller module:

- ESD strap
- 3/32-inch Allen wrench
- 5/32-inch Allen wrench
- Flat-head screwdriver

7.1.4.2 Precautions

Refer to Chapter 1 for ESD, grounding, module handling, and program card handling guidelines.

Ground yourself to the cabinet grounding stud (refer to Figure 7–1) before servicing the controller module.

7.1.4.3 Module Removal

Use the following procedure to remove the controller module:

1. If you have not done so already, unlock and open the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
2. Examine the green OCP reset (//) LED (refer to Figure 7–2) on both controllers. At least one green LED should not remain lit continuously after basic troubleshooting (refer to Section 7.1.1).

   If both green LEDs stay lit continuously, both controllers have failed. Refer to Section 7.1.5.

3. Connect a maintenance terminal to the MMJ (refer to Figure 7–2) of each functioning or partially functioning controller, and enter the following commands:

```
CLI> SHOW THIS_CONTROLLER FULL
CLI> SHOW DEVICES FULL
CLI> SHOW UNITS FULL
```

4. Record the output from the commands and keep it available for reference.

Note

Never remove a controller while it is still servicing devices.

---

5. If the controller you are removing is still functioning (green LED flashing) you must shut down the controller by following the guidelines in Section 7.1.2.

   If the controller's green LED is lit continuously, it has already shut down, and the surviving controller has assumed service to its devices.

Note

Early controller models had a program card EMI shield. This shield may be discarded.

---

6. On the controller you are removing, unsnap and discard the program card EMI shield (if attached; refer to Figure 7–2).
7. Remove the program card by pushing the eject button (refer to Figure 7–3) next to the card. Pull the card out and save it for use in the replacement controller module.
8. **HSJ-series:** Loosen the captive screws on the CI cable connector (refer to Figure 7–3) with a flat-head screwdriver and remove the cable from the front of the controller module.

CAUTION

Do not remove host port cables from an HSD-series controller while the power is on to *any* members on the DSSI bus, including the controller and host. Doing so risks short circuits that may blow fuses on all the members.

   HSD-series: Turn off power to all members on the DSSI bus. Then, with a flat-head screwdriver, loosen the captive screws on the DSSI cable connector and terminator, and remove them from the trilink connector. (If necessary for controller access, loosen the captive screws on the trilink connector and remove it from the front of the companion controller.)

9. Remove the maintenance terminal cable (if attached).
10. Loosen the four screws (refer to Figure 7–3) on each side of the front bezel with a 3/32-inch Allen wrench (HSJ-series controllers) or flat-head screwdriver (HSD- and HSZ-series controllers).
11. Use a gentle up-and-down rocking motion to loosen the module from the shelf backplane.

12. Slide the module out of the shelf (noting which rails the module was seated in) and place on an approved ESD work surface or mat.

13. If necessary, you may now remove the cache module as described in Section 7.2.3.

7.1.4.4 Module Replacement/Installation

Use the following procedure to replace the controller module:

1. Replace the cache module now, if you removed it. Refer to 7.2.4.
2. Make sure the OCP cable (HSJ-series only) is correctly plugged into the underside of the module (refer to Figure 7–5).
3. Slide the controller module into the shelf using its slot's rightmost rails as guides (refer to Figure 7–6).
4. Use a gentle up-and-down rocking motion to help seat the module into the backplane. Press firmly on the module until it is seated. Finally, press firmly once more to make sure the module is seated.
5. Tighten the four screws on the front bezel using a 3/32-inch Allen wrench (HSJ-series controllers) or flat-head screwdriver (HSD- and HSZ-series controllers).
6. Connect a maintenance terminal to the MMJ of the new controller.

Before Proceeding

Restore initial controller parameters by following the steps in Section 7.1.4.5.

7. Press and hold both controllers' green reset (//) buttons. Then insert the program card into the new controller. The program card eject button will extend when the card is fully inserted.
8. Release both reset buttons.
9. Enter the following command to initialize the controller:

```
CLI> RESTART THIS_CONTROLLER
```

   If the controllers initialize correctly, their green LEDs will begin to flash at 1 Hz. If an error occurs during initialization, the OCP will display a code. Refer to Chapter 5 to analyze the code.

10. If you wish, you may disconnect the maintenance terminal. The terminal is not required for normal controller operation.
11. Close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.

7.1.4.5 Restoring Initial Parameters

A new controller module has no initial parameters, so you must use a maintenance terminal to enter them. Refer to information in the CONFIGURATION.INFO file or on the configuration sheet packaged with your system, whichever is most current, for parameters. Be sure to use the same parameters from the removed controller when installing a replacement. Follow these steps:

CAUTION

Do not install HSJ-series CI host port cables until after setting all parameters listed here. Failure to follow this procedure may result in adverse effects on the host/cluster.

CAUTION

SET FAILOVER establishes controller-to-controller communication and copies configuration information. Always enter this command on one controller only. COPY=*configuration-source* specifies where the *good* configuration data are located. *Never* blindly specify SET FAILOVER. Know where your good configuration information resides before entering the command.

Note

Not all steps are applicable to all controller models. Steps applicable to certain models are designated as such.

1. (HSD-series controller) Power the controller on before entering parameters.
2. Enter the following command to copy configuration information to the new controller:

   ```
   CLI> SET FAILOVER COPY=OTHER_CONTROLLER
   ```

3. Enter the following command to set the MAX_NODES (HSJ-series controllers):

   ```
   CLI> SET THIS_CONTROLLER MAX_NODES=n
   ```

   where *n* is 8, 16, or 32.
4. Enter the following command to set a valid controller ID:

   ```
   CLI> SET THIS_CONTROLLER ID=n
   ```

   where *n* is the (HSJ-series controller) CI node number (0 through (MAX_NODES – 1)).

   or *n* is the (HSD-series controller) one-digit DSSI node number (0 through 7). Each controller DSSI node number must be unique on its DSSI interconnect.

5. Enter the following command to set the SCS node:

   ```
   CLI> SET THIS_CONTROLLER SCS_NODENAME="xxxxxx"
   ```

   where *xxxxxx* is a one- to six-character alphanumeric name for this node. The node name must be enclosed in quotes with an alphabetic character first. Each SCS node name must be unique within its VMScluster.[4]

6. Enter the following command to set the MSCP allocation class:

   ```
   CLI> SET THIS_CONTROLLER MSCP_ALLOCATION_CLASS=n
   ```

   where *n* is 1 through 255. Digital recommends providing a unique allocation class value for every pair of dual-redundant controllers in the same cluster.

7. Enter the following command to set the TMSCP allocation class:

   ```
   CLI> SET THIS_CONTROLLER TMSCP_ALLOCATION_CLASS=n
   ```

   where *n* is 1 through 255.

   Note

   Always restart the controllers after setting the ID, SCS node name, or allocation classes.

8. Restart both controllers either by pressing the green reset (//) buttons, or entering the following commands:

   ```
   CLI> RESTART OTHER_CONTROLLER
   CLI> RESTART THIS_CONTROLLER
   ```

9. Enter the following commands to verify the preceding parameters were set:

   ```
   CLI> SHOW THIS_CONTROLLER
   CLI> SHOW OTHER_CONTROLLER
   ```

10. Connect the host port cables to the front of the controllers. Do *not* connect the controllers in a dual-redundant pair to separate, different host CPUs.

    HSJ-series: Connect the CI cable and tighten its captive screws with a flat-head screwdriver.

    CAUTION

    Do not connect host port cables to an HSD-series controller while the power is on to *any* members on the DSSI bus, including the controller and host. Doing so risks short circuits that may blow fuses on all the members.

    HSD-series: Disconnect controller power. Then connect the DSSI cable and the terminator to the trilink connector, and tighten their captive screws. Restore power to all members on the DSSI bus.

[4] Refer to Chapter 4 for important information about VMS node names.

11. Enter the following commands to enable CI paths A and B to the host (HSJ-series controllers):

```
CLI> SET THIS_CONTROLLER PATH_A
CLI> SET THIS_CONTROLLER PATH_B
CLI> SET OTHER_CONTROLLER PATH_A
CLI> SET OTHER_CONTROLLER PATH_B
```

    Enter the following commands to enable the host port path (HSD-series controllers):

```
CLI> SET THIS_CONTROLLER PATH
CLI> SET OTHER_CONTROLLER PATH
```

12. Use the following commands to verify your configuration matches the earlier, printed configuration before proceeding:

```
CLI> SHOW DEVICES FULL
CLI> SHOW UNITS FULL
```

7.1.5 Both Dual-Redundant Controllers

In the rare event that both controllers in your dual-redundant configuration fail, both controllers' green OCP reset (//) LEDs will be lit continuously. You will have to replace both controller modules.

CAUTION

Simultaneously replacing both controllers in a dual-redundant configuration causes system down time for the duration of the service cycle. Digital recommends only using this procedure if both controllers fail, or if your system is off line already for another reason.

Otherwise, to replace both controllers, follow the steps in Section 7.1.4. Replace the controllers one at a time and maintain device service.

Use the following guidelines to simultaneously replace both controllers:

1. Examine the green OCP reset (//) LED on both controllers. Follow basic troubleshooting guidelines (refer to Section 7.1.1), if necessary.
2. For any fully or partially functioning controller, connect a terminal and enter the following commands:

```
CLI> SHOW THIS_CONTROLLER FULL
CLI> SHOW DEVICES FULL
CLI> SHOW UNITS FULL
```

3. Record the output from the commands and keep it available for reference.

CAUTION

Never remove a controller while it is still servicing devices.

---

4. Shut down any fully or partially functioning controller (green LED flashing) by following the guidelines in Section 7.1.2.
5. Remove both controllers by referring to the steps 6 through 13 in Section 7.1.3.3.

6. Replace the first of the controllers as if this were a nonredundant configuration (refer to Section 7.1.3.4).
7. Replace the second controller by following the dual-redundant procedure (refer to Section 7.1.4.4).

7.2 Cache Module

Most controller modules will have a read cache module installed behind them in the controller shelf. Currently there are two read cache modules available: 16 MB and 32 MB.

7.2.1 Tools Required

You will need the following tools to remove or replace the read cache module:

- ESD strap
- nonconductive ESD mat
- 3/32-inch Allen wrench
- 5/32-inch Allen wrench
- Flat-head screwdriver

7.2.2 Precautions

Refer to Chapter 1 for ESD, grounding, module handling, and program card handling guidelines.

Ground yourself to the cabinet grounding stud (Figure 7–1) before servicing the read cache module.

7.2.3 Module Removal

Use the following procedure to remove the read cache module:

1. The controller module is seated in front of the read cache module. Any time you service a read cache, you must shut down the controller(s) based on considerations of configuration, down time, and so on. Refer to Section 7.1.
2. To access the read cache module, remove its controller module. Refer to Section 7.1.
3. Use a gentle up-and-down rocking motion to loosen the module from the shelf backplane.
4. Slide the read cache module out of the shelf, noting which rails it was seated in, and place it on an approved ESD mat.

7.2.4 Module Replacement/Installation

Use the following procedure to replace the read cache module:

1. The controller module is seated in front of the read cache module. Any time you service a read cache, you must shut down controller(s) based on considerations of configuration, down time, and so on. Refer to Section 7.1.
2. To replace the read cache module, its controller module must already be removed. (You should replace the read cache module before reinstalling the controller module.)
3. Slide the read cache module into the shelf using its slot's leftmost rails as guides (refer to Figure 7–6).

4. Press firmly and use a gentle up-and-down rocking motion on the module until it is seated. Finally, press firmly once more to make sure the module is seated.
5. Replace the controller module. Refer to Section 7.1.

7.2.5 Upgrading Cache Modules

You can upgrade a cache module by increasing memory capacity as follows:

1. Determine your cache module type by entering the CLI> SHOW THIS_CONTROLLER command. The following information is displayed:

```
CLI> SHOW THIS_CONTROLLER

Controller:
        HSJ40 CX01234561 Software V1.4, Hardware 0000
        Not configured for dual-redundancy
        SCSI address 7
Host port:
        Node name: HSJA7, valid CI node 29, 32 max nodes
        System ID 4200101DF52F
        Path A is ON
        Path B is ON
        MSCP allocation class    3
        TMSCP allocation class   3
Cache:
        16 megabyte read cache, version 1
        Cache is GOOD
```

Note the cache module size, cache version number, and firmware version.

Note

If you upgrade from 16- to 32-MB read cache, you will need to return the 16-MB module to Digital for replacement when you order the upgrade.

An HSJ40 controller may have a version 1 or 2 cache module. All HSJ30, HSD30, and HSZ40 models will have version 2 cache modules.

You must also run HS operating firmware Version 1.4 or higher to operate *any* version 2 or higher cache module. (Version 1 cache modules are also compatible with firmware Version 1.4.)

2. See Tables 7–1 through 7–4 to find and order the part number you need for the upgrade:

Table 7–1 Cache Upgrade, HSJ40 Controller

Current Cache	Desired Cache	Option Required
16 MB (Ver. 1 or 2)	32 MB	HSJ40–XE

Table 7–2 Cache Upgrade, HSJ30 Controller

Current Cache	Desired Cache	Option Required
None	16 MB 32 MB	HSJ30–XD HSJ30–XF
16 MB	32 MB	HSJ30–XE

Table 7–3 Cache Upgrade, HSD30 Controller

Current Cache	Desired Cache	Option Required
None	16 MB 32 MB	HSD30–XD HSD30–XF
16 MB	32 MB	HSD30–XE

Table 7–4 Cache Upgrade, HSZ40 Controller

Current Cache	Desired Cache	Option Required
None	16 MB 32 MB	HSZ40–XD HSZ40–XF
16 MB	32 MB	HSZ40–XE

3. If necessary, remove the cache module as described in Section 7.2.3.
4. Insert the upgraded cache module by following the steps in 7.2.4.

7.3 Program Card

Whenever you remove a failed controller module (refer to Section 7.1), you remove the PCMCIA program card. However, there are times when you need to remove *only* the program card, such as when you install updated firmware.

You are allowed to remove one or both program cards from a dual-redundant configuration, or one card from a nonredundant configuration.

Note

When you update firmware, you must remove *both* program cards from a dual-redundant configuration. Furthermore, the two cards in a dual-redundant configuration *must* contain the same version of firmware.

Use the procedures in this section when you are removing and replacing *only* the program card.

7.3.1 Tools Required

You will need a 5/32-inch Allen wrench to remove or replace the program card.

7.3.2 Precautions

Refer to Chapter 1 for program card handling guidelines.

7.3.3 Card Removal

Use the following procedure to remove the program card:

1. If you have not done so already, unlock and open the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
2. Examine the green OCP reset (//) LED(s) on the controller(s). They should be flashing.

   If a green LED is lit continuously, its controller has failed. To service the controller, refer to Section 7.1.

   Note

   You need not record configuration information; the configuration infomation is not lost when removing a program card.

3. Connect a maintenance terminal to the MMJ of the controller(s) you are removing the program card from, and shut down the controller(s) by following the guidelines in Section 7.1.2.

   The green LED(s) should light continuously when shutdown completes.

   Note

   Earlier controller models had a program card EMI shield. This shield may be discarded.

4. Unsnap and discard the program card EMI shield(s), if attached.
5. Remove the program card(s) by pushing the eject button(s) (refer to Figure 7–3) next to the card(s).
6. Pull the card(s) out.
7. If you are updating firmware, follow the instructions included with your new firmware for used card return or disposal.

7.3.4 Card Replacement/Installation

Use the following procedure to replace the program card:

Note

If you are updating firmware, install your new program card(s) by following the instructions included with the card(s).

Otherwise, you may use the following guidelines to replace the program card(s).

1. **For a nonredundant configuration:**

   Press and hold the controller green OCP reset (//) button. Then insert the program card. The program card eject button will extend when the card is fully inserted.

   For a dual-redundant configuration:

   Press and hold *both* green reset buttons at the same time, *even if you are only* *replacing one of the cards*. Then insert the program card(s). The program card eject button will extend when the card is fully inserted.

2. Release the reset button(s) to initialize the controller(s).

   If the controller(s) initialize correctly, the green reset LED(s) will begin to flash at 1 Hz. If an error occurs during initialization, the OCP(s) will display a code. Refer to Chapter 5 to analyze any codes.

3. If you wish, you may disconnect the maintenance terminal. The terminal is not required for normal controller operation.

4. Close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.

7.4 External CI Cables (HSJ-Series)

Use the procedures in this section when you are removing and replacing external CI cables.

7.4.1 Tools Required

You will need 5/32-inch Allen wrench to remove or replace external CI cables.

7.4.2 Precautions

Refer to Chapter 1 for CI cable handling guidelines.

7.4.3 Cable Removal

Use the following procedure to remove external CI cables:

1. The CI interface includes two connections (paths A and B). You should determine what paths are suspect before proceeding. Refer to Chapter 5 for troubleshooting guidelines.

   Note

   When only one external CI cable requires replacement, you need only halt activity and disconnect cables for the (one) suspect path.

2. For the suspect path(s), enter one or both of the following commands to halt activity on the suspect host path(s):

   ```
   CLI> SET THIS_CONTROLLER NOPATH_A
   
   CLI> SET THIS_CONTROLLER NOPATH_B
   ```

   CAUTION

   Always disconnect the external CI cable from the star coupler *first*, then disconnect it from the internal CI cable *second*.

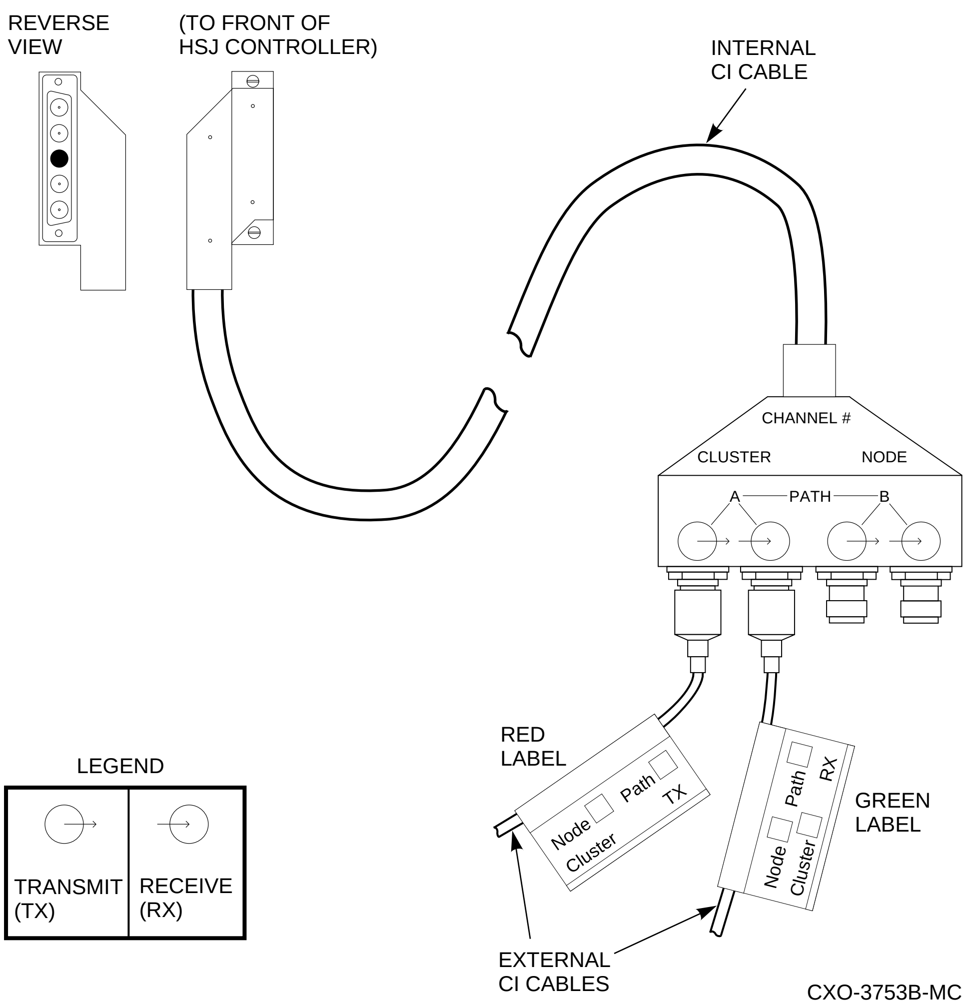
   Never leave unterminated paths on the star coupler. *Never* leave cables, terminated or not, attached at the star coupler and disconnected at the internal CI cable connector. This minimizes adverse effects on the cluster and prevents a short circuit between the two ground references.

3. Disconnect the external CI cable connectors from the star coupler *one at a time, in the following order* (see Figure 7–7):

   TXA
   RXA
   TXB
   RXB

4. Attach terminators to the open star coupler connectors.
5. If necessary to access to internal/external CI cable connector, unlock and open the cabinet (SW800 series) using a 5/32-inch Allen wrench.
6. Disconnect the external CI cables from the internal CI cable.
7. Remove the cable.

Figure 7–7 External and Internal CI Cables (HSJ-series)



7.4.4 Cable Replacement/Installation

Use the following procedure to replace the external CI cables:

CAUTION

Always connect the external CI cable to the internal CI cable *first*, then connect it to the star coupler *second*.

Never leave unterminated paths on the star coupler. *Never* leave cables, terminated or not, attached at the star coupler and disconnected at the internal CI cable connector. This minimizes adverse effects on the cluster and prevents a short circuit between the two ground references.

---

1. Connect the external CI cables to the internal CI cable.
2. If necessary, close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
3. Remove any terminators from the star coupler connections.
4. Connect the external CI cable connectors to the star coupler *one at a time, in the following order* (refer to Figure 7–7):

   RXB
   TXB
   RXA
   TXA

5. For the replaced path(s), enter the following commands to resume activity on the replaced host path(s):

```
CLI> SET THIS_CONTROLLER PATH_A

CLI> SET THIS_CONTROLLER PATH_B
```

7.5 Internal CI Cables (HSJ-series)

Servicing internal CI cables causes down time for the affected controller because both host paths (A and B) must be disabled for the duration of the procedure. Use the procedures in this section when you are removing and replacing internal CI cables.

7.5.1 Tools Required

You will need the following tools to remove or replace internal CI cables:

- 5/32-inch Allen wrench
- Tie wrap cutters
- Flat-head screwdriver

7.5.2 Precautions

Refer to Chapter 1 for CI cable handling guidelines.

7.5.3 Cable Removal

Use the following procedure to remove internal CI cables:

1. You should determine that paths are, in fact, suspect before proceeding. Refer to Chapter 5 for troubleshooting guidelines.
2. Enter the following commands to halt activity on *both* host paths:

```
CLI> SET THIS_CONTROLLER NOPATH_A
CLI> SET THIS_CONTROLLER NOPATH_B
```

CAUTION

Always disconnect the external CI cable from the star coupler *first*, then disconnect it from the internal CI cable *second*.

Never leave unterminated paths on the star coupler. *Never* leave cables, terminated or not, attached at the star coupler and disconnected at the internal CI cable connector. This minimizes adverse effects on the cluster and prevents a short circuit between the two ground references.

---

3. Disconnect the external CI cable connectors from the star coupler *one at a time, in the following order* (refer to Figure 7–7):

   TXA
   RXA
   TXB
   RXB

4. Attach terminators to the open star coupler connectors.
5. Unlock and open the cabinet (SW800 series) using a 5/32-inch Allen wrench.
6. Disconnect the external CI cables from the internal CI cable.
7. Loosen the captive screws on the internal CI cable where it attaches to the front of the controller using a flat-head screwdriver, and disconnect the internal CI cable from the controller.
8. Remove the internal CI cable from the cabinet, cutting tie wraps as necessary.

7.5.4 Cable Replacement/Installation

Use the following procedure to replace internal CI cables:

1. Position and route the internal CI cable within the cabinet.
2. Connect the internal CI cable to the front of the controller, and tighten the captive screws on the internal CI cable where it attaches to the controller using a flat-head screwdriver.

CAUTION

Always connect the external CI cable to the internal CI cable *first*, then connect it to the star coupler *second*.

Never leave unterminated paths on the star coupler. *Never* leave cables, terminated or not, attached at the star coupler and disconnected at the internal CI cable connector. This minimizes adverse effects on the cluster and prevents a short circuit between the two ground references.

---

3. Connect the external CI cables to the internal CI cable.
4. Remove any terminators from the star coupler connections.
5. Connect the external CI cable connectors to the star coupler *one at a time, in the following order* (refer to Figure 7–7):

   RXB
   TXB
   RXA
   TXA

6. Install any tie wraps as necessary to hold the internal CI cable in place.
7. Close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
8. Enter the following commands to resume activity on the host paths:

```
CLI> SET THIS_CONTROLLER PATH_A
CLI> SET THIS_CONTROLLER PATH_B
```

7.6 DSSI Host Cables (HSD-series)

Servicing DSSI host cables (Figure 7–8) causes system down time for all bus members because all power must be disconnected from every member on the DSSI bus before cable removal/replacement. Use the procedures in this section when you are removing and replacing DSSI host cables.

(Optional) The trilink connector may be considered part of the DSSI host cable during service.

CAUTION

Do not service the host port cables of an HSD-series controller while the power is on to *any* members on the DSSI bus, including the controller and host. Doing so risks short circuits that may blow fuses on all the members.

7.6.1 Tools Required

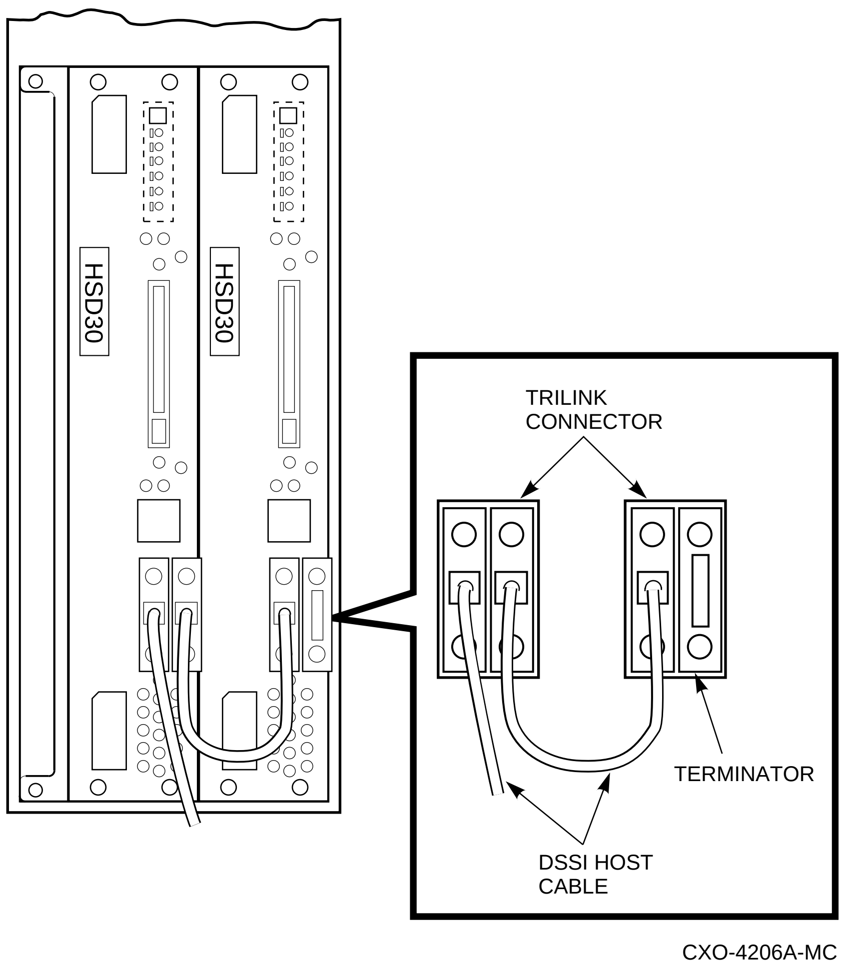
You will need the following tools to remove or replace DSSI host cables:

- 5/32-inch Allen wrench
- Tie wrap cutters
- Flat-head screwdriver

7.6.2 Precautions

Refer to Chapter 1 for DSSI host cable handling guidelines.

Figure 7–8 DSSI Host Cables



7.6.3 Cable Removal

Use the following procedure to remove DSSI host cables:

1. Enter the following command to halt activity on the host path:

   ```
   CLI> SET THIS_CONTROLLER NOPATH
   ```

2. Disconnect power from all members, including the HSD-series controller and host, on the DSSI bus.
3. Disconnect the DSSI host cable from the host or other device (the device at the other end of the cable from the controller).
4. If necessary to access the HSD-series controller, unlock and open the cabinet (SW800 series) using a 5/32-inch Allen wrench.
5. Loosen the captive screws on the DSSI host cable where it attaches to the trilink connector on the front of the controller, and disconnect the cable.
6. Remove the DSSI host cable from the cabinet, cutting tie wraps as necessary.

7. (Optional) Loosen captive screws and remove the terminator or secondary DSSI host cable attached to the trilink connector.
8. (Optional) Loosen captive screws and remove the trilink connector from the front of the controller.

7.6.4 Cable Replacement/Installation

Use the following procedure to replace DSSI host cables:

1. (Optional) Attach the trilink connector to the front of the controller and tighten its captive screws.
2. Position and route the DSSI host cable within the cabinet.
3. Connect the DSSI host cable to the trilink connector on the front of the controller, and tighten the captive screws on the DSSI host cable connector.
4. (Optional) Connect and tighten captive screws for the terminator or secondary DSSI host cable (at the open connection of the trilink connector).
5. Install any tie wraps as necessary to hold the DSSI host cable in place.
6. Close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
7. Connect the other end of the cable to the appropriate device on the bus.
8. Reapply power to the controller and devices on the DSSI bus.
9. Enter the following command to resume activity on the host path:

```
CLI> SET THIS_CONTROLLER PATH
```

7.7 SCSI Host Cables (HSZ-Series)

Servicing SCSI host cables (Figure 7–9) causes subsystem down time because the host path will be disconnected for the duration of the procedure. Use the procedures in this section when you are removing and replacing SCSI host cables.

CAUTION

Never leave active SCSI host buses unterminated during service. How you service your cables, and what devices you may leave running, terminated, and so on, will depend on your configuration.

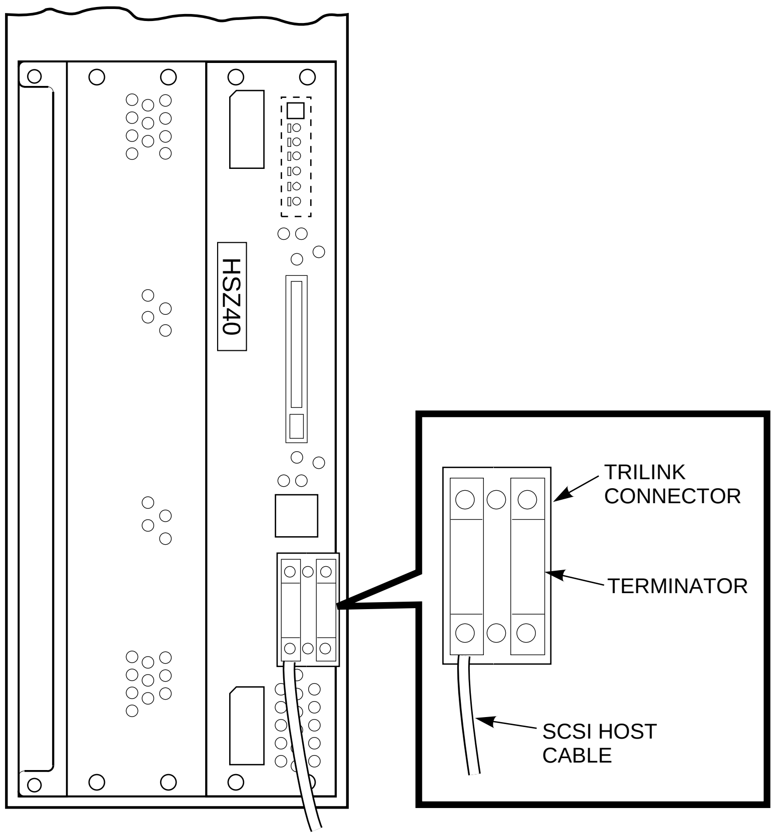
(Optional) The trilink connector may be considered part of the SCSI host cable during service.

7.7.1 Tools Required

You will need the following tools to remove or replace SCSI host cables:

- 5/32-inch Allen wrench
- Tie wrap cutters
- Flat-head screwdriver

Figure 7–9 SCSI Host Cable



7.7.2 Precautions

Refer to Chapter 1 for SCSI host cable handling guidelines.

7.7.3 Cable Removal

Use the following procedure to remove SCSI host cables:

1. Disconnect the SCSI host cable from the host or other device (the device at the other end of the cable from the controller).
2. If necessary to access the HSZ-series controller, unlock and open the cabinet (SW800 series) using a 5/32-inch Allen wrench.
3. Loosen the captive screws on the SCSI host cable where it attaches to the trilink connector on the front of the controller, and disconnect the cable.
4. Remove the SCSI host cable from the cabinet, cutting tie wraps as necessary.
5. (Optional) Loosen captive screws and remove the terminator or secondary SCSI host cable attached to the trilink connector.
6. (Optional) Loosen captive screws and remove the trilink connector from the front of the controller.

7.7.4 Cable Replacement/Installation

Use the following procedure to replace SCSI host cables:

1. (Optional) Attach the trilink connector to the front of the controller and tighten its captive screws.
2. Position and route the SCSI host cable within the cabinet.
3. Connect the SCSI host cable to the trilink connector on the front of the controller, and tighten the captive screws on the SCSI host cable connector.
4. (Optional) Connect and tighten captive screws for the terminator or secondary SCSI host cable (at the open connection of the trilink connector).
5. Install any tie wraps as necessary to hold the SCSI host cable in place.
6. Close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
7. Connect the other end of the cable to the appropriate device on the bus, removing terminators as necessary.

7.8 SCSI Device Port Cables

Servicing SCSI device port cables causes subsystem down time because you must remove devices to access SCSI connectors on the BA350–MA (controller) and BA350–SB (device) shelf backplanes.

Note

If the desired cable connects to a device shelf in the lower part of a cabinet, it may be easier to remove the device shelf rather than attempt this procedure with the shelf installed. Refer to the *StorageWorks Solutions Shelf and SBB User's Guide* for procedures to remove a device shelf and for correct SCSI cable lengths.

7.8.1 Tools Required

You will need the following tools to remove or replace device port cables:

- ESD strap
- 3/32-inch Allen wrench
- 5/32-inch Allen wrench
- Flat-head screwdriver

7.8.2 Precautions

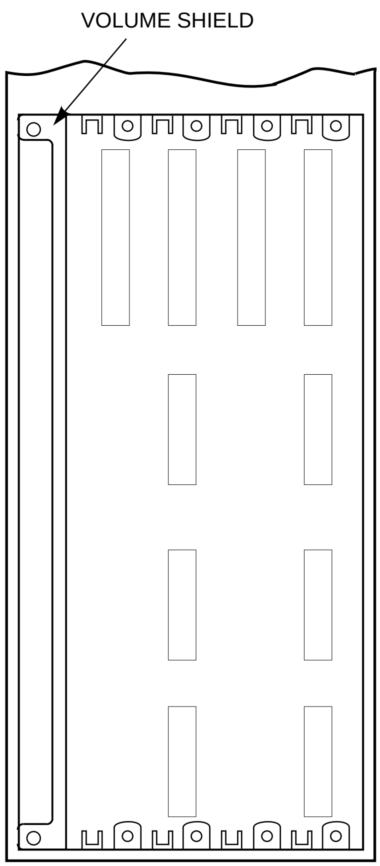
Refer to Chapter 1 for ESD, grounding, module handling, and cable handling guidelines.

7.8.3 Cable Removal

Use the following procedure to remove device port cables:

1. Unlock and open the cabinet (SW800 series) using a 5/32-inch Allen wrench.
2. Remove the controller(s) and cache module(s) by referencing the procedures described in Sections 7.1 and 7.2.
3. Using a flat-head screwdriver, loosen the two captive screws on each side of the volume shield, and remove the shield (see Figure 7–10).

Figure 7–10 Volume Shield



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4. Remove the cable from the BA350–MA (controller) shelf backplane by pinching the cable connector side clips and disconnecting the cable.

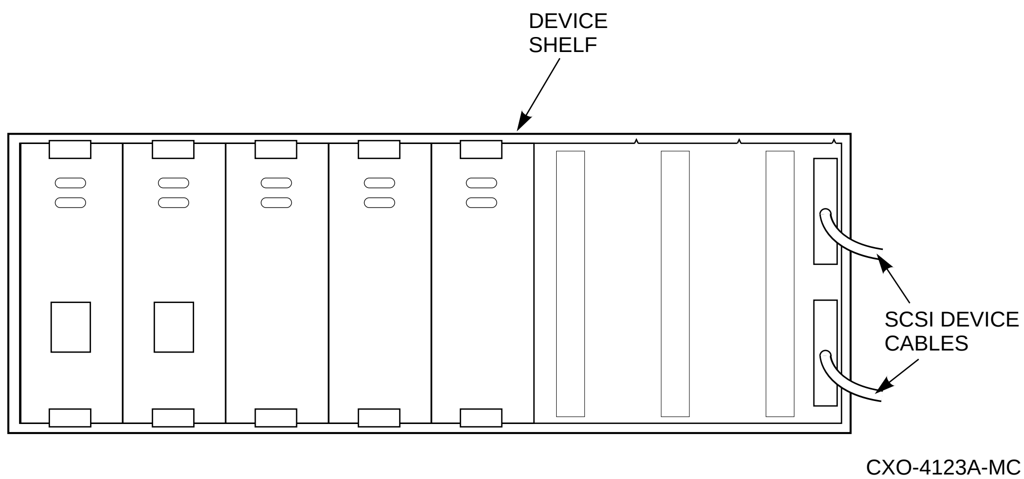
CAUTION

Digital recommends labelling devices to indicate what slot they were removed from. If SBBs are removed and then returned to a different slot, *customer data may be destroyed*.

Let disk drives spin down for at least 30 seconds prior to removing them from the device shelf. Gyroscopic motion from a spinning disk may cause you to drop and damage the SBB.

5. Remove any SBBs necessary to access the SCSI cable, as shown in Figure 7–11. (Press down on the two SBB mounting tabs to release it from the shelf, and pull the device straight out.)
6. Remove the cable from the BA350–SB (device) shelf backplane by pinching the cable connector side clips and disconnecting the cable.

Figure 7–11 SCSI Device Cables



7.8.4 Cable Replacement/Installation

Use the following procedure to replace device port cables:

CAUTION

Be very careful when inserting cable connectors into connectors within the BA350–MA and BA350–SB shelves. Inserting a poorly aligned cable connector can damage the shelf connector.

You must replace the entire shelf if its connectors are damaged.

1. For the device shelf connector, *gently* slide the cable connector in from one side to the other, and rock the connector from top to bottom to seat it.
2. Listen for the connector to snap into place.
3. For the controller shelf connector, *gently* slide the cable connector in from one side to the other, and rock the connector from top to bottom to seat it.

4. Listen for the connector to snap into place.

CAUTION

Return a device to the slot from which it was removed. If SBBs are removed and then returned to a different slot, *customer data may be destroyed*.

5. Insert the SBBs into the device shelf *making sure that all SBBs are returned to their original slots*.

   The SBB mounting tabs will snap into place as the SBBs are locked into the shelf.
6. Replace the volume shield in the controller shelf and tighten the captive screws finger tight using a flat-head screwdriver (refer to Figure 7–10).
7. Replace the cache module(s) and controller(s) by referencing the procedures described in Sections 7.1 and 7.2.
8. Close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.

WARNING

Service procedures described in this manual that involve blower removal or access to the rear of the shelf must be performed only by qualified service personnel.

7.9 Blowers

The BA350–MA and BA350–SB StorageWorks shelves have two rear-mounted blowers that cool the controllers and storage devices (see Figure 7–12). Connectors on the shelf backplane provide +12 Vdc power to operate them. When either blower fails, the shelf status (upper) LED on the power SBB turns off, and an error message is passed to the controller or host.

As long as one blower is operating, there is sufficient air flow to prevent an overtemperature condition. If both blowers fail, the shelf can overheat in as little as 60 seconds.

7.9.1 Tools Required

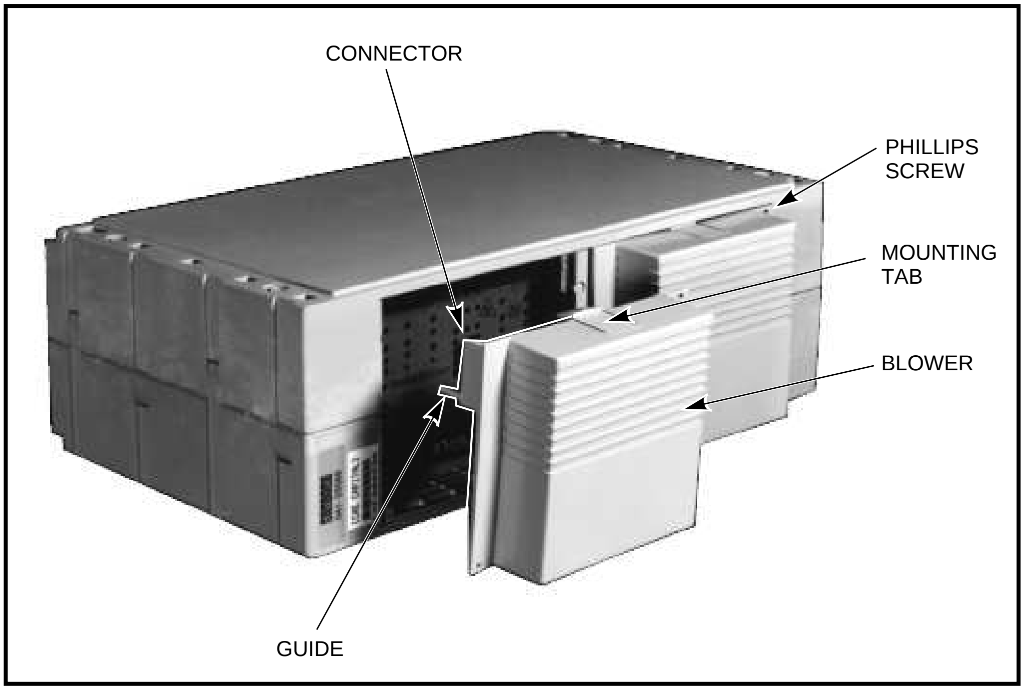
You will need the following tools to remove or replace the blower:

- 5/32-inch Allen wrench
- Phillips screwdriver (#2)

7.9.2 Precautions

Refer to Chapter 1 for safety guidelines.

Figure 7–12 Replacing a Blower



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7.9.3 Blower Removal

WARNING

To reduce the risk of electrical energy hazard, disconnect the power cables from the shelf power supplies before removing shelf blower assemblies or performing service in the backplane area.

Use the following procedure to remove a blower:

1. Unlock and open the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
2. If you cannot access the rear of the shelf, remove its SCSI device cables as described in Section 7.8. Then remove the shelf as described in the *StorageWorks Solutions Shelf and SBB User's Guide*.
3. Disconnect the power cables from the shelf power SBBs. The primary power supply cord is black. The secondary power supply cord is gray.
4. Use a Phillips screwdriver to remove the safety screw in the upper right corner or lower left corner of the blower.
5. Press the upper and lower blower mounting tabs together to release the blower.
6. Pull the blower straight out to disconnect it from the shelf power connector.

7.9.4 Blower Replacement/Installation

WARNING

To reduce the risk of electrical energy hazard, disconnect the power cables from the shelf power supplies before replacing shelf blower assemblies or performing service in the backplane area.

Use the following procedure to replace a blower:

1. Align the replacement blower connector and push the blower straight in, making sure it is fully seated and that both mounting tabs lock in place.
2. Replace the safety screw in the corner of the blower using a Phillips screwdriver.
3. If you had to remove the shelf to access the blowers, replace the shelf as described in the *StorageWorks Solutions Shelf and SBB User's Guide*. Then replace its SCSI device cables as described in Section 7.8.
4. Connect the shelf power cables and verify that the shelf and all SBBs are operating properly.

Note

If the upper power supply LED (shelf status) does not come on and all the shelf power supplies are operating, the second blower may have failed or the wrong blower may have been replaced.

5. Close and lock the cabinet doors (SW800 series) using the 5/32-inch Allen wrench.

7.10 Power Supplies

There are two methods for replacing power supply SBBs: **hot swap** and **cold swap**.

- Use hot swap to replace a power supply *only* when there are two power supplies in a shelf. Hot swap allows you to remove the defective power supply while the other supply furnishes power.

Note

Hot swap does not disable the shelf or its contents.

- Use cold swap during installation or when there is no operational shelf power supply. Should this occur on a controller shelf, the controller, cache module, and all associated SCSI buses are disabled until power is restored. On a device shelf, those particular devices are disabled, though their controller will still service devices on other shelves.

7.10.1 Tools Required

You will need a 5/32-inch Allen wrench to remove or replace a power supply.

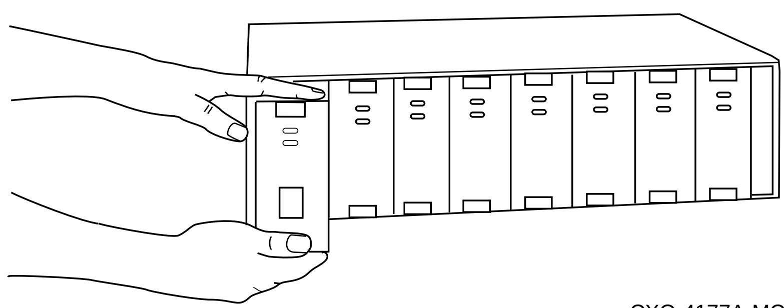
7.10.2 Precautions

Refer to Chapter 1 for safety guidelines.

7.10.3 Power Supply Removal

Use the following procedure to remove a power supply (see Figure 7–13):

Figure 7–13 Power Supply Removal



Note

The cold swap procedure is identical, except you should take the shelf contents (devices or controllers) off line *before* removing the power supply.

1. Unlock and open the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
2. Make sure the power status (lower) LED on the power supply is off.
3. Unplug the power supply.
4. Press the two mounting tabs together to release the power supply from the shelf.

CAUTION

The power supply is relatively heavy and can be damaged if dropped. Always use *both* hands to fully support the power supply during removal.

5. Use both hands to pull the power supply out of the shelf.

7.10.4 Power Supply Replacement/Installation

Use the following procedure to replace a power supply (refer to Figure 7–13):

CAUTION

The power supply is relatively heavy and can be damaged if dropped. Always use *both* hands to fully support the power supply during replacement.

1. Hold the power supply in both hands and firmly push it into the shelf until you hear the mounting tabs snap into place.
2. Plug the power cord back into the power supply.
3. Observe the power and shelf status LEDs to make sure both turn on. If both LEDs do not turn on, refer to Chapter 5 for troubleshooting basics.
4. Close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.

7.11 Warm Swap

When you **warm swap** a storage SBB or a controller, you quickly and efficiently remove the hardware *and* install a replacement. Warm swap is possible *without* taking your controllers out of service or adversely affecting activity on the rest of the subsystem. Using warm swap also preserves data integrity.

Note

Warm swap is not applicable to service on unpowered StorageWorks shelves. Do not attempt to execute warm swap on an unpowered shelf.

7.11.1 SBB Warm Swap

Device warm swap involves quickly removing and replacing a disk drive, tape drive, or other storage SBB. You can safely remove SBBs without taking your system or controller off line. However, before removing a device, either the controller or the operator must determine that the swap is necessary.[5]

- The controller determines that a device is bad by trying to access the device, receiving no response from the device, or detecting excessive errors from the device.
- The operator decides to remove a device by examining the OCP codes, the SBB LEDs, system messages, or system error log information.

7.11.1.1 Tools Required

You will need a 5/32-inch Allen wrench to warm swap a device.

[5] You may also use the SBB warm swap procedure to add a device to an empty shelf slot.

7.11.1.2 Precautions

Refer to Chapter 1 for safety guidelines.

7.11.1.3 Device Removal

CAUTION

Warm swap supports removal and replacement of only *one* SBB at a time. Should another SBB need to be swapped, you must repeat the entire warm swap procedure.

You must follow steps in this section in their exact order so that the following is ensured:

- Preserve data integrity (especially for devices with older SCSI interface designs).
- Reduce chances of making a port unusable for a long period, which can render several devices inaccessible.
- Prevent the controller from performing unpredictably.

Use the following procedure to remove a device:

1. You must dismount the device from the host *before* proceeding. (For example, enter the DISMOUNT command if you are using the OpenVMS operating system.)

   Refer to your operating system documentation for procedures necessary for dismounting a device.
2. Unlock and open the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
3. Quiesce the SBB's port by pressing and holding the controller port button for the SBB. Continue holding the button until all amber OCP LEDs light.

   Note

   Only one port may be quiesced at any time.

   If the button is not held long enough, or multiple buttons are pushed in quick succession, *all* buttons are ignored (no ports are quiesced). You must press and hold the button again to quiesce the port.

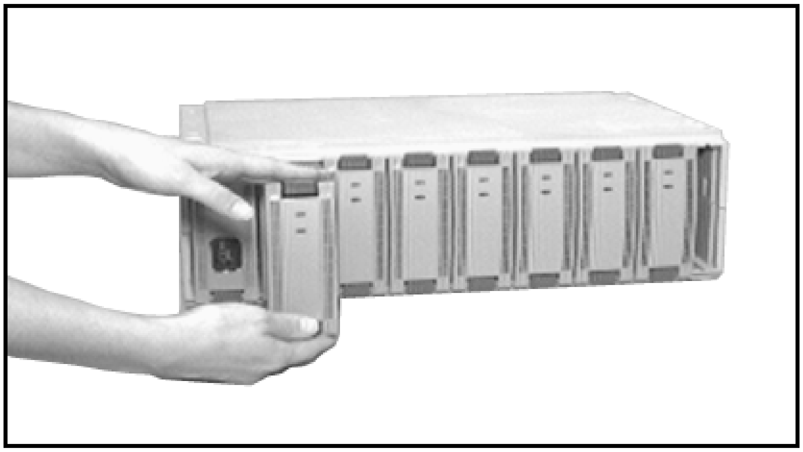
   ---
4. Wait until the chosen port LED flashes alternately with the other port LEDs (this indicates I/O has stopped). The alternating pattern flashes for approximately 30 seconds, during which you may remove the SBB.

   If the pattern does not appear after a minute or two, another shelf is asserting a fault signal that prevents any quiesce function on this controller. To correct the problem, you must locate the suspect shelf and do one of three things:

   - Remove all devices from the shelf.
   - Disconnect the shelf's SCSI device cables (Section 7.8).
   - Repair/replace the shelf power supply (Section 7.10).

5. To remove the SBB, press its two mounting tabs together to release it from the shelf, and pull it out using both hands (see Figure 7–14).

Figure 7–14 SBB Warm Swap



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While the OCP LEDs are flashing, any SBBs on the quiesced port that have status LEDs will also flash.

Note

The length of time required for I/O to stop can vary from zero seconds to several minutes, depending on load, device type, and cache status.

After you remove the SBB, the flashing pattern on the OCP stops, and normal operation on the ports resumes. At this time the removed SBB's port LED will turn on. The LED stays on until the SBB is returned to its slot or until another SBB is inserted in the slot. The remaining port LEDs turn off.

7.11.1.4 Device Replacement

Use a replacement device of the same type as the removed device. Otherwise, subsystem failures such as the establishment of stripesets may occur. Use the following procedure to replace a device:

1. Quiesce the SBBs port by pressing and holding the port button for the SBB. Continue holding the button until all amber OCP LEDs light.

Note

Only one port may be quiesced at any time.

If the button is not held long enough, or multiple buttons are pushed in quick succession, *all* buttons are ignored (no ports are quiesced). You must press and hold the button again to quiesce the port.

---

2. Wait until the chosen port LED flashes alternately with the other port LEDs (this indicates I/O has stopped). The alternating pattern flashes for approximately 30 seconds, during which you may insert the SBB.

   If the pattern does not appear after a minute or two, another shelf is asserting a fault signal that prevents any quiesce function on this controller. To correct the problem, you must locate the suspect shelf and do one of three things:

   - Remove all devices from the shelf.
   - Disconnect the shelf's SCSI device cables (Section 7.8).
   - Repair/replace the shelf power supply (Section 7.10).

   While the OCP LEDs are flashing, any SBBs on the quiesced port that have status LEDs will also flash.

   Note

   The length of time required for I/O to stop can vary from zero seconds to several minutes, depending on load, device type, and cache status.

3. Hold the SBB in both hands, and firmly push it into the shelf until you hear the mounting tabs snap into place.

7.11.1.5 Restoring the Device to the Configuration

After you insert the SBB, the flashing pattern on the OCP stops, and normal operation on the ports resumes. At this time the port LEDs will turn off.

- If you inserted a new device in a previously *unused* slot, that port's LED remains lit until the device is added by entering the following command (see Appendix B):

  ```
  CLI> ADD device
  ```

- If a tape SBB is inserted in a slot where a disk SBB was previously installed, the port LED remains lit until the device is added using the ADD command, *and* you delete the previously installed device from the list of known devices, as follows:

  ```
  CLI> DELETE device-name
  ```

- If the new disk is to be part of a storage set, you must delete the storage set from the configuration and create (ADD) it again.
- Initialize a newly inserted disk by entering the following:

  ```
  CLI> INITIALIZE container
  ```

  where *container* is either the disk, or a group of disks linked as a storage set.

  This initializes the metadata on each disk in the container, including the one that was just swapped.

  Note

  If you think you have failed to perform warm swap exactly as stated here, you should reinitialize the controller. Otherwise, the controller may perform unpredictably.

Remember to close and lock cabinet doors (SW800 series) using a 5/32-inch Allen wrench after finishing the device warm swap.

7.11.2 Controller Warm Swap (HSJ-Series Controllers)

Use warm swap to efficiently remove and replace one controller in a dual-redundant configuration. When you warm swap a controller, you are changing out a controller in the most transparent method available to the HS controller subsystem.

Performing warm swap involves removing one controller, while forcing the other controller into failover. Because the remaining controller executes failover, it assumes control of the absent controller's devices. This minimzes impact to system performance and downtime.

Note

You must warm swap only one controller at a time. Never attempt to remove both controllers in your dual-redundant configuration using warm swap.

Try to have a replacement controller available prior to starting warm swap. Otherwise, you must to terminate the warm swap program and restart it later when you have a replacement.

7.11.2.1 Tools Required

You will need the following tools to warm swap a controller:

- ESD strap
- 3/32-inch Allen wrench
- 5/32-inch Allen wrench
- Flat-head screwdriver

7.11.2.2 Precautions

Refer to Chapter 1 for ESD, grounding, module handling, and program card handling guidelines.

Ground yourself to the cabinet grounding stud (refer to Figure 7–1) before servicing the controller module.

7.11.2.3 Controller Removal

Use the following procedure to remove the controller:

1. Apply either a virtual terminal connection or a maintenance terminal to the controller you will *not* be removing.
2. Enter the RUN C_SWAP command. The system responds with the following:

```
Controller Warm Swap, Software Version -V1.4
Copyright © Digital Equipment Corporation 1993.

*** Sequence to REMOVE other HSJ40 has begun. ***

Do you wish to REMOVE the other HSJ40 Y/N [N]?
```

3. Enter "Y" to continue the procedure.

```
Will its cache module also be removed Y/N [N]?
```

4. Enter “Y” only if you will be removing the controller’s cache module as well.

```
Killing other controller.
Attempting to quiese all ports.

   Port 1 quiesced.
   Port 2 quiesced.
   Port 3 quiesced.
   Port 4 quiesced.
   Port 5 quiesced.
   Port 6 quiesced.

All ports quiesced.

Remove the other HSJ40 (the one WITHOUT a blinking green LED) within 5 minutes.
```

Note

Do not remove the controller with the blinking green LED reset (//) button.

5. You have 5 minutes to remove the controller following the steps described in Table 7–5. Your terminal will update you with the time remaining to complete the removal procedure, as shown in the following example:

```
Time remaining 4 minutes, 40 seconds.
```

Note

If you fail to remove the controller within five minutes, the subsystem will restart the quiesced ports, and you will have to begin this procedure again.

Table 7–5 Module Removal

Step	Description
1	Ground yourself to the cabinet grounding stud (refer to Figure 7–1).
2	Unlock and open the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.
3	Unsnap and discard the program card EMI shield (if attached; refer to Figure 7–2).
4	Remove the program card by pushing the eject button (refer to Figure 7–3) next to the card. Pull the card out and save it for use in the replacement controller module.
5	Loosen the captive screws on the host interface (CI) cable connector (refer to Figure 7–3) with a flat-head screwdriver and remove the cable from the front of the controller module.
6	Loosen the four screws (refer to Figure 7–3) on each side of the front bezel with a 3/32-inch Allen wrench.
7	Use a gentle up-and-down rocking motion to loosen the module from the shelf backplane.
8	Slide the module out of the shelf (noting which rails the module was seated in) and place on an approved ESD work surface or mat.
9	If necessary, you may now remove the cache module as described in Section 7.2.3.

Once you remove the controller, you will see the following displayed as the subsystem uses the remaining controller to service the quiesced ports:

```
Restarting ALL ports.
   Port 1 restarted.
   Port 2 restarted.
   Port 3 restarted.
   Port 4 restarted.
   Port 5 restarted.
   Port 6 restarted.
```

7.11.2.4 Controller Replacement

Use the following procedure to replace the controller:

1. The system will prompt you with the following to replace the controller:

   ```
   Do you have a replacement HSJ40 readily available [N]?
   ```

   Try to have a replacement available. If you do not have one, you must answer with “N”. Then, the warm swap sequence will terminate, and you must restart the routine later when you have a replacement.

2. When you find a replacement, you can restart the sequence by entering the RUN C_SWAP command again. The system responds with the following:

   ```
   Do you have a replacement HSJ40 readily available [N]?
   ```

   Answer “Y” if you have the controller.

3. The following is displayed next:

   ```
   *** Sequence to INSERT other HSJ40 has begun. ***

   Do you wish to INSERT the other HSJ40 [N]?
   ```

   Answer Y to insert the controller.

   Remember to first reinsert the cache module if applicable.

   ```
   Attempting to quiese all ports.

      Port 1 quiesced.
      Port 2 quiesced.
      Port 3 quiesced.
      Port 4 quiesced.
      Port 5 quiesced.
      Port 6 quiesced.

   All ports quiesced.

   Insert the other HSJ40, WITHOUT its program card, and press Return
   ```

4. Insert the cache (if applicable) and controller now. Follow the steps outlined in Table 7–6.

Table 7–6 Module Replacement

Step	Description
1	Ground yourself to the cabinet grounding stud (refer to Figure 7–1).
2	You should replace the cache module now, if you removed it. Refer to Section 7.2.4.
3	Make sure the OCP cable is correctly plugged into side two of the module (refer to Figure 7–5).
4	Slide the controller module into the shelf using its slot's rightmost rails as guides (refer to Figure 7–6).
5	Use a gentle up-and-down rocking motion to help seat the module into the backplane. Press firmly on the module until it is seated. Finally, press firmly once more to make sure the module is seated.
6	Tighten the four screws on the front bezel using a 3/32-inch Allen wrench.
8	Connect a maintenance terminal to the MMJ of the other controller (the one you did not replace) if one is not already connected.

```
Restarting ALL ports.

   Port 1 restarted.
   Port 2 restarted.
   Port 3 restarted.
   Port 4 restarted.
   Port 5 restarted.
   Port 6 restarted.

The configuration has two contollers.
```

5. Follow the steps in the system message:

```
The Controller Warm Swap program has terminated. To restart the other
controller:

 1) Enter the RESTART OTHER command.
 2) Press and hold the Reset button (//) while inserting the program card.
 3) Release Reset (//) and the controller will initialize.
 4) Configure new controller by referring to the HS Array Controller
    User's Guide.
```

   If the controller initializes correctly, its green reset LED will begin to flash at 1 Hz. If an error occurs during initialization, the OCP will display a code. Refer to Chapter 5 to analyze the code.

6. Restore parameters for the new controller using the steps in Section 7.11.2.5.

7.11.2.5 Restoring Parameters

The new controller module has no initial parameters, so you must use a maintenance terminal to enter them. Refer to information in the CONFIGURATION.INFO file or on the configuration sheet packaged with your system, whichever is most current, for parameters. Be sure to use the same parameters from the removed controller when installing a replacement. Follow these steps:

CAUTION

Do not install HSJ-series CI host port cables until after setting all parameters listed here. Failure to follow this procedure may result in adverse effects on the host/cluster.

CAUTION

SET FAILOVER establishes controller-to-controller communication and copies configuration information. Always enter this command on one controller only. COPY=*configuration-source* specifies where the *good* configuration data are located. *Never* blindly specify SET FAILOVER. Know where your good configuration information resides before entering the command.

---

1. Enter the following command to copy configuration information to the new controller:

   ```
   CLI> SET FAILOVER COPY=THIS_CONTROLLER
   ```

2. Enter the following command to set the MAX_NODES:

   ```
   CLI> SET OTHER_CONTROLLER MAX_NODES=n
   ```

   where *n* is 8, 16, or 32.

3. Enter the following command to set a valid controller ID:

   ```
   CLI> SET OTHER_CONTROLLER ID=n
   ```

   where *n* is the CI node number (0 through (MAX_NODES – 1)).

4. Enter the following command to set the SCS node:

   ```
   CLI> SET OTHER_CONTROLLER SCS_NODENAME="xxxxxx"
   ```

   where *xxxxxx* is a one- to six-character alphanumeric name for this node. The node name must be enclosed in quotes with an alphabetic character first. Each SCS node name must be unique within its VMScluster.[6]

5. Enter the following command to set the MSCP allocation class:

   ```
   CLI> SET OTHER_CONTROLLER MSCP_ALLOCATION_CLASS=n
   ```

   where *n* is 1 through 255. Digital recommends providing a unique allocation class value for every pair of dual-redundant controllers in the same cluster.

6. Enter the following command to set the TMSCP allocation class:

   ```
   CLI> SET OTHER_CONTROLLER TMSCP_ALLOCATION_CLASS=n
   ```

   where *n* is 1 through 255.

   Note

   Always restart the new controller after setting the ID, SCS node name, or allocation classes.

   ---

7. Restart the new controller either by pressing its green reset (//) button, or entering the following command:

   ```
   CLI> RESTART OTHER_CONTROLLER
   ```

[6] Refer to Chapter 4 for important information about VMS node names.

8. Enter the following command to verify the preceding parameters were set.

```
CLI> SHOW OTHER_CONTROLLER FULL
```

9. Connect the host port cable to the front of the new controller. Do *not* connect the controllers in a dual-redundant pair to separate, different host CPUs.
10. Enter the following commands to enable CI paths A and B to the host:

```
CLI> SET OTHER_CONTROLLER PATH_A
CLI> SET OTHER_CONTROLLER PATH_B
```

11. If you wish, you may disconnect the maintenance terminal. The terminal is not required for normal controller operation.
12. Close and lock the cabinet doors (SW800 series) using a 5/32-inch Allen wrench.

A

Field Replaceable Units

This appendix lists HS controller field replaceable units (FRUs), required tools and equipment, and related FRUs.

A.1 Controller Field Replaceable Units

The following FRUs come with the various controller modules. Part numbers are correct as of publication of this manual but are subject to change. Always verify your information in case part numbers or ordering methods have changed.

Table A–1 HSJ40 FRUs

FRU	Part Number	
HSJ40 CI SCSI controller module (including OCP and bezel)	70–30097–01	
16 MB read cache module (Version 1)	54–22229–02	(discontinued)
32 MB read cache module (Version 1)	54–22229–01	(discontinued)
16 MB read cache module (Version 2)	54–22910–02	
32 MB read cache module (Version 2)	54–22910–01	
StorageWorks HSJ40 program card	BG–PYU6A–0A	
CI internal cables	GRAY–17–03427–02	
SCSI–2 device port cables	BN21H–02	

Table A–2 HSJ30 FRUs

FRU	Part Number
HSJ30 CI SCSI controller module (including OCP and bezel)	70–30097–02
16 MB read cache module (Version 2)	54–22910–02
32 MB read cache module (Version 2)	54–22910–01
StorageWorks HSJ30 program card	BG–PYU6A–0A
CI internal cables	GRAY–17–03427–02
SCSI–2 device port cables	BN21H–02

Table A–3 HSD30 FRUs

FRU	Part Number
HSD30 DSSI SCSI controller module (including bezel and trilink connector)	70–31458–01
16 MB read cache module (Version 2)	54–22910–02
32 MB read cache module (Version 2)	54–22910–01
StorageWorks HSD30 program card	BG–Q6HL0–0A
SCSI–2 device port cables	BN21H–02
Trilink connector	12–39921–02 (included in 70–31458–01)
50-pin DSSI bus terminator	12–31281–01

Table A–4 HSZ40 FRUs

FRU	Part Number
HSZ40 SCSI-to-SCSI controller module (including bezel and trilink connector)	70–31457–01
16 MB read cache module (Version 2)	54–22910–02
32 MB read cache module (Version 2)	54–22910–01
StorageWorks HSZ40 program card	BG–Q6HN0–0A
SCSI–2 device port cables	BN21H–02
Trilink connector	12–39921–01 (included in 70–31457–01)
68-pin SCSI bus terminator	12–37004–03

A.2 Required Tools and Equipment

The following tools and equipment are required for controller maintenance:

- Portable antistatic kit, part number 29–26246–00
- ESD mat—for all module replacement service
- 3/32-inch Allen wrench—for replacing HSJ-series controllers
- 5/32-inch Allen Wrench—for opening the front door of a SW800 series data center cabinet.
- Flat-head screwdriver—for replacing host cables, HSD-series controllers, and HSZ controllers
- Small flat-head screwdriver—for replacing trilink connectors while SCSI cables are attached

An EIA–423 compatible terminal is needed for setting the initial configuration. When using this terminal, a connecting cable (between the terminal and the controller) that supports EIA–423 communication is required.

A.3 Related Field Replaceable Units

The following FRUs are related to the HS controllers. (Refer to the appropriate StorageWorks documentation for removal and replacement procedures for these components if not found in this manual.)

Table A–5 Controller Related FRUs

FRU	Part Number
CI external cable	BLUE–17–01551–*xx*†
Controller shelf (with backplane)	BA350–MA
Device shelf (with backplane)	BA350–SB
Shelf power supply	H7429–AA
NULL modem DECconnect laptop 9-pin cable	H8571–J
DEC connect cable	BC16E–*xx*†
SCSI–1-to-SCSI–2 transition cable, 0.2 meter (8-inch)‡	17–03831–01

†Where *xx* equals the length in feet.

‡When using a TZ8x7, a transition cable must be routed between the TZ8x7 device and the SCSI–2 cable (because the device is SCSI–1).

B

Command Line Interpreter

This appendix provides the following information:

- A comprehensive list of all CLI commands
- CLI error messages the operator may encounter
- Examples of some common CLI-based procedures

An overview of using the CLI, as well as a description of how to access and exit the CLI, is provided in Chapter 4.

B.1 CLI Commands

The following sections detail each of the allowable commands in the CLI with required parameters and qualifiers. The defaults for each qualifier are indicated by a capital “D” in parentheses (D). Examples are given after the command format, parameters, description, and qualifiers.

ADD CDROM

Adds a CDROM drive to the known list of CDROM drives.

Note

This command is valid for HSJ and HSD controllers only.

Format

ADD CDROM container-name SCSI-location

Parameters

container-name
Specifies the name that will be used to refer to this CDROM drive. This name will be referred to when creating units and stripesets. The name must start with a letter (A through Z) and can then consist of up to eight more characters made up of A through Z, 0 through 9, period (.), dash (-) and underscore (_), for a total of nine characters.

SCSI-location
The location of the CDROM drive to be added in the form PTL where **P** designates the port (1 through 6 or 1 through 3, depending on the controller model), **T** designates the target ID of the CDROM drive, 0 through 6, in a nonfailover configuration, or 0 through 5 if the controller is in a failover configuration, and **L** designates the LUN of the CDROM drive (0 through 7).

When entering PTL, at least one space must separate the the port, target, and LUN.

Description

Adds a CDROM drive to the known list of CDROM drives and names the drive. This command must be used when a new SCSI–2 CDROM drive is to be added to the configuration.

Examples

1.
```
CLI> ADD CDROM CD_PLAYER 1 0 0
```

A CDROM drive is added to port 1, target 0, LUN 0, and named CD_PLAYER.

ADD DISK

Adds a disk drive to the known list of disk drives.

Format

ADD DISK *container-name SCSI-location*

Parameters

container-name

Specifies the name that will be used to refer to this disk drive. This name will be referred to when creating units and stripesets. The name must start with a letter (A through Z) and can then consist of up to eight more characters made up of A through Z, 0 through 9, period (.), dash (-) and underscore (_), for a total of nine characters.

SCSI-location

The location of the disk drive to be added in the form PTL where **P** designates the port (1 through 6 or 1 through 3, depending on the controller model), **T** designates the target ID of the disk drive, 0 through 6, in a nonfailover configuration, or 0 through 5 if the controller is in a failover configuration, and **L** designates the LUN of the disk drive (0 through 7).

When entering PTL, at least one space must separate the port, target, and LUN.

Description

Adds a disk drive to the known list of disk drives and names the drive. This command must be used when a new SCSI–2 disk drive is to be added to the configuration.

Qualifiers

TRANSPORTABLE
NOTRANSPORTABLE (D)

In normal operations, the controller makes a small portion of the disk inaccessible to the host and uses this area to store metadata, which improves data reliability, error detection, and recovery. This vast improvement comes at the expense of transportability.

If NOTRANSPORTABLE is specified (or allowed to default) and there is no valid metadata on the unit, the unit must be initialized.

If TRANSPORTABLE is specified and there *is* valid metadata on the unit, the unit will have to be initialized in order to remove the metadata.

Note

Digital recommends that you avoid specifying TRANSPORTABLE unless transportability of disk drives or media is imperative and there is no other way to accomplish the movement of data.

When entering an ADD DISK command, NOTRANSPORTABLE is the default.

Examples

1. `CLI> ADD DISK RZ26_100 1 0 0`

   A nontransportable disk is added to port 1, target 0, LUN 0, and named RZ26_100.

2. `CLI> ADD DISK DISK0 2 3 0 NOTRANSPORTABLE`

   A nontransportable disk is added to port 2, target 3, LUN 0, and named DISK0.

3. `CLI> ADD DISK TDISK0 3 2 0 TRANSPORTABLE`

   A transportable disk is added to port 3, target 2, LUN 0, and named TDISK0.

ADD STRIPESET

Creates a stripeset from a number of containers.

Format

ADD STRIPESET container-name container-name1 container-name2 [container-nameN]

Parameters

container-name
Specifies the name that will be used to refer to this stripeset. The name must start with a letter (A through Z) and can then consist of up to eight more characters made up of A through Z, 0 through 9, period (.), dash (-) and underscore (_), for a total of nine characters.

container-name1 container-name2 container-nameN
The containers that will make up this stripeset. A stripeset may be made up of from two to fourteen containers.

Description

Adds a stripeset to the known list of stripesets and names the stripeset. This command must be used when a new stripeset is to be added to the configuration.

Qualifiers

CHUNKSIZE=*n*
CHUNKSIZE=DEFAULT (D)
Specifies the chunksize to be used. The chunksize may be specified in blocks (CHUNKSIZE=*n*), or you may let the controller determine the optimal chunksize (CHUNKSIZE=DEFAULT).

When entering an ADD command, CHUNKSIZE=DEFAULT is the default.

Examples

1.
```
CLI> ADD STRIPESET STRIPE0 DISK0 DISK1 DISK2 DISK3
```

A STRIPESET is created out of four disks (DISK0, DISK1, DISK2 and DISK3). Because the chunksize was not specified, the chunksize will be the default.

2.
```
CLI> ADD STRIPESET STRIPE0 DISK0 DISK1 DISK2 DISK3 CHUNKSIZE=16
```

A STRIPESET is created out of four disks (DISK0, DISK1, DISK2 and DISK3). The chunksize will be 16 blocks.

ADD TAPE

Adds a tape drive to the known list of tape drives.

Note

This command is valid for HSJ and HSD controllers only.

Format

ADD TAPE device-name SCSI-location

Parameters

device-name

Specifies the name that will be used to refer to this tape drive. This name will be referred to when creating units. The name must start with a letter (A through Z) and can then consist of up to eight more characters made up of A through Z, 0 through 9, period (.), dash (-) and underscore (_), for a total of nine characters.

SCSI-location

The location of the tape drive to be added in the form PTL where **P** designates the port (1 through 6 or 1 through 3, depending on the controller model), **T** designates the target ID of the tape drive, 0 through 6, in a nonfailover configuration, or 0 through 5 if the controller is in a failover configuration, and **L** designates the LUN of the tape drive (0 through 7).

When entering PTL, at least one space must separate the the port, target, and LUN.

Description

Adds a tape drive to the known list of tape drives and names the drive. This command must be used when a new SCSI–2 tape drive is to be added to the configuration.

Examples

1.
```
CLI> ADD TAPE TAPE0 1 0 0
```

A tape drive is added to port 1, target 0, LUN 0, and named TAPE0.

ADD UNIT

Adds a logical unit to the controller.

Format

ADD UNIT unit-number container-name

Parameters

***unit-number* (HSJ and HSD only)**
The device type letter followed by the logical unit number that the host will use to access the unit. The device type letter is either "D" for disk devices (including CDROMs) or "T" for tape devices. Using this format, logical unit 3, which is made up of a disk or disks (such as a stripeset), would be specified as D3. Logical unit 7, which is made up of a tape device would be T7.

***unit-number* (HSZ only)**
The unit number determines both the target (0 though 7) and the LUN that the device will be made available from. The 100's place of the unit number is the target and the 1's place is the LUN. For example D401 would be target 4, LUN 1. D100 would be target 1, LUN 0. D5 would be target 0, LUN 5.

Note

The only target numbers specified in the unit number *must* be previously specified in the SET THIS_CONTROLLER ID=(*n*1, *n*2) command. A target number may not be specified that has not been previously specified by the SET THIS_CONTROLLER ID= command.

container-name
The name of the container that will be used to create the unit.

Description

The ADD UNIT command is used to add a logical unit for the host to access. All requests by the host to the logical unit number will be mapped as requests to the container specified in the ADD UNIT command.

For disk devices (and stripesets built out of disk devices), the metadata on the container must be initialized before a unit may be created from it. If the container's metadata cannot be found, or is incorrect, an error will be displayed and the unit will not be created.

Qualifiers for a unit created from a CDROM drive (HSJ and HSD only)

MAXIMUM_CACHED_TRANSFER=*n*
MAXIMUM_CACHED_TRANSFER=32 (D)
Specifies the maximum size transfer in blocks to be cached by the controller. Any transfers over this size will not be cached. Valid values are 1 through 1024.

When entering the ADD UNIT command, MAXIMUM_CACHED_TRANSFER=32 is the default.

READ_CACHE (D)
NOREAD_CACHE
Enables and disables the controller's read cache on this unit.

When entering an ADD UNIT command, READ_CACHE is the default.

RUN (D)
NORUN
Enables and disables a unit's ability to be spun up. When RUN is specified, the devices that make up the unit will be spun up. If NORUN is specified, the unit will be spun down.

When entering an ADD UNIT command, RUN is the default.

Qualifiers for a unit created from a disk drive

MAXIMUM_CACHED_TRANSFER=*n*
MAXIMUM_CACHED_TRANSFER=32 (D)
Specifies the maximum size transfer in blocks to be cached by the controller. Any transfers over this size will not be cached. Valid values are 1 through 1024.

When entering the ADD UNIT command, MAXIMUM_CACHED_TRANSFER=32 is the default.

READ_CACHE (D)
NOREAD_CACHE
Enables and disables the controller's read cache on this unit.

When entering an ADD UNIT command, READ_CACHE is the default.

RUN (D)
NORUN
Enables and disables a unit's ability to be spun up. When RUN is specified, the devices that make up the unit will be spun up. If NORUN is specified the unit will be spun down.

When entering an ADD UNIT command, RUN is the default.

WRITE_PROTECT
NOWRITE_PROTECT (D)
Enables and disables write protection of the unit.

When entering an ADD UNIT command, NOWRITE_PROTECT is the default.

Qualifiers for a unit created from a stripeset

MAXIMUM_CACHED_TRANSFER=*n*
MAXIMUM_CACHED_TRANSFER=32 (D)
Specifies the maximum size transfer in blocks to be cached by the controller. Any transfers over this size will not be cached. Valid values are 1 through 1024.

When entering the ADD UNIT command, MAXIMUM_CACHED_TRANSFER=32 is the default.

READ_CACHE (D)
NOREAD_CACHE
Enables and disables the controller's read cache on this unit.

When entering an ADD UNIT command, READ_CACHE is the default.

RUN (D)
NORUN
Enables and disables a unit's ability to be spun up. When RUN is specified, the devices that make up the unit will be spun up. If NORUN is specified the unit will be spun down.

When entering an ADD UNIT command, RUN is the default.

WRITE_PROTECT
NOWRITE_PROTECT (D)
Enables and disables write protection of the unit.

When entering an ADD UNIT command, NOWRITE_PROTECT is the default.

Qualifiers for a unit created from a tape drive (HSJ and HSD only)

DEFAULT_FORMAT=*format*
DEFAULT_FORMAT=DEVICE_DEFAULT (D)
Specifies the tape format to be used unless overridden by the host. Note that not all devices support all formats. The easiest way to determine what formats are supported by a specific device is to enter "SHOW <tape unit number> DEFAULT_FORMAT= ?"—the valid options will be displayed.

Supported tape formats are as follow:

- DEVICE_DEFAULT

  The default tape format is the default that the device uses, or, in the case of devices that are settable via switches on the front panel, the settings of those switches.
- 800BPI_9TRACK
- 1600BPI_9TRACK
- 6250BPI_9TRACK
- TZ85
- TZ86
- TZ87_NOCOMPRESSION
- TZ87_COMPRESSION
- DAT_NOCOMPRESSION
- DAT_COMPRESSION
- 3480_NOCOMPRESSION
- 3480_COMPRESSION

When entering the ADD UNIT command for a tape device, DEFAULT_FORMAT=DEVICE_DEFAULT is the default.

Examples

1. ```
   CLI> ADD UNIT D0 DISK0
   ```

   Disk unit number 0 is created from container DISK0.
   ```

2.
```
CLI> ADD UNIT T0 TAPE12
```

Tape unit number 0 is created from container TAPE12.

CLEAR_ERRORS CLI

Stops the display of errors at the CLI prompt.

Format

```
CLEAR_ERRORS CLI
```

Description

Errors detected by controller firmware are listed before the CLI prompt. These errors are listed even after the error condition is rectified, until either the controller is restarted, or the CLEAR_ERRORS CLI command is entered.

Note

This command does not clear the error conditions; it only clears the reporting of the errors at the CLI prompt.

Examples

1.
```
CLI>
```
```
All NVPM components initialized to their default settings.
CLI> CLEAR_ERRORS CLI
CLI>
```

This clears the message “All NVPM components initialized to their default settings.” that was displayed at the CLI prompt.

DELETE *container-name*

Deletes a container from the list of known containers.

Format

DELETE container-name

Parameters

container-name
Specifies the name that identifies the container. This is the name given the container when it was created using the ADD command (ADD DEVICE, ADD STRIPESET, and so forth).

Description

Checks to see if the container is used by any other containers or a unit. If the container is in use, an error will be displayed and the container will not be deleted.

If the container is not in use, it is deleted.

Examples

1.
```
CLI> DELETE DISK0
```
DISK0 is deleted from the known list of containers.

2.
```
CLI> DELETE STRIPE0
```
STRIPE0 is deleted from the known list of containers.

DELETE *unit-number*

Deletes a unit from the list of known units.

Format

```
DELETE   unit-number
```

Parameters

unit-number
Specifies the logical unit number (on HSDs and HSJs D0–D4094 or T0–T4094, on HSZs D0–D7 or T0–T7) that is to be deleted. This is the name given the unit when it was created using the ADD UNIT command.

Description

If the logical unit specified is on line to a host, the unit will not be deleted unless the OVERRIDE_ONLINE qualifier is specified. If any errors occur when trying to flush the user data, the logical unit will not be deleted.

Qualifiers for HSD and HSJ controllers

OVERRIDE_ONLINE
NOOVERRIDE_ONLINE (D)
If the logical unit is on line to the controller, it will not be deleted unless OVERRIDE_ONLINE is specified.

If the OVERRIDE_ONLINE qualifier is specified, the unit will be spun down, the user data will be flushed to disk and the logical unit will be deleted.

CAUTION

Customer data may be lost or corrupted if the OVERRIDE_ONLINE qualifier is specified.

NOOVERRIDE_ONLINE is the default.

Examples

1. `CLI> DELETE D12`

   Disk unit number 12 is deleted from the known list of units.

2. `CLI> DELETE T3 OVERRIDE_ONLINE`

   Tape unit number 3 is deleted from the known list of units even if it is currently on line to a host.

DIRECTORY

Lists the diagnostics and utilities available on THIS_CONTROLLER.

Format

DIRECTORY

Description

The DIRECTORY command lists the various diagnostics and utilities that are available on THIS_CONTROLLER. A directory of diagnostics and utilities available on this controller is displayed.

For specific information about the diagnostics and utilities available, refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual*.

Examples

1.

```
CLI> DIRECTORY
TILX  X067   D
DILX  X067   D
VTDPY X067   D

ECHO  X067   D
DIRECTX067   D
CLI   X067   D
```

A directory listing.

EXIT

Exits the CLI and breaks a virtual terminal connection.

Format

EXIT

Description

When entering the EXIT command from a host, using a virtual terminal connection, the connection is broken and control is returned to the host. If entered from a maintenance terminal, the EXIT command restarts the CLI, displaying the copyright notice, the controller type, and the last fail packet.

Examples

1.
```
CLI> EXIT

Copyright © Digital Equipment Corporation 1993
HSJ40 Software version E140, Hardware version 0000

Last fail code: 01800080

Press " ?" at any time for help.

CLI>
```

An EXIT command issued from a maintenance terminal.

2.
```
CLI> EXIT
Control returned to host
$
```

An EXIT command entered on a terminal that was connected to the CLI via a DUP connection.

HELP

Displays an overview of how to get help.

Format

```
HELP
```

Description

The HELP command displays a brief description on how to use the question mark (?) to obtain help on any command or function of the CLI.

Examples

1.
```
CLI> HELP
Help may be requested by typing a question mark (?) at the CLI prompt.  This
will display a list of all available commands

For further information you may enter a partial command and type a space
followed by a "?" to print a list of all available options at that point in
the command.  For example:

          SET THIS_CONTROLLER ?

Will print a list of all legal SET THIS_CONTROLLER commands
```

Displaying help using the HELP command.

2.
```
CLI> SET ?
Your options are:
   FAILOVER
   OTHER_CONTROLLER
   NOFAILOVER
   THIS_CONTROLLER
   Unit number or container name
```

Obtaining help on the SET command, using the “?” facility.

INITIALIZE

Initializes the metadata on the container specified.

Format

INITIALIZE   container-name

Parameters

container-name
Specifies the container name to initialize.

Description

The INITIALIZE command initializes a container so a logical unit may be created from it. When initializing a single disk drive container, if NOTRANSPORTABLE was specified or allowed to default on the ADD DISK or SET *disk-name* commands, a small amount of disk space is made inaccessible to the host and used for metadata. The metadata will be initialized. If TRANSPORTABLE was specified, any metadata will be destroyed on the device and the full device will be accessible to the host.

CAUTION

The INITIALIZE command destroys all customer data on the container.

When an initialize is required:

- When a unit is going to be created from a newly installed disk
- When a unit is going to be created from a newly created storage set (stripeset)

When an initialize is specifically *not* required:

- When a unit has been deleted, and a new unit is going to be created from the same container.
- When a storage set that was initialized in the past has been deleted, then re-added using the same members as before.

Examples

1. ```
   CLI> INITIALIZE DISK0
   ```

   Container DISK0 is initialized. If NOTRANSPORTABLE was specified (or allowed to default), metadata is written on it.

2. ```
   CLI> INITIALIZE STRIPE0
   ```

   Container STRIPE0 is initialized and metadata is written on it.

LOCATE

Locates devices (disks, tapes, and storage sets) by lighting the amber device fault LED on the StorageWorks building block (SBB).

Format

LOCATE

Description

The LOCATE command illuminates the amber device fault LEDs (the lower LED on the front of an SBB) of the containers specified. The LOCATE command can also be used as a lamp test.

Qualifiers

ALL

The LOCATE ALL command turns on the amber device fault LEDs of all configured devices. This qualifier can also be used as a lamp test. See LOCATE CANCEL to turn off the LEDs.

An error is displayed if no devices have been configured.

CANCEL

The LOCATE CANCEL command turns off all amber device fault LEDs on all configured devices.

An error is displayed if no devices have been configured.

DISKS

The LOCATE DISKS command turns on the amber device fault LEDs of all configured disks. See LOCATE CANCEL to turn off the LEDs.

An error is displayed if no disks have been configured.

TAPES

The LOCATE TAPES command turns on the amber device fault LEDs of all configured tape devices. See LOCATE CANCEL to turn off the LEDs.

An error is displayed if no tape devices have been configured.

UNITS

The LOCATE UNITS command turns on the amber device fault LEDs of all devices used by units. This command is useful to determine which devices are not currently configured into logical units. See LOCATE CANCEL to turn off device the LEDs.

An error is displayed if no units have been configured.

PTL *SCSI-location*

The LOCATE PTL *SCSI-location* command turns on the amber device fault LEDs at the given SCSI location. *SCSI-location* is specified in the form PTL where **P** designates the port (1 through 6 or 1 through 3, depending on the controller model), **T** designates the target ID of the device (0 through 6) in a nonfailover configuration, or (0 through 5) if the controller is in a failover configuration, and **L** designates the LUN of the device (0 through 7).

When entering the PTL, at least one space must separate the port, target, and LUN. See LOCATE CANCEL to turn off the LEDs.

An error is displayed if the port, target, or LUN is invalid, or if no device is configured at that location.

device or storage set name or unit number (*entity*)
The LOCATE *entity* turns on the amber device fault LEDs that make up the entity supplied. If a device name is given, the device's LED is lit. If a storage set name is given, all device LEDs that make up the storage set are lit. If a unit number is given, all device LEDs that make up the unit are lit. See LOCATE CANCEL to turn off the LEDs.

An error is displayed if no entity by that name or number has been configured.

Examples

1. `CLI> LOCATE DISK0`

   Turns on the device fault LED on device DISK0.

2. `CLI> LOCATE D12`

   Turns on the device fault LEDs on all devices that make up disk unit number 12.

3. `CLI> LOCATE DISKS`

   Turns on the device fault LEDs on all disk devices.

RENAME

Renames a container.

Format

RENAME old-container-name new-container-name

Parameters

old-container-name
Specifies the existing name that identifies the container.

new-container-name
Specifies the new name to identify the container. This name is referred to when creating units and storage sets. The name must start with a letter (A through Z) and can then consist of up to eight more characters made up of A through Z, 0 through 9, period (.), dash (-) and underscore (_), for a total of nine characters.

Description

Gives a known container a new name by which to be referred.

Examples

1.
```
CLI> RENAME DISK0 DISK100
```
Rename container DISK0 to DISK100.

RESTART OTHER_CONTROLLER

Restarts the other controller.

Note

This command is valid for HSJ and HSD controllers only.

Format

```
RESTART OTHER_CONTROLLER
```

Description

The RESTART OTHER_CONTROLLER command restarts the other controller.

If any disks are on line to the other controller, the controller will not restart unless the OVERRIDE_ONLINE qualifier is specified (HSD and HSJ only). If any user data cannot be flushed to disk, the controller will not restart unless the IGNORE_ERRORS qualifier is specified.

Specifying IMMEDIATE will cause the other controller to restart immediately without flushing any user data to the disks, even if drives are on line to the host.

The RESTART OTHER_CONTROLLER command will not cause a failover to this controller in a dual-redundant configuration. The other controller will restart and resume operations where it was interrupted.

Qualifiers for HSD and HSJ controllers

IGNORE_ERRORS
NOIGNORE_ERRORS (D)
If errors result when trying to write user data, the controller will not be restarted unless IGNORE_ERROR is specified.

CAUTION

Customer data may be lost or corrupted if the IGNORE_ERRORS qualifier is specified.

NOIGNORE_ERRORS is the default.

IMMEDIATE
NOIMMEDIATE (D)
If IMMEDIATE is specified, immediately restart the controller without checking for online devices.

CAUTION

Customer data may be lost or corrupted if the IMMEDIATE qualifier is specified.

NOIMMEDIATE is the default.

OVERRIDE_ONLINE
NOOVERRIDE_ONLINE (D)
If any units are on line to the controller, the controller will not be restarted unless OVERRIDE_ONLINE is specified.

If the OVERRIDE_ONLINE qualifier is specified, the controller will restart after all customer data is written to disk.

CAUTION

Customer data may be lost or corrupted if the OVERRIDE_ONLINE qualifier is specified.

NOOVERRIDE_ONLINE is the default.

Examples

1.
```
CLI> RESTART OTHER_CONTROLLER
```
Restart the other controller as long as the other controller does not have any units that are on line.

2.
```
CLI> RESTART OTHER_CONTROLLER OVERRIDE_ONLINE
```
Restart the other controller even if there are units on line to the other controller.

RESTART THIS_CONTROLLER

Restarts this controller.

Format

RESTART THIS_CONTROLLER

Description

The RESTART THIS_CONTROLLER command restarts this controller.

If any disks are on line to this controller, the controller will not restart unless the OVERRIDE_ONLINE qualifier is specified (HSD and HSJ only). If any user data cannot be flushed to disk, the controller will not restart unless the IGNORE_ERRORS qualifier is specified.

Specifying IMMEDIATE will cause this controller to restart immediately without flushing any user data to the disks, even if drives are on line to a host.

The RESTART THIS_CONTROLLER command will not cause a failover to the other controller in a dual-redundant configuration. This controller will restart and resume operations where it was interrupted.

Note

If you enter a RESTART THIS_CONTROLLER command and you are using a virtual terminal to communicate with the controller, the connection will be lost when this controller restarts.

Qualifiers for HSD and HSJ controllers

IGNORE_ERRORS
NOIGNORE_ERRORS (D)
If errors result when trying to write user data, the controller will not be restarted unless IGNORE_ERROR is specified.

CAUTION

Customer data may be lost or corrupted if the IGNORE_ERRORS qualifier is specified.

NOIGNORE_ERRORS is the default.

IMMEDIATE
NOIMMEDIATE (D)
If IMMEDIATE is specified, immediately restart the controller without checking for online devices.

CAUTION

Customer data may be lost or corrupted if the IMMEDIATE qualifier is specified.

NOIMMEDIATE is the default.

OVERRIDE_ONLINE
NOOVERRIDE_ONLINE (D)
If any units are on line to the controller, the controller will not be restarted unless OVERRIDE_ONLINE is specified.

If the OVERRIDE_ONLINE qualifier is specified, the controller will restart after all customer data is written to disk.

CAUTION

Customer data may be lost or corrupted if the OVERRIDE_ONLINE qualifier is specified.

NOOVERRIDE_ONLINE is the default.

Qualifiers for HSZ controllers

IGNORE_ERRORS
NOIGNORE_ERRORS (D)
If errors result when trying to write user data, the controller will not be restarted unless IGNORE_ERROR is specified.

CAUTION

Customer data may be lost or corrupted if the IGNORE_ERRORS qualifier is specified.

NOIGNORE_ERRORS is the default.

IMMEDIATE
NOIMMEDIATE (D)
If IMMEDIATE is specified, immediately restart the controller without checking for online devices.

CAUTION

Customer data may be lost or corrupted if the IMMEDIATE qualifier is specified.

NOIMMEDIATE is the default.

Examples

1.
```
CLI> RESTART THIS_CONTROLLER
```
Restart this controller as long as this controller does not have any units that are on line.

2.
```
CLI> RESTART THIS_CONTROLLER OVERRIDE_ONLINE
```
Restart this controller even if there are units on line to this controller.

RUN

Runs a diagnostic or utility on THIS_CONTROLLER.

Format

RUN   program-name

Parameters

program-name
The name of the diagnostic or utility to be run. DILX and TILX are examples of utilities and diagnostics that can be run from the CLI.

Description

The RUN command enables various diagnostics and utilities on THIS_CONTROLLER. Diagnostics and utilities can *only* be run on the controller where the terminal or DUP connection is connected.

For specific information about available diagnostics and utilities, refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual*.

Examples

1.
```
CLI> RUN DILX

Copyright © Digital Equipment Corporation 1993
Disk Inline Exerciser - version 1.0
            .
            .
            .
```

How the diagnostic DILX would be run.

SELFTEST OTHER_CONTROLLER

Runs a self-test on the other controller.

Note

This command is valid for HSJ and HSD controllers only.

Format

SELFTEST OTHER_CONTROLLER

Description

The SELFTEST OTHER_CONTROLLER command shuts down the other controller, then restarts it in DAEMON loop-on-self-test mode. The OCP reset (//) button must be pushed to take the other controller out of loop-on-self-test mode.

If any disks are on line to the other controller, the controller will not self-test unless the OVERRIDE_ONLINE qualifier is specified (HSD and HSJ only). If any user data cannot be flushed to disk, the controller will not self-test unless the IGNORE_ERRORS qualifier is specified.

Specifying IMMEDIATE will cause the other controller to self-test immediately without flushing any user data to the disks, even if drives are on line to the host.

Qualifiers for HSD and HSJ controllers

IGNORE_ERRORS
NOIGNORE_ERRORS (D)
If errors result when trying to write user data, the controller will not start self-test unless IGNORE_ERROR is specified.

CAUTION

Customer data may be lost or corrupted if the IGNORE_ERRORS qualifier is specified.

NOIGNORE_ERRORS is the default.

IMMEDIATE
NOIMMEDIATE (D)
If IMMEDIATE is specified, immediately start the self-test on the controller without checking for online devices.

CAUTION

Customer data may be lost or corrupted if the IMMEDIATE qualifier is specified.

NOIMMEDIATE is the default.

OVERRIDE_ONLINE
NOOVERRIDE_ONLINE (D)
If any units are on line to the controller, self-test will not take place unless OVERRIDE_ONLINE is specified.

If the OVERRIDE_ONLINE qualifier is specified, the controller will start self-test after all customer data is written to disk .

CAUTION

Customer data may be lost or corrupted if the OVERRIDE_ONLINE qualifier is specified.

NOOVERRIDE_ONLINE is the default.

Examples

1. `CLI> SELFTEST OTHER_CONTROLLER`

   Start the self-test on the other controller, as long as the other controller does not have any units that are on line.

2. `CLI> SELFTEST OTHER_CONTROLLER OVERRIDE_ONLINE`

   Start the self-test on the other controller even if there are units on line to the other controller.

SELFTEST THIS_CONTROLLER

Runs a self-test on this controller.

Format

SELFTEST THIS_CONTROLLER

Description

The SELFTEST THIS_CONTROLLER command shuts down the this controller, then restarts it in DAEMON loop-on-self-test mode. The OCP reset (//) button must be pushed to take this controller out of loop-on-self-test mode.

If any disks are on line to this controller, the controller will not self-test unless the OVERRIDE_ONLINE qualifier is specified (HSD and HSJ only). If any user data cannot be flushed to disk, the controller will not self-test unless the IGNORE_ERRORS qualifier is specified.

Specifying IMMEDIATE will cause this controller to self-test immediately without flushing any user data to the disks, even if drives are on line to a host.

Note

If you enter a SELFTEST THIS_CONTROLLER command, and you are using a virtual terminal to communicate with the controller, the connection will be lost when this controller starts the self-test.

Qualifiers for HSD and HSJ controllers

IGNORE_ERRORS
NOIGNORE_ERRORS (D)
If errors result when trying to write user data, the controller will not start self-test unless IGNORE_ERROR is specified.

CAUTION

Customer data may be lost or corrupted if the IGNORE_ERRORS qualifier is specified.

NOIGNORE_ERRORS is the default.

IMMEDIATE
NOIMMEDIATE (D)
If IMMEDIATE is specified, immediately start the self-test on the controller without checking for online devices.

CAUTION

Customer data may be lost or corrupted if the IMMEDIATE qualifier is specified.

NOIMMEDIATE is the default.

OVERRIDE_ONLINE
NOOVERRIDE_ONLINE (D)
If any units are on line to the controller, SELFTEST will not take place unless OVERRIDE_ONLINE is specified.

If the OVERRIDE_ONLINE qualifier is specified, the controller will start self-test after all customer data is written to disk .

CAUTION

Customer data may be lost or corrupted if the OVERRIDE_ONLINE qualifier is specified.

NOOVERRIDE_ONLINE is the default.

Qualifiers for HSZ controllers

IGNORE_ERRORS
NOIGNORE_ERRORS (D)
If errors result when trying to write user data, the controller will not start self-test unless IGNORE_ERROR is specified.

CAUTION

Customer data may be lost or corrupted if the IGNORE_ERRORS qualifier is specified.

NOIGNORE_ERRORS is the default.

IMMEDIATE
NOIMMEDIATE (D)
If IMMEDIATE is specified, immediately start the self-test on the controller without checking for online devices.

CAUTION

Customer data may be lost or corrupted if the IMMEDIATE qualifier is specified.

NOIMMEDIATE is the default.

Examples

1.
```
CLI> SELFTEST THIS_CONTROLLER
```
Start the self-test on this controller as long as this controller does not have any units on line.

2.
```
CLI> SELFTEST THIS_CONTROLLER OVERRIDE_ONLINE
```
Start the self-test on this controller even if there are units on line to this controller.

SET *disk-container-name*

Modifies the characteristics of a disk drive.

Format

SET disk-container-name

Parameters

disk-container-name
Specifies the name of the disk drive whose characteristics will be modified.

Description

Changes the characteristics of a disk drive.

Qualifiers

TRANSPORTABLE
NOTRANSPORTABLE (D)
In normal operations, the controller makes a small portion of the disk inaccessible to the host and uses this area to store metadata, which improves data reliability, error detection, and recovery. This vast improvement comes at the expense of transportability.

If NOTRANSPORTABLE is specified (or allowed to default) and there is no valid metadata on the unit, the unit must be initialized.

If TRANSPORTABLE is specified and there *is* valid metadata on the unit, the unit will have to be initialized in order to remove the metadata.

Note

Digital recommends that you avoid specifying TRANSPORTABLE unless transportability of disk drives or media is imperative and there is no other way to accomplish the movement of data.

When entering an ADD DISK command, NOTRANSPORTABLE is the default.

Examples

1.
```
CLI> SET DISK130 TRANSPORTABLE
```
DISK130 is made transportable.

SET FAILOVER

Places THIS_CONTROLLER and OTHER_CONTROLLER into a dual-redundant configuration.

Format

SET FAILOVER COPY=*configuration-source*

Parameters

COPY=configuration-source
Specifies where the "good" copy of the device configuration resides.

If THIS_CONTROLLER is specified for *configuration-source*, all the device configuration information on THIS_CONTROLLER (the one that either the maintenance terminal is connected to or the virtual terminal is connected to) is copied to the other controller.

If OTHER_CONTROLLER is specified for *configuration-source*, all the device configuration information on the OTHER_CONTROLLER (the controller that either the maintenance terminal or the virtual terminal connection is *not* connected to) will be copied to this controller.

Description

The SET FAILOVER command places THIS_CONTROLLER and the OTHER_CONTROLLER in a dual-redundant configuration. After entering this command, if one of the two controllers fail, the devices attached to the failed controller become available to and accessible through the operating controller.

CAUTION

All device configuration information on the controller *not* specified by the COPY= parameter is destroyed and overwritten by the configuration information found in the controller specified by the COPY= parameter. **Make sure you know where your good configuration information is stored, or you have a complete copy of the device configuration, BEFORE entering this command**.

A considerable amount of work and effort will be lost by overwriting a good configuration with incorrect information if the wrong controller is specified by the COPY= parameter.

Also note that due to the amount of information that must be passed between the two controllers, this command may take up to 1 minute to complete.

Examples

1.
```
CLI> SET FAILOVER COPY=THIS_CONTROLLER
```

This places two controllers into a dual-redundant configuration, where the "good" data was on the controller that the maintenance terminal or virtual terminal connection was connected to.

2. `CLI> SET FAILOVER COPY=OTHER_CONTROLLER`

   This places two controllers into a dual-redundant configuration, where the "good" data was on the controller that the maintenance terminal or virtual terminal connection was *not* connected to.

SET NOFAILOVER

Removes THIS_CONTROLLER and OTHER_CONTROLLER (if reachable) from a dual-redundant configuration.

Format

```
SET NOFAILOVER
```

Description

The SET NOFAILOVER command removes THIS_CONTROLLER and the OTHER_CONTROLLER (if currently reachable) from a dual-redundant configuration. Before or immediately after entering this command, one controller should be physically removed because the sharing of devices is not supported by single controller configurations.

The controller on which the command was entered will always be removed from a dual-redundant state, even if the other controller is not currently reachable. No configuration information is lost when leaving a dual-redundant state.

Examples

1. ```
   CLI> SET NOFAILOVER
   ```

   The two controllers are taken out of dual-redundant configuration.
   ```

SET OTHER_CONTROLLER

Modifies the other controller's parameters (in a dual-redundant configuration the controller that the maintenance terminal is *not* connected to or the controller that is *not* the target of the DUP connection.

Note

This command is valid for HSJ and HSD controllers only.

Format

SET OTHER_CONTROLLER

Description

The SET OTHER_CONTROLLER command allows you to modify the controller parameters of the other controller in a dual-redundant configuration.

Qualifiers for HSD controllers

ID=*n*
Specifies the DSSI node number (0 through 7).

MSCP_ALLOCATION_CLASS=*n*
Specifies the allocation class (0 through 255 in a single controller configuration or 1 through 255 in a dual-redundant configuration).

When first installed, the controller's MSCP_ALLOCATION_CLASS is set to 0.

PATH
NOPATH
Enables or disables the DSSI port.

When first installed, NOPATH is set.

PROMPT="new prompt"
Specifies a 1- to 16-character prompt enclosed in quotes that will be displayed when the controller's CLI prompts for input. Only printable ASCII characters are valid.

When first installed, the CLI prompt is set to the first three letters of the controller's model number (for example, HSJ>, HSD> or HSZ>).

SCS_NODENAME="*xxxxxx*"
Specifies a one to six character name for node.

TERMINAL_PARITY={ODD,EVEN}
NOTERMINAL_PARITY
Specifies the parity transmitted and expected. Parity options are ODD or EVEN. NOTERMINAL_PARITY causes the controller not to check for or transmit any parity on the terminal lines.

When first installed, the controller's terminal parity is set to NOTERMINAL_PARITY.

TERMINAL_SPEED=*baud_rate*
Sets the terminal speed to 300, 600, 1200, 2400, 4800, or 9600 baud. The transmit speed is always equal to the receive speed.

When first installed, the controller's terminal speed is set to 9600 baud.

TMSCP_ALLOCATION_CLASS=*n*
Specifies the allocation class (0 through 255 in a single controller configuration or 1 through 255 in a dual-redundant configuration).

When first installed, the controller's TMSCP_ALLOCATION_CLASS is set to 0.

Qualifiers for HSJ controllers

ID=*n*
Specifies the CI node number (0 through (MAX_NODES – 1)).

MAX_NODES=*n*
Specifies the maximum number of nodes (8, 16, or 32).

When first installed, the controller's MAX_NODES is set to 16.

MSCP_ALLOCATION_CLASS=*n*
Specifies the allocation class (0 through 255 in a single controller configuration or 1 through 255 in a dual-redundant configuration).

When first installed, the controller's MSCP_ALLOCATION_CLASS is set to 0.

PATH_A
NOPATH_A
Enables or disables CI Path A.

When first installed, NOPATH_A is set.

PATH_B
NOPATH_B
Enables or disables CI Path B.

When first installed, NOPATH_B is set.

PROMPT="new prompt"
Specifies a 1- to 16-character prompt enclosed in quotes that will be displayed when the controller's CLI prompts for input. Only printable ASCII characters are valid.

When first installed, the CLI prompt is set to the first three letters of the controller's model number (for example, HSJ>, HSD> or HSZ>).

SCS_NODENAME="*xxxxxx*"
Specifies a one to six character name for node.

TERMINAL_PARITY={ODD,EVEN}
NOTERMINAL_PARITY
Specifies the parity transmitted and expected. Parity options are ODD or EVEN. NOTERMINAL_PARITY causes the controller not to check for or transmit any parity on the terminal lines.

When first installed, the controller's terminal parity is set to NOTERMINAL_PARITY.

TERMINAL_SPEED=*baud_rate*
Sets the terminal speed to 300, 600, 1200, 2400, 4800, or 9600 baud. The transmit speed is always equal to the receive speed.

When first installed, the controller's terminal speed is set to 9600 baud.

TMSCP_ALLOCATION_CLASS=*n*
Specifies the allocation class (0 through 255 in a single controller configuration or 1 through 255 in a dual-redundant configuration).

When first installed, the controller's TMSCP_ALLOCATION_CLASS is set to 0.

Examples

1.
```
CLI> SET OTHER_CONTROLLER PATH_A PATH_B SPEED=1200
```

Turns on the other HSJ controller's two CI paths and sets the terminal speed to 1200 baud.

SET *stripeset-container-name*

Modifies the characteristics of a stripeset.

Format

SET stripeset-container-name

Parameters

stripeset-container-name
Specifies the name of the stripeset whose characteristics will be modified.

Description

Changes the characteristics of a stripeset.

Qualifiers

CHUNKSIZE=*n*
CHUNKSIZE=DEFAULT (D)
Specifies the chunksize to be used. The chunksize may be specified in blocks (CHUNKSIZE=*n*), or you may let the controller determine the optimal chunksize (CHUNKSIZE=DEFAULT).

When entering an ADD command, CHUNKSIZE=DEFAULT is the default.

Note

The chunksize may not be changed if the stripeset is currently in use by a unit. To change the chunksize, the unit must first be deleted, then the chunksize may be changed.

CAUTION

If the chunksize is changed the stripeset must be initialized, which will destroy all customer data on the stripeset.

Examples

1.
```
CLI> SET STRIPE0 CHUNKSIZE=32
```

Stripeset STRIPE0's chunksize is set to 32.

SET THIS_CONTROLLER

Modifies this controller's parameters (the controller that the maintenance terminal is connected to or the target of the DUP connection).

Format

SET THIS_CONTROLLER

Description

The SET THIS_CONTROLLER command allows you to modify controller parameters on THIS_CONTROLLER in single and dual-redundant configurations.

Qualifiers for HSD controllers

ID=*n*
Specifies the DSSI node number (0 through 7).

MSCP_ALLOCATION_CLASS=*n*
Specifies the allocation class (0 through 255 in a single controller configuration or 1 through 255 in a dual-redundant configuration).

When first installed, the controller's MSCP_ALLOCATION_CLASS is set to 0.

PATH
NOPATH
Enables or disables the DSSI port.

When first installed, NOPATH is set.

PROMPT="new prompt"
Specifies a 1- to 16-character prompt enclosed in quotes that will be displayed when the controller's CLI prompts for input. Only printable ASCII characters are valid.

When first installed, the CLI prompt is set to the first three letters of the controller's model number (for example, HSJ>, HSD> or HSZ>).

SCS_NODENAME="*xxxxxx*"
Specifies a one to six character name for node.

TERMINAL_PARITY={ODD,EVEN}
NOTERMINAL_PARITY
Specifies the parity transmitted and expected. Parity options are ODD or EVEN. NOTERMINAL_PARITY causes the controller not to check for or transmit any parity on the terminal lines.

When first installed, the controller's terminal parity is set to NOTERMINAL_PARITY.

TERMINAL_SPEED=*baud_rate*
Sets the terminal speed to 300, 600, 1200, 2400, 4800, or 9600 baud. The transmit speed is always equal to the receive speed.

When first installed, the controller's terminal speed is set to 9600 baud.

TMSCP_ALLOCATION_CLASS=*n*
Specifies the allocation class (0 through 255 in a single controller configuration or 1 through 255 in a dual-redundant configuration).

When first installed, the controller's TMSCP_ALLOCATION_CLASS is set to 0.

Qualifiers for HSJ controllers

ID=*n*
Specifies the CI node number (0 through (MAX_NODES – 1)).

MAX_NODES=*n*
Specifies the maximum number of nodes (8, 16, or 32).

When first installed, the controller's MAX_NODES is set to 16.

MSCP_ALLOCATION_CLASS=*n*
Specifies the allocation class (0 through 255 in a single controller configuration or 1 through 255 in a dual-redundant configuration).

When first installed, the controller's MSCP_ALLOCATION_CLASS is set to 0.

PATH_A
NOPATH_A
Enables or disables CI Path A.

When first installed, NOPATH_A is set.

PATH_B
NOPATH_B
Enables or disables CI Path B.

When first installed, NOPATH_B is set.

PROMPT="new prompt"
Specifies a 1- to 16-character prompt enclosed in quotes that will be displayed when the controller's CLI prompts for input. Only printable ASCII characters are valid.

When first installed, the CLI prompt is set to the first three letters of the controller's model number (for example, HSJ>, HSD> or HSZ>).

SCS_NODENAME="*xxxxxx*"
Specifies a one to six character name for node.

TERMINAL_PARITY={ODD,EVEN}
NOTERMINAL_PARITY
Specifies the parity transmitted and expected. Parity options are ODD or EVEN. NOTERMINAL_PARITY causes the controller not to check for or transmit any parity on the terminal lines.

When first installed, the controller's terminal parity is set to NOTERMINAL_PARITY.

TERMINAL_SPEED=*baud_rate*
Sets the terminal speed to 300, 600, 1200, 2400, 4800, or 9600 baud. The transmit speed is always equal to the receive speed.

When first installed, the controller's terminal speed is set to 9600 baud.

TMSCP_ALLOCATION_CLASS=*n*
Specifies the allocation class (0 through 255 in a single controller configuration or 1 through 255 in a dual-redundant configuration).

When first installed, the controller's TMSCP_ALLOCATION_CLASS is set to 0.

Qualifiers for HSZ controllers

ID=*n* or ID=*n*1,*n*2
Specifies one or two SCSI target IDs (0 through 7). If two target IDs are specified, they must be enclosed in parenthesis and separated by a comma.

Note

The unit number determines which target the LUN will be available under. For example, D203 would be target 2, LUN 3. D500 would be target 5, LUN 0. D5 would be target 0, LUN 5.

PROMPT="new prompt"
Specifies a 1- to 16-character prompt enclosed in quotes that will be displayed when the controller's CLI prompts for input. Only printable ASCII characters are valid.

When first installed, the CLI prompt is set to the first three letters of the controller's model number (for example, HSJ>, HSD> or HSZ>).

TERMINAL_PARITY={ODD,EVEN}
NOTERMINAL_PARITY
Specifies the parity transmitted and expected. Parity options are ODD or EVEN. NOTERMINAL_PARITY causes the controller not to check for or transmit any parity on the terminal lines.

When first installed, the controller's terminal parity is set to NOTERMINAL_PARITY.

TERMINAL_SPEED=*baud_rate*
Sets the terminal speed to 300, 600, 1200, 2400, 4800, or 9600 baud. The transmit speed is always equal to the receive speed.

When first installed, the controller's terminal speed is set to 9600 baud.

Examples

1.
```
CLI> SET THIS_CONTROLLER PATH_A PATH_B SPEED=1200
```

Turns on this HSJ controller's two CI paths and sets the terminal speed to 1200 baud.

2.
```
CLI> SET THIS_CONTROLLER ID=5
```

Sets this HSZ controller so it responds to requests for target 5.

3.
```
CLI> SET THIS_CONTROLLER ID=(2,5)
```

Sets this HSZ controller so it responds to requests for targets 2 and 5.

SET *unit-number*

Modifies the unit parameters.

Format

SET   unit-number

Parameters

unit-number
Specifies the logical unit number (on HSDs and HSJs D0–D4094 or T0–T4094, on HSZs D0–D7 or T0–T7) whose software switches are to be modified. This is the name given the unit when it was created using the ADD UNIT command.

Description

The SET command is used to change logical unit parameters.

Qualifiers for a unit created from a CDROM drive (HSJ and HSD only)

MAXIMUM_CACHED_TRANSFER=*n*
MAXIMUM_CACHED_TRANSFER=32 (D)
Specifies the maximum size transfer in blocks to be cached by the controller. Any transfers over this size will not be cached. Valid values are 1 through 1024.

When entering the ADD UNIT command, MAXIMUM_CACHED_TRANSFER=32 is the default.

READ_CACHE (D)
NOREAD_CACHE
Enables and disables the controller's read cache on this unit.

When entering an ADD UNIT command, READ_CACHE is the default.

RUN (D)
NORUN
Enables and disables a unit's ability to be spun up. When RUN is specified, the devices that make up the unit will be spun up. If NORUN is specified the unit will be spun down.

When entering an ADD UNIT command, RUN is the default.

Qualifiers for a unit created from a disk drive

MAXIMUM_CACHED_TRANSFER=*n*
MAXIMUM_CACHED_TRANSFER=32 (D)
Specifies the maximum size transfer in blocks to be cached by the controller. Any transfers over this size will not be cached. Valid values are 1 through 1024.

When entering the ADD UNIT command, MAXIMUM_CACHED_TRANSFER=32 is the default.

READ_CACHE (D)
NOREAD_CACHE
Enables and disables the controller's read cache on this unit.

When entering an ADD UNIT command, READ_CACHE is the default.

RUN (D)
NORUN
Enables and disables a unit's ability to be spun up. When RUN is specified, the devices that make up the unit will be spun up. If NORUN is specified the unit will be spun down.

When entering an ADD UNIT command, RUN is the default.

WRITE_PROTECT
NOWRITE_PROTECT (D)
Enables and disables write protection of the unit.

When entering an ADD UNIT command, NOWRITE_PROTECT is the default.

Qualifiers for a unit created from a stripeset

MAXIMUM_CACHED_TRANSFER=*n*
MAXIMUM_CACHED_TRANSFER=32 (D)
Specifies the maximum size transfer in blocks to be cached by the controller. Any transfers over this size will not be cached. Valid values are 1 through 1024.

When entering the ADD UNIT command, MAXIMUM_CACHED_TRANSFER=32 is the default.

READ_CACHE (D)
NOREAD_CACHE
Enables and disables the controller's read cache on this unit.

When entering an ADD UNIT command, READ_CACHE is the default.

RUN (D)
NORUN
Enables and disables a unit's ability to be spun up. When RUN is specified, the devices that make up the unit will be spun up. If NORUN is specified the unit will be spun down.

When entering an ADD UNIT command, RUN is the default.

WRITE_PROTECT
NOWRITE_PROTECT (D)
Enables and disables write protection of the unit.

When entering an ADD UNIT command, NOWRITE_PROTECT is the default.

Qualifiers for a unit created from a tape drive (HSJ and HSD only)

DEFAULT_FORMAT=*format*
DEFAULT_FORMAT=DEVICE_DEFAULT (D)
Specifies the tape format to be used unless overridden by the host. Note that not all devices support all formats. The easiest way to determine what formats are supported by a specific device is to enter “SHOW <tape unit number> DEFAULT_FORMAT= ?”—the valid options will be displayed.

Supported tape formats are as follow:

- DEVICE_DEFAULT

  The default tape format is the default that the device uses, or, in the case of devices that are settable via switches on the front panel, the settings of those switches.
- 800BPI_9TRACK
- 1600BPI_9TRACK
- 6250BPI_9TRACK
- TZ85
- TZ86
- TZ87_NOCOMPRESSION
- TZ87_COMPRESSION
- DAT_NOCOMPRESSION
- DAT_COMPRESSION
- 3480_NOCOMPRESSION
- 3480_COMPRESSION

When entering the ADD UNIT command for a tape device, DEFAULT_FORMAT=DEVICE_DEFAULT is the default.

Examples

1. ```
   CLI> SET D1 WRITE_PROTECT NOREAD_CACHE
   ```

   Write protect and turn off the read cache on unit D1

2. ```
   CLI> SET T47 DEFAULT_FORMAT=1600BPI_9TRACK
   ```

   Set unit T47 to 1600 bpi.

SHOW CDROMS

Shows all CDROM drives and drive information.

Note

This command is valid for HSJ and HSD controllers only.

Format

SHOW CDROMS

Description

The SHOW CDROMS command displays all the CDROM drives known to the controller.

Qualifiers

FULL
If the FULL qualifier is specified, additional amplifying information may be displayed after each device.

Examples

1.
```
CLI> SHO CDROM
Name          Type          Port Targ  Lun                   Used by
------------------------------------------------------------------------------

CDROM230      cdrom            2    3    0                   D623
CDROM240      cdrom            2    4    0                   D624
```

A normal listing of CDROMs.

2.
```
CLI> SHO CDROM FULL
Name          Type          Port Targ  Lun                   Used by
------------------------------------------------------------------------------

CDROM230      cdrom            2    3    0                   D623
          DEC      RRD44   (C) DEC  3593
CDROM240      cdrom            2    4    0                   D624
          DEC      RRD44   (C) DEC  3593
```

A full listing of CDROMs

SHOW *cdrom-container-name*

Shows information about a CDROM.

Format

SHOW cdrom-container-name

Parameters

cdrom-container-name
The name of the CDROM drive that will be displayed.

Description

The SHOW *cdrom-container-name* command is used to show specific information about a particular CDROM drive.

Examples

1.
```
CLI> SHO CDROM230
Name          Type          Port Targ  Lun                    Used by
------------------------------------------------------------------------------

CDROM230      cdrom            2    3    0                    D623
          DEC      RRD44   (C) DEC  3593
```

A listing of CDROM CDROM230.

SHOW DEVICES

Shows physical devices and physical device information.

Format

SHOW DEVICES

Description

The SHOW DEVICES command displays all the devices known to the controller. First disks are shown, then tapes and finally CDROMs.

Qualifiers

FULL

If the FULL qualifier is specified, additional amplifying information may be displayed after each device.

Information contained in the amplifying information is dependent on the device type.

Examples

1.

```
CLI> SHOW DEVICES
Name          Type          Port Targ  Lun                    Used by
------------------------------------------------------------------------------

DI0           disk            1    0    0                     D100
DI1           disk            1    1    0                     D110
TAPE110       tape            3    1    0                     T110
TAPE130       tape            3    3    0                     T130
CDROM230      cdrom           2    3    0                     D623
CDROM240      cdrom           2    4    0                     D624
```

A basic listing of devices attached to the controller.

2.

```
CLI> SHOW DEVICES FULL
Name          Type          Port Targ  Lun                    Used by
------------------------------------------------------------------------------

DI0           disk            1    0    0                     D100
          DEC      RZ35     (C) DEC X388
DI1           disk            1    1    0                     D110
          DEC      RZ26     (C) DEC T386
TAPE110       tape            3    1    0                     T110
          DEC      TZ877    (C) DEC 930A
TAPE130       tape            3    3    0                     T130
          DEC      TZ877    (C) DEC 930A
CDROM230      cdrom           2    3    0                     D623
          DEC      RRD44   (C) DEC  3593
CDROM240      cdrom           2    4    0                     D624
          DEC      RRD44   (C) DEC  3593
```

A full listing of devices attached to the controller.

SHOW DISKS

Shows all disk drives and drive information.

Format

```
SHOW DISKS
```

Description

The SHOW DISKS command displays all the disk drives known to the controller.

Qualifiers

FULL
If the FULL qualifier is specified, additional amplifying information may be displayed after each device.

Examples

1.
```
CLI> SHOW DISKS
Name          Type          Port Targ  Lun                   Used by
------------------------------------------------------------------------------

DI0           disk             1    0    0                   D100
DI1           disk             1    1    0                   D110
```

A basic listing of disks attached to the controller.

2.
```
CLI> SHOW DISKS FULL
Name          Type          Port Targ  Lun                   Used by
------------------------------------------------------------------------------

DI0           disk             1    0    0                   D100
          DEC      RZ35     (C) DEC X388
DI1           disk             1    1    0                   D110
          DEC      RZ26     (C) DEC T386
```

A full listing of disks attached to the controller.

SHOW *disk-container-name*

Shows information about a disk drive.

Format

SHOW disk-container-name

Parameters

disk-container-name
The name of the disk drive that will be displayed.

Description

The SHOW *disk-container-name* command is used to show specific information about a particular disk.

Examples

1.
```
CLI> SHOW DI3
Name          Type          Port Targ  Lun                   Used by
------------------------------------------------------------------------------

DI3           disk             1    3    0                   D130
          DEC      RZ26     (C) DEC X388
```

A listing of disk DI3.

SHOW OTHER_CONTROLLER

Shows the other controller's information.

Note

This command is valid for HSJ and HSD controllers only.

Format

SHOW OTHER_CONTROLLER

Description

Shows all controller, port, and terminal information for the other controller.

Qualifiers

FULL
If the FULL qualifier is specified, additional amplifying information is displayed after the normal controller information.

Examples

1.
```
CLI> SHOW OTHER_CONTROLLER
Controller:
        HSJ40 ZG313FF115 Software E140, Hardware 0000
        Configured for dual-redundancy with ZG30355555
            In dual-redundant configuration
        SCSI address 6
Host port:
        Node name: HSJ306, valid CI node 6, 32 max nodes
        System ID 420010061120
        Path A is ON
        Path B is ON
        MSCP allocation class    3
        TMSCP allocation class   3
Cache:
        32 megabyte read cache, version 2
```

The basic HSJ controller information.

2.
```
CLI> SHOW OTHER_CONTROLLER
Controller:
        HSD30 ZG33400026 Software E140, Hardware 0000
        Configured for dual-redundancy with CX40100000
            All devices failed over to this controller
        SCSI address 7
Host port:
        Node name: HSD001, valid DSSI node 1
        Host path is ON
        MSCP allocation class    9
        TMSCP allocation class   9
Cache:
        32 megabyte read cache, version 2
```

The basic HSD controller information.

3.
```
CLI> SHOW OTHER_CONTROLLER FULL
Controller:
        HSJ40 ZG313FF115 Software E140, Hardware 0000
        Configured for dual-redundancy with ZG30355555
            In dual-redundant configuration
        SCSI address 6
Host port:
        Node name: HSJ306, valid CI node 6, 32 max nodes
        System ID 420010061120
        Path A is ON
        Path B is ON
        MSCP allocation class    3
        TMSCP allocation class   3
Cache:
        32 megabyte read cache, version 2

Extended information:
        Terminal speed 19200 baud, eight bit, no parity, 1 stop bit
        Operation control: 00000005  Security state code: 41415
```

A full HSJ controller information listing.

SHOW STORAGESETS

Shows storage sets and storage set information.

Format

```
SHOW STORAGESETS
```

Description

The SHOW STORAGESETS command displays all the storage sets known by the controller. A storage set is any collection of containers, such as stripesets.

Stripesets will be displayed first.

Qualifiers

FULL
If the FULL qualifier is specified, additional amplifying information may be displayed after each storage set.

Examples

1.
```
CLI> SHOW STORAGESETS
Name         Storageset                   Uses            Used by
------------------------------------------------------------------------------

ST1          stripeset                    DISK500         D1
                                          DISK510
                                          DISK520
```

A basic listing of all storage sets.

2.
```
CLI> SHOW STORAGESETS FULL
Name         Storageset                   Uses            Used by
------------------------------------------------------------------------------

ST1          stripeset                    DISK500         D1
                                          DISK510
                                          DISK520
          CHUNKSIZE = DEFAULT
ST2              stripeset                DISK400         D17
                                          DISK410
                                          DISK420
          CHUNKSIZE = DEFAULT
```

A full listing of all storage sets.

SHOW STRIPESETS

Shows stripesets and related stripeset information.

Format

```
SHOW STRIPESETS
```

Description

The SHOW STRIPESET command displays all the stripesets known by the controller.

Qualifiers

FULL
If the FULL qualifier is specified, additional amplifying information may be displayed after each storage set.

Examples

1.
```
CLI> SHOW STRIPESETS
Name          Storageset                      Uses             Used by
------------------------------------------------------------------------------

ST1           stripeset                       DISK500          D1
                                              DISK510
                                              DISK520

ST2           stripeset                       DISK400          D17
                                              DISK410
                                              DISK420
```

A basic listing of all stripesets.

2.
```
CLI> SHOW STRIPESETS FULL
Name          Storageset                      Uses             Used by
------------------------------------------------------------------------------

ST1           stripeset                       DISK500          D1
                                              DISK510
                                              DISK520

          CHUNKSIZE = DEFAULT
ST2           stripeset                       DISK400          D17
                                              DISK410
                                              DISK420

          CHUNKSIZE = DEFAULT
```

A full listing of all stripesets.

SHOW *stripeset-container-name*

Shows information about a stripeset.

Format

SHOW stripeset-container-name

Parameters

stripeset-container-name
The name of the stripeset that will be displayed.

Description

The SHOW *stripeset-container-name* command is used to show specific information about a particular stripeset.

Examples

1.
```
CLI> SHOW STRIPE0
Name          Storageset                     Uses            Used by
------------------------------------------------------------------------------

STRIPE0       stripeset                      DISK500         D1
                                             DISK510
                                             DISK520
          CHUNKSIZE = DEFAULT
```

A listing of stripeset STRIPE0.

SHOW TAPES

Shows all tape drives and tape drive information.

Note

This command is valid for HSJ and HSD controllers only.

Format

SHOW TAPES

Description

The SHOW TAPES command displays all the tape drives known to the controller.

Qualifiers

FULL
If the FULL qualifier is specified, additional amplifying information may be displayed after each device.

Examples

1.
```
CLI> sho t0
MSCP unit                                    Uses
--------------------------------------------------------------

  T0                                         TAPE0
        Switches:
          DEFAULT_FORMAT = TZ87_NOCOMPRESSION
        State:
          AVAILABLE
          No exclusive access
CLI>
```

Shows an individual tape unit.

SHOW *tape-container-name*

Shows information about a tape drive.

Format

SHOW tape-container-name

Parameters

tape-container-name
The name of the tape drive that will be displayed.

Description

The SHOW *tape-container-name* command is used to show specific information about a particular tape drive.

Examples

1.
```
HSJB0> SHOW TAPE230
Name          Type          Port Targ  Lun                    Used by
------------------------------------------------------------------------------

TAPE230       tape             2    3    0                    T230
          DEC      TSZ07            0309
```

A listing of TAPE230.

SHOW THIS_CONTROLLER

Shows this controller's information.

Format

SHOW THIS_CONTROLLER

Description

Shows all controller, port, and terminal information for this controller.

Qualifiers

FULL
If the FULL qualifier is specified, additional amplifying information is displayed after the normal controller information.

Examples

1.
```
CLI> SHOW THIS_CONTROLLER
Controller:
        HSJ40 ZG313FF115 Software E140, Hardware 0000
        Configured for dual-redundancy with ZG30355555
            In dual-redundant configuration
        SCSI address 6
Host port:
        Node name: HSJ306, valid CI node 6, 32 max nodes
        System ID 420010061120
        Path A is ON
        Path B is ON
        MSCP allocation class    3
        TMSCP allocation class   3
Cache:
        32 megabyte read cache, version 2
```

The basic HSJ controller information.

2.
```
CLI> SHOW THIS_CONTROLLER
Controller:
        HSD30 ZG33400026 Software E140, Hardware 0000
        Configured for dual-redundancy with CX40100000
            All devices failed over to this controller
        SCSI address 7
Host port:
        Node name: HSD001, valid DSSI node 1
        Host path is ON
        MSCP allocation class    9
        TMSCP allocation class   9
Cache:
        32 megabyte read cache, version 2
```

The basic HSD controller information.

3.
```
CLI> SHOW THIS_CONTROLLER
Controller:
        HSZ40 SC00103056 Software E140, Hardware 0000
        SCSI address 6
Host port:
        valid SCSI target 2
Cache:
        32 megabyte read cache, version 2
```

The basic HSZ controller information.

4.
```
CLI> SHOW THIS_CONTROLLER FULL
Controller:
        HSJ40 ZG313FF115 Software E140, Hardware 0000
        Configured for dual-redundancy with ZG30355555
            In dual-redundant configuration
        SCSI address 6
Host port:
        Node name: HSJ306, valid CI node 6, 32 max nodes
        System ID 420010061120
        Path A is ON
        Path B is ON
        MSCP allocation class    3
        TMSCP allocation class   3
Cache:
        32 megabyte read cache, version 2

Extended information:
        Terminal speed 19200 baud, eight bit, no parity, 1 stop bit
        Operation control: 00000005  Security state code: 41415
```

A full HSJ controller information listing.

SHOW UNITS

Shows all units and unit information.

Format

SHOW UNITS

Description

The SHOW UNITS command displays all the units known by the controller. First disks (including CDROMs) are listed, then tapes.

Qualifiers

FULL

If the FULL qualifier is specified after UNITS, additional amplifying information may be displayed after each *unit-number*, such as the switch settings.

Examples

1.
```
CLI> SHOW UNITS
MSCP unit                                    Uses
---------------------------------------------------------------

  D100                                       DI0
  D110                                       DI1
  D150                                       DI5
```

A basic listing of units available on the controller.

2.
```
CLI> SHOW UNITS FULL
MSCP unit                                    Uses
---------------------------------------------------------------

  D100                                       DI0
        Switches:
          RUN                   READ_CACHE               NOWRITE_PROTECT
          NOTRANSPORTABLE
          MAXIMUM_CACHED_TRANSFER_SIZE = 32
        State:
          ONLINE to this controller
          No exclusive access
  D110                                       DI1
        Switches:
          RUN                   READ_CACHE               NOWRITE_PROTECT
          NOTRANSPORTABLE
          MAXIMUM_CACHED_TRANSFER_SIZE = 32
        State:
          ONLINE to this controller
          No exclusive access
  D150                                       DI5
        Switches:
          RUN                   READ_CACHE               NOWRITE_PROTECT
          NOTRANSPORTABLE
          MAXIMUM_CACHED_TRANSFER_SIZE = 32
        State:
          ONLINE to this controller
          No exclusive access
```

A full listing of units available on the controller.

SHOW *unit-number*

Shows information about a unit.

Format

SHOW unit-number

Parameters

unit-number
The unit number of the unit to display.

Description

The SHOW *unit-number* command is used to show specific information about a particular unit.

Examples

1.
```
CLI> SHOW D150
MSCP unit                                    Uses
--------------------------------------------------------------

  D150                                       DI5
        Switches:
          RUN                   READ_CACHE              NOWRITE_PROTECT
          NOTRANSPORTABLE
          MAXIMUM_CACHED_TRANSFER_SIZE = 32
        State:
          ONLINE to this controller
          No exclusive access
```

A listing of a specific disk unit.

2.
```
CLI> sho t110
MSCP unit                                    Uses
--------------------------------------------------------------

  T110                                       TAPE110
        Switches:
          DEFAULT_FORMAT = DEVICE_DEFAULT
        State:
          AVAILABLE
          No exclusive access
```

A listing of a specific tape unit.

SHUTDOWN OTHER_CONTROLLER

Shuts down and does not restart the other controller.

Note

This command is valid for HSJ and HSD controllers only.

Format

```
SHUTDOWN OTHER_CONTROLLER
```

Description

The SHUTDOWN OTHER_CONTROLLER command shuts down the other controller.

If any disks are on line to the other controller, the controller will not shut down unless the OVERRIDE_ONLINE qualifier is specified (HSD and HSJ only). If any user data cannot be flushed to disk, the controller will not shut down unless the IGNORE_ERRORS qualifier is specified.

Specifying IMMEDIATE will cause the other controller to shut down immediately without flushing any user data to the disks, even if drives are on line to the host.

Qualifiers for HSD and HSJ controllers

IGNORE_ERRORS
NOIGNORE_ERRORS (D)
If errors result when trying to write user data, the controller will not be shut down unless IGNORE_ERROR is specified.

CAUTION

Customer data may be lost or corrupted if the IGNORE_ERRORS qualifier is specified.

NOIGNORE_ERRORS is the default.

IMMEDIATE
NOIMMEDIATE (D)
If IMMEDIATE is specified, immediately shut down the controller without checking for online devices.

CAUTION

Customer data may be lost or corrupted if the IMMEDIATE qualifier is specified.

NOIMMEDIATE is the default.

OVERRIDE_ONLINE
NOOVERRIDE_ONLINE (D)
If any units are on line to the controller, the controller will not be shut down unless OVERRIDE_ONLINE is specified.

If the OVERRIDE_ONLINE qualifier is specified, the controller will shut down after all customer data is written to disk.

CAUTION

Customer data may be lost or corrupted if the OVERRIDE_ONLINE qualifier is specified.

NOOVERRIDE_ONLINE is the default.

Examples

1. `CLI> SHUTDOWN OTHER_CONTROLLER`

   Shuts down the other controller as long as the other controller does not have any units on line.

2. `CLI> SHUTDOWN OTHER_CONTROLLER OVERRIDE_ONLINE`

   Shuts down the other controller even if there are units on line to the other controller.

SHUTDOWN THIS_CONTROLLER

Shuts down and does not restart this controller.

Format

```
SHUTDOWN THIS_CONTROLLER
```

Description

The SHUTDOWN THIS_CONTROLLER command shuts down this controller.

If any disks are on line to this controller, the controller will not shut down unless the OVERRIDE_ONLINE qualifier is specified (HSD and HSJ only). If any user data cannot be flushed to disk, the controller will not shut down unless the IGNORE_ERRORS qualifier is specified.

Specifying IMMEDIATE will cause this controller to shut down immediately without flushing any user data to the disks, even if drives are on line to a host.

Note

If you enter a SHUTDOWN THIS_CONTROLLER command, communication with the controller will be lost when this controller shuts down.

Qualifiers for HSD and HSJ controllers

IGNORE_ERRORS
NOIGNORE_ERRORS (D)
If errors result when trying to write user data, the controller will not be shut down unless IGNORE_ERROR is specified.

CAUTION

Customer data may be lost or corrupted if the IGNORE_ERRORS qualifier is specified.

NOIGNORE_ERRORS is the default.

IMMEDIATE
NOIMMEDIATE (D)
If IMMEDIATE is specified, immediately shut down the controller without checking for online devices.

CAUTION

Customer data may be lost or corrupted if the IMMEDIATE qualifier is specified.

NOIMMEDIATE is the default.

OVERRIDE_ONLINE
NOOVERRIDE_ONLINE (D)
If any units are on line to the controller, the controller will not be shut down unless OVERRIDE_ONLINE is specified.

If the OVERRIDE_ONLINE qualifier is specified, the controller will shut down after all customer data is written to disk.

CAUTION

Customer data may be lost or corrupted if the OVERRIDE_ONLINE qualifier is specified.

NOOVERRIDE_ONLINE is the default.

Qualifiers for HSZ controllers

IGNORE_ERRORS
NOIGNORE_ERRORS (D)
If errors result when trying to write user data, the controller will not be shut down unless IGNORE_ERROR is specified.

CAUTION

Customer data may be lost or corrupted if the IGNORE_ERRORS qualifier is specified.

NOIGNORE_ERRORS is the default.

IMMEDIATE
NOIMMEDIATE (D)
If IMMEDIATE is specified, immediately shuts down the controller without checking for online devices.

CAUTION

Customer data may be lost or corrupted if the IMMEDIATE qualifier is specified.

NOIMMEDIATE is the default.

Examples

1.
```
CLI> SHUTDOWN THIS_CONTROLLER
```
Shuts down this controller as long as this controller does not have any units on line.

2.
```
CLI> SHUTDOWN THIS_CONTROLLER OVERRIDE_ONLINE
```
Shuts down this controller even if there are units on line to this controller.

B.2 CLI Messages

The following sections describe messages you may encounter during interactive use of the CLI.

B.2.1 Error Conventions

An Error *nnnn:* means that the command did not complete. Except for a few of the failover messages (6000 series), no part of the command was executed. When encountering an error going into or exiting dual-redundant mode, some synchronization problems are unavoidable; the error message in such a case will tell you what to do to get things back in synchronization.

Multiple error messages may result from one command.

Items in angle brackets (<>) will be replaced at run time with names, numbers, and so on.

B.2.2 CLI Error Messages

For HSJ and HSD30 controllers:

Error 1000: Unit number must be from 0 to 4094

For HSZ controllers:

Error 1000: The LUN portion of the unit number must be from 0 to 7

Explanation: This error results from an ADD UNIT command where the *n* in the D*n* or T*n* specified is out of range. The MSCP or TMSCP unit number after the “D” or “T” must be in the range of 0 to 4094.

Retry the ADD UNIT command with a correct number.

Error 1010: Maximum cached transfer size must be 1 through 1024 blocks

Explanation: This error results from a SET <unit number> or an ADD UNIT command where MAXIMUM_CACHED_TRANSFER_SIZE was specified. MAXIMUM_CACHED_TRANSFER_SIZE must be in the range 1 through 1024. Retry the SET or ADD command with a correct number.

Error 1020: CHUNKSIZE must be from <minimum> to <maximum>

Explanation: This error results from a SET *storageset-container-name* or an ADD (storage set type) command where CHUNKSIZE was specified. The chunksize must be DEFAULT, VOLUME or greater than 15. Retry the SET or ADD command with DEFAULT, VOLUME or a correct number.

Error 1030: Cannot set chunksize on a storageset that is still part of a configuration

Explanation: Chunksize must be set before a storage set is bound to a unit. If you wish to change the chunksize, delete the unit and then change it.

CAUTION

After changing the chunksize, an INITIALIZE command is required to rewrite the container’s metadata. This will destroy customer data.

Error 1090: Tape unit numbers must start with the letter 'T'

Explanation: All tape unit numbers are of the form "T*n*." This error is displayed if you add a tape unit and do not begin the unit number with the letter "T."

Retry the ADD command with a "T" at the start of the unit number.

Error 1100: Disk unit numbers must start with the letter 'D'

Explanation: All disk unit numbers are of the form "D*n*." This error is displayed if you add a disk unit and do not begin the unit number with the letter "D."

Retry the ADD command with a "D" at the beginning of the unit number.

Error 1110: Unit numbers may not have leading zeros

Explanation: Tape and disk unit numbers may not be of the form "D03," for example, "D3" should be specified.

Retry the ADD command without any leading zeros.

Error 1120: LUN <lun> is already used

Explanation: Lun number <lun> has already been used by a disk or tape.

Retry the ADD command specifying a different LUN.

Error 1130: The unit number cannot exceed <max_unit>

Explanation: You specified a unit number that was out of bounds.

Try to add the unit again using a unit number that is less than or equal to <max_unit>.

Error 1140: Invalid unit number. Valid unit number range(s) are:
<start> to <end>

Explanation: You attempted to create a unit out of the valid unit ranges. The valid unit ranges are given by the <start> and <end> values.

Retry the ADD command specifying a unit number in the correct range.

Error 2000: Port must be 1 - <maximum port number>

Explanation: When adding a device, you specified a port less than 1 or greater than <maximum port number>.

Retry the command specifying a port within the range given.

Error 2010: Target must be 0 - <maximum target number>

Explanation: When adding a device, you specified a target greater than <maximum target number>.

In single controller configurations, <maximum target number> is 6. In dual-redundant configurations, <maximum target number> is 5.

Error 2020: LUN must be 0 - 7

Explanation: When adding a device, you specified a LUN greater than 7.

Error 2030: This port, target, and LUN already in use by another device.

Explanation: When adding a device, you specified PTL that is already specified by another device.

Error 2040: Cannot set TRANSPORTABLE when device in use by an upper layer

Explanation: A disk cannot be set to TRANSPORTABLE once it is being used by an upper level (unit or storage set).

Error 2050: Cannot set NOTRANSPORTABLE when device in use by an upper layer

Explanation: A disk cannot be set to NOTRANSPORTABLE once it is being used by an upper level (unit or storage set).

Error 4000: The CLI prompt must have 1 to 16 characters.

Explanation: This error results from a SET THIS_CONTROLLER or SET OTHER_CONTROLLER command with the qualifier PROMPT=. The length of the CLI prompt must be at least one character and may not exceed 16 characters. Retry the command with the correct number of characters.

Error 4010: Illegal character in CLI prompt.

Explanation: A nonprintable character was specified. Only ASCII characters space " " through tilde "~" may be specified (hex 20–7E).

Error 4020: Terminal speed must be 300, 1200, 2400, 4800, 9600 or 19200

Explanation: This error results from a SET THIS_CONTROLLER or SET OTHER_CONTROLLER command with the argument TERMINAL_SPEED=. The only valid baud rates that may be specified are 110, 300, 1200, 2400, 4800, or 9600 baud. Retry the command with a correct terminal speed.

Error 4030: Controller ID must be in the range 0 to <max nodes minus 1>.

Explanation: The ID= was specified with a number greater than <max nodes minus 1>. If increasing the controller's ID, set MAX_NODES first, then the controller's ID.

Error 4040: SCS nodename length must be from 1 to 6 characters.

Explanation: This error results from a SET THIS_CONTROLLER or SET OTHER_CONTROLLER command with the argument SCS_NODENAME=. The SCS node name must consist of one to six alphanumeric characters enclosed in quotes with an alphabetic character first. Retry the command with a correct SCS node name length.

Error 4050: SCS nodename must start with an alpha character and contain only A-Z and 0-9.

Explanation: This error results from a SET THIS_CONTROLLER or SET OTHER_CONTROLLER command with the argument SCS_NODENAME=. The SCS node name must consist of alphanumeric characters enclosed in quotes with an alphabetic character first. Retry the command with a correct SCS node name.

Error 4060: Allocation class must be from <minimum> to 255.

Explanation: An illegal MSCP or TMSCP allocation class was specified. The <minimum> is 0 for a single controller configuration, or 1 for a dual-redundant configuration.

Error 4070: Max nodes must be 2, 8, 16 or 32

Explanation: This error results from a SET THIS_CONTROLLER or SET OTHER_CONTROLLER command with the argument MAX_NODES=. Max nodes must be 2, 8, 16 or 32 nodes. Retry the command with a correct max node number.

Error 4080: Current node ID too large for requested max nodes setting.

Explanation: This error results from a SET THIS_CONTROLLER or SET OTHER_CONTROLLER command with the arguments MAX_NODES= or ID=. MAX_NODES= was specified with a number less than the controller's ID or the controller's ID was specified with a number greater than (MAX_NODES – 1). If decreasing MAX_NODES, set the controller's ID first, then MAX_NODES.

Error 4090: Module has invalid serial number. This controller cannot be used Call Digital Services.

Explanation: This error means that an uninitialized controller has slipped out of manufacturing, or the NV memory was destroyed. Contact Digital Multivendor Services.

Error 4100: Unable to RESTART other controller.

Explanation: A communication error occurred when trying to restart the other controller. Retry the RESTART command.

Error 4110: Unable to SHUTDOWN other controller.

Explanation: A communication error occurred when trying to shut down the other controller. Retry the SHUTDOWN command.

Error 4120: Unable to SELFTEST other controller.

Explanation: A communication error occurred when trying to self-test the other controller. Retry the SELFTEST command.

Error 4130: Unable to setup controller restart.

Explanation: A communication error occurred when trying to RESTART or self-test the other controller. Retry the RESTART or SELFTEST command.

Error 4140: Unable to lock the other controller's NV memory

Explanation: Most configuration commands, such as ADD, DELETE, and SET, require both controllers in a dual-redundant configuration to be up and functioning so configuration changes can be recorded in both controllers. If one controller is not running, this message results when you attempt to change the configuration.

Restart the other controller and try the command again, or SET NOFAILOVER on the remaining controller.

Error 4150: Unable to rundown the following units on the other controller: <list of problem units>

Explanation: When attempting to SHUTDOWN, RESTART or SELFTEST the other controller, some units could not be successfully spun down. This can be caused either by online units or errors when trying to spin down the units. Either rectify the problems on the problem units or enter the SHUTDOWN, RESTART or SELFTEST command with the qualifier OVERRIDE_ONLINE or IGNORE_ERRORS.

Error 4160: Unable to rundown the following units on this controller: <list of problem units>

Explanation: When attempting to SHUTDOWN, RESTART or SELFTEST the this controller, some units could not be successfully spun down. This can be caused either by online units or errors when trying to spin down the units. Either rectify the problems on the problem units or enter the SHUTDOWN, RESTART or SELFTEST command with the qualifier OVERRIDE_ONLINE or IGNORE_ERRORS.

Error 4170: Only <max_targets> targets may be specified

Explanation: When setting THIS_CONTROLLER ID=, you specified too many IDs; you may only specify up to <max_targets> IDs.

Retry the SET THIS_CONTROLLER ID= command with no more than <max_targets> IDs specified.

Error 4180: Invalid unit number(s) still present that must be deleted before the controller ID may be changed. All unit numbers must be in the range(s): <start> to <end>

Explanation: You attempted to change the controller ID(s) when there were still units using those IDs. The current valid unit ranges are given by the <start> and <end> values.

Either delete the units that use the ID that will no longer be specified, or retry the SET THIS_CONTROLLER ID= specifying the ID being used by the existing units.

Error 5000: A program name may be from 1 to 6 characters.

Explanation: This error results from a “RUN <program name>.”

Error 5010: The requested program is currently busy.

Explanation: This error results from a “RUN <program name>.” The program requested is being run by someone else.

Error 5020: The requested program is unknown.

Explanation: This error results from a “RUN <program name>”. Enter “DIR” to get a list of available programs.

Error 5030: Insufficient memory for request.

Explanation: This error results from a “RUN <program name>” resource problem. Retry the command later.

Error 6000: Communication failure with other controller.

Explanation: There was a communication problem with the other controller. This typically happens if the other controller is shutting down. If these messages happen often when the other controller is not shutting down, call Digital Multivendor Services.

Error 6010: Other controller not present

Explanation: When asked to communicate with another controller (the result of any one of a number of commands), the other controller was found not to be running.

If the other controller is in the process of restarting, retry the command later. If the other controller is shut down or turned off, start it. If the other controller is no longer present, enter a SET NOFAILOVER command to take it out of dual-redundant mode.

Error 6020: Initial failover handshake not yet complete

Explanation: For a short period of time after start up, the two controllers must communicate to set up a dual-redundant mode. This setup time is typically less than 1 minute. If commands that require controller-to-controller communication are entered during this setup time, error 6020 results.

Retry the command later.

Error 6030: Unable to communicate with the other controller to setup FAILOVER

Explanation: Could not setup FAILOVER due to communication problems between the controllers.

The command should be retried later.

Error 6040: The write of the other controller's configuration information did not succeed; information may be in an inconsistent state. Before further use both controllers should be removed from dual-redundant mode (SET NOFAILOVER) and then placed back into dual-redundant mode (SET FAILOVER) to assure consistency

Explanation: Communication was lost in the middle of a SET FAILOVER command.

Follow the instructions included in the error message.

Error 6050: Communication failure with other controller while putting controllers into dual-redundant mode. Reissue the SET FAILOVER command

Explanation: Communication was lost in the middle of a SET FAILOVER command.

Follow the instructions included in the error message.

Error 6070: Illegal command—this controller not configured for dual-redundancy

Explanation: A command was entered to a single controller configuration that requires two controllers to be in dual-redundant mode.

If two controllers are supposed to be in dual-redundant mode, enter a SET FAILOVER command. If not, do not enter the command that resulted in the error.

Error 6080: Illegal command—this controller not currently in dual-redundant mode

Explanation: A command was entered to a dual-redundant-configured controller, but the other controller was not available for communication.

Restart the other controller and wait until it is communicating with this controller. If this controller is no longer supposed to be in dual-redundant mode, enter a SET NOFAILOVER command.

Error 6090: In failover no device may be configured at target 6 <device type> <device name> is at PTL <port> <target> <lun>

Explanation: Target addresses 6 and 7 are used by the controllers when in a dual-redundant configuration. When in a single controller configuration, target 6 is available for use by devices. If devices are configured at target 6 and you attempted to install a dual-redundant configuration, this error is displayed for all devices that use target 6 and the controllers will not be placed in a dual-redundant configuration.

You should both logically and physically reconfigure the drives so that target 6 is not used.

Error 6100: Allocation classes cannot be zero for a dual-redundant configuration. Set MSCP and TMSCP allocation classes to non-zero.

Explanation: If in a dual-redundant configuration, the allocation class must not be set to zero.

Error 6110: This controller already in failover mode. You must issue a SET NOFAILOVER command first

Explanation: A SET FAILOVER cannot be entered on a controller already in failover.

Error 6120: Other controller already in failover mode. You must issue a SET NOFAILOVER command first

Explanation: A SET FAILOVER ccommand was entered and although this controller was not configured for dual redundancy, the other controller was.

Error 6170: An <controller type> and <controller type> cannot configured for failover

Explanation: Two different controllers (such as an HSJ and an HSZ) cannot be configured for failover.

Replace the other controller with the same model as this one and reenter the command.

Error 9000: Cannot rename a unit

Explanation: Only devices and storage sets may be renamed. If you attempt to rename a unit, this message results.

Error 9010: <name> is an illegal name, it must be from 1 to 9 characters.

Explanation: This error results from an ADD command with an illegal name given.

Error 9020: <name> is an illegal name, it must start with A-Z

Explanation: This error results from an ADD command with an illegal name given.

Error 9030: <name> is an illegal name, characters may consist only of A-Z, 0-9, ., - or _

Explanation: This error results from an ADD command with an illegal name given.

Error 9040: <name> conflicts with keyword <keyword>

Explanation: The name given in an ADD command conflicts with a CLI keyword. Specify another name.

Error 9050: Configuration area full

Explanation: The total number of units, devices, and storage sets that can be configured is 195 in any combination. This error results when you exceed that number of nodes.

Delete some units or devices in order to recover some configuration nodes.

Error 9060: <name> does not exist

Explanation: Some operation (SET, DELETE, INITIALIZE, and so forth) specified a name that does not exist.

Check the name and retry the command.

Error 9070: <name> is still part of a configuration. Delete upper configuration first.

Explanation: Devices may not be deleted if they are still in use by storage sets or units. Storage sets may not be deleted if they are still used by units.

Delete configurations from the top down; delete units, then stripesets, and then finally devices.

Error 9080: <name> is already used

Explanation: An ADD command specified a name that is already in use.

Specify another name.

Error 9090: A <device type> cannot be used in a <storageset type>

Explanation: The device specified cannot be used in the storage set specified, for example, tapes cannot be bound into a stripeset.

Reexamine the configuration and correct the incompatibility.

Error 9100: A <storageset type> must have from <least> to <most> entities

Explanation: The wrong number of devices was specified for this storage set. Different storage sets require different numbers of devices.

Reexamine the configuration, then correct the number of devices.

Error 9130: Cannot delete ONLINE unit

Explanation: The unit specified in a DELETE command is on line to a host.

Dismount the unit at the host then retry the command. Or add the OVERRIDE_ONLINE qualifier to the DELETE command.

Error 9140: Cannot delete exclusive access unit

Explanation: The unit specified in a DELETE command is set up for exclusive access.

Take the unit out of exclusive access mode and retry the command.

Error 9150: INITIALIZE is no longer supported at the unit level. You must INITIALIZE the container that makes up this unit

Explanation: You tried to initialize a unit. Units may no longer be initialized. The container that makes up the unit must be initialized before a unit is created out of the container.

Error 9160: Non-disk devices cannot be INITIALIZED

Explanation: Tapes and CDROMS may not be initialized.

Error 9170: <device type> <device name> at PTL <port> <target> <lun> No device installed

Explanation: When a unit is added or initialized, the configuration of the devices that makes up the unit is checked. If no device is found at the PTL specified, this error is displayed.

Check both the logical and physical configuration of the unit and correct any mismatches.

Error 9180: <device type> <device name> at PTL <port> <target> <lun> Incorrect device type installed

Explanation: When a unit is added or initialized, the configuration of the devices that make up the unit is checked. If a non-disk device is found at the PTL specified, this error is displayed.

Check both the logical and physical configuration of the unit and correct any mismatches.

Error 9190: Unit <unum> is currently online

Explanation: When a SHUTDOWN, RESTART, or SELFTEST command is entered without the OVERRIDE_ONLINE qualifier and online devices are found, the command is aborted and the units that are currently on line are listed.

Either retry the command with OVERRIDE_ONLINE qualifier or dismount all devices from the hosts.

Error 9200: <name> conflicts with unit names

Explanation: This error results from an ADD command. Names in the format of D*n* and T*n,* where *n* is a number from 0 to 4094, are reserved for units. Rename the storage set or device that is being added so it does not conflict with the unit names and retry the command.

Error 9210: Cannot check if drives are online to the other controller

Explanation: When trying to check for online drives on the other controller, there was a communication failure.

Retry the command.

Error 9230: Unable to modify switches requested

Explanation: This error results from a SET command. The system is currently busy. Retry the SET command later.

Error 9240: Cannot delete unit in maintenance mode

Explanation: When trying to delete a unit, the unit was found to be in Maintenance mode. This is typically the result of trying to delete a unit that is in use by DILX or TILX.

Make sure that DILX and TILX is not being run against the unit that is to be deleted, and retry the command.

Error 9250: Initialize of disk failed

Explanation: Unable to write metadata on disk. Make sure the disk is functioning properly.

Error 9260: Cannot INITIALIZE a container that is still part of a configuration. Delete upper configuration first

Explanation: A container cannot be initialized that is part of another configuration or is being used by a unit.

Delete the upper configuration and reenter the INITIALIZE command.

Error 9270: No metadata found on container, unit not created. An INITIALIZE <container name> must be issued before this container may be used

Explanation: You attempted to create a unit from a container that did not have valid metadata.

INITIALIZE the metadata on the container, then create a unit out if it.

Error 9300: Metadata found on container. Are you sure this is a TRANSPORTABLE container? An INITIALIZE must be issued before this container may be used.

Explanation: Metadata was found on a TRANSPORTABLE container.

Enter an INITIALIZE command.

Error 9330: NV memory write collision. Please try again

Explanation: Two users were trying to configure the CLI at the same time. Check the configuration you were trying to modify to make sure it is unchanged and retry the command.

Error 9350: Metadata found on container but the chunksize is different Either a SET <storageset name> CHUNKSIZE=<chunksize> or an INITIALIZE <storageset name> must be issued before this container may be used

Explanation: The chunksize defined by the ADD or SET command is different than that on the media.

Either INITIALIZE the storageset or SET the chunksize to the given value.

Error 9360: A tape is not installed at the PTL <port> <target> <lun>. Cannot set tape switches unless a tape is installed

Explanation: A SET or ADD command specified a tape format, but there was no tape installed at the tape's PTL.

Install a tape and retry the command.

Error 9370: A <tape name> is an unsupported device. Tape switches cannot be set on unsupported devices

Explanation: The tape installed is not currently supported by the controller.

Replace the tape with a supported device and retry the command.

Error 9380: Unable to allocate unit for NORUN to RUN transition

Explanation: The unit could not be allocated so the controller could do a RUN/NORUN transition.

Retry the command. If this error persists, call Digital Multivendor Services.

Error 9390: Cannot change default tape format while tape drive online to host

Explanation: The default tape format cannot be changed when the tape drive is on line to a host. Dismount the tape drive from the host and retry the command.

Error 9400: Cannot rundown or allocate unit in order to delete it

Explanation: Retry the command. If this error persists, call Digital Multivendor Services.

B.2.3 Warning Conventions

A Warning *nnnn:* means that the command completed, but there is a situation that you should be aware of. Typically, a warning will result in an unusable configuration; you will have to either logically reconfigure the cabinet using the CLI or physically reconfigure the cabinet by moving the disks around.

Multiple warning messages may result from one command.

Items in angle brackets (<>) will be replaced at run time with names, numbers, and so on.

B.2.4 CLI Warning Messages

Warning 3000: This storageset is configured with more than one disk per port. This will cause a degradation in performance

Explanation: This error results from an ADD *storageset-type* command. The storage set specified has more than one member per port. One method of increasing the controller's performance is through parallel transfers to members of a storage set. If multiple members of a storage set are on one port, transfers must be done in serial to those members.

Though multiple storage set members on one port will work, it is strongly recommended that the storage set be deleted and reconfigured with one member per port.

Warning 3010: Unable to check all device types that make up this storageset. If the storageset is made up of different device types, it may result in a storageset of reduced size

Explanation: This error results from an ADD *storageset-type* command. Device types being added to a storage set are checked to make sure that they are the correct device types. If one or more devices could not be checked, this warning is displayed.

You should check all the devices to make sure that they are correctly installed and configured.

Warning 3020: This storageset is configured with different device types. This may result in a storageset of reduced size

Explanation: This error results from an ADD *storageset-type* command. Device types being added to a storage set are checked to assure that they are the same types. If all devices are not the same, this warning is displayed. Storage set size is determined by the size of the smallest device, so the storage set configured will be of reduced size.

If a reduced size storage set is acceptable, nothing need be done in response to this warning. To realize the mazimum storage set size, all devices that make up the storage set should be identical.

Warning 4000: A restart of this controller will be required before all the parameters modified will take effect

Explanation: This error results from a SET THIS_CONTROLLER command. Some controller parameters require a restart before they can take effect. If any of those parameters are changed, this warning is displayed. It is recommended that a restart via the RESTART THIS_CONTROLLER command be done as soon as possible.

Warning 4010: A restart of the other controller will be required before all the parameters modified will take effect

Explanation: This error results from a SET OTHER_CONTROLLER command. Some controller parameters require a restart before they can take effect. If any of those parameters are changed, this warning is displayed. Restart the controller and retry the command.

Warning 4020: A restart of both this and the other controller will be required before all the parameters modified will take effect

Explanation: This error results from a SET THIS_CONTROLLER or a SET OTHER_CONTROLLER command. Some controller parameters require a restart of both controllers before they can take effect. If any of those parameters are changed, this warning is displayed. Restart both controllers and retry the command.

Warning 6000: Communication failure with other controller while taking controllers out of dual-redundant mode. Enter a SET NOFAILOVER command on the other controller

Explanation: This error results from a SET NOFAILOVER command. This controller was unable to communicate with the other controller to notify it that it is no longer in dual-redundant mode. Typically, this occurs when the other controller has already been removed prior to the SET NOFAILOVER command.

A SET NOFAILOVER command should be entered on the other controller as soon as possible.

Warning 9030: Cannot determine if the correct device type is at the PTL specified

Explanation: When a device is added, the location specified is checked to see if the correct device type is present. This error results when no device responds from the location specified.

Check the physical configuration and the PTL that was specified.

Warning 9040: There is currently a <device type> at the PTL specified

Explanation: When a device is added, the location specified is checked to see if the correct device type is present. This error results when a device different from the one specified is found at the location specified (for example, a tape is found where a disk was added).

Check the physical configuration and the PTL that was specified.

Warning 9050: <device type> <device name> at PTL <port> <target> <lun> No device installed.

Explanation: When a unit is added, the configuration of the disks that make up the unit is checked. If no device is found at the PTL specified, this warning is displayed.

Check both the logical and physical configuration of the devices that make up the unit and correct any mismatches.

Warning 9060: <device type> <device name> at PTL <port> <target> <lun> Incorrect device type installed

Explanation: When a unit is added, the configuration of the disks that make up the unit is checked. If a non-disk device is found at the PTL specified, this warning is displayed.

Check both the logical and physical configuration of the devices that make up the unit and correct any mismatches.

B.3 Examples

The following examples show some commonly performed CLI functions. Your subsystem parameters will of course differ from those shown here.

B.3.1 Setting HSD-Series Parameters, Nonredundant

```
SET THIS_CONTROLLER ID=5
SET THIS_CONTROLLER SCS_NODENAME="HSD03"
SET THIS_CONTROLLER MSCP_ALLOCATION_CLASS=4
SET THIS_CONTROLLER TMSCP_ALLOCATION_CLASS=4
RESTART THIS_CONTROLLER
[this controller restarts at this point]
SET THIS_CONTROLLER PATH
```

These commands could optionally be entered on fewer lines:

```
SET THIS_CONTROLLER ID=5 SCS_NODENAME="HSD03"
SET THIS_CONTROLLER MSCP_ALLOCATION_CLASS=4 TMSCP_ALLOCATION_CLASS=4
RESTART THIS_CONTROLLER
[this controller restarts at this point]
SET THIS_CONTROLLER PATH
```

B.3.2 Setting HSJ-Series Parameters, Dual-Redundant

```
SET THIS_CONTROLLER MAX_NODES=16
SET THIS_CONTROLLER ID=5 SCS_NODENAME="HSJ01"
SET THIS_CONTROLLER MSCP_ALLOCATION_CLASS=4 TMSCP_ALLOCATION_CLASS=4
SET FAILOVER COPY=THIS
SET OTHER_CONTROLLER MAX_NODES=16
SET OTHER_CONTROLLER ID=7 SCS_NODENAME="HSJ02"
RESTART OTHER_CONTROLLER
[other controller restarts at this point]
RESTART THIS_CONTROLLER
[this controller restarts at this point]
SET THIS_CONTROLLER PATH_A PATH_B
SET OTHER_CONTROLLER PATH_A PATH_B
```

B.3.3 Setting HSZ-Series Parameters

```
SET THIS_CONTROLLER ID=5
RESTART THIS_CONTROLLER
[this controller restarts at this point]
```

B.3.4 Setting Terminal Speed and Parity

```
SET THIS_CONTROLLER TERMINAL_SPEED=19200 NOTERMINAL_PARITY
```

Note

Garbage will appear on the terminal after setting the controller’s terminal speed until you set the terminal’s speed to match the new speed.

B.3.5 Adding Devices

This example shows how to define the devices on a six-port controller. Define devices one at a time through the ADD command, specifying device type (DISK/TAPE/CDROM), device name, and device PTL location.

```
CLI> ADD DISK DISK0 1 0 0
CLI> ADD DISK DISK1 2 0 0
CLI> ADD DISK DISK2 3 0 0
CLI> ADD DISK DISK3 4 0 0
CLI> ADD DISK DISK4 4 1 0
CLI> ADD TAPE TAPE0 5 1 0
CLI> ADD CDROM CDROM0 6 0 0
```

This example created the following devices:

Device Type	Device Name	Port	Target	LUN
Disk	DISK0	1	0	0
Disk	DISK1	2	0	0
Disk	DISK2	3	0	0
Disk	DISK3	4	0	0
Disk	DISK4	4	1	0
Tape	TAPE0	5	1	0
CDROM	CDROM0	6	0	0

B.3.6 Adding Storage Sets

Storage sets are created from disks. In the previous example, devices were given names to make them identifiable. Use these names when creating storage sets.

```
CLI> ADD STRIPESET STRIPE0 DISK0 DISK1 DISK2 DISK3
```

This example creates a stripeset (named STRIPE0) using disks DISK0, DISK1, DISK2, and DISK3 from Section B.3.5. All members of the storage set (a stripeset) must have been previously defined using ADD DISK.

Tapes and CDROMs cannot be bound to storage sets.

B.3.7 Initializing Containers

Disks and storage sets are also called containers. Containers must be initialized *before* they are made available to a host via the ADD UNIT command. The following initializes containers from the previous examples:

```
CLI> INITIALIZE STRIPE0
CLI> INITIALIZE DISK4
```

Initializing a tape or CDROM is not required (and is not allowed).

B.3.8 Adding Logical Units

Units can be created from any container (either device or storage set). Tapes and CDROMs are always bound directly to units because they cannot comprise a storage set.

The following makes the devices and containers from the previous examples available to the host as units:

```
CLI> ADD UNIT D0 STRIPE0
CLI> ADD UNIT D100 DISK4
CLI> ADD UNIT D120 CDROM0
CLI> ADD UNIT T0 TAPE0
```

This creates disk unit 0 from stripeset STRIPE0, disk unit 100 from DISK4, disk unit 120 from CDROM0, and tape unit 0 from TAPE0. At the UNIT level, CDROMs are treated as disks (but only a subset of the disk SET commands are available for CDROMs).

B.3.9 Device Configuration Examples

The following examples show some different device configurations.

Creating a Unit From a Disk Device

```
CLI> ADD DISK DISK0 2 0 0
CLI> INITIALIZE DISK0
CLI> ADD UNIT D0 DISK0
```

Creating a Unit From a Tape Device

```
CLI> ADD TAPE TAPE0 3 0 0
CLI> ADD UNIT T0 TAPE0
```

Creating a Unit From a Four-Member Stripeset

```
CLI> ADD DISK DISK0 1 0 0
CLI> ADD DISK DISK1 2 0 0
CLI> ADD DISK DISK2 3 0 0
CLI> ADD DISK DISK2 1 1 0
CLI> ADD STRIPESET STRIPE0 DISK0 DISK1 DISK2 DISK3
Warning 3000: This storageset is configured with more than one disk per port
              This will cause a degradation in performance
CLI> INITIALIZE STRIPE0
CLI> ADD UNIT D0 STRIPE0
```

Creating a Write-Protected Unit From a Disk

```
CLI> ADD DISK DISK0 2 0 0
CLI> INITIALIZE DISK0
CLI> ADD UNIT D0 DISK0 WRITE_PROTECT
```

Write Protecting an Existing Unit

```
CLI> ADD DISK DISK0 2 0 0
CLI> INITIALIZE DISK0
CLI> ADD UNIT D0 DISK0
CLI> SET D0 WRITE_PROTECT
```

Renumbering Disk Unit 0 to Disk Unit 100

```
CLI> ADD DISK DISK0 2 0 0
CLI> INITIALIZE DISK0
CLI> ADD UNIT D0 DISK0
CLI> DELETE D0
CLI> ADD UNIT D100 DISK0
```

Note that no INITIALIZE is required because DISK0 has already been initialized.

Creating a Transportable Unit From a Disk Device

```
CLI> ADD DISK DISK0 2 0 0 TRANSPORTABLE
CLI> INITIALIZE DISK0
CLI> ADD UNIT D0 DISK0
```

or:

```
CLI> ADD DISK DISK0 2 0 0
CLI> SET DISK0 TRANSPORTABLE
CLI> INITIALIZE DISK0
CLI> ADD UNIT D0 DISK0
```

Deleting the Unit, Stripeset and All Disks Associated With the Stripeset

```
CLI> DELETE D0
CLI> DELETE STRIPE0
CLI> DELETE DISK0
CLI> DELETE DISK1
CLI> DELETE DISK2
CLI> DELETE DISK3
```

C

HSJ-Series Error Logging

This appendix details errors the HSJ-series controller reports in its host event logs under the OpenVMS operating system, as well as how to extract the information from the logs.

Note

Host event log translations are correct as of the date of publication of this manual. However, log information may change with firmware updates. Refer to your *StorageWorks Array Controller Operating Firmware Release Notes* for event log information updates.

C.1 Reading an HSJ-Series Error Log

To understand the error logs, use the following guidelines:

- Each error log contains an "MSLG$B_FORMAT" field (in the upper portion of the log), plus a "CONTROLLER DEPENDENT INFORMATION" area (in the lower portion of the log). "CONTROLLER DEPENDENT INFORMATION" will vary according to the "MSLG$B_FORMAT" field.

  Example C–1 shows an example of an ERF translated host error log (a Disk Transfer Event log). See Example C–1 to find "MSLG$B_FORMAT" and "CONTROLLER DEPENDENT INFORMATION".

- The key to interpreting error logs is a 32 bit **instance code** located in the "CONTROLLER DEPENDENT INFORMATION" area. The instance code uniquely identifies the following:
  - The error or condition
  - The component reporting the condition
  - The recommended repair action
  - The threshold when the repair action should be taken

Note

The instance code is the single, most important part of interpreting the error log. This is a departure from HSC-based error logs, where other fields in the error information contained values of primary interest.

Example C–1 Disk Transfer Error Event Log

```
V A X / V M S       SYSTEM ERROR REPORT       COMPILED 16-MAR-1993 11:05:04
                                                                  PAGE 146.

******************************* ENTRY     12. *******************************
ERROR SEQUENCE 2832.                            LOGGED ON:        SID 05903914
DATE/TIME 16-MAR-1993 10:27:58.95                            SYS_TYPE 00000000
SYSTEM UPTIME: 4 DAYS 02:11:34
SCS NODE: CNOTE                                              VAX/VMS V5.5-2

ERL$LOGMESSAGE ENTRY  KA825  HW REV# B  PATCH REV# 28.  UCODE REV# 20.
                      BI NODE # 2.

I/O SUB-SYSTEM, UNIT _FRED$DUA115:

      MESSAGE TYPE        0001
                                  DISK MSCP MESSAGE
      MSLG$L_CMD_REF  9DB30013
      MSLG$W_UNIT         0073
                                  UNIT #115.
      MSLG$W_SEQ_NUM      0002
                                  SEQUENCE #2.
      MSLG$B_FORMAT         02
                                  DISK TRANSFER LOG
      MSLG$B_FLAGS          00
                                  UNRECOVERABLE ERROR
      MSLG$W_EVENT        000B
                                  DRIVE ERROR
                                  UNKNOWN SUBCODE #0000(X)
      MSLG$Q_CNT_ID   00134534
                      01280001
                                  UNIQUE IDENTIFIER, 000100134534(X)
                                  MASS STORAGE CONTROLLER
                                  MODEL = 40.
      MSLG$B_CNT_SVR        FF
                                  CONTROLLER SOFTWARE VERSION #255.
      MSLG$B_CNT_HVR        00
                                  CONTROLLER HARDWARE REVISION #0.
      MSLG$W_MULT_UNT     0005
      MSLG$Q_UNIT_ID  00000001
                      02FF0000
                                  UNIQUE IDENTIFIER, 000000000001(X)
                                  DISK CLASS DEVICE (166)
                                  MODEL = 255.
      MSLG$B_UNIT_SVR       0B
                                  UNIT SOFTWARE VERSION #11.
      MSLG$B_UNIT_HVR       0C
                                  UNIT HARDWARE REVISION #12.
      MSLG$B_LEVEL          01
      MSLG$B_RETRY          00
      MSLG$L_VOL_SER  00001492
                                  VOLUME SERIAL #5266.
      MSLG$L_HDR_CODE 000659B6
                                  LOGICAL BLOCK #416182.
                                  GOOD LOGICAL SECTOR
```

(continued on next page)

Example C–1 (Cont.) Disk Transfer Error Event Log

```
CONTROLLER DEPENDENT INFORMATION
      LONGWORD 1.     03094002
                                    /.@../
      LONGWORD 2.     00003C51
                                    /Q<../
      LONGWORD 3.     00000000
                                    /..../
      LONGWORD 4.     000016D4
                                    /Ô.../
      LONGWORD 5.     00000000
                                    /..../
      LONGWORD 6.     00030002
                                    /..../
      LONGWORD 7.     56415246
                                    /CNOT/
      LONGWORD 8.     20205355
                                    /E  /
      LONGWORD 9.     00000501
                                    /..../
      LONGWORD 10.    36325A52
                                    /RZ26/
      LONGWORD 11.    20202020
                                    /    /
      LONGWORD 12.    29432820
                                    / (C)/
      LONGWORD 13.    43454420
                                    / DEC/
      LONGWORD 14.    20202020
                                    /    /
      LONGWORD 15.    31202020
                                    /   1/
      LONGWORD 16.    i00F0002A
                                    /*.ð./
      LONGWORD 17.    59060004
                                    /...Y/
      LONGWORD 18.    000016B6
                                    /¶.../
      LONGWORD 19.    01030000
                                    /..../
      LONGWORD 20.    000A8001
                                    /..../
```

The 32-bit instance code always appears in "LONGWORD 1" of "CONTROLLER DEPENDENT INFORMATION", with the following exceptions:

- When MSLG$B_FORMAT reads "09 BAD BLOCK REPLACEMENT ATTEMPT", the instance code does not appear, because ERF does not provide "CONTROLLER DEPENDENT INFORMATION".
- When MSLG$B_FORMAT reads "0A MEDIA LOADER LOG", the instance code appears in "LONGWORD 2".
- When MSLG$B_FORMAT reads "00 CONTROLLER LOG", the instance code appears in part of both "LONGWORD 1" and "LONGWORD 2."

  For this "MSLG$B_FORMAT", the code is skewed and not directly readable as a longword. (The code's low-order bytes appear in the two high-order bytes of "LONGWORD 1", and the code's high-order bytes appear in the two low-order bytes of "LONGWORD 2"). For example:

```
CONTROLLER DEPENDENT INFORMATION
     LONGWORD 1.     030A0000
                                     /..../
     LONGWORD 2.     24010102
                                     /...$/
```

  In this case, the instance code is 0102030A.

  A OpenVMS DCL command procedure is provided at the end of this appendix (see Section C.6) for deskewing this particular instance code. Running the command procedure will make the error log directly readable when used in conjunction with the other information supplied in this appendix.

- Once you locate and identify the instance code, see the following sections for further information:
  - Section C.3 contains the Event Log Code tables, Tables C–2 through C–49. These tables list specific code descriptions.
  - Section C.2 contains detailed error packet descriptions, based on template type.
  - Section C.4 contains error threshold values.
  - Section C.5 contains recommended repair actions.
- When you look up a specific instance code, you will notice that each error belongs to one of fifteen **template** types. Each template type has a one byte value identifying it, which is also located in the "CONTROLLER DEPENDENT INFORMATION" area longwords, as shown in Table C–1.

  You may be able to use Table C–1 to quickly identify the template type, after examining the longwords in the "CONTROLLER DEPENDENT INFORMATION" area. However, since the location of the value identifying the template varies, the safest way to determine the template is to use the instance code. The template type is always the very next byte after the instance code.

Table C–1 Template Types

Description	Template	Longword	Value	Deskewed Value
Last Failure Event Log	01†	2	24**01**xxxx	000024**01**
Failover Event Log	05†	2	00**05**xxxx	000000**05**
Host buffer Access Error Event Log	10	2	00000C**10**	
Nonvolatile Parameter Memory Component Event Log	11	2	000008**11**	
Backup Battery Failure Event Log	12	2	000000**12**	
Subsystem Built-In Self Test Failure Event Log	13†	2	24**13**xxxx	000024**13**
Cache Memory Failure Event Log	14	2	000024**14**	
CI Port Event Log	31†	2	0C**31**xxxx	00000C**31**
CI Port/Port Driver Event Log	32†	2	10**32**xxxx	000010**32**
CI System Communication Services Event Log	33†	2	2C**33**xxxx	00002C**33**
Device Services Nontransfer Event Error Log	41†	2	04**41**xxxx	000004**41**
Disk Transfer Error Event Log	51	2	00003C**51**	
Disk Bad Block Replacement (BBR) Attempt Event Log	57	No Longwords		
Tape Transfer Error Event Log	61	2	00003C**61**	
Media Loader Error Event Log	71	3	00003C**71**	

†The MSLG$B_FORMAT field for these templates will read "00 CONTROLLER LOG", so you may want to run the OpenVMS DCL command procedure provided at the end of this appendix (Section C.6) for deskewing the longwords.

- You should use the template type to learn even more from the error log. Information available in longwords, other than the instance code, includes the following:
  - Template type
  - Template information size
  - Event time
  - Drive sense data
  - Other information specific to the template

  Knowing the template type allows you to better use Section C.2 to obtain a complete description of each template and determine where information is located within the associated "CONTROLLER DEPENDENT INFORMATION".

C.2 Event Log Formats

Note

The numeric code values discussed in the figures and tables of this appendix are hexadecimal, unless otherwise stated.

The HSJ30/40 controller reports significant events that occur during normal controller operation using the following standard MSCP and TMSCP error log message formats:

- Controller Errors
- Memory Errors
- Disk Transfer Errors
- Bad Block Replacement Attempts
- Tape Errors
- Media Loader Errors
- Disk Copy Data Correlation

To more fully use the remainder of this appendix, you should become familiar with MSCP and TMSCP protocols, especially in the area of error log message formats.

C.2.1 Implementation Dependent Information Area

With the exception of the Disk Copy Data Correlation error log message format, each of the error log message formats listed in Section C.2 provide an “implementation dependent information” area located at the end of the message. For HSJ30/40 controller-specific event logs, this area is formatted as shown in Figure C–1.

Note that the fields shown in Figure C–1 always begin on a longword boundary within HSJ30/40 controller-specific event logs. If the “implementation dependent information” area of a particular MSCP error log message format does not begin on a longword boundary, a “reserved” field containing the appropriate number of bytes is appended to the format to provide the necessary alignment (such as offset 16 in Figure C–15).

Implementation Dependent Information Fields:

instance code

A number that uniquely identifies the event being reported. The format of this field is shown in Figure C–2.

Figure C–1 Implementation Dependent Information Format

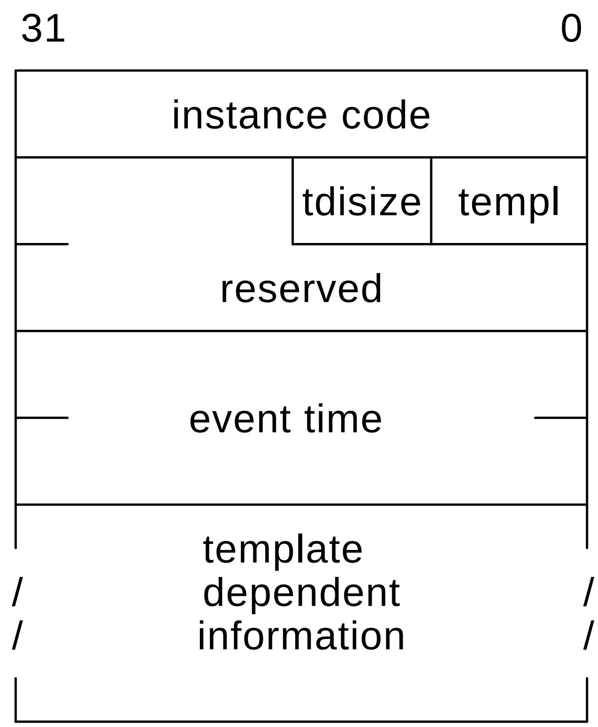
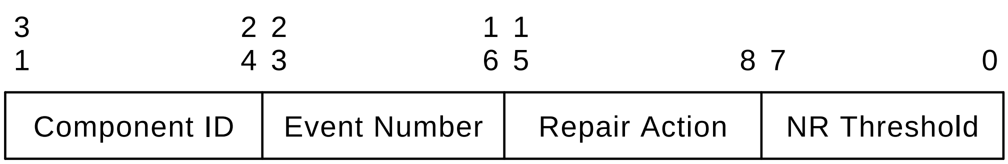


Figure C–2 Instance Code Format



Instance Code Specific Subfields:

NR Threshold

The notification/recovery threshold assigned to the event. This value indicates when notification/recovery action should be taken. See Section C.4 for more detail.

Repair Action

The recommended repair action code assigned to the event. This value indicates what notification/recovery action should be taken when the NR Threshold is reached. See Section C.5 for more detail.

Event Number

A number, when combined with the value contained in the Component ID subfield, uniquely identifies the event.

Component ID

A number that uniquely identifies the firmware component that detected the event as shown in Table C–2.

templ

A number that uniquely describes the format of the “template dependent information” field.

tdisize

The number of bytes contained in the “template dependent information” field.

reserved

Reserved for future use.

event time

The time the event occurred according to the power on time value maintained by the HSJ30/40 controller operational firmware.

The power on time value is a 64-bit unsigned integer that represents the total number of seconds HSJ30/40 controller operational firmware has executed on the HSJ30/40 controller board. Note that the time expended during controller reinitializations, power-on diagnostics, and system initialization is not accounted for by this value.

template dependent information

A variable length field containing information specific to the event being reported.

This field is divided into separate fields specific to the template identified in the “templ” field. The template-specific fields common to multiple event logs are described in separate subsections of Section C.2.2 to avoid duplication of the field descriptions in Section C.2.3.

C.2.2 Common Event Log Fields

Common fields are generated across certain event logs. These common fields are described in Sections C.2.2.1 through C.2.2.5.

C.2.2.1 CI Host Interconnect Services Common Event Log Fields

The fields common to certain event logs generated by the CI Host Interconnect Services firmware component are shown in Figure C–3.

Figure C–3 CI Host Interconnect Services Common Event Log Fields

31	16	15	0
his status			
error id			
vcstate	intopcd	dst	src
scs opcode		ppd opcode	

CI Host Interconnect Services Common Fields:

his status

The Host Interconnect Services status code as shown in Table C–3.

error id

The address of the Host Interconnect Services routine that detected the event.

src

The CI source node address.

dst

The CI destination node address.

intopcd

The CI message opcode as shown in Table C–4.

vcstate

The virtual circuit state code as shown in Table C–5.

Note

The setting of the high order bit (Bit 7) in this field indicates the state of ID polling for the virtual circuit.

If Bit 7 is set, ID polling is complete. Otherwise, ID polling is incomplete.

ppd opcode

The Port/Port Driver layer opcode as shown in Table C–6.

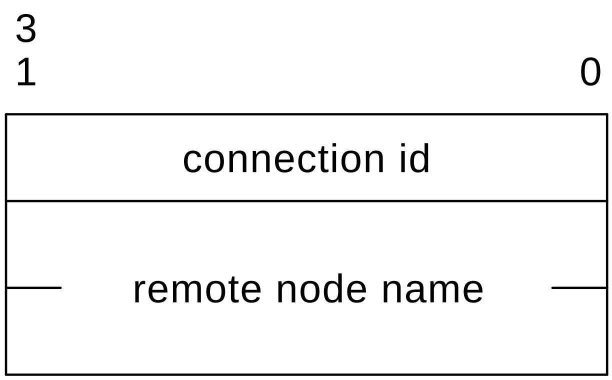
scs opcode

The System Communication Services layer opcode as shown in Table C–7.

C.2.2.2 Host/Server Connection Common Fields

The fields common to certain event logs generated by the Disk and Tape MSCP Server, CI Host Interconnect Services, Device Services, and Value Added firmware components are shown in Figure C–4.

Figure C–4 Host/Server Connection Common Fields



Host/Server Connection Common Fields:

connection id

Identifies the host/server connection associated with the event being reported. If this value is zero, the host/server connection information was invalidated before the event could be reported.

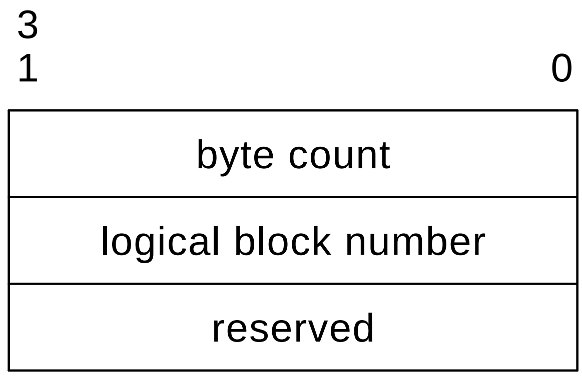
remote node name

An 8-byte ASCII string that represents the node name associated with the host/server connection identified in the “connection id” field. If the “connection id” field is zero, the content of this field is undefined.

C.2.2.3 Byte Count/Logical Block Number Common Fields

The fields common to certain event logs generated by the Device Services and Value Added firmware components are shown in Figure C–5.

Figure C–5 Byte Count/Logical Block Number Common Fields



Byte Count/Logical Block Number Common Fields:

byte count

Number of bytes of the HSJ30/40 controller firmware component initiated transfer successfully transferred.

logical block number

Starting logical block number of the HSJ30/40 controller firmware component initiated transfer.

reserved

Reserved for future use, currently contains the value 0.

C.2.2.4 Device Location/Identification Common Fields

The fields common to certain event logs generated by the Device Services and Value Added firmware components are shown in Figure C–6.

Device Location/Identification Common Fields:

device locator

The location within the HSJ30/40 controller's subsystem of the target device involved in the event being reported. This field is formatted as shown in Figure C–7.

Figure C–6 Device Location/Identification Common Fields

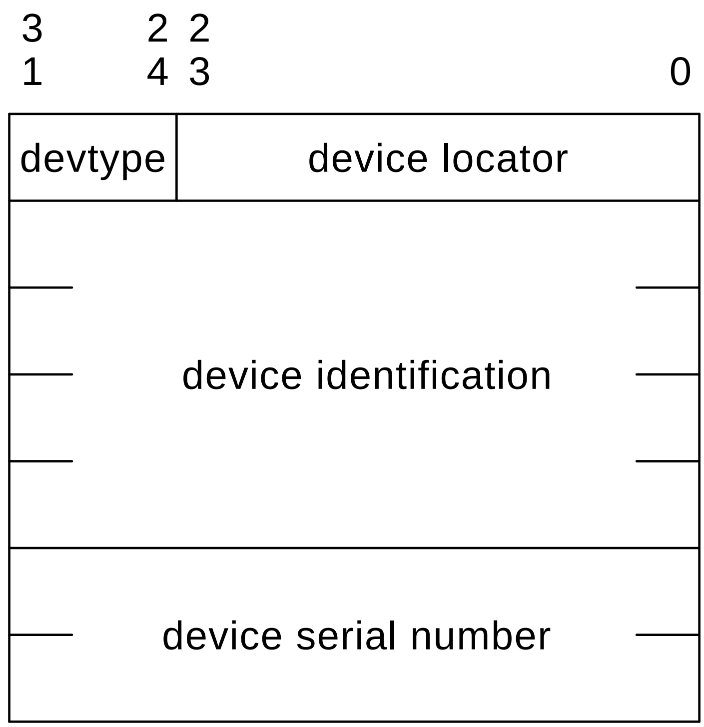
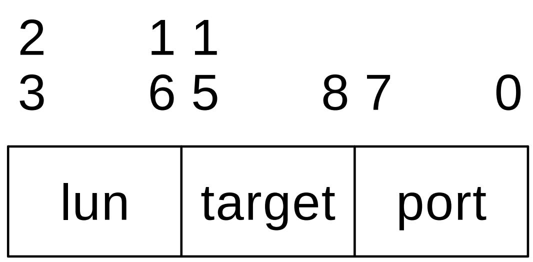


Figure C–7 Device Locator Field Format



Device Locator Specific Subfields:

port

The SCSI bus number to which the target device is connected.

target

The SCSI target number on the “port” to which the target device is connected.

lun

The logical unit number on the “target” by which the target device is logically addressed.

devtype

The SCSI device type of the device. The various SCSI device types supported by the HSJ30/40 controller are shown in Table C–9.

device identification

Sixteen bytes of ASCII data as defined by the device vendor in the Product Identification field of the SCSI INQUIRY command data.

The most significant character of the product identification data will appear in the low order byte of the first longword of this field while the least significant character appears in the high order byte of the last long word.

device serial number

Eight bytes of ASCII data as defined by the device vendor in the Product Serial Number field of the SCSI Unit Serial Number Page data.

The most significant character of the serial number data will appear in the low order byte of the first longword of this field while the least significant character appears in the high order byte of the last longword.

Note that the number of characters of serial number data supplied may vary from vendor to vendor as well as from device to device. If the serial number data supplied is less than eight characters, this field is ASCII space filled from the lowest order byte (relative to the low order byte of the first longword) containing a serial number character through the high order byte of the last longword. If the serial number data supplied are greater than eight characters, the serial number data are truncated at eight bytes (that is, the least significant character(s) of the serial number data are lost). If the serial number data are not available at all, this field is ASCII space filled.

C.2.2.5 SCSI Device Sense Data Common Fields

The fields common to certain event logs generated by the Device Services and Value Added firmware components are shown in Figure C–8.

The first two fields shown in Figure C–8, the “cmdopcd” and “sdqual” fields, are supplied by the HSJ30/40 controller to provide qualifying information required to interpret the other SCSI Sense Data Common fields. The other fields, “ercdval” through “keyspec”, contain standard Sense Data, returned in the response of a SCSI REQUEST SENSE command issued to the target device or generated by the HSJ30/40 controller on the target device’s behalf.

Figure C–8 SCSI Device Sense Data Common Fields

31 24	23 16	15 8	7 0
segment	ercdval	sdqual	cmdopcd
info			snsflgs
cmdspec		addsnsl	info
ascq	asc	cmdspec	
keyspec			frucode

Figure C–9 Sense Data Qualifier Field Format

7	6	5	4	3	2	1	0
dssd	rsvd	fbw	msbd	uweuo	bufmode		

SCSI Device Sense Data Common Fields:

cmdopcd

The operation code of the SCSI command issued to the target device. SCSI command operation codes vary according to device type (see Table C–10) so the content of this field depends on the content of the “devtype” field.

See the description of the “ercdval” field for information regarding the validity of this field.

sdqual

This field contains information necessary to determine whether or not the Sense Data contained in the “ercdval” through “keyspec” fields are supplied by an attached device or generated by the HSJ30/40 controller itself and to qualify the content of the “info” field. This field is formatted as shown in Figure C–9.

Sense Data Qualifier Specific Subfields:

bufmode

The SCSI buffered mode selected on the device. The various SCSI Buffered Modes are shown in Table C–11.

uweuo

This bit is set to one if and only if an unrecoverable write error was detected while unwritten objects (that is, data blocks, filemarks, or setmarks) remain in the buffer.

msbd

This bit is set to one if and only if the MODE SENSE block descriptor is nonzero.

fbw

This bit is set to one if and only if the Fixed bit of the WRITE command is set to one.

rsvd

Reserved for future use.

dssd

This bit is set to one if and only if the Sense Data contained in the “ercdval” through “keyspec” fields are supplied by the target device.

If this bit is zero, the Sense Data contained in the “ercdval” through “keyspec” fields are generated by the HSJ30/40 controller on behalf of the target device because the Sense Data could not be obtained from that device.

ercdval

This field contains byte 0 of the Sense Data returned in the response of a SCSI REQUEST SENSE command. This field is formatted as shown in Figure C–10.

Figure C–10 SCSI Sense Data Byte Zero (“ercdval”) Field Format

7	6	5	4	3	2	1	0
Valid	Error Code						

SCSI Sense Data Byte Zero (“ercdval”) Specific Subfields:

Error Code

An error code of 70 indicates that the event being reported occurred during the execution of the current command, identified in the “cmdopcd” field.

An error code of 71 indicates that the event being reported occurred during execution of a previous command for which GOOD status has already been returned. The "cmdopcd" field is undefined in this case.

For error codes 70 and 71 the remaining fields of the event log (such as segment, snsflgs, info, and so forth) will contain the standard SCSI Sense Data fields (bytes 1 through 17) returned in the response of a SCSI REQUEST SENSE command.

An error code of 7F indicates that the Sense Data fields are in a vendor-specific format so the content of the remaining event log fields can only be determined from documentation provided by the vendor of the target device.

The SCSI standard states that error code values 72 through 7E are currently reserved for future use and that error codes 00 through 6F are not defined. Should this field contain any of those codes the remaining event log fields are undefined.

Valid

If this bit is set to one, the content of the Sense Data Information field (bytes 3 through 6) is valid and its content is as defined by the SCSI standard (see the description of the "info" field for the SCSI definition of the Sense Data Information field). Otherwise, the Sense Data Information field is not as defined by the SCSI standard (refer to documentation provided by the device vendor for their definition of the field).

segment

This field contains byte 1 (Segment field) of the Sense Data returned in the response of a SCSI REQUEST SENSE command. If the "cmdopcd" is an 18 (COPY), 39 (COMPARE), or 3A (COPY AND VERIFY), this field contains the number of the current segment descriptor.

snsflgs

This field contains byte 2 of the Sense Data returned in the response of a SCSI REQUEST SENSE command. This field is formatted as shown in Figure C–11.

Figure C–11 SCSI Sense Data Byte Two ("snsflgs") Field Format

7	6	5	4	3	2	1	0
FM	EOM	ILI	Rsvd	Sense Key			

SCSI Sense Data Byte Two ("snsflgs") Specific Subfields:

Sense Key

The sense key provides generic categories in which events can be reported. The sense keys are described in Table C–12.

ILI

An incorrect length indicator (ILI) bit of one usually indicates that the requested logical block length did not match the logical block length of the data on the medium.

EOM

For sequential-access devices (that is, "devtype" is 1) an end-of-me dium (EOM) bit set to one indicates that the unit is at or past the early-warning if the direction was forward or that the command could not be completed because beginning-of-partition was encountered if the direction was reverse.

FM

A filemark (FM) bit set to one indicates that the current command has read a filemark or setmark. The Additional Sense Code field (see "asc" field description) may be used to indicate whether or not a filemark or setmark was read. Note that the reporting of setmarks is optional.

info

This field contains bytes 3 through 6 (Information field) of the Sense Data returned in the response of a SCSI REQUEST SENSE command. The content of this field varies depending on the values contained in the "devtype" and "cmdopcd" fields and the "bufmode", "uweuo", "msbd", and "fbw" subfields of the "sdqual" field as follows:

- Regardless of the value of the "devtype" field and the "sdqual" subfields, if the "cmdopcd" is an 18 (COPY), 39 (COMPARE), or 3A (COPY AND VERIFY), this field contains the difference (residue) of the requested number of blocks minus the actual number of blocks copied or compared for the current segment descriptor.

- Regardless of the value of the “sdqual” subfields, if “devtype” is 0 (Direct-Access Devices—such as magnetic disk) or 5 (CDROM Devices) and “cmdopcd” is not an 18 (COPY), 39 (COMPARE), or 3A (COPY AND VERIFY), this field contains the unsigned logical block address associated with the value contained in the Sense Key subfield of the “snsflgs” field (see Figure C–11).
- Regardless of the value of “cmdopcd,” if “devtype” is 1 (Sequential-Access Devices—such as magnetic tape) and “uweuo” is 1 and “bufmode” is either 1 or 2, this field contains the following:
  - The total number of objects in the buffer if “msbd” and “fbw” are both 1.
  - The number of bytes in the buffer, including filemarks and setmarks, if “msbd” is 1 and “fbw” is 0.

addsnsl

This field contains byte 7 (Additional Sense Length field) of the Sense Data returned in the response of a SCSI REQUEST SENSE command. This field contains the number of additional Sense Data bytes to follow.

If this value is less than 10, the content of some or all of the remaining event log fields (that is, cmdspec, asc, ascq, frucode, and keyspec) may be undefined. The “cmdspec” field is undefined unless this value is 4 or greater. The “asc” and “ascq” fields are undefined unless this value is 6 or greater. The “frucode” field is undefined unless this value is 7 or greater. The “keyspec” field is undefined unless this value is 10 or greater.

If this value is greater than 10, the device supplied the Additional Sense Bytes field, which begins at byte 12 of the Sense Data. The content of the Additional Sense Bytes field is not included in the event log.

cmdspec

If the value contained in the “addsnsl” field is 4 or greater, this field contains bytes 8 through 0B (Command-Specific Information field) of the Sense Data returned in the response of a SCSI REQUEST SENSE command. The content of this field varies depending on the value contained in the “cmdopcd” field as follows:

- If the “cmdopcd” is an 18 (COPY), 39 (COMPARE), or 3A (COPY AND VERIFY), the low order byte of this field contains the starting byte number of an area relative to Sense Data byte 0 that contains (unchanged) the source logical unit’s status byte and sense data and the next higher order byte contains the starting byte number of an area relative to Sense Byte 0 that contains (unchanged) the destination logical unit’s status byte and sense data. If the low order or next higher order byte of this field contains the value zero, no status byte or sense data was supplied for the corresponding (source or destination) logical unit. The content of the highest order two bytes of this field is undefined.

- If the “cmdopcd” is a 7 (REASSIGN BLOCKS), this field contains the logical block address of the first defect descriptor not reassigned. If information about the first defect descriptor not reassigned is not available, or if all the defects have been reassigned, this field will contain the value FFFFFFFF.
- If the “cmdopcd” is a 31 (SEARCH DATA EQUAL), 30 (SEARCH DATA HIGH), or 32 (SEARCH DATA LOW) and the Sense Key subfield of the “snsflgs” field (refer to Figure C–11) value is EQUAL, this field contains the record offset of the matching record.

asc
ascq

If the value contained in the “addsnsl” field is 6 or greater and the “dssd” subfield of the “sdqual” field is equal to 1, the “asc” and “ascq” fields contain the values supplied in the byte 0C (Additional Sense Code) and byte 0D (Additional Sense Code Qualifier) fields, respectively, of the Sense Data returned in the response of a SCSI REQUEST SENSE command issued to the target device. The Additional Sense Code (ASC) field and the Additional Sense Code Qualifier (ASCQ) field together describe the event being reported. The standard SCSI ASC/ASCQ codes are “devtype” dependent as shown in Tables C–13 through C–16. Note that the SCSI standard defines ASCs within the range 80 through FF in combination with ASCQs within the range 00 through FF and ASCQs within the range 80 through FF regardless of ASC value as being vendor specific. Refer to documentation provided by the vendor of the target device for a description of an ASC/ASCQ value that falls within the defined vendor specific ranges.

If the value contained in the “addsnsl” field is 6 or greater and the “dssd” subfield of the “sdqual” field is equal to 0, the “asc” and “ascq” fields contain HSJ30/40 controller vendor-specific SCSI ASC/ASCQ codes generated by the HSJ30/40 on behalf of the target device. See Table C–17 for the descriptions of the HSJ30/40 controller vendor-specific SCSI ASC/ASCQ codes.

frucode

If the value contained in the “addsnsl” field is 7 or greater, this field contains byte 0E (Field Replaceable Unit field) of the Sense Data returned in the response of a SCSI REQUEST SENSE command. If this field is nonzero, the target device is identifying the “field replaceable unit” that has failed. Refer to documentation for the target device for complete details of the meaning of this value.

keyspec

If the value contained in the “addsnsl” field is 10 or greater, this field contains bytes 0F through 11 (Sense-Key Specific field) of the Sense Data returned in the response of a SCSI REQUEST SENSE command. The definition of this field is determined by the value of the Sense Key subfield of the “snsflgs” field. This field is reserved for Sense Key values other than ILLEGAL REQUEST, RECOVERED ERROR, HARDWARE ERROR, MEDIUM ERROR, and NOT READY.

If the Sense Key value is ILLEGAL REQUEST, the format of this field is as shown in Figure C–12.

Figure C–12 SCSI Sense Data Byte 0F through 11 (“keyspec”) Field—Field Pointer Bytes Format

7	6	5	4	3	2	1	0	
SKSV	C/D	Reserved		BPV	Bit Pointer			LOB
Field Pointer							(MSB)	
							(LSB)	HOB

SCSI Sense Data Byte 0F through 11 (“keyspec”)—Field Pointer Bytes Specific Subfields:

Bit Pointer and BPV

A bit pointer valid (BPV) bit of zero indicates that the value in the Bit Pointer subfield is not valid. A BPV bit of one indicates that the Bit Pointer subfield specifies which bit of the byte designated by the Field Pointer field is in error. When a multiple-bit field is in error, the Bit Pointer subfield points to the most-significant (left-most) bit of the field.

C/D

A command data (C/D) bit of one indicates that the illegal parameter is in the command descriptor block. A C/D bit of zero indicates that the illegal parameter is in the data parameters sent by the initiator during the DATA OUT phase.

SKSV

The content of the “keyspec” field is valid if and only if this bit is set to one.

Field Pointer

The Field Pointer subfield indicates which byte of the command descriptor block or of the parameter data was in error. When a multiple-byte field is in error, the pointer points to the most-significant (left-most) byte of the field.

If the Sense Key value is RECOVERED ERROR, HARDWARE ERROR, or MEDIUM ERROR, the format of this field is as shown in Figure C–13.

Figure C–13 SCSI Sense Data Byte 0F through 11 (“keyspec”) Field—Actual Retry Count Bytes Format

7	6	5	4	3	2	1	0	
SKSV	Reserved							LOB
Actual Retry Count							(MSB)	
							(LSB)	HOB

SCSI Sense Data Byte 0F through 11 (“keyspec”)—Actual Retry Count Bytes Specific Subfields:

SKSV

The content of the “keyspec” field is valid if and only if this bit is set to one.

Actual Retry Count

The actual retry count subfield contains the implementation-specific information on the actual number of retries of the recovery algorithm used in attempting to recover an error or exception condition.

If the Sense Key value is NOT READY and the last command issued to the device was a FORMAT UNIT, the format of this field is as shown in Figure C–14.

Figure C–14 SCSI Sense Data Byte 0F through 11 (“keyspec”) Field—Progress Indication Bytes Format

7	6	5	4	3	2	1	0	
SKSV	Reserved							LOB
Progress Indication							(MSB)	
							(LSB)	HOB

SCSI Sense Data Byte 0F through 11 (“keyspec”)—Progress Indication Bytes Specific Subfields:

SKSV

The content of the “keyspec” field is valid if and only if this bit is set to one.

Progress Indication

This subfield is a percent complete indication in which the returned value is the numerator that has 10000 as its denominator. The progress indication is based upon the total format operation including any certification or initialization operations.

C.2.3 Specific Event Log Formats

In addition to the common fields generated across certain event logs, there is specific information for each log, based on template type. The specific information is described in Sections C.2.3.1 through C.2.3.14.

C.2.3.1 Last Failure Event Log (Template 01)

Unrecoverable conditions detected by either the firmware or hardware, and certain operator initiated conditions result in the termination of HSJ30/40 controller operation.

In most cases, following such a termination, the controller will attempt to restart (that is, reinitialization) with hardware components and firmware data structures initialized to the states necessary to perform normal operations.

If the restart is successful and communications are reestablished with the host system(s), and “Miscellaneous” error logging is enabled by one or more host systems, the HSJ30/40 controller will send a Last Failure Event Log that describes the condition that caused controller operation to terminate to all host systems that have enabled “Miscellaneous” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

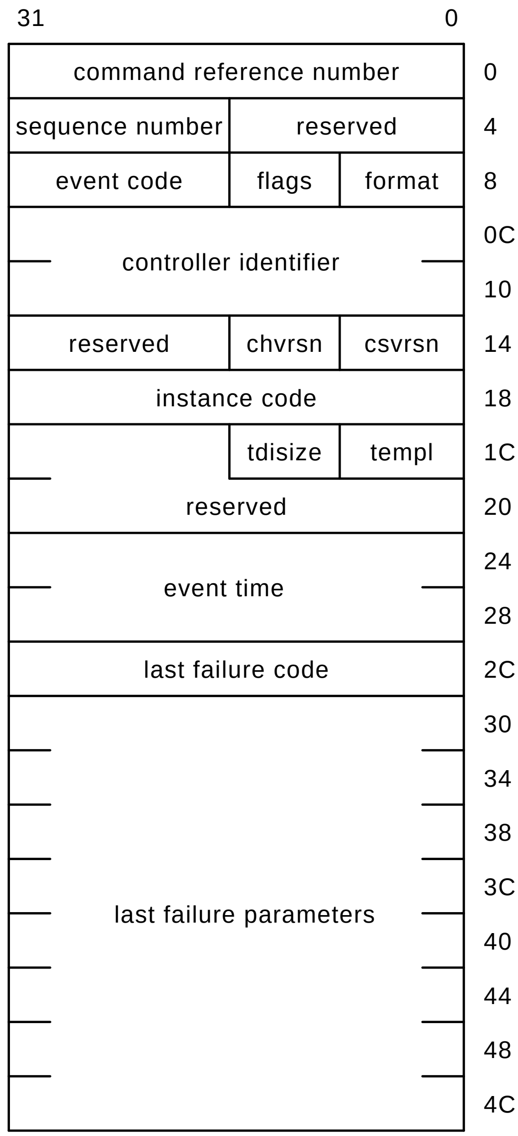
The Last Failure Event Log is reported via the T/MSCP Controller Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–15.

Last Failure Event Log Format Specific Fields:

format

This field contains the value 00 (that is, T/MSCP Controller Errors error log format code).

Figure C–15 Last Failure Event Log (Template 01) Format



event code

The values that can be reported in this field for this event log are shown in Table C–18.

reserved (offset 16)

This field contains the value 0.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–18.

templ

See Section C.2.1 for the description of this field.

This field contains the value 01 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 24 for this event log.

reserved (offset 1E)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

last failure code

A number that uniquely describes the unrecoverable condition being reported as shown in Tables C–33 through C–48. The format of this field is shown in Figure C–16.

Note

Do not confuse this field with the “instance code” field. They are similar in format but convey different information.

Figure C–16 Last Failure Code Format

31 ... 24	23 ... 16	15 ... 8	7	6 ... 4	3 ... 0
Component ID	Error Number	Repair Action	HW	Rest Code	Param Count

Last Failure Code Specific Subfields:

Parameter Count

The number of longwords of supplemental information provided in the “last failure parameters” field.

Restart Code

A number that describes the actions taken to restart the controller after the unrecoverable condition was detected, as shown in Table C–49.

HW

Hardware/firmware flag. If this flag is equal to 1, the unrecoverable condition is due to a hardware-detected fault. If this flag is equal to 0, the unrecoverable condition is due to a firmware-detected inconsistency.

Repair Action

The recommended repair action code assigned to the condition. This value indicates what notification/recovery action should be taken. See Section C.5 for more detail.

Error Number

A number, when combined with the value contained in the Component ID subfield, uniquely identifies the condition detected.

Component ID

A number that uniquely identifies the firmware component that reported the condition, as shown in Table C–2.

last failure parameters

This field contains supplemental information specific to the failure being reported.

The content of the parameters supplied (if any) are described in the individual "last failure code" descriptions contained in Tables C–33 through C–48.

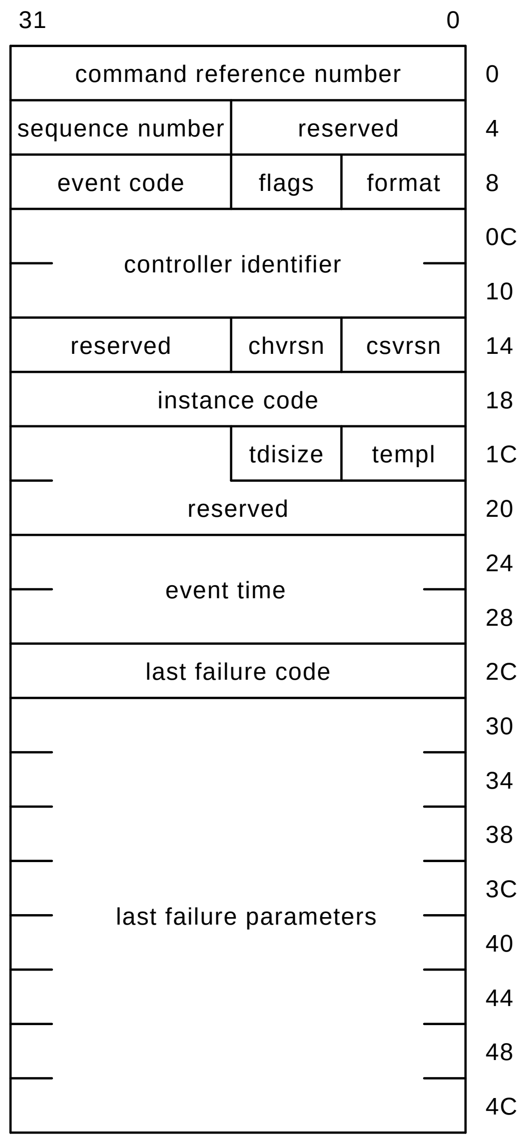
C.2.3.2 Failover Event Log (Template 05)

The HSJ30/40 controller Failover Control firmware component reports errors and other conditions encountered during redundant controller communications and failover operation via the Failover Event Log.

The Failover Event Log will be sent to all host systems that have enabled "Miscellaneous" error logging on a connection or connections established with the HSJ30/40 controller's Disk and/or Tape MSCP Server.

The Failover Event Log is reported via the T/MSCP Controller Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–17.

Figure C–17 Failover Event Log (Template 05) Format



Failover Event Log Format Specific Fields:

format

This field contains the value 00 (that is, T/MSCP Controller Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–19.

reserved (offset 16)

This field contains the value 0.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–19.

templ

See Section C.2.1 for the description of this field.

This field contains the value 05 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 24 for this event log.

reserved (offset 1E)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

last failure code
last failure parameters

These fields contain the last failure information supplied in the last gasp message sent by the other HSJ30/40 controller in a dual-redundant configuration as a normal part of terminating controller operation.

See Section C.2.3.1 for the description of the format of these fields.

Note that the content of certain of the fields described previously may be undefined depending on the value supplied in the "instance code" field. See Table C–19 for more detail.

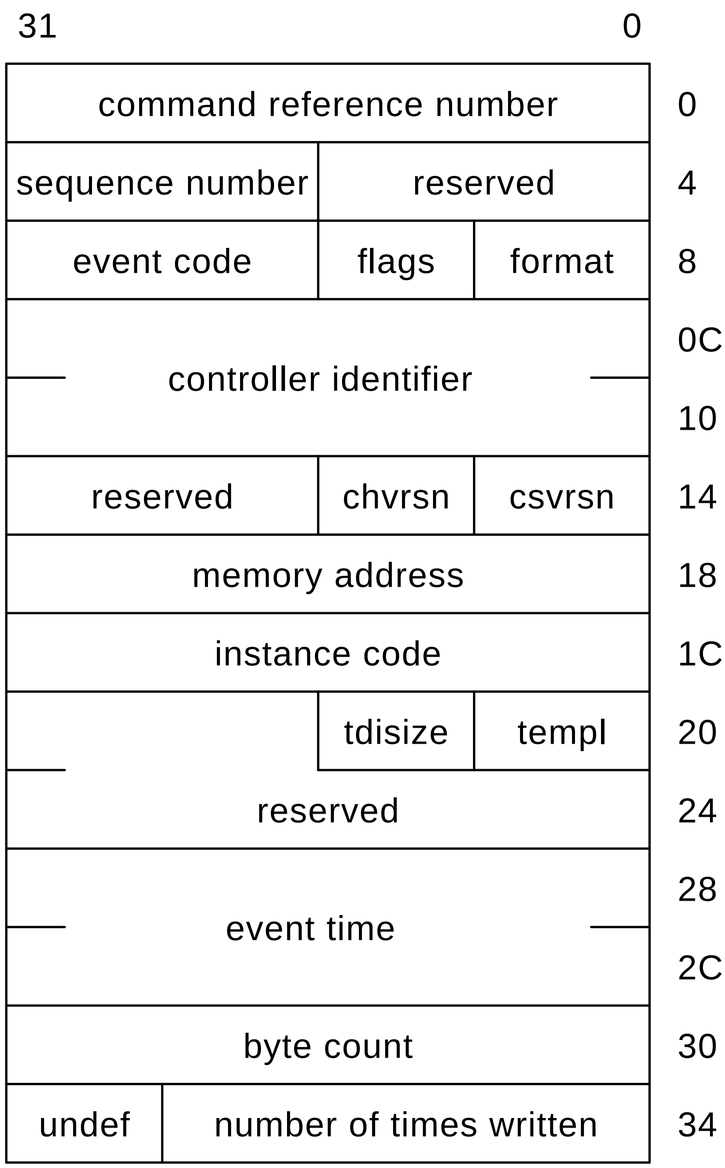
C.2.3.3 Nonvolatile Parameter Memory Component Event Log (Template 11)

The HSJ30/40 controller Executive firmware component reports errors detected while accessing a Nonvolatile Parameter Memory Component via the Nonvolatile Parameter Memory Component Event Log.

The Nonvolatile Parameter Memory Component Event Log will be sent to all host systems that have enabled "Miscellaneous" error logging on a connection or connections established with the HSJ30/40 controller's Disk and/or Tape MSCP Server.

The Nonvolatile Parameter Memory Component Event Log is reported via the T/MSCP Memory Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–18.

Figure C–18 Nonvolatile Parameter Memory Component Event Log (Template 11) Format



Nonvolatile Parameter Memory Component Event Log Format Specific Fields:

format

This field contains the value 01 (that is, T/MSCP Memory Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–20.

memory address

The physical address of the beginning of the affected Nonvolatile Parameter Memory component area.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–20.

templ

See Section C.2.1 for the description of this field.

This field contains the value 11 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 08 for this event log.

reserved (offset 22)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

byte count

The number of bytes contained in the affected Nonvolatile Parameter Memory component area (that is, the area bounded by: “memory address” through “memory address” + “byte count” –1).

number of times written

The number of times the affected Nonvolatile Parameter Memory component area has been written.

undef

This field is only present to provide longword alignment; its content is undefined.

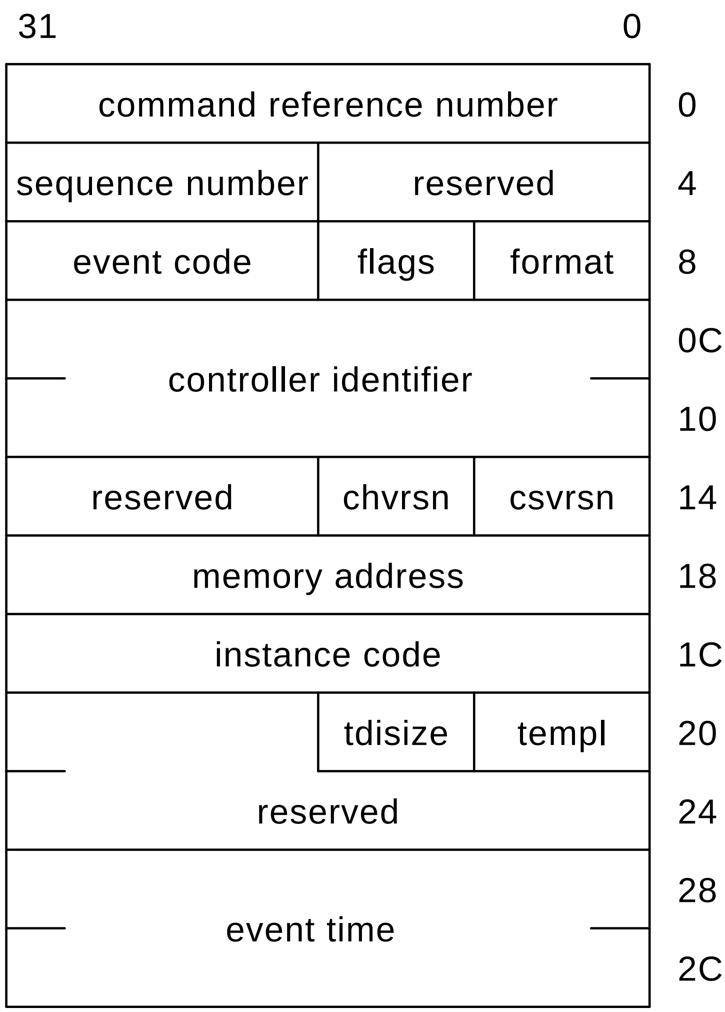
C.2.3.4 Backup Battery Failure Event Log (Template 12)

The HSJ30/40 controller Value Added Services firmware 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 Log.

The Backup Battery Failure Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

The Backup Battery Failure Event Log is reported via the T/MSCP Memory Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–19.

Figure C–19 Backup Battery Failure Event Log (Template 12) Format



Backup Battery Failure Event Log Format Specific Fields:

format

This field contains the value 01 (that is, T/MSCP Memory Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–21.

memory address

The content of this field depends on the value supplied in the “instance code” field. See Table C–21 for more detail.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–21.

templ

See Section C.2.1 for the description of this field.

This field contains the value 12 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 00 for this event log.

reserved (offset 22)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

C.2.3.5 Subsystem Built-In Self-Test Failure Event Log (Template 13)

The HSJ30/40 controller Subsystem Built-In Self-Tests firmware component reports errors detected during test execution via the Subsystem Built-In Self-Test Failure Event Log.

The Subsystem Built-In Self-Test Failure Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

The Subsystem Built-In Self-Test Failure Event Log is reported via the T/MSCP Controller Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–20.

Figure C–20 Subsystem Built-In Self-Test Failure Event Log (Template 13) Format

31			0	
command reference number				0
sequence number		reserved		4
event code		flags	format	8
controller identifier				0C
				10
reserved		chvrsn	csvrsn	14
instance code				18
		tdisize	templ	1C
reserved				20
event time				24
				28
hdrflgs	hdrtype	undefined		2C
tflags	tcmd	tnum	te	30
return code		error code		34
address of error				38
expected error data				3C
actual error data				40
extra status 1				44
extra status 2				48
extra status 3				4C

Subsystem Built-In Self-Test Failure Event Log Format Specific Fields:

format

This field contains the value 00 (that is, T/MSCP Controller Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–22.

reserved (offset 16)

This field contains the value 0.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–22.

templ

See Section C.2.1 for the description of this field.

This field contains the value 13 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 24 for this event log.

reserved (offset 1E)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

undefined

This field is only present to provide longword alignment, its content is undefined.

hdrtype
hdrflgs
te
tnum
tcmd
tflags
error code
return code
address of error
expected error data
actual error data
extra status 1
extra status 2
extra status 3

The content of these fields varies depending on the HSJ30/40 controller Subsystem Built-in Self-Test that detected the error condition and the error condition that was detected.

C.2.3.6 Memory System Failure Event Log (Template 14)

The HSJ30/40 controller Executive firmware component and the Cache Manager, part of the Value Added firmware component, report the occurrence of memory errors via the Memory System Failure Event Log.

The Memory System Failure Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

The Memory System Failure Event Log is reported via the T/MSCP Memory Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–21.

Memory System Failure Event Log Format Specific Fields:

format

This field contains the value 01 (that is, T/MSCP Memory Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–23.

memory address

The content of this field depends on the value supplied in the “instance code” field. See Table C–23 for more detail.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–23.

templ

See Section C.2.1 for the description of this field.

This field contains the value 14 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 34 for this event log.

reserved (offset 22)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

Figure C–21 Memory System Failure Event Log (Template 14) Format

31		0	
command reference number			0
sequence number	reserved		4
event code	flags	format	8
controller identifier			0C
			10
reserved	chvrsn	csvrsn	14
memory address			18
instance code			1C
	tdisize	templ	20
reserved			24
event time			28
			2C
byte count			30
dsr			34
csr			38
dcsr			3C
der			40
ear			44
edr			48
err			4C
rsr			50
rdr0			54
rdr1			58
wdr0			5C
wdr1			60

byte count

The number of bytes contained in the bad memory area (that is, the area bounded by: “memory address” through “memory address” + “byte count” –1).

dsr
csr
dcsr
der
ear
edr
err
rsr

These fields contain the values contained in the registers of the DRAB that detected the memory failure.

rdr0
rdr1
wdr0
wdr1

These fields contain the values contained in the HSJ30/40 controller's Read and Write Diagnostic registers.

Note that the content of certain of the fields described previously may be undefined depending on the value supplied in the "instance code" field. See Table C–23 for more detail.

C.2.3.7 CI Port Event Log (Template 31)

The HSJ30/40 controller Host Interconnect Services firmware component reports errors detected while performing work related to the CI Port communication layer via the CI Port Event Log.

The CI Port Event Log will be sent to all host systems that have enabled "Miscellaneous" error logging on a connection or connections established with the HSJ30/40 controller's Disk and/or Tape MSCP Server.

The CI Port Event Log is reported via the T/MSCP Controller Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–22.

CI Port Event Log Format Specific Fields:

format

This field contains the value 00 (that is, T/MSCP Controller Errors error log format code).

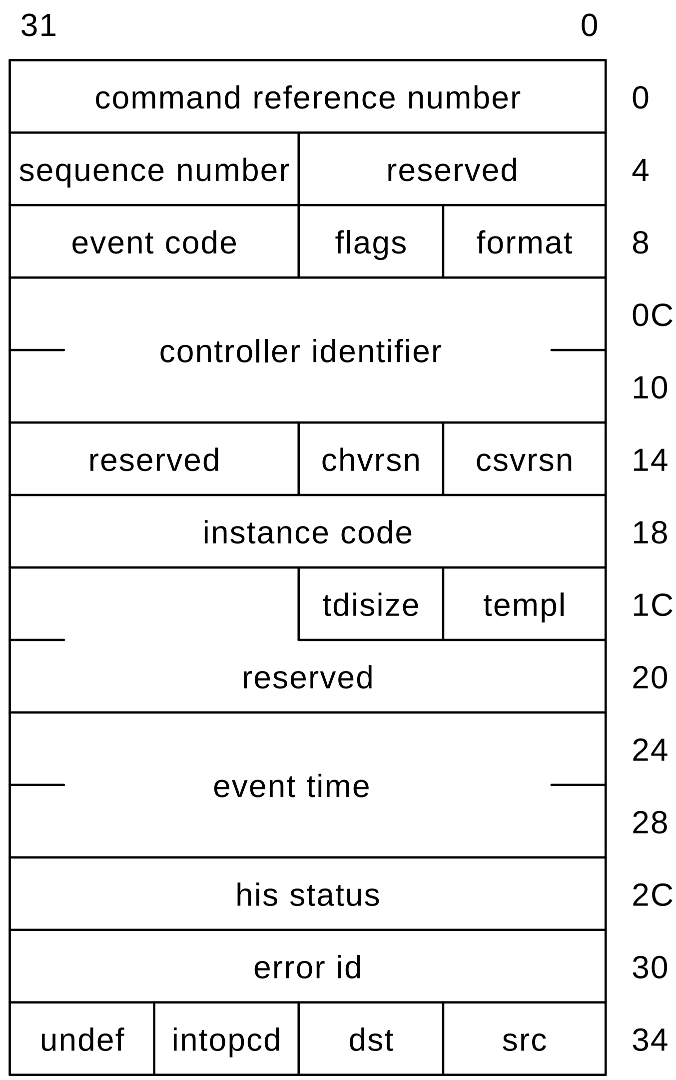
event code

The values that can be reported in this field for this event log are shown in Table C–24.

reserved (offset 16)

This field contains the value 0.

Figure C–22 CI Port Event Log (Template 31) Format



instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–24.

templ

See Section C.2.1 for the description of this field.

This field contains the value 31 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 0C for this event log.

reserved (offset 1E)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

his status
error id
src
dst
intopcd

See Section C.2.2.1 for the description of these fields.

undef

This field is only present to provide longword alignment; its content is undefined.

C.2.3.8 CI Port/Port Driver Event Log (Template 32)

The HSJ30/40 controller Host Interconnect Services firmware component reports errors detected while performing work related to the CI Port/Port Driver (PPD) communication layer via the CI Port/Port Driver Event Log.

The CI Port/Port Driver Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

The CI Port/Port Driver Event Log is reported via the T/MSCP Controller Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–23.

CI Port/Port Driver Event Log Format Specific Fields:

format

This field contains the value 00 (that is, T/MSCP Controller Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–25.

reserved (offset 16)

This field contains the value 0.

Figure C–23 CI Port/Port Driver Event Log (Template 32) Format

31			0	
command reference number				0
sequence number		reserved		4
event code		flags	format	8
controller identifier				0C
				10
reserved		chvrsn	csvrsn	14
instance code				18
		tdisize	templ	1C
reserved				20
event time				24
				28
his status				2C
error id				30
vcstate	intopcd	dst	src	34
undefined		ppd opcode		38

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–25.

templ

See Section C.2.1 for the description of this field.

This field contains the value 32 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 10 for this event log.

reserved (offset 1E)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

his status
error id
src
dst
intopcd
vcstate
ppd opcode

See Section C.2.2.1 for the description of these fields.

undefined

This field is only present to provide longword alignment; its content is undefined.

Note that the content of certain of the fields described previously may be undefined depending on the value supplied in the “instance code” field. See Table C–25 for more detail.

C.2.3.9 CI System Communication Services Event Log (Template 33)

The HSJ30/40 controller Host Interconnect Services firmware component reports errors detected while performing work related to the CI System Communication Services (SCS) communication layer via the CI System Communication Services Event Log.

The CI Communication Services Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

The CI System Communication Services Event Log is reported via the T/MSCP Controller Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–24.

CI System Communication Services Event Log Format Specific Fields:

format

This field contains the value 00 (that is, T/MSCP Controller Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–26.

Figure C–24 CI System Communication Services Event Log (Template 33) Format

<table>
<tr><td colspan="2">31</td><td colspan="2" align="right">0</td><td></td></tr>
<tr><td colspan="4">command reference number</td><td>0</td></tr>
<tr><td colspan="2">sequence number</td><td colspan="2">reserved</td><td>4</td></tr>
<tr><td colspan="2">event code</td><td>flags</td><td>format</td><td>8</td></tr>
<tr><td colspan="4" rowspan="2">controller identifier</td><td>0C</td></tr>
<tr><td>10</td></tr>
<tr><td colspan="2">reserved</td><td>chvrsn</td><td>csvrsn</td><td>14</td></tr>
<tr><td colspan="4">instance code</td><td>18</td></tr>
<tr><td colspan="2"></td><td>tdisize</td><td>templ</td><td>1C</td></tr>
<tr><td colspan="4">reserved</td><td>20</td></tr>
<tr><td colspan="4" rowspan="2">event time</td><td>24</td></tr>
<tr><td>28</td></tr>
<tr><td colspan="4">his status</td><td>2C</td></tr>
<tr><td colspan="4">error id</td><td>30</td></tr>
<tr><td>vcstate</td><td>intopcd</td><td>dst</td><td>src</td><td>34</td></tr>
<tr><td colspan="2">scs opcode</td><td colspan="2">ppd opcode</td><td>38</td></tr>
<tr><td colspan="4">connection id</td><td>3C</td></tr>
<tr><td colspan="4" rowspan="2">remote node name</td><td>40</td></tr>
<tr><td>44</td></tr>
<tr><td colspan="4">remote connection id</td><td>48</td></tr>
<tr><td colspan="4">received connection id</td><td>4C</td></tr>
<tr><td colspan="4">send connection id</td><td>50</td></tr>
<tr><td colspan="2">undefined</td><td colspan="2">connection state</td><td>54</td></tr>
</table>

reserved (offset 16)

This field contains the value 0.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–26.

templ

See Section C.2.1 for the description of this field.

This field contains the value 33 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 2C for this event log.

reserved (offset 1E)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

his status
error id
src
dst
intopcd
vcstate
ppd opcode
scs opcode

See Section C.2.2.1 for the description of these fields.

connection id
remote node name

See Section C.2.2.2 for the description of these fields.

remote connection id

The remote connection identifier supplied by the host node.

received connection id

The connection identifier of the System Application (SYSAP) that is receiving the message contained in the Host Transaction Block.

send connection id

The connection identifier of the System Application (SYSAP) that is sending the message contained in the Host Transaction Block.

connection state

The connection state code as shown in Table C–8.

undefined

This field is only present to provide longword alignment; its content is undefined.

Note that the content of certain of the fields described previously may be undefined depending on the value supplied in the “instance code” field. See Table C–26 for more detail.

C.2.3.10 Device Services Nontransfer Error Event Log (Template 41)

The HSJ30/40 controller Device Services firmware component reports errors detected while performing nontransfer work related to disk, tape, or media loader device operations via the Device Services Nontransfer Event Log.

If the error is associated with a command issued by a host system, the Device Services Nontransfer Error Event Log will be sent to the host system that issued the command on the same connection upon which the command was received if “This Host” error logging is enabled on that connection, and to all host systems that have enabled “Other Host” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

If the error is associated with a command issued by an HSJ30/40 controller firmware component, the Device Services Nontransfer Error Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

The Device Services Nontransfer Error Event Log is reported via the T/MSCP Controller Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–25.

Device Services Nontransfer Error Event Log Format Specific Fields:

format

This field contains the value 00 (that is, T/MSCP Controller Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–27.

reserved (offset 16)

This field contains the value 0.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–27.

templ

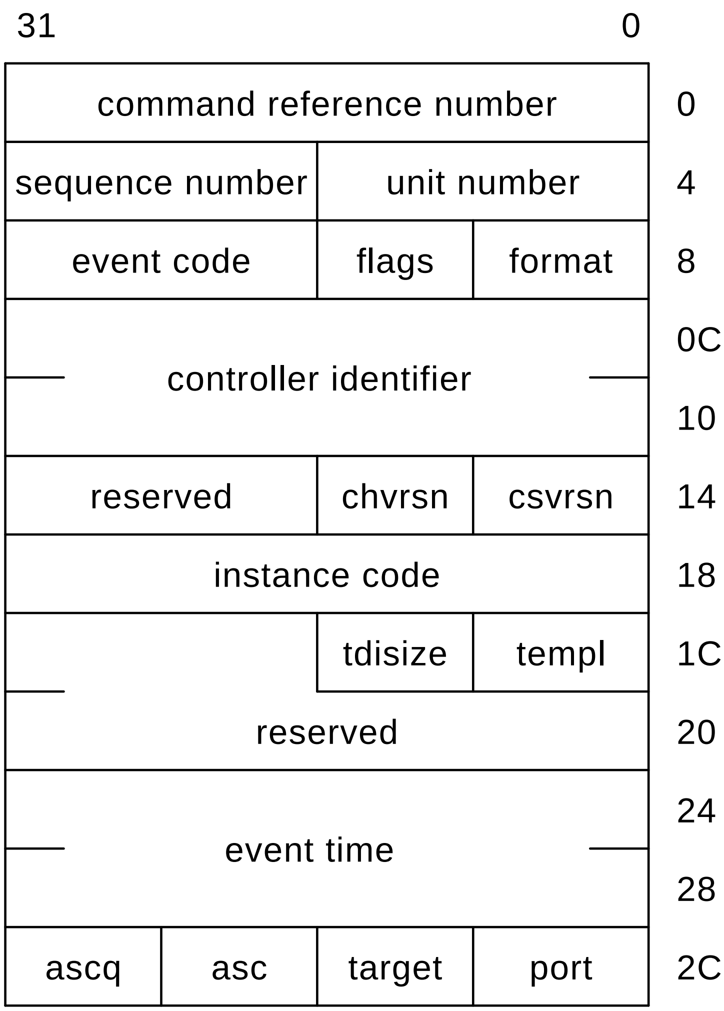
See Section C.2.1 for the description of this field.

This field contains the value 41 for this event log.

tdisize

See Section C.2.1 for the description of this field.

Figure C–25 Device Services Nontransfer Error Event Log (Template 41) Format



This field contains the value 04 for this event log.

reserved (offset 1E)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

port

The SCSI bus number affected by the error being reported.

target

The SCSI target number on the “port” affected by the error being reported.

asc
ascq

The “asc” and “ascq” fields contain the values supplied in byte 0C (Additional Sense Code) and byte 0D (Additional Sense Code Qualifier) fields, respectively, of the Sense Data returned in the response of a SCSI REQUEST SENSE command issued to the target device. The description of the value supplied in the “instance code” field (see Table C–27) describes the Sense Key value supplied in the Sense Data returned.

Note that the content of certain of the fields described previously may be undefined depending on the value supplied in the “instance code” field. See Table C–27 for more detail.

C.2.3.11 Disk Transfer Error Event Log (Template 51)

The HSJ30/40 controller Device Services and Value Added Services firmware components report errors detected while performing work related to disk unit transfer operations via the Disk Transfer Error Event Log.

If the error is associated with a command issued by a host system, the Disk Transfer Error Event Log will be sent to the host system that issued the command on the same connection upon which the command was received if “This Host” error logging is enabled on that connection and to all host systems that have enabled “Other Host” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

If the error is associated with a command issued by a HSJ30/40 controller firmware component, the Disk Transfer Error Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection established with the HSJ30/40 controller’s Disk MSCP Server.

The Disk Transfer Error Event Log is reported via the MSCP Disk Transfer Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–26.

Disk Transfer Error Event Log Format Specific Fields:

format

This field contains the value 02 (that is, MSCP Disk Transfer Errors error log format code).

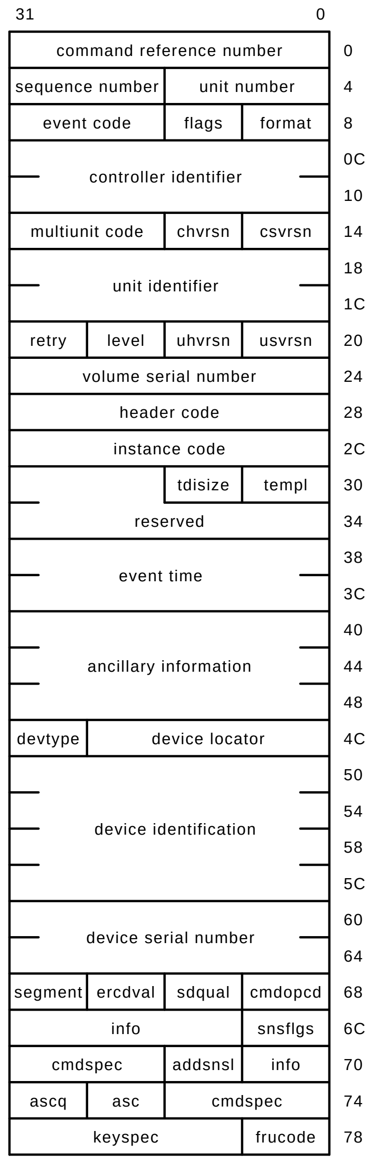
event code

The values that can be reported in this field for this event log are shown in Table C–28.

instance code

See Section C.2.1 for the description of this field.

Figure C–26 Disk Transfer Error Event Log (Template 51) Format



The values that can be reported in this field for this event log are shown in Table C–28.

templ

See Section C.2.1 for the description of this field.

This field contains the value 51 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 3C for this event log.

reserved (offset 32)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

ancillary information

The format of this field varies depending on whether or not the event being reported is associated with a command issued by a host system or one issued by an HSJ30/40 controller firmware component.

If the event is associated with a command issued by a host system, this field is formatted as described in Section C.2.2.2.

If the event is associated with a command issued by an HSJ30/40 controller firmware component, this field is formatted as described in Section C.2.2.3.

device locator
devtype
device identification
device serial number

See Section C.2.2.4 for the description of these fields.

cmdopcd
infoq
ercdval
segment
snsflgs
info
addsnsl
cmdspec
asc
ascq
frucode
keyspec

See Section C.2.2.5 for the description of these fields.

Note that the content of certain of the fields described previously may be undefined depending on the value supplied in the “instance code” field. See Table C–28 for more detail.

C.2.3.12 Disk Bad Block Replacement Attempt Event Log (Template 57)

The HSJ30/40 controller Value Added firmware component reports disk unit bad block replacement attempt results via the Disk Bad Block Replacement Attempt Event Log.

If the replacement is associated with a command issued by a host system, the Disk Bad Block Replacement Attempt Event Log will be sent to the host system that issued the command on the same connection upon which the command was received if “This Host” error logging is enabled on that connection, and to all host systems that have enabled “Other Host” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

If the replacement is associated with a command issued by an HSJ30/40 controller firmware component, the Disk Bad Block Replacement Attempt Error Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection established with the HSJ30/40 controller’s Disk MSCP Server.

The Disk Bad Block Replacement Attempt Event Log is reported via the MSCP Bad Block Replacement Attempt error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–27.

Disk Bad Block Replacement Attempt Event Log Format Specific Fields:

format

This field contains the value 09 (that is, MSCP Bad Block Replacement Attempt error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–29.

reserved (offset 36)

This field contains the value 0.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–29.

templ

See Section C.2.1 for the description of this field.

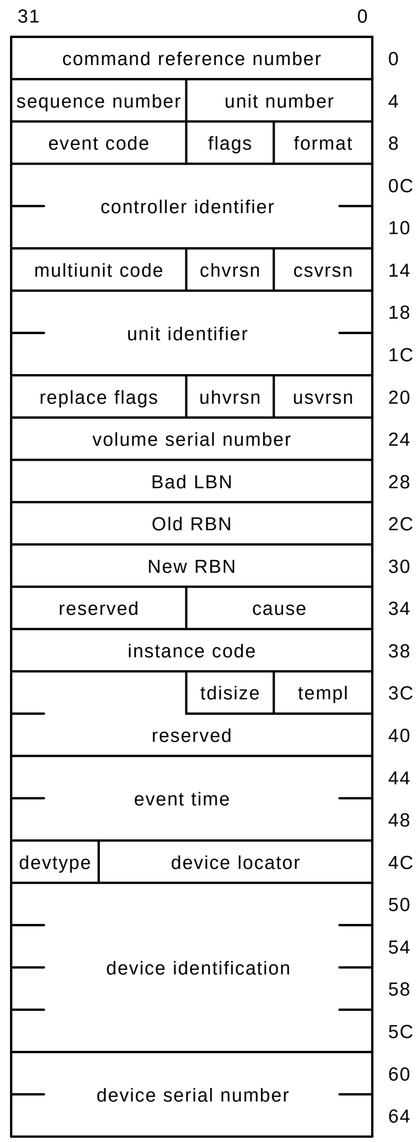
This field contains the value 57 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 1C for this event log.

Figure C–27 Disk Bad Block Replacement Attempt Event Log (Template 57) Format



reserved (offset 3E)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

device locator
devtype
device identification
device serial number

See Section C.2.2.4 for the description of these fields.

Note that the content of certain of the fields described previously may be undefined depending on the value supplied in the “instance code” field. See Table C–29 for more detail.

C.2.3.13 Tape Transfer Error Event Log (Template 61)

The HSJ30/40 controller Device Services and Value Added Services firmware components report errors detected while performing work related to tape unit transfer operations via the Tape Transfer Error Event Log.

If the error is associated with a command issued by a host system, the Tape Transfer Error Event Log will be sent to the host system that issued the command on the same connection upon which the command was received if “This Host” error logging is enabled on that connection, and to all host systems that have enabled “Other Host” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

If the error is associated with a command issued by an HSJ30/40 controller firmware component, the Tape Transfer Error Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection established with the HSJ30/40 controller’s Tape MSCP Server.

The Tape Transfer Error Event Log is reported via the TMSCP Tape Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–28.

Tape Transfer Error Event Log Format Specific Fields:

format

This field contains the value 05 (that is, TMSCP Tape Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–30.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–30.

Figure C–28 Tape Transfer Error Event Log (Template 61) Format

31			0	
command reference number				0
sequence number		unit number		4
event code		flags	format	8
controller identifier				0C
				10
multiunit code		chvrsn	csvrsn	14
unit identifier				18
				1C
retry	level	uhvrsn	usvrsn	20
position (object count)				24
reserved		fhvrsn	fsvrsn	28
instance code				2C
		tdisize	templ	30
reserved				34
event time				38
				3C
ancillary information				40
				44
				48
devtype	device locator			4C
device identification				50
				54
				58
				5C
device serial number				60
				64
segment	ercdval	sdqual	cmdopcd	68
info			snsflgs	6C
cmdspec		addsnsl	info	70
ascq	asc	cmdspec		74
keyspec			frucode	78

templ

See Section C.2.1 for the description of this field.

This field contains the value 61 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 3C for this event log.

reserved (offset 32)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

ancillary information

The format of this field varies depending on whether or not the event being reported is associated with a command issued by a host system or one issued by an HSJ30/40 controller firmware component.

If the event is associated with a command issued by a host system, this field is formatted as described in Section C.2.2.2.

If the event is associated with a command issued by an HSJ30/40 controller firmware component, this field is considered “reserved” and contains the value 0.

device locator
devtype
device identification
device serial number

See Section C.2.2.4 for the description of these fields.

cmdopcd
infoq
ercdval
segment
snsflgs
info
addsnsl
cmdspec
asc
ascq
frucode
keyspec

See Section C.2.2.5 for the description of these fields.

Note that the content of certain of the fields described previously may be undefined depending on the value supplied in the “instance code” field. See Table C–30 for more detail.

C.2.3.14 Media Loader Error Event Log (Template 71)

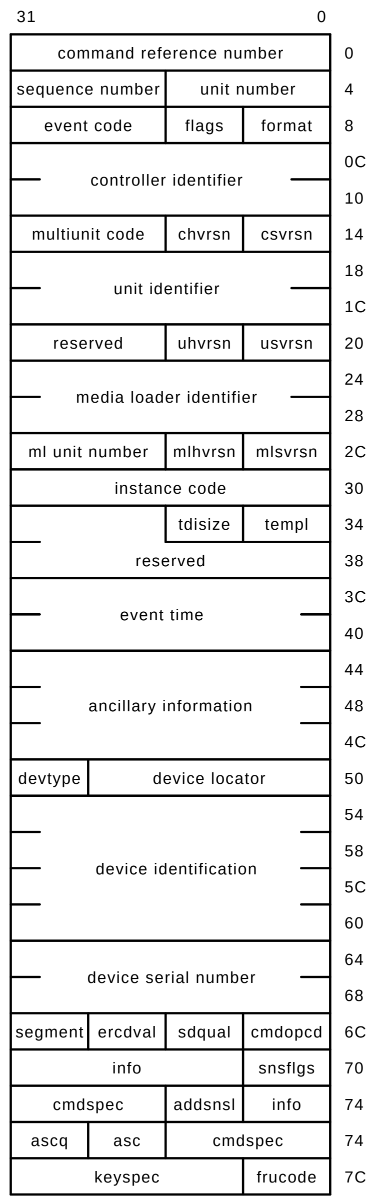
The HSJ30/40 controller Device Services firmware component reports errors detected while performing work related to media loader operations via the Media Loader Error Event Log.

If the error is associated with a command issued by a host system, the Media Loader Error Event Log will be sent to the host system that issued the command on the same connection upon which the command was received if “This Host” error logging is enabled on that connection, and to all host systems that have enabled “Other Host” error logging on a connection or connections established with the HSJ30/40 controller’s Disk and/or Tape MSCP Server.

If the error is associated with a command issued by an HSJ30/40 controller firmware component, the Media Loader Error Event Log will be sent to all host systems that have enabled “Miscellaneous” error logging on a connection established with the HSJ30/40 controller’s Tape MSCP Server.

The Media Loader Error Event Log is reported via the T/MSCP Media Loader Errors error log message format. The format of this event log, including the HSJ30/40 controller specific fields, is shown in Figure C–29.

Figure C–29 Media Loader Error Event Log (Template 71) Format



Media Loader Error Event Log Format Specific Fields:

format

This field contains the value 0A (that is, T/MSCP Media Loader Errors error log format code).

event code

The values that can be reported in this field for this event log are shown in Table C–31.

instance code

See Section C.2.1 for the description of this field.

The values that can be reported in this field for this event log are shown in Table C–31.

templ

See Section C.2.1 for the description of this field.

This field contains the value 71 for this event log.

tdisize

See Section C.2.1 for the description of this field.

This field contains the value 3C for this event log.

reserved (offset 36)

This field contains the value 0.

event time

See Section C.2.1 for the description of this field.

ancillary information

The format of this field varies depending on whether or not the event being reported is associated with a command issued by a host system or one issued by an HSJ30/40 controller firmware component.

If the event is associated with a command issued by a host system, this field is formatted as described in Section C.2.2.2.

If the event is associated with a command issued by an HSJ30/40 controller firmware component, this field is considered “reserved” and contains the value 0.

device locator
devtype
device identification
device serial number

See Section C.2.2.4 for the description of these fields.

cmdopcd
infoq
ercdval
segment
snsflgs
info
addsnsl
cmdspec
asc
ascq
frucode
keyspec

See Section C.2.2.5 for the description of these fields.

C.2.3.15 Disk Copy Data Correlation Event Log

The HSJ30/40 controller Disk MSCP Server firmware component reports errors detected while performing Disk Copy Data commands via the Disk Copy Data Correlation Event Log.

The format of the Disk Copy Data Correlation Event Log is identical to the format of the MSCP Disk Copy Data Correlation error log message.

The HSJ30/40 controller generates Disk Copy Data Correlation Event Logs in accordance with MSCP protocol.

If a Controller Error (subcode "Local Connection Request Failed, Insufficient Resources to Request Local Connection") or a Controller Error (subcode "Remote Connection Request Failed, Insufficient Resources to Request Remote Connection") condition is detected, the HSJ30/40 controller will store one of values shown in Table C–32 in the first longword of the "event dependent information" field of the MSCP Disk Copy Data Correlation error log message to identify the resource that is lacking.

C.3 Event Log Codes

Tables C–2 through C–49 list specific codes contained within the event log information.

Table C–2 Firmware Component Identifier Codes

Code	Description
01	Executive Services
02	Value Added Services
03	Device Services
04	Fault Manager
06	Dual Universal Asynchronous Receiver/Transmitter Services
07	Failover Control
08	Nonvolatile Parameter Memory Failover Control
20	Command Line Interpreter
40	Host Interconnect Services
42	Host Interconnect Port Services
60	Disk and Tape MSCP Server
61	Diagnostics and Utilities Protocol Server
62	System Communication Services Directory Service
80	Disk Inline Exerciser (DILX)
81	Tape Inline Exerciser (TILX)
82	Subsystem Built-In Self-Tests (BIST)
83	Automatic Device Configuration Program (CONFIG)

Table C–3 Host Interconnect Services Status Codes

Code	Description
00000000	Request succeeded.
00000001	The remote sent a message over a connection that has been invalidated.
00000002	The remote sent a message for which no receive credit is available.
00000003	Received a message from the remote while in an invalid or illegal connection state.
00000004	Pending work exists but connection state is invalid or illegal.
00000009	Request failed, no additional information available.
00000032	A PPD message was received from the remote but the Virtual Circuit is in an invalid or illegal state.
00000033	A PPD START was received from the remote but the Virtual Circuit state indicates that the Virtual Circuit is already OPEN.
00000034	A PPD NODE_STOP was received from the remote.
00000035	The “PPD START send without receiving a PPD START in response” limit has been reached; the remote node is acknowledging the packets but not responding to them.

(continued on next page)

Table C–3 (Cont.) Host Interconnect Services Status Codes

Code	Description
00000036	The “PPD STACK send without receiving a PPD ACK in response” limit has been reached; the remote node is acknowledging the packets but not responding to them.
00000064	The “CI IDREQ send without receiving a CI ID in response” limit has been reached on both Path A and Path B; the remote node is acknowledging the packets but not responding to them.
00000065	A CI ID or CI CNF packet (transmitted by the thread on behalf of Host Interconnect Services) could not be successfully transmitted.
00010009	VC closed due to CI ID request failure.
00020009	VC closed due to unexpected SCS state.
00030009	VC closed due to CI START failure.
00040009	VC closed due to CI STACK failure.
00050009	VC closed due to PPD ACK failure.
00060009	VC closed due to PPD NODE_STOP or PPD START message received.
00070009	VC closed due to NAK ADP retry CI ID transmit failure.
00080009	VC closed due to NAK ADP retry transmit failure.
00090009	VC closed due to NOR DDL retry transmit failure on Path A.
000A0009	VC closed due to NOR DDL retry transmit failure on Path B.
000B0009	VC closed due to NOR ADP retry CI ID transmit failure.
000C0009	VC closed due to NOR ADP retry transmit failure.
000D0009	VC closed due to NAK DDL retry transmit failure on Path A.
000E0009	VC closed due to NAK DDL retry transmit failure on Path B.
000F0009	VC closed due to arbitration timeout on Path A.
00100009	VC closed due to arbitration timeout on Path B.
00110009	VC closed due to Path A off.
00120009	VC closed due to Path B off.
00130009	VC closed due to dual receive.
00140009	VC closed due to invalid receive data structure state.
00150009	VC closed due to no path.
00160009	VC closed due to message transmit closed.
00170009	VC closed due to data transmit closed.
00180009	VC closed due to message scan.
00190009	VC closed due to data scan.
001A0009	VC closed due to data timeout.
001B0009	VC closed due to unrecognized packet.
001C0009	VC closed due to data transmit failure.
001D0009	VC closed due to CI ID complete failure.
001E0009	VC closed due to lost command.
001F0009	Not implemented in CI environment.

Table C–4 CI Message Operation Codes

Code	Description
00	Reserved
01	DG
02	MSG
03	CNF
04	MCNF
05	IDREQ
06	RST
07	STRT
08	DATREQ0
09	DATREQ1
0A	DATREQ2
0B	ID
0C	PSREQ
0D	LB
0E	MDATREQ
0F	RETPS
10	SNTDAT
11	RETDAT
12	SNTMDAT
13	RETMDAT

Table C–5 CI Virtual Circuit State Codes

Code	Description
0001	VC_CLOSED
0002	START_SENT
0003	START_REC
0004	VC_OPEN
0005	VC_CLOSING

Table C–6 Port/Port Driver Message Operation Codes

Code	Description
0000	START
0001	STACK
0002	ACK
0003	SCS_DG
0004	SCS_MSG
0005	ERROR_LOG
0006	NODE_STOP

Table C–7 System Communication Services Message Operation Codes

Code	Description
0000	CONNECT_REQ
0001	CONNECT_RSP
0002	ACCEPT_REQ
0003	ACCEPT_RSP
0004	REJECT_REQ
0005	REJECT_RSP
0006	DISCONNECT_REQ
0007	DISCONNECT_RSP
0008	CREDIT_REQ
0009	CREDIT_RSP
000A	APPL_MSG
000B	APPL_DG

Table C–8 CI Connection State Codes

Code	Description
0000	CLOSED
0001	LISTENING
0002	CONNECT_SENT
0003	CONNECT_ACK
0004	CONNECT_REC
0005	ACCEPT_SENT
0006	REJECT_SENT
0007	OPEN
0008	DISCONNECT_SENT
0009	DISCONNECT_REC
000A	DISCONNECT_ACK
000B	DISCONNECT_MATCH

Table C–9 Supported SCSI Device Type Codes

Code	Description
00	Direct-Access Devices (such as magnetic disk).
01	Sequential-Access Devices (such as magnetic tape).
05	CDROM Devices.
08	Medium Changer Devices (such as jukeboxes).

Table C–10 SCSI Command Operation Codes

Code	Supported Device Types (See Table C–9)	Description
00	00, 01, 05, 08	TEST UNIT READY
01	01	REWIND
01	00, 05, 08	REZERO UNIT
03	00, 01, 05, 08	REQUEST SENSE
04	00	FORMAT UNIT
05	01	READ BLOCK LIMITS
07	08	INITIALIZE ELEMENT STATUS
07	00	REASSIGN BLOCKS
08	00, 01, 05	READ (6 byte)
0A	00, 01	WRITE (6 byte)
0B	00, 05	SEEK (6 byte)
0F	01	READ REVERSE
10	01	WRITE FILEMARKS
11	01	SPACE
12	00, 01, 05, 08	INQUIRY
13	01	TAPE VERIFY
14	01	RECOVER BUFFERED DATA
15	00, 01, 05, 08	MODE SELECT (6 byte)
16	00, 01, 05, 08	RESERVE UNIT
17	00, 01, 05, 08	RELEASE UNIT
18	00, 01, 05	COPY
19	01	ERASE
1A	00, 01, 05, 08	MODE SENSE (6 byte)
1B	00, 05	START STOP UNIT
1B	01	LOAD UNLOAD
1C	00, 01, 05, 08	RECEIVE DIAGNOSTIC RESULTS
1D	00, 01, 05, 08	SEND DIAGNOSTIC
1E	00, 01, 05, 08	PREVENT-ALLOW MEDIUM REMOVAL
25	00, 05	READ CAPACITY
28	00, 05	READ (10 byte)
2A	00	WRITE (10 byte)
2B	08	POSITION TO ELEMENT
2B	01	LOCATE
2B	00, 05	SEEK (10 byte)
2E	00	WRITE AND VERIFY (10 byte)
2F	00, 05	VERIFY (10 byte)
30	00, 05	SEARCH DATA HIGH (10 byte)

(continued on next page)

Table C–10 (Cont.) SCSI Command Operation Codes

Code	Supported Device Types (See Table C–9)	Description
31	00, 05	SEARCH DATA EQUAL (10 byte)
32	00, 05	SEARCH DATA LOW (10 byte)
33	00, 05	SET LIMITS (10 byte)
34	01	READ POSITION
34	00, 05	PRE-FETCH
35	00, 05	SYNCHRONIZE CACHE
36	00, 05	LOCK-UNLOCK CACHE
37	00	READ DEFECT DATA (10 byte)
39	00, 01, 05	COMPARE
3A	00, 01, 05	COPY AND VERIFY
3B	00, 01, 05, 08	WRITE BUFFER
3C	00, 01, 05, 08	READ BUFFER
3E	00, 05	READ LONG
3F	00	WRITE LONG
40	00, 01, 05, 08	CHANGE DEFINITION
41	00	WRITE SAME
42	05	READ SUB-CHANNEL
43	05	READ TOC (table of contents)
44	05	READ HEADER
45	05	PLAY AUDIO (10 byte)
47	05	PLAY AUDIO MSF
48	05	PLAY AUDIO TRACK/INDEX
49	05	PLAY TRACK RELATIVE (10 byte)
4B	05	PAUSE/RESUME
4C	00, 01, 05, 08	LOG SELECT
4D	00, 01, 05, 08	LOG SENSE
55	00, 01, 05, 08	MODE SELECT (10 byte)
5A	00, 01, 05, 08	MODE SENSE (10 byte)
A5	05	PLAY AUDIO (12 byte)
A5	08	MOVE MEDIUM
A6	08	EXCHANGE MEDIUM
A8	05	READ (12 byte)
A9	05	PLAY TRACK RELATIVE (12 byte)
AF	05	VERIFY (12 byte)
B0	05	SEARCH DATA HIGH (12 byte)
B1	05	SEARCH DATA EQUAL (12 byte)
B2	05	SEARCH DATA LOW (12 byte)

(continued on next page)

Table C–10 (Cont.) SCSI Command Operation Codes

Code	Supported Device Types (See Table C–9)	Description
B3	05	SET LIMITS (12 byte)
B5	08	REQUEST VOLUME ELEMENT ADDRESS
B6	08	SEND VOLUME TAG
B8	08	READ ELEMENT STATUS

Table C–11 SCSI Buffered Modes Codes

Code	Description
0	The target shall not report GOOD status on write commands until the data blocks are actually written on the medium.
1	The target may report GOOD status on write commands as soon as as all the data specified in the write command has been transferred to the target's buffer. One or more blocks may be buffered prior to writing the block(s) to the medium.
2	The target may report GOOD status on write commands as soon as: (1) All the data specified in the write command has been successfully transferred to the target's buffer, and (2) All buffered data from different initiators has been successfully written to the medium.
3	Reserved for future use.
4	Reserved for future use.
5	Reserved for future use.
6	Reserved for future use.
7	Reserved for future use.

Table C–12 SCSI Sense Key Codes

Code	Description
0	NO SENSE. 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 “snsflgs” field.
1	RECOVERED ERROR. Indicates that the last command completed successfully with some recovery action performed by the target. Details may be determinable by examining the “info” field.
2	NOT READY. Indicates that the logical unit addressed cannot be accessed. Operator intervention may be required to correct this condition.
3	MEDIUM ERROR. 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. This sense key may also be returned if the target is unable to distinguish between a flaw in the medium and a specific hardware failure (sense key 4).
4	HARDWARE ERROR. Indicates that the target detected a non-recoverable hardware failure (for example, controller failure, device failure, parity error, and so forth) while performing the command or during a self-test.
5	ILLEGAL REQUEST. Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands (FORMAT UNIT, SEARCH DATA, and so forth). If the target detects an invalid parameter in the command descriptor block, then it shall terminate the command without altering the medium. If the target detects an invalid parameter in the additional parameters supplied as data, then the target may have already altered the medium. This sense key may also indicate that an invalid IDENTIFY message was received.
6	UNIT ATTENTION. Indicates that the removable medium may have been changed or the target has been reset.
7	DATA PROTECT. Indicates that a command that reads or writes the medium was attempted on a block that is protected from this operation. The read or write operation is not performed.
8	BLANK CHECK. Indicates that a write-once device or a sequential-access device encountered blank medium or format-defined end-of-data indication while reading or a write-once device encountered a non-blank medium while writing.
9	Vendor Specific. This sense key is available for reporting vendor specific conditions.
A	COPY ABORTED. Indicates a COPY, COMPARE, or COPY AND VERIFY command was aborted due to an error condition on the source device, the destination device, or both.
B	ABORTED COMMAND. Indicates that the target aborted the command. The initiator may be able to recover by trying the command again.
C	EQUAL. Indicates a SEARCH DATA command has satisfied an equal comparison.
D	VOLUME OVERFLOW. Indicates that a buffered peripheral device has reached the end-of-partition and data may remain in the buffer that has not been written to the medium. A RECOVER BUFFERED DATA command(s) may be issued to read the unwritten data from the buffer.
E	MISCOMPARE. Indicates that the source data did not match the data read from the medium.
F	RESERVED.

Table C–13 SCSI ASC/ASCQ Codes For Direct-Access Devices (such as magnetic disk)

ASC Code	ASCQ Code	Description
00	00	No additional sense information.
00	06	I/O process terminated.
01	00	No index/sector signal.
02	00	No seek complete.
03	00	Peripheral device write fault.
04	00	Logical unit not ready, cause not reportable.
04	01	Logical unit is in process of becoming ready.
04	02	Logical unit not ready, initializing command required.
04	03	Logical unit not ready, manual intervention required.
04	04	Logical unit not ready, format in progress.
06	00	No reference position found.
07	00	Multiple peripheral devices selected.
08	00	Logical unit communication failure.
08	01	Logical unit communication time-out.
08	02	Logical unit communication parity error.
09	00	Track following error.
0A	00	Error log overflow.
0C	01	Write error recovered with auto reallocation.
0C	02	Write error—auto reallocation failed.
10	00	ID CRC or ECC error.
11	00	Unrecovered read error.
11	01	Read retries exhausted.
11	02	Error too long to correct.
11	03	Multiple read errors.
11	04	Unrecovered read error—auto reallocate failed.
11	0A	Miscorrected error.
11	0B	Unrecovered read error—recommend reassignment.
11	0C	Unrecovered read error—recommend rewrite the data.
12	00	Address mark not found for ID field.
13	00	Address mark not found for data field.
14	00	Recorded entity not found.
14	01	Record not found.
15	00	Random positioning error.
15	01	Mechanical positioning error.
15	02	Positioning error detected by read of medium.
16	00	Data synchronization mark error.
17	00	Recovered data with no error correction applied.

(continued on next page)

Table C–13 (Cont.) SCSI ASC/ASCQ Codes For Direct-Access Devices (such as magnetic disk)

ASC Code	ASCQ Code	Description
17	01	Recovered data with retries.
17	02	Recovered data with positive head offset.
17	03	Recovered data with negative head offset.
17	05	Recovered data using previous sector ID.
17	06	Recovered data without ECC—data auto-reallocated.
17	07	Recovered data without ECC—recommend reassignment.
17	08	Recovered data without ECC—recommend rewrite.
18	00	Recovered data with error correction applied.
18	01	Recovered data with error correction and retries applied.
18	02	Recovered data—data auto-reallocated.
18	05	Recovered data—recommend reassignment.
18	06	Recovered data—recommend rewrite.
19	00	Defect list error.
19	01	Defect list not available.
19	02	Defect list error in primary list.
19	03	Defect list error in grown list.
1A	00	Parameter list length error.
1B	00	Synchronous data transfer error.
1C	00	Defect list not found.
1C	01	Primary defect list not found.
1C	02	Grown defect list not found.
1D	00	Miscompare during verify operation.
1E	00	Recovered ID with ECC correction.
20	00	Invalid command operation code.
21	00	Logical block address out of range.
22	00	Illegal function (should use 0020, 0024, or 0026)
24	00	Invalid field in CDB.
25	00	Logical unit not supported.
26	00	Invalid field in parameter list.
26	01	Parameter not supported.
26	02	Parameter value invalid.
26	03	Threshold parameters not supported.
27	00	Write protected.
28	00	Not ready to ready transition, medium may have changed.
29	00	Power on, reset, or bus device reset occurred.
29	01	Power on occurred.

(continued on next page)

Table C–13 (Cont.) SCSI ASC/ASCQ Codes For Direct-Access Devices (such as magnetic disk)

ASC Code	ASCQ Code	Description
29	02	SCSI bus reset occurred.
29	03	Bus device reset occurred.
2A	00	Parameters changed.
2A	01	Mode parameters changed.
2A	02	Log parameters changed.
2B	00	Copy cannot execute because host cannot disconnect.
2C	00	Command sequence error.
2F	00	Commands cleared by another initiator.
30	00	Incompatible medium installed.
30	01	Cannot read medium—unknown format.
30	02	Cannot read medium - incompatible format.
30	03	Cleaning cartridge installed.
31	00	Medium format corrupted.
31	01	Format command failed.
32	00	No defect spare location available.
32	01	Defect list update failure.
37	00	Rounded parameter.
39	00	Saving parameters not supported.
3A	00	Medium not present.
3D	00	Invalid bits in identify message.
3E	00	Logical unit has not self-configured yet.
3F	00	Target operating conditions have changed.
3F	01	Microcode has been changed.
3F	02	Changed operating definition.
3F	03	Inquiry data has changed.
40	00	Ram failure (should use 8040 through FF40).
41	00	Data path failure (should use 8040 through FF40).
42	00	Power-on or self-test failure (should use 8040 through FF40).
43	00	Message error.
44	00	Internal target failure.
45	00	Select or reselect failure.
46	00	Unsuccessful soft reset.
47	00	SCSI parity error.
48	00	Initiator detected error message received.
49	00	Invalid message error.
4A	00	Command phase error.

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Table C–13 (Cont.) SCSI ASC/ASCQ Codes For Direct-Access Devices (such as magnetic disk)

ASC Code	ASCQ Code	Description
4B	00	Data phase error.
4C	00	Logical unit failed self-configuration.
4E	00	Overlapped commands attempted.
53	00	Media load or eject failed.
53	02	Medium removal prevented.
5A	00	Operator request or state change input (unspecified).
5A	01	Operator medium removal request.
5A	02	Operator selected write protect.
5A	03	Operator selected write permit.
5B	00	Log exception.
5B	01	Threshold condition met.
5B	02	Log counter at maximum.
5B	03	Log list codes exhausted.
5C	00	Rpl status change.
5C	01	Spindles synchronized.
5C	02	Spindles not synchronized.
40	*nn*	Diagnostic failure detected on component *nn*; where *nn* identifies a specific target device component (*nn* range 80 through FF). Refer to documentation provided by the vendor of the target device for a description of the component identified by *nn*.

Table C–14 SCSI ASC/ASCQ Codes For Sequential-Access Devices (such as magnetic tape)

ASC Code	ASCQ Code	Description
00	00	No additional sense information.
00	01	Filemark detected.
00	02	End-of-partition/medium detected.
00	03	Setmark detected.
00	04	Beginning-of-partition/medium detected.
00	05	End-of-data detected.
00	06	I/O process terminated.
03	00	Peripheral device write fault.
03	01	No write current.
03	02	Excessive write errors.
04	00	Logical unit not ready, cause not reportable.
04	01	Logical unit is in process of becoming ready.

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Table C–14 (Cont.) SCSI ASC/ASCQ Codes For Sequential-Access Devices (such as magnetic tape)

ASC Code	ASCQ Code	Description
04	02	Logical unit not ready, initializing command required.
04	03	Logical unit not ready, manual intervention required.
04	04	Logical unit not ready, format in progress.
07	00	Multiple peripheral devices selected.
08	00	Logical unit communication failure.
08	01	Logical unit communication time-out.
08	02	Logical unit communication parity error.
09	00	Track following error.
0A	00	Error log overflow.
0C	00	Write error.
11	00	Unrecovered read error.
11	01	Read retries exhausted.
11	02	Error too long to correct.
11	03	Multiple read errors.
11	08	Incomplete block read.
11	09	No gap found.
11	0A	Miscorrected error.
14	00	Recorded entity not found.
14	01	Record not found.
14	02	Filemark or setmark not found.
14	03	End-of-data not found.
14	04	Block sequence error.
15	00	Random positioning error.
15	01	Mechanical positioning error.
15	02	Positioning error detected by read of medium.
17	00	Recovered data with no error correction applied.
17	01	Recovered data with retries.
17	02	Recovered data with positive head offset.
17	03	Recovered data with negative head offset.
18	00	Recovered data with error correction applied.
1A	00	Parameter list length error.
1B	00	Synchronous data transfer error.
20	00	Invalid command operation code.
21	00	Logical block address out of range.
24	00	Invalid field in CDB.
25	00	Logical unit not supported.

(continued on next page)

Table C–14 (Cont.) SCSI ASC/ASCQ Codes For Sequential-Access Devices (such as magnetic tape)

ASC Code	ASCQ Code	Description
26	00	Invalid field in parameter list.
26	01	Parameter not supported.
26	02	Parameter value invalid.
26	03	Threshold parameters not supported.
27	00	Write protected.
28	00	Not ready to ready transition, medium may have changed.
29	00	Power on, reset, or bus device reset occurred.
29	01	Power on occurred.
29	02	SCSI bus reset occurred.
29	03	Bus device reset occurred.
2A	00	Parameters changed.
2A	01	Mode parameters changed.
2A	02	Log parameters changed.
2B	00	Copy cannot execute because host cannot disconnect.
2C	00	Command sequence error.
2D	00	Overwrite error on update in place.
2F	00	Commands cleared by another initiator.
30	00	Incompatible medium installed.
30	01	Cannot read medium—unknown format.
30	02	Cannot read medium—incompatible format.
30	03	Cleaning cartridge installed.
31	00	Medium format corrupted.
33	00	Tape length error.
37	00	Rounded parameter.
39	00	Saving parameters not supported.
3A	00	Medium not present.
3B	00	Sequential positioning error.
3B	01	Tape position error at beginning-of-medium.
3B	02	Tape position error at end-of-medium.
3B	08	Reposition error.
3D	00	Invalid bits in identify message.
3E	00	Logical unit has not self-configured yet.
3F	00	Target operating conditions have changed.
3F	01	Microcode has been changed.
3F	02	Changed operating definition.
3F	03	Inquiry data has changed.

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Table C–14 (Cont.) SCSI ASC/ASCQ Codes For Sequential-Access Devices (such as magnetic tape)

ASC Code	ASCQ Code	Description
43	00	Message error.
44	00	Internal target failure.
45	00	Select or reselect failure.
46	00	Unsuccessful soft reset.
47	00	SCSI parity error.
48	00	Initiator detected error message received.
49	00	Invalid message error.
4A	00	Command phase error.
4B	00	Data phase error.
4C	00	Logical unit failed self-configuration.
4E	00	Overlapped commands attempted.
50	00	Write append error.
50	01	Write append position error.
50	02	Position error related to timing.
51	00	Erase failure.
52	00	Cartridge fault.
53	00	Media load or eject failed.
53	01	Unload tape failure.
53	02	Medium removal prevented.
5A	00	Operator request or state change input (unspecified).
5A	01	Operator medium removal request.
5A	02	Operator selected write protect.
5A	03	Operator selected write permit.
5B	00	Log exception.
5B	01	Threshold condition met.
5B	02	Log counter at maximum.
5B	03	Log list codes exhausted.
40	*nn*	Diagnostic failure detected on component *nn*; where *nn* identifies a specific target device component (*nn* range 80 through FF). Refer to documentation provided by the vendor of the target device for a description of the component identified by *nn*.

Table C–15 SCSI ASC/ASCQ Codes For CDROM Devices.

ASC Code	ASCQ Code	Description
00	00	No additional sense information.
00	06	I/O process terminated.
00	11	Audio play operation in progress.
00	12	Audio play operation paused.
00	13	Audio play operation successfully completed.
00	14	Audio play operation stopped due to error.
00	15	No current audio status to return.
02	00	No seek complete.
04	00	Logical unit not ready, cause not reportable.
04	01	Logical unit is in process of becoming ready.
04	02	Logical unit not ready, initializing command required.
04	03	Logical unit not ready, manual intervention required.
06	00	No reference position found.
07	00	Multiple peripheral devices selected.
08	00	Logical unit communication failure.
08	01	Logical unit communication time-out.
08	02	Logical unit communication parity error.
09	00	Track following error.
09	01	Tracking servo failure.
09	02	Focus servo failure.
09	03	Spindle servo failure.
0A	00	Error log overflow.
11	00	Unrecovered read error.
11	05	L-ec uncorrectable error.
11	06	CIRC unrecovered error.
14	00	Recorded entity not found.
14	01	Record not found.
15	00	Random positioning error.
15	01	Mechanical positioning error.
15	02	Positioning error detected by read of medium.
17	00	Recovered data with no error correction applied.
17	01	Recovered data with retries.
17	02	Recovered data with positive head offset.
17	03	Recovered data with negative head offset.
17	04	Recovered data with retries and/or CIRC applied.
17	05	Recovered data using previous sector id.
18	00	Recovered data with error correction applied.

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Table C–15 (Cont.) SCSI ASC/ASCQ Codes For CDROM Devices.

ASC Code	ASCQ Code	Description
18	01	Recovered data with error correction and retries applied.
18	02	Recovered data—data auto-reallocated.
18	03	Recovered data with CIRC.
18	04	Recovered data with LEC.
18	05	Recovered data—recommend reassignment.
18	06	Recovered data - recommend rewrite.
1A	00	Parameter list length error.
1B	00	Synchronous data transfer error.
20	00	Invalid command operation code.
21	00	Logical block address out of range.
24	00	Invalid field in CDB.
25	00	Logical unit not supported.
26	00	Invalid field in parameter list.
26	01	Parameter not supported.
26	02	Parameter value invalid.
26	03	Threshold parameters not supported.
28	00	Not ready to ready transition, medium may have changed.
29	00	Power on, reset, or bus device reset occurred.
29	01	Power on occurred.
29	02	SCSI bus reset occurred.
29	03	Bus device reset occurred.
2A	00	Parameters changed.
2A	01	Mode parameters changed.
2A	02	Log parameters changed.
2B	00	Copy cannot execute because host cannot disconnect.
2C	00	Command sequence error.
2F	00	Commands cleared by another initiator.
30	00	Incompatible medium installed.
30	01	Cannot read medium—unknown format.
30	02	Cannot read medium—incompatible format.
37	00	Rounded parameter.
39	00	Saving parameters not supported.
3A	00	Medium not present.
3D	00	Invalid bits in identify message.
3E	00	Logical unit has not self-configured yet.
3F	00	Target operating conditions have changed.
3F	01	Microcode has been changed.

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Table C–15 (Cont.) SCSI ASC/ASCQ Codes For CDROM Devices.

ASC Code	ASCQ Code	Description
3F	02	Changed operating definition.
3F	03	Inquiry data has changed.
43	00	Message error.
44	00	Internal target failure.
45	00	Select or reselect failure.
46	00	Unsuccessful soft reset.
47	00	SCSI parity error.
48	00	Initiator detected error message received.
49	00	Invalid message error.
4A	00	Command phase error.
4B	00	Data phase error.
4C	00	Logical unit failed self-configuration.
4E	00	Overlapped commands attempted.
53	00	Media load or eject failed.
53	02	Medium removal prevented.
57	00	Unable to recover table-of-contents.
5A	00	Operator request or state change input (unspecified).
5A	01	Operator medium removal request.
5B	00	Log exception.
5B	01	Threshold condition met.
5B	02	Log counter at maximum.
5B	03	Log list codes exhausted.
63	00	End of user area encountered on this track.
64	00	Illegal mode for this track.
40	*nn*	Diagnostic failure detected on component *nn*; where *nn* identifies a specific target device component (*nn* range 80 through FF). Refer to documentation provided by the vendor of the target device for a description of the component identified by *nn*.

Table C–16 SCSI ASC/ASCQ Codes For Medium Changer Devices (such as jukeboxes)

ASC Code	ASCQ Code	Description
00	00	No additional sense information.
00	06	I/O process terminated.
02	00	No seek complete.
04	00	Logical unit not ready, cause not reportable.
04	01	Logical unit is in process of becoming ready.
04	02	Logical unit not ready, initializing command required.
04	03	Logical unit not ready, manual intervention required.
06	00	No reference position found.
07	00	Multiple peripheral devices selected.
08	00	Logical unit communication failure.
08	01	Logical unit communication time-out.
08	02	Logical unit communication parity error.
0A	00	Error log overflow.
15	00	Random positioning error.
15	01	Mechanical positioning error.
1A	00	Parameter list length error.
1B	00	Synchronous data transfer error.
20	00	Invalid command operation code.
21	00	Logical block address out of range.
21	01	Invalid element address.
24	00	Invalid field in CDB.
25	00	Logical unit not supported.
26	00	Invalid field in parameter list.
26	01	Parameter not supported.
26	02	Parameter value invalid.
26	03	Threshold parameters not supported.
28	00	Not ready to ready transition, medium may have changed.
28	01	Import or export element accessed.
29	00	Power on, reset, or bus device reset occurred.
29	01	Power on occurred.
29	02	SCSI bus reset occurred.
29	03	Bus device reset occurred.
2A	00	Parameters changed.
2A	01	Mode parameters changed.
2A	02	Log parameters changed.
2C	00	Command sequence error.
2F	00	Commands cleared by another initiator.

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Table C–16 (Cont.) SCSI ASC/ASCQ Codes For Medium Changer Devices (such as jukeboxes)

ASC Code	ASCQ Code	Description
30	00	Incompatible medium installed.
37	00	Rounded parameter.
39	00	Saving parameters not supported.
3A	00	Medium not present.
3B	0D	Medium destination element full.
3B	0E	Medium source element empty.
3D	00	Invalid bits in identify message.
3E	00	Logical unit has not self-configured yet.
3F	00	Target operating conditions have changed.
3F	01	Microcode has been changed.
3F	02	Changed operating definition.
3F	03	Inquiry data has changed.
43	00	Message error.
44	00	Internal target failure.
45	00	Select or reselect failure.
46	00	Unsuccessful soft reset.
47	00	SCSI parity error.
48	00	Initiator detected error message received.
49	00	Invalid message error.
4A	00	Command phase error.
4B	00	Data phase error.
4C	00	Logical unit failed self-configuration.
4E	00	Overlapped commands attempted.
53	00	Media load or eject failed.
53	02	Medium removal prevented.
5A	00	Operator request or state change input (unspecified).
5A	01	Operator medium removal request.
5B	00	Log exception.
5B	01	Threshold condition met.
5B	02	Log counter at maximum.
5B	03	Log list codes exhausted.
40	*nn*	Diagnostic failure detected on component *nn*; where *nn* identifies a specific target device component (*nn* range 80 through FF). Refer to documentation provided by the vendor of the target device for a description of the component identified by *nn*.

Table C–17 HSJ30/40 Controller Vendor Specific SCSI ASC/ASCQ Codes

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	03	Fault Manager detected an unknown error code.
80	06	Maximum number of errors for this I/O exceeded.
80	07	Drive reported recovered error without transferring all data.
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.
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.
A1	00	Shelf OK is not properly asserted.
A1	01	Unable to clear SWAP interrupt, interrupt disabled.
A1	02	Swap interrupt reenabled.
A1	03	Asynchronous SWAP detected.
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.

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Table C–17 (Cont.) HSJ30/40 Controller Vendor Specific SCSI ASC/ASCQ Codes

ASC Code	ASCQ Code	Description
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.
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.

Table C–18 Last Failure Event Log (Template 01) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
01010302	03EA	EXEC$BUGCHECK called with HW flag set. (that is, an unrecoverable hardware detected fault occurred).
0102030A	040A	EXEC$BUGCHECK called with HW flag clear (that is, an unrecoverable firmware inconsistency was detected).

Table C–19 Failover Event Log (Template 05) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
07030B0A	022A	Failover Control detected a receive packet sequence number mismatch. The HSJ30/40s are out of synchronization with each other and are unable to communicate. Note that in this instance the “last failure code” and “last failure parameters” fields are undefined.
07040B0A	022A	Failover Control detected a transmit packet sequence number mismatch. The HSJ30/40s are out of synchronization with each other and are unable to communicate. Note that in this instance the “last failure code” and “last failure parameters” fields are undefined.
07050064	022A	Failover Control received a Last Gasp message from the other HSJ30/40. The other HSJ30/40 is expected to restart itself within a given time period. If it does not, it will be held reset with the “Kill” line.

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Table C–19 (Cont.) Failover Event Log (Template 05) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
07060C01	022A	Failover Control detected that both HSJ30/40s are acting as SCSI ID 6. Because IDs are determined by hardware, it is unknown which HSJ30/40 is the real SCSI ID 6. Note that in this instance the "last failure code" and "last failure parameters" fields are undefined.
07070C01	022A	Failover Control detected that both HSJ30/40s are acting as SCSI ID 7. Because IDs are determined by hardware, it is unknown which HSJ30/40 is the real SCSI ID 7. Note that in this instance the "last failure code" and "last failure parameters" fields are undefined.
07080B0A	022A	Failover Control was unable to send keepalive communication to the other HSJ30/40. It is assumed that the other HSJ30/40 is hung or not started. Note that in this instance the "last failure code" and "last failure parameters" fields are undefined.

Table C–20 Nonvolatile Parameter Memory Component Event Log (Template 11) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
01032002	012A	Nonvolatile parameter memory component EDC check failed; content of the component reset to default settings.

Table C–21 Backup Battery Failure Event Log (Template 12) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
02032001	012A	Journal SRAM backup battery failure; detected during system restart. The "memory address" field contains the starting physical address of the Journal SRAM.
02042001	012A	Journal SRAM backup battery failure; detected during periodic check. The "memory address" field contains the starting physical address of the Journal SRAM.

Table C–22 Subsystem Built-In Self-Test Failure Event Log (Template 13) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
82012002	020A	An unrecoverable error was detected during execution of the NCR710 Subsystem Built-In Self-Test. One of the ports on the controller module has failed; some/all of the attached storage is no longer accessible via this controller.
82022202	020A	An unrecoverable error was detected during execution of the Cache Memory/DRAB Chip Subsystem Built-In Self-Test that rendered half of the cache memory unusable.
82032202	020A	An unrecoverable error was detected during execution of the Cache Memory/DRAB Chip Subsystem Built-In Self-Test that rendered the entire cache memory unusable.
82042002	020A	A spurious interrupt was detected during the execution of a Subsystem Built-In Self-Test.
82052002	020A	An unrecoverable error was detected during execution of the HOST PORT Subsystem Test. The system will not be able to communicate with the host.
82062002	020A	An unrecoverable error was detected during execution of the UART/DUART Subsystem Test. This will cause the console to be unusable. This will cause failover communications to fail.
82072002	020A	An unrecoverable error was detected during execution of the FX Subsystem Test.
82082002	020A	An unrecoverable error was detected during execution of the nbuss init Test.

Table C–23 Memory System Failure Event Log (Template 14) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
02072201	012A	The CACHE Dynamic RAM Controller and Arbitration engine 0 (DRAB0) failed testing performed by the Cache Diagnostics. The “memory address” field contains the starting physical address of the CACHEA0 memory.
02082201	012A	The CACHE Dynamic RAM Controller and Arbitration engine 1 (DRAB1) failed testing performed by the Cache Diagnostics. The “memory address” field contains the starting physical address of the CACHEA1 memory.
020C2201	012A	Cache Diagnostics have declared the cache bad during testing. The “memory address” field contains the starting physical address of the CACHEA0 memory.

Table C–24 CI Port Event Log (Template 31) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
40016001	006A	CI A/B transmit cables are crossed.
40026001	006A	CI A/B receive cables are crossed.
4009640A	006A	CI Port detected bad Path A upon attempting to transmit a packet.
400A640A	006A	CI Port detected bad Path B upon attempting to transmit a packet.
400B640A	006A	CI Port detected bad Path A upon attempting to transmit a packet.
400C640A	006A	CI Port detected bad Path B upon attempting to transmit a packet.
400D640A	006A	CI Port detected bad Path A upon attempting to transmit a packet.
400E640A	006A	CI Port detected bad Path B upon attempting to transmit a packet.

Table C–25 CI Port/Port Driver Event Log (Template 32) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
4003640A	006A	CI Port detected a Dual Receive condition that resulted in the closure of the Virtual Circuit. This error condition will be eliminated in a future CI interface chip.
4004020A	006A	Host Interconnect Services detected protocol error upon validating a received packet.
4007640A	006A	CI Port detected error upon attempting to transmit a packet. This resulted in the closure of the Virtual Circuit.
403D020A	006A	Received packet with an unrecognized PPD opcode. Note that the content of the “vcstate” field is undefined in this instance.
40440064	006A	Received a PPD NODE_STOP and closed virtual circuit.

Table C–26 CI System Communication Services Event Log (Template 33) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
4015020A	006A	Remote SYSAP sent an SCS APPL_MSG but no receive credit was available.
4029010A	006A	Illegal connection state. Not in CONNECT_REC connection state when an SCS ACCEPT_REQ is pending.
402A010A	006A	Illegal connection state. Not in CONNECT_REC connection state when an SCS REJECT_REQ is pending.
402B010A	006A	Illegal connection state. Not in CLOSED connection state when an SCS CONNECT_REQ is pending.
402C010A	006A	Illegal connection state. Not in OPEN or DISCONNECT_REC connection state when an SCS DISCONNECT_REQ is pending.
4051020A	006A	Received SCS CONNECT_RSP when not in CONNECT_SENT connection state.
4052020A	006A	Received SCS CONNECT_RSP when the connection is no longer valid.
4053020A	006A	Received SCS ACCEPT_REQ when not in CONNECT_ACK connection state.
4054020A	006A	Received SCS ACCEPT_RSP when not in the ACCEPT_SENT connection state.
4055020A	006A	Received SCS REJECT_REQ when not in the CONNECT_ACK connection state.
4056020A	006A	Received SCS REJECT_RSP when not in the REJECT_SENT connection state.
4057020A	006A	Received SCS DISCONNECT_REQ when not in the OPEN, DISCONNECT_SENT or DISCONNECT_ACK connection state.
4058020A	006A	Received SCS DISCONNECT_RSP when not in the DISCONNECT_SENT or DISCONNECT_MATCH connection state.
4059020A	006A	Received SCS CREDIT_REQ when in the DISCONNECT_REC or DISCONNECT_MATCH connection state.
405A020A	006A	Received SCS APPL_MSG when in the DISCONNECT_SENT or DISCONNECT_ACK connection state.
405B020A	006A	Received SCS ACCEPT_REQ on a connection that is no longer valid. Note that in this instance if the “connection ID” field is zero, the content of the “VCSTATE”, “remote node name”, “remote connection id”, and “connection state” fields are undefined.
405C020A	006A	Received SCS ACCEPT_RSP on a connection that is no longer valid. Note that in this instance if the “connection ID” field is zero, the content of the “VCSTATE”, “remote node name”, “remote connection id”, and “connection state” fields are undefined.

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Table C–26 (Cont.) CI System Communication Services Event Log (Template 33) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
405D020A	006A	Received SCS REJECT_REQ on a connection that is no longer valid. Note that in this instance if the "connection ID" field is zero, the content of the "VCSTATE", "remote node name", "remote connection id", and "connection state" fields are undefined.
405E020A	006A	Received SCS REJECT_RSP on a connection that is no longer valid. Note that in this instance if the "connection ID" field is zero, the content of the "VCSTATE", "remote node name", "remote connection id", and "connection state" fields are undefined.
405F020A	006A	Received SCS DISCONNECT_REQ on a connection that is no longer valid. Note that in this instance if the "connection ID" field is zero, the content of the "VCSTATE", "remote node name", "remote connection id", and "connection state" fields are undefined.
4060020A	006A	Received SCS DISCONNECT_RSP on a connection that is no longer valid. Note that in this instance if the "connection ID" field is zero, the content of the "VCSTATE", "remote node name", "remote connection id", and "connection state" fields are undefined.
4061020A	006A	Received SCS CREDIT_REQ on a connection that is no longer valid. Note that in this instance if the "connection ID" field is zero, the content of the "VCSTATE", "remote node name", "remote connection id", and "connection state" fields are undefined.
4062020A	006A	Received SCS CREDIT_RSP on a connection that is no longer valid. Note that in this instance if the "connection ID" field is zero, the content of the "VCSTATE", "remote node name", "remote connection id", and "connection state" fields are undefined.
4063020A	006A	Received SCS APPL_MSG on a connection that is no longer valid. Note that in this instance if the "connection ID" field is zero, the content of the "VCSTATE", "remote node name", "remote connection id", and "connection state" fields are undefined.
4064020A	006A	Received an unrecognized SCS message. Note that in this instance if the "connection ID" field is zero, the content of the "VCSTATE", "remote node name", "remote connection id", and "connection state" fields are undefined.
4065020A	006A	Received SCS CONNECT_RSP with an unrecognized status. Connection is broken by Host Interconnect Services.
4066020A	006A	Received SCS REJECT_REQ with an invalid reason.
4067020A	006A	Received SCS APPL_MSG with no receive credit available.

Table C–27 Device Services Nontransfer Error Event Log (Template 41) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
021B0064	0014	Disk Bad Block Replacement attempt completed for a read of controller metadata from a location outside the user data area of the disk. Note that due to the way Bad Block Replacement is performed on SCSI disk drives, information on the actual replacement blocks is not available to the controller and is therefore not included in the event report.
021A0064	0014	Disk Bad Block Replacement attempt completed for a write of controller metadata to a location outside the user data area of the disk. Note that due to the way Bad Block Replacement is performed on SCSI disk drives, information on the actual replacement blocks is not available to the controller and is therefore not included in the event report.
03010101	006A	No command control structures available for disk operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03820101	006A	No command control structures available for tape operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03B40101	006A	No command control structures available for media loader operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03C80101	006A	No command control structures available for operation to a device that is unkown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03022002	002A	SCSI interface chip command timeout during disk operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03832002	002A	SCSI interface chip command timeout during tape operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03B52002	002A	SCSI interface chip command timeout during media loader operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03C92002	002A	SCSI interface chip command timeout during operation to a device that is unknown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03034002	016A	Byte transfer timeout during disk operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03844002	016A	Byte transfer timeout during tape operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03B64002	016A	Byte transfer timeout during media loader operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03CA4002	016A	Byte transfer timeout during operation to a device that is unknown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03044402	01AA	SCSI bus errors during disk operation. Note that in this instance the “asc” and “ascq” fields are undefined.

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Table C–27 (Cont.) Device Services Nontransfer Error Event Log (Template 41) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
03854402	01AA	SCSI bus errors during tape operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03B74402	01AA	SCSI bus errors during media loader operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03D24402	01AA	SCSI bus errors during device operation. The device type is unknown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03052002	002A	Device port SCSI chip reported gross error during disk operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03862002	002A	Device port SCSI chip reported gross error during tape operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03B82002	002A	Device port SCSI chip reported gross error during media loader operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03CD2002	002A	Device port SCSI chip reported gross error during operation to a device that is unknown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03062002	008A	Non-SCSI bus parity error during disk operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03872002	008A	Non-SCSI bus parity error during tape operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03B92002	008A	Non-SCSI bus parity error during media loader operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03CE2002	008A	Non-SCSI bus parity error during operation to a device that is unknown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03070101	01CA	Source driver programming error encountered during disk operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03880101	01CA	Source driver programming error encountered during tape operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03BA0101	01CA	Source driver programming error encountered during media loader operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03CF0101	01CA	Source driver programming error encountered during operation to a device that is unknown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03080101	01EA	Miscellaneous SCSI Port Driver coding error detected during disk operation. Note that in this instance the “asc” and “ascq” fields are undefined.

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Table C–27 (Cont.) Device Services Nontransfer Error Event Log (Template 41) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
03890101	01EA	Miscellaneous SCSI Port Driver coding error encountered during tape operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03BB0101	01EA	Miscellaneous SCSI Port Driver coding error detected during media loader operation. Note that in this instance the “asc” and “ascq” fields are undefined.
03CB0101	01EA	Miscellaneous SCSI Port Driver coding error detected during operation to a device that is unkown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03270101	01EA	A disk related error code was reported that was unknown to the Fault Management firmware. Note that in this instance the “asc” and “ascq” fields are undefined.
038A0101	01EA	A tape related error code was reported that was unknown to the Fault Management firmware. Note that in this instance the “asc” and “ascq” fields are undefined.
03BC0101	01EA	A media loader related error code was reported that was unknown to the Fault Management firmware. Note that in this instance the “asc” and “ascq” fields are undefined.
03CC0101	01EA	A error code was reported that was unknown to the Fault Management firmware. Note that in this instance the “asc” and “ascq” fields are undefined.
03D04002	01AA	A failure occurred while attempting a SCSI Test Unit Ready or Read Capacity command to a device. The device type is unknown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03D14002	006A	The identification of a device does not match the configuration information. The actual device type is unknown to the controller. Note that in this instance the “asc” and “ascq” fields are undefined.
03F00402	00EB	The shelf indicated by the “port” field is reporting a problem. This could mean one or both of the following: • If the shelf is using dual power supplies, one power supply has failed. • One of the shelf cooling fans has failed. Note that in this instance the “target”, “asc”, and “ascq” fields are undefined.
03F10502	00EB	The SWAP interrupt from the shelf indicated by the “port” field can not be cleared. All SWAP interrupts from all ports will be disabled until corrective action is taken. When SWAP interrupts are disabled, both HSJ30/40 controller front panel button presses and removal/insertion of devices are not detected by the HSJ30/40 controller. Note that in this instance the “target”, “asc”, and “ascq” fields are undefined.

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Table C–27 (Cont.) Device Services Nontransfer Error Event Log (Template 41) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
03F20064	00EB	The SWAP interrupts have been cleared and reenabled for all shelves. Note that in this instance the “port”, “target”, “asc”, and “ascq” fields are undefined.
03F30064	00EB	An asynchronous SWAP interrupt was detected by the HSJ30/40 controller for the shelf indicated by the “port” field. Possible reasons for this occurance include: • Device insertion/removal • Shelf power failure • SWAP interrupts reenabled. Note that in this instance the “target”, “asc”, and “ascq” fields are undefined.
03D3450A	00EB	During device initialization, the device reported the SCSI Sense Key NO SENSE. 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.
03D4450A	00EB	During device initialization, the device reported the SCSI Sense Key RECOVERED ERROR. This indicates the last command completed successfully with some recovery action performed by the target.
03D5450A	00EB	During device initialization, the device reported the SCSI Sense Key NOT READY. This indicates that the logical unit addressed cannot be accessed. Operator intervention may be required to correct this condition.
03D6450A	00EB	During device initialization, the device reported the SCSI Sense Key MEDIUM ERROR. This indicates that the command terminated with a nonrecovered error condition that was probably caused by a flaw in the medium or an error in the recorded data. This 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).
03D7450A	00EB	During device initialization, the device reported the SCSI Sense Key HARDWARE ERROR. This indicates that the target detected a nonrecoverable hardware failure (for example, controller failure, device failure, parity error, and so forth) while performing the command or during a self-test.

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Table C–27 (Cont.) Device Services Nontransfer Error Event Log (Template 41) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
03D8450A	00EB	During device initialization, the device reported the SCSI Sense Key ILLEGAL REQUEST. Indicates that there was an illegal parameter in the command descriptor block or in the additional parameters supplied as data for some commands (FORMAT UNIT, SEARCH DATA, and so forth). If the target detects an invalid parameter in the command descriptor block, then it shall terminate the command without altering the medium. If the target detects an invalid parameter in the additional parameters supplied as data, then the target may have already altered the medium. This sense key may also indicate that an invalid IDENTIFY message was received.
03D9450A	00EB	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.
03DA450A	00EB	During device initialization, the device reported the SCSI Sense Key DATA PROTECT. This indicates that a command that reads or writes the medium was attempted on a block that is protected from this operation. The read or write operation is not performed.
03DB450A	00EB	During device initialization, the device reported the SCSI Sense Key BLANK CHECK. This indicates that a write-once device or a sequential-access device encountered blank medium or format-defined end-of-data indication while reading or a write-once device encountered a non-blank medium while writing.
03DC450A	00EB	During device initialization, the device reported a SCSI Vendor Specific Sense Key. This sense key is available for reporting vendor specific conditions.
03DD450A	00EB	During device initialization, the device reported the SCSI Sense Key COPY ABORTED. This indicates a COPY, COMPARE, or COPY AND VERIFY command was aborted due to an error condition on the source device, the destination device, or both.
03DE450A	00EB	During device initialization, the device reported the SCSI Sense Key ABORTED COMMAND. This indicates the target aborted the command. The initiator may be able to recover by trying the command again.
03DF450A	00EB	During device initialization, the device reported the SCSI Sense Key EQUAL. This indicates a SEARCH DATA command has satisfied an equal comparison.
03E0450A	00EB	During device initialization, the device reported the SCSI Sense Key VOLUME OVERFLOW. This indicates a buffered peripheral device has reached the end-of-partition and data may remain in the buffer that has not been written to the medium. A RECOVER BUFFERED DATA command(s) may be issued to read the unwritten data from the buffer.
03E1450A	00EB	During device initialization, the device reported the SCSI Sense Key MISCOMPARE. This indicates the source data did not match the data read from the medium.

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Table C–27 (Cont.) Device Services Nontransfer Error Event Log (Template 41) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
03E2450A	00EB	During device initialization, the device reported a reserved SCSI Sense Key.

Table C–28 Disk Transfer Error Event Log (Template 51) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
02090064	0007	A data compare error was detected during the execution of a compare modified READ or WRITE command. Note that in this instance the SCSI Device Sense Data fields, "cmdopcd" through "keyspec", are undefined.
03094002	000B	An unrecoverable disk drive error was encountered while performing work related to disk unit operations.
0328450A	000B	The disk device reported standard SCSI Sense Data.
030C4002	014B	A Drive failed because a Test Unit Ready command or a Read Capacity command failed.
030D000A	0103	Drive was failed by a Mode Select command received from the host.
030E4002	00EB	Drive failed due to a deferred error reported by drive.
030F4002	00E8	Unrecovered Read or Write error.
03104002	002B	No response from one or more drives.
0311430A	012B	Nonvolatile memory and drive metadata indicate conflicting drive configurations.
0312430A	012B	The Synchronous Transfer Value differs between drives in the same storageset.
03134002	012B	Maximum number of errors for this data transfer operation exceeded.
03144002	00CB	Drive reported recovered error without transferring all data.
03154002	00E8	Data returned from drive is invalid.
03164002	012B	Request Sense command to drive failed.
03170064	0016	Illegal command for pass through mode.
03180064	0016	Data transfer request error.
03194002	012B	Premature completion of a drive command.
031A4002	002B	Command timeout.
031B0101	002B	Watchdog timer timeout.
031C4002	002B	Disconnect timeout.
031D4002	012B	Unexpected bus phase.
031E4002	012B	Disconnect expected.

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Table C–28 (Cont.) Disk Transfer Error Event Log (Template 51) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
031F4002	012B	ID Message not sent by drive.
03204002	012B	Synchronous negotiation error.
03214002	012B	The drive unexpectedly disconnected from the SCSI bus.
03224002	012B	Unexpected message.
03234002	012B	Unexpected Tag message.
03244002	012B	Channel busy.
03254002	012B	Message Reject received on a valid message.
0326450A	00EB	The disk device reported Vendor Unique SCSI Sense Data.

Table C–29 Disk Bad Block Replacement Attempt Event Log (Template 57) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
02110064	0014	Disk Bad Block Replacement attempt completed for a read within the user data area of the disk. Note that due to the way Bad Block Replacement is performed on SCSI disk drives, information on the actual replacement blocks is not available to the controller and is therefore not included in the “Old RBN” and “New RBN” fields. The content of those fields is undefined.
02020064	0014	Disk Bad Block Replacement attempt completed for a write within the user data area of the disk. Note that due to the way Bad Block Replacement is performed on SCSI disk drives, information on the actual replacement blocks is not available to the controller and is therefore not included in the “Old RBN” and “New RBN” fields. The content of those fields is undefined.

Table C–30 Tape Transfer Error Event Log (Template 61) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
020A0064	0007	A data compare error was detected during the execution of a compare modified READ or WRITE command. Note that in this instance the SCSI Device Sense Data fields, “cmdopcd” through “keyspec”, are undefined.
03644002	000B	An unrecoverable tape drive error was encountered while performing work related to tape unit operations.
038B450A	000B	The tape device reported standard SCSI Sense Data.
03674002	014B	A Drive failed because a Test Unit Ready command or a Read Capacity command failed.
0368000A	0103	Drive was failed by a Mode Select command received from the host.
03694002	00EB	Drive failed due to a deferred error reported by drive.
036A4002	00E8	Unrecovered Read or Write error.
036B4002	002B	No response from one or more drives.
036C430A	012B	Nonvolatile memory and drive metadata indicate conflicting drive configurations.
036D430A	012B	The Synchronous Transfer Value differs between drives in the same storageset.
036E4002	012B	Maximum number of errors for this data transfer operation exceeded.
036F4002	00CB	Drive reported recovered error without transferring all data.
03704002	00E8	Data returned from drive is invalid.
03714002	012B	Request Sense command to drive failed.
03720064	0016	Illegal command for pass through mode.
03730064	0016	Data transfer request error.
03744002	012B	Premature completion of a drive command.
03754002	002B	Command timeout.
03760101	002B	Watchdog timer timeout.
03774002	002B	Disconnect timeout.
03784002	012B	Unexpected bus phase.
03794002	012B	Disconnect expected.
037A4002	012B	ID Message not sent by drive.
037B4002	012B	Synchronous negotiation error.
037C4002	012B	The drive unexpectedly disconnected from the SCSI bus.
037D4002	012B	Unexpected message.
037E4002	012B	Unexpected Tag message.
037F4002	012B	Channel busy.
03804002	012B	Message Reject received on a valid message.
0381450A	00EB	The tape device reported Vendor Unique SCSI Sense Data.

Table C–31 Media Loader Error Event Log (Template 71) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
03964002	0097	An unrecoverable media loader error was encountered while performing work related to media loader operations.
03BD450A	0097	The media changer device reported standard SCSI Sense Data.
03994002	0097	A Drive failed because a Test Unit Ready command or a Read Capacity command failed.
039A000A	0077	Drive was failed by a Mode Select command received from the host.
039B4002	0097	Drive failed due to a deferred error reported by drive.
039C4002	0097	Unrecovered Read or Write error.
039D4002	0037	No response from one or more drives.
039E430A	0097	Nonvolatile memory and drive metadata indicate conflicting drive configurations.
039F430A	0097	The Synchronous Transfer Value differs between drives in the same storageset.
03A04002	0097	Maximum number of errors for this data transfer operation exceeded.
03A14002	0097	Drive reported recovered error without transferring all data.
03A24002	0097	Data returned from drive is invalid.
03A34002	0097	Request Sense command to drive failed.
03A40064	0016	Illegal command for pass through mode.
03A50064	0016	Data transfer request error.
03A64002	0097	Premature completion of a drive command.
03A74002	0037	Command timeout.
03A80101	0037	Watchdog timer timeout.
03A94002	0037	Disconnect timeout.
03AA4002	0097	Unexpected bus phase.
03AB4002	0097	Disconnect expected.
03AC4002	0097	ID Message not sent by drive.
03AD4002	0097	Synchronous negotiation error.
03AE4002	0097	The drive unexpectedly disconnected from the SCSI bus.
03AF4002	0097	Unexpected message.
03B04002	0097	Unexpected Tag message.
03B14002	0097	Channel busy.
03B24002	0097	Message Reject received on a valid message.
03B3450A	0097	The media changer device reported Vendor Unique SCSI Sense Data.

Table C–32 Disk Copy Data Correlation Event Log “event dependent information” Values

Value	Description
00000001	Unable to allocate a sufficient number of DCD Context Blocks to support this host.
00000002	Unable to find an inactive Unit Path Block.
00000003	Unable to find an inactive Source Unit Block.
00000004	Insufficient resources returned by HIS$CONNECT.

Table C–33 Executive Services Last Failure Codes

Code	Description
01000100	Memory allocation failure during executive initialization.
01010100	An interrupt without any handler was triggered.
01020100	Entry on timer que 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. • Last Failure Parameter[0] contains the PC value. • Last Failure Parameter[1] contains the AC value. • Last Failure Parameter[2] contains the fault type and subtype values. • Last Failure Parameter[3] contains the address of the faulting instruction.
01060100	An attempt was made to do EXEC UART I/O when there is no support for it.
01070100	Timer chip setup failed.
01082004	The core diagnostics reported a fault. • Last Failure Parameter[0] contains the error code value (same as blinking OCP LEDs error code). • Last Failure Parameter[1] contains the address of the fault. • Last Failure Parameter[2] contains the actual data value. • Last Failure Parameter[3] contains the expected data value.
01800080	A powerfail interrupt occured.

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Table C–33 (Cont.) Executive Services Last Failure Codes

Code	Description
01812088	A processor interrupt was generated by the Master Dynamic RAM Controller and Arbitration engine (DRAB) with an indication that an unrecoverable memory access problem occurred. • Last Failure Parameter[0] contains the Master DRAB Setup Register value. • Last Failure Parameter[1] contains the Master DRAB CSR Register value. • Last Failure Parameter[2] contains the Master DRAB Diagnostic CSR Register value. • Last Failure Parameter[3] contains the Master DRAB Diagnostic Error Register value. • Last Failure Parameter[4] contains the Master DRAB Error Address Register value. • Last Failure Parameter[5] contains the Master DRAB Error Data Register value. • Last Failure Parameter[6] contains the Master DRAB Error Region Register value. • Last Failure Parameter[7] contains the Master DRAB Region Setup Register value.
01822288	A processor interrupt was generated by the CACHEA0 Dynamic RAM Controller and Arbitration engine (DRAB) with an indication that an unrecoverable memory access problem occurred. • Last Failure Parameter[0] contains the CACHEA0 DRAB Setup Register value. • Last Failure Parameter[1] contains the CACHEA0 DRAB CSR Register value. • Last Failure Parameter[2] contains the CACHEA0 DRAB Diagnostic CSR Register value. • Last Failure Parameter[3] contains the CACHEA0 DRAB Diagnostic Error Register value. • Last Failure Parameter[4] contains the CACHEA0 DRAB Error Address Register value. • Last Failure Parameter[5] contains the CACHEA0 DRAB Error Data Register value. • Last Failure Parameter[6] contains the CACHEA0 DRAB Error Region Register value. • Last Failure Parameter[7] contains the CACHEA0 DRAB Region Setup Register value.

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Table C–33 (Cont.) Executive Services Last Failure Codes

Code	Description
01832288	A processor interrupt was generated by the CACHEA1 Dynamic RAM Controller and Arbitration engine (DRAB) with an indication that an unrecoverable memory access problem occurred. • Last Failure Parameter[0] contains the CACHEA1 DRAB Setup Register value. • Last Failure Parameter[1] contains the CACHEA1 DRAB CSR Register value. • Last Failure Parameter[2] contains the CACHEA1 DRAB Diagnostic CSR Register value. • Last Failure Parameter[3] contains the CACHEA1 DRAB Diagnostic Error Register value. • Last Failure Parameter[4] contains the CACHEA1 DRAB Error Address Register value. • Last Failure Parameter[5] contains the CACHEA1 DRAB Error Data Register value. • Last Failure Parameter[6] contains the CACHEA1 DRAB Error Region Register value. • Last Failure Parameter[7] contains the CACHEA1 DRAB Region Setup Register value.
01842288	A processor interrupt was generated by the CACHEB0 Dynamic RAM Controller and Arbitration engine (DRAB) with an indication that an unrecoverable memory access problem occurred. • Last Failure Parameter[0] contains the CACHEB0 DRAB Setup Register value. • Last Failure Parameter[1] contains the CACHEB0 DRAB CSR Register value. • Last Failure Parameter[2] contains the CACHEB0 DRAB Diagnostic CSR Register value. • Last Failure Parameter[3] contains the CACHEB0 DRAB Diagnostic Error Register value. • Last Failure Parameter[4] contains the CACHEB0 DRAB Error Address Register value. • Last Failure Parameter[5] contains the CACHEB0 DRAB Error Data Register value. • Last Failure Parameter[6] contains the CACHEB0 DRAB Error Region Register value. • Last Failure Parameter[7] contains the CACHEB0 DRAB Region Setup Register value.

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Table C–33 (Cont.) Executive Services Last Failure Codes

Code	Description
01852288	A processor interrupt was generated by the CACHEB1 Dynamic RAM Controller and Arbitration engine (DRAB) with an indication that an unrecoverable memory access problem occurred. • Last Failure Parameter[0] contains the CACHEB1 DRAB Setup Register value. • Last Failure Parameter[1] contains the CACHEB1 DRAB CSR Register value. • Last Failure Parameter[2] contains the CACHEB1 DRAB Diagnostic CSR Register value. • Last Failure Parameter[3] contains the CACHEB1 DRAB Diagnostic Error Register value. • Last Failure Parameter[4] contains the CACHEB1 DRAB Error Address Register value. • Last Failure Parameter[5] contains the CACHEB1 DRAB Error Data Register value. • Last Failure Parameter[6] contains the CACHEB1 DRAB Error Region Register value. • Last Failure Parameter[7] contains the CACHEB1 DRAB Region Setup Register value.
01860080	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.
01870080	A processor interrupt was generated with an indication that the (//) RESET button on the controller module was depressed.
01880080	A processor interrupt was generated with an indication that the program card was removed.
01890080	A powerfail interrupt occurred because of watch dog timeout.
018A0080	Cache region timeout with no other DRAB errors.

Table C–34 Value Added Services Last Failure Codes

Code	Description
02000100	Initialization code was unable to allocate enough memory to set up the receive data descriptors.
02010100	Initialization code was unable to allocate enough memory to set up 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$ALLOCATE_MEM_ZEROED failed to return memory when populating the miscellaneous DWD stack.
020E0100	A call to RESMGR$ALLOCATE_SEND_DATA_DESC failed to return a send data descriptor when populating the send_dd_stack.
020F0100	A call to RESMGR$ALLOCATE_RCV_DATA_DESC failed to return a receive data descriptor when populating the rcv_dd_stack.
02100100	A call to EXEC$ALLOCATE_MEM_ZEROED failed to return memory when creating the device services state table.
02170100	Unable to allocate memory for the Free Node Array.
02180100	Unable to allocate memory for the Free Buffer Descriptor Array.
021B0100	A call to EXEC$ALLOCATE_MEM_ZEROED failed to return memory when populating the disk read EDC DWD stack.
021C0100	A call to EXEC$ALLOCATE_MEM_ZEROED failed to return memory when populating the disk write EDC DWD stack.
021D0100	Unable to allocate memory for the Free Buffer Array.
021E0100	Unable to allocate memory for the Free Strip Node 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	A callback from DS on a transfer request has returned a bad or illegal DWD status. • Last Failure Parameter[0] contains the DWD Status. • Last Failure Parameter[1] contains the DWD address. • Last Failure Parameter[2] contains the PUB Address. • Last Failure Parameter[3] contains the Device Port.

(continued on next page)

Table C–34 (Cont.) Value Added Services Last Failure Codes

Code	Description
022E0102	An invalid mapping type was specified for a logical unit. • Last Failure Parameter[0] contains the USB address. • Last Failure Parameter[1] contains the Unit Mapping Type.
02360101	Unrecognized state supplied to FOC$SEND callback routine va_dap_snd_cmd_complete. Last Failure Parameter[0] contains the unrecognized value.
02370102	Unsupported return from HIS$GET_CONN_INFO routine • Last Failure Parameter[0] contains the DD address. • Last Failure Parameter[1] contains the invalid status.
02392084	A processor interrupt was generated by the HSJ30/40 controller's XOR engine (FX), with no bits set in the CSR to indicate a reason for the interrupt. • Last Failure Parameter[0] contains the FX Control and Status Register (CSR). • Last Failure Parameter[1] contains the FX DMA Indirect List Pointer register (DILP). • Last Failure Parameter[2] contains the FX DMA Page Address register (DADDR). • Last Failure Parameter[3] contains the FX DMA Command and control register (DCMD).
023A2084	A processor interrupt was generated by the HSJ30/40 controller's XOR engine (FX), indicating an unrecoverable error condition. • Last Failure Parameter[0] contains the FX Control and Status Register (CSR). • Last Failure Parameter[1] contains the FX DMA Indirect List Pointer register (DILP). • Last Failure Parameter[2] contains the FX DMA Page Address register (DADDR). • Last Failure Parameter[3] contains the FX DMA Command and control register (DCMD).
02440100	The logical unit mapping type was detected invalid in va_set_disk_geometry( ).
02530102	An invalid status was returned from CACHE$LOOKUP_LOCK( ). • Last Failure Parameter[0] contains the DD address. • Last Failure Parameter[1] contains the invalid status.

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Table C–34 (Cont.) Value Added Services Last Failure Codes

Code	Description
02560102	An invalid status was returned from CACHE$LOOKUP_LOCK( ). • Last Failure Parameter[0] contains the DD address. • Last Failure Parameter[1] contains the invalid status.
02570102	An invalid status was returned from VA$XFER( ) during a operation. • Last Failure Parameter[0] contains the DD address. • Last Failure Parameter[1] contains the invalid status.
025A0102	An invalid status was returned from CACHE$LOOKUP_LOCK( ). • Last Failure Parameter[0] contains the DD address. • Last Failure Parameter[1] contains the invalid status.
025B0102	An invalid mapping type was specified for a logical unit. • Last Failure Parameter[0] contains the USB address. • Last Failure Parameter[1] contains the Unit Mapping Type.
025C0102	An invalid mapping type was specified for a logical unit. • Last Failure Parameter[0] contains the USB address. • Last Failure Parameter[1] contains the Unit Mapping Type.
02620102	An invalid status was returned from CACHE$LOOKUP_LOCK( ). • Last Failure Parameter[0] contains the DD address. • Last Failure Parameter[1] contains the invalid status.
02690102	An invalid status was returned from CACHE$OFFER_WRITE_DATA( ). • Last Failure Parameter[0] contains the DD address. • Last Failure Parameter[1] contains the invalid status.
02720100	A request was made to read a device metadata block with an invalid block type.
02730100	A request was made to write a device metadata block with an invalid block type.
02790102	An invalid status was returned from VA$XFER( ) in a complex read operation. • Last Failure Parameter[0] contains the DD address. • Last Failure Parameter[1] contains the invalid status.

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Table C–34 (Cont.) Value Added Services Last Failure Codes

Code	Description
027B0102	An invalid status was returned from VA$XFER( ) in a complex ACCESS operation. • Last Failure Parameter[0] contains the DD address. • Last Failure Parameter[1] contains the invalid status.
027D0100	Unable to allocate memory for a Failover Control Block.
027E0100	Unable to allocate memory for a Failover Control Block.
027F0100	Unable to allocate memory for a Failover Control Block.
02800100	Unable to allocate memory for a Failover Control Block.
02820100	Unable to allocate memory for the Dirty Count Array.
02830100	Unable to allocate memory for the Cache Buffer Index Array.
02840100	Unable to allocate memory for the XNode Array.
02850100	Cache was declared bad by the Cache Diagnostics after first Meg was tested. Cannot recover and use local memory because those initial buffers cannot be retrieved.
02860100	Unable to allocate memory for the Fault Management Event Information Packet used by the Cache Manager in generating error logs to the host.
02880100	Invalid FOC Message in cmfoc_snd_cmd.
02890100	Invalid FOC Message in cmfoc_rcv_cmd.
028A0100	Invalid return status from DIAG$CACHE_MEMORY_TEST.
028B0100	Invalid return status from DIAG$CACHE_MEMORY_TEST.
028C0100	Invalid error status given to cache_fail.
028D0100	Invalid number of banks in cache.
028E0100	Cache module is locked when not expected.
028F0100	Invalid status returned from CACHE$CHECK_METADATA.
02900100	Unable to allocate memory for the First Cache Buffer Index Array.
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.
02950100	Invalid DCA state detected in start_crashover.
02960100	Invalid DCA state detected in start_failover.
02970100	Invalid DCA state detected in init_failover.
029B0100	The host port software has insufficient resources to set up a block data transfer operation for a WRITE command.
029C0100	The host port software has insufficient resources to set up a block data transfer operation for a COMPARE command.

Table C–35 Device Services Last Failure Codes

Code	Description
03020101	Invalid SCSI direct-access device opcode in miscellaneous command DWD. Last Failure Parameter[0] contains the SCSI command opcode.
03030101	Invalid SCSI sequential-access device opcode in miscellaneous command DWD. Last Failure Parameter[0] contains the SCSI command opcode.
03040101	Invalid SCSI CDROM device opcode in miscellaneous command DWD. Last Failure Parameter[0] contains the SCSI command opcode.
03050101	Invalid SCSI medium changer device opcode in miscellaneous command DWD. Last Failure Parameter[0] contains the SCSI command opcode.
03060101	Invalid SCSI device type in PUB. Last Failure Parameter[0] contains the SCSI device type.
03070101	Invalid CDB Group Code detected during create of miscellaneous command DWD Last Failure Parameter[0] contains the SCSI command opcode.
03080101	Invalid SCSI OPTICAL MEMORY device opcode in miscellaneous command DWD. Last Failure Parameter[0] contains the SCSI command opcode.
030A0100	Error DWD not found in port in_proc_q.
030B0188	A dip error was detected when pcb_busy was set. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the new info NULL - SSTAT0 - DSTAT - ISTAT. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.
03150100	More DBDs than allowded for in mask.
031E0100	Cannot 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 error information packet (EIP) or device work descriptor (DWD) were not supplied to the Device Services error logging code.
032A0100	HIS$GET_CONN_INFO( ) returned an unexpected completion code.
032B0100	A Device Work Discriptor (DWD) was supplied with a NULL Physical Unit Block (PUB) pointer.

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Table C–35 (Cont.) Device Services Last Failure Codes

Code	Description
03320101	An invalid code was passed to the error recovery thread in the error_stat field of the PCB. Last Failure Parameter[0] contains the PCB error_stat code.
03330188	A parity error was detected by a 710 while sending data out onto the SCSI bus. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the PCB copy of the 710 TEMP register. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.
03350188	The TEA (bus fault) signal was asserted into a 710. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the PCB copy of the 710 TEMP register. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.

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Table C–35 (Cont.) Device Services Last Failure Codes

Code	Description
03360188	A 710's host bus watchdog timer expired. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the PCB copy of the 710 TEMP register. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.
03370108	A 710 detected an illegal script instruction. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the PCB copy of the 710 TEMP register. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.

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Table C–35 (Cont.) Device Services Last Failure Codes

Code	Description
03380188	A 710's DSTAT register contains multiple asserted bits, or an invalidly asserted bit, or both. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the PCB copy of the 710 TEMP register. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.
03390108	An unknown interrupt code was found in a 710's DSPS register. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the PCB copy of the 710 TEMP register. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.
033C0101	An invalid code was seen by the error recovery thread in the er_funct_step field of the PCB. Last Failure Parameter[0] contains the PCB er_funct_step code.

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Table C–35 (Cont.) Device Services Last Failure Codes

Code	Description
033E0108	An attempt was made to restart a 710 at the SDP DBD. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the PCB copy of the 710 TEMP register. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.
033F0108	An EDC error was detected on a read of a soft-sectored device - path not yet implemented. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the PCB copy of the 710 TEMP register. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.
03410101	Invalid SCSI device type in PUB. Last Failure Parameter[0] contains the PUB SCSI device type.

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Table C–35 (Cont.) Device Services Last Failure Codes

Code	Description
03420188	A UDC interrupt could not be associated with either a DWD or the non-callable scripts. • Last Failure Parameter[0] contains the PCB reg710_ptr value. • Last Failure Parameter[1] contains the PCB copy of the 710 TEMP register. • Last Failure Parameter[2] contains the PCB copy of the 710 DBC register. • Last Failure Parameter[3] contains the PCB copy of the 710 DNAD register. • Last Failure Parameter[4] contains the PCB copy of the 710 DSP register. • Last Failure Parameter[5] contains the PCB copy of the 710 DSPS register. • Last Failure Parameter[6] contains the PCB copies of the 710 SSTAT2/SSTAT1/SSTAT0/DSTAT registers. • Last Failure Parameter[7] contains the PCB copies of the 710 LCRC/RESERVED/ISTAT/DFIFO registers.
03470100	Insufficient memory available for static structure allocation.
03480100	Insufficient memory available for static structure allocation.
03490100	DWDs exhausted.
034A2080	Diagnostics report all NCR710s are broken.

Table C–36 Fault Manager Last Failure Codes

Code	Description
04010101	The requestor ID component of the instance code passed to FM$REPORT_EVENT is larger than the maximum allowed for this environment. Last Failure Parameter[0] contains the instance code value.
04020102	The requestor's error table index passed to FM$REPORT_EVENT is larger than the maximum allowed for this requestor. • Last Failure Parameter[0] contains the instance code value. • Last Failure Parameter[1] contains the requester error table index value.
04030102	The USB index supplied in the EIP is larger than the maximum number of USBs. • Last Failure Parameter[0] contains the instance code value. • Last Failure Parameter[1] contains the USB index value.
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 eip. • Last Failure Parameter[0] contains the instance code value. • Last Failure Parameter[1] contains the format code value. • Last Failure Parameter[2] contains the requester error table index value.
04050100	The Fault Manager could not allocate memory for its Event Information Packet (EIP) buffers.
04060100	The Fault Manager could not allocate a Datagram HTB in its initialization routine.
04070103	There is more EIP information than will fit into a datagram. The requestor specific size is probably too large. • Last Failure Parameter[0] contains the instance code value. • Last Failure Parameter[1] contains the format code value. • Last Failure Parameter[2] contains the requester error table index value.
04080102	The event log format found in the already-built EIP is not supported by the Fault Manager. The bad format was discovered while trying to copy the EIP information into a datagram HTB. • Last Failure Parameter[0] contains the format code value. • Last Failure Parameter[1] contains the instance code value.
04090100	The caller of FM$CANCEL_EVENT_NOTIFICATION passed an address of an event notification routine that does not match the address of any routines for which event notification is enabled.

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Table C–36 (Cont.) Fault Manager Last Failure Codes

Code	Description
040D0100	FM$ENABLE_EVENT_NOTIFICATION was called to enable EIP notification but the specified routine was already enabled to receive EIP notification.
040F0102	The eip->generic.mscp1.flgs field of the EIP passed to FM$REPORT_ EVENT contains an invalid flag. • Last Failure Parameter[0] contains the instance code value. • Last Failure Parameter[1] contains the value supplied in the eip- >generic.mscp1.flgs field.

Table C–37 Dual Universal Asynchronous Receiver/Transmitter Services Last Failure Codes

Code	Description
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.

Table C–38 Failover Control Last Failure Codes

Code	Description
07010100	All available slots in the FOC notify table are filled.
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.

Table C–39 Nonvolatile Parameter Memory Failover Control Last Failure Codes

Code	Description
08010101	A remote state change was received from the FOC thread that NVFOC does not recognize. 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. 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. Last Failure Parameter[0] contains the unknown work value
08050100	An unlock was received and the controller was not locked by the other controller.
08060100	A read 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.
080E0101	An out-of-range receiver ID was received by the NVFOC communication utility (master send to slave send ACK). 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). 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. Last Failure Parameter[0] contains the bad ID value.
08110101	NVFOC tried to defer more than one FOC send. Last Failure Parameter[0] contains the master ID of the connection that had the multiple delays.
08120100	Unable to lock other controller's NVmemory despite the fact that the running and handshake_complete flags are set.
08130100	Could not allocate memory to build a callback context block on an unlock NVmemory call.
08140100	Could not allocate memory to build a workblock to queue to the NVFOC thread.
08150100	A lock was requested by the other controller but the memory is already locked by the other controller.
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.

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Table C–39 (Cont.) Nonvolatile Parameter Memory Failover Control Last Failure Codes

Code	Description
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 Last Failure Parameter[0] contains the ID type value that was received on the NVFOC remote work queue.

Table C–40 Command Line Interpreter Last Failure Codes

Code	Description
20010100	The action for work on the CLI queue should be CLI_CONNECT, CLI_COMMAND_IN or CLI_PROMPT. If it is not one of these three, this bugcheck will result.
20020100	The FAO returned a non-successful response. 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 was not of type CLI.
20070100	A work item of an unknown type was placed on the CLI's DUP Virtual Terminal thread work queue by the CLI.
20080000	This controller requested this controller to restart.
20090010	This controller requested this controller to shut down.
200A0000	This controller requested this controller to self-test.
200B0100	Could not get enough memory for FCBs to receive information from the other controller.
200C0100	After a CLI command the NV memory was still locked. The CLI should always unlock NV memory when the command is complete (if it had an error or not).
200D0101	After many calls to DS$PORT_BLOCKED, we never got a FALSE status back (which signals that nothing is blocked). Last Failure Parameter[0] contains the port number (1–n) that we were waiting on to be unblocked.

Table C–41 Host Interconnect Services Last Failure Codes

Code	Description
40000101	An unrecognized CI opcode was received by HIS. These packets are packets with CI opcodes recognized by the port but not by HIS. Last Failure Parameter[0] contains the CI opcode value.
40150100	LOCAL VC Timer in unexpected state.
40280100	Failed to allocate Buffer Name Table.
40290100	Failed to allocate ACB.
402A0100	Failed to allocate ID member template.
402B0100	Failed to allocate DG HTBs.
402C0100	Failed to allocate message HTBs.
402D0101	S_max_node greater than MAX_VC_ENTRIES. Last Failure Parameter[0] contains the S_ci_max_nodes value.
402E0101	S_max_node not set to valid value (8, 16, 32, 64, 128, 256). Last Failure Parameter[0] contains the S_ci_max_nodes value.
402F0100	Failure to allocate a HIS EIP structure
40300100	Failure in memory allocation
40510100	htb_id type not DG, when attempting to deallocate DG HTB.
40520100	htb_id type not RCV_SND, when attempting to dealloc recv queue HTB.
40530100	htb_id type not RCV_SND, when attempting to dealloc SCS queue HTB.
40560100	Failed to find a virtual circuit entry for CCB during his_close_connection routine.
407B0100	SCS command timeout unexpectedly inactive during SCS Accept Request.
407C0100	SCS command timeout unexpectedly inactive during SCS Reject Request.
408E0100	Message receive queue count disagrees with # HTBs on the queue.
408F0100	Unrecognized HTB ID type.
40900100	htb_id type not DG, when attempting to xmit DG HTB.
40930100	Message receive queue count disagrees with # HTBs on the queue.
40950100	Create transfer request with 0-byte count
40960100	Create transfer request with 0-byte count
40970100	Create transfer request with 0-byte count
40980100	Create transfer request with 0-byte count
409C0100	Illegal return value from HIS$MAP.
409D0100	Illegal return value from HIS$MAP.
40B40101	Invalid value in max_nodes field of se_params structure. Last Failure Parameter[0] contains the max_nodes field value.

Table C–42 Host Interconnect Port Services Last Failure Codes

Code	Description
42000100	Cmpl_main routine found invalid port transmit status.
42020100	Cannot start timer.
42030100	Cannot restart work timer.
42060100	HP_INIT could not allocate initial buffers
420B0100	HP_INIT could not allocate initial bufs for path a dl_ctl table
42332080	Receive_main found destination address in the rcv packet does not match node address.
42340100	HP could not allocate buffers for I/O rundown in VC Close.
42382080	Ci_isr found that the YACI hardware had invalid transmit status on Path A, no bits set.
42392080	Ci_isr found that the YACI hardware had invalid transmit status on Path B, no bits set.
423A2080	CI_ISR found the abort bit set with out any valid reason; Path A.
423B2080	CI_ISR found transmit parity error without abort bit set; Path A.
423C2080	CI_ISR found buffer underflow without abort bit set; Path A.
423D2080	CI_ISR found the abort bit set with out any valid reason; Path B.
423E2080	CI_ISR found transmit parity error without abort bit set; Path B.
423F2080	CI_ISR found buffer underflow without abort bit set; Path B.
42442080	Ci_isr found that yaci hardware had a parity error.
42452080	Ci_isr found that yaci hardware had a bus timeout error.
42472080	Ci_isr found Data parity on Transmit Path A.
42482080	Ci_isr found Data parity on Transmit Path B.
424B0001	Ci_isr found Host Reset on Path A. Last Failure Parameter[0] contains the node number of the resetting node.
424C0001	Ci_isr found Host Reset on Path B. Last Failure Parameter[0] contains the node number of the resetting node.
424D2080	Ci_isr found Fetch parity on Transmit Path A.
424E2080	Ci_isr found Fetch parity on Transmit Path B.

Table C–43 Disk and Tape MSCP Server Last Failure Codes

Code	Description
60000100	Invalid return value from routine HIS$PREPARE_MSG_XMIT, processing write command.
60010100	Invalid return value from routine HIS$PREPARE_MSG_XMIT, processing read command.
60030100	Invalid return value from routine HIS$XMIT_APPL_MSG, processing completed non-automatic end message.
60040100	Invalid return value from routine HIS$XFER_BLOCK_DATA, processing return of Write History Log to host buffers.
60050100	Invalid return value from routine HIS$CONNECT, while DCD attempting to establish connection to a remote subsystem.
60060100	Invalid return value from routine HIS$XMIT_APPL_MSG, while dmscp_dcd_send_cmd attempting to send a command to a remote subsystem.
60070100	Invalid return value from routine HIS$MAP, while dmscp_dcd_allocate_bh attempting to map a buffer.
60080100	Invalid return value from routine HIS$XMIT_APPL_MSG, while dmscp_dcd_src_gcs_send attempting to send a GCS command to a remote subsystem.
60090100	Invalid return value from routine HIS$DISCONNECT, while dmscp_dcd_comm_path_event attempting to disconnect a remote source connection.
600B0100	Invalid return value from routine HIS$PREPARE_MSG_XMIT, processing TMSCP Write, Read or Compare Host Data command.
600C0100	Invalid return value from routine RESMGR$ALLOCATE_DATA_SEGMENT.
600D0100	Opcode field in command being aborted is not valid.
600E0100	Opcode of command to be initiated is invalid.
600F0100	Opcode of command to be initiated is invalid.
60100100	Opcode field in non-sequential command being inititated is invalid.
60110100	Opcode of command to be initiated is invalid.
60120100	Opcode of TMSCP command to be aborted is invalid.
60130100	tmscp_clear_cdl_cmpl_rtn detected an unexpected opcode.
60140100	tmscp_clear_cdl_cmpl_rtn detected an unexpected opcode.
60150100	VA$CHANGE_STATE failed to change the SW Write protect when requested to do so as part of the Disk Set Unit Characteristics command.
60160100	VA$CHANGE_STATE failed to change the SW Write protect when requested to do so as part of the Tape Set Unit Characteristics command.
60170100	Invalid type in entry of long interval work queue.
60180100	mscp_short_interval found an Invalid type in entry of long interval work queue.
60190100	dmscp_dcd_send_cmd found that the SIWI Work Item code supplied is unrecognized or invalid in this context during DCD inhibited processing.
601A0100	dmscp_dcd_send_cmd found that the SIWI Work Item code supplied is unrecognized or invalid in this context during HIS$XMIT_APPL_MSG failure processing.
601B0100	Invalid EVENT_CODE parameter in call to dmscp_connection_event.

(continued on next page)

Table C–43 (Cont.) Disk and Tape MSCP Server Last Failure Codes

Code	Description
601C0100	Invalid EVENT_CODE parameter in call to tmscp_connection_event.
601D0100	Invalid EVENT_CODE parameter in call to dmscp_dcd_comm_path_event.
601E0100	Invalid EVENT_CODE parameter in call to dmscp_dcd_comm_path_event.
601F0100	Invalid EVENT_CODE parameter in call to mscp_do_disconnect.
60250100	An attempt was about to be made to return a progress indicator to the host that was 0xFFFFFFFF, the only invalid value.
60260100	An WH_DAF command was requested to be performed by the wrong process.
60270100	A non-immediate WHM operation was passed to the dmscp_exec_whm_ immediate routine.
60280100	This routine found an invalid xfer_state so cannot continue.
60290100	HIS did not allocate an HTB when there should have been one reserved for this connection as determined by mscp_rcv_listen.
602A0100	HIS did not allocate an HTB when there should have been one reserved for this connection as determined by dmscp_dcd_src_gcs_send.
602B0100	HIS did not allocate an HTB when there should have been one reserved for this connection as determined by dmscp_dcd_comm_path_event.
602C0100	When trying to put THE extra send-HTB on the connections send_htb_list there was already one on the queue.
602D0100	The VA$CHANGE_STATE service did not set the Software write protect as requested (for disk).
602E0100	The VA$CHANGE_STATE service did not set the Software write protect as requested (for tape).
603B0100	Initial HIS$LISTEN call for MSCP$DISK was unsuccessful.
603C0100	Initial HIS$LISTEN call for MSCP$TAPE was unsuccessful.
603F0100	dmscp_dcd_send_cmd received a command on an idle remote source connection that is no longer valid.
60400100	Unrecognized or invalid in this context return value from routine RESMGR$ALLOCATE_DATA_SEGMENT, while dmscp_dcd_allocate_ dseg attempting to allocate a data segment.
60410100	Unrecognized or invalid in this context return value from routine RESMGR$ALLOCATE_DATA_BUFFERS, while dmscp_dcd_allocate_ dbuf attempting to allocate a data buffer.
60420100	dmscp_dcd_rmte_end_msg was unable to find a command message that corresponds to end message it is currently processing.
60430100	dmscp_dcd_src_gcs_send was entered even though remote connection lost is indicated. This condition should not occur because the command timer is deactivated when a connection is lost (and the server is running at the same priority as HIS and cannot invalidate a connection).
60440100	dmscp_dcd_src_gcs_cmpl found the command being GCSed is no longer at the head of the remote connection's queue.
60450100	dmscp_dcd_errlog_rvc found that an error log is not associated with a command, internal miscellaneous error logs are assumed to not be associated with a connection and remote miscellaneous error logs generation was not requested.

(continued on next page)

Table C–43 (Cont.) Disk and Tape MSCP Server Last Failure Codes

Code	Description
60460100	dmscp_dcd_elrt_scc_send was entered to issue a remote source connection SCC but was unable to find an available HTB on the connection's htb_list. With no active DCDs the connection should always have HTBs available.
60480100	tmscp_suc_avl_cmpl_rtn found the unit not in the available state.
60490100	tmscp_clear_cdl_cmpl_rtn found the state change failed.
604A0100	tmscp_clear_cdl_cmpl_rtn found the state change failed.
604B0100	Subroutine process_event returned a value to dmscp_dcd_comm_path_event that indicates that an internal disconnect request occurred while processing an immediate communications event.
604D0100	Subroutine process_event returned a value to dmscp_dcd_comm_path_event that indicates that a connection established event occurred while no DCD commands were active.
604F0100	tmscp_set_cmpl_rtn found the state change failed.
60500100	dmscp_dcd_op_cmpl found an unrecognized P_STS value in a DCD HTB status field.
60550100	mscp_initialize unable to get LOCAL STATIC memory from exec for use as a local connection ITB.
60560100	mscp_initialize unable to get LOCAL STATIC memory from exec for use as an AVAILABLE ITB.
60570100	mscp_initialize unable to get LOCAL STATIC memory from exec for use as an AVAILABLE state change ITB.
60580100	mscp_initialize unable to get LOCAL STATIC memory from exec for use as a state change ITB.
605D0100	tmscp_onl_cleanup_rtn detected a failure in enabling variable speed mode suppression.
605E0100	tmscp_suc_cmpl_rtn detected a failure in enabling variable speed mode suppression.
605F0100	tmscp_suc_cmpl_rtn detected a failure in enabling variable speed mode suppression.
60610100	mscp_initialize unable to get BUFFER STATIC memory from exec for use as Write History Logs.
60620100	mscp_initialize unable to get LOCAL STATIC memory from exec for use as Write History Log Allocation Failure Lists.
60640100	Invalid condition when there exists no unused Write History Log Entries.
60650100	Attempting to block incoming requests for the tape/loader when it was unexpectedly found already blocked.
60660100	Loader boundary block request to stall incoming requests to the tape/loader unit was not setup as expected.
60670100	Invalid return value from routine HIS$XMIT_APPL_MSG.
60680100	VA$ENABLE_NOTIFICATION failed with insufficient resources at init time.
606B0100	mscp_foc_receive_cmd detected that the message sent from the other controller had an illegal usb index.
606C0100	mscp_foc_receive_cmd detected that the message sent from the other controller had an illegal exclusive access state.

(continued on next page)

Table C–43 (Cont.) Disk and Tape MSCP Server Last Failure Codes

Code	Description
606D0100	FOC provided mscp_foc_send_cmpl_rtn with an invalid status for the FOC$SEND transmit command completion.
606E0100	FOC provided mscp_foc_send_rsp_done with an invalid transmit status for the FOC$SEND transmit response completion.

Table C–44 Diagnostics and Utilities Protocol Server Last Failure Codes

Code	Description
61020100	HIS$LISTEN call failed with INSUFFICIENT_RESOURCES.
61090100	LISTEN_CONNECTION_ESTABLISHED event from HIS specified a connection ID for a connection we already know about.
610C0100	HIS has reported a connection event that should not be possible.

Table C–45 System Communication Services Directory Service Last Failure Codes

Code	Description
62000100	HIS$LISTEN call failed with INSUFFICIENT_RESOURCES.
62010100	Failure to allocate associated work queue.
62020100	Failure to allocate associated timer queue.
62030100	Failure to allocate connection ID timers.

Table C–46 Disk Inline Exerciser (DILX) Last Failure Codes

Code	Description
80010100	An HTB was not available to issue an IO when it should have been.
80020100	A unit could not be dropped from testing because an available command failed.
80030100	DILX tried to release a facility that was not 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 commands via va$d_abort( ) but the HTBs have not been returned.
80080100	While DILX was deallocating HIS EIP buffers, at least one could not be found.
80090100	DILX received an end message that corresponds to an opcode not supported by DILX.

(continued on next page)

Table C–46 (Cont.) Disk Inline Exerciser (DILX) Last Failure Codes

Code	Description
800A0100	DILX was was not able to restart HIS timer.
800B0100	DILX tried to issue an IO for an opcode that is not supported.
800C0100	DILX tried to issue a oneshot IO for an opcode that is not supported.
800D0100	A DILX device control block contains an unsupported unit_state.
800E0100	While trying to print an Event Information Packet, DILX discovered an unsupported MSCP error log format.
80100100	DILX could not compare buffers because no memory was available from EXEC$ALLOCATE_MEM_ZEROED.
80120100	DILX expected an EIP to be on the receive EIP question but no EIPs were there.
80130100	DILX was asked to fill a data buffer with an unsupported data pattern.
80140100	DILX could not process an unsupported answer in dx$reuse_params( ).

Table C–47 Tape Inline Exerciser (TILX) Last Failure Codes

Code	Description
81010100	An HTB was not available to issue an IO when it should have been
81020100	A unit could not be dropped from testing because an available command failed
81030100	TILX tried to release a facility that was not reserved by TILX
81040100	TILX tried to change the unit state from MAINTENANCE_MODE to NORMAL but was rejected because of insufficient resources
81050100	TILX tried to change the USB unit state from MAINTENANCE_MODE to NORMAL but TILX never received notification of a successful state change
81060100	TILX tried to switch the unit state from MAINTENANCE_MODE to NORMAL but was not successful
81070100	TILX aborted all commands via va$d_abort( ) but the htbs have not been returned
81080100	While TILX was deallocating HIS EIP buffers, at least one could not be found
81090100	TILX received an end message that corresponds to an opcode not supported by TILX
810A0100	TILX was was not able to restart HIS timer
810B0100	TILX tried to issue an IO for an opcode that is not supported.
810C0100	TILX tried to issue a oneshot IO for an opcode that is not supported.
810D0100	A TILX device control block contains an unsupported unit_state.
810E0100	TILX received an unsupported Value Added status in a Value Added completion message.
810F0100	TILX found an unsupported device control block substate while trying to build a command for the Basic Function test.
81100100	TILX found an unsupported device control block substate while trying to build a command for the Read-Only test.

(continued on next page)

Table C–47 (Cont.) Tape Inline Exerciser (TILX) Last Failure Codes

Code	Description
81110100	TILX found an unsupported device control block substate while trying to build a command for the User-Defined test.
81120100	TILX received an EOT encountered while in a substate where EOT encountered should not occur.
81130100	TILX calculated an illegal position type value while trying to generate a command for the position intensive phase of the Basic Function test.
81140100	While trying to display an EIP, TILX discovered an unsupported MSCP error log format.
811A0100	TILX expected a deferred error to be on the receive deferred error question but no deferred errors were there.
811B0100	TILX was asked to fill a data buffer with an unsupported data pattern.
811C0100	TILX could not process an unsupported answer in tx$reuse_params( ).

Table C–48 Automatic Device Configuration Program (CONFIG) Last Failure Codes

Code	Description
83010100	The CLI prompt was not returned to the Auto-Config virtual terminal code within a reasonable amount of time.
83020100	An unsupported message type or terminal request was received by the Auto-Config virtual terminal code from the CLI.
83030100	Not all alter_device requests completed within the timeout interval.

Table C–49 Controller Restart Codes

Code	Description
0	Full restart
1	No restart

C.4 Event Notification/Recovery Threshold

An Event Notification/Recovery Threshold value is assigned to each significant event that can be reported by an HSJ30/40 controller. The Event Notification/Recovery Threshold values and their meanings are shown in Table C–50.

Table C–50 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 a controller firmware component (such as protocol violations, host buffer access errors, internal inconsistencies, and so forth) is indicated.
64	INFORMATIONAL	An event having little or no effect on proper controller or device operation is indicated.

With the exception of events reported via the Disk Copy Data Correlation Event Log, the Event Notification/Recovery Threshold value assigned to a particular event is supplied in the NR Threshold subfield of the “instance code” field of the event log used to report the event. See Section C.2 for “instance code” field details.

Disk Copy Data Correlation Event Log Conditions

The Event Notification/Recovery Threshold Classification assigned to the following conditions reported via a Disk Copy Data Correlation Event Log is SOFT (see Table C–50):

- Subcommand Error (subcode “Destination—Command Timed Out”)
- Subcommand Error (subcode “Source—Command Timed Out”)
- Subcommand Error (subcode “Destination—Inconsistent State”), cases A, B, C, D, E, and F.
- Controller Error (subcode “Local Connection Request Failed, Insufficient Resources to Request Local Connection”)
- Controller Error (subcode “Remote Connection Request Failed, Insufficient Resources to Request Local Connection”)

All other conditions that can be reported via the Disk Copy Data Correlation Event Log are not assigned a specific Event Notification/Recovery Threshold Classification because they can be correlated with the associated condition specific event log.

C.5 Recommended Repair Action

A Recommended Repair Action code is assigned to each significant event that can be reported by an HSJ30/40 controller. The Recommended Repair Action codes and their meanings are shown in Table C–51.

Table C–51 Recommended Repair Action Codes

Code	Description
00	No action necessary.
01	An unrecoverable hardware detected fault occurred or an unrecoverable firmware inconsistency was detected, proceed with HSJ30/40 controller support avenues. Contact Digital Multivendor Services.
02	Inconsistent/erroneous information received from the operating system, proceed with operating system software support avenues. Contact Digital Multivendor Services.
03	Follow the recommended repair action contained in the “last failure code” field.
04	Two possible problem sources are indicated: • In the case of a shelf with dual power supplies, one of the power supplies has failed. Follow repair action 07 for the power supply with the power LED out. • One of the shelf blowers has failed. Follow repair action 06.
05	Four possible problem sources are indicated: • Total power supply failure on a shelf. Follow repair action 09. • A device inserted into a shelf that has a broken internal SBB connector. Follow repair action 0A. • A standalone device is connected to the HSJ30/40 controller with an incorrect cable. Follow repair action 08. • A HSJ30/40 controller hardware failure. Follow repair action 20.
06	Determine which blower has failed and replace it. Refer to Chapter 7 for the blower removal procedure.
07	Replace power supply. Refer to Chapter 7 for the power supply removal procedure.
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. Refer to Chapter 7.
0B	The other HSJ30/40 controller in a dual-redundant configuration has been reset with the “Kill” line by the HSJ30/40 controller that reported the event. To restart the “Killed” HSJ30/40 controller, enter the CLI RESTART OTHER command on the “Surviving” HSJ30/40 controller and then press the (//) RESET button on the “Killed” HSJ30/40 controller. If the other HSJ30/40 controller is repeatedly being “Killed” for the same or a similar reason, follow repair action 20.

(continued on next page)

Table C–51 (Cont.) Recommended Repair Action Codes

Code	Description
0C	Both HSJ30/40 controllers in a dual-redundant configuration are attempting to use the same SCSI ID (either 6 or 7 as indicated in the event report). Note that the other HSJ30/40 controller of the dual-redundant pair has been reset with the "Kill" line by the HSJ30/40 controller that reported the event. Two possible problem sources are indicated: • A HSJ30/40 controller hardware failure. • A controller backplane failure. Follow repair action 20 for the "Killed" HSJ30/40 controller. If the problem persists, then follow repair action 20 for the "Surviving" HSJ30/40 controller. If the problem still persists, then replace the controller backplane.
20	Replace HSJ30/40 controller module. Refer to Chapter 7 for proper replacement procedure.
22	Replace indicated HSJ30/40 cache module.
40	If the Sense Data FRU field is non-zero, follow repair action 41. Otherwise, replace the appropriate FRU associated with the device's SCSI interface or the entire device.
41	Consult the device's 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. If the problem persists, replace the controller backplane, drive backplane, or controller module.
45	Interpreting the device supplied Sense Data is beyond the scope of the HSJ30/40 controller firmware. Refer to the device documentation to determine the appropriate repair action, if any.
60	Swap the transmit and receive cables for the indicated path.
61	Check indicated path cables for proper installation.
63	Check the CI adapter on the host system identified in the "remote node name" field for proper operation.

Recommended Repair Action codes apply to each reportable event (except those reported via the Disk Copy Data Correlation Event Log) as identified by the value contained in the Repair Action subfield of the "instance code" field of the event logs described in Section C.2.

For events reported via the Last Failure Event Log the Recommended Repair Action code is contained in the Repair Action subfield of the "last failure code" field of that event log.

Disk Copy Data Correlation Event Log Conditions

The Recommended Repair Action Code assigned to the following conditions reported via a Disk Copy Data Correlation Event Log is 01 (see Table C–51):

- Subcommand Error (subcode "Destination—Command Timed Out")
- Subcommand Error (subcode "Source—Command Timed Out")
- Subcommand Error (subcode "Destination—Inconsistent State"), cases C, D, E, and F.
- Controller Error (subcode "Local Connection Request Failed, Insufficient Resources to Request Local Connection")

- Controller Error (subcode “Remote Connection Request Failed, Insufficient Resources to Request Local Connection”)

The Recommended Repair Action Code assigned to the following condition reported via a Disk Copy Data Correlation Event Log is 02 (see Table C–51):

- Subcommand Error (subcode “Source—Inconsistent State”), cases A and B.

All other conditions that can be reported via the Disk Copy Data Correlation Event Log are not assigned a specific Recommended Repair Action Code because they can be correlated with the associated condition specific event log.

C.6 Deskew Command Procedure

Example C–2 presents a command procedure to deskew the “CONTROLLER DEPENDENT INFORMATION” for a “CONTROLLER LOG” type error log.

Example C–2 Deskew Command Procedure Example

```
$! P1 = Input file name
$! P2 = Output file name
$ on warning then $exit
$ inew_entry = " ******************************* ENTRY"
$ ctrl_entry = "                                       CONTROLLER LOG"
$ lw_entry = "       LONGWORD"
$ ctrl_inp = "FALSE"
$ lw_string = ""
$ open/read inf ’p1’
$ open/write ouf ’p2’
$in_loop:
$ read/end=in_done inf inr
$ inrlen = f$length(inr)
$ if f$locate(new_entry,inr) .ne. inrlen
$ then
$  write sys$output inr
$  if ctrl_inp
$  then
$   gosub convert_longs
$   ctrl_inp = "FALSE"
$  endif
$ else
$  if f$locate(ctrl_entry,inr) .ne. inrlen
$  then
$   write sys$output inr
$   ctrl_inp = "TRUE"
$   lw_string = ""
$  endif
$  if f$locate(lw_entry,inr) .ne. inrlen .and. ctrl_inp
$  then
$   lw = f$element(2," ",f$edit(inr,"TRIM,COMPRESS"))
$   if lw_string .eqs. ""
$   then
$    lw_string = f$extract(0,4,lw)
$   else
$    lw_string = lw + lw_string
$   endif
$  endif
$ endif
$ write ouf inr
$ goto in_loop
$in_done:
$ close inf
$  if ctrl_inp
$  then
$   gosub convert_longs
$  endif
$ close ouf
$ exit
$convert_longs:
$ index = 1
$ write ouf "<FF>"
$ write ouf ""
```

(continued on next page)

Example C–2 (Cont.) Deskew Command Procedure Example

```
$ write ouf ""
$ write ouf ""
$ write ouf "LONGWORD DESKEW:"
$ write ouf ""
$ write ouf ""
$convert_longs_loop:
$ len = f$length(lw_string)
$ if len .le. 4 then goto convert_longs_done
$ lw = f$extract(len - 8,8,lw_string)
$ write ouf " LONGWORD[''index'] = ",lw
$ lw_string = f$extract(0,len - 8, lw_string)
$ index = index + 1
$ goto convert_longs_loop
$convert_longs_done:
$ write ouf "<FF>"
$ return
```

Example C–3 shows an ERF error log before running the command procedure.

Example C–3 ERF Error Log Before Command Procedure

```
V A X / V M S       SYSTEM ERROR REPORT        COMPILED 16-MAR-1993 12:30:07
                                                                PAGE 144.

******************************* ENTRY      11. *******************************
ERROR SEQUENCE 2820.                                LOGGED ON:       SID 05903914
DATE/TIME 16-MAR-1993 11:35:45.39                             SYS_TYPE 00000000
SYSTEM UPTIME: 2 DAYS 22:48:03
SCS NODE: CNOTE                                                VAX/VMS V5.5-2

ERL$LOGMESSAGE ENTRY  KA825  HW REV# B  PATCH REV# 28.  UCODE REV# 20.
                      BI NODE # 2.

I/O SUB-SYSTEM, UNIT _HSJ402$DUA20:

      MESSAGE TYPE        0001
                                      DISK MSCP MESSAGE
      MSLG$L_CMD_REF  5B54001E
      MSLG$W_SEQ_NUM      0039
                                      SEQUENCE #57.
      MSLG$B_FORMAT         00
                                      CONTROLLER LOG
      MSLG$B_FLAGS          00
                                      UNRECOVERABLE ERROR
      MSLG$W_EVENT        01CA
                                      CONTROLLER ERROR
                                      POLICY PROCESS ERROR
      MSLG$Q_CNT_ID   00000021
                      01280001
                                      UNIQUE IDENTIFIER, 000100000021(X)
                                      MASS STORAGE CONTROLLER
                                      MODEL = 40.
      MSLG$B_CNT_SVR        FF
                                      CONTROLLER SOFTWARE VERSION #255.
      MSLG$B_CNT_HVR        00
                                      CONTROLLER HARDWARE REVISION #0.

CONTROLLER DEPENDENT INFORMATION

      LONGWORD 1.     01010000
                                      /..../
      LONGWORD 2.     044103CF
                                      /Ï.A./
      LONGWORD 3.     00000000
                                      /..../
      LONGWORD 4.     00470000
                                      /..G./
      LONGWORD 5.     00000000
                                      /..../
      LONGWORD 6.     00020000
                                      /..../
      LONGWORD 7.     00000000
                                      /..../
```

Example C–4 shows the same ERF error log after running the command procedure (notice the deskewed longwords).

Example C–4 ERF Error Log After Command Procedure

```
 V A X / V M S       SYSTEM ERROR REPORT        COMPILED 16-MAR-1993 12:30:07
                                                                    PAGE 144.

 ******************************* ENTRY     11. *******************************
 ERROR SEQUENCE 2820.                            LOGGED ON:        SID 05903914
 DATE/TIME 16-MAR-1993 11:35:45.39                            SYS_TYPE 00000000
 SYSTEM UPTIME: 2 DAYS 22:48:03
 SCS NODE: CNOTE                                               VAX/VMS V5.5-2

 ERL$LOGMESSAGE ENTRY  KA825  HW REV# B  PATCH REV# 28.  UCODE REV# 20.
                       BI NODE # 2.

 I/O SUB-SYSTEM, UNIT _HSJ402$DUA20:

       MESSAGE TYPE        0001
                                       DISK MSCP MESSAGE
       MSLG$L_CMD_REF  5B54001E
       MSLG$W_SEQ_NUM      0039
                                       SEQUENCE #57.
       MSLG$B_FORMAT         00
                                       CONTROLLER LOG
       MSLG$B_FLAGS          00
                                       UNRECOVERABLE ERROR
       MSLG$W_EVENT        01CA
                                       CONTROLLER ERROR
                                       POLICY PROCESS ERROR
       MSLG$Q_CNT_ID   00000021
                       01280001
                                       UNIQUE IDENTIFIER, 000100000021(X)
                                       MASS STORAGE CONTROLLER
                                       MODEL = 40.
       MSLG$B_CNT_SVR        FF
                                       CONTROLLER SOFTWARE VERSION #255.
       MSLG$B_CNT_HVR        00
                                       CONTROLLER HARDWARE REVISION #0.

 CONTROLLER DEPENDENT INFORMATION

       LONGWORD 1.     01010000
                                       /..../
       LONGWORD 2.     044103CF
                                       /Ï.A./
       LONGWORD 3.     00000000
                                       /..../
       LONGWORD 4.     00470000
                                       /..G./
       LONGWORD 5.     00000000
                                       /..../
       LONGWORD 6.     00020000
                                       /..../
       LONGWORD 7.     00000000
                                       /..../
LONGWORD DESKEW:
```

(continued on next page)

Example C–4 (Cont.) ERF Error Log After Command Procedure

```
LONGWORD[1] = 03CF0101
LONGWORD[2] = 00000441
LONGWORD[3] = 00000000
LONGWORD[4] = 00000047
LONGWORD[5] = 00000000
LONGWORD[6] = 00000002
```

D

HSD-Series Error Logging

This appendix details errors the HSD-series controller will report in its host error logs under the OpenVMS operating system, as well as how to extract the information from the logs.

Note

Host error log translations are correct as of the date of publication of this manual. However, log information may change with firmware updates. Refer to your *StorageWorks Array Controller Operating Firmware Release Notes* for error log information updates.

D.1 Reading an HSD-series Error Log

You can interpret an HSD-series error log the same way as an HSJ-series error log (Appendix C), with the following exeptions:

- Template type 31 does not exist for HSD-series error logs.
- Template types 32 and 33 have changed as shown in Table D–1.

Table D–1 Template Types

Description	Template	Longword	Value	Deskewed Value
DSSI Port/Port Driver Event Log	32†	2	10**32**xxxx	000010**32**
DSSI System Communication Services Event Log	33†	2	2C**33**xxxx	00002C**33**

†The MSLG$B_FORMAT field for these templates will read "00 CONTROLLER LOG," so you may want to run the OpenVMS DCL command procedure provided at the end of Appendix C for deskewing the longwords.

D.2 Event Log Formats

In general, the event log formats for the HSD-series controller are identical to those for the HSJ-series. However, where the HSJ-series uses “CI” to describe the host interface, the HSD-series controller uses “DSSI”.

For example, in the following table, the terms in the first column for HSJ-series controllers translate to the terms in the second column for for HSD-series controllers. Be aware of this change in terminology as you use Appendix C to decode your error logs.

CI Host Interconnect Services Common Event Log Fields	DSSI Host Interconnect Services Common Event Log Fields
CI source node address	DSSI source node address
CI destination node address	DSSI destination node address
CI Virtual Circuit State Codes	DSSI Virtual Circuit State Codes
CI Port/Port Driver Event Log (Template 32)	DSSI Port/Port Driver Event Log (Template 32)
CI System Communication Services Event Log (Template 33)	DSSI System Communication Services Event Log (Template 33)

D.3 Event Log Codes

Tables D–2 through D–5 show some important difference in reported codes between HSJ- and HSD-series controllers. Some entries may show identical numeric codes with different description text, while other entries are in fact different (HSD-series controller only) codes and descriptions.

Be aware of these differences when decoding HSD-series controller error logs using Appendix C.

Table D–2 Host Interconnect Services Status Codes

Code	Description
00000064	The "DSSI IDREQ send without receiving a DSSI ID in response" limit has been reached on Path A; the remote node is acknowledging the packets but not responding to them.
00000065	A DSSI ID or DSSI CNF packet (transmitted by the thread on behalf of Host Interconnect Services) could not be successfully transmitted.
00010009	Virtual circuit closed due to DSSI ID request failure.
00030009	Virtual circuit closed due to DSSI START failure.
00040009	Virtual circuit closed due to DSSI STACK failure.
00070009	Virtual circuit closed due to NAK ADP retry DSSI ID transmit failure.
000A0009	Not implemented in DSSI environment.
000B0009	Virtual circuit closed due to NOR ADP retry DSSI ID transmit failure.
000E0009	Not implemented in DSSI environment.
00100009	Not implemented in DSSI environment.
00120009	Not implemented in DSSI environment.
001D0009	Virtual circuit closed due to DSSI ID complete failure.

(continued on next page)

Table D–2 (Cont.) Host Interconnect Services Status Codes

Code	Description
001F0009	Virtual circuit closed due to DSSI retry.

Table D–3 DSSI Port/Port Driver Event Log (Template 32) Instance/MSCP Event Codes

Instance Code	MSCP Event Code	Description
4007640A	006A	DSSI Port detected error upon attempting to transmit a packet. This resulted in the closure of the Virtual Circuit.

Table D–4 Host Interconnect Services Last Failure Codes

Code	Description
40000101	An unrecognized DSSI opcode was received by HIS. These packets are packets with DSSI opcodes recognized by the port but not by HIS. Last Failure Parameter[0] contains the DSSI opcode value.

Table D–5 Host Interconnect Port Services Last Failure Codes

Code	Description
420C0100	HP_INIT could not allocate initial HTB for Path A.
420D0100	HP_INIT could not allocate HPHW structure.
42350100	HP found a negative offset in a Host Data transfer operation.
42640100	Scan packet que found bad path select case for DSSI.
42680102	Dssi_err_isr routine found that 720 report status for initiator mode. Last Failure Ped an unexpected status for target mode. Last Failure Parameter[0] contains the 720 chip dstat register value. Last Failure Parameter[1] contains the 720 chip sist1 register value.
42690101	Dssi_isr routine found that the 720 script reported an invalid Receive status. Last Failure Parameter[0] contains the receive interrupt status written by the 720 chip.
426B0101	Dssi_err_isr routine found that 720 interrupted without status Last Failure Parameter[0] contains the 720 chip istat register value.
42742001	Dssi_err_isr routine found that 720 reported a bus error on the FIB internal bus. Last Failure Parameter[0] contains the 720 chip dstat register value.
42752002	Dssi_err_isr routine found that 720 reported a bus error on the FIB internal bus. Last Failure Parameter[0] contains the 720 chip dstat register value. Last Failure Parameter[1] contains the 720 chip dcmd register value.
42760102	Dssi_err_isr routine found that 720 reported an unexpected status for initiator mode. Last Failure Parameter[0] contains the 720 chip dstat register value. Last Failure Parameter[1] contains the 720 chip sist1 register value.

(continued on next page)

Table D–5 (Cont.) Host Interconnect Port Services Last Failure Codes

Code	Description
42770102	Dssi_err_isr routine found that 720 reported an unexpected status for initiator mode. Last Failure Parameter[0] contains the 720 chip dstat register value. Last Failure Parameter[1] contains the 720 chip sist1 register value.

D.4 Recommended Repair Action

Table D–6 shows a difference in description text for recommended repair actions on HSD-series controllers.

Be aware of the difference when decoding HSD-series controller error logs using Appendix C.

Table D–6 Recommended Repair Action Codes

Code	Description
63	Check the DSSI adapter on the host system identified in the "remote node name" field for proper operation.

E

HSZ-Series Error Logging

This appendix details errors the HSZ-series controller will report in its host event logs under the DEC OSF/1 AXP operating system, as well as how to extract the information from the logs.

Note

Host event log translations are correct as of the date of publication of this manual. However, log information may change with firmware updates. Refer to your *StorageWorks Array Controllers HSZ40 Array Controller Operating Firmware Release Notes* for error log information updates.

E.1 Reading an HSZ-Series Error Log

Example E–1 shows an example of a uerf translated host error log. The uerf utility under the DEC OSF/1 AXP operating system will show the target and LUN of the unit in question. Use your current configuration information to match the unit to the devices it is mapped to. Then, test and/or service the devices on a case-by-case basis.

Example E–1 was generated using the uerf -o full command on an HSZ40 controller with a KZTSA host adapter.

Example E–1 The uerf utility Error Event Log

```
******************************** ENTRY    19. ********************************

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

EVENT CLASS                            ERROR EVENT
OS EVENT TYPE                  199.    CAM SCSI
SEQUENCE NUMBER                 19.
OPERATING SYSTEM                       DEC OSF/1
OCCURRED/LOGGED ON                     Tue Mar 15 12:36:47 1994
OCCURRED ON SYSTEM                     dombek
SYSTEM ID                 x0004000F    CPU TYPE: DEC
                                       CPU SUBTYPE: KN15AA

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

CLASS                         x0000    DISK
SUBSYSTEM                     x0000    DISK
BUS #                         x000E
                              x0392    LUN x2
                                       TARGET x2

----- CAM STRING -----

ROUTINE NAME                           cdisk_check_sense

----- CAM STRING -----

ROUTINE NAME                           cdisk_check_sense

----- CAM STRING -----

                                        Hardware Error bad block number: 0

----- CAM STRING -----

ERROR TYPE                             Hard Error Detected

----- CAM STRING -----

DEVICE NAME                            DEC     HSZ40

----- CAM STRING -----

                                       Active CCB at time of error

----- CAM STRING -----

                                       CCB request completed with an error
ERROR - os_std, os_type = 11, std_type = 10

----- ENT_CCB_SCSIIO -----
```

(continued on next page)

Example E–1 (Cont.) The uerf utility Error Event Log

```
*MY ADDR                     x8A960728
CCB LENGTH                       x00C0
FUNC CODE            x01
CAM_STATUS                       x0084     CAM_REQ_CMP_ERR
                                           AUTOSNS_VALID
PATH ID              14.
TARGET ID            2.
TARGET LUN           2.
CAM FLAGS                    x00000442
                                           CAM_QUEUE_ENABLE
                                           CAM_DIR_IN
                                           CAM_SIM_QFRZDIS
*PDRV_PTR                    x8A960428
*NEXT_CCB                    x00000000
*REQ_MAP                     x8A971E00
VOID (*CAM_CBFCNP)()         x003B5520
*DATA_PTR                    x40023230
DXFER_LEN                    x00000200
*SENSE_PTR                   x8A960450
SENSE_LEN            xA0
CDB_LEN              x06
SGLIST_CNT                       x0000
CAM_SCSI_STATUS                  x0002     SCSI_STAT_CHECK_CONDITION
SENSE_RESID          x00
RESID                        x00000000
CAM_CDB_IO           x0000000000000001DA681B08
CAM_TIMEOUT                  x0000003C
MSGB_LEN                         x0000
VU_FLAGS                         x4000
TAG_ACTION           x20

----- CAM STRING -----

                                           Error, exception, or abnormal
                                            _condition

----- CAM STRING -----

                                           HARDWARE ERROR - Nonrecoverable
                                            _hardware error

----- ENT_SENSE_DATA -----
```

(continued on next page)

Example E–1 (Cont.) The uerf utility Error Event Log

```
ERROR CODE                 x0070     CODE x70
SEGMENT           x00
SENSE KEY                  x0004     HARDWARE ERR
INFO BYTE 3       x00
INFO BYTE 2       x00
INFO BYTE 1       x00
INFO BYTE 0       x00
ADDITION LEN      x98
CMD SPECIFIC 3    x00
CMD SPECIFIC 2    x00
CMD SPECIFIC 1    x00
CMD SPECIFIC 0    x00
ASC               x44
ASQ               x00
FRU               x00
SENSE SPECIFIC    x000000
ADDITIONAL SENSE
0000:   00030000  01080108  00000206  40020000       *...............@*
0010:   01510309  08002800  01DA681B  01000000       *..Q..(...h......*
0020:   00000700  20202020  58432020  33323130       *....      CX0123*
0030:   37363534  5A373845  00000000  36333400       *4567E87Z.....436*
0040:   325A5241  20202038  43282020  45442029       *ARZ28     (C) DE*
0050:   00000043  00000000  00000004  00000000       *C...............*
0060:   01080000  00000000  00000000  00000000       *................*
0070:   00000000  00000000  00000000  00000000       *................*
0080:   00000000  00000000  00000000  00000000       *................*
0090:   7E250000  00005E3C  00000000  00000000       *..%~<^..........*
```

Glossary

ac distribution

The method of distributing ac power in a cabinet.

ac power supply

A power supply designed to produce dc power from an ac input.

adapter

A device that converts the protocol and hardware interface of one bus type into that of another without changing the functionality of the bus. See *signal converter*.

American National Standards Institute

See *ANSI*.

ANSI

American National Standards Institute. An organization that develops and publishes electronic and mechanical standards.

array controller

A hardware/software device that facilitates communications between a host and one or more devices organized in an array. The HS controllers are array controllers.

BA350–Mx controller shelf

The StorageWorks controller shelf used for HS-family controller modules, cache modules, and shelf power units.

BA350–Sx SBB shelf

A StorageWorks shelf used for only power units and SBBs.

bad block

A block containing a defect that:

- Exceeds the correction capability of the subsystem error correction scheme.
- Exceeds a drive-specified error threshold. Once a block exceeds this threshold, data integrity is not guaranteed.
- Imposes too great a strain on system performance. In this case, the subsystem still assures data integrity, but the extensive error correction required for each block access causes too great a strain on system performance.

bad block replacement

See *BBR*.

battery backup unit

See BBU

BBR

Bad block replacement.

BBU

StorageWorks battery backup unit that extends power availability after the loss of primary ac power or a power supply to protect against the corruption or loss of data.

BIST

Built-in self-test. BIST is the internal self-test routine for the HS controller module microprocessor chip.

block

A stream of data transferred as a unit. Used interchangeably with the term **sector** for disk drives to represent 512 bytes (for 16- and 32-bit host architectures) or 576 bytes (for 36-bit architectures). A block is the smallest data unit addressable on a subunit. It occupies a specific physical position relative to the index and is available for reading or writing once per disk rotation. The five types of blocks follow:

1. Diagnostic block—Used for drive read or write diagnostics. The diagnostic block area is not visible to the host operating system. However, it is visible to the controller. Diagnostic block addresses are 28 bits wide and are called diagnostic block numbers (DBNs).
2. External block—Contains the format control tables. The external block area is not visible to the host operating system. However, it is visible to the controller. External block addresses are 28 bits wide and are called external block numbers (XBNs).
3. Logical block—Contains the host applications area and the Replacement Control Table. All logical blocks are visible to the host operating system. Logical block addresses are 28 bits wide and are called logical block numbers (LBNs).
4. Physical block—Contains all the blocks on a subunit. DBNs, LBNs, RBNs, and XBNs are subsets of the physical block area. Physical block addresses are 28 bits wide and are called physical block numbers (PBNs).
5. Replacement block—A reserved block used as a replacement for a bad block on a subunit. Replacement block addresses are 28 bits wide and are called replacement block numbers (RBNs).

blower

An airflow device mounted in a StorageWorks shelf.

Built-in self-test

See *BIST*.

cable distribution unit

See *CDU*.

carrier

A standard, StorageWorks shelf-compatible, plastic shell into which a device can be installed. Sometimes called SBB carrier.

CDU

Cable distribution unit. The power entry device for StorageWorks center cabinets. The unit provides the connections necessary to distribute ac power to cabinet shelves and fans.

CI bus

Digital's computer interconnect bus using two serial paths, each with a transfer rate of 70 Mb/s (8.75 MB/s).

CIRT

CI receiver/transmitter

CI20

DECSYSTEM–20 interface to the CI bus.

CI750

VAX 11/750 and VAX 11/751 interface to the CI bus.

CI780

VAX 11/780 and VAX 11/782 interface to the CI bus.

CLI

Command line interpreter for, and user interface to, the HS-family controller firmware.

cluster

A collection of processors called nodes, attached to each other by a high-speed bus. These processors are independent and survivable. They may be general-purpose computers or special-purpose servers, such as the HS controller, providing a special set of services to the rest of the nodes.

command line interpreter

See *CLI*.

cold swap

A method of device replacement that requires that power be removed from all shelves in a cabinet. This method is used when conditions preclude the use of the warm swap or hot swap methods.

container

Either a single disk device, or group of disk devices linked as a storage set.

controller

A hardware/software device that facilitates communications between a host and one or more devices.

controller shelf

A StorageWorks shelf designed to contain controller and cache memory modules.

CRC

A checkword (polynomial checksum) generally appended to a disk data transfer. CRC is computed using data message bits as coefficients divided by a generating polynomial. The resulting remainder is the CRC. When a transmitter computes and transmits a CRC following a data transfer, the receiver can recompute and compare it with the received version to verify correct reception. EDC and ECC (both used by disks) are examples of CRC checkwords.

cyclic redundancy check

See *CRC*.

DAEMON

Diagnostic And Execution MONitor. DAEMON is a part of HS controller self-testing that includes port and cache initialization and self-test routines.

DAT

Digital Audio Tape. A format for recording digital data on a cartridge tape.

data center cabinet

A generic reference to the large cabinets, such as the SW800 series, in which StorageWorks components can be mounted.

device driver

An operating system software module used to physically control an I/O device. In DSA, conventional device drivers are replaced by a single driver for an entire class of devices, such as disk drives, and a single port driver for the host-to-controller transport mechanism. For example, a host computer communicating with an HSJ-series controller uses disk and tape class drivers and the CI port driver.

device shelf

A StorageWorks shelf designed to contain SBBs.

Diagnostic And Execution MONitor

See *DAEMON*.

Diagnostics and Utilities Protocol

See *DUP*.

digital audio tape

See DAT

DIGITAL Standard Disk Format

See *DSDF*.

DSDF

The Digital Storage Architecture (DSA) standard for disk media format. DSDF specifies the mechanism for mapping a contiguous logical block address space into a possibly imperfect physical space, as well as defining diagnostic and factory areas. DSDF is transparent to the system.

DIGITAL Storage Architecture

See *DSA*.

DSA

A set of specifications and interfaces describing standards for designing mass storage products. DSA defines the functions performed by host computers, controllers, and drives. It also specifies how they interact to accomplish mass storage management.

DIGITAL Storage System Interconnect

See DSSI

DILX

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.

Disk Inline Exerciser

See *DILX*.

DIGITAL Storage Architecture

See *DSA*.

DSSI

Digital's storage system interconnect bus with an 8-bit data transfer rate of 4-5 MB/s.

dual universal asynchronous receiver transmitter

See *DUART*.

dual cabinet power configuration

A cabinet ac power configuration in which two ac sources and two ac power supplies are used to supply dc power to the cabinet's SBB shelves.

dual porting (or dual access)

The ability of a disk or tape drive to be accessed by two controllers. All DSA drives have a standard dual-port feature. DSA drives can be online to only one controller at a time. However, they are able to disconnect themselves from a failed controller (or be disconnected by a failing controller) and become available for continued service through the other controller.

dual shelf power configuration

A cabinet ac power configuration in which one ac source and two ac power supplies are used to supply dc power to the cabinet's SBB shelves.

dual-redundant configuration

A controller configuration consisting of a primary and backup controller in one controller shelf . Both controllers normally share access to each other's devices. If the primary controller fails, the backup controller assumes control over the failing controller's devices.

DUART

Dual Universal Asynchronous Receiver Transmitter. An integrated circuit containing two serial, asynchronous transceiver circuits.

DUP

Diagnostic and Utility Protocol. Host application software that allows a host operator terminal to connect to the controller's command line interpreter. See also *virtual terminal*.

ECC

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.

EDC

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.

EIP

Error information packet. The EIP includes bytes of data meant to be decoded into information explaining error events.

electromagnetic interference

See EMI

electrostatic discharge

See ESD

EMI

Electromagnetic interference. The impairment of a signal by an electromagnetic disturbance.

error correction code

See *ECC*.

error detection code

See *EDC*.

error information packet

See *EIP*.

ESD

Electrostatic discharge. The discharge of a potentially harmful static electric voltage as a result of improper grounding.

EXEC

Firmware executive. EXEC is the portion of HS controller firmware that acts as the operating system for the controller.

extended status

An additional set of status information maintained by the drive that is of interest to a host error log. Extended status is drive-type specific and is not utilized by the controller except as input to the host error log and diagnostic processes.

failover

A software process that takes place when one controller fails in a dual-redundant configuration and the other controller takes over service to the devices of the failed controller.

fan

An airflow device mounted in a StorageWorks cabinet.

fast, differential SCSI

See *FD SCSI*.

fast, wide, differential SCSI

See *FWD SCSI*.

FD SCSI

The fast, differential SCSI bus with an 8-bit data transfer rate of 10 MB/s.

See also *FWD SCSI* and *SCSI*.

field replaceable unit

See *FRU*.

filler panel

A sheet metal or plastic panel used to cover unused mounting areas in StorageWorks cabinets and shelves.

firmware executive

See *EXEC*.

flush

To write cached data to storage.

FRU

field replaceable unit.

full-height device

A single device that occupies an entire 5.25 inch SBB carrier. StorageWorks full-height devices have an order number suffix of "–VA".

FWD SCSI

The fast, wide, differential SCSI bus with a 16-bit data transfer rate of up to 20 MB/s.

See also *FD SCSI* and *SCSI*.

half-height device

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.

HBVS

Host-Based Volume Shadowing. Also known as Phase 2 Volume Shadowing.

HBVS assistance

RAID level 1a. The HS controller performs HBVS assistance by independently directing shadow copy operations that were requested by the host between two units under the given controller.

Hierarchical Storage Controller

See HSC.

HIS

Host Interconnect Services. The firmware that communicates with the host in HS-family controllers.

host

The primary or controlling computer to which a storage subsystem is attached.

Host-Based Volume Shadowing

See *HBVS*.

Host Interconnect Services

See *HIS*.

host logical unit

A virtual group of devices addressable as a unit. See also *logical unit*.

hot swap

A method of device replacement whereby the complete system remains on line and active during device removal and reinstallation. The device being removed or reinstalled is the only device that cannot perform operations during this process.

HSC

Hierarchical Storage Controller. An intelligent mass storage server used on the CI bus. Capable of supporting a total of eight disk and/or tape data channels, the HSC is part of the System Interconnect Architecture and Digital Storage Architecture. By performing as an I/O manager, the HSC can be classified as an I/O server, removing the burden of I/O management from the CPU.

initiator

The SCSI bus member that requests an operation be performed by another member (target). When the HS controller interacts with physical storage devices, it is the initiator. Furthermore, when the host CPU interacts with the HSZ-series controller, the host is the initiator.

instance code

The four-byte value transmitted in the error log packet that is key to interpreting the error.

KILL line

The controller-to-controller disable signal used in a dual-redundant configuration.

least recently used

See LRU.

logical unit

A virtual group of devices addressable as a unit. Also called host logical unit.

logical unit number

See *LUN*.

LRU

Least recently used. This is cache terminology for the block replacement policy for the read cache.

LUN

A value of 0 through 7 that identifies a logical unit to a SCSI initiator.

maintenance terminal

The operator terminal used to identify an HS-family controller, to enable its host paths, to define its subsystem configuration, and to check its status. The HS-family maintenance terminal interface is designed to accept any terminal conforming to EIA–423. A maintenance terminal is only required to initially configure a controller and is not required for normal operations.

Mass Storage Control Protocol

See MSCP.

MIST

Module integrity self-test. MIST tests controller functions upon initialization. See also *DAEMON*.

Module integrity self-test

See *MIST*.

MSCP

Mass Storage Control Protocol. The message-level protocol used by the HSJ- and HSD-series controllers to communicate with a host computer. The three types of MSCP communication are sequential messages, datagrams, and block data transfers.

Network Interconnect

See *NI*.

NI

One of two standard interconnects used in the System Interconnect Architecture (CI is the other). The NI (also known as the Ethernet) connects communications servers and compute servers, creating a local area network.

node

An intelligent entity in a distributed computing configuration. Nodes are independent but linked, as in a network or a cluster, becoming parts of a whole. In a cluster, HSJ-series controllers and host computers are cluster nodes.

nonredundant

A configuration in which there is no backup hardware in place for the hardware that is present.

nontransportable

A device setting that indicates the device is MSCP compliant and contains metadata. Nontransportable devices can be moved amongst HS controller subsystems, but not taken directly to non-HS controller systems. See also *transportable*.

nonvolatile

See NV.

nonvolatile memory

See NVMEM.

nonvolatile parameters memory

See NVPM.

NV

Nonvolatile. A term used to describe memory, the contents of which survive loss of power.

NVMEM

Nonvolatile memory. NVMEM is the battery backed-up SRAM on the controller module.

NVPM

Nonvolatile parameter memory. NVPM is a portion of NVMEM used to store controller configuration data.

OCP

Operator control panel. The control/indicator panel associated with a device. The OCP is usually mounted on the device and is accessible to the operator.

offline

One of the possible status conditions of a mass storage device or server. When a device is offline, it is not capable of communicating with the controller. When the controller is offline, it is inaccessible to any node in the configuration.

operator control panel

See OCP.

PCMCIA

Personal Computer Memory Card Industry Association. An organization that develops standards for ROM memory cards.

Personal Computer Memory Card Industry Association

See *PCMCIA*.

port

The hardware and software used to connect a host controller to a communication bus, such as a CI, SCSI, or SDI bus.

port/target/LUN

See *PTL*.

program card

The PCMCIA card containing the HS controller operating firmware.

PTL

Port/target/LUN. PTL is a three-number hierarchical value representing a device location to a SCSI initiator. For example, PTL 143 is a device on port 1 of the initiator, target 4 on port 1, and LUN 3 under target 4.

qualified device

A device that has been fully tested in all appropriate StorageWorks hardware and software configurations, and is in complete compliance with Digital and country-specific standards (for example, FCC and TÜV).

quiesce

To make a bus inactive or dormant. The operator must quiesce SCSI bus operations, for example, during a device warm swap.

radio frequency interference

See RFI.

redundant array of independent disks

See RAID.

read cache

A block of high-speed memory used by a controller to buffer data being read from storage devices by a host. A read cache increases the controller's effective device access speed by satisfying host read requests from its local cache memory when possible, instead of from external storage devices. The controller maintains in the cache copies of data recently requested by the host, and may fetch blocks of data ahead in anticipation that the controller will access the next sequential blocks. In a basic read cache, host write requests are handled without involving the cache. See also *write through cache.*

RAID

Redundant array of independent disks. A set of storage techniques devised to increase the performance and availability of a storage subsystem.

restore

Data previously backed up on tape is retrieved for disk storage using the normal priority. Backup is used to preserve information in the event of a disk failure. Restore is used to recover the information.

RFI

Radio frequency interference. The impairment of a signal by an unwanted radio signal or radio disturbance.

SBB

StorageWorks building block. A device housed in a standard StorageWorks SBB carrier. An SBB has a standard physical and electrical interface that is compatible with those of StorageWorks shelves and enclosures.

SBB shelf

A StorageWorks shelf, such as the BA350–SB, designed to house plug-in SBB modules.

SCA

The interface specifications and protocols defining the connection of independent computer systems into clusters.

SCS

System Communication Services. A delivery protocol for packets of information (commands or data) to or from the host.

SCSI

Small Computer System Interface. An ANSI interface defining the physical and electrical parameters of a parallel I/O bus used to connect hosts to a maximum of seven devices. The StorageWorks device interface is implemented according to the SCSI–2 standard, allowing the synchronous transfer of 8-bit data at rates of up to 10 MB/s.

shelf brackets

Sheet metal components designed to attach and position StorageWorks shelves in their associated enclosures.

signal converter

A device that converts the protocol and hardware interface of one bus type into that of another without changing the functionality of the bus. See *adapter*.

single cabinet power configuration

A cabinet ac power configuration in which only one ac source and one ac power supply is used to supply dc power to the cabinet's SBB shelves.

skirt

A trim panel designed to mount around the base of the cabinet.

Small Computer System Interface

See *SCSI*.

standard disk interface

See *SDI*.

standard tape interface

See *STI*.

storage set

A grouping of disk drives that make up a new distinct container.

StorageWorks

Digital's family of 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 enclosures to form storage subsystems.

StorageWorks building block

See *SBB*.

stripeset

In a RAID configuration, a virtual disk drive with its physical data spread across multiple physical disks. Stripeset configurations do not include a data recovery mechanism.

supported device

A device tested as functionally compatible with an approved StorageWorks hardware and software configuration.

surviving controller

The controller in a dual-redundant pair that assumes service to its companion's devices when the companion fails. See also *failover*.

System Communication Architecture

See *SCA*.

System Communications Services

See SCS.

Tape Inline Exerciser

See *TILX*.

Tape Mass Storage Control Protocol

See *TMSCP*.

target

A member of a SCSI bus responsible for carrying out operations requested by an initiator. The physical storage devices are targets of the HS controller. Also, the HSZ-series controller is a target of its host CPU.

TILX

Tape Inline Exerciser. Diagnostic firmware used to test the data transfer capabilities of tape drives in a way that simulates a high level of user activity.

TMSCP

Tape Mass Storage Control Protocol. An applications protocol used by the HSJ- and HSD-series controllers to communicate with the host computer. TMSCP is tape-specific but overlaps and shares certain portions of MSCP.

transportable

A device setting that indicates the device is not MSCP compliant and does not contain metadata. Transportable devices can be moved between HS controller subsystems and non-HS controller systems. However, such devices do not support forced error, and should not be set to transportable after correct installation in an HS controller subsystem. See also *nontransportable*.

VAXcluster System Console

See *VCS*.

VCS

VAXcluster System Console. This terminal allows access to hosts (by networks). Another method of accessing the controller. See also *DUP*.

virtual terminal

A software path from an operator terminal on the host to the controller's CLI interface. 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.

warm swap

A controller function that allows devices to be added, removed, or replaced while the subsystem remains operational. All activity on the device's SCSI bus must normally be halted for the duration of the warm swap operation.

write through cache

A technique for handling host write requests in read caches. When the host requests a write operation, the cache writes data directly to the external storage device and updates the cache memory to make sure that the memory does not contain obsolete data. This technique increases the chances that future host read requests can be filled from the cache. The host sees the write operation as complete only after the external storage device has been updated. Also see *read cache.*

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