StorageWorks™ Array Controllers

HS Family of Array Controllers User's Guide

Order Number: EK–HSFAM–UG. B01

The *StorageWorks Array Controllers HS Family of Array Controllers User's Guide* contains instructions for installing and using HSJ30, HSJ40, HSD30, and HSZ40 array controllers.

Digital Equipment Corporation
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Preface

Introduction

This *StorageWorks™ Array Controllers HS Family of Array Controllers User's Guide* contains instructions for installing and using the HSJ30, HSJ40, HSD30, and HSZ40 array controllers.

For purposes of this manual, the term "HS controller" refers to several models, as shown in Table 1.

Table 1 HS Controller Models

Series	Model	Controllers *not* covered in this manual[1]
HSJ™	HSJ40 HSJ30	Any HSC™ controller
HSD30™	HSD30	HSD05
HSZ™	HSZ40	HSZ10, HSZ15

[1]The controllers listed in this column are not part of the HS array controller family.

Intended Audience

This manual is intended for customers, system managers, and Digital Multivendor Services engineers responsible for installing and using HS array controller subsystems.

Structure

This manual is organized as follows:

Chapter 1 Provides an overview of the HS family of array controllers, physical descriptions of HS array controllers and their features, a discussion of the StorageWorks shelves and cabinets that house HS controllers, and module specification tables.

Chapter 2 Provides a technical hardware overview of HS array controllers and a summary of how the firmware works. A description of the failover process for HSJ and HSD30 controllers is included.

Chapter 3 Describes the configuration rules and restrictions for standard and nonstandard HS array controller subsystems.

Chapter 4 Describes site preparation requirements, personnel and tools needed for installation, electrostatic discharge protection, subsystem component handling guidelines, preconfigured subsystem installation procedures, and upgrades.

Chapter 5	Describes controller initialization, subsystem configuration from the CLI, customer acceptance tests with power applied, operator control panel (OCP) buttons and LEDS, and device and controller warm swap.
Chapter 6	Describes when HS array controllers initialize, how to locate and read fault LEDs on the OCP, run online diagnostics and user utilities, and run local controller programs.
Chapter 7	Describes the operating system support for HS array controllers, as well as restrictions and comments.
Appendix A	Lists HS array controller option order numbers.
Appendix B	Describes the HS array controller command line interpreter (CLI) in its entirety.
Appendix C	Lists the RAID levels with brief descriptions supported by HS array controllers for Version 1.4 of the HS Operating firmware.
Glossary	Lists acronyms and other terms specific to StorageWorks HS Family of Array Controllers, and associated cabinets and shelves.

Related Documentation

The following table lists documents that contain information related to this product:

Document Title	Order Number
HSJ30/40 Firmware Array Controller Software Product Description (SPD47.26.04)	AE–PYTGE–TE
HSD30 Firmware Array Controller Software Product Description (SPD 53.53.00)	AE–Q6HKA–TE
HSZ40 Firmware Array Controller Software Product Description (SPD 53.54.00)	AE–Q6HMA–TE
StorageWorks Array Controllers HS Family of Array Controllers Service Manual	EK–HSFAM–SV
StorageWorks Array Controllers HSJ30/40 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 Family StorageWorks Building Blocks User's Guide	EK–SBB35–UG
StorageWorks BA350–MA 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 Metric Shelf Bracket Kit Installation Guide	EK–35XRD–IG
StorageWorks SW800-Series Data Center Cabinet Cable Distribution Unit Installation Sheet	EK–SWCDU–IS
StorageWorks SW800-Series Data Center Cabinet Installation and User's Guide	EK–SW800–IG
StorageWorks SW500-Series Cabinet Installation and User's Guide	EK–SW500–IG
StorageWorks SW500-Series Cabinet Cable Distribution Unit Installation Guide	EK–SW5CU–IG
The Digital Guide to RAID Storage Technology	EC–B1960–45

Document Title	Order Number
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, in the glossary, or both.
italic type	Italic type indicates emphasis 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*.
CDROM	Is used to indicate both a command and a hardware device. The proper usage of CD–ROM (with a hyphen) is not used to avoid reader confusion.

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1

Introduction to HS Array Controllers

This chapter contains an overview of the HS array family of controllers. A list of key attributes for each controller and the BA350–MA controller shelf is provided. This chapter also provides a brief description of the protocols used with each controller platform functional environment.

1.1 Overview of HS Array Controllers

The HS array controllers are a family of controller products designed to provide open interface interconnection for the following:

- Digital Equipment Corporation SCSI devices
  - Solid state disks
  - Disk drives
  - Tape drives
  - CDROM drives
- Redundant arrays of independent disks (RAID)

Note

The HS array controllers support a variety of storage devices. Refer to product-specific release notes and software product descriptions for supported devices for each controller platform (HSJ30/40, HSD30, or HSZ40 controllers). Any limitations or restrictions are provided in the product-specific release notes.

For purposes of this manual, the term "HS controller" refers to several models, as shown in Table 1–1.

Table 1–1 HS Controller Models

Series	Model	Controllers *not* covered in this manual†
HSJ™	HSJ40 HSJ30	Any HSC™ controller
HSD30™	HSD30	HSD05
HSZ™	HSZ40	HSZ10, HSZ15

†The controllers in this column are not part of the HS array controllers family.

The HS array controller family is an integral part of the StorageWorks array subsystem. HS array controllers provide high performance, high availability, and high connectivity access to SCSI devices from the host by way of a

variety of interconnects. The interconnects discussed in this manual are CI, DSSI, and SCSI for the HSJ30/HSJ40, HSD30, and HSZ40 array controllers respectively. These controllers support various operating systems as described in controller-specific release notes and in Chapter 7 of this manual.

Note

Hereafter, HSJ30/HSJ40 controllers are referred to as HSJ controllers unless the text is controller-model specific.

1.2 Housing for HS Array Controllers

The controller modules and associated read cache modules mount in a BA350–MA controller shelf. Each BA350–MA shelf supports up to two controller modules, two read cache modules, and one or two shelf power supplies.

The BA350–MA controller shelf slides into slots in StorageWorks cabinets. The same array cabinets contain storage shelves that hold the storage devices supported by the controllers.

The SCSI–2 device cables are connected to the BA350–MA controller shelf backplane, routed out the front of the controller shelf, and routed into the front of storage shelves (such as the BA350–SB shelf) that hold the SCSI–2 devices.

At the lowest level, a SCSI–2 device fits into a plastic carrier. The combination of the plastic carrier and the storage device is called a StorageWorks building block (SBB).

1.3 Physical Description of HS Array Controllers

The following sections describe the physical attributes of each HS array controller model to include HSJ, HSD30, and HSZ40 array controllers.

1.3.1 HSJ30/HSJ40 Array Controllers Description

The physical HSJ40 controller module has three SCSI shelf backplane connectors with the following features:

- Each shelf backplane connector supports two SCSI–2 ports for a total of six SCSI–2 ports for the HSJ40 controller. The HSJ30 array controller supports three SCSI–2 ports. The HSJ30 controller's CLI does not allow any configurations past port 3 to be entered, and any devices on the remaining ports are ignored.
- Each SCSI–2 port supports up to six (or seven) SCSI–2 devices[1], depending on the subsystem configuration.

  The HSJ30 controller supports up to 18 devices in a dual-redundant configuration. Lower availability configurations can support up to 21 devices (seven per SCSI port) if nonredundant power is not used. Other availability options also are sacrificed. Digital does not recommend this configuration.

[1] A dual-redundant controller configuration supports up to 36 devices. Lower availability configurations can support up to 42 devices (seven per SCSI port), but this will sacrifice a convenient upgrade to any of the possible higher availability options. For this reason, Digital does not recommend this configuration.

- The six SCSI–2 device cables (three for HSJ30) from the controller shelf can be routed to more than one SBB shelf as desired, taking into consideration prescribed configuration rules and restrictions as listed in Chapter 3.

The HSJ30 or HSJ40 controller resides on a single module that can be configured alone **(nonredundant)** or with a second *like* controller module for **dual-redundant** availability, and a read cache module (one for each controller module).

Note

Do not mix an HSJ30 controller with an HSJ40 controller in the same dual-redundant controller shelf. When HSJ30 and HSJ40 controllers are mixed in the same shelf, the controllers detect the mismatch and do not allow access to any devices.

CAUTION

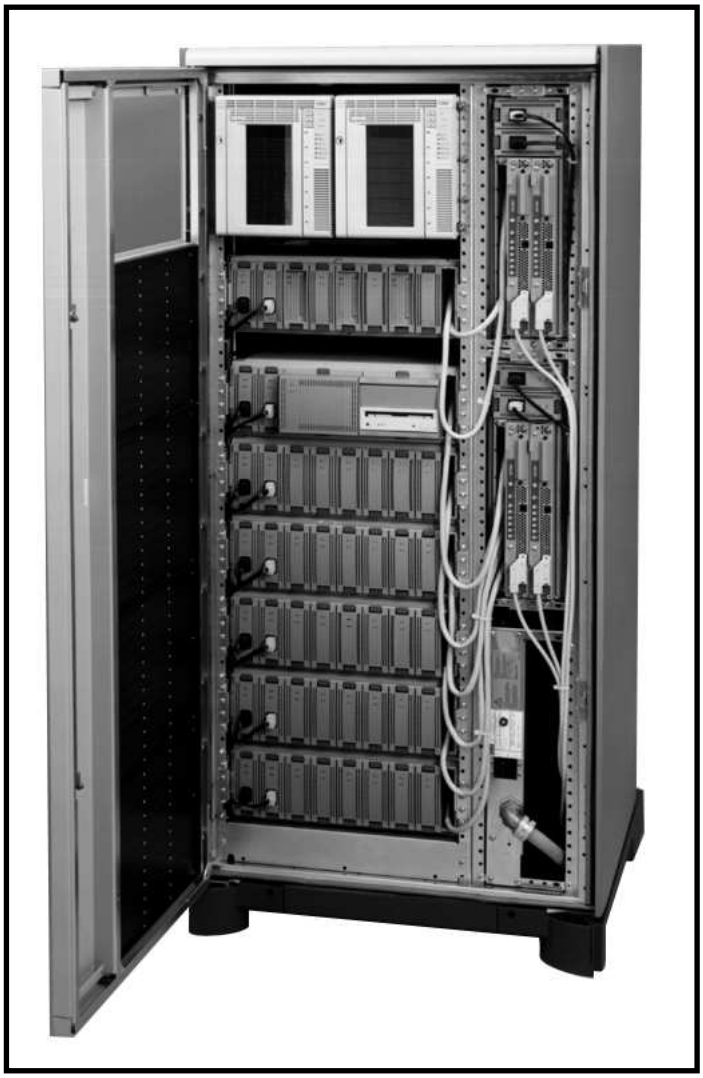
In a dual-redundant configuration with read cache, both read cache modules must have the same number of megabytes. The firmware version also must be the same for both controllers for proper operation of the subsystem. When firmware versions and/or cache module sizes are mismatched, the controllers detect the mismatch and do not allow access to any devices.

The HSJ controllers interconnect to the host by way of Digital's CI interface. An internal CI host port cable connects to each controller and routes through the cabinet, exiting at the bottom back of the cabinet. Four external (blue) CI cables connect to the end of each internal CI host port connector and route into a star coupler. From the star coupler, the cables route to the host computer. Refer to VAXcluster configuration guides for supported configurations with star couplers.

The combination of HSJ30 or HSJ40 controllers in BA350–MA controller shelves, storage shelves with their power supplies, assorted SCSI–2 device and CI cables, and cable distribution units, compose the HSJ30 or HSJ40 controller subsystem. Refer to the *VAXcluster Systems Guidelines for VAXcluster System Configurations* manual for supported configurations with storage components.

Figure 1–1 shows an HSJ40 controller subsystem configuration in an SW800-series (1700 mm high) data center cabinet (front view). Controller subsystems also are available in an SW500-series (1100 mm high) cabinet, and other configurations may be available over time.

Figure 1–1 HSJ40 Controller Subsystem in an SW800-Series Data Center Cabinet



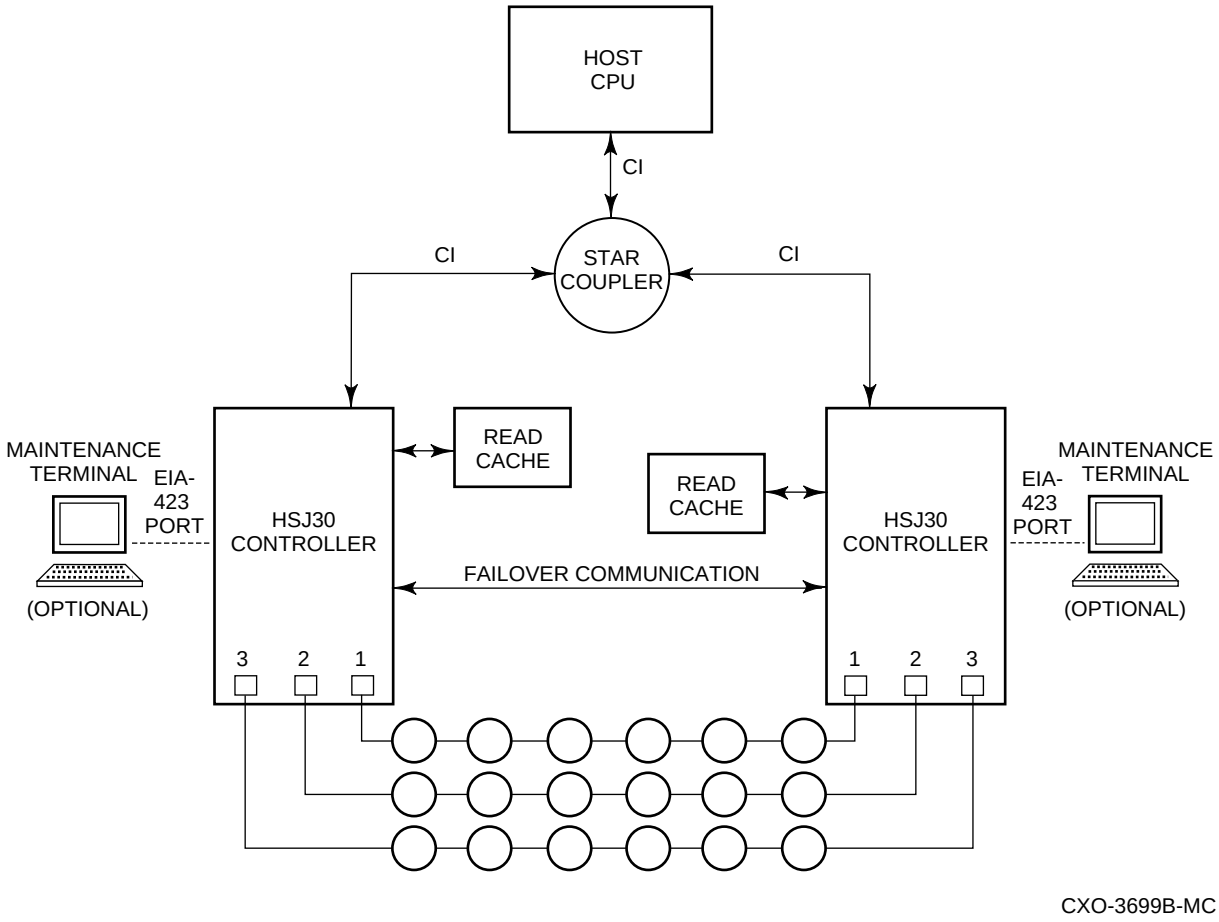
CXO-3658B-PH

Figure 1–2 depicts a block diagram of a dual-redundant HSJ30 controller subsystem. In an HSJ30 dual-redundant configuration, two controllers attach to three SCSI–2 buses within the same controller shelf.

Note

The same block diagram applies to the HSJ40 controller, except the HSJ40 controller would have six SCSI–2 buses.

Figure 1–2 Dual-Redundant HSJ30 Controller Subsystem—Block Diagram



1.3.2 HSD30 Array Controller Description

The physical HSD30 controller module has three shelf backplane connectors with the following features:

- One SCSI shelf backplane connector supports two SCSI–2 ports, and a second SCSI connector supports one SCSI–2 port for a total of three SCSI–2 ports. The third connector is not used.
- Each SCSI–2 port supports up to six (or seven) SCSI–2 devices[2], depending on the subsystem configuration.
- The three SCSI–2 port cables from the controller shelf can be routed to more than one device shelf as desired, taking into consideration prescribed configuration rules and restrictions as listed in Chapter 3.

The HSD30 controller resides on a single module that can be configured alone (nonredundant) or with a second HSD30 controller module for dual-redundant availability, and a read cache module (one for each controller module).

[2] A dual-redundant controller configuration supports up to 18 devices. Lower availability configurations can support up to 21 devices (seven per SCSI port), but this will sacrifice a convenient upgrade to any of the possible higher availability options, such as redundant power.

The HSD30 controller host port is an 8-bit wide DSSI interface. The HSD30 array controller requires a DSSI trilink connector block (Digital part number 12–39921–02) mounted on its host connector (which is included with each controller), and requires external terminators (Digital part number 12–31281–01) as appropriate. (Refer to Section 4.6.2.2 for installation instructions for DSSI host port cables.)

Digital allows up to four HSD30 controllers per DSSI bus (for example, four nonredundant controllers, two dual-redundant controller pairs, or one dual-redundant controller pair and two nonredundant controllers). Refer to the *StorageWorks Array Controllers HSD30 Array Controller Operating Firmware Release Notes* for changes or restrictions.

The combination of HSD30 controllers in BA350–MA controller shelves, storage shelves with their power supplies, assorted SCSI–2 device and DSSI host cables, and cable distribution units, compose the HSD30 controller subsystem. HSD30 array controller subsystems are available in an SW800-series data center cabinet or an SW500-series cabinet.

1.3.2.1 DSSI Bus Rules

The following are DSSI bus rules to consider for properly installing and operating your HSD30 controller subsystem:

- All systems connected to the same DSSI bus must have a common power/ground.
- Each DSSI bus supports up to eight nodes. Each of the following counts as one DSSI node: a DSSI adapter, an RF-disk controller interface, or a TF-tape controller interface.
- Each DSSI bus must be terminated at each end at all times; breaking the bus while a cluster is operational can lead to data corruption.

Refer to the *VAXcluster Systems Guidelines for VAXcluster System Configurations* manual for supported host configurations with DSSI controllers.

1.3.3 HSZ40 Array Controller Description

The physical HSZ40 controller module has three shelf backplane connectors with the following features:

- Each shelf backplane connector supports two SCSI–2 ports for a total of six SCSI–2 ports.
- Each SCSI–2 port supports up to six (or seven) SCSI–2 devices depending on the subsystem configuration.
- The six SCSI–2 port cables from the controller shelf can be routed to more than one device shelf as desired, taking into consideration prescribed configuration rules and restrictions as listed in Chapter 3.

The HSZ40 controller resides on a single module that is configured alone (nonredundant) in the BA350–MA controller shelf. The HSZ40 controller currently does not support dual-redundant configurations. One read cache module is supported for each controller module.

The HSZ40 controller is supported in a single host environment where the host can have 8-bit single-ended adapters or 16-bit differential adapters. The HSZ40 controller host port is a 16-bit fast-wide-differential (FWD) SCSI–2 interface, which requires a DWZZA adapter for those hosts that have 8-bit single-ended adapters. (Refer to Chapter 3 for supported host adapters.)

Note

Either a desktop (DWZZA–AA) or SBB (DWZZA–VA) DWZZA host adapter can be used for hosts that require an 8-bit single-ended adapter. Refer to the *StorageWorks Solution Shelf and SBB User's Guide* for more information about DWZZA-series SCSI bus signal converters.

The HSZ40 controller *requires* a SCSI trilink connector block (Digital part number 12–39921–01, H885–AA) mounted on its host connector (which is included with each controller), and requires external terminators (H879–AA, 68-pin) as appropriate. Refer to Section 4.6.2.3 for host port cable installation instructions.

The host SCSI ID for HSZ40 controllers is set via the controller's command line interpreter (CLI). (The default is 2, but the ID will be displayed as invalid, so it should be set immediately.) Use the CLI command SHOW THIS_CONTROLLER command to determine the SCSI ID of the controller.

One HSZ40 controller can be assigned one or two SCSI target IDs. This allows support of up to 16 logical units (LUNs) per HSZ40 controller. Refer to Appendix B for examples of how this is done.

The combination of an HSZ40 array controller in a BA350–MA controller shelf, storage shelves with their power supplies, assorted SCSI–2 device and SCSI host cables, and cable distribution units, compose the HSZ40 controller subsystem. HSZ40 array controller subsystems are available in an SW800-series data center cabinet or an SW500-series cabinet.

1.4 Controller Host Interconnect Services

The CI (HSJ) and DSSI (HSD30) interfaces use MSCP and TMSCP as the storage protocols over which access to the controller-attached SCSI devices are performed.

The SCSI FWD (HSZ40) interface uses the SCSI-2 protocol for a host to access LUNs attached to the controller (which is a SCSI target as seen by the host).

Devices attached to (HSJ40 and HSZ40) array controllers connect to six ports (HSJ30 and HSD30 controller devices connect to three ports). The controllers reference these devices as Port-Target-LUN (**PTL**) addresses. These devices are configured via the CLI using local names with specific attributes (such as device type, parameters, and so forth). These PTLs can then be configured into storage sets before being configured as units or LUNs.

1.5 Addressing Storage Within the Subsystem

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

1. From the controller SCSI device interface—at the physical device level
2. From the host interface—at the virtual device level

The following sections describe both levels of storage addressing.

1.5.1 Controller Storage Addressing

Note

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

Figure 1–3 shows a typical physical storage device interface for an HSZ40 controller. Each of the controller's six device ports support a SCSI bus connected with up to six devices. The devices typically reside in a StorageWorks BA350–S*x* SBB shelf.

Currently, all controllers support only one controller LUN per physical device or storage set. (A storage set is a collection of containers, such as a stripeset, that make up a container.) 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 zero. This is reserved for future use.)

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

1.5.2 Host Storage Addressing

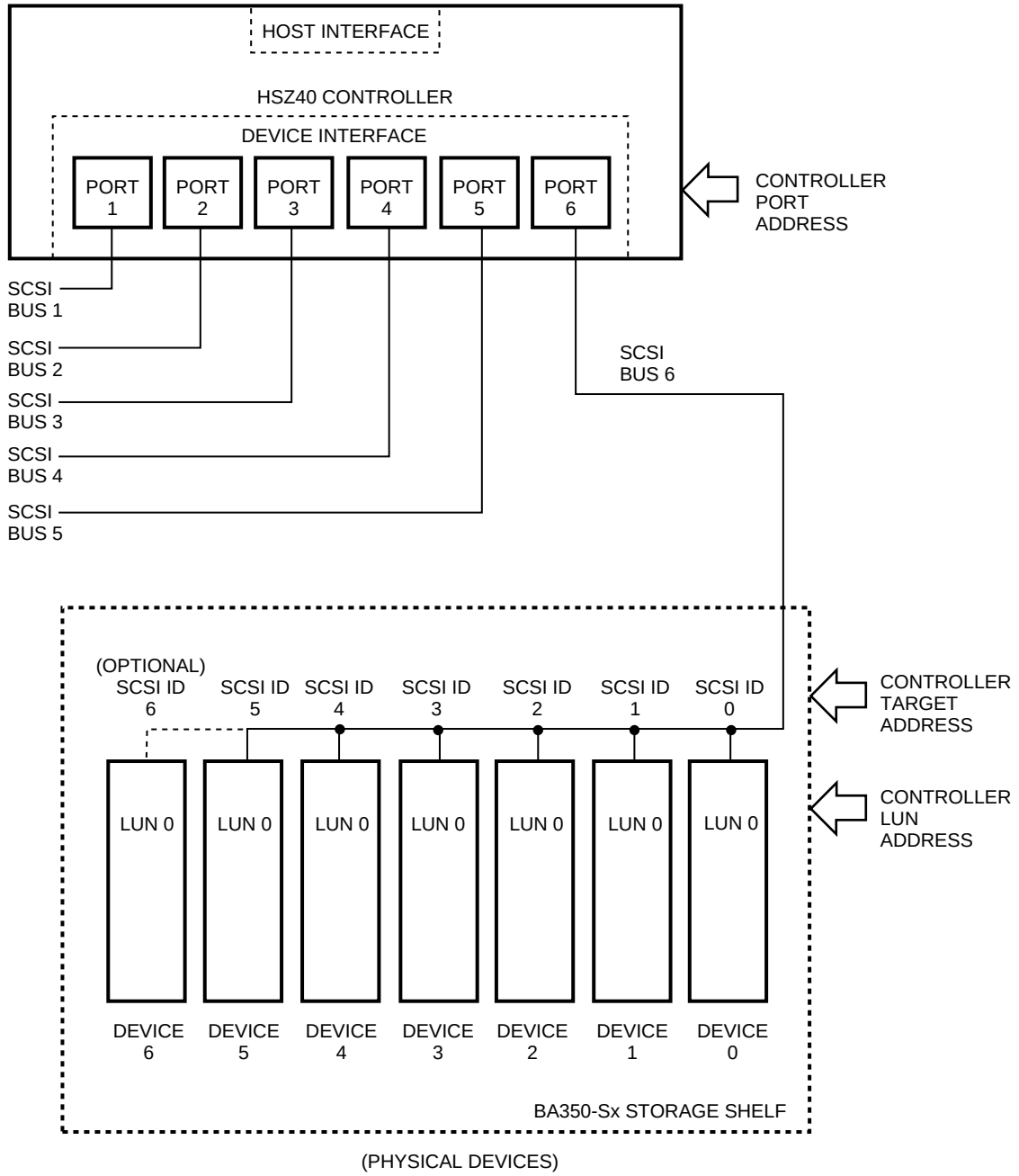
Note

The information in this section applies to all controllers. However, refer to Section 1.5.3 for specific 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.

To support certain high-level storage subsystem functions such as RAID, the controller presents the entire *physical* device configuration (from Figure 1–3) to the host as a group of **host logical units**. A host logical unit usually 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. The user configures host logical units using the CLI.

Figure 1–3 Controller Storage Addressing



Note

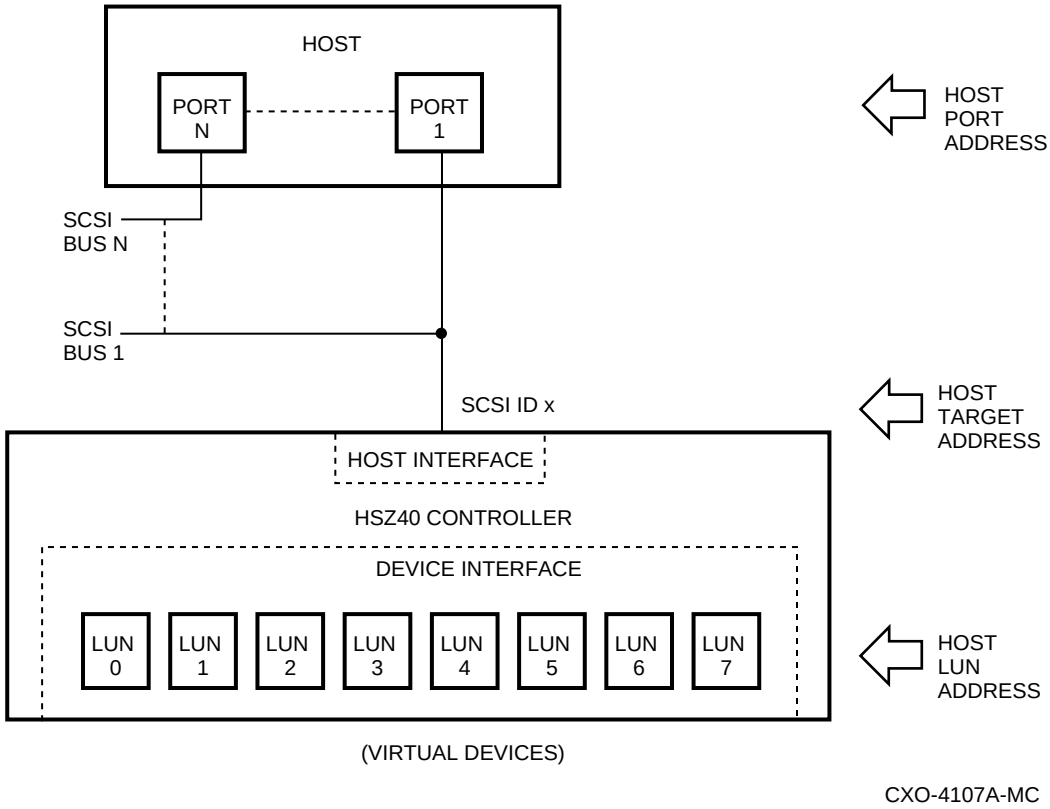
Controller LUNs (devices) and host logical units *may* represent the same structure, but only if the user configures controller devices in a one-to-one unit relationship with the host. This situation may or may not occur under normal operation.

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

1.5.3 Host Storage Addressing (HSZ40 Controllers)

Figure 1–4 shows a typical connection between an HSZ40 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 HSZ40 controller resides on one of the SCSI buses. The HSZ40 controller can be assigned one or two SCSI target IDs on the bus.

Figure 1–4 Host Storage Addressing (HSZ40 Controllers)



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 HSZ40 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 only on the controller's device interface, and SCSI host LUNs exist only 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 rarely occurs under normal operation, that is, with device storage set use.

1.5.3.1 Host Port Target LUN Addressing (HSZ40 Controllers)

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 HSZ40 controller connected to it.
2. The target selection—The host selects the controller's SCSI ID (that is, the target) on that port/bus.
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.

1.6 HSJ Array Controller Dual Data Link

The HSJ controllers fully support **dual data link** (DDL) operations. That is, they can have operations in progress simultaneously on both CI paths. Either receive/receive, receive/transmit, or transmit/transmit operations can be active at the same time. The only restriction on a DDL operation is that simultaneous transmit and simultaneous receive operations cannot be active on the same virtual circuit. The packets that are simultaneously active can be to any two separate CI nodes, or a transmit and a receive operation can be active to the same node if it also supports DDL operation, such as the CIXCD adapter. Each CI path (Path A and Path B) runs in half duplex, that is, it can either be transmitting or receiving on a path, but not both at the same time.

1.7 Controller Features

The following HS controller pertain to all HS controller models unless otherwise indicated:

- Executive and subsystem services for the controller firmware.
- SCSI–2 device services and device port drivers for disk drives and tape drives.
- Controller-based exercisers for disk drives (DILX) and tape drives (TILX).
- Easy remote system management through use of the following:
  - DUP protocol for CI pass-through from the host to the HSJ controller's command line interpreter (CLI).

Note

HSJ and HSD30 controllers support DUP connections. HSZ40 controllers can use a SCSI virtual terminal connection from a host application

program called HSZUTIL. Refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* for instructions for running the HSZUTIL program.

  - An EIA–423 compatible terminal port for use with a **maintenance terminal** or VAXcluster console system to set parameters and define configurations.

- HSZ40 controllers support tagged queuing and have full LUN support.
- Error recovery and error log reporting.
- Physical device addressing and access.
- RAID 0 (striping drives)—2 to 14 member stripesets supported (6 member stripesets are recommended, that is, 1 per SCSI-2 device port).
- RAID 1a host-based volume shadowing assists on HSJ and HSD30 controllers under the VMS operating system. Intra-HSJ and -HSD30 controller data copy operations for device-to-device data movement.
- HSJ and HSD30 controller dual-redundant configurations with 15-second automatic failover of attached storage devices should one controller fail.
- Mixed disk and tape support on the same controller and on the same port for HSJ and HSD30 controllers.
- Tape drive media loader support. Refer to product specific release notes for exceptions.
- 16- or 32-MB optional read cache module for HSJ30, HSD30, and HSZ40 controllers. (16 MB read cache modules come with HSJ40 controllers.)
- Device warm-swap support.
- Controller warm-swap support for HSJ array controllers.
- Program card containing controller-resident firmware for controller initialization and ease of updating controller firmware.
- Bad block replacement (BBR) and MSCP forced error support for disk drives attached to HSJ and HSD30 controllers.
- Peak transfer rate of up to 10 MB per second per device port for HSJ, HSD30, and HSZ40 array controllers.

1.7.1 Subsystem Configuration Rules

Refer to the configuration rules listed in the *StorageWorks Solutions Shelf and SBB Configuration Guide* when using a BA350 subsystem shelf component.

Refer to Chapter 3 of this document for HS array controller subsystem configuration rules and guidelines.

1.7.2 Controllers and Cache Modules Specifications

Tables 1–2, 1–3, and 1–4 list the physical and electrical specifications for the HS controllers and their cache modules.

Table 1–2 HSJ Array Controller and Cache Module Specifications

Specification	Controller Module Typical	Controller Module Maximum	Read Cache 16 MB	Read Cache 32 MB
Width	12.5 inches	n/a	12.5 inches	12.5 inches
Depth	9.5 inches	n/a	7.75 inches	7.75 inches
Power Consumption	40.5 watts	47.8 watts	1.5 watts	2 watts
Voltage @ +5 V	6.5 A	7.1 A	300 mA	400 mA
Voltage @ +12 V	0.67 A	.84 A	2 mA	negligible

Table 1–3 HSD30 Controller and Cache Module Specifications

Specification	Controller Module Typical	Controller Module Maximum	Read Cache 16 MB	Read Cache 32 MB
Width	12.5 inches	n/a	12.5 inches	12.5 inches
Depth	8.75 inches	n/a	7.75 inches	7.75 inches
Power Consumption	29.87 watts	24.19 watts	1.5 watts	2 watts
Voltage @ +5 V	4.15 A	4.56 A	300 mA	400 mA
Voltage @ +12 V	.01 A	.02 A	2 mA	negligible

Table 1–4 HSZ40 Controller and Cache Module Specifications

Specification	Controller Module<Typical	Controller Module Maximum	Read Cache 16 MB	Read Cache 32 MB
Width	12.5 inches	n/a	12.5 inches	12.5 inches
Depth	8.75 inches	n/a	7.75 inches	7.75 inches
Power Consumption	24.77 watts	28.7 watts	1.5 watts	2 watts
Voltage @ +5 V	4.93 A	5.42 A	300 mA	400 mA
Voltage @ +12 V	.01 A	.02 A	2 mA	negligible

1.8 StorageWorks Controller Subsystem Products

Digital offers several preconfigured HS array controller subsystems. However, if you wish to customize your own system, read the *StorageWorks Solution Configuration Guide* and the *StorageWorks Solutions Shelf and SBB User's Guide* for guidance in creating a customized, configure-to-order (CTO) subsystem.

Note

If you decide to install SCSI–2 devices that have not been qualified by Digital for use with your array controller, the performance and correct operation of those devices or the controllers may not be satisfactory nor guaranteed by Digital.

Most of the Digital's SBB devices come in either a 3½-inch or a 5¼-inch SBB as shown in Figures 1–5 and 1–6 respectively.

Figure 1–5 3½-Inch SBB (Power Unit)

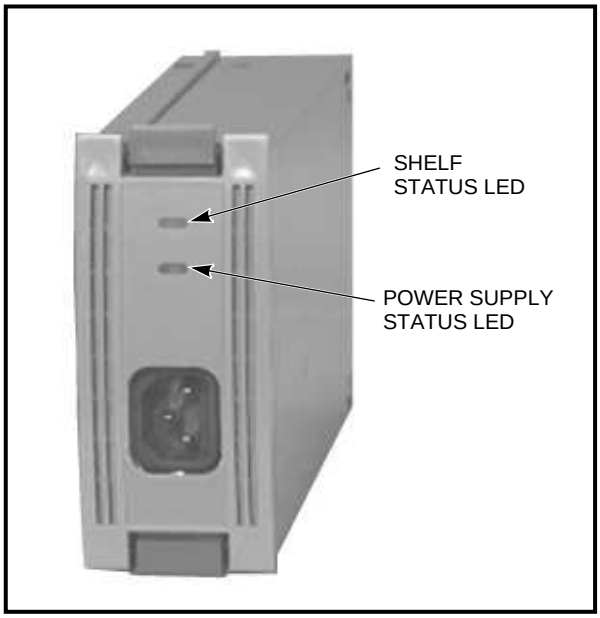


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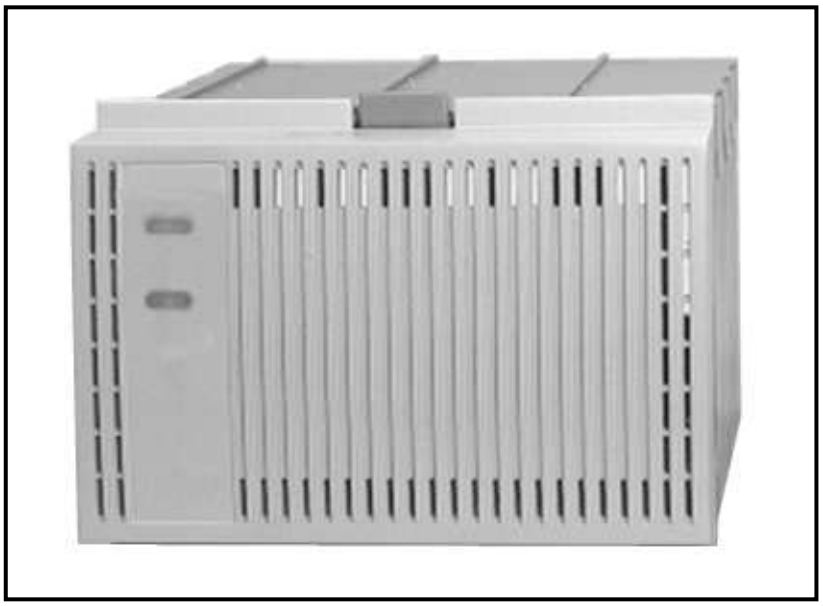
Figure 1–6 5¼-Inch SBB



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A 3½-inch SBB occupies one slot in a BA350–SB SBB shelf. Three slots are required to house 5¼-inch SBBs.

Snap-in SBBs can provide power, controllers, storage, adapters, and battery back-up units. Not all SBBs types are supported by each type of HS array controller. Refer to the current HS array controller model-specific SPDs and release notes for detailed information.

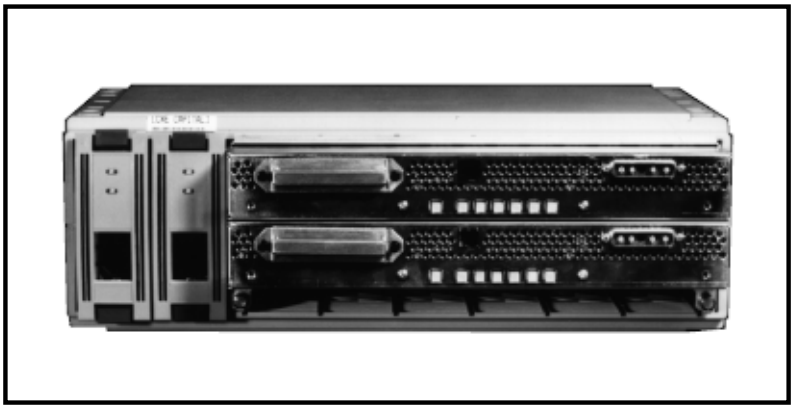
The currently supported cabinets that house HS controllers, options, and devices are either SW800-series data center cabinets or SW500-series cabinets. Refer to the following documents for information about these cabinets:

- *StorageWorks SW800-Series Data Center Cabinet Installation and User's Guide*
- *StorageWorks SW500-Series Cabinet Installation and User's Guide*
- *StorageWorks SW800-Series Data Center Cabinet Cable Distribution Unit Installation Sheet*
- *StorageWorks SW500-Series Cabinet Cable Distribution Unit Installation Sheet*

1.8.1 BA350–MA Controller Shelf

An HS controller is mounted in a BA350–MA controller shelf, like the one shown in Figure 1–7, which is configured for dual redundancy. The controller shelf holds a maximum of two controller modules, two cache modules, and two shelf power supplies. The standard orientation of the controller shelf in an SW800-series data center cabinet is in a vertical position (not in a horizontal position as shown in Figure 1–7). The controller shelf is mounted horizontally in the SW500-series cabinet.

Figure 1–7 BA350–MA Controller Shelf in a Dual-Redundant HSJ40 Array Controller Configuration



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Note

In a dual-redundant controller configuration with the controller shelf mounted vertically in the front of an SW800-series data center cabinet, or horizontally in a SW500-series cabinet, the controller closest to the SCSI–2 device cables is ID #6. In a nonredundant HS array controller configuration (one controller mounted in the controller shelf), the

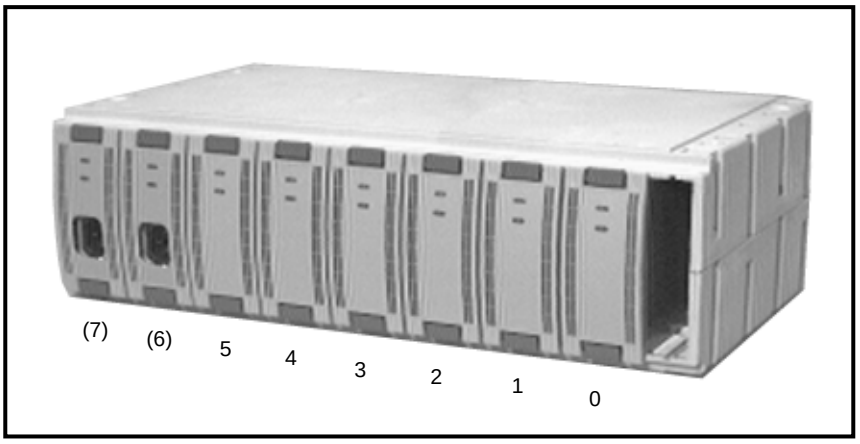
controller must be installed in the slot farthest from the SCSI–2 device cables (ID #7).

1.8.2 BA350–SB SBB Shelf

A BA350–SB[3] SBB shelf can hold a maximum of eight 3½-inch SBB devices. Each SBB slides into a shelf position called a **slot**. The slots are numbered 0 through 7, from right to left (with the shelf mounted horizontally). Depending on configuration restrictions, six (or seven) single-ended, eight-bit, SCSI–2 devices and one or two power supplies can be installed in one BA350–SB SBB shelf.

Figure 1–8 shows a fully populated BA350–SB SBB shelf with six devices and two power supplies. The primary power supply resides in slot 7, and the secondary power supply or battery backup unit resides in slot 6 (if not occupied by a storage device).

Figure 1–8 BA350–SB Fully Populated SBB Shelf



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Details for configuring BA350–SB SBB shelves can be found in the *StorageWorks Solutions Shelf and SBB User's Guide* and the *StorageWorks Solutions Configuration Guide*.

Features of the BA350–SB SBB Shelf

When used with an HS family array controller, the BA350 SBB shelf family provides the following features:

- Use of Digital approved SCSI–2 devices
- Warm swap installation and removal of snap-in devices
- Mix of 3½-inch and 5¼-inch devices
- Freedom to build customized subsystems
- Optional redundant power supply SBB or Battery Backup Unit (BBU)
- Visual status indicators

[3] The BA350–SB SBB shelf is a direct replacement for the BA350–SA SBB shelf. The BA350–SB shelf can be used in either an FCC Class A or Class B environment.

The SCSI–2 address of a device in a BA350–SB SBB shelf is determined by its physical position in the SBB shelf for 3½-inch devices, and by adjustments on the SBB or device for 5¼-inch devices.

1.9 MSCP and TMSCP Protocols (to Hosts)

The CI and DSSI interfaces use MSCP and TMSCP communication protocols as the storage protocols to access HSJ and HSD30 controller-attached SCSI–2 devices. MSCP and TMSCP are high-level storage protocols used by many Digital storage subsystem products.

1.10 SCSI Protocol (to Hosts)

The SCSI interface uses the SCSI protocol for a host to access LUNs (logical units) attached to the HSZ40 controller (SCSI target as seen by the host). The HSZ40 controller supports tagged command queuing and full LUN support. SCSI supports up to 8 LUNs per target (of which one HSZ40 controller can be assigned one or two SCSI target IDs).

Controllers that use SCSI–2 protocol can adapt by programming, either to an initiator host computer system, or to a target peripheral controller system on the SCSI–2 bus.

The HS controllers use SCSI–2 protocol to communicate between the controller and the attached SCSI–2 devices.

The controller operates in three possible states:

- Connected as a target (from a host)
- Disconnected from the host (controller performed)
- Reselect the host (controller performed)

A summary of the protocol between the initiator (host) and a target (controller) is as follows:

1. The host selects a SCSI–2 controller.
2. The controller requests a command from the host that directs the task to be performed, for example, to read a controller LUN.

   The target (controller) can disconnect at this point, leaving the host bus free for other operations while the controller processes the request.
3. The target (controller) interprets the command and executes it. For example, the controller reads data from the disk and then reselects the host to send or receive data to or from the host (initiator).
4. When the data has been transferred, the controller sends the host the SCSI status byte.
5. After the host accepts the status byte, the controller frees the host bus, leaving it free for the next operation.
6. The speed of transfers on the SCSI bus between a host and a controller (up to 20 MB per second in FAST wide mode, otherwise up to 10 MB per second or 5 MB per second in wide mode) is determined by bus-level negotiation. The HS array controllers negotiate for FAST and WIDE operation of the SCSI bus if supported by the host. The 20 MB per second, 10 MB per second, or 5 MB per second rates occur only during the data phase, and all other activity is

asynchronous for command overhead. The HSZ40 controller's host firmware has very low command overhead on the host SCSI bus.

1.10.1 SCSI Protocol (to Devices)

The HS controllers use SCSI–2 protocol to communicate between the controller and the attached SCSI–2 devices.

The controller operates in three possible states:

- Connected as an initiator (to a device)
- Disconnected to the device (device performed)
- Reselected (device performed)

A summary of the protocol between the initiator (controller) and a target (storage device) is as follows:

1. The controller selects a SCSI–2 device.
2. The device requests a command from the controller that directs the task to be performed, for example, to read a disk.

   The target (device) can disconnect at this point, leaving the device port bus free for other operations while the device is processing the request.
3. The target (device) interprets the command and executes it. For example, the target (device) reads data from the disk and then reselects the controller to send or receive the data to or from the controller.
4. When the data has been transferred, the device sends the controller the SCSI status byte.
5. After the controller accepts the status byte, the device frees the bus, leaving it free for the next operation.
6. The speed of transfers on the SCSI bus between a device and a controller (up to 10 MB per second or 5 MB per second in 8 bit single-ended or 8 bit FAST single-ended modes) is determined by bus-level negotiation. The HS array controllers negotiate for FAST operation of the SCSI bus if supported by the device. The 10 MB per second and 5 MB per second rates occur only during the data phase, and all activity is asynchronous for command overhead.

2
Controller Technical Description

The HS array controllers provide functional connections between SCSI–2 storage devices and host computer interconnects using CI, DSSI, or SCSI host port buses (for HSJ, HSD30, or HSZ40 array controllers respectively). The following sections present brief overviews of controller hardware and functionality.

2.1 HS Array Controller Hardware Functional Overview

The HS array controllers each reside on a single module. Each controller consists of a controller module and its attached operator control panel (OCP) with front bezel. A separate 16- or 32-MB read cache module can be ordered with each controller.

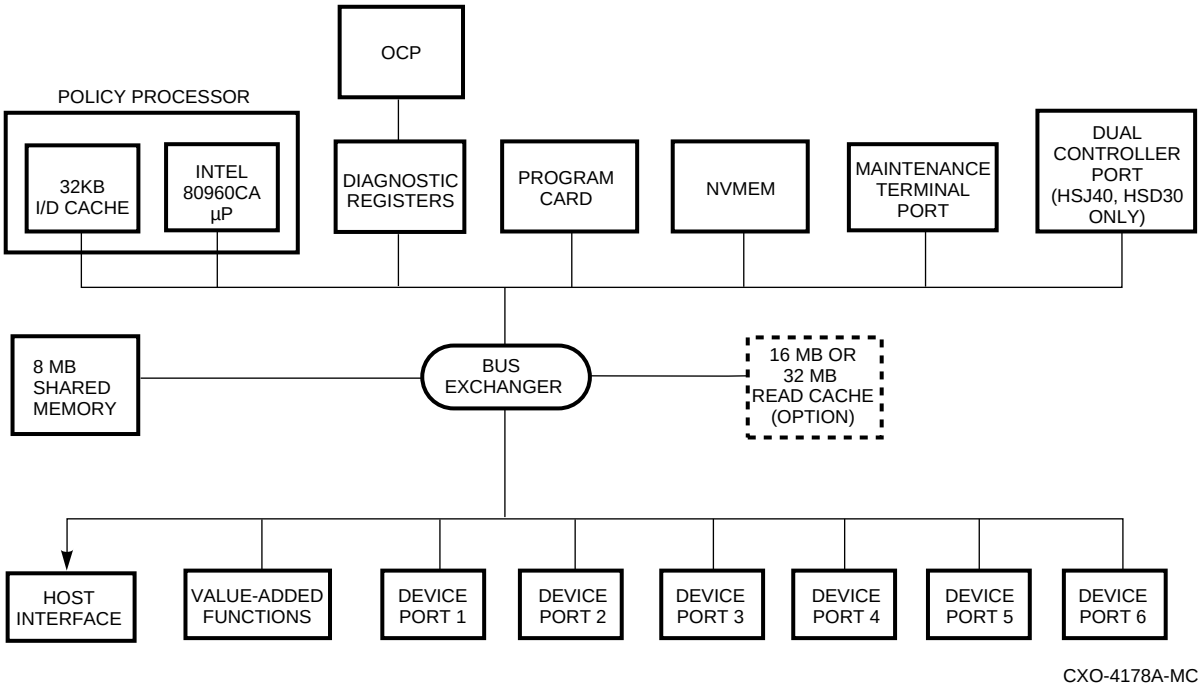
Each HS controller provides a connection to a host computer and an array of storage devices connected by SCSI–2 buses. A second controller also may be interconnected in a redundant arrangement called a **dual-redundant** configuration (for HSJ and HSD30 controllers). Maintenance terminals can be connected to each controller through a modified modular jack (MMJ) located on the front bezel of each controller. An EIA–423 compatible terminal, VCS, or serial line must be used. Restrictions may apply to some controller models for VCS support.

The HS controller hardware consists of the following:

- Policy processor hardware
- Program card
- Nonvolatile memory 32 KB battery backed-up SRAM (NVMEM)
- I/D cache (32 KB SRAM cache)
- EIA–423 maintenance terminal port with MMJ port (dual controller communication port)
- Operator control panel (OCP)
- Bus exchangers
- Shared memory (8 MB)
- CI, DSSI, or SCSI host interface (host port)
- SCSI–2 interfaces (device ports)
- 16- or 32-MB read cache module

Figure 2–1 is a functional block diagram for HS array controllers. The host interface block is controller specific. There are three to six SCSI device ports depending on the controller model (the block diagram shows six ports).

Figure 2–1 HS Array Controller Functional Block Diagram



2.1.1 Policy Processor Hardware

The policy processor hardware is used by the policy firmware processor to control all but the low-level device and host port operations. The policy processor also runs the controller firmware loaded from the program card.

2.1.2 Shared Memory

Shared memory consists of a gate array controller and associated buffer memory. This memory is shared between bus devices and contains data structures with data buffers. When no cache module is present with the controller, a portion of the controller module's shared memory is used during normal operation as a cache. When a read cache module is installed, the portion of the controller module's shared memory, otherwise used for caching, holds the cache module context for cache look-ups.

2.1.3 Bus Exchangers

The bus exchange devices allow high-speed communication between bus devices and shared memory. The bus exchangers allow all of the pieces of the controller to operate together. One bus exchange device handles the address lines, while the other one handles the data lines.

2.1.4 CI, DSSI, or SCSI Interfaces (Host Ports)

A CI, DSSI, or SCSI interface allows direct memory access of data between the host port and shared memory. Setup and maintenance of the host port is done by the policy processor hardware.

2.1.5 SCSI–2 Device Ports

The SCSI–2 device ports for the controllers are implemented using SCSI–2 port processor chips performing 8-bit operations in normal or FAST mode. The port 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)[1] SCSI–2 devices.

2.1.6 Read Cache Module

The read cache used with HS array controllers reduces the controller's latency and may increase I/O's per second for performance. During normal operations, a read operation from the host either accesses data currently in the controller's cache or obtains the requested data from a disk.

If a host read operation is a cache "hit" (data is already contained in the read cache), the data is supplied back to the host immediately, thereby improving the I/O performance by reducing latency.

If the host read operation is a cache "miss" (data is not in the read cache), the controller accesses the appropriate disk to satisfy the request. The controller then reads the data, returns it to the host, and writes it to the cache.

For host write operations, data is written to the cache *and* the disk. This write-through caching improves the performance of subsequent reads of data previously written.

Cache transfer sizes have a maximum size of 64 KB (128 logical blocks) enabled per logical unit. Read caching is enabled by default at 16 KB (32 logical blocks), and can be optionally enabled or disabled using the CLI SET unit-number command. (This feature can be used on a per unit basis.)

Transfers that are larger than the maximum size (or 64 KB, whichever is smaller) are not cached. This prevents large transfers from flushing the cache.

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

2.1.7 Operator Control Panel

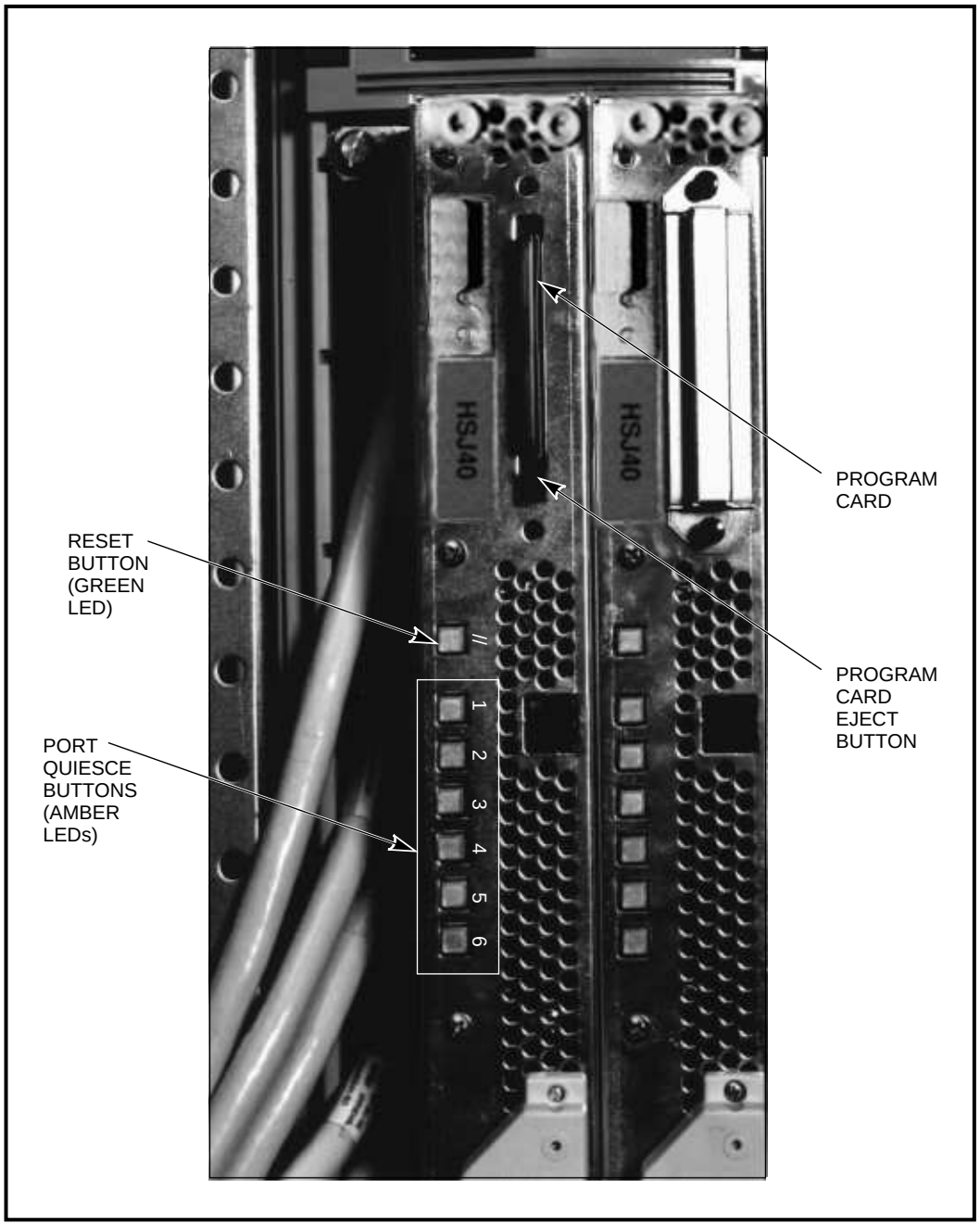
The operator control panel (OCP) LEDs reflect the state of the controller or the external bus. The green OCP LED is reserved for the controller, and the amber LEDs are reserved for the SCSI–2 port information. When a fault condition (hard failure) occurs, the OCP LEDs indicate a fault code. If a controller has ceased functioning, the green LED is lit continuously.

The controller can be reset/restarted (if needed) by pressing the reset (//) button on the OCP.

Figure 2–2 shows the OCP on an HSJ40 controller's front bezel. (The EMI shield shown on the second controllers is no longer used.)

[1] A dual-redundant controller configuration supports 36 devices. Lower availability configurations can support up to 42 devices (7 per SCSI–2 port), but this will sacrifice a convenient upgrade to any of the possible higher availability options.

Figure 2–2 HSJ40 Controller OCP and Program Card Locations



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The following sections briefly describe the physical appearance of the operator control panels for HSJ30, HSJ40, HSD30, and HSZ40 controllers.

2.1.7.1 HSJ40 and HSJ30 Controller OCP

The OCP for the HSJ40 array controller has seven buttons with embedded LEDs. The HSJ30 controller uses the same OCP, but only three of the six port buttons can be used functionally to quiesce a port. All six amber LEDs on the HSJ30 and HSJ40 controller's OCPs report fault codes. Both controllers utilize the reset button.

The buttons and LEDs serve two functions. The green button resets the controller. The other amber buttons allow the port (associated with each button) to be *quiesced* when the button is pushed, allowing for a device warm-swap procedure, thus decreasing subsystem down time. The OCP is sometimes referred to as the bus quiesce panel.

2.1.7.2 HSD30 Controller OCP

The OCP for the HSD30 array controller has one button with embedded green LED for the reset button, and three recessed port buttons. There are six amber LEDs located directly to the left (for vertically mounted controllers) of the port buttons. The LEDs are located under the port buttons when the OCP is mounted horizontally.

The buttons and LEDs serve two functions. The green button is used to reset the controller. The three recessed buttons allow the port (associated with each button) to be quiesced when the button is pushed, allowing for a device warm-swap procedure, thus decreasing subsystem down time. You need a pointed object to push the port buttons.

2.1.7.3 HSZ40 Controller OCP

The operator control panel for the HSZ40 array controller has one button with embedded green LED for the reset button, and six recessed port buttons. The six amber LEDs for the associated port buttons are located directly to the left (for vertically mounted controllers) of the port buttons. The LEDs are located under the port buttons when the OCP is mounted horizontally.

The buttons and LEDs serve two functions. The green button is used to reset the controller. The six recessed buttons allow the port (associated with each button) to be quiesced when the button is pushed, allowing for a device warm-swap procedure, thus decreasing subsystem down time. Use a pointed object to push any of the three port buttons.

2.1.8 Program Card

The program card is a PCMCIA standard program card device. The firmware for the controller is loaded from the program card into the shared memory of the controller module each time the controller initializes. The firmware is validated prior to loading into shared memory.

The program card must remain in place when the controller is in operation. Removing the program card during operation causes the controller to go into a reset state. To recover from this state, push the program card back into place and press the controller's reset (//) button.

In a dual-redundant controller configuration, both program cards must be the same firmware revision. If not, the controllers in the configuration will not allow access to any devices.

Figure 2–2 shows the program card location in a controller front bezel and its associated eject button.

2.1.9 Nonvolatile Memory (NVMEM)

The HS array controller module has 32 KB of battery backed-up, nonvolatile memory. This memory stores parameter information and assists with value-added functions.

2.1.10 EIA–423 Maintenance Terminal Port

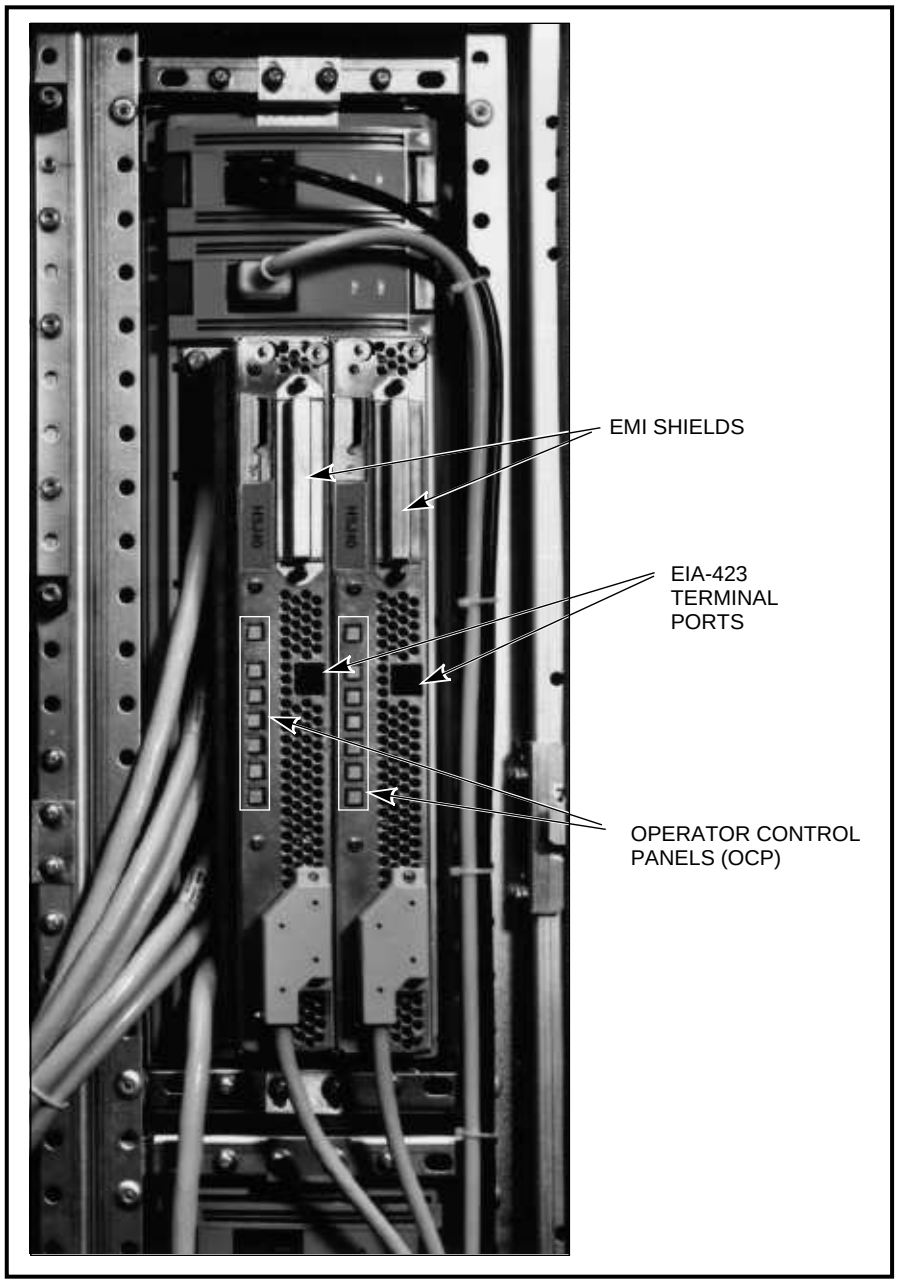
Each controller has a modified modular jack (MMJ) on its front bezel that supports EIA–423 compatible terminals. A terminal is plugged into the jack during subsystem installation to set initial controller parameters. Either a maintenance terminal or a virtual terminal using a DUP connection can be used to add devices, stripesets, and so on. Refer to Figure 2–3 for the location of the EIA–423 terminal port.

Note

The EMI shields shown in Figure 2–3 were shipped on the original HSJ40 controllers. Through FCC testing it was determined that these shields were unnecessary. EMI shields are no longer shipped with any HS array controllers.

If a terminal is plugged into a controller in a dual-redundant configuration, and the controller is still functioning, you can communicate with the other controller in the configuration.

Figure 2–3 Location of the EIA–423 Maintenance Terminal Ports



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2.1.11 Dual Controller Port

The HSJ and HSD30 controllers have an internal port that allows communication through the backplane with a second controller within the same controller shelf. This port is used in dual-redundant configurations allowing one controller to take over for the other controller. This process is called **failover**. During failover the "surviving" controller supports the SCSI–2 device ports and attached devices from the other (failed) controller.

2.2 HS Array Controller Firmware Overview

The HS array controller firmware, called **Hierarchical Storage Operating Firmware (HSOF)**, consists of diagnostics, functional code, and utilities. The firmware architecture features a common core of routines to handle the SCSI–2 device ports, a series of firmware routines to handle each supported host interconnect, and a set of value-added functions such as disk caching and failover (refer to Section 2.3 for a description of failover).

Controller firmware is loaded on the program card. Once the card is inserted and locked into place (and only after the contents are validated), the contents of the program card are loaded into shared memory of the controller module. Each time the firmware is updated, a new program card is made available and can be purchased with an update package or an update service contract.

After the contents of the program card are copied to shared memory, most of the diagnostics, and all the functional code and utilities run from shared memory on the controller.

The HS array controller's software includes the following five sections of software:

- Core functions—Diagnostics and the controller executive
- Host interconnect functions—Host port, host interconnect services, and system applications (SYSAP)
- Extended/user/system manager functions—Command line interpreter (CLI), DUP (or HSZUTIL) support, and error logging/fault management

Note

Refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* for details concerning the host application called HSZUTIL.

- Devices services—SCSI–2 port control software (command, data, and error recovery)
- Value added functions—Data mapping, caching, state change, FOC (failover), storage set member management, and error recovery

A summary of HS controller peak performance is presented in Table 2–1. These performance figures assume that the host interface has twice the overhead of the SCSI–2 device ports. The throughput request sizes are 512 bytes, while the bandwidth requests are 64 KB in size. Increasing the request sizes decreases the throughput performance due to bus bandwidth limitations.

All of the following performance figures assume that the underlying storage devices can satisfy the I/O load, and that the host systems are capable of generating the I/O stream. Some of these performance numbers were measured using multiple host adapters per bus to a single controller. The best performance for throughput and the best performance for bandwidth are reported (not necessarily from the same hardware configuration). Please note that different configurations and host parameter settings can produce different performance results.

Table 2–1 HS Array Controller Peak Performance

Controller Type	Requests/Second Throughput	MB/Sec Bandwidth
HSJ (CI) goal	1400	6
HSJ40 (CI) measured	1400	5
HSJ30 (CI) measured	1300	3.5
HSZ40 (SCSI) goal	1400	6
HSZ40 (SCSI) measured	1400	8-10
HSD30 (DSSI) goal	1100	4
HSD30 (DSSI) measured	1000	3

These performance statistics are subject to change. Refer to product specific *HS Array Controller Operating Firmware Release Notes* for the most current performance information.

2.2.1 Core Functions

The core functions of HS array controller firmware provide the following:

- Test and diagnostic capabilities
- Executive functions
- Maintenance functions
- Subsystem management functions

These functions are described in the following sections in the order they are used, beginning with the controller being powered on.

2.2.1.1 Controller Self-Test

The controller self-test is performed at power-up as a go/nogo status of the controller subsystem. This self-test includes a test of the cache modules.

Self-test is fault tolerant with respect to the following:

- Memory maps around bad spots in the memory of the cache.
- SCSI ports—Five ports (for HSJ40 or HSZ40 controllers) or two ports (for HSJ30 or HSD30 controllers) can be bad and the controller will still initialize.
- Half or all of the cache can be bad and the controllers will still initialize.
- CACHE tests are partitioned to speed up the initialization of the controller and still fully test the cache.

2.2.1.2 Storage Connectivity

Storage connectivity functions include the following:

- SCSI–2 device services (8 bit, single-ended normal or FAST synchronous mode)
- Device port driver
- Disk and tape drive support on one controller (includes optical devices and tape loaders)
- Physical device addressing and access

2.2.1.3 Maintenance Functions

Maintenance functions include the controller-based exercisers, such as DILX and TILX, for the attached SCSI–2 disk and tape drive devices. These utilities generate a (user-selected low or high) load on the controller, bypassing the host port.

2.2.1.4 Management Functions

The following functions are *not* required for normal controller data storage and retrieval operations, but they are useful for system management configuration, performance, and fault monitoring:

- Setting parameters and displaying status
- Diagnostic Utility Protocol (DUP)
- Error log reporting and recovery
- Hardware diagnostics
- VTDPY status display utility

2.2.2 Host Interconnect Protocols

The three host interconnections supported by the HS operating firmware are CI, DSSI, and SCSI. The following lists the protocols used between the host and each HS array controller model:

- **CI** (HSJ)—SCS and MSCP (and/or TMSCP) protocols and DUP, DUP remote console, HBVS assists, and sequential tape and tape loaders.
- **DSSI** (HSD30)—SCS and MSCP (and/or TMSCP) protocol and DUP, DUP remote console, HBVS assists, and sequential tape and tape loaders.
- **SCSI** (HSZ40)—SCSI–2 protocol with SCSI pass-through software to the command line interpreter (CLI), command queuing, and mode select/sense support for SCSI.

2.2.3 Value-Added Functions

The controller's firmware contains value-added functions to enhance basic availability, performance, subsystem management and maintenance, and connectivity features offered in the firmware. The firmware also contains value-added unique functionality features, that are described in the following sections.

- Availability functions

  A 15-second failover capability for the CI and DSSI host interfaces are available in dual-redundant HSJ and HSD30 array controller configurations.

- Performance functions

  Performance of the controller is enhanced by the value-added performance function of read caching with basic least recently used (LRU) replacement. For stripesets, parallel transfer initiation is performed to and from all stripeset members simultaneously.

- Maintenance and management functions

  The controller firmware contains the value-added feature of device warm swap support.

- Connectivity functions

The HS array controllers provide a flexible interconnecting bridge between SCSI–2 devices and a host computer using CI, DSSI, or SCSI interconnects.

HS controllers provide interconnect connections to host computer interfaces and arrays of devices connected to a maximum of six SCSI–2 buses for HSJ40 and HSZ40 controllers (HSJ30 and HSD30 controllers support a maximum of three SCSI–2 buses). Mixed disk drives, tape drives, and other devices can be connected allowing for model-specific restrictions.

A second (redundant) HSJ or HSD30 controller also can be interconnected. EIA–423 compatible terminals can be connected to one or both EIA–423 terminal ports. A VAXcluster console system (VCS) or serial interface also can be connected to the EIA–423 terminal port for maintenance and installation.

- Unique functionality

  HSJ and HSD30 controller firmware supports mixed disk and tape drives on the same port. Refer to the model-specific SPD and operating firmware release notes for any specific information, restrictions, and changes.

2.3 What Is Failover?

The following section describes what failover is and how it works. For more information about the SET FAILOVER and SET NOFAILOVER commands and their qualifiers, refer to Appendix B.

Failover is the software process that takes place when one HS controller fails in a dual-redundant controller configuration. In a failover (dual-redundant) configuration, information is shared between the two controllers, such as:

- Storage set names
- Actual device configuration (PTL descriptions) and the association to named storage sets
- Logical unit definitions

Devices and stripesets are defined as **containers**. Once defined, the configuration is automatically communicated between the two controllers.

All resources will be considered “unbound” to a particular controller until a logical device is brought online by a host using one of the controllers. At this point, all containers used by the logical unit become solely accessible to the controller through which the logical device was brought online.

In a failover configuration, all commands are shared between the two controllers with the exception of the following commands:

- 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 is directed to the correct controller, THIS_CONTROLLER referring to the controller that the maintenance terminal is connected to or the target of the virtual terminal connection, and OTHER_CONTROLLER referring to the other controller that makes up the dual-redundant pair.

To place both controllers into a failover configuration, enter the following command at the CLI> prompt:

```
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 located.

CAUTION

If a failover configuration is to be set up using two new controllers, Digital recommends that the controllers be placed in a failover configuration (by entering the SET FAILOVER command) BEFORE any device configuration commands are performed. Then, as devices, storage sets, and units are added to the controller, they are automatically added to the other controller as well.

IMPORTANT: Given two unconfigured controllers, it is possible to fully configure one controller, then enter the SET FAILOVER command. However, if the wrong controller is specified on the COPY= qualifier, all device configuration information will be *lost*.

If a new controller is added to an existing configuration, the SET FAILOVER command must be used with great care, specifying the existing controller (with the "good" device configuration information) after the COPY= qualifier.

To remove a controller from a failover configuration, enter the following command at the CLI> prompt:

```
CLI> SET NOFAILOVER
```

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

The first command in the following example places two controllers into a failover configuration where the "good" data is *not* on the controller that is attached to the terminal. (This would be typical of installing a new controller. The maintenance terminal would be attached to the new controller to set the controller's ID, to set the SCS node name, to turn on paths to the host, and to set failover.) The second command in the example is how two controllers are taken out of a failover configuration.

```
CLI> SET FAILOVER COPY=OTHER_CONTROLLER
CLI> SET NOFAILOVER
```

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 and cache module, if any, attached to the failed controller will become available to and accessible through the operating controller.

In a dual-redundant configuration, both controllers have copies of the same information. Even if you configure disk drives, tape drives, storage sets, and units after entering the SET FAILOVER command, the configuration information is communicated between the two controllers in real time, so their configurations are always identical. This is how the surviving controller knows the configuration if the other controllers fails.

CAUTION

All device configuration information on the controller NOT specified by the COPY= qualifier is overwritten by the configuration information found in the controller specified by the COPY= qualifier. Make sure you know where your good and/or complete copy of device configuration parameters is stored BEFORE entering this command.

A considerable amount of work and effort could easily be lost by overwriting a good configuration information with incorrect information if the wrong controller is specified by the COPY= qualifier.

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.

In a dual-rendundant configuration, failover should normally complete in 30 seconds or less. 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 30 seconds to complete, that is less than 5 seconds per port (for an HSJ40 controller).

2.3.1 Failover Testing

Failover testing can be safely performed by pressing the program card eject button on either of the running controllers in a dual-redundant configuration, causing a hard reset of the controller. The controller remains in a reset state until you reinsert the program card and momentarily push the OCP reset (//) button.

3

Configuration Rules and Restrictions

This chapter describes configuration rules and restrictions for standard and nonstandard (customized) HS array controller subsystems. When specific rules and restrictions are not provided, references are given to the proper StorageWorks documentation.

Note

Configuration rules and restrictions apply to all HS array controller platforms (HSJ30, HSJ40, HSD30, and HSZ40 array controllers) unless stated otherwise.

3.1 Ordering Considerations

Digital provides the following configuration approaches for ordering HS controller subsystems:

- Preconfigured (packaged) systems (standard starter subsystems)
- Configured-to-order (CTO) systems (custom configurations)
- A combination of preconfigured and CTO systems

Refer to Appendix A for a list of preconfigured controller subsystem option numbers. Not all controller models have preconfigured subsystem option numbers. Your Digital sales representative can assist you with order numbers.

3.2 Cabinets

The following considerations apply when loading controller and storage shelves in SW800-series data center cabinets and SW500-series cabinets.

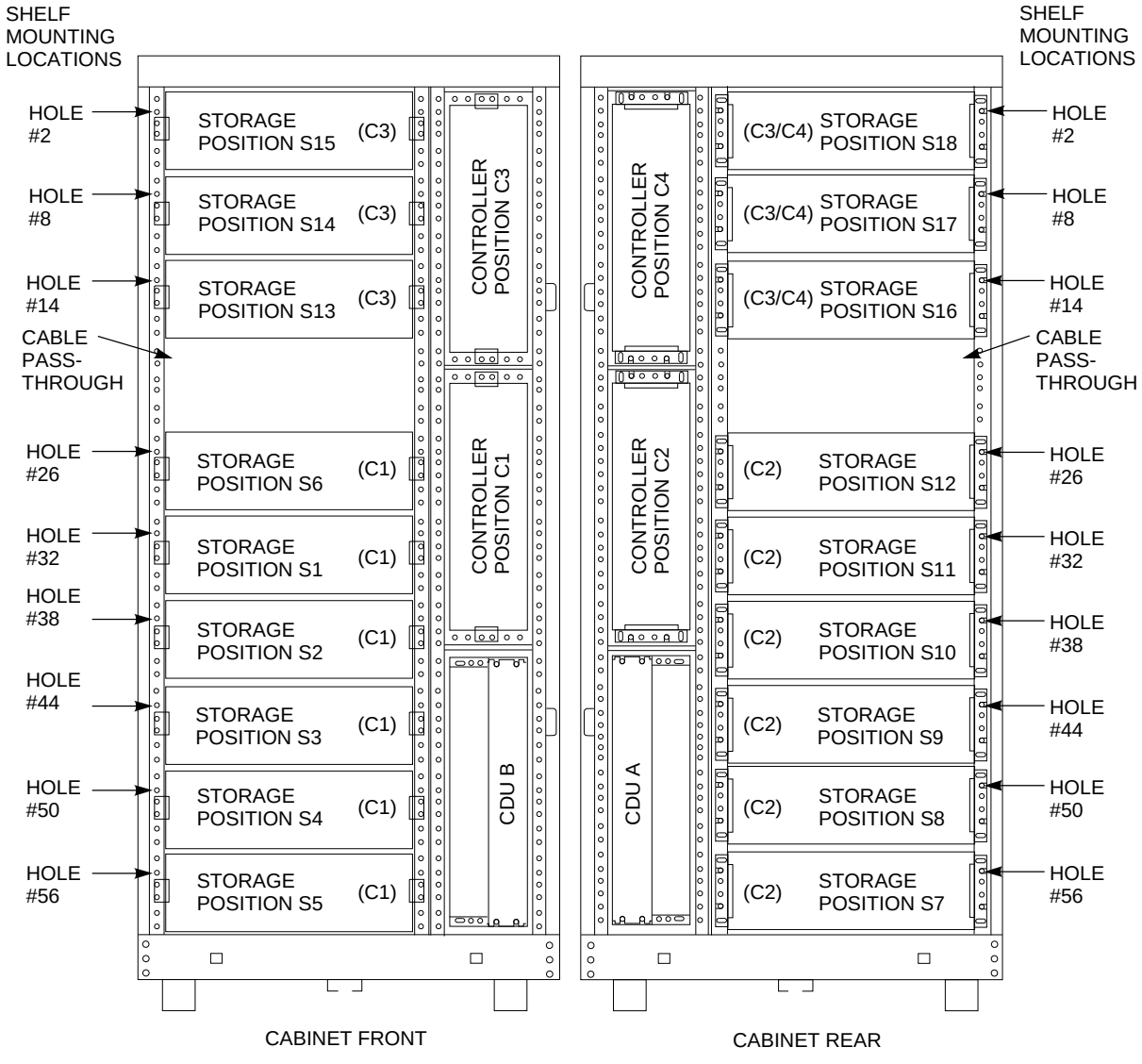
Note

In the loading sequence illustrations in this chapter, the designator “S” indicates a BA350–SB storage shelf and the designator “C” indicates a BA350–MA controller shelf.

3.2.1 SW800-Series Data Center Cabinet

This section describes the rules that apply to controller subsystem configurations in SW800-series data center cabinets. Figure 3–1 shows the loading sequence for storage and controller shelves (without tape drives) in an SW800-series data center cabinet.

Figure 3–1 SW800-Series Data Center Cabinet Loading Sequence (With No Tape Positions)



The following rules apply to subsystem configurations in SW800-series data center cabinets:

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

- 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. (The associated BA350–MA controller shelf must be near enough to satisfy this restriction.)
  - 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.
- Any TZ8x7 half-rack tape loader device must be located at the top front (each tape loader occupies the full cabinet depth) positions, filling the two top BA350–SB shelf positions (front and back). Up to four tape drive loader devices can be loaded in an SW800-series data center cabinet, displacing shelves S6 and S12-S18.

  Figure 3–2 and Figure 3–3 show the loading sequence for storage and controller shelves when two or four TZ8xx-series tape devices are installed in a SW800-series data center cabinet.

Figure 3–2 SW800-Series Data Center Cabinet Loading Sequence with Two Tape Drive Positions

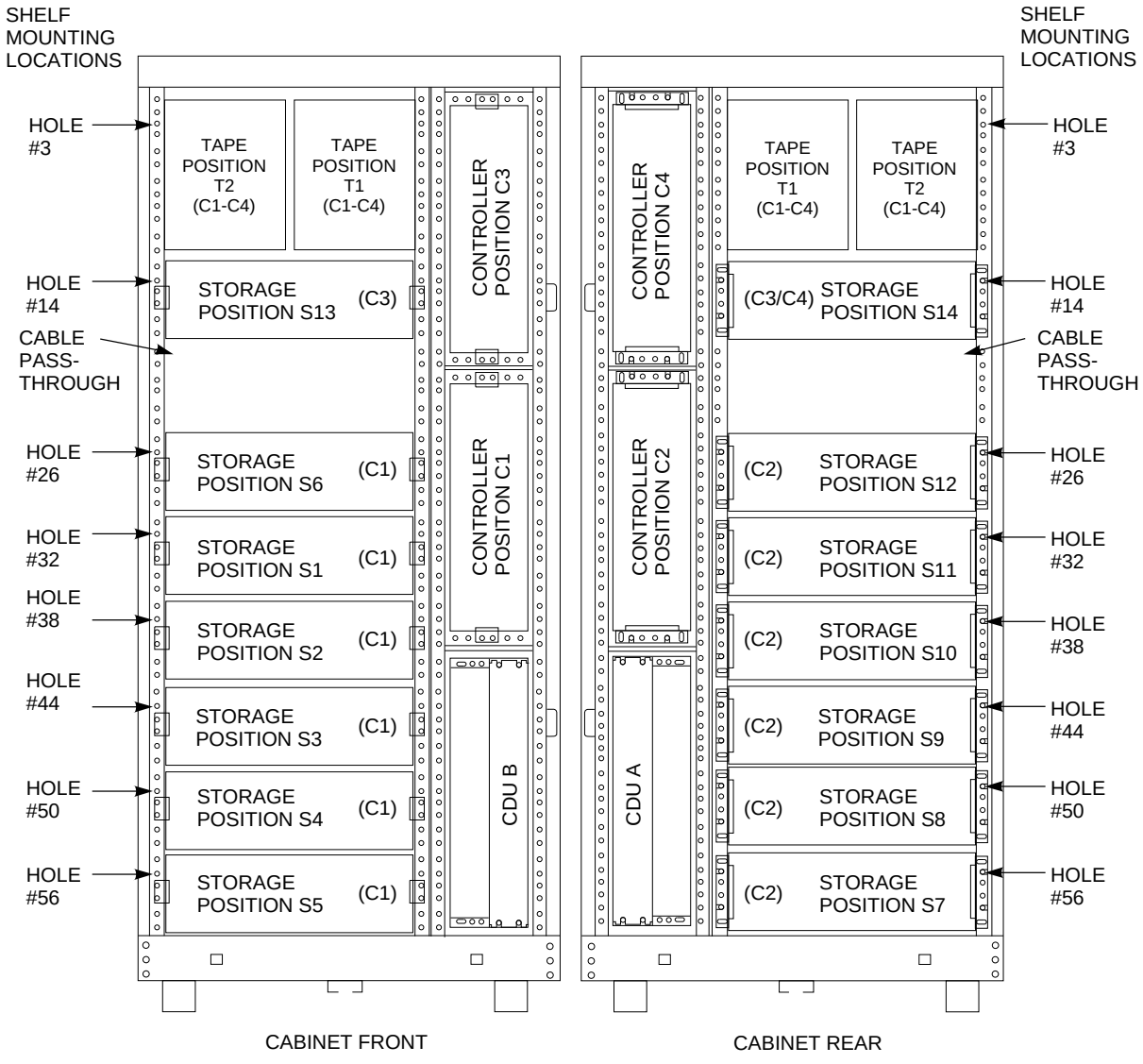
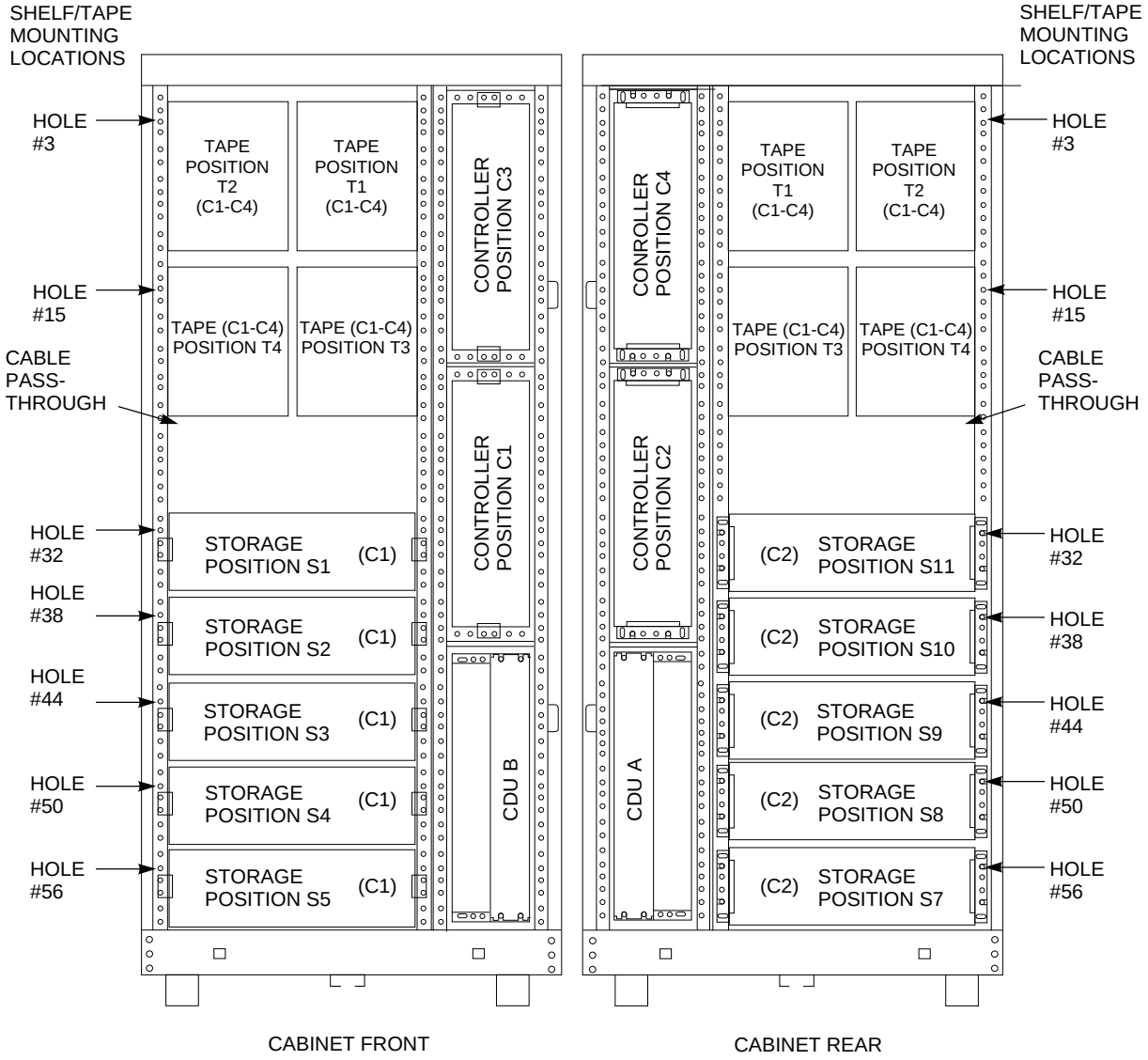


Figure 3–3 SW800-Series Data Center Cabinet Loading Sequence with Four Tape Drive Positions



CXO-4162C-MC

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 2.0 meter SCSI–2 cable (order number BN21H–02), which is then connected to one of the controller's SCSI–2 ports.

- Using a fourth controller shelf: By convention, the third controller shelf (C3) would use (only) the top three (or four) storage shelves in the front of the cabinet, and the fourth controller shelf (position C4) would use the top three (or four) storage shelves in the back of the cabinet. (Refer to Figure 3–1.)
- Up to 42 devices can be attached, using seven 3½-inch SBBs in each of six BA350–SB shelves, attached to controllers with six controller ports.

Note

Redundant power or a dual-redundant controller is not supported when using 42 devices. This is not a Digital recommended configuration.

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

Refer to the *StorageWorks SW800-Series Data Center Cabinet Installation and User's Guide* for more details.

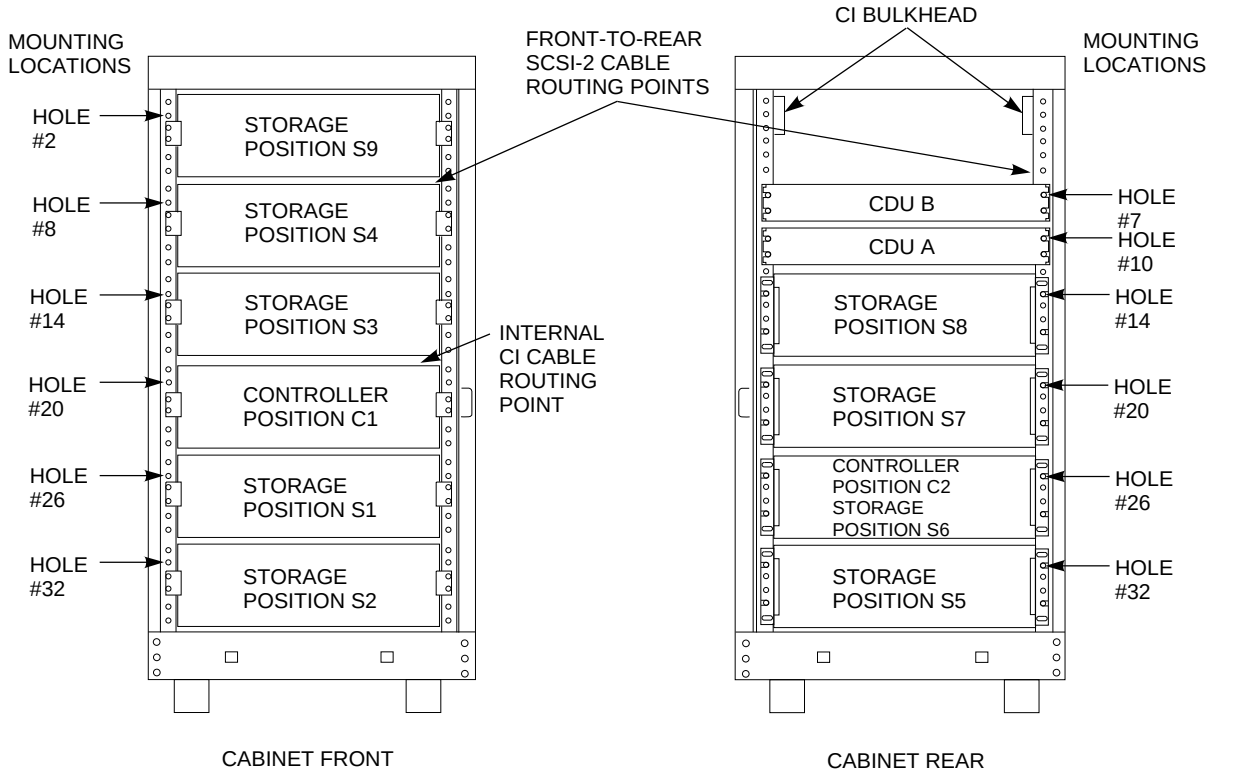
3.2.2 SW500-Series Cabinets

This section describes the rules that apply to controller subsystem configurations in SW500-series cabinets. Figure 3–4 shows the loading sequence for storage and controller shelves in an SW500-series cabinet.

The following rules apply to controller subsystem configurations in an SW500-series cabinet:

- 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.
- 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. The associated BA350–MA controller shelf must be located near enough to satisfy this restriction.
  - 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 the first restriction. Thus, a single subsystem (C1) can accommodate up to 16 5¼-inch SBBs.

Figure 3–4 SW500-Series Cabinet Loading Sequence



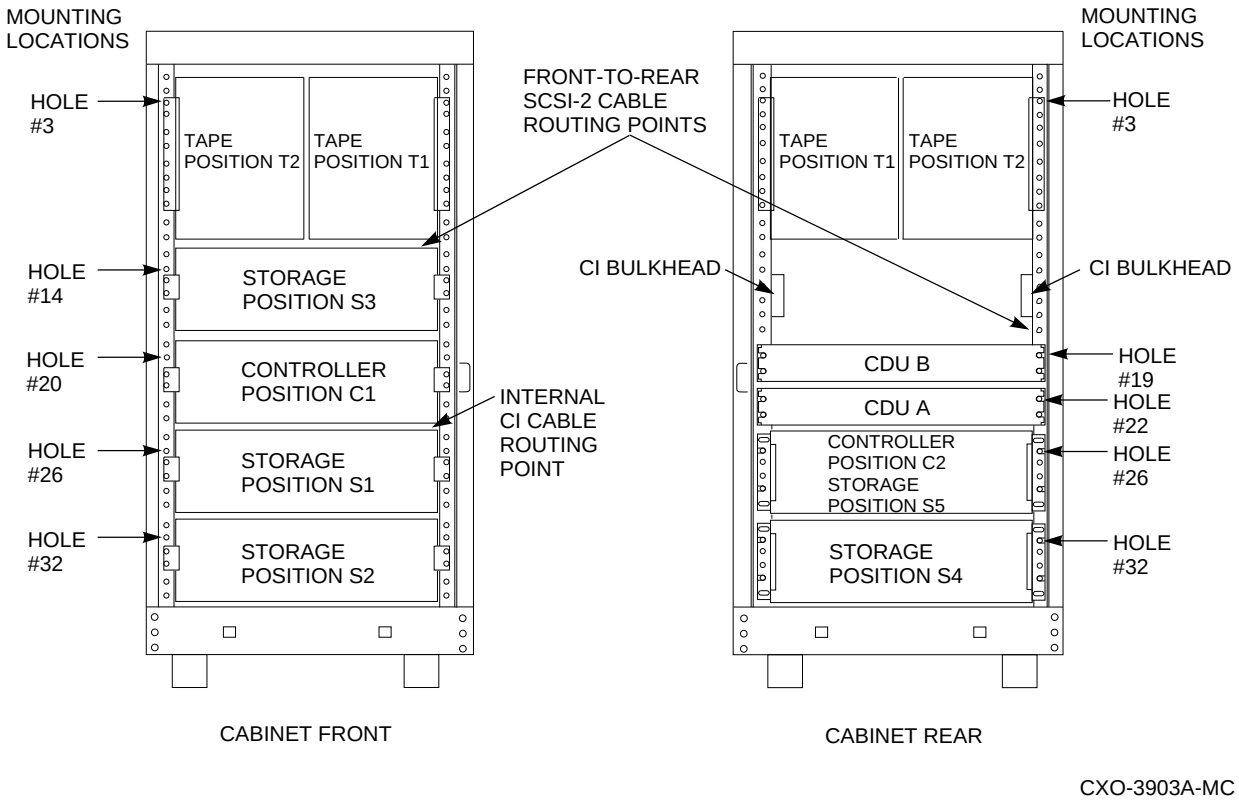
CXO-3902A-MC

- Any TZ8x7 half-rack tape loader must be located at the top front (each tape loader occupies the full cabinet depth) positions, filling the two top BA350–SB shelf positions (front and rear). 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 devices must be connected (as in the SW800-series data center cabinet) to a controller port.
- Use of a second controller shelf: By convention, the first controller shelf (C1) would use S1-S4 and S9; the second controller shelf (C2) would use 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).

Refer to the *StorageWorks SW500-Series Cabinet Installation and User's Guide* for more details.

Figure 3–5 shows the loading sequence for storage and controller shelves when TZ8xx-series tape devices are installed in an SW500-series cabinet.

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



3.2.3 Shelves

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

- No more than a single extension from one BA350–SB device shelf is permitted. The two BA350–SB shelves must be physically adjacent to each other. Intermixing 5¼-inch SBBs and 3½-inch SBB is permitted per StorageWorks configuration rules. Figure 3–6 shows an example of device shelves in a single extension configuration.
- 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) can be configured per controller port, and those devices must be physically adjacent to each other at the top of the cabinet.

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

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

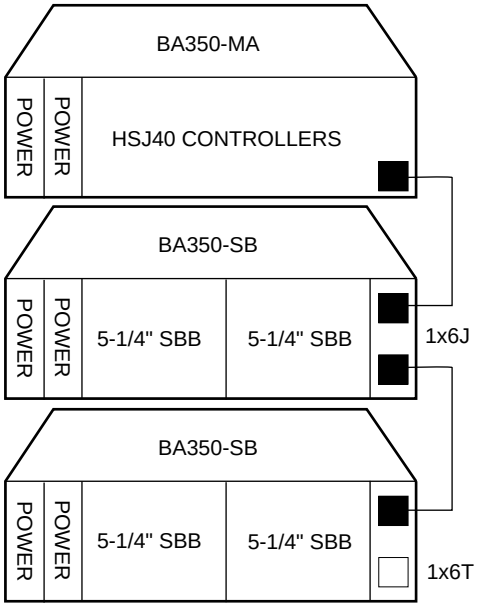
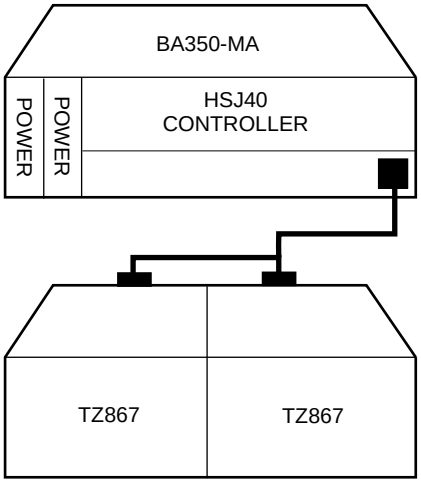


Figure 3–7 Adjacent Devices on a Single Port



- When using a 1.0 meter cable with a controller in the lower controller shelf position (C1) in the front of the SW800 or SW500 cabinet, all front-mounted shelves can be reached. The 2.0 meter cable reaches all shelves, but does not permit shelf jumpering. (Refer to Figure 3–1.)

3.3 Controllers

The following sections describe specifics for configuring controllers.

3.3.1 Nonredundant HS Controller Configurations

The following considerations apply to nonredundant controller configurations:

- The maximum recommended HS controller subsystem configuration is 6 devices per port (36 devices) for six port controllers, or 18 devices for 3 port controllers. This allows for the addition of another HS controller and additional power supplies in the storage shelves. A nonredundant controller configuration can support seven devices per port. However, Digital recommends 6 devices per port to permit the ease of future upgrades.
- A nonredundant controller should be installed in the controller slot furthest from the BA350–MA controller 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 storage shelf.
- For HSD30 controllers, only four HSD30 controllers per DSSI bus are allowed (for example, four nonredundant controllers, or one dual-redundant pair and two nonredundant controllers, or two dual-redundant pairs).
- HSZ40 controllers can currently only be configured as nonredundant. Two nonredundant HSZ40 controllers cannot be placed in the same BA350–MA controller shelf.

3.3.2 Dual-Redundant HS Controller Configurations

The following considerations apply to dual-redundant HS controller configurations:

- Only HSJ and HSD30 controllers can be configured as dual-redundant (at the time of this printing).
- Dual-redundant controllers are located in the same BA350–MA shelf, and are connected to each other through the controller shelf backplane. Both controllers have access to all the devices on each other's ports. This setup increase availability and provides for failover when one controller in the pair fails. (The surviving controller takes over service of all devices.)
- Dual-redundant controller configurations follow the same guidelines as nonredundant configurations, except there is no option to increase to 7 devices per port.
- Dual-redundant controllers must be on the same bus to the host.

3.3.3 Optimal Performance Configurations

For optimal performance, configure to the following guidelines:

- Balance the number of devices on each port of the controller, such as for 18 3½-inch SBBs, (three devices on each of the six 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.
- Intermixing higher and lower performance devices on each port is beneficial. Therefore, put higher performance devices on separate ports. For example, put multiple solid state disks on separate ports.

Use the guidelines given in Table 3–1.

Table 3–1 Number of High-Performance Devices per Number of Ports

Number of Relatively Higher Performance Devices	Maximum Number of Devices Configured per Port
1 - 6	1
7 - 12	2
13 - 18	3

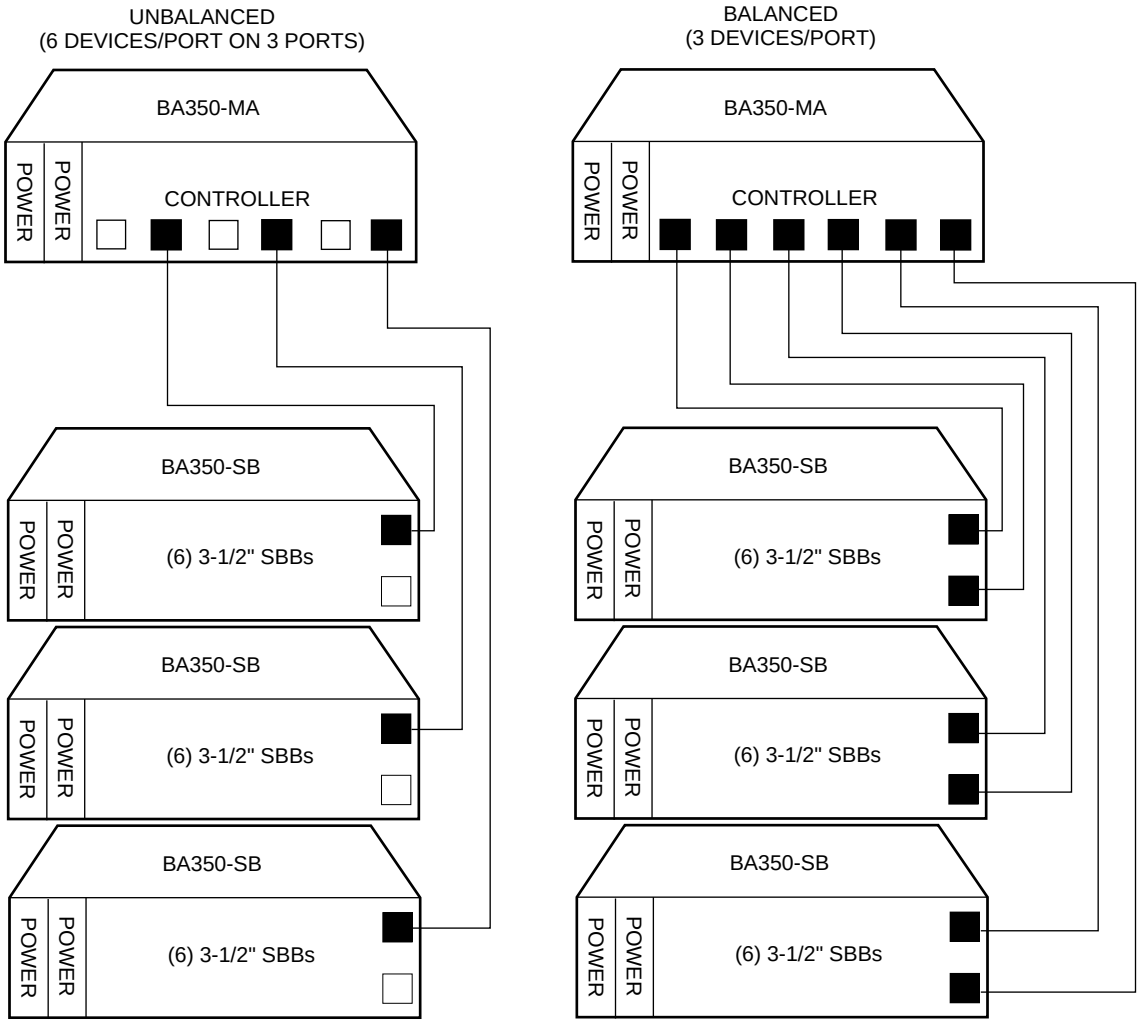
- Limit the number of devices per controller port to three in dual-redundant configurations. In doing so, both controllers access three devices per each other's port, maintaining six SCSI–2 devices total.
- Maximize the amount of cache memory per controller with the 16- or 32-MB cache module option.

3.3.3.1 Highest Performance

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

This results in approximately half of the devices normally accessed through each controller. Should one controller fail, its devices fail over to the other controller automatically. Refer to Section 2.3 for a description of the failover process.

Figure 3–8 Balanced Devices Within Device Shelves



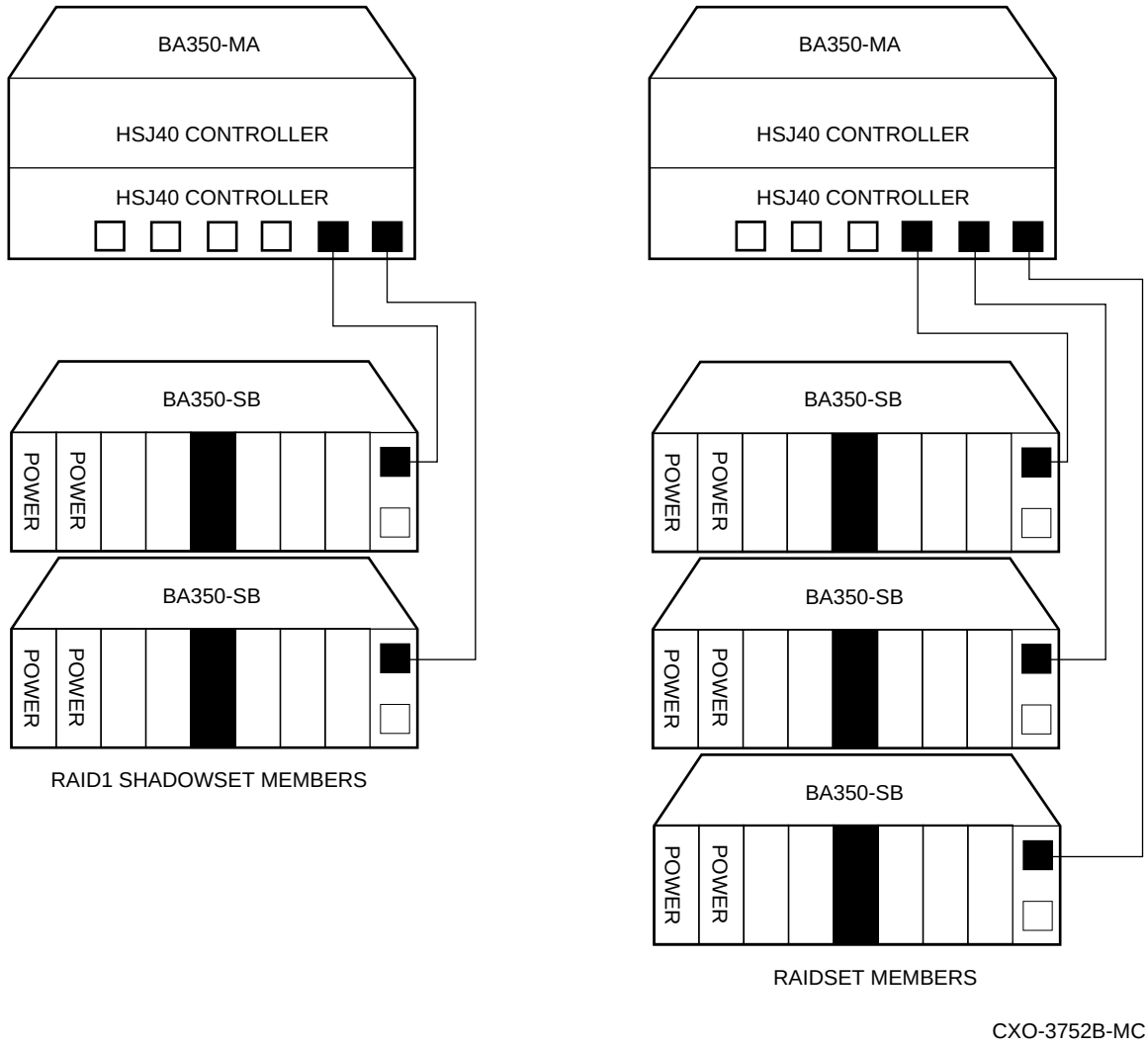
3.3.4 Optimal Availability Configurations

For optimal availability, configure to the following guidelines:

- Use 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 using host-based RAID implementations (for example, shadowing).

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

Figure 3–9 Optimal Availability Configuration Example



3.3.4.1 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.

3.4 Typical and Recommended Configurations

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

3.4.1 Table Conventions

The following describes the designations used in the following sections. Using these designations help you determine the possible devices in each shelf and the possible number of devices in similarly configured shelves:

```
(n)mxoT
```

or

```
(n)mxoJ
```

Where:

n is the number (in parentheses) of device shelves of this type.
m is the number of SCSI–2 connections to a device shelf.
o is the number of devices on each SCSI–2 connection.
T is the device shelf is terminated.
J is the device shelf is jumpered.

Using these translations and the following formulas, you can determine the following:

(*m* * *o*) is the number of possible devices in each shelf.

(*n* * *m* * *o*) is the possible number of devices in similarly configured shelves.

3.4.2 3½-Inch SBB Restrictions

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

3.4.2.1 3½-Inch SBB Recommended Configurations

Tables 3–2 and 3–3 list some recommended configurations for 3½-inch SBBs in 6-port and 3-port controller configurations.

Table 3–2 3½-Inch SBB Configurations, 6-Port Controllers

Number of Devices	Number of BA350–SB Shelves*	Configure as**	Available as 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

Key for Table Conventions

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

1x6T refers to a single path SCSI–2 connection terminated in the shelf. The devices appear as IDs 0 through 5.

1x7T refers to a single path SCSI–2 connection terminated in the shelf. The devices appear as IDs 0 through 6.

Parentheses ( ) around a number indicates the number of device shelves.

T indicates that the shelf is terminated.

* Consult *StorageWorks Solutions Shelf and SBB 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 only (not recommended) for 6 port controllers.

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 unused for a 1x6T or 1x7T.

Table 3–3 3½-Inch SBB Configurations, 3-Port Controllers

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 and SBB 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).

3.4.3 5¼-Inch SBB Restrictions

The following restrictions apply when using 5¼-inch SBBs in your configuration. Refer to your model-specific 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 10 shelves) can be used within each SW800-series data center cabinet. The sixth port is left unused. Alternately, four jumpered ports permit two single-shelf connections on the remaining two controller ports, which is preferable.

  This is permitted only in the lower front of the cabinet from the C1 controller position. Five such ports can take up to a maximum of 10 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 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.

3.4.3.1 5¼-Inch SBB Recommended Configurations

Tables 3–4 and 3–5 list some recommended configurations for 5¼-inch SBBs exclusively.

Table 3–4 5¼-Inch SBB Configurations, 6-Port Controllers

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		

†Cannot be configured in SW500-series cabinets.

Key for Table Conventions

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).

Parentheses ( ) around a number indicates the number of device shelves.

T indicates the shelf is terminated.

J indicates the shelf is not terminated and jumpered to the next shelf.

* Consult the *StorageWorks Solutions Shelf and SBB User's Guide* to configure BA350–SB storage shelves.
** 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 Figure 3–1 for SW800-series data center cabinet controller positions.)

Table 3–5 5¼-Inch SBB Configurations, 3-Port Controllers

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

†Cannot be configured in SW500-series cabinets.

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 and SBB User's Guide* for BA350–SB shelf information.
** Available for additional 5¼-inch device.

3.4.4 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 can be located in the same shelf with three or four 3½-inch SBBs.

3.4.5 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. Table 3–6 lists the minimum shelf count for various numbers of 3½-inch SBBs in an SW800 data center cabinet for 6-port controller configurations and Table 3–7 lists them for 3-port controller configurations.

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

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

Key for Table Conventions

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

Table 3–7 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 and SBB User's Guide* for BA350–SB shelf information.
** Nonredundant controller and power configurations (not recommended).

3.5 Host Adapter Support

The following host adapters are currently supported for HSJ array controllers:

- CIXCD (for XMI based systems)
- CIBCA–B (for BI based systems)
- CI780 (for SBO based systems)

Note

Refer to the *VAXcluster Systems Guidelines for VAXcluster System Configurations* manual for a list of CPUs supported by these adapters.

The CIBCA–A, which is superseded by the CIBCA–B host adapter, is not supported.

The HSJ controllers follow the same CI configuration rules as the members of the HSC controller product family that support from 1 to 31 host nodes.

The following host adapters are currently supported for HSD30 array controllers:

- SHAC (for various DEC and VAX systems)
- D4000 (for DEC 4000 systems)
- KFMSA (for XMI based systems)

The following host adapters are currently supported for HSZ40 array controllers:

- KZTSA (for DEC 3000 systems). See the HSZ40 release notes for restrictions.
- KZMSA (for DEC 7000/10000 systems via DWZZA)

Refer to model-specific HS array controller SPD and firmware release notes for restrictions and the most current information.

4
Installation

4.1 Customer Site Preparation

Site planning and preparation are necessary before installing an HS array controller subsystem. Site preparation activities should have been completed before you received your subsystem order. However, if your planning or preparation was incomplete, complete all required site preparation before you begin the installation process.

WARNING

To prevent damage to equipment and personnel, make sure all power sources meet the specifications required for this equipment.

Your site preparation plan should include:

- Power requirements
- Floor space requirements
- Environmental considerations (such as temperature and humidity)
- Device environment (including maximum altitude for operation and storage)
- Subsystem weight considerations (for floor supports)
- Upgrade considerations (for future subsystem expansion)

Refer to the *StorageWorks SW800-Series Data Center Cabinet Installation Guide* or *StorageWorks SW500-Series Cabinet Installation and User's Guide* for details concerning site preparation and unpacking information for your controller subsystem cabinet.

Using a site preparation plan helps you fulfill the requirements to support your controller subsystem. After verifying that all requirements are met, you are ready to install your controller subsystem.

The following sections contain information you should read before installing your controller subsystem.

4.1.1 Power and Power Cord Requirements

Before installing your controller subsystem, ensure that the correct power cable for your site is attached to the cabinet's cable distribution unit (CDU), and that the power requirements for your country and your site have been met at the cabinet level.

For specific information about power cord plugs, refer to the *StorageWorks SW800-Series Data Center Cabinet Installation Guide* (three phase) or the *StorageWorks SW500-Series Cabinet Installation and User's Guide* (single phase).

4.1.2 Shelf Power Configuration Rules

Refer to the *StorageWorks Solutions Shelf and SBB User's Guide* for specific power unit configuration rules. The term power unit describes both power supplies and battery backup units.

4.1.3 Environmental Considerations

The HS array controller subsystem operates in a business or light industrial environment that complies with FCC Class A computing device standards. The cleanliness of the site is important for the operation of any computer system, and HS controllers require adherence to cleanliness standards. Temperature and humidity standards must be met to maintain proper operation of your subsystem.

4.1.4 Environmental Specifications

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

Table 4–1 StorageWorks Environmental Specifications

Condition	Specification
Optimum Operating Environment	
Temperature Rate of change Step change	+18° to +24°C (+65° to +75°F) 3°C (5.4°F) 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) MS

4.2 Before You Begin

Before you begin installing your HS array controller subsystem, consider the following items:

- How many people are needed for unpacking and installation?
- What type of tools are needed for unpacking and installation?
- What ESD protection is required?

The following sections discuss these items.

4.2.1 Personnel Needed for Installation

The number of people needed to install an HS array controller subsystem depends on the size and weight of the subsystem cabinet. Most add-on options require only one person.

A fully-loaded SW800-series or SW500-series cabinet can require two to three people to remove it from the shipping pallet because of the cabinet's weight. For details, refer to the *StorageWorks SW800-Series Data Center Cabinet Installation Guide* or the *StorageWorks SW500-Series Cabinet Installation and User's Guide*.

4.2.2 Tools Needed for Installation

The following tools may be needed during the installation of your controller subsystem:

- Wrench to lower and tighten the four cabinet leveler feet.
- Allen wrench (5/32-inch) to open the cabinet front door for installing a second controller module, or read cache module upgrade.
- Allen wrench (3/32-inch) to remove the front OCP bezel.
- Small straight-edge screwdriver to install host port cables.
- ESD wrist strap for handling the controller or cache modules (if applicable). The part number for the Portable Anti-Static Kit is 29–26246–00.
- A pointed object, such as a ballpoint pen, to push the port buttons on HSD30 and HSZ40 array controller operator control panels.

4.2.3 Electrostatic Discharge Protection

This section describes the necessary precautions and procedure for protecting the controller subsystem components against electrostatic discharge (ESD). ESD is a common problem for any electronic device and may cause lost data, system down time, or other problems. The most common source of static electricity is the movement of people in contact with carpets and clothing materials. Low humidity allows a large amount of electrostatic charge to build up.

Use the following strategies to minimize electrostatic discharge problems:

- Maintain more than 40 percent humidity in the computer room.
- Place the subsystem cabinet away from heavy traffic paths.
- Do not use carpet, if possible. If carpet is necessary, choose an antistatic carpet. If a carpet already is installed, place antistatic mats around the subsystem to help decrease electrostatic discharge.

CAUTION

Use proper ESD grounding procedures or damage can result to your controller or read cache modules.

Prior to handling (removing or replacing) a controller module or cache module, do the following:

1. Obtain and attach an ESD wrist strap to your wrist.
2. Plug the other end of the wrist strap to the ground stud located on the cabinet's vertical rail that is common for both the BA350–MA controller shelves and the storage shelves. This stud is located approximately half way down from the top of the rail.
3. Obtain an approved antistatic bag and/or a grounded antistatic mat.

A ground stud is located on the center vertical rails inside the front and back doors of the SW800-series data center cabinet.

A ground stud is located on the vertical rails inside the front and back of the SW500-series cabinet.

4.3 Controller Components Handling Guidelines

As with any electronic equipment, some components of your controller subsystem need special handling. The following sections describe handling guidelines for modules, program cards, and cables.

4.3.1 Module Handling Guidelines

When handling a controller or cache module, follow these ESD grounding guidelines:

CAUTION

Use the ESD grounding procedure prior to handling the controller or read cache module, or damage to the modules could result.

- Obtain and attach an ESD wrist strap to your wrist. Make sure the strap fits snugly to your wrist.
- Plug the other end into the grounding stud located on the vertical rail that separates the BA350–MA controller shelves from the device shelves.
- Remove the module from its shelf and place it into an approved antistatic bag or onto a grounded antistatic mat.
- Remain grounded while installing a replacement module.
- Remove the ESD connection from the cabinet ground stud.
- Remove the ESD wrist strap from your wrist.

4.3.2 Program Card Handling Guidelines

Use the following guidelines when handling the program card:

CAUTION

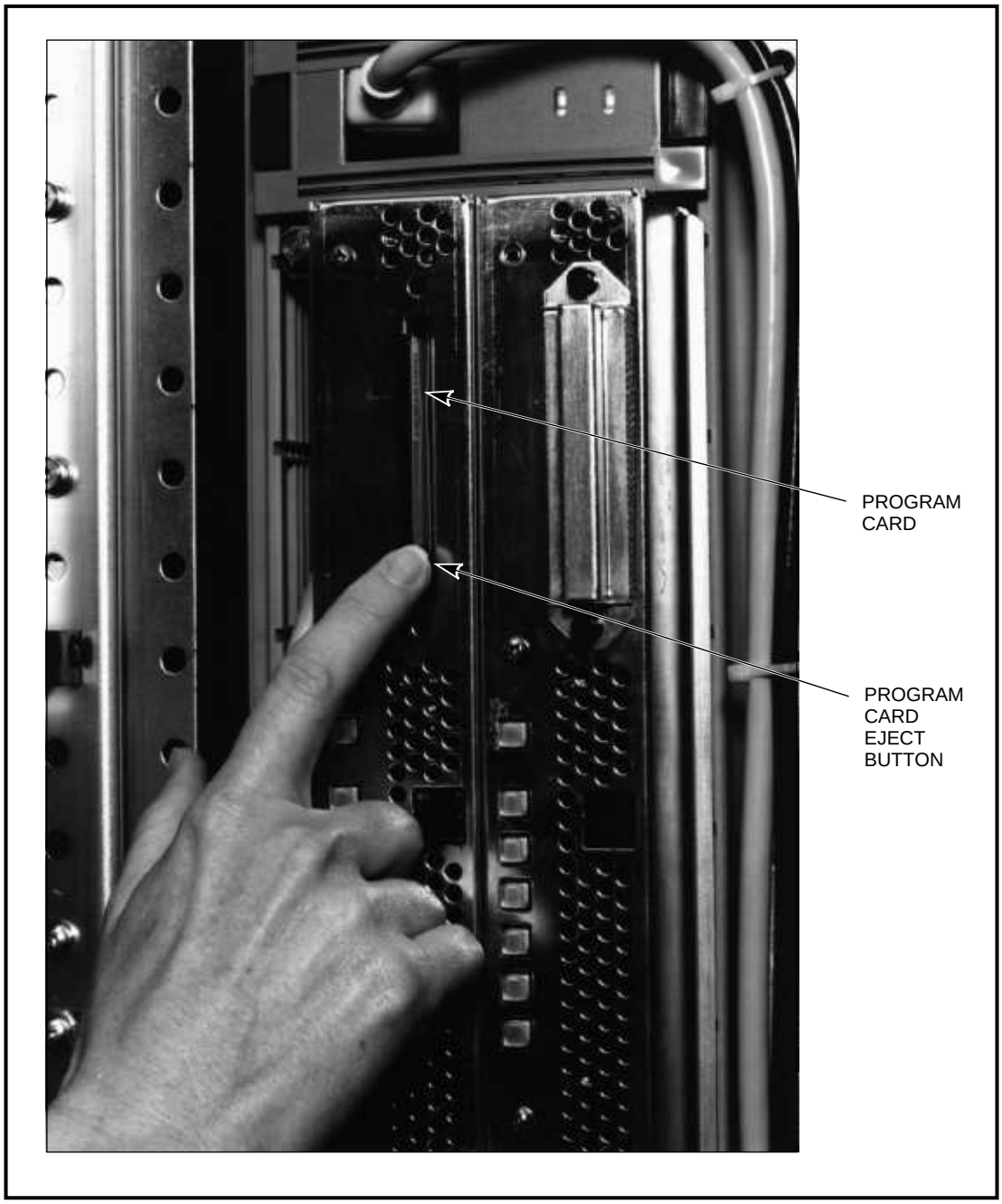
Follow these program card guidelines or damage to the program card may result.

- Keep the program card in its original carrying case unless installing it.
- Do not twist or bend the program card.
- Do not touch the contacts.
- Keep out of direct sunlight.
- DO NOT immerse the program card in water or chemicals.
- Always push the eject button to remove the card. Refer to Figure 4–1.
- An ESD strap is *not* required.

Note

Figure 4–1 shows an EMI shield covering the program card on the controller in ID slot 7. Some early HSJ40 controllers shipped with EMI shields. These shields are not needed. If you have an HSJ40 controller with an EMI shield, you may discard it. EMI shields are no longer shipped with HS array controllers.

Figure 4–1 Location of Program Card Eject Button



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4.3.3 Cabling Guidelines

Preplanning your cabling needs and adhering to cable handling guidelines ensure proper operation of your controller subsystem. The following sections describe host cable guidelines for each host interface type (CI, DSSI, and SCSI).

4.3.3.1 CI Host Port Cable Handling Guidelines for HSJ Controllers

When handling or moving CI cables when the power on, it is very important that the internal CI cable does not become grounded. This means that **no metal** can touch the silver plug portion of these cables, except a CI host cable connector.

CAUTION

DO NOT let the silver plug portion of the internal CI cable become grounded (touch metal). If this cable should become grounded, damage to the equipment can result.

4.3.3.2 DSSI Host Port Cable Handling Guidelines for HSD30 Controllers

Always handle DSSI host port cables with power removed. When connecting or disconnecting a node to the DSSI bus, node power should be off. Take all DSSI nodes off line to remove power from all entities on the DSSI bus that will be connected to the HSD30 controller's host port.

CAUTION

Component damage may result if DSSI host port cables are connected or disconnected with power applied.

The maximum DSSI host port cable length between DSSI nodes for HSD30 controllers is 4.87 meters (16 feet). The overall (end-to-end) maximum configuration DSSI host port cable length is 18.28 meters (60 feet).

Note

HSD30 controllers use DSSI host port cables with microribbon style connectors at the controller end of the cables.

4.3.3.3 SCSI Host Port Cable Handling Guidelines for HSZ40 Controllers

SCSI host port cables may be removed or replaced with power applied. However, make sure that if you must remove the SCSI host port cables for any reason while power is applied, that you do the following:

- If it is at the end of the SCSI host bus, leave the SCSI host port cable and the terminator connected to the trilink when you remove the trilink from the controller's front bezel.
- If it is in the middle of the SCSI host bus, leave both SCSI host port cables connected to the trilink when you remove the trilink from the controller's front bezel.

These actions are necessary to prevent breaking the SCSI bus connection. Be careful not to bend any connector pins when plugging the SCSI host port cables into the trilink.

Note

Hint: Use a very small straight blade screwdriver when disconnecting the trilink connector block (with cables and/or terminators attached) from the

front bezel of the controller. The clearance between a terminator and a host port cable or two host port cables is minimal.

The maximum terminator to terminator length of the fast and slow SCSI buses, including all cables and shelf buses, is listed in Table 4–2.

Table 4–2 SCSI Bus Parameters

Bus Type	Transfer Rate	Meters	Feet
8-bit, single-ended	5 MB/s	6	19.68
8-bit, single-ended	10 MB/s	3	9.84
16-bit, differential	20 MB/s	25	82.02

Refer to the *StorageWorks Solutions Configuration Guide* and the *StorageWorks Solutions Shelf and SBB User's Guide* for more information about SCSI bus cables and connectors, terminators, and trilink connector blocks.

4.3.3.4 Controller to Storage Shelf SCSI–2 Device Cable Guidelines

The following are SCSI–2 device cable length restrictions for HS array controllers:

- Controller to the one BA350–SB storage shelf—2.0 meters maximum
- Controller to the first (of two) BA350–SB storage shelves—1.0 meters maximum
- Controller to the first TZ8x7 tape drive—2.0 meters maximum
- Controller shelf #1—1.0 meter SCSI–2 cables (typically, in the SW800-series data center cabinet), or 1.0 meter SCSI–2 cables to front storage shelves and 2.0 meter SCSI–2 cables to the back shelves in the SW500-series cabinet.
- Controller shelf #2—2.0 meter SCSI–2 cables (typically, in the SW800-series data center cabinet), or 1.0 meter cables to the back shelves and 2.0 meter cables to the front shelves in the SW500-series cabinet.
- Controller shelf #3—1.0 meter SCSI–2 cables to front storage shelves, and 2.0 meter SCSI–2 cables to the back shelves (typically).
- Controller shelf #4—Typically not used in the SW800-series data center cabinet.

Note

Controller shelf #4 can use 2.0 meter SCSI–2 cables to the front or back shelves in an SW800-series data center cabinet.

4.4 Unpacking Your Subsystem

When delivered, your controller subsystem is packed in a carton and attached to a shipping pallet. Upon receipt of your subsystem, perform the following tasks:

- Check the carton and pallet for signs of shipping damage.
- Report any damage to Digital Multivendor Customer Services or the Digital sales office in your area, and to the local carrier who delivered your equipment.
- Use standard practices found in the *StorageWorks SW800-Series Data Center Cabinet Installation and User's Guide* or the *StorageWorks SW500-Series Cabinet Installation and User's Guide* to unpack and remove your subsystem cabinet from the shipping pallet.
- Keep all packing materials and shipping labels for later use and reference.
- Remove and read your subsystem documentation before beginning the installation process.

4.5 Installing a Preconfigured or CTO Controller Subsystem

You can order from several preconfigured controller subsystems offered by Digital, or you can choose to order a controller subsystem configured (configured-to-order [CTO]) to your specific needs. Appendix A lists some of the options and CTO subsystems available.

The HS array controller subsystems are available in large SW800-series data center cabinets or smaller SW500-series cabinets. Each subsystem comes with a specified number of HS array controllers and cache modules, power supplies, storage shelves with storage devices, and device cables. Some systems come with host port cables. Ask your Digital sales representative for details about ordering host port cables. You are encouraged to order preconfigured or CTO subsystems for simplicity of subsystem installation.

If you choose to configure your own controller subsystem, refer to Chapter 3 for configuration rules and restrictions.

Figure 4–2 shows one version of a preconfigured HS array controller subsystem in an SW500-series cabinet. The SW500-series cabinet has the capacity to hold 10 shelves (either device or controller) mounted horizontally. Six shelves can be installed in the front of the cabinet, and four shelves can be installed in the back of the cabinet.

Figure 4–2 HS Array Controller SW500-Series Cabinet

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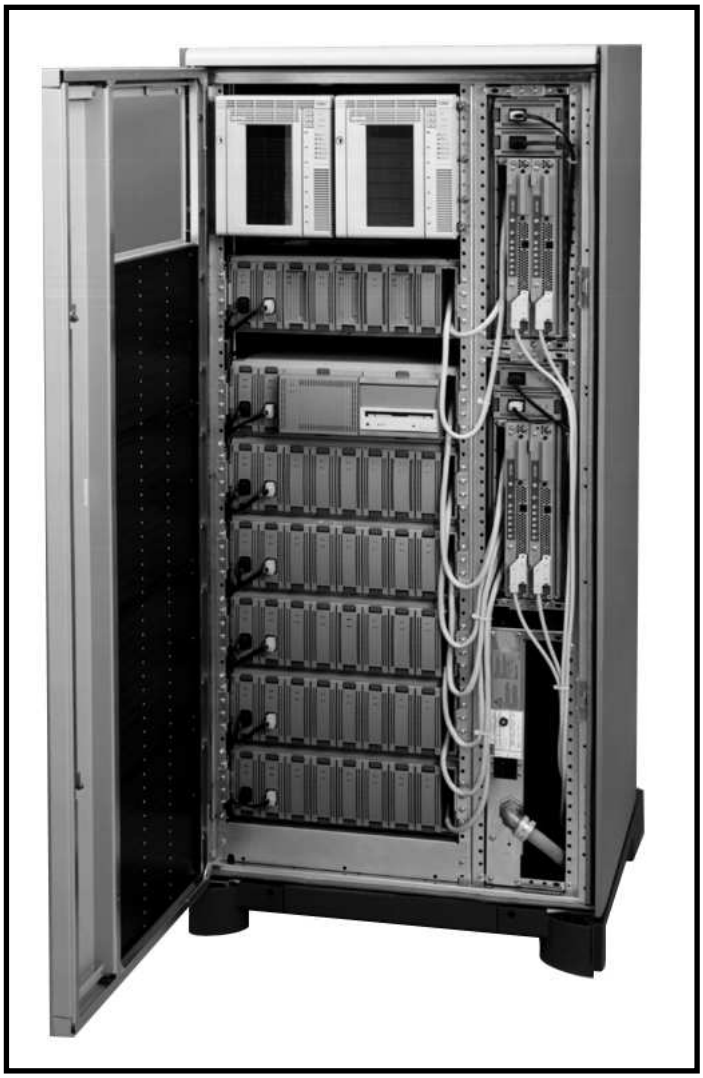
Figure 4–3 shows one version of a preconfigured HSJ40 controller subsystem in an SW800-series data center cabinet. An SW800-series data center cabinet has the capacity to hold up to 18 storage shelves (mounted horizontally) and four controller shelves (mounted vertically). Nine storage shelves can be installed in the front of the cabinet, and nine storage shelves can be installed in the back of the cabinet.

Figure 4–3 HSJ40 Array Controller SW800-Series Data Center Cabinet



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4.5.1 General Configuration Rules for SWxxx-Series Cabinets

The following rules apply to the configuration of both the SW800-series data center or SW500-series cabinets:

- Measure cabinet capacities by the number of individual shelves that can be installed into the cabinet (for example, BA350–SB storage shelves).
- Abide by the cabinet-specific installation sequence to maintain gravitational stability. Failure to follow the sequence may result in tipping over the cabinet.
- Shelf configuration rules apply to all cabinets unless otherwise noted. Shelf-specific configuration rules are in the *StorageWorks Solutions Shelf and SBB User's Guide* and in Chapter 3 of this manual.
- Switch-controlled input power is required for each shelf.

- Bulkhead input/output (I/O) connections for the shelves, the host computer, and/or external controllers are provided.
- An SW800-series data center cabinet or an SW500-series cabinet does not typically support dc power modules.
- Input power can be either 60 Hz or 50 Hz with the appropriate cabinet cable distribution unit (SW800–AA or SW800–AB, and SW500–AA or SW500–AB).
- For the controller and storage shelves, a second cable distribution unit (CDU) is required to support more than a single power supply per shelf.

4.6 Installation Instructions for Preconfigured and CTO Subsystems

Installing a preconfigured or CTO HS controller subsystem requires that you follow the guidelines and procedures discussed in this section.

Preconfigured and CTO subsystems have all subsystem components preinstalled (controller module, cache module, SCSI–2 device cables, storage shelves, devices, power supplies, and so forth).

Note

Internal host port cables are included with HSJ controllers. (External CI cables must be ordered separately.) Host port cables must be ordered separately for HSD30 and HSZ40 controllers.

Therefore, you need to do only the following:

1. Unpack the subsystem and move it into place. Refer to cabinet-specific installation guides for unpacking instructions.
2. Open the front and back doors of the cabinet.
3. Visually inspect all subsystem components to determine whether:
   - All cables are seated properly
   - All SBBs are seated properly
   - All controller and cache modules are seated properly
   - All shelf fans are seated properly
   - All program cards are properly loaded
4. Plug the cabinet power cord into the proper wall outlet.
5. Plug a maintenance terminal's EIA cable into the EIA–423 terminal port on the front bezel of your controller (for defining your subsystems's initial configuration parameters). Refer to Section 4.6.1 for maintenance terminal setup information.
6. Turn on the power to your maintenance terminal.

CAUTION

If you are installing an HSJ controller and it is the first HSJ in an existing cluster, check the CI hardware configuration of all CI controllers in the cluster for the quiet slot time setting. 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 causes incorrect operation of the CI.

---

7. Turn on the circuit breakers (CB1) on the cabinet's cable distribution units to the ON (|) position. The subsystem controllers and devices will begin their normal initialization sequence.
8. Check to see what preconfigured parameters have been set at the factory from your maintenance terminal (after controller and device initialization have completed) by entering the CLI command SHOW THIS_CONTROLLER. (A hardcopy printout of factory parameter settings may accompany your subsystem.)
9. Define the configuration parameters *before* connecting your host port cables. Refer to Chapter 5 for the specific order for defining parameters for nonredundant and dual-redundant controller configurations. Define the parameters from a maintenance terminal connected to your controller.
10. If you have an HSJ controller, connect the appropriate host port cables to the front bezel host port connectors on your HSJ controllers (see Figure 4–4).

    If you have an HSD30 controller, remove power before connecting the appropriate host port cables and/or terminators to the supplied trilink connector on the front bezel of your controller.

    If you have an HSZ40 controller, connect the appropriate host port cables and terminators to the trilink connector block on the front bezel host port connectors of your controller.

    Refer to Section 4.6.2.1, Section 4.6.2.3, or Section 4.6.2.2 for specific information for connecting your controller's host port cables.

Note

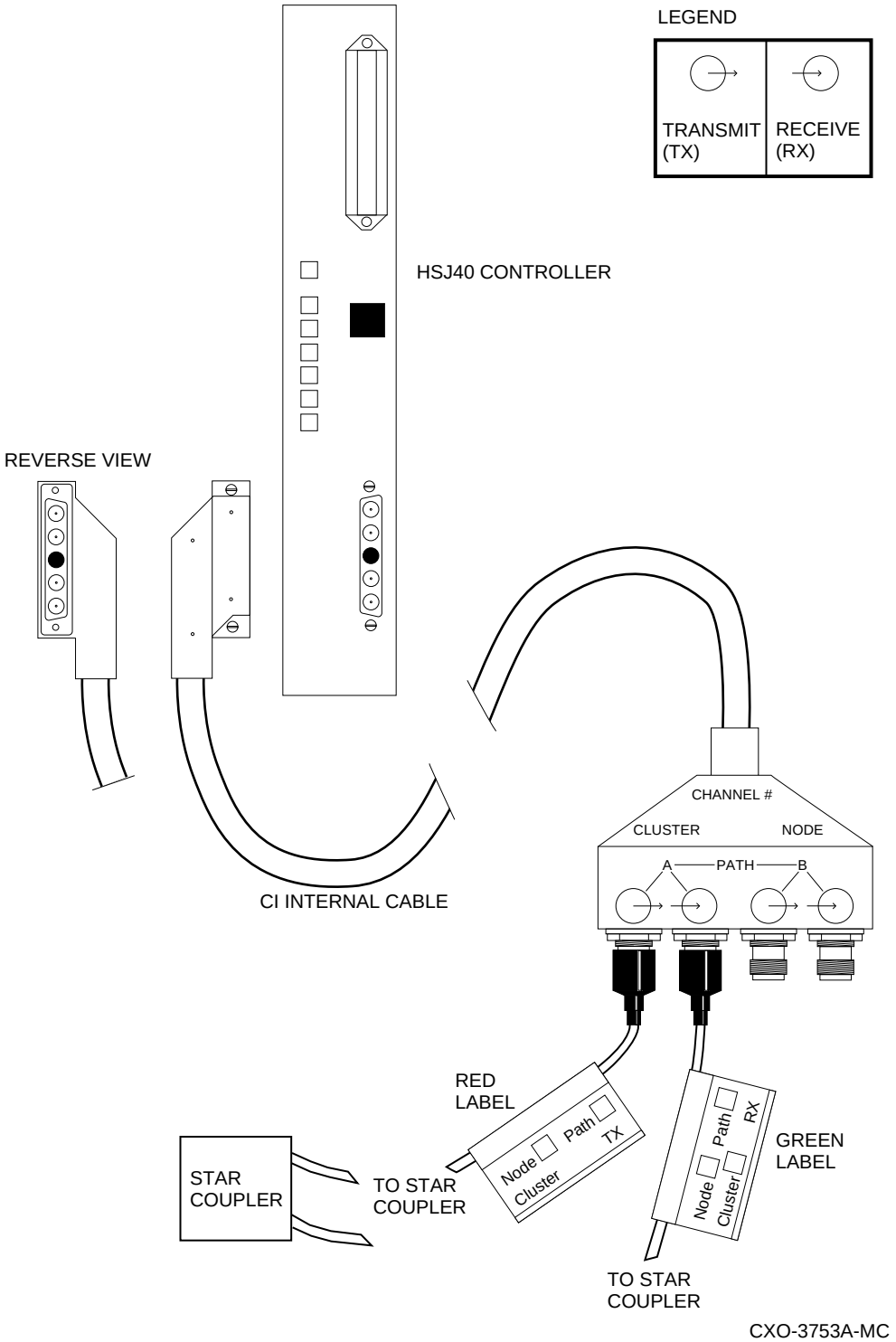
Do not connect the controller end of any internal host port cables to your controller unless the controller's initial parameters have been set and the host ports have been enabled. (HSD30 controller host port cables must be connected with the power off.)

4.6.1 Connecting a Terminal to the EIA–423 Maintenance Terminal Port

You do not need a locally connected maintenance terminal for normal operations. However, you must connect a terminal for initial controller parameter configuration; thereafter, use a terminal only when the host port is inoperative. Refer to your terminal documentation if you are unfamiliar with how to connect a terminal and set it up. Use the following procedure to connect an EIA–423 compatible terminal:

1. Make sure the power switch on the back of the terminal is OFF (0).
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 EIA–423 terminal port on the controller's front bezel.

Figure 4–4 Internal CI Cable with External CI Cables Attached for HSJ Controllers



4. Turn the terminal power switch to the ON position.
5. Set the terminal at 9600 baud, with 8 data bits, 1 stop bit, and no parity. Refer to your terminal documentation for terminal setup instructions.

6. Press the Return key if no HS*x*> prompt is visible on the screen. (This brings you to the controller's command line interpreter (CLI).)

4.6.2 Preset Controller Configuration Parameters

The controller's minimum configuration parameters are defined at the factory. Refer to the controller's configuration printout supplied with your documentation packet. You can verify the preset parameters and make changes as necessary by entering the following commands at the HSx> prompt:

```
HSx> SHOW THIS_CONTROLLER
HSx> SHOW DEVICES
```

The controller's ID and all configured devices are displayed. If nothing is shown as configured, refer to Chapter 5 for complete procedures to define your controller's configuration.

If the controller and attached devices are displayed, then enter the following command:

```
HSx> SHOW UNITS
```

This command displays logical unit number assignments. A preconfigured or CTO subsystem may not have these defined at the factory, nor are the host paths enabled, nor is the CI or DSSI node number (or SCSI target ID for HSZ40 controllers)set, nor are the allocation classes set. Refer to Section 5.2.4 and Section 5.2.5 to establish these parameter settings.

After setting your parameters, make sure they are printed and kept available (in a safe place) to assist in servicing the subsystem in the future. Make a new printout each time you change your configuration parameters or add or delete units or storage sets.

After your host port cables and terminators have been connected, you can continue setting your controller configuration by adding devices, storage sets, and so forth.

4.6.2.1 Installing Host Port Cables for HSJ Controllers

Preconfigured HSJ controller subsystems come with the internal host port cables installed. When installing a second controller to a nonredundant (single) controller configuration, you simply route the new cable using the same path as the host port cable for the first controller.

Connect four external (blue) CI cables to the exiting end of the internal CI host port cable connector and then route them to the star coupler. Figure 4–4 shows the physical attributes of an internal CI host port cable. The connection of the transmit and receive external (blue) CI cables to the PATH A connections of the internal CI cable connector also are shown.

Note

The four CI cable connections located on the exiting end of each internal CI host port cable have rubber shipping caps on each connection. Remove the rubber shipping caps before connecting the external (blue) CI cables. Keep these caps with the cabinet for later use.

4.6.2.2 Installing Host Port Cables for HSD30 Controllers

The following procedure describes how to connect host port cables, trilink connector blocks, and terminators for HSD30 controllers:

1. Power down the controller shelf (if power is applied) by removing the input power cables to the power supply SBBs in the controller shelf.
2. Take all DSSI nodes off line to remove power from the DSSI bus that will be connected to the HSD30 controller.
3. Plug the supplied trilink connector block (Digital part number 12–39921–02) into the host port connector on the front bezel of the HSD30 controller (if it is not already in place). Make sure that the trilink connector pins are not bent or damaged before installing the it on the HSD30 controller.
4. Connect the DSSI host port cables to the trilink connector block as follows:
   - If the HSD30 controller is at the end of the DSSI bus, connect one end of the DSSI host port cable to the trilink, and connect the other end to the host computer. Plug a DSSI bus terminator (50-pin, part number 12–31281–01) into the other trilink connector.
   - If the HSD30 controller occupies a mid-point of the DSSI bus, connect the DSSI host port cables from adjacent nodes to both trilink connectors. The DSSI bus terminator is not used on the trilink in this configuration.

CAUTION

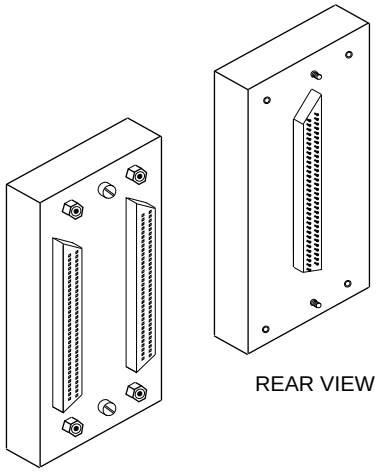
Before removing DSSI host port cables from the HSD30 controller's trilink connector, remove power to all devices on the port (this includes the host adapter).

4.6.2.3 Installing Host Port Cables for HSZ40 Controllers

The following procedure describes how to connect host port cables, trilink connector blocks, and terminators for HSZ40 controllers:

1. Plug the supplied trilink connector block (part number H885–AA) into the host port connector on the front bezel of the HSZ40 controller (if it is not already in place).
2. Plug the SCSI host port cable into the trilink connector on the front bezel of the HSZ40 controller. Figure 4–5 shows the H885–AA trilink connector block used for HSZ40 controllers.

Figure 4–5 HSZ40 Controller Trilink Connector Block



3. Plug the supplied terminator (68-pin, part number 12–37004–03, Digital option number H879–AA) into the other connector of the trilink (if this is the end of the SCSI host port bus).
4. If the host uses an 8-bit single-ended adapter, route the host port cable from the trilink connector into a DWZZA-series SCSI bus signal converter (either a 3 1/2-inch SBB DWZZA–VA or a desktop DWZZA–AA model with a self-contained power supply).

   If you use a 3 1/2-inch SBB DWZZA signal converter, do the following:

   - Plug a 3 1/2-inch SBB DWZZA–VA signal converter into SCSI slot 0 in a BA350–SB storage shelf (the DWZZA receives its power from the shelf).
   - Plug the SCSI host port cable coming from the controller's trilink into the connector on the front of the DWZZA.
   - Plug a SCSI–P cable into the first (upper) connector in that BA350–SB storage shelf.
   - Route the other end of the SCSI–P cable to the host.

   If you use a desktop DWZZA–AA signal converter, do the following:

   - Plug the SCSI host port cable coming from the controller's trilink into the connector on the front of the DWZZA–AA signal converter.
   - Route the other end of the host port cable to the host.
5. For 16-bit FWD adapters, route the host port cable directly from the controller's trilink connector, through the cabinet, and to the host port adapter.

Refer to the *StorageWorks Solutions Shelf and SBB User's Guide* for detailed information on DWZZA-series SCSI bus signal converters. Refer to the *StorageWorks Solutions Configuration Guide* for information on the H885–AA trilink connector block.

Two important considerations for all SCSI buses are bus termination and bus length. Each bus must be terminated to each end of the bus. Maximum bus lengths must be taken into consideration when designing your subsystem.

When removing SCSI host port cables, always remove the trilink connector with the host port cables and terminator attached to maintain the SCSI termination.

4.7 Installing a Dual-Redundant HS Controller and Cache Module

This section describes how to install a second HS controller and cache module into a *preexisting* nonredundant controller configuration to form a dual-redundant controller configuration. A dual-redundant controller configuration is appropriate for higher availability and includes the capability to failover devices. The HSJ and HSD30 controllers support dual-redundant configurations.

Dual-redundant HSZ40 controller configurations are not supported for the Version 1.4 firmware release. Operating system functionality is required to support this feature.

Note

Refer to Section 5.11 and Section 5.12 for instructions for removing and replacing controller and cache modules.

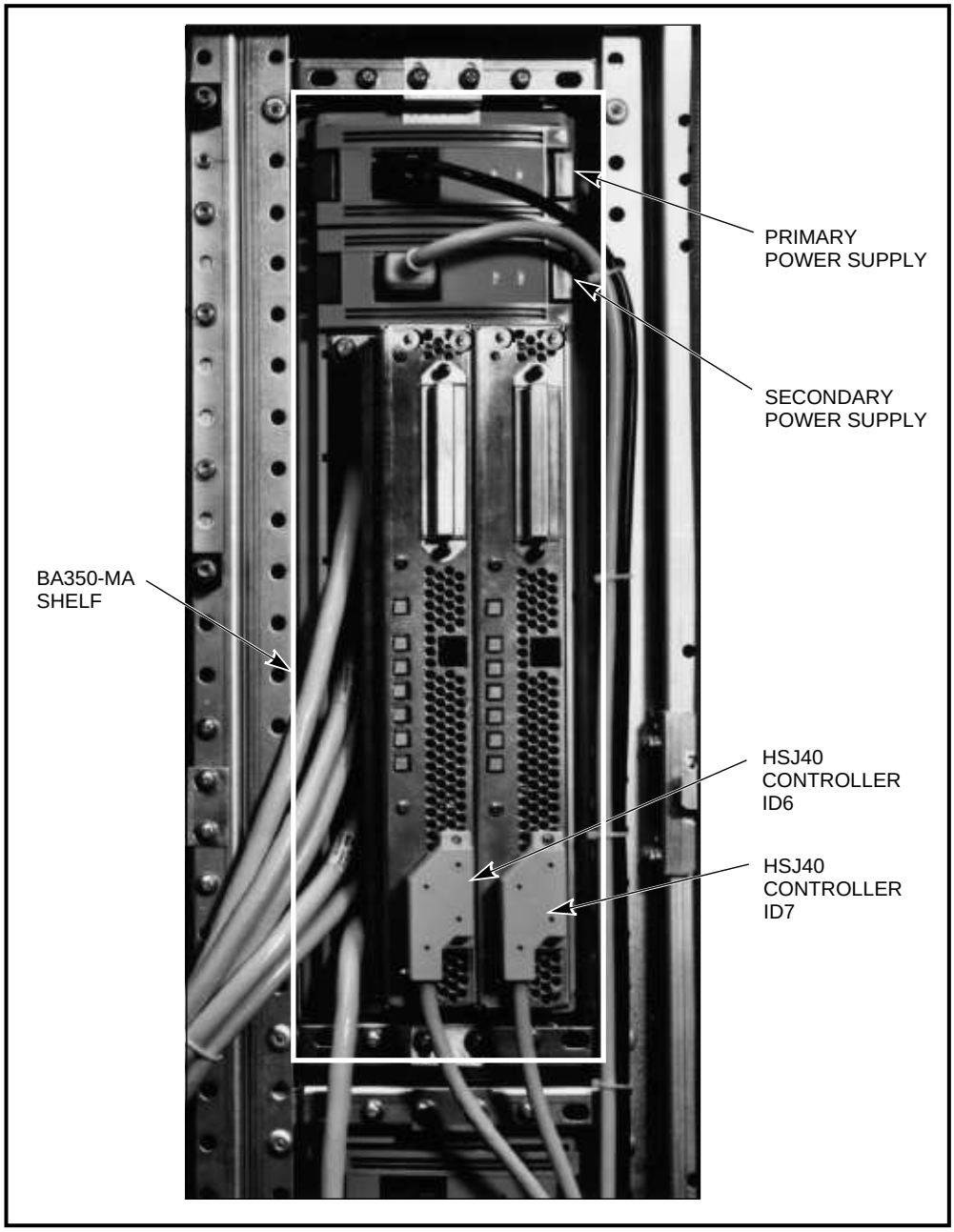
The HSJ controllers support controller warm swap. Therefore, you have a choice of using the following procedure or the controller warm swap procedure (refer to Section 5.10).

Controller warm swap is not supported at this time for HSD30 and HSZ40 array controllers.

The second controller will occupy SCSI ID #6. The second controller will not function correctly if there are attached devices in slot 6 of any device shelf for any port. (Check that each port has no more than six SCSI–2 devices at ID numbers 0 through 5.)

Refer to Figure 4–6 for an example of the locations for the controllers in the controller shelf and their designated controller ID numbers.

Figure 4–6 Controller ID Numbers



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CAUTION

In a dual-redundant configuration with cache , both cache modules must have the same number of megabytes. The controller firmware version must be the same for both controllers for proper operation of the subsystem. When the firmware version and/or cache module sizes are mismatched, the controllers detect the mismatch and do not allow access to any devices.

4.7 Installing a Dual-Redundant HS Controller and Cache Module

Use the following procedure for installing a second controller module with its accompanying cache module into an existing HSJ controller shelf:

CAUTION

Most of this procedure can be used to add a second HSD30 controller, providing the power is removed to all devices on the DSSI bus. Failing to do so risks shorting circuits that may blow fuses on all the devices on the bus.

If for some reason your first HSD30 controller occupies SCSI ID slot 6 (which it should not), you cannot effectively add an HSD30 controller to slot (SCSI ID) 7 because of interference from the trilink connector block attached to the companion controller in slot 6. Refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* if you have this situation.

1. Halt all I/O operations for the first controller in the controller shelf and dismount its devices from a virtual (host) terminal. The command for this step is operating system specific.
2. Unplug the black power cord from the primary power unit, and unplug the gray power cord from the secondary power unit (if present) in the controller shelf. This removes power from the shelf.

Note

Connecting the SCSI–2 port cables now prevent having to remove the metal divider plate and cache module later to access the SCSI–2 port connectors. The following four steps are unnecessary if access for changing or adding SCSI–2 cables is not required.

3. Remove the metal divider plate inside the controller shelf that separates the module area from the SCSI–2 port cable area in the shelf. Loosen the screws at the top and bottom of the shield. This allows room to get your hands into the shelf to plug in the SCSI–2 cable connectors.
4. Connect SCSI–2 port cables as required to the port connectors inside the controller shelf. Route the cables out the front of the controller shelf and into the front of the storage shelves according to configuration guidelines and restrictions.
5. Plug the new SCSI–2 port cables into your choice of storage shelves as required.
6. Replace the metal divider plate that separates the SCSI–2 port cable area from the module area in the controller shelf, then tighten the two screws to hold it in place.
7. Attach an ESD ground strap to the cabinet ground stud and the other end of the strap to your wrist. Figure 4–7 shows the location of the SW800-series data center cabinet ground stud. The SW500-series cabinet's ground studs are in a similar locations.

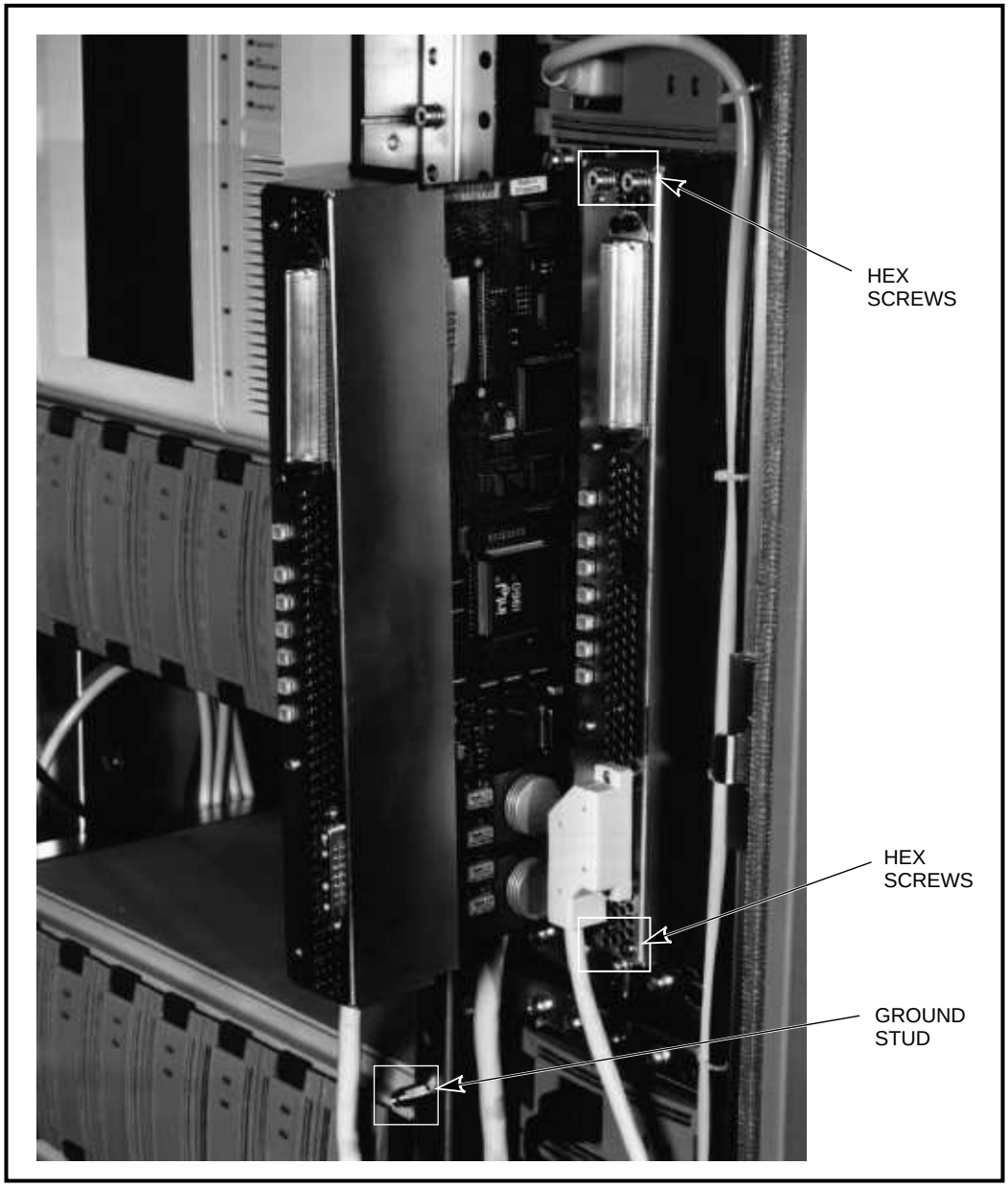
8. Insert a new cache module into the cache module slot (if applicable). The cache module slot is the first slot to the right of the metal divider plate.

Note

You can recognize the cache module slot because it has only one connector on the backplane. The controller slots have three connectors. You can see the slot from the front of the controller shelf.

9. Insert the new HS controller module into the controller module slot to the right (for vertically mounted modules) or above (for horizontally mounted modules) of the cache module you just installed.
10. Secure the front bezel assembly to the controller shelf with its four hex screws (one in each corner). Figure 4–7 shows the location of the front bezel hex screws.
11. Set your initial configuration parameters for your new controller. Refer to Section 5.2.5.

Figure 4–7 Locations of the SW800-Series Cabinet Ground Stud and Controller Shelf Hex Screws



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You are now ready to install any host port cables appropriate for your specific controller model. However, do not plug in the controller side of the host port cables until all initial controller parameters have been set and the host ports have been turned on. Use the following procedures for your specific controller model:

1. **For HSJ Controllers:**

   Route the internal CI host port cable using the same path as the internal CI host port cable coming from the first HSJ controller in the shelf. The internal CI host port cable exits at the back of the cabinet.

   CAUTION

   Do not plug the CI host port cable connector into the controller's front bezel until the minimum controller configuration is verified and the host port is enabled, from a maintenance terminal using the command line interpreter.

   The four external CI host port cable connections on the end of the internal CI host port cable connector, ship with rubber caps on each connection. Remove the rubber shipping caps before connecting the external (blue) CI cables. Keep these caps with the cabinet for later use.

   Attach the four external (blue) CI cables to the internal CI host port cable connector and route them to the star coupler.

   For HSD30 Controllers:

   For an *HSD30* controller (with DSSI bus power removed from all devices on the DSSI bus), remove the terminator from the trilink on the first controller and replace it with a short DSSI host port cable. Plug the other end of this short cable to the trilink on the newly installed controller's front bezel. Plug the terminator removed from the first controller into the trilink connector of the new controller.

2. Plug a maintenance terminal cable into the MMJ for the EIA–423 terminal port on the new controller's front bezel.
3. Plug the black primary power unit cord back into the primary power unit for the first controller, and the gray secondary power unit cord back into the secondary power unit (if present). This applies power to the entire controller shelf backplane. (Do not apply power to HSD30 controller shelves until the trilink connector block, host port cables, and terminators have been connected.)
4. Unsnap the EMI shield (if applicable) that covers the program card on the new controller's front bezel. Later model controllers do not have EMI shields.

   Note

   The program card revision MUST be the same revision as the program card in the other controller in that controller shelf, for normal operation.

   Make sure the cache module has the same number of megabytes as the other cache module in the same controller shelf.

   The controllers detect the mismatch in either case and do not allow access to any devices.

5. Press and hold both OCP reset (//) buttons. Insert the program card into the slot on the new controller's front bezel. Make sure the dot on the program card faces the dot on the front bezel.

6. Press the program card firmly until the eject button is extended to a point nearly even with the card.
7. Release both OCP reset (//) buttons.
8. Follow the HS controller CLI initialization sequence. Refer to Section 5.2 for complete CLI instructions.
9. Make sure that all new controller parameters are printed and kept in a safe place. (Parameters should have been kept after installing and/or powering up the first controller at initial installation.)

4.8 Installing the Program Card

This section describes the program card insertion process. Figure 4–8 shows the location of the program card and its associated eject button.

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. Insert the program card. The program card eject button extends when the card is fully inserted.

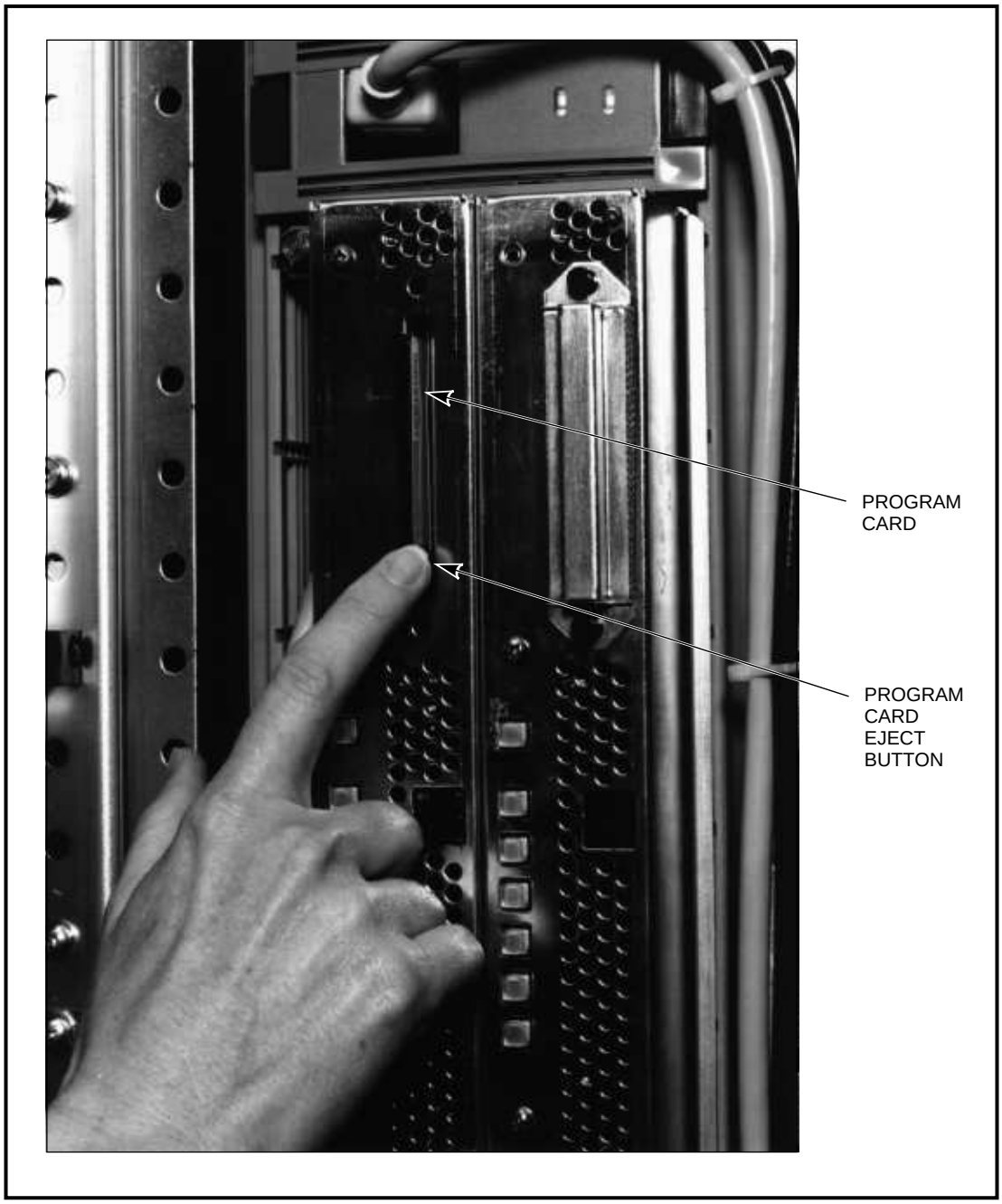
   For a dual-redundant configuration, press and hold both green reset buttons at the same time, even if you are only replacing one of the cards. Insert the program cards. The program card eject button extends when the card is fully inserted.
2. Release the reset buttons to initialize the controllers.

   If the controllers initialize correctly, the green reset LEDs begin to flash at 1 Hz. If an error occurs during initialization, the OCPs display a code. Refer to the LED error code tables in Chapter 5.
3. If you wish, you may disconnect the maintenance terminal. The terminal is not required for normal controller operation.

CAUTION

The program card must remain inserted at all times during controller operation. If the program card is removed during operation, the controller will not function.

Figure 4–8 Location of the Program Card and Its Eject Button



4.9 Upgrading Your HS Array Controller Subsystem Components

The following is a list of components that you can upgrade in your HS controller subsystem:

- Program card—Upgrade your firmware by replacing the program card with a program card containing the new firmware version.

- Read cache module—Upgrade from a 16 MB read cache module to 32 MB read cache module , or for subsystems with no read cache, upgrade to a 16- or 32-MB read cache.
- HS array controller subsystem—Upgrade by adding a second controller and cache to form a dual-redundant controller configuration (for HSJ and HSD30 array controllers).

CAUTION

In a dual-redundant configuration with cache , both cache modules must have the same number of megabytes. The controller firmware version must be the same for both controllers for proper operation of the subsystem. When the firmware version and/or cache module sizes are mismatched, the controllers detect the mismatch and do not allow access to any devices.

- Power supply—Add redundant power by adding a second power supply to your controller or storage shelves. (Refer to the *StorageWorks Solutions Configuration Guide* for power supply details.)

Note

When adding redundant power supplies, you also need to add a second cable distribution unit.

- BA350–MA shelf—Add up to four controller shelves to your SW800-series data center cabinet, or up to two controller shelves to your SW500-series cabinet.
- More storage devices—Add additional disk drives, tape drives, or other supported devices to unused slots in your storage shelves.

4.10 Upgrading Your Cache Module

You may want to upgrade your current 16 MB read cache module to a 32 MB read cache module. Or if you ordered your controller without cache, you can choose between a 16- or 32 MB read cache module. The following section describes how to determine what kind of cache module you currently have in your subsystem. You then can determine which option numbers to order for your upgrade by referring to the appropriate table for your specific controller.

4.10.1 How to Determine Your Cache Module Type

You can upgrade your cache module by increasing its memory size. To determine your cache module type (version type and number of megabytes), enter the SHOW THIS_CONTROLLER command at the CLI> prompt.

Note

The original HSJ40 controllers shipped with Version 1 read cache modules. The HSJ30, HSD30, and HSZ40 controllers use Version 2 read cache modules.

You must have HS operating firmware Version 1.4 or greater to operate with a Version 2 read cache module. However, Version 1 read cache modules also operate with Version 1.4 HS operating firmware.

Example 4–1 shows an HSJ40 controller subsystem without a cache module:

Example 4–1 No Cache Module Installed

```
MASS>SHOW THIS_CONTROLLER
Controller:
        HSJ40 ZG303FF082 Software V1.4, Hardware 0000
        Not configured for dual-redundancy
        SCSI address 7
Host port:
        Node name: MASS, valid CI node 4, 32 max nodes
        System ID 420010042D4D
        Path A is ON
        Path B is ON
        MSCP allocation class    6
        TMSCP allocation class   6
Cache:
        No cache
MASS>
```

Example 4–2 shows a controller subsystem with a Version 1 32 MB read cache module.

Example 4–2 32 MB Read Cache Module

```
HSJ>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:
        32 megabyte read cache, version 1
        Cache is GOOD
HSJ>
```

As you can see, the cache module size and version are displayed, as well as, the status of the cache module.

Refer to Tables 4–3, 4–4, 4–5, and 4–6 for ordering information.

Table 4–3 Read Cache Upgrade Ordering Information for HSJ40 Controllers

If you have...	And you want...	Order...
Version 1 or 2 read cache	32 MB read cache	HSJ40–XE

Table 4–4 Read Cache Upgrade Ordering Information for HSJ30 Controllers

If you have...	And you want...	Order...
No cache	16 MB read cache	HSJ30–XD
	32 MB read cache	HSJ30–XF
16 MB read cache	32 MB read cache	HSJ30–XE

Table 4–5 Read Cache Upgrade Ordering Information for HSD30 Controllers

If you have...	And you want...	Order...
No cache	16 MB read cache	HSD30–XD
	32 MB read cache	HSD30–XF
16 MB read cache	32 MB read cache	HSD30–XE

Table 4–6 Read Cache Upgrade Ordering Information for HSZ40 Controllers

If you have...	And you want...	Order...
No cache	16 MB read cache	HSZ40–XD
	32 MB read cache	HSZ40–XF
16 MB read cache	32 MB read cache	HSZ40–XE

Note

Return all 16 MB read cache modules to Digital when ordering 32 MB read cache module upgrades.

Refer to Appendix A for descriptions of the various option numbers.

5
Controller Operations

5.1 HS Array Controller Initialization

The HS array controller is initialized by any one of the following actions:

- Upon a power-up cycle
- Upon a firmware reset
- By pressing the OCP reset (//) button on the front bezel of the HS array controller
- From a host clear (or bus INIT)

The following action may initialize the controller, but it is not supported:

- When the operator removes and replaces the program card while the controller is running.[1]

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

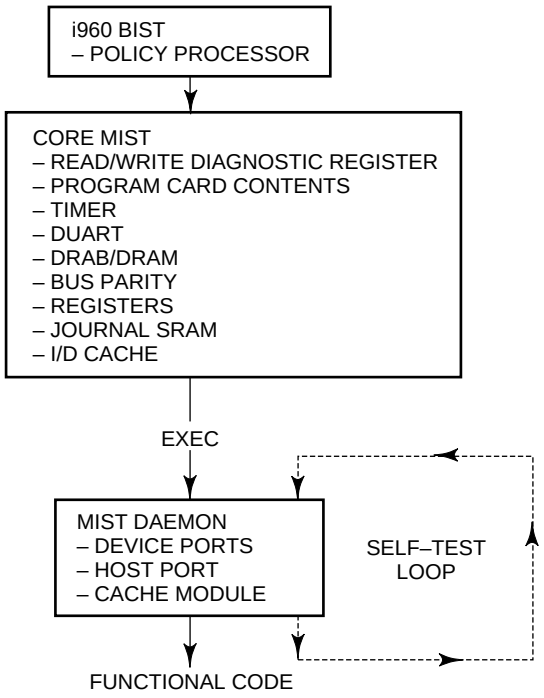
- Built-in self-test
- Core module integrity self-test
- Module integrity self-test DAEMON

Initialization time varies depending on the model of your controller and the size of your cache module, if any. However, initialization always completes in less than 1 minute.

Figure 5–1 details the initialization process for both single and dual-redundant controller configurations.

[1] Occasionally, this does not force initialization, so the controller shows no activity. If this occurs, press the green reset (//) button to initialize the controllers.

Figure 5–1 Controller Diagnostics Flow Chart



The initialization begins when the policy processor on the controller module executes a built-in self test (BIST). If BIST fails, the controller shows no activity and all indicators on the OCP are off. When this self-test completes, the policy processor reads initial setup parameters to determine the journal address of the hardware setup parameters and process control information. After these parameters are located, the following sequence executes to initialize the controller:

- A set of minimum integrity diagnostics (MIST) are run to verify that the bus hardware is functional, the program card contents are valid, and that shared memory is good. MIST includes tests of the following functions of the controller:
  - Validation of the program card contents
  - Shared memory check
  - All devices on the shared memory bus with the policy processor

  When testing shared memory, the first 2 MB must test good; the remainder of the memory can have up to 16 bad areas before the entire memory is declared bad.

  When MIST has completed, the program card copies the controller firmware to the first 2 MB of shared memory. The program card contents are then validated using error detection code (EDC) built into shared memory. Once validated, periodic checks of the controller firmware in shared memory are not required. Control of the controller is then passed to the firmware executive in

shared memory on the controller module. If a fault occurs at any time during core MIST, the OCP displays an error code.

- The firmware executive (EXEC) initializes and a call is made to the diagnostic and execution monitor (DAEMON) to complete the subsystem self-test diagnostics. When executing these diagnostics, DAEMON uses the services provided by the EXEC to handle any interrupts and errors generated during the tests. Errors detected during these tests are displayed on the OCP LEDs. The diagnostics run by DAEMON include the following:
  - A test of the host port—The controller still becomes operational if this port is not functioning.
  - A test of the device ports—The controller still becomes operational if one or more ports are not functioning. However, if *all* of the SCSI–2 ports are unresponsive, the controller does not initialize.
  - A test of the memory devices on the cache module—Only 2 MB of the memory must test valid for the cache module to be operational. However, if the cache module fails, the controller still functions by using a portion of shared memory for minimal read caching operations.

    The remainder of read cache is tested after initialization, in the background during normal operation.
  - A test of the RAID FX hardware—To ensure proper compare functions, DAEMON tests the XOR operations of the FX chip and the associated XBUF memory of the controller module. Initialization stops if this test fails.
- The EXEC finishes the initialization and starts the firmware on the controller.

If a hard failure occurs anytime during the initialization sequence, the controller OCP LEDs display an error indication. An error report can be printed on a virtual (host) terminal or a maintenance terminal (if one is connected).

CAUTION

The program card must remain in its slot for continuous controller subsystem operations. If the program card is removed during normal operations, the controller automatically resets.

5.1.1 Dual-Redundant Controller Configuration Initialization Sequence

The two controllers in a dual-redundant configuration exchange status signals (messages) during their individual initialization sequences. The first message occurs just after the initialization starts. This message informs the other (or first) controller that an initialization is taking place, so the other (or second) controller does not assume that the initializing controller is broken, and does not attempt to disable it.

A controller in a dual-redundant configuration is disabled by the other controller when it is determined to be nonfunctional or not responding properly. The functioning controller sends a message to the other controller which induces failover. When this happens, the functioning controller takes control of the storage devices that were online to the disabled controller. Maintenance can now take place on the failed controller.

Once one controller has disabled the other controller, you must enter the following command to restart the controller that is disabled:

```
HSx> RESTART OTHER_CONTROLLER
```

Enter this command by way of a local or virtual terminal to the running controller to re-enable the disabled controller's operation.

5.1.2 Controller Subsystem Initialization

When the controller is part of a StorageWorks subsystem, controller initialization takes place during power-up. In the event of a reset due to a partial or complete power failure, equipment failure, error condition, or a host clear, a subset of the initialization sequence runs in the subsystem.

A complete StorageWorks subsystem initialization includes the following steps:

1. When turning on the power, all shelves in the subsystem are reset and entities in the shelves, including disk drives, controller, and cache modules, begin their initialization sequences.
2. Each entity then completes its initialization and self-tests as applicable.
3. During the initialization, the controller interrogates the entities that it has established connections with, including other controllers in the subsystem. The controllers can perform activities with the entities, such as illuminating the device activity LED (green) on a disk drive's carrier while the drive is spinning up or down.
4. When the initialization sequence on all entities completes, the controller begins data transfer and other operations with the hosts.

5.1.3 Controller Cache Module Initialization Sequence

As part of the controller's diagnostics, the firmware tests the cache module. Upon completion of these tests, the cache module is available for use. This is a two stage test: a minimum test, plus a postinitialization background test for quick initialization.

During functional code, when the cache manager determines that the cache is unlocked, the cache manager tests the dynamic ram controller and arbitration engine (DRAB) followed by the memory. If cache is locked by the other controller (dual-redundant configurations), then all DAEMON diagnostics are postponed.

5.2 Command Line Interpreter

The command line interpreter (CLI) is the user interface to the controller. The CLI allows you to add to or modify the controller's configuration by using CLI commands. The following sections explain how to define a configuration and modify it when needed. A detailed description of the CLI commands is given in Appendix B.

Note

The initial controller configuration must be set using a terminal connected to the EIA–423 maintenance port on the front of the controller. This is because the controller has an invalid ID and the host ports paths are turned off (the host port path is always on for HSZ40 controllers). Thereafter, a virtual terminal (host terminal) can be used to modify the

controller's configuration (via a DUP or virtual maintenance terminal connection, HSZUTIL) allowing remote system management.

In a dual-redundant controller configuration, one terminal can set both controller's configurations. Refer to Appendix B for information on when this can be done in the configuration process.

5.2.1 CLI Access

After initial configuration, you can access the CLI using a maintenance terminal or a virtual terminal. The actual method of establishing the virtual terminal connection varies depending on your operating system and interface type. Refer to Section 7.3.1.

Note

The CLI> prompt may have been set to reflect your array controller's model type at the factory, such as, HSJ>, HSZ>, or HSD>.

5.2.2 CLI Command Sets

CLI consists of the following six command sets:

- CLI failover commands are used to support dual-redundant controller configurations.
- CLI controller commands are used for the following:
  a. Sets and shows the basic controller parameters
  b. Sets the controller ID (CI or DSSI node number, or SCSI target ID [the default ID for HSZ40 controllers is 2])
  c. Sets the resident terminal characteristics
  d. Restarts the controller
  e. Fails over devices
  f. Runs resident diagnostics and utility programs
- CLI device commands allow you to specify and show the location of physical SCSI–2 devices attached to each controller.

Note

Only devices that have been defined by the ADD command are used by the controller. Devices that have been placed in the shelf, but have not been defined using the ADD command are NOT used by the controller. Locations of devices are specified using a Port-Target-LUN (**PTL**) format. (Other restrictions may apply when adding removable media devices.)

- CLI storage set commands are used for the following:
  a. Adding
  b. Setting
  c. Renaming

d. Showing storage sets (stripesets)

- CLI logical unit commands are used to add, set, or show logical units that have been built from devices or storage sets.
- CLI diagnostic and utility commands are used for general support functions on the controller. These commands invoke exercisers that test the data transfer capabilities of disk and tape drives. The two exercisers are DILX (a disk inline exerciser) and TILX (a tape inline exerciser). Refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* on how to run these exercisers.

Remember these two rules when using CLI:

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

5.2.3 How to Exit CLI

If you are using a maintenance terminal for the CLI, you cannot log out. Entering the EXIT command merely restarts the CLI and displays the copyright notice, the controller type, and the last fail packet.

If you are using a DUP connection for the CLI, enter the following command to exit the CLI and return control to the host:

```
CLI> EXIT
```

If you are connected to a virtual terminal (via DUP for OpenVMS), and you specified the qualifier /LOG=CONFIGURATION.INFO on your command line, a log file of your session in CLI is created. You must use the EXIT command to exit the CLI in order to print the CONFIGURATION.INFO file.

5.2.4 Order of Definition for Configuration for a Nonredundant Controller Configuration

If you have a nonredundant controller configuration, perform the following steps at installation to set up your controller's configuration parameters.

Define the configuration in the following order from a maintenance terminal connected to the EIA–423 terminal port connector port on the front bezel of your controller. Not all steps are applicable to each controller model. Therefore, each step in the following procedure lists applicable models for that step.

CAUTION

Do not install the host port cables until after you have set all of the parameters listed. Failure to follow this process can result in a cluster crash.

1. Set the MAX_NODES parameter (HSJ controllers only):

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

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

2. Set a valid ID for the controller (all controller models):

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

   Where *n* has the following values:

   - The HSJ controller's CI node number (0 through (MAXNODES-1)).
   - The HSD30 controller's one digit DSSI node number (0 through 7). Each HSD30 controller's DSSI node number must be unique for its DSSI interconnect configuration.
   - The HSZ40 controller's SCSI target ID(s) (0 through 7).

3. Set the SCS node name (HSJ and HSD30 controllers):

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

   where *xxxxxx* is a one- to six-character alphanumeric name for this node and must be enclosed in quotes with an alphabetic character first.

   Note

   Each HSJ or HSD30 controller SCS node name must be unique within its VMScluster system.

4. Set the MSCP allocation class (HSJ and HSD30 controllers):

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

   where *n* is 0 through 255 (in a single controller configuration) or 1 through 255 (in a dual-redundant controller configuration).

5. Set the TMSCP allocation class (HSJ and HSD30 controllers):

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

   where *n* is 0 through 255 (in a single controller configuration) or 1 through 255 (in a dual-redundant controller configuration).

6. Restart the controller by pressing the OCP reset (//) button on the controller's front bezel, or enter the following command at the CLI> prompt to restart the controller:

   ```
   CLI> RESTART THIS_CONTROLLER
   ```

7. Enter the SHOW CONTROLLER command to determine whether the preceding parameters are set:

   ```
   CLI> SHOW THIS_CONTROLLER
   ```

8. Enable the host port paths (HSJ controllers):

   ```
   CLI> SET THIS_CONTROLLER PATH_A
   ```

   Enter the following command at the CLI> prompt to enable CI Path B to the host for HSJ controllers:

   ```
   CLI> SET THIS_CONTROLLER PATH_B
   ```

   Enter the following command at the CLI> prompt to enable host port paths for HSD30 controllers:

   ```
   CLI> SET THIS_CONTROLLER PATH
   ```

The host port paths for HSZ40 controllers are always on, so a command does not exist for turning the host paths on.

Note

Always restart the controller after setting the controller's ID, the SCS node name, or the allocation classes by pressing the OCP reset (//) button on the controller's front bezel, or by entering the appropriate RESTART command at the CLI> prompt.

9. Plug internal and external host port cables, trilink connector blocks, and terminators as applicable. Refer to the appropriate sections in Chapter 4 for instructions for making these connections.

WARNING

Do not plug the host port cables into the trilink connector block on the front bezel of HSD30 controllers with power applied. If you do, termination power could short to ground causing fuses to blow in your host adapter or devices.

The following steps identify the devices, the storage sets, and the logical units to the host. If these steps are not completed, the host does not recognize the devices. These steps can be done from a virtual terminal.

1. Define the devices by using the following command:

Note

Refer to Section 6.3.14 for instructions for using the CONFIGURE utility for automatically configuring devices.

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

For example:

```
CLI>ADD DISK DISK0 1 0 0
CLI>ADD TAPE TAPE0 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 controller's port, target, and LUN for the device. When entering the port, target, and LUN, at least one space must separate the port, target, and LUN.

You can use the ADD *device-type* command any time you need to add a device to the configuration.

Note

If you add a removable media device to an HSJ or HSD30 controller, it is not known to the host until one of the following occurs: the media is loaded into the device, the host is rebooted, or the virtual circuit is broken and re-established. This behavior is a feature of MSCP/TMSCP.

2. Add the storage sets for the devices, for example:

```
CLI> ADD STRIPESET STRIPE0 DISK0 DISK1 DISK2 DISK3
```

Refer to Appendix B for examples for adding storage sets (ADD STRIPESET). If you do not need storage sets for your configuration, skip this step.

3. Enter the following command to initialize *containers* prior to adding them to the configuration. This is a change from the HSJ firmware release prior to Version 1.4 of the HSJ operating firmware. Refer to Section 5.3 for further details about initializing transportable and nontransportable disk drives.

```
CLI> INITIALIZE container-name
```

For example:

```
CLI> INITIALIZE DISK0
CLI> INITIALIZE STRIPE0
```

CAUTION

The INITIALIZE command destroys all customer data on the container. Refer to the Appendix B INITIALIZE command section of this manual for specific requirements for using this command.

When initializing a single disk drive container, if the NOTRANSPORTABLE qualifier 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 the TRANSPORTABLE qualifier was specified, any metadata is destroyed on the device and the full device is accessible to the host. Refer to Appendix B for details of when an initialize is required and when it is not required.

4. Add the units that use either the devices directly or the storage sets built from the devices by entering the following command at the CLI> prompt:

```
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.

5.2.5 Order of Definition for Configuration for a Dual-Redundant Controller Configuration

If you have a new dual-redundant controller configuration, perform the following steps at initial installation to set up your controller's configuration parameters.

Define the configuration in the following order from a maintenance terminal connected to the EIA–423 terminal port connector port on the front bezel of your array controller:

CAUTION

Do not install the host port cables until after you have set all of the parameters listed. Power must be removed from all entities on the DSSI bus for HSD30 controllers.

1. Set the MAX_NODES parameter on both controllers (HSJ controllers only):

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

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

2. Set a valid ID number for both controllers (HSJ and HSD30 controllers):

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

   Where *n* has the following values:

   - The HSJ controller's CI node number (0 through (MAXNODES–1)).
   - The HSD30 controller's one digit DSSI node number (0 through 7). Each HSD30 controller's DSSI node number must be unique for its DSSI interconnect configuration.

3. Set the SCS node names for both controllers (HSJ and HSD30 controllers):

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

   where *xxxxxx* is a one- to six-character alphanumeric name for this node and must be enclosed in quotation marks and a alphabetic character first.

Note

Each HSJ or HSD30 controller's SCS node name must be unique within its VMScluster system.

4. Set the MSCP allocation class on both controllers (HSJ and HSD30 controllers):

Note

Provide different (unique) allocation class values for every pair of dual-redundant controllers in the cluster. In a dual-redundant controller configuration, the allocation class must not be zero, otherwise, failover does not occur.

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

where *n* is 0 through 255 (in a single controller configuration) or 1 through 255 (in a dual-redundant controller configuration).

5. Set the TMSCP allocation class on both controllers (HSJ and HSD30 controllers):

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

   where *n* is 0 through 255 (in a single controller configuration) or 1 through 255 (in a dual-redundant controller configuration).

6. Restart both controllers by pressing the OCP reset (//) button on each controller's front bezel, or enter the following commands at the CLI> prompt to restart the controller:

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

7. Set failover by entering the following command at the CLI> prompt (HSJ and HSD30 controllers):

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

   Refer to Section 2.3 for a detailed explanation of failover, the COPY= qualifier, THIS_CONTROLLER, and OTHER_CONTROLLER commands.

   Note

   The SET FAILOVER command establishes controller-to-controller communication and also determines where the configuration information resides for a failover situation. If you have a dual-redundant controller configuration, enter this command on one controller only. The COPY= qualifier should specify where the "good" data is located. Do not blindly specify COPY=THIS_CONTROLLER. Know where you "good" configuration information resides before entering the command.

8. Enter the following command at the CLI> prompt to determine whether the preceding parameters are set (all controller models):

   ```
   CLI> SHOW THIS_CONTROLLER
   ```

9. Enable the host port paths for both controllers (HSJ controllers).

   Enter the following command at the CLI> prompt to enable CI Path A and Path B to the host:

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

   Enter the following commands at the CLI> prompt to enable the host port paths for HSD30 controllers:

   ```
   CLI> SET THIS_CONTROLLER PATH
   ```

   Note

   Always restart the controller after setting the controller's ID, the SCS node name, or the allocation class by pressing the OCP reset (//) button on the controller's front bezel, or by entering the RESTART command at the CLI> prompt.

10. Plug internal and external host port cables, trilink connector blocks, and terminators as applicable. Refer to the appropriate sections in Chapter 4 for instructions for making these connections.

WARNING

Do not plug the host port cables into the trilink connector block on the front bezel of HSD30 controllers with power applied. If you do, termination power could short to ground causing fuses to blow in your host adapter or devices.

The following steps identify the devices, the storage sets, and the logical units to the host. If these steps are not completed, the host does not recognize the devices. These steps can be done from a virtual terminal.

1. Define the devices by using the following CLI command:

Note

Refer to Section 6.3.14 for instructions for using the CONFIGURE utility for automatically configuring devices.

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

For example:

```
CLI>ADD DISK DISK0 1 0 0
CLI>ADD TAPE TAPE0 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 your name to refer to that device. The name is referenced when creating units or storage sets.

SCSI-location is the controller's port, target, and LUN for the device. When entering the port, target, and LUN, at least one space must separate the port, target, and LUN.

You can use the ADD *device-type* command any time you need to add a device to the configuration.

2. Add the storage sets for the devices.

Refer to Appendix B for examples for adding storage sets (ADD STRIPESET). If you do not need storage sets for your configuration, skip this step.

Note

If you add a removable media device to an HSJ or HSD30 controller, it is not known to the host until one of the following occurs: the media is loaded into the device, the host is rebooted, or the virtual circuit is broken and re-established. This behavior is a feature of MSCP/TMSCP.

3. Enter the INITIALIZE command to initialize *containers* prior to adding them to the configuration. This is a change from HSJ firmware releases prior to Version 1.4 of the HS operating firmware. Refer to Section 5.3 for further details about initializing transportable and nontransportable disk drives.

   ```
   CLI> INITIALIZE container-name
   ```

   For example:

   ```
   CLI>INITIALIZE DISK0
   CLI>INITIALIZE STRIPE0
   ```

   CAUTION

   The INITIALIZE command destroys all customer data on the container. Refer to the Appendix B INITIALIZE command section of this manual for specific requirements for using this command.

   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 is destroyed on the device and the full device is accessible to the host. Refer to Appendix B for details of when an initialize is required and when it is not required.

4. Add the units that use either the devices directly or the storage sets built from the devices by entering the following command at the CLI> prompt:

   ```
   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.

5.3 Using the TRANSPORTABLE and NOTRANSPORTABLE Qualifiers

Before initializing a device using the CLI INITIALIZE command, make sure you know the status of that device. Ask yourself the following questions before proceeding with a device initialization:

- Is this device set transportable?
- Is this device set nontransportable?
- Is this an HS array controller device or did it come from a non-Hs or non-HSC k.SCSI array controller system?

When you bring a device from non-HS/non-HSC-K.scsi array controller system, and initialize it as nontransportable, you lose a few blocks of data. This is the metadata at the end of the LBN area.

Therefore, when bringing transportable devices to an HSJ/HSD/HSZ array controller system, initialize the device as transportable, then copy the data on that disk to another nontransportable unit. Then reinitialize that device as nontransportable, thereby putting metadata on the previously transportable device.

Note

Do not keep any device set as transportable on an HSJ/HSD/HSZ array controller system because you want forced error support on all units behind the HS array controllers. This is mandatory for use in Host-Based Volume Shadowing and is important for improving the data integrity of the entire array. Devices set transportable are *not* supported for shadow sets.

The transportable feature is provided to bring old non-HS array controller system customer data into the array system easily, not for normal system usage.

If you bring in a nontransportable device and initialize it, you destroy all forced error information for that device. So instead, if the unit was already set nontransportable, just enter the CLI ADD UNIT command (after adding the disk) and the HS array controller code verifies that the metadata is present. An initialization is NOT required.

Devices set transportable are not MSCP compliant. Device set nontransportable (using the NOTRANSPORTABLE qualifier) are MSCP compliant because they have metadata that provides forced error support.

5.4 Customer Acceptance Tests with Power Applied

This section describes customer acceptance tests. Refer to Chapter 6 for information on how to run DILX and TILX.

Perform the following tasks for customer acceptance:

- Power ON—Resets all shelves and starts the spin-up cycle of the devices within the shelves.
- HS array controller initialization—Includes controller diagnostics and runs every time the controller is powered on.
- Device self-tests—Causes each device in each shelf in the cabinet to begin self-tests and the spin up (for disk drives) process.
- DILX—Tests disk drives in the subsystem cabinet (use the default time listed in the DILX questions). Set all subsystem parameters (controller ID, SCS node name, allocation classes) before running DILX and TILX.

  DILX tests logical units that can consist of storage sets or physical devices. Error reports identify the logical units, not the physical devices. Therefore, if errors occur while running against a storage set, the storage set should be reconfigured as individual devices, and then DILX run against the individual devices.
- TILX—Tests tape drives in the subsystem cabinet (use the default time listed in the TILX questions).

5.5 How to Use and Interpret the Controller OCP Buttons and LEDs

The HS array controller modules have attached operator control panels (OCPs), sometimes called bus quiesce panels. Depending on the controller model, the OCPs have a reset button and from three to six port buttons. A green LED is embedded in the OCP reset (//) button. Amber LEDs are used to report error code information.

The green button with embedded LED on the OCP is the controller reset (//) button. The use of the reset (//) button and the remaining port buttons can vary depending on the state of the controller module, whether it is initializing or in normal operation.

Port device buttons and associated LEDs are numbered one through six (from the reset button) for those models with six port buttons. Models with three ports are numbered one through three (however, all six amber LEDs are used to report error code information on three port controllers).

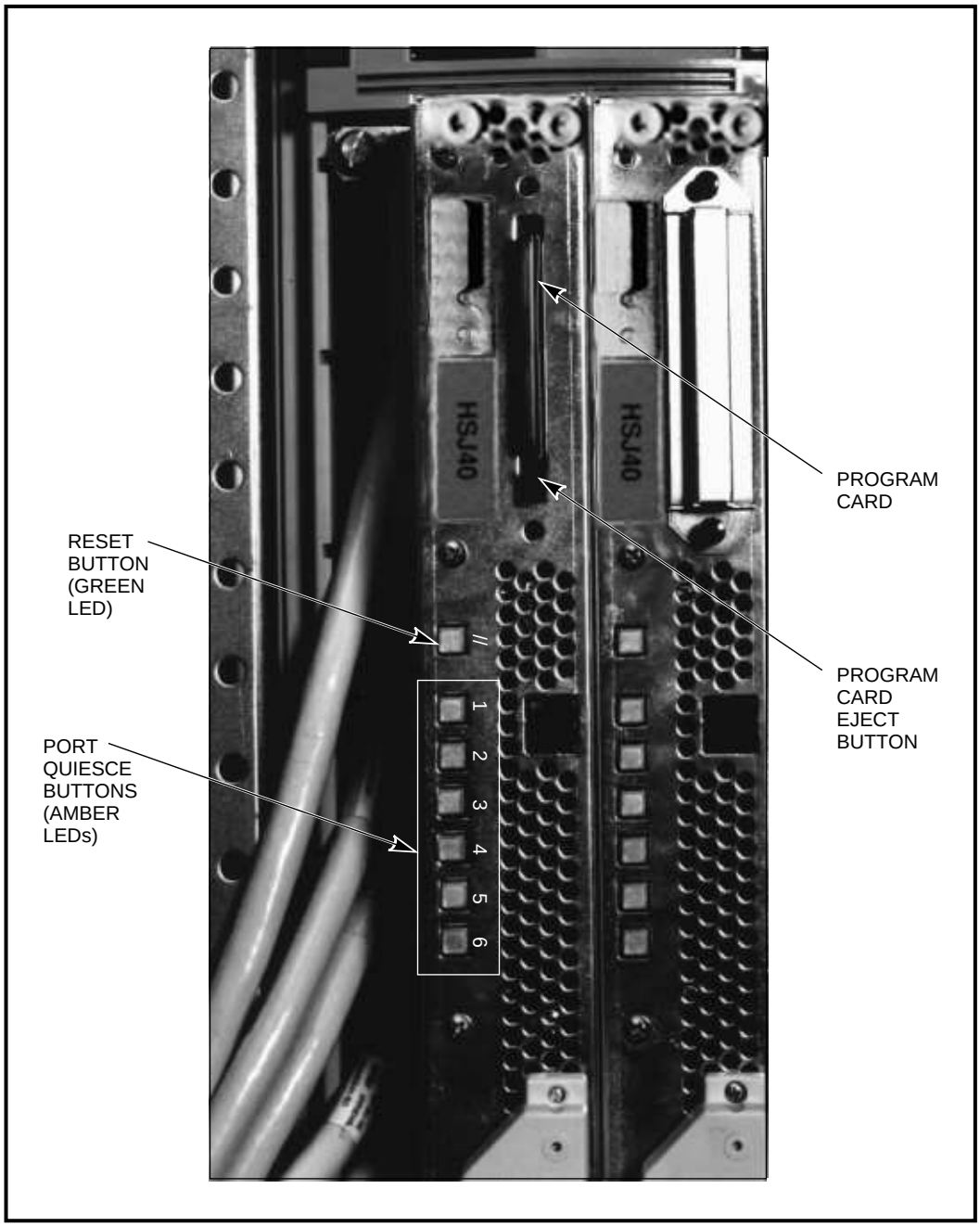
5.5.1 Uses of the OCP Buttons and LEDs

The buttons and LEDs on the OCP are used in two ways:

- During controller initialization, the LEDs report diagnostic errors and the state of the controller.
- The port buttons and their amber LEDs are used functionally, after the initialization process has completed, to perform warm swap procedures for the devices attached to the controller.

  Refer to Figure 5–2 for the location of the OCP reset (//) and Port Quiesce buttons (on an HSJ40 array controller). The reset (//) and port quiesce buttons are located in a similar location for the other HS array controller models.

Figure 5–2 HSJ40 Operator Control Panel Reset and Port Buttons



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5.5.2 How the OCP Functions

At the moment controller initialization begins, hardware turns on the green LED in the reset (//) button, with the remaining LEDs turned off. This denotes the initialization state.

If at any point in the initialization sequence an error is found by controller diagnostics, the amber OCP LEDs are illuminated by the controller diagnostics, indicating an error has been detected.

Figure 5–3 shows the solid OCP LED error codes displayed when a failure occurs during initialization or during normal controller operations. Figure 5–4 shows the flashing OCP LED error codes displayed when failures occur during normal controller operations.

Figure 5–3 HS Array Controllers Solid OCP LED Error 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 5–4 HS Array Controllers Flashing OCP LED Error 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 5–4 (Cont.) HS Array Controllers Flashing OCP LED Error 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 5–4 (Cont.) HS Array Controllers Flashing OCP LED Error 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

When a configuration mismatch (usually after a warm swap procedure) or a disk drive failure is detected, the port LED for the affected disk drive is solidly lit.

Error indications may or may not clear when the controller is reset. Try resetting the controller by pushing the OCP reset (//) button to see whether the same error indication is repeated. If the error indication is the same, replace the indicated FRU. If the error indication changes, look up that code in Figure 5–3 or Figure 5–4 and replace the indicated FRU.

Note

The OCP LEDs flash once per second to indicate normal operations, remain on solid or flash three times per second to indicate an error condition.

At this point, the port buttons and associated LEDs are used as Bus Quiesce Request buttons in device warm swap removal and replacement procedures.

5.6 Power Supply Status LEDs

Refer to the *StorageWorks Solutions Shelf and SBB User's Guide* for information concerning power supply status LEDs. Power supplies have a shelf status LED and a power supply status LED. The top LED is the shelf status LED (SBB LED) discussed in the warm swap procedure.

5.7 Battery Backup Unit (BBU) Status LEDs

Refer to the *StorageWorks Solutions Shelf and SBB User's Guide* for information concerning the battery backup unit status and fault LEDs. Device shelves can use BBUs if they do not have a second power supply.

5.8 Description of Device Warm Swap

Device **warm swap** is a sequence of quick removal and insertion steps, allowing an operator to safely remove a device and insert another device in its place, or add a new device. This means that "safe" removal of a failed device, or the addition of a new device, is possible using device warm swap procedures.

The reason for performing the following steps is to protect data integrity for other shelf devices, and to reduce the chance of an operator causing a port to be unusable for a long period of time (which could render several devices inaccessible). Only one port may be quiesced at any time.

Before removing a device, either the controller or an operator must determine that the operation is necessary. The controller determines whether a device is bad by trying to access the device, receiving no response from the device, or by detecting excessive errors from the device.

An operator can decide whether a device must be removed by observing the OCP LED error code, by observing the device LED, or by checking the system error log information. In any case, a sequence must be followed to properly remove a device from the subsystem device shelf.

5.9 Disk and Tape Warm Swap

Disks can be safely removed and replaced without taking the system down or taking the controller off line. The procedure is divided into removal (covering the steps necessary before disk removal) and replacement (covering the steps necessary before disk replacement).

Note

Disk warm swap includes removal *and* replacement of *one disk at a time*. Should another disk need to be removed, the entire warm swap procedure must be repeated. Each step must be done in the order given to preserve data integrity during normal operations.

You need a 5/32-inch Allen wrench to open the doors of the cabinet. This is the only tool required for disk warm swap.

5.9.1 Disk SBB Warm Swap Removal

CAUTION

Always dismount disk drives (using the system DISMOUNT command) before beginning this procedure. Perform this warm swap procedure **EXACTLY** as stated, or the controller can perform unpredictably.

For all configurations except those using storage sets, you must dismount the device from the host *before* proceeding, for example, using the VMS operating system, use the DISMOUNT command.

Refer to your operating system documentation for procedures necessary for dismounting a device.

Disk drive SBBs can be safely removed using the following process:

1. Unlock and open the cabinet doors using a 5/32-inch Allen wrench.
2. Press and hold the port button for the disk SBB you wish to remove. Continue holding the button in until all amber OCP LEDs light.

   Note

   If the button is not held in long enough, or multiple buttons are pushed in quick succession, *all* button pushes are ignored and the port is not quiesced. You must press the button again to quiesce the port.

3. Wait until the chosen port LED flashes alternately with the other port LEDs (this indicates I/O has stopped). This alternating pattern flashes for approximately 30 seconds, during which time 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 of this controller. For tips to correct the problem, refer to Section 5.9.4. If more information is needed, refer to *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* for instructions for troubleshooting and resolving the problem.
4. Remove the disk (or tape) SBB from its device shelf by squeezing both plastic tabs at the top and bottom of the SBB towards the center of the SBB. Slide the SBB out of the shelf using both hands as shown in Figure 5–5.

Figure 5–5 SBB Warm Swap

CXO-3611B-PH

While the OCP LEDs are flashing their alternating pattern, the shelf SBB LEDs for all disk SBBs on that port also flash. Although tape drives do not always have LEDs, remove them at this time if you are using warm swap to remove a tape drive.

All SBB LEDs flash three times per second.

Note

The time to stop the I/O can vary from zero seconds to several minutes, depending on the load, device type, and cache status.

Once the disk SBB is removed, the flashing pattern on the OCP stops and normal operation of the other ports resume. At this time, the port LED on the SBB you just removed turns on. This LED remains on until the SBB is returned to its slot or another SBB is inserted in that slot. The remaining port LEDs turn off.

5.9.2 Disk SBB Warm Swap Replacement

Disk SBBs can be safely replaced (inserted) using the following process:

1. Quiesce the SBB's port by pressing and holding the port button for the disk drive you wish to replace. Continue holding the button in until all amber OCP LEDs light.

Note

If the button is not held in long enough, or multiple buttons are pushed in quick succession, *all* button pushes are ignored and the port is not quiesced. You must press the button again to quiesce the port.

If the amber LEDs do not light to indicate the bus is quiesced, there may be a problem with a power supply in one of the shelves in the cabinet. Refer to Section 5.9.4 for tips on resolving this problem. If more information is needed, refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* for troubleshooting procedures if this problem should occur.

2. Wait until the chosen port LED flashes alternately with the other port LEDs (this indicates I/O has stopped). This alternating pattern flashes for approximately 30 seconds, during which time you may insert the SBB.
3. Replace (insert) the disk SBB using both hands to push it into the shelf until you hear the mounting tabs snap into place.

   After the SBB insertion is completed, the flashing pattern on the OCP stops and normal operation of the ports resume. At this time, the port LEDs turn off.

   Note

   The time to stop the I/O can vary from zero seconds to several minutes, depending on the load and the type or device.

   If a *new* device is added in a previously unused slot, the port LED remains on until the device is added using the CLI ADD DISK command. Refer to Appendix B.

   If a tape device is placed in a slot where a disk device was previously installed, the port LED remains on until the device is added using the CLI ADD DISK command. Delete the previously installed disk from the list of CLI known devices using the CLI DELETE *device-name* command. Refer to Appendix B.
4. Initialize the inserted device by entering the following CLI command:

   ```
   CLI> INITIALIZE logical-unit-name
   ```

   This initializes the metadata on each disk device in the logical unit, including the device that was just swapped.

   Note

   If you failed to perform the warm swap exactly as stated, you must restart the controller. Otherwise, the controller can perform unpredictably.

5. Close and lock the cabinet doors using a 5/32-inch Allen wrench.

5.9.3 Tape Drive Warm Swap

The same procedure used to warm swap disk drives also is used for 3½-inch and 5¼-inch tape drive SBBs. Refer to Section 5.9.1 and Section 5.9.2.

5.9.4 When the Quiesce Bus State Is Not Displayed

When a power supply fails in a shelf with only one power supply, the shelf becomes inactive. A shelf with a failed power supply asserts a status signal, SWAP_L, to the controller. This signal tells the controller that the physical configuration of the shelf has changed during a normal warm swap operation.

The interrupt level coming into the controller is the same as that of the OCP buttons. The shelf constantly asserts this interrupt to the controller. Usually, the interrupt goes away rapidly during the warm swap operation. Having an interrupt remain active degrades the operation of the controller, as a result the controller disables this interrupt. Disabling the interrupt means that the controller does not respond to OCP button pushes, so the port cannot be quiesced.

If the bus quiesce LED pattern is not displayed after pushing the appropriate port button (as described in the warm swap procedure) within a minute or two, a failed power supply on another shelf within the cabinet may be causing the problem. This problem must be fixed before restarting the warm swap procedure.

To correct the problem do one of the following:

- Replace the power supply in the failed shelf (or shelves)
- Remove all devices in the failed shelf (or shelves)
- Unplug the SCSI cable within the failed shelf (or shelves)

After one of the corrective actions listed has been completed, wait 2 to 3 minutes for the controller to observe the removal of the SWAP_L signal and re-enable the interrupt. You can then begin using the warm swap procedure as documented in Section 5.9.1 and Section 5.9.2.

Note

The bus quiesce procedure for warm swap is NOT necessary when removing or adding devices to an unpowered shelf.

5.10 Controller Warm Swap Utility

Controller warm swap is supported on HSJ array controllers beginning with firmware Version 1.4 (versions prior to Version 1.4 do not support controller warm swap on HSJ array controllers). It is not necessary to remove power from the controller shelf for HSJ controllers. This utility is called C_SWAP.

Controller warm swap for HSZ40 controllers does not include using the C_SWAP command. You must use the appropriate SHUTDOWN command for your operating system.

Controller warm swap for HSD30 controllers is not supported. Power must be removed from the controller shelf before removing the DSSI host port cables and then the controller(s).

The Controller Warm Swap Utility (C_SWAP) is used to remove and replace HS array controllers or cache modules in a dual-redundant configuration. All I/O operations are failed over to the controller running C_SWAP, and the bus is allowed settling time to prepare for the remove/replace operation. C_SWAP does not perform any operations to optimize the HS array controller configuration. When warm swapping a controller, you are removing/replacing a controller in the most transparent method available to the HS array controller subsystem.

Warm swap differs from executing the CLI SHUTDOWN command in that devices are not off line until a replacement is found, and you do not need to remove power from the controller.

CAUTION

You must warm swap only one controller at a time. Never attempt to remove both controllers in your dual-redundant configuration using warm swap.

Note

Try to have a replacement controller available prior to starting warm swap. Otherwise, you will have to terminate the warm swap program and restart it again later when you have a replacement.

5.10.1 When to Use C_SWAP

Use C_SWAP when you want to remove and replace a single HS controller or cache module that is part of a redundant pair. You can either replace the second module immediately while in C_SWAP, or you can exit C_SWAP and leave the failed-over controller running until you replace the second module at a later time.

Because C_SWAP performs a quiesce operation on all ports of the HS array controller, you should use C_SWAP even if failover has already occurred due to a fatal error in one controller.

5.10.2 Functions of C_SWAP

C_SWAP performs the following functions during module removal/replacement procedures:

- Prompts you to identify the module to be removed
- Fails over I/O to the HS array controller that is running C_SWAP
- Performs a quiesce procedure for all HS array controller ports on the bus
- Prompts you to remove and replace the failed controller
- Restarts the subsystem in either failed-over configuration or full redundant operation

You can abort the C_SWAP utility by entering the Ctrl/C (followed by pressing the Return key) or Ctrl/Y (followed by pressing the Return key) commands at any time during its operation.

5.10.3 Removing a Controller During a C_Swap Operation

Use the following procedure to warm swap an HS controller:

1. Set up either a virtual terminal connection or your maintenance terminal for the controller you are **not** removing.
2. Enter the following command:

   ```
   HSx> RUN C_SWAP
   ```

   The system responds with:

   ```
   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]? YES
   ```

3. Answer Y to continue the procedure.

   ```
   Will its cache module also be removed Y/N [N]? YES
   ```

4. Answer Y only if you are removing the controller's cache module as well.

After you answer the controller/cache module identity prompts, C_SWAP fails over the I/O for that controller to the controller running C_SWAP. The failover operation is complete when the green indicator (reset LED) on the HS array controller module to be replaced stays lit. C_SWAP then performs a bus quiesce operation and prompts you to remove the specified modules, as shown in the following example:

```
Killing other controller.
Attempting to quiesce 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.
Time remaining 4 minutes, 50 seconds.
```

CAUTION

Do not remove the controller with the blinking green LED reset (//) button.

5. You have 5 minutes to perform the remove operation for an HSJ controller/cache module swap, and 2 minutes for an HSJ controller-only swap, following the steps described in Section 5.11. If you do not complete the removal in this time, the configuration that was running when you started is restored, all ports are restarted, and C_SWAP exits. All ports remain quiesced during this interval. If you have not inserted a replacement controller or cache module you are prompted as follows:

   ```
   Do you have a replacement HSJ40 readily available [N]? Return
   No OTHER HSJ40 immediately available, program exiting.
   ```

   If you enter NO or press Return in response to this prompt, C_SWAP exits with the HS array controller in the failed-over configuration. If you answer YES, you are given an additional time interval to perform the remove/replace operation.

   The replacement configuration must contain both a cache module and an HS array controller module. The replacement HS array controller module must have its program card removed for C_SWAP to properly restart the configuration. Once the second controller is detected, C_SWAP displays a restart procedure and exits. You must enter the CLI command RESTART OTHER_CONTROLLER to properly restart the configuration.

5.10.4 Replacing a Controller During a C_Swap Operation

The following is an example of a C_SWAP session for an HSJ controller/cache module swap in which the replacement HSJ controller is not immediately available. After you have entered the RUN C_SWAP command, C_SWAP prompts you as follows:

```
Do you have a replacement HSJ40 readily available [N]? NO
```

Try to have a replacement available. If you do not have one, you have to answer N. Then, the warm swap sequence terminates, and you have to restart the routine later when you have a replacement.

When you find a replacement, you can restart the sequence by entering the RUN C_SWAP command again. The system responds with:

```
Do you have a replacement HSJ40 readily available [N]? YES
```

1. Answer Y if you have the controller.

   ```
   *** Sequence to INSERT other HSJ40 has begun. ***

   Do you wish to INSERT the other HSJ40 [N]? YES
   ```

2. Answer Y to insert the controller. (A message about the cache appears only if you removed the cache module in the first place.)

   Remember to reinsert the cache if necessary.

   ```
   Attempting to quiesce 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.
   ```

3. Insert the cache (if applicable) and controller now. Follow the steps outlined in Section 5.12.

   ```
   Restarting ALL ports.

      Port 1 restarted.
      Port 2 restarted.
      Port 3 restarted.
      Port 4 restarted.
      Port 5 restarted.
      Port 6 restarted.
   The Controller Warm swap program has terminated.

   The configuration has two controllers.
   To restart the other HSJ40:

     1) Enter the command RESTART OTHER_CONTROLLER.
     2) Press and hold in the Reset (//) button while inserting the
        program card.
     3) Release Reset (//); the controller will initialize.


   HSJ> RESTART OTHER_CONTROLLER
   HSJ>
   ```

Follow the steps on the display message to restart the other controller. After the new controller has initialized, perform the following steps:

1. Plug a maintenance terminal into the EIA–423 terminal port in the front bezel of the new controller.
2. Set the new HSJ controller's initial parameters:
   - Set the MAX_NODES parameter to the same value as the other controller in the pair.

- Set the controller ID to the same number that the failed controller was assigned.
- Set the SCS node name to the same value that the failed controller was assigned.
- Set the MSCP and TMSCP allocations classes to the same values as the other controller in the pair.

3. Connect the host port cable and enable the host port path.
4. Enter the RESTART THIS_CONTROLLER command.
5. Enter the SET FAILOVER COPY=OTHER_CONTROLLER command to copy the configuration parameters from the original controller to the new controller.
6. Unplug the maintenance terminal from the new controller.

Refer to Section 5.2.5 for examples of the CLI commands for setting initial parameters in a dual-redundant configuration.

5.11 Physically Removing a Controller Module During a C_Swap Operation

When running the C_SWAP utility, you are prompted to remove the controller module. Use the following procedure to physically remove the controller module.

Have the following tools available in order to remove the controller module:

- ESD strap
- Allen wrenches (3/32-inch and 5/32-inch)
- Small straight-edge screwdriver

Note

User proper ESD procedures when handling controller or cache modules.

Use the following procedure to remove the controller module from the controller shelf (for HSJ controller warm swap):

1. Unlock and open the subsystem cabinet doors using a 5/32-inch Allen wrench.
2. At the time indicated in the controller warm swap utility, remove the program card from the failed controller by unsnapping the EMI shield (if attached), then push the eject button next to the card. Pull the card out and have it ready for use in the replacement controller.
3. Remove the maintenance terminal EIA cable, if attached.
4. Using a straight-edge screwdriver to loosen the captive screws on the host port cable, then remove the cable from the front bezel of the controller you are replacing.
5. Loosen the four screws on each side of the front bezel using a 3/32-inch Allen wrench.

Note

Make sure your ESD group strap is plugged into the ground stud on your cabinet's frame. Attach the wrist strap securely to your wrist.

6. Use a gentle up-and-down rocking motion to loosen the module from the shelf backplane.
7. 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.

5.12 Physically Replacing a Controller Module During a C_Swap Operation

Note

User proper ESD procedures when handling controller or cache modules.

Use the following procedure to replace your controller module during the controller warm swap replacement (for HSJ controller warm swap):

1. You should replace the cache module now, if you removed it.
2. Check the OCP cable to ensure it is correctly plugged into side 2 of the controller module (HSJ controllers).
3. Slide the controller module into the shelf into the same controller slot occupied by the module you previously removed. Use a gentle up-and-down rocking motion to help seat the module into the backplane. Push in firmly on the module to ensure the controller is *firmly* seated. You should hear a click. Then, push firmly again to ensure that it is seated properly.
4. Tighten the four screws through the front bezel using a 3/32-inch Allen wrench.
5. Reconnect the host port cable and tighten the captive screws using a straight-edge screwdriver.
6. Connect the maintenance terminal cable to the MMJ port and continue with the controller warm swap procedure as indicated.
7. Press and hold the controller's green reset (//) button, then insert the program card into the new controller. The program card eject button extends to be almost even with the outer edge of the program card when the card is fully inserted.
8. Release the reset button.
9. Set the initial controller parameters (controller ID and so forth).
10. You can disconnect the maintenance terminal. The terminal is not required for normal controller operation.
11. After the controller warm swap procedure is completed, close and lock the cabinet doors using the 5/32-inch Allen wrench.

6
Diagnostics and Utilities

This chapter contains brief overviews about controller initialization self-tests and diagnostics, DILX (drive exerciser), TILX (tape exerciser), and VTDPY (the customer utility).

Also included are descriptions and instructions for running HS array controller local programs, such as C_SWAP (a controller warm swap utility) and CONFIGURE (an automatic configuration utility).

For error reporting information, refer to the *StorageWorks Array Controller HS Family of Array Controllers Service Manual*.

6.1 Initialization Diagnostics

Any of the following actions cause the controller to initialize:

- Upon a power-up cycle
- Upon a firmware reset
- By pressing the reset (//) button on the controller's OCP
- From a host clear

During a controller initialization sequence, the controller diagnostics run automatically. Refer to Section 5.1 for a complete description of the initialization diagnostics.

If a hard failure occurs anytime during the initialization sequence, the controller OCP LEDs indicate an error. An error report also prints at a local terminal. An error displays at the prompt the next time the prompt is returned. If no message displays, press the Return key on the terminal and the error message should display.

6.2 Connecting to the Controller

You can connect to the controller using a maintenance terminal connected to the EIA–423 terminal port or a virtual (host) terminal using a diagnostic utility protocol (DUP or HSZUTIL) connection.

6.3 HS Array Controller Local Programs

The HS array controller firmware includes a set of local programs that include the following:

- DILX (disk inline exerciser)
- TILX (tape inline exerciser)
- VTDPY (gathers and displays system state and performance information)
- C_SWAP (controller warm swap utility)

- CONFIGURE (configuration management tool)

The following sections describe each local program and how it is used.

6.3.1 DILX

Note

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

The **disk inline exerciser** (DILX) is a diagnostic tool used to exercise the data transfer capabilities of selected disks connected to an HSJ or HSD30 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 also can be run on CDROMs, but must be run only in *read-only* mode. Thus, DILX can be used to determine the health of a controller and the disks or CDROMs connected to it and to acquire performance statistics.

You can run DILX from a maintenance terminal, from a VCS, or from a virtual terminal (refer to Section 7.3.1). If you are attaching a VCS, you must have it plugged into the EIA–423 maintenance port.

Note

If you have an HSZ40 array controller, you can only run DILX from a maintenance terminal or by using the HSZUTIL host program. (Refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* for a instructions for using HSZUTIL.)

6.3.2 Invoking DILX

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

Note

If you want to run both DILX and TILX at the same time, DILX and TILX can be run concurrently with one program initiated from the HSJ (or HSD30) controller maintenance terminal port, and the other program run from a DUP connection to the host. However, Digital recommends that DILX and TILX *not* be run while normal I/O operations are in progress, as they degrade system performance due to the heavy load they impose on the controller.

To invoke DILX from a maintenance terminal, enter the following command at the CLI> prompt (or HSx> prompt, if set):

```
CLI> RUN DILX
```

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

```
CLI> VCS CONNECT device_name
```

Where *device_name* is the controller's SCS node name.

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

Note

The *device_name* **must** be specified for a VCS.

To invoke DILX from a virtual terminal, refer to Section 7.3.1.

6.3.3 Interrupting DILX Execution

Use the following guidelines to interrupt DILX execution:

Note

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

Note

Do not enter Ctrl/G from a VCS because it causes VCS to terminate. VCS acts on the sequence and the sequence never gets sent to DILX. Use Ctrl/T when interrupting DILX from a VCS.

- Ctrl/G causes DILX to produce a performance summary. DILX continues normal execution without affecting the run-time parameters.
- Ctrl/C causes DILX to produce a performance summary, stop testing, and prompts the *reuse parameters* question.
- Ctrl/Y causes DILX to abort. The *reuse parameters* question is not prompted.
- Ctrl/T causes DILX to produce a performance summary. DILX then continues executing normally without affecting any of the run-time parameters.

6.3.4 Running DILX

CAUTION

DILX allows autoconfiguring disk drives. This allows for quick configuring and testing of all units at once. Be aware that customer data is lost when running this test. Digital recommends using the Auto-Configure option only during initial installation.

The following text and examples are meant to be an overview of DILX, not an all-encompassing procedure for running DILX. Refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* for specific instructions for running DILX and TILX (including abort codes, error codes, and so forth).

There are two DILX tests:

- Basic function test

- User-Defined test

Note

The basic function test should be used most of the time. The user-defined test should be used for special problems only.

The basic function test for DILX executes in (three or) four phases:

- Initial write pass (optional phase)
- Random I/O (a read-only mode can be chosen)
- Data intensive (for testing disk throughput)
- Seek intensive (stimulates head motions of selected disks)

CAUTION

The user defined test in DILX should be run by *knowledgeable personnel only*, otherwise, customer data can be destroyed.

User-Defined Test (DILX)—When you select this test, you are prompted for input to define a specific test. In the 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, erase, or quit). Quit is really 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

For a detailed description of the various DILX tests and questions that DILX prompts you, refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual*.

Note

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

6.3.5 DILX Examples

Note

The following examples of DILX can be run on HSJ and HSD30 array controllers only. If you have an HSZ40 array controller, refer to the HSZ40 array controller example.

In the first example, all functions are chosen for DILX. The SCS node name is MASS1. DILX was invoked from a virtual terminal using a DUP connection from an OpenVMS VAX system. This is an extensive (long) run for the following reasons:

- The initial write pass was chosen
- Not enough time was taken for the initial write pass to complete
- Not enough time for normal testing to continue for a reasonable length of time after the initial write pass

6.3.5.1 Using All Functions (Long Run)

In this example, when no answer appears after the question mark (?), the user chose the default (indicated within brackets [ ]).

CAUTION

This test writes to disks. All user data is destroyed.

Example 6–1 Using All Functions

```
$ 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 V14J
 MASS1   HSJ V14J
(Entered a Ctrl/C here.)
DUP>SET HOST/DUP/SERVER=MSCP$DUP MASS1/TASK=DILX
%HSCPAD-I-LOCPROGEXE, Local program executing - type ^\ to exit
Copyright © Digital Equipment Corporation 1993
Disk Inline Exerciser - version 2.0
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.
Do you wish to perform an Auto-Configure (y/n) [n] ?
```

(continued on next page)

Example 6–1 (Cont.) Using All Functions

```
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 6–1 (Cont.) Using All Functions

```
   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>
```

6.3.5.2 Using All Defaults (Read-Only)

Note

The following example can be used for DILX runs on HSJ and HSD30 array controllers only.

In the following example, DILX is run using all defaults. This is executed in read-only mode. No data on the units under test will be destroyed. The entire user-available LBN range on each disk is accessible for DILX testing. DILX was invoked from a maintenance terminal.

Example 6–2 Using All Defaults (Read-Only)

```
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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Disk Inline Exerciser - version 2.0

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.

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

(continued on next page)

Example 6–2 (Cont.) Using All Defaults (Read-Only)

```
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

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>
```

6.3.5.3 Using Auto-Configure with Half of the All Units Option

In the following example DILX is run using the Auto-Configure option with the half of all units option:

Example 6–3 Using Auto-Configure with Half of the All Units Option

```
HSJ> RUN DILX

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Disk Inline Exerciser - version 2.0

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.

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:
```

(continued on next page)

Example 6–3 (Cont.) Using Auto-Configure with Half of the All Units Option

```
      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>
```

6.3.5.4 Using Auto-Configure with the All Units Option

In the following example DILX is run using the Auto-Configure option with the all units option:

Example 6–4 Using Auto-Configure with the All Units Option

```
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 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 6–4 (Cont.) Using Auto-Configure with the All Units Option

```
 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.

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>
```

6.3.5.5 Using Auto-Configure on an HSZ40 Array Controller

The following is an example of a DILX run on an HSZ40 array controller when the Auto-Configure option was picked. This example also shows some error messages.

Example 6–5 Using Auto-Configure on an HSZ Controller

```
HSZ> SHOW DEVICE
Name          Type          Port Targ  Lun                    Used by
------------------------------------------------------------------------------

DISK100       disk             1    0    0                    D0
DISK110       disk             1    1    0                    D1
DISK130       disk             1    3    0                    D2
DISK140       disk             1    4    0                    D3
DISK150       disk             1    5    0                    D4
DISK440       disk             4    4    0                    D5

HSZ> RUN DILX

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Disk Inline Exerciser - version 2.0
It is recommended that DILX only be run when there is no host activity
present on the HSZ. Do you want to continue (y/n) [n]?y

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.

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

     ****  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 0 successfully allocated for testing
Unit 1 successfully allocated for testing
Unit 2 successfully allocated for testing
Unit 3 successfully allocated for testing
Unit 4 successfully allocated for testing
Unit 5 successfully allocated for testing
Maximum number of units are now configured

   DILX testing started at: 13-JAN-1993 04:36:17
    Test will run for 60 minutes
    Type ^G to get a current performance summary
    Type ^C to terminate the DILX test prematurely
    Type ^Y to terminate DILX prematurely

  The unit status and/or the unit device type changed unexpectedly.
  Unit 5 dropped from testing

   DILX Summary at 13-JAN-1993 04:40:48
   Test minutes remaining: 56, expired: 4

Cnt err in HEX  IC:03F00402  PTL:00/00/FF  Key:06  ASC/Q:A1/00  HC:1  SC:0
  Total Cntrl Errs   Hard Cnt 1   Soft Cnt 0
```

(continued on next page)

Example 6–5 (Cont.) Using Auto-Configure on an HSZ Controller

```
Unit 0     Total IO Requests 29779
  No errors detected
Unit 1     Total IO Requests 15810
  No errors detected
Unit 2     Total IO Requests 15816
  No errors detected
Unit 3     Total IO Requests 15816
  No errors detected
Unit 4     Total IO Requests 15816
  No errors detected
Unit 5     Total IO Requests 4035
  Err in Hex: IC 0326450A  PTL:04/04/00  Key:04  ASC/Q:80/06  HC:2  SC:0
  Err in Hex: IC 0328450A  PTL:04/04/00  Key:04  ASC/Q:03/00  HC:1  SC:0
  Total Errs   Hard Cnt 3   Soft Cnt 0
  The unit status and/or the unit device type changed unexpectedly.
  Unit 5 dropped from testing

DILX - Normal Termination

HSZ>
```

6.3.5.6 Using the All Units Option on an HSZ40 Array Controller

The following is an example of a DILX run on an HSZ40 array controller without the use of auto-configure and choosing all units.

Example 6–6 Using the All Units Option on an HSZ40 Controller

```
HSZ> RUN DILX

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Disk Inline Exerciser - version 2.0
It is recommended that DILX only be run when there is no host activity
present on the HSZ. Do you want to continue (y/n) [n] ?y

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.

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

Use all defaults and run in read only mode (y/n) [y]?n
Enter execution time limit in minutes (1:65535) [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
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] ?5
  *** Available tests are:
    1. Basic Function
    2. User Defined
```

(continued on next page)

Example 6–6 (Cont.) Using the All Units Option on an HSZ40 Controller

```
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
Perform data compare (y/n) [n] ?y
Enter compare percentage (1:100) [5] ?
Disk unit numbers on this controller include:
    0
    1
    2
    3
    4
    5
Enter unit number to be tested ?0
Unit 0 will be write enabled.
Do you still wish to add this unit (y/n) [n] ?y
Enter start block number (0:3124637) [0] ?
Enter end block number (0:3124637) [3124637] ?
Unit 0 successfully allocated for testing
Select another unit (y/n) [n] ?y
Enter unit number to be tested ?1
Unit 1 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 1 successfully allocated for testing
Select another unit (y/n) [n] ?n

   DILX testing started at: 13-JAN-1993 04:47:17
    Test will run for 10 minutes
    Type ^G 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 04:49:08
   Test minutes remaining: 9, expired: 1

Unit 0     Total IO Requests 25190
  Read Count   0   Write Count 25190
  KB xfer   Read 0   Write 201520   Total 201520
  No errors detected
Unit 1     Total IO Requests 6398
  Read Count   0   Write Count 6398
  KB xfer   Read 0   Write 51184   Total 51184
  No errors detected
Reuse Parameters (stop, continue, restart, change_unit) [stop] ?

DILX - Normal Termination

HSZ>
```

6.3.5.7 Using All Defaults on an HSZ40 Array Controller

The following is an example of a DILX run on an HSZ40 array controller without using the auto-configure option and using the all defaults option:

Example 6–7 Using All Defaults on an HSZ40 Controller

```
HSZ> RUN DILX

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Disk Inline Exerciser - version 2.0
It is recommended that DILX only be run when there is no host activity
present on the HSZ. Do you want to continue (y/n) [n]?y

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.

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:
    0
    1
    2
    3
    4
    5
Enter unit number to be tested ?0
Unit 0 successfully allocated for testing
Select another unit (y/n) [n] ?y
Enter unit number to be tested ?4
Unit 4 successfully allocated for testing
Select another unit (y/n) [n] ?n

   DILX testing started at: 13-JAN-1993 04:52:56
    Test will run for 10 minutes
    Type ^G 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 04:54:45
   Test minutes remaining: 9, expired: 1

Cnt err in HEX  IC:03164002  PTL:01/00/00  Key:04  ASC/Q:89/00  HC:2  SC:0
  Total Cntrl Errs   Hard Cnt 2   Soft Cnt 0

Unit 0     Total IO Requests 251
  Err in Hex: IC 0326450A  PTL:01/00/00  Key:03  ASC/Q:80/00  HC:1  SC:0
  Err in Hex: IC 02110064  PTL:01/00/00  Key:01  ASC/Q:18/02  HC:0  SC:2
  Err in Hex: IC 0326450A  PTL:01/00/00  Key:01  ASC/Q:18/8B  HC:0  SC:2
  Total Errs   Hard Cnt 1   Soft Cnt 7
Unit 4     Total IO Requests 2101
  No errors detected
Reuse Parameters (stop, continue, restart, change_unit) [stop] ?

DILX - Normal Termination

HSZ>
```

Refer to the *StorageWorks™ Array Controllers HS Family of Array Controllers Service Manual* for more details for running DILX.

6.3.6 TILX

Note

Before running TILX, be sure that all units you wish to test are dismounted from the host.

The **tape inline exerciser (TILX)** is a diagnostic tool used to exercise the data transfer capabilities of selected tape drives connected to an HSJ or HSD30 controller. TILX exercises tapes 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 the CLI, from VCS, or from a virtual (host) terminal.

CAUTION

TILX should be run ONLY using scratch tapes. This test writes to the tape and destroys any data that exists.

6.3.7 Invoking TILX

The following section describes how to invoke TILX from a maintenance terminal at the CLI> prompt (or HSx> prompt if set), from a VCS, or from a virtual terminal through a DUP connection.

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

```
CLI> RUN TILX
```

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

```
CLI> VCS CONNECT device_name
```

Where *device_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 *device_name* **must** be specified for a VCS.

To invoke TILX from a virtual terminal, refer to Section 7.3.1.

6.3.8 Interrupting TILX Execution

Use the following guidelines to interrupt TILX execution.

Note

The circumflex 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 causes VCS to terminate. VCS acts on the sequence and the sequence never gets sent to TILX. Use Ctrl/T when interrupting TILX from a VCS.

- Ctrl/G causes TILX to produce a performance summary. TILX continues normal execution without affecting the run-time parameters.
- Ctrl/C causes TILX to produce a performance summary, stop testing, and prompt the *reuse parameters* question.
- Ctrl/Y causes TILX to terminate. The *reuse parameters* question is not prompted.
- Ctrl/T causes TILX to produce a performance summary. TILX then continues executing normally without affecting any of the run-time parameters.

6.3.9 Running TILX

TILX prompts a series of questions needed to collect the parameters to perform a TILX test. Enter "Y" to use the defaults for TILX (most of the other TILX questions are not prompted). Enter "N" and the defaults are not used. You must then answer each question as it is displayed. For more details and a list of defaults, refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual*.

TILX has the following three tests:

- Basic function test
- User-Defined test
- Read-Only test

For details of these tests refer to *StorageWorks Array Controllers HS Family of Array Controllers Service Manual*.

6.3.10 TILX Examples

The following sections present two TILX examples, one using all functions, the other using all defaults. A read-only test example is not shown.

6.3.10.1 Using All Functions

In the following example, all functions are chosen for TILX using a longer run time and higher record count than the default. The performance statistics and a performance summary are displayed every 10 minutes. In this case, TILX is invoked from a maintenance terminal. This example was run on an HSJ40 controller.

Example 6–8 Using All Functions

(continued on next page)

Example 6–8 (Cont.) Using All Functions

```
HSJ> RUN TILX

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Tape Inline Exerciser - version 1.0
Enter TILX hex debug flags (0:ffff) [0] ?

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
```

(continued on next page)

Example 6–8 (Cont.) Using All Functions

```
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>
```

6.3.10.2 Using All Defaults

In the following example, all defaults are chosen for TILX. This is a semiextensive 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 tape drives. TILX is invoked from a maintenance terminal.

CAUTION

TILX should be run ONLY using scratch tapes. This test writes to the tape and destroys any data that exists.

Example 6–9 Using All Defaults

```
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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Tape Inline Exerciser - version 1.0

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
```

(continued on next page)

Example 6–9 (Cont.) Using All Defaults

```
   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>
```

Refer to the *StorageWorks™ Array Controllers HS Family of Array Controllers Service Manual* for more details for running TILX.

6.3.11 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, VTDPY can be run only on terminals connected the the HS controller maintenance terminal port.

Note

VCS can be used only from a terminal attached to the EIA–423 terminal port of the HS array controller.

VTDPY 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.

6.3.12 How to Run VTDPY

Only one VTDPY session can be run on each controller at one time. 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 Section 7.3.1.

6.3.12.1 Using the VTDPY Control Keys

Use the following control key sequences to work the VTDPY display:

Table 6–1 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.

6.3.12.2 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 6.3.12.1.

Table 6–2 VTDPY Commands

Command String	Function
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.

(continued on next page)

Table 6–2 (Cont.) VTDPY Commands

Command String	Function
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 can follow the supplied keyword. The command line interpreter is not case sensitive, so keywords can be entered in uppercase, lowercase, or mixed case.

Upon successful execution of a command other than HELP, the command line interpreter is exited and the display is resumed. Typing a carriage return without a command also exits the command line interpreter 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 command line interpreter prompts for an additional command instead of returning to the display.

6.3.12.3 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 6–1 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 6–2 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 6–3 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 6–4 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 6–5 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 6–6 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 6–7 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 6–8 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 is displayed across one line.

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 are not 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 appear:

- **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 appear:

- **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 6–3 describes the processes that may appear 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 6–3 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	A 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 6–3 (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 available only 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 which has negotiated synchronous transfers, and the negotiated transfer method currently in use between the controller and the initiators. This subdisplay is available only 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 communication has been negotiated.

❹ A numeric value indicates the synchronous data rate which 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 is used unless the initiator successfully negotiates for synchronous communications. If there is no communication with a given target ID, the communication mode is 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 available only on CI based controllers.

❶ Packets received from a remote node

❷ Packets sent to a remote node that were ACKed

❸ Packets sent to a remote node that were NAKed

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 available only on DSSI based controllers.

❶ Packets received from a remote node

❷ Packets sent to a remote node that were ACKed

❸ Packets sent to a remote node that were NAKed

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 of the node number. 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 it 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 happens 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 of the node number. 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 is not displayed for DSSI based controllers.
- **B** indicates only CI path B is functioning properly. In this example, node 14 demonstrates this. This value is not displayed for DSSI based controllers.
- **X** indicates the CI cables are crossed. In this example, node 27 demonstrates this. This value is not displayed for DSSI based controllers.
- A circumflex (**^**) 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      hH❸
```

Description

This display shows what devices the controller has been able to identify on the device busses.

Note

The controller does 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 (abbreviated)

```
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 can 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 may appear:

- **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 Customer Service. 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 inconsistency.
- **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 available only 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 contained only 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 contained only 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 can 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 contained only 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 can 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 may appear:

- **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 Customer Service. 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 inconsistency.
- **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.

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 can 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 following device type letters may appear:

- **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 also is 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 queuing, the maximum value is 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 in 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.

6.3.13 Controller Warm Swap Utility

The Controller Warm Swap Utility (C_SWAP) is used to warm swap HS array controllers or cache modules in a dual-redundant configuration. Refer to Section 5.10 for complete instructions for running the Controller Warm Swap Utility.

6.3.14 Configure Utility

The Configure Utility locates and adds devices to an HS array controller.

6.3.14.1 When to Use the Configure Utility

You should run the Configure Utility whenever new devices are added to the HS array controller.

6.3.14.2 Description

The Configure Utility searches all PTL device combinations to determine what devices exist on the subsystem. It adds those devices that are found. The Configure Utility does *not* initialize these devices, and it does *not* add units or storage sets.

6.3.14.3 Running the Configure Utility

You can run the Configure Utility on either a virtual terminal or on a maintenance terminal.

Before running the Configure Utility, use the CLI SHOW DEVICES command to verify the list of devices that are currently connected to the HS array controller, as shown in the following example. The example shows the Configure Utility as it is run on an HSJ or HSD30 array controller. The text of the prompts may change slightly when run on other controllers from the HS array controller family.

Note

Program names are limited to six characters. Therefore, to run this program, use RUN CONFIG as your command.

```
HSJ> SHOW DEVICES
No devices
HSJ> RUN CONFIG

Copyright © Digital Equipment Corporation 1993
Auto-Config Local Program Invoked

Auto-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 which are found. It will not initialize devices, add units or
storage sets. Do you want to continue (y/n) [y] ? YES

Auto-Config is building it's 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
```

```
Auto-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 Configure Utility, you may have to initialize your containers using the INITIALIZE command as described in Appendix B.

If for some reason a device in the cluster has the same PTL as the Configure Utility assigns, the program assigns an alpha character after the name. For example, if another device is called DISK100, the utility assigns the name DISK100A to the new device. (The utility compares this DISK100A to the other device PTLs in the cluster and if DISK100A has already been used, the utility increments to DISK100B and so forth). This avoids the assignment of duplicate PTLs in the same cluster.

7

Operating System Support

7.1 Digital Supported Operating Systems

Operating system support for controllers includes the following two categories as detailed in the HS Operating Firmware Software Product Description (SPD) and HS Operating Firmware Release Notes:

- **Digital supported with limitations**:

  The controller and devices have been tested for proper and correct operation in conjunction with specific versions and configurations of systems and operating systems that preceded the introduction of the controller.

  The specific operating system version, CPU platform, and system configuration are documented in the controller SPD and/or release notes with one or more of the topics that follow. These should be verifiable from Digital Multivendor Customer Services and Customer Support Center (CSC) personnel.

  During product support activity, calls to the CSC and escalation to Digital Multivendor Customer Services should refer to this controller as a "supported with limitations" product, to route the call to the appropriate technical support group as necessary.

- **Digital fully supported**:

  The controller is a fully supported system component for use with specific versions and configurations of systems and operating systems either preceding or following the introduction of the controller. Specifics are denoted in the SPD, firmware release notes, and subsequent addenda for each operating system. If the controller is "fully supported," the controller is either:

  – Listed in the operating system documentation (for example, the operating system SPD, release notes, supported device list, or systems and options catalog).

    OR

  – Verifiable as "fully supported" from the Digital CSC, Digital Multivendor Customer Services, or other Digital support organizations.

To be a valid system configuration, a device *must* be supported (fully or with limitations) by the controller AND be supported (fully or with limitations) by the operating system. Thus, a device must be supported by BOTH the controller and the operating system to be valid device. Refer to both the controller SPD and the operating system SPD for device support specifics.

Other restrictions can apply to some operating systems when an HS array controller subsystem is installed. Refer to the HS array controller model-specific SPDs and firmware release notes for other restrictions.

7.2 HS Array Controller System Management

System management of the HS array controllers is meant to be done remotely over a VCS or DUP connection (or by using HSZUTIL for HSZ40 controllers) with the exception of entering the vital controller parameters (controller ID and so forth). Only the vital controller parameters must be entered from a maintenance terminal connected directly to the controller's EIA–423 port at initial installation or when replacing a failed controller.

Table 7–1 list the minimum operating support support for HSJ, HSD30, and HSZ40 array controllers.

Table 7–1 Minimum Operating System Support for HS Array Controllers

Operating System	HSJ30/40	HSD30	HSZ40
OpenVMS AXP	Version 1.5[1]	Version 1.5[1]	N/S[2]
OpenVMS VAX	Version 5.5–2[1]	Version 5.5–2	N/S[2]
VAX VMS	Version 5.5–1[1]	N/S[2]	N/S[2]
DEC OSF/1 AXP	N/S[2]	N/S[2]	Version 2.0[3]

[1]Supported with limitations.

[2]Not supported at time of printing.

[3]Fully supported with KZTSA adapter driver for DEC OSF/1 AXP Version 2.0, or with the KZMSA adapter.

7.3 OpenVMS and VMS VAX Operating Systems

The following sections provide information pertinent to OpenVMS and VMS VAX operating systems.

Refer to the OpenVMS operating system documentation for operating system specific information. The OpenVMS operating system versions that support the controller are listed in the controller or operating system specific SPD and release notes.

7.3.1 CLI Access via DUP with OpenVMS Operating System

After initial configuration, you can access CLI using a virtual terminal for HSJ and HSD30 controllers. The method of establishing the virtual terminal connection varies depending on the operating system and interface type.

If you are entering commands from a host terminal, the following command creates a virtual terminal connection to your controller's command line interpreter (CLI) from OpenVMS operating systems:

Note

You must have the DIAGNOSE privilege to use the following command.

From a host terminal at the VMS DCL prompt, enter the following command:

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

If you do not want to have a log file created, delete the /LOG=CONFIGURATION.INFO portion of the command. Substitute the name of the program you want to run after the /TASK= portion of the command, such as DILX if you want to run a test without going into the controller's CLI.

Using the /LOG=CONFIGURATION.INFO qualifier creates a log file of your session in CLI if you are creating your HS controller's configuration. You will be instructed to log out of the session and print the file after the configuration is defined. Keep this file handy at all times. Each time you alter your controller's configuration using the CLI, ALWAYS use the /LOG= qualifier to maintain a record of configuration changes.

Refer to Appendix B for detailed descriptions of the CLI commands.

Creating a virtual terminal connection from a host terminal under the OpenVMS VAX operating system requires that the FYDRIVER be loaded. 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 the error message, load the OpenVMS VAX FYDRIVER as follows:

```
$ MCR SYSGEN
SYSGEN> CONNECT FYA0 /NOADAPTER
SYSGEN> EXIT
$
```

Once the driver is loaded, you may make the virtual terminal connection as described in this section.

VAXcluster Console System

You can attach a VCS to any HS array controller. If you are unfamiliar with VCS, refer to the VCS Software Manual for complete instructions.

7.3.2 OpenVMS VAX Support

HS operating firmware (beginning with Version 1.4J) supports up to 14 member RAID0 storage sets. However, OpenVMS VAX Version 5.5–2 (and earlier) operating system versions do not support disk device capacities larger than 16,777,216 blocks (about 8.5 GB) as file-structured devices. This must be considered when creating HS array controller storage sets for use with these OpenVMS operating system versions. Do not create storage sets above this limit, for example, do not create stripesets of more than two RZ74 disk drives because three RZ74 disk drives have a capacity of over 11 GB.

CAUTION

Exceeding the 8.5 GB limit may cause data corruption without prior warnings to the user.

The following subsections are limitations and clarifications of the OpenVMS and VAX VMS operating system for HS controller support.

7.3.2.1 HSJ and HSD30 Controller Disks as Boot Devices

The HSJ and HSD30 controllers have certain restrictions when used with specific systems. Those restrictions are described in the following sections.

VAX 7000 and VAX 10000

Note

The following restriction is continued from HS operating firmware Version 1.1J.

HSJ and HSD30 controller disks as VAX 7000 and VAX 10000 boot devices—HS controller operating firmware Version 1.1 and later support manual and automatic booting for VAX 7000/10000 systems. For a disk drive connected to an HSJ or HSD30 controller to be both a VAX 7000/10000 manual *and* automatic boot device, the following conditions must be met:

1. VAX 7000/10000 console code must be at Version 3.2 or greater.
2. HS operating firmware must be at version Version 1.1J or greater for HSJ40 controllers and Version 1.4 for HSJ30 and HSD30 controllers.

Note

Contact your Digital Multivendor Customer Services representative if you need to upgrade your VAX 7000/10000 console code to Version 3.2 or greater.

If your VAX 7000/10000 console code version is earlier than Version 3.2, you are limited to manual booting. To manually boot your system, perform the following steps:

1. Ensure that the disk drives attached to an HSJ or HSD30 controller are visible to the boot driver by entering the SHOW DEVICE command repeatedly (from the virtual console) until the disk drives attached to the HSJ or HSD30 controller are reported (usually two repetitions are sufficient).
2. Enter the default boot device string. (Refer to the VAX console instructions in the VAX console documentation.)
3. Enter the BOOT command.

DEC 7000 and DEC 10000

Note

The following restriction is continued from Version 1.1J of the HS operating firmware (for HSJ40 controllers).

HSJ and HSD30 controller disk drives may not be used as boot/system disk drives for DEC 7000/10000 systems. Digital expects to remove this restriction in the future.

7.3.2.2 HSJ and HSD30 Controller-Attached Disk Drives and VMS AUTOGEN Program

The OpenVMS AUTOGEN.COM file must be edited for HSJ and HSD30 controller-attached disks to be recognized. If AUTOGEN is run without modification in a system that includes HSJ or HSD30 controller-attached disk drives, the following error may be 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 HSJ or HSD30 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 to support these values.

For VAX VMS Version 5.5–1 and OpenVMS Version 5.5–2 operating systems, the AUTOGEN.COM DCL procedure selects 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 Version 5.5–2) pertinent to devices is shown in the following example. Change one element in the speed list (the –1 shown enclosed in a box) to 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, 4,-1, 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 HSJ or HSD30 controller-attached disk drives to be recognized as a supported device type.

For the OpenVMS VAX Version 6.0 operating system, 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 allows AUTOGEN to run successfully against HSJ or HSD30 controller-attached disk drives to be used as system disks.

Note

OpenVMS VAX Version 6.1 or later software does note require modifications to AUTOGEN.COM file.

7.3.3 Using the Preferred Path Utility with OpenVMS

Attempt to use the OpenVMS Preferred Path utility to balance units between controllers for better performance in a dual-redundant controller configuration. Refer to the *VMS I/O User's Guide* for more information.

7.3.4 SHOW DEVICE Command with OpenVMS

Note

This section pertains only to OpenVMS Version 5.5-1 and Version 5.5-2.

If a device is set as **NOTRANSPORTABLE**, the device type is not recognized using the SHOW DEVICE/FULL or SHOW DEVICE [VMS *unit_name*]/FULL command. The following is an example of the display shown for an unknown device:

Note

The SCS node name may be part of the device name.

```
$ SHOW DEVICE $3$DUA1/FULL

Disk $3$DUA1: (FRED), device type (type not yet identified), is online, file-
    oriented device, shareable, available to cluster, error logging is enabled.

    Error count                    0    Operations completed             50543
    Owner process                 ""    Owner UIC                        [0,0]
    Owner process ID        00000000    Dev Prot    S:RWED,O:RWED,G:RWED,W:RWED
    Reference count                0    Default buffer size                512
    Total blocks             6151059    Sectors per track                   57
    Total cylinders             2570    Tracks per cylinder                 42
    Host name                 "FRED"    Host type, avail              HSJ4, yes
    Allocation class               3
```

Note in the example that "Host type" indicates an HSJ4 (meaning HSJ40).

The following command line displays the name reported by the controller. In this example, HSX01 is the device name of 3DUA1. Use this command line to determine the controller's *REAL* device name even though VMS reports "type not yet identified."

```
$ WRITE SYS$OUTPUT F$GETDVI("$3$DUA1","media_name")
  HSX01
```

Refer to the *StorageWorks HS Array Controller Operating Firmware Release Notes* for further information.

7.3.5 Using the CLUSTER_SIZE Qualifier for Large Devices or Storage Sets with OpenVMS Systems

Digital recommends that the formula displayed by the OpenVMS operating system 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.

7.3.5.1 VAX VMS Version 5.5–1 (and earlier)

If you are using OpenVMS VAX Version 5.5–1 or earlier, and you are attempting to initialize a device using the DCL INITIALIZE command (or the DCL BACKUP/IMAGE command), you will receive the following error message:

Note

The INITIALIZE command may incorrectly set the cluster size.

```
$ INITIALIZE  device-name
"unfavorable cluster size"
```

This message can be circumvented by using the /CLUSTER_SIZE=*n* qualifier. The recommended value of *n* can be determined by using the following formula:

```
$ INITIALIZE/CLUSTER_SIZE=number-of-blocks device-name
```

The maximum size you can specify for a volume is one-hundredth the size of the volume; the minimum size you can specify is calculated with the following formula:

$$\frac{\text{disk\_size (number\_of\_blocks)}}{255*4096}$$

For Files–11 On-Disk Structure Level 2 disks, the cluster size default depends on the disk capacity; disks that are 50,000 blocks or larger have a default cluster size of 3, those smaller than 50,000 blocks have a default value of 1.

When using the BACKUP/IMAGE command, use the following steps:

1. Enter the INITIALIZE/CLUSTER_SIZE=*number-of-blocks device-name* command
2. Enter the BACKUP/IMAGE/NOINITIALIZE command

For further details refer to OpenVMS VAX operating system software release notes and other OpenVMS VAX documentation.

7.3.5.2 OpenVMS VAX V5.5–2 (and above)

The "unfavorable cluster size" error message does not occur with OpenVMS VAX Versions 5.5–2 or higher.

7.3.6 Shadow Set Operation with OpenVMS Systems

Timeout Value—In OpenVMS VAX operating system versions earlier than Version 6.0, timed-out I/O requests to shadow set members can lead to member disks attached to HSJ40 controllers being dropped from shadow sets. In some cases, this can lead to host crashes. To avoid this possibility, Digital strongly recommends changing the value of the SYSGEN parameter SHADOW_MBR_TMO to at least 120 (seconds) for systems running operating system Version 6.0 and earlier. Version 6.1 of OpenVMS (and later) avoids this problem by retrying timed-out operations to shadow set members several times.

7.3.6.1 Shadow Set Members

Each physical device used in a OpenVMS operating system host-based shadow set must be the same physical device type (for example, any of the controller supported disk devices such as RZ25, RZ26, or RZ74 disk drives).

Note

You may not use transportable units as shadow set members.

A shadow set made of two or three RZ26 disk drives on one (or more) HSJ40 controllers is valid. However, a mixture (in one shadow set) of RZ74 disk drives and RZ26 disk drives is NOT valid and should not be attempted.

Because the HSJ and HSD30 controllers report both disk drive types as HSX00 (HSX00 is an example of a device type code), you must distinguish between the two device types by determining:

- Capacity. The capacity must be identical for all devices used within a single shadow set.
- Physical device. The physical device type must be identical for all devices to be used in a single host-based shadow set. The physical device type is obtained by entering the controller SHOW DISK command.

Storage sets created in the controller's configuration and combined with other storage sets in a host-based shadow set also must be identical.

7.3.7 ERF with OpenVMS Systems

The limitations in this section apply to specific versions of the OpenVMS VAX and OpenVMS AXP operating systems as indicated in the release notes and/or in the controller SPD.

The error report formatter (ERF) does not decode controller and device names, but does decode the basic MSCP and TMSCP error packet contents. The basic MSCP and TMSCP packets are decoded except for the controller model byte which is not translated from decimal 40 to the character string "HSJ40." The following is an example from an OpenVMS VAX error log translated by ERF:

Note

The string "MODEL = 40." should be interpreted as "HSJ40."

```
MSLG$Q_CNT_ID   30300019
                01280001
                          UNIQUE IDENTIFIER, 000130300019(X)
                          MASS STORAGE CONTROLLER
                          MODEL = 40.
```

Some subcodes and all controller-dependent information is not decoded by ERF. Instructions for how to decode this information is contained in the *StorageWorks Controllers HS Family of Array Controllers Service Manual*. The following is an example of an OpenVMS VAX error log that did not decode the subcodes and the controller dependent information:

```
       MSLG$W_EVENT        040A
                                    CONTROLLER ERROR
                                    UNKNOWN SUBCODE #0020(X)
       MSLG$Q_CNT_ID   30300019
                       01280001
                                    UNIQUE IDENTIFIER, 000130300019(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.     030A0000
                                    /..../
       LONGWORD 2.     24010102
                                    /...$/
       LONGWORD 3.     00000000
                                    /..../
       LONGWORD 4.     7BDF0000
                                    /..ß{/
       LONGWORD 5.     00000000
                                    /..../
       LONGWORD 6.     01000000
                                    /..../
       LONGWORD 7.     00004200
                                    /.B../
       LONGWORD 8.     00000000
                                    /..../
       LONGWORD 9.     00000000
                                    /..../
       LONGWORD 10.    00000000
                                    /..../
       LONGWORD 11.    00000000
                                    /..../
       LONGWORD 12.    00000000
                                    /..../
       LONGWORD 13.    00000000
                                    /..../
       LONGWORD 14.    00000000
                                    /..../
       LONGWORD 15.    4F4C0000
                                    /..LO/
```

ERF does not recognize (translate) devices or their device-specific extended error status. However, ERF does decode basic MSCP and TMSCP reported error packets from the HSJ or HSD30 controller.

Refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* for ERF decode and error packet information for the HSJ or HSD30 controllers.

7.3.8 OpenVMS AXP Support

Refer to the OpenVMS AXP operating system documentation for operating system specific information. The OpenVMS AXP operating system versions that support the HSJ and HSD30 controllers are listed in the SPD and the release notes. With the exception of ERF limitations, the other limitations listed in this chapter do not apply to the OpenVMS AXP operating system unless otherwise specified in the OpenVMS AXP documentation.

Refer to Section 7.3.7 for details of limitations for ERF under the OpenVMS AXP operating system. Refer to Section 7.3.1 for the method of establishing a virtual terminal connection via DUP for HSJ and HSD30 controllers.

Creating a virtual terminal connection under the OpenVMS AXP operating system requires that the FYDRIVER be loaded. 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 OpenVMS AXP FYDRIVER as follows:

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

Once the driver is loaded, you may make the virtual terminal connection. Refer to Section 7.3.1.

7.4 DEC OSF/1 AXP Support

Refer to the DEC OSF/1 AXP operating system documentation for operating system specific information. Refer to HS array controller-specific SPDs and release notes for supported versions. Not all controller models are currently supported by the DEC OSF/1 AXP operating system.

Note

Using a DUP connection is not currently supported on DEC OSF/1 AXP systems. All configuration set up, parameter definitions, and utilities must be run by using an appropriate terminal emulator with a maintenance terminal connected to your controller's terminal port.

7.4.1 UERF with DEC OSF/1 AXP for HSZ40 Controllers

The UNIX error report formatter (UERF) support under the DEC OSF/1 AXP operating system does not completely decode error log entries for the HSZ40 controller. The DEC OSF/1 AXP operating system can log events to the binary.errlog file, however, UERF does not have added support for detailed information from HS array controllers. UERF processes the header information as much possible and then reports that it has an unknown device type at this time. Digital expects to improve this in the future. Only limited support is available with this tool. Other error event logging support tools will be available in the near future.

The following is an example of an HSZ40 controller UERF error event log using the UERF -0 FULL command (and KZTSA host adapter):

Example 7–1 UERF HSZ40 Controller Error Event Log

```
----- 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 7–1 (Cont.) UERF HSZ40 Controller 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 7–1 (Cont.) UERF HSZ40 Controller 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        *..%~<^.........*
```

7.4.2 Configurations and Device Support for the HSZ40 Controller

The following sections describe the type of device support and how those devices can be used for the Version 1.4 firmware release for HSZ40 array controllers.

Only disk-type devices (RZxx and EZxx) are supported at the time of printing. Refer to the controller release notes and SPD for current information. Disks attached via an HSZ40 controller can be either data or system devices[1]. A disk (physical or virtual) used as a system device for DEC OSF/1 AXP MUST be defined as UNIT0 (LUN 0 as visible to the system).

7.4.2.1 Virtual Terminal Capability

The virtual maintenance terminal facility for communicating with an HSZ40 controller over its SCSI bus interface is provided by a host user application called HSZUTIL. For details about HSZUTIL restrictions and instructions for using the program, refer to the *StorageWorks Array Controllers HS Family of Array Controllers Service Manual* revision B01.

7.4.2.2 DEC OSF/1 AXP Device Special Files for HSZ40 Controllers

For DEC OSF/1 AXP to recognize multiple LUNs behind a given target (such as the HSZ40 controller) [hereafter referred to as units], you need to create device special files for each LUN. The following information is required to create these device special files:

- The bus number in which your SCSI Host Adapter resides
- The target number containing the LUN you want recognized

[1] Refer to the HSZ40 controller release notes for restrictions.

- The LUN number you want recognized

You may want to use the following guidelines in choosing file names for the device special files you create:

```
rz<device#><LUN#><partition#>   for the block oriented device special file
rrz<device#><LUN#><partition#>  for the character oriented device special file
```

Where:

rz and *rrz* are the standard prefixes for SCSI direct access device special files.
device# is calculated by ((bus# * 8) + target#).
LUN# is the LUN behind the target (0 through 7).
partition# corresponds to the disk partition (a through h).

The DEC OSF/1 AXP command for creating a device special file is mknod. You must be a superuser to use this command. Enter man mknod on your DEC OSF/1 AXP system for more details on the mknod command.

You need to create the following:

- 16 device special files for each unit
- 8 block-oriented device special files (1 for each partition a through h)
- 8 character-oriented device special files (1 for each partition a through h)

The mknod command requires the following two parameters to create a device special file:

- major number
- minor number

The major number for SCSI direct access devices is 8. The minor number for partition a is calculated using the following formula:

```
minor number = (bus# * 16384) + (target# * 1024) + (LUN# * 64)
```

The minor number for each subsequent partition for this unit is derived by adding 1 to the current partition (for example, the minor number for partition b is 1 + minor number for partition a).

Example 7–2 Creating Device Special Files (NATIVE SCSI Host Adapter)

Suppose you want to communicate with LUN 0 on an HSZ40 at target ID 2 connected via the SCSI bus to a native SCSI host adapter at bus 1. The following steps create the device special files for this configuration:

1. Generate the file name for partition device special files:

   device# = (1 * 8) + 2 = 10

   file name = rz100a (block) and rrz100a (character)

2. Calculate the minor number for partition device special files:

   minor number = (1 * 16384) + (2 * 1024) + (0 * 64) = 18432

3. Create the device special files using mknod:

```
mknod /dev/rz100a b 8 18432
mknod /dev/rrz100a b 8 18432

mknod /dev/rz100b b 8 18433
mknod /dev/rrz100b b 8 18433

mknod /dev/rz100c b 8 18434
mknod /dev/rrz100c b 8 18434

mknod /dev/rz100d b 8 18435
mknod /dev/rrz100d b 8 18435

mknod /dev/rz100e b 8 18436
mknod /dev/rrz100e b 8 18436

mknod /dev/rz100f b 8 18437
mknod /dev/rrz100f b 8 18437

mknod /dev/rz100g b 8 18438
mknod /dev/rrz100g b 8 18438

mknod /dev/rz100h b 8 18439
mknod /dev/rrz100h b 8 18439
```

At this point, you should be able to write a disk label to /dev/rrz100c with the following command:

```
disklabel -rw /dev/rrz100c hsz40
```

Example 7–3 Creating Device Special Files (KZTSA SCSI Host Adapter)

Suppose you want to communicate with LUN 4 on an HSZ40 at target ID 2 connected via the SCSI bus to a KZTSA SCSI host adapter at bus 14. The following steps create the device special files for this configuration:

1. Generate the file name for partition device special files:

```
device# = (14 * 8) + 2 = 114

file name = rz1144a (block) and rrz1144a (character)
```

2. Calculate the minor number for partition device special files:

```
minor number = (14 * 16384) + (2 * 1024) + (4 * 64) = 231680
```

3. Create the device special files using mknod:

```
mknod /dev/rz1144a b 8 231680
mknod /dev/rrz1144a b 8 231680

mknod /dev/rz1144b b 8 231681
mknod /dev/rrz1144b b 8 231681

mknod /dev/rz1144c b 8 231682
mknod /dev/rrz1144c b 8 231682

mknod /dev/rz1144d b 8 231683
mknod /dev/rrz1144d b 8 231683

mknod /dev/rz1144e b 8 231684
mknod /dev/rrz1144e b 8 231684

mknod /dev/rz1144f b 8 231685
mknod /dev/rrz1144f b 8 231685

mknod /dev/rz1144g b 8 231686
mknod /dev/rrz1144g b 8 231686

mknod /dev/rz1144h b 8 231687
mknod /dev/rrz1144h b 8 231687
```

At this point, you should be able to write a disk label to /dev/rrz1144c with the following command:

```
disklabel -rw /dev/rrz1144c hsz40
```

A

Option Order Numbers

This appendix contains order numbers for controller options and preconfigured subsystems.

Table A–1 lists the HSJ30 controller options.

Table A–1 HSJ30 Controller Options

Order Number	Description
HSJ30–AA	StorageWorks Array Cntrl 130c; 18 SCSI–2 Disk/Tape/Optical Device support; RAID 0, Base Firmware.
HSJ30–AD	StorageWorks Array Cntrl 130c; 18 SCSI–2 Disk/Tape/Optical Device support; 16 MB Read Cache; RAID 0, Base Firmware.
HSJ30-AF	StorageWorks Array Cntrl 130c; 18 SCSI–2 Disk/Tape/Optical Device support; 32 MB Read Cache; RAID 0, Base Firmware.
HSJ30–XE	HSJ30 controller read cache replacement for the 16 MB read cache that comes with the HSJ30–AD option, a 32 MB read cache module; mandatory return of installed 16 MB read cache required.
HSJ3X–AA	HSJ30 to HSJ40 controller upgrade. Increase connectivity from maximum of 18 to 36 devices.
HSJ30–XD	HSJ30 controller 16 MB read cache module option for HSJ30–AA.
HSJ30–XF	HSJ30 controller 32 MB read cache module option for HSJ30–AA.
QA–0W9AA–HS	SWKS HSJ MSC PCRM Kit.

Table A–2 lists the HSJ40 controller options.

Table A–2 HSJ40 Controller Options

Order Number	Description
HSJ40–AD	StorageWorks Array Cntrl 140c; 36 SCSI–2 Disk/Tape/Optical Device support; 16 MB Read Cache; RAID 0, Base Firmware.
HSJ40–AF	StorageWorks Array Cntrl 140c; 36 SCSI–2 Disk/Tape/Optical Device support; 32 MB Read Cache; RAID 0, Base Firmware.
HSJ40–XE	HSJ40 controller read cache replacement for the 16 MB read cache that comes with the HSJ40–AD option, a 32 MB read cache module; mandatory return of installed 16 MB read cache required.
QA–0W9AA–HS	SWKS HSJ MSC PCRM Kit.

Table A–3 lists the HSJ42 subsystem options.

Table A–3 HSJ42 Controller Subsystem Options

Order Number	Description
HSJ42–AD	Two StorageWorks Array Cntrl 140c; 36 SCSI–2 Disk/Tape/SSD/Optical Device support; 32 MB total Read Cache; RAID 0, Base Firmware.
HSJ42–AF	Two StorageWorks Array Cntrl 140c; 36 SCSI–2 Disk/Tape/SSD/Optical Device support; 64 MB total Read Cache; RAID 0, Base Firmware.

Table A–4 lists the HSJ44 subsystem options.

Table A–4 HSJ44 Controller Subsystem Options

Order Number	Description
HSJ44–AD	Four StorageWorks Array Cntrl 140c; 72 SCSI–2 Disk/Tape/SSD/Optical Device support; 64 MB total Read Cache; RAID 0, Base Firmware.
HSJ44–AF	Four StorageWorks Array Cntrl 140c; 72 SCSI–2 Disk/Tape/SSD/Optical Device support; 128 MB total Read Cache; RAID 0, Base Firmware.

Table A–5 lists the HSD30 controller options.

Table A–5 HSD30 Controller Options

Order Number	Description
HSD30–AA	StorageWorks Array Cntrl 130d; 18 SCSI–2 Disk/Tape/SSD/Optical Device support; RAID 0, Base Firmware.
HSD30–AD	StorageWorks Array Cntrl 130d; 18 SCSI–2 Disk/Tape/SSD/Optical Device support; 16 MB Read Cache; RAID 0, Base Firmware.
HSD30–AF	StorageWorks Array Cntrl 130d; 18 SCSI–2 Disk/Tape/SSD/Optical Device support; 32 MB Read Cache; RAID 0, Base Firmware.
HSD30–XD	HSD30 controller 16 MB read cache option for HSD30–AA.
HSD30–XE	HSD30 controller read cache replacement for the 16 MB read cache that comes with the HSD30–AD option, a 32 MB read cache module; mandatory return of installed 16 MB read cache required.
HSD30–XF	HSD30 controller 32 MB read cache option for HSD30–AA, 32 MB total.
QA–2YHAA–HS	SWKS HSD30 MSC PCRM Kit

Table A–6 lists the HSZ40 controller options.

Table A–6 HSZ40 Controller Options

Order Number	Description
HSZ40–AA	StorageWorks Array Cntrl 140z; 42 SCSI–2 disk device support; No Cache; RAID 0, Base Firmware.
HSZ40–AD	StorageWorks Array Cntrl 140z; 42 SCSI–2 disk device support; 16 MB Read Cache; RAID 0, Base Firmware.
HSZ40–AF	StorageWorks Array Cntrl 140z; 42 SCSI–2 disk device support; 32 MB Read Cache; RAID 0, Base Firmware.
HSZ40–XD	16 MB read cache module option for HSZ40–AA.
HSZ40–XF	32 MB read cache module option for HSZ40–AA.
HSZ40–XE	HSZ40 controller read cache replacement for the 16 MB read cache that comes with the HSJ40–AD option, a 32 MB read cache module; mandatory return of installed 16 MB read cache required.
QA–2YJAA–HS	SWKS HSZ40 MSC PCRM Kit.

The SWKS MSC PCRM kits contain the following:

- One HS Operating Firmware array controller software product description (SPD) for that controller.
- One *HS Array Controller Operating Firmware Vx.x Release Notes* for that controller. (Refer to the related documents list in the preface of this manual for order numbers.)
- One *StorageWorks Array Controllers HS Family of Array Controllers User's Guide*, order number EK–HSFAM–UG (Revision B01).
- One SWKS PCRM MFG (program card) appropriate for that controller using the following order numbers:
  - Order number BG–PYU6A–0A (for HSJ controllers)
  - Order number BG–Q6HL0–0A (for HSD30 controllers)
  - Order number BG–Q6HN0–0A (for HSZ40 controllers)

Note

Cables must be ordered separately. Cable part numbers are listed in the *StorageWorks Shelf Configuration Guide*.

Table A–7 lists the preconfigured HSJ40 controller subsystems currently available. Configurations can be added or deleted as the market dictates. Refer to the *Digital Systems and Options Catalog* or the *DEC Direct Hardware Catalog* for the most current order numbers.

Table A–7 HSJ40 Controller Preconfigured Subsystems Options

Order Number	Description
SW810–AA	StorageWorks Array 140c, 6.3 GB with 6 RZ26–VA[1] disk drives in an SW800–AA cabinet; 60 HZ, 120/208v 3-phase. Requires separately ordered HSJ40 controller.
SW810–AB	StorageWorks Array 140c, 6.3 GB with 6 RZ26–VA[1] disk drives in an SW800–AB cabinet; 50 HZ, 220/416v 3-phase. Requires separately ordered HSJ40 controller.
SW811–AA	StorageWorks Array 140c, 21.0 GB with 6 RZ74–VA disk drives in an SW800–AA cabinet; 60 HZ, 120/208V 3-phase. Requires separately ordered HSJ40 controller.
SW811–AB	StorageWorks Array 140c, 21.0 GB with 6 RZ74–VA disk drives in an SW800–AB cabinet, 50 HZ, 240/416V 3-phase. Requires separately ordered HSJ40 controller.
SW812–AA	StorageWorks Array 140c, 12.6 GB with 6 RZ28–VA[2] disk drives in an SW800–AA cabinet; 60 HZ, 120/208V 3-phase. Requires separately ordered HSJ40 controller.
SW812–AB	StorageWorks Array 140c, 12.6 GB with 6 RZ28–VA[2] disk drives in an SW800–AB cabinet; 50 HZ, 240/416V 3-phase. Requires separately ordered HSJ40 controller.
SW510–AC	StorageWorks Array 140c, 6.3 GB with 6 RZ26–VA[1] disk drives in an SW500–AC cabinet; 60 HZ, 120V single phase. Requires separately ordered HSJ40 controller.
SW510–AD	StorageWorks Array 140c, 6.3 GB with 6 RZ26–VA[1] disk drives in an SW500–AD cabinet; 50 HZ, 240V single phase. Requires separately ordered HSJ40 controller.
SW511–AC	StorageWorks Array 140c, 21.0 GB with 6 RZ74–VA disk drives in an SW500–AC cabinet; 60 HZ, 120V single phase. Requires separately ordered HSJ40 controller.
SW511–AD	StorageWorks Array 140c, 21.0 GB with 6 RZ74–VA disk drives in an SW500–AD cabinet; 50 HZ, 240V single phase. Requires separately ordered HSJ40 controller.
SW512–AC	StorageWorks Array 140c, 12.6 GB with 6 RZ28–VA[2] disk drives in an SW500–AC cabinet; 60 HZ, 120V single phase. Requires separately ordered HSJ40 controller.
SW512–AD	StorageWorks Array 140c, 12.6 GB with 6 RZ28–VA[2] disk drives in an SW500–AD cabinet; 50 HZ, 240V single phase. Requires separately ordered HSJ40 controller.

[1]The RZ26L–VA disk drive may be substituted for the RZ26–VA disk drive.

[2]The RZ28B–VA disk drive may be substituted for the RZ28–VA disk drive.

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 5.

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=(n1, n2) 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

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

RAID Technology Levels

The HS array controllers are designed to be RAID-ready. RAID-ready means that it is not necessary to make any changes to applications to use Digital Equipment Corporation RAID storage subsystems.

Each disk array set, be it two or thirty-six, appears as one or more large, single disks to the user. RAID enhances the capability of disk storage as discussed in the following sections.

The following section provides an overview of the redundant arrays of independent disks (RAID) technology levels supported by Version 1.4 of the HS operating system firmware.

RAID Level Descriptions

The RAID methodology is implemented with hardware, firmware and software in several configurations arbitrarily called "levels." RAID levels are designated 0 through 6 and have no relation to quality or performance ranking. The user's choice of level depends on application and business needs. The following list briefly describes the various RAID levels:

- RAID 0—RAID 0 is known as striping. Striping spreads data across multiple disks, breaking the user data into segments designated as "chunks." In a four disk stripe set, A, B, C, and D, for example, the first chunk is written on disk A, the second on disk B, the third on disk C, the fourth on disk D, the fifth on disk A, and so on.

  Note

  If any member of a RAID 0 set fails, all data is lost from the entire set.

  The system administrator sets the chunk size based upon application requirements. If the chunk size is set to be relatively large related to the average input/output (I/O) size, all of the disks may be able to execute different read/write requests simultaneously. If there are large numbers of frequently accessed files, this may be especially beneficial.

  If the chunk size is set significantly smaller than the average I/O size, then most or all of the disks in the stripe set will be able to transfer data for a single request in parallel. This method increases the data transfer rate for large I/Os.

- RAID 1a—RAID 1a is currently provided by host-based volume shadowing with HBVS assists performed by the controller on copy operations between shadow set members behind the same controller (local disk copy data [DCD]). This means that disk A is paired with shadow disk B, which contains all of the data of disk A. This is more costly, but provides automatic, immediate availability of data should one disk fail. RAID 1a is supported by HSJ and HSD30 array controllers.

Glossary

ac distribution

The method of controlling ac power in a cabinet.

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* **SCSI bus signal converter**.

allocation class

A numerical value assigned to an integrated storage element to indicate which hosts on a cluster it will be served by.

array controller

A hardware/software device that facilitates communications between a host and one or more devices organized in an array. HS family controllers are examples of array controllers.

BA350–Mx controller shelf

The StorageWorks controller shelf used for HS array controller modules, cache modules, and shelf power supplies.

BA350–Sx SBB shelf

The common name for any StorageWorks shelf that contains only power units and storage SBBs.

BBR

bad block replacement. The procedure used to locate a replacement block, mark the bad block as replaced, and move the data from the bad block to the replacement block.

BBU

battery backup unit. A StorageWorks SBB option that extends power availability after the loss of primary ac power or a power supply to protect against the corruption or loss of data. This is not used for the HSJ controller shelves.

block

The smallest data unit addressable on a disk. Also called a sector. In DSSI integrated storage elements, a block contains 512 bytes of customer data, EDC, ECC, flags, and the block's address header.

CDU

Cable distribution unit. The power entry device for StorageWorks cabinets. The unit provides the connections necessary to distribute ac power to cabinet shelves and fans.

CI bus

Computer interconnect bus. Uses two serial paths, each with a transfer rate of 70 MB/s (8.75 MB/s).

CLI

Command line interpreter. Operator command line interface for the HS family controller firmware.

container

Any entity that is capable of storing data, whether it is a physical device or a group of physical devices. A disk and a stripeset are examples of a container.

controller shelf

A StorageWorks shelf designed to contain controller and cache memory modules.

data center cabinet

A generic reference to the large cabinets, such as the SW800-series, in which StorageWorks components can be mounted.

DDL

dual data link. The ability to operate on the CI bus using both paths at the same time.

differential SCSI bus

A signal's level is determined by the potential difference between two wires. A differential bus is more robust and less subject to electrical noise than is a single-ended bus.

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.

DSA

Digital Storage Architecture. A set of specifications and interfaces describing standards for designing mass storage products. DSA defines the functions performed by host computers, controllers, and disk drives. It also specifies how they interact to accomplish mass storage management.

DSSI

Digital Storage System Interconnect. A Digital-specific data bus with an 8-bit data transfer rate of 4-5 MB/s.

dual-redundant

Two controllers in one controller shelf providing the ability for one controller to take over the work of the other controller in the event of a failure of the other controller.

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**.

DWZZA

The StorageWorks compatible SCSI bus signal converter. *See* **SCSI bus signal converter**.

ECC

error correction code. One or more cyclic redundancy check (CRC) words that allow detection of a mismatch between transmitted and received data in a communications system, or between stored and retrieved data in a storage system. The ECC allows for location and correction of an error in the received/retrieved data. All ECCs have limited correction power.

EDC

error detection code. One or more checksum words that allow detection of a mismatch between transmitted and received data in a communications system, or between stored and retrieved data in a storage system. The EDC has no data correction capability.

ESD

electrostatic discharge. The discharge of a potentially harmful static electric voltage as a result of improper grounding.

Failover

Failover is the software process that takes place when one controller in a dual-redundant configuration fails and the other controller takes over the devices of the failed controller and services them to the host until or if the failed controller comes back or is replaced.

flush

The act of writing customer data from the read cache module to the media.

FRU

field replaceable unit. A hardware component that can be replaced at a customer's site.

FWD SCSI

fast, wide, differential SCSI. The differential SCSI bus with a 16-bit data transfer rate of up to 20 MB/s.

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.

HSOF

HSOF. An abbreviation for Hierarchical Storage Operating Firmware.

HIS

Host Interconnect Services. The firmware in the HS array controller that communicates with the host.

host

The primary or controlling computer to which a storage subsystem is attached.

HS Operating Firmware

Hierarchical Storage Operating Firmware or software contained on a program card used with HS array controllers.

initiator

A SCSI device that requests an I/O process to be performed by another SCSI device (a target). This is always the controller.

KB

The standard abbreviation for kilobyte, 1024 bytes.

KB/s

The standard abbreviation for kilobytes per second.

LED

The standard abbreviation for light emitting diode.

local terminal

A term used to describe a terminal plugged into the EIA–423 maintenance port on the front bezel of the HS array controller. Also called a maintenance terminal.

logical unit (host logical unit)

A physical device or a storage set seen by the host. Often these logical units are spread across more than one physical device, especially in RAID implementations. This is *not* a LUN.

logical unit number

See **LUN**.

LRU

Least recently used. This is cache terminology for the block replacement policy for the read cache.

LUN

A logical unit number is a physical or virtual peripheral device addressable through a target. LUNs use their target bus connection to communicate on the SCSI bus.

maintenance terminal

Any EIA–423 compatible terminal to be plugged into the HS controller. This terminal is used to identify the controller, enable host paths, define the configuration, and check controller status. It is not required for normal operations. It is sometimes referred to as a local terminal.

MB

The standard abbreviation for megabyte, 1024 kilobytes.

MB/s

The standard abbreviation for megabytes per second.

metadata

Data written on the physical disk that is not visible to the host/customer that allows the HS array controller to maintain a high integrity of customer data.

MSCP

Mass Storage Control Protocol. The protocol by which blocks of information are transferred between the host and the controller.

nonredundant

A single controller configuration. A controller configuration which does not include an second backup controller permitting failover in the event of a failure.

NV

Nonvolatile. A term used to describe memory, the contents of which survive loss of power.

Port

The hardware and software used to connect a host controller to a communication bus, such as CI, DSSI, or SCSI bus. This term also is used to describe the connect between the controller and SCSI storage devices.

PTL

Port-Target-LUN device notation. Where **P** designates the port (1 through 6), **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).

qualified device

A device that has been fully tested in an approved StorageWorks configuration, (that is, shelf, cabinet, power supply, cabling, and so forth) and is in complete compliance with country-specific standards (for example, FCC, TUV, and so forth) and with all Digital standards.

quiesce

To make a bus inactive or dormant. The operator must quiesce SCSI bus operations, for example, during a device warm swap.

RAID

Redundant array of independent disks. The multiple storage access methods devised for performance (RAID 0, striping) and/or various cost levels of availability (RAID 1 through RAID 5).

RAID set

Two or more physical disks that are configured in a way to allow one physical disk to fail without loss of customer data.

read cache

The cache is used to accelerate read operations by retaining data which has been previously read, written, or erased, based on a prediction that it will be reread.

replacement policy

The method by which a spare disk is selected to replace a disk that has failed in a raidset.

SBB

StorageWorks building block. A modular carrier plus the individual mechanical and electromechanical interface required to mount it into a standard shelf. Any device conforming to shelf mechanical and electrical standards is considered an SBB.

SBB shelf

StorageWorks building block shelf. A StorageWorks shelf, such as the BA350–Sx, designed to house plug-in SBB modules.

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 SCSI–2 standard, allowing the synchronous transfer of 8-bit data at rates of up to 10 MB/s.

SCSI bus signal converter

Sometimes referred to as an adapter. (1) A connecting device that permits the attachment of accessories or provides the capability to mount or link units. (2) The device that connects a 16-bit, differential SCSI bus operating in the 8-bit mode to an 8-bit, single-ended SCSI bus.

SCSI device

A host computer adapter, a peripheral controller, or an intelligent peripheral that can be attached to the SCSI bus.

SCSI device ID

The bit-significant representation of the SCSI addressing that refers to one of the signal lines numbered 0 through 7. Also referred to as a *target* ID.

SCSI end-bus position

The physical location of a controller, a SCSI bus controller, or a device that contains the bus terminator.

SCSI–A cable

A 50-conductor (25 twisted pairs) cable used for single-ended, SCSI–2 bus connections.

SCSI–P cable

A 68-conductor (34 twisted pairs) cable used for differential bus connections.

Small Computer System Interface

See **SCSI**.

spare set

A spareset is a pool of disk drives used by the controller to replace failing members of a RAID set.

SPD

Abbreviation for Software Product Description.

storage set

Any collection of containers, such as stripesets that make up a 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 enclosure to form storage subsystems.

StorageWorks building block

See **SBB**.

stripesets

A virtual disk drive with its physical data spread across multiple physical disks. Stripeset configurations do not include a data recovery mechanism.

tagged command queuing

Allows a device to have multiple I/O requests outstanding to it at one time.

Target

Is a SCSI device that performs an operation requested by an initiator. Target is determined by the device's address on its SCSI bus. For example, the HSJ controller can address targets 0 through 6 in a single configuration or targets 0 through 5 in a dual-redundant configuration.

TILX

Tape Inline Exerciser. Diagnostic firmware used to text the data transfer capabilities of tape drives in a way that simulates a high level of user activity.

TMSCP

Tape Mass Storage Control Protocol. The protocol by which blocks of information are transferred between the host and the controller.

unit

The host's view of a container on an HS array controller. A unit may be made up of simply a physical disk or tape drive, or a more complex container such as a RAID set.

value-added firmware

The firmware that provides logical block mapping, cache, RAID, and so on.

VCS

VAXcluster system console. This terminal allows access to the maintenance port on the controller from the host that connects to other 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. The path can be established via the host port on the controller (using DUP) or via the maintenance port through on intermediary host (VCS). A virtual terminal is also sometimes called a host console.

warm swap

A method used to add or swap devices while the system remains on line during device removal, replacement, or addition. All activity on the bus where the device is being swapped must be halted for the duration of the removal, replacement, or addition.

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