Compaq StorageWorks™

HSJ80 Array Controller
ACS Version 8.5J-2

Maintenance and Service Guide

First Edition (August 2000)
Part Number: EK–J80MS–SA. A01
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About This Guide

This guide describes the features and part numbers of the HSJ80 array controllers running array controller software (ACS) versions 8.5J and 8.5J-2. This guide also contains replacement procedures for hardware and software components, and subsystem upgrade procedures.

This guide does not contain information about:

- The operating environments to which the controller might be connected, nor does this guide contain detailed information about subsystem enclosures or their components. See the documentation that accompanied these peripherals for this information.
- Troubleshooting resources, including various utilities, software templates, and event reporting codes. See the controller troubleshooting resources guide that accompanied the array controller for this information.

Intended Audience

This publication is for use by *Compaq StorageWorks* DS–BA356–MW controller enclosure and Model 2200 Ultra SCSI controller enclosure customers and employees who are responsible for maintaining the subsystems.

How This Guide is Arranged

This guide discusses maintenance procedures pertaining to the HSJ80 array controller. The guide is organized as follows:

Chapter 1, General Description

This chapter describes the subsystem components for the DS–BA356–MW controller enclosure and Model 2200 enclosure. This chapter also describes the connectors, switches, and LEDs for various elements. Two part numbers (6–3 and 2–5–2 formats) are listed for the various elements.

Chapter 2, Common Replacement Information and Procedures

This chapter describes preliminary information, replacement and cleaning procedures that apply to the DS–BA356–MW controller enclosure and Model 2200 enclosure.

Chapter 3, Replacement Procedures for DS–BA356–MW Enclosure Elements

This chapter describes element replacement procedures that are specific to the DS–BA356–MW enclosure.

Chapter 4, Replacement Procedures for Model 2200 Enclosure Elements

This chapter describes element replacement procedures that are specific to the Model 2200 enclosure.

Chapter 5, Upgrading the Subsystem

This chapter describes procedures that upgrade DS–BA356–MW controller enclosure and Model 2200 enclosure functionality through either hardware or ACS software improvements.

Appendix A, Array Controller Specifications

This appendix provides physical, electrical, and environmental specifications for the array controller, and physical and electrical specifications for the cache module.

Glossary

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Conventions

This guide uses the text conventions in Table 1 and special notices provided within this section.

Text Conventions

Table 1 Text Conventions

Convention	Meaning
Bold	Keyboard keys appear in boldface. For example: **Enter**/**Return** or **Y**(es) key
SMALL CAPS	Used to indicate the status of an LED. For example: FLASHING means turning on and off, ON means on, and OFF means off
ALLCAPS	Command syntax that must be entered exactly as shown and for commands discussed within text, for example: SET FAILOVER COPY=OTHER_CONTROLLER "Use the SHOW SPARESET command to show the contents of the spareset."
`Monospaced`	Screen display.
italic	User entered command variable or numeric value, for example: SHOW *RAIDset-name* or SET THIS_CONTROLLER CACHE_FLUSH_TIMER=*nn*
	Identifies the first use of *Compaq* specific trademarks or service marks in this document, for example: *Compaq*, *StorageWorks*, and *Tru64*.
	Reference to other publications, for example: "See the *HSG80 Array Controller ACS Version 8.5 Release Notes* for details."
	Adds emphasis to text, for example: "*Do not* use the following command...."

Table 1 Text Conventions (Continued)

Convention	Meaning
. . .	Indicates that a portion of an example or figure has been omitted.
"this controller"	The controller serving the current CLI session through a local or remote terminal.
"other controller"	The controller in a dual-redundant pair that is connected to the controller serving the current CLI session.

Special Notices

This guide does not contain detailed descriptions of standard safety procedures. However, this guide does contain warnings for procedures that might cause personal injury and cautions for procedures that might damage the controller or its related components. Look for these symbols when performing the procedures in this guide:

WARNING: A warning indicates the presence of a hazard that can cause personal injury if precautions in the text are not observed.

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

IMPORTANT: An important note is a type of note that provides information essential to the completion of a task. Users can disregard information in a note and still complete a task, but they should not disregard an important note.

NOTE: A note provides additional information that is related to the completion of an instruction or procedure.

Getting Help

After exhausting the information in this guide, obtain further information and help using the Compaq website at http://www.compaq.com/storage. The website maintains information on this product as well as the latest drivers and Flash ROM images. The website also provides access to worldwide Compaq technical support phone numbers through the "Contact Us" link.

Related Publications

Table 2 lists documents related to the use of the controller, cache module, and external cache battery.

Table 2 Related Publications

Document Title	Part Number
HSJ80 Array Controller ACS Version 8.5J-2 Troubleshooting Resources Guide	EK–J80TR–SA
HSJ80 Array Controller ACS Version 8.5J-2 Installation and Configuration Guide	AA–RN17A–TE
HSJ80 Array Controller ACS Version 8.5J-2 Configuration Planning Guide	EK–HSJCP–PA
HSJ80 Array Controller ACS Version 8.5J-2 CLI Reference Guide	EK–HSJCL–RA
HSJ80 Array Controller ACS Version 8.5J-2 Software Solution Kit Overview	EK–HSJSO–OA
HSJ80 Array Controller ACS Version 8.5J-2 for OpenVMS Release Notes	EK–HSJAA–RA
DS–BA356–MW Controller Enclosure Upgrade/Add-on Kit Quick Setup Guide	EK–356MW–QA
DS–BA356–MW Controller Enclosure Upgrade/Add-on Kits Installation Guide	EK–356MW–IA
DS-BA356-MW Controller Enclosure User Guide	EK–356MW–UA
Command Console V2.3 for MA6000 User's Guide	AA–RMBDA–TE
Model 2100 and 2200 Ultra SCSI Controller Enclosure User Guide	EK-SE2C8-UA
The RAIDBOOK—A Source for RAID Technology	RAID Advisory Board

Chapter 1

General Description

This chapter illustrates and describes, in general terms, the DS–BA356–M*x* enclosure and Model 2200 enclosure subsystems and their major components, plus connectors, switches, and LEDs.

Subsystem Components — Exploded Views

This section illustrates the various subsystem enclosures, components, and specific attributes of each component. Spare part numbers are included as a convenience, under two part numbering systems (6–3 and 2–5–2).

HSJ80 Subsystem in a DS–BA356–MW Enclosure

Figure 1–1 and Table 1–1 identify an HSJ80 subsystem with a DS–BA356–MW enclosure.

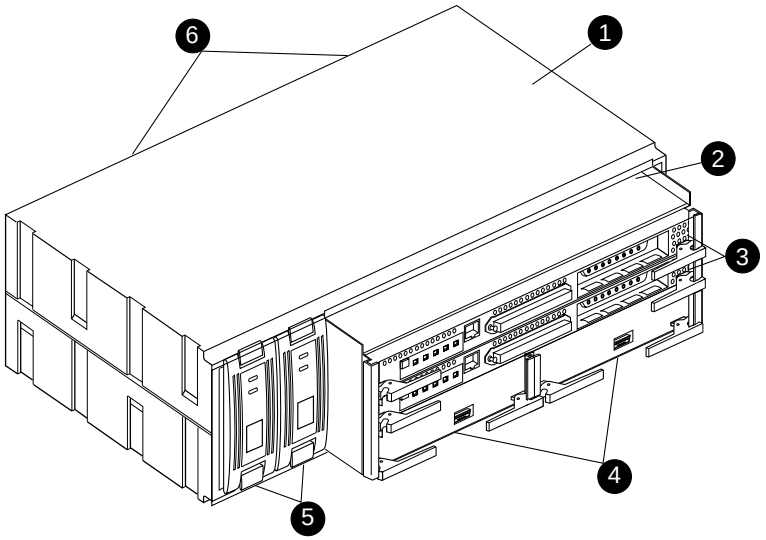


Figure 1–1. HSJ80 subsystem in a DS–BA356–MW enclosure

Table 1–1 HSJ80 Subsystem in a DS–BA356–MW Enclosure

Item	Description	6–3 Part Number	2–5–2 Part Number
❶	DS–BA356–MW enclosure	146246–001	70–33274–02
❷	I/O module	126313–001	70–33724–S1
❸	HSJ80 controller	158413–001	70–40057–S1
❹	Cache module (original) Cache module (upgraded)	400295–001 400295–002	70–33256–S1 70–33256–S2
❺	180 W Power supply	400288–001	FC–BA35X–HH
❻	Cooling fan, blue		70-29761-07

HSJ80 Subsystem in a Model 2200 Enclosure

Figure 1–2 and Table 1–2 identify an HSJ80 subsystem with a Model 2200 enclosure.

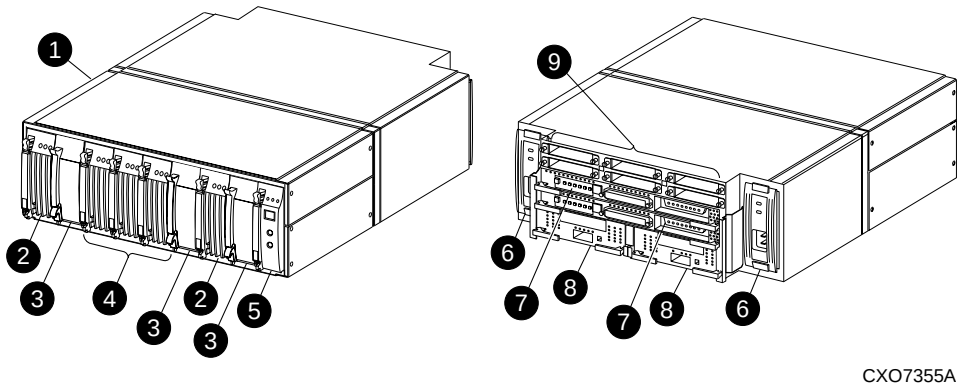


Figure 1–2. HSJ80 subsystem in a Model 2200 enclosure

Table 1–2 HSJ80 Subsystem in a Model 2200 Enclosure

Item	Description	6–3 Part Number	2–5–2 Part Number
❶	Model 2200 rack-mountable enclosure	126314–001	70–33725–S1
❷	ECB without a battery pack ECB battery pack	126312–001 147514–001	70–33547–S1 12–44670–S4
❸	Blank bezel	173406–001	74–60460–01
❹	Fan	126310–001	70–33538–S1
❺	EMU	126315–001	70–40081–S1
❻	180 W Power supply	400288–001	FC–BA35X–HH
❼	HSJ80 Controller	158413–001	70–40057–S1
❽	Cache module (upgraded)	400295–002	70–33256–S2
❾	I/O module	126313–001	70–33724–S1

Model 2200 Enclosure Serial Port UPS Cable Connection

Figure 1–3 and Table 1–3 identify the UPS communication cable that connects to the serial port on a Model 2200 enclosure.

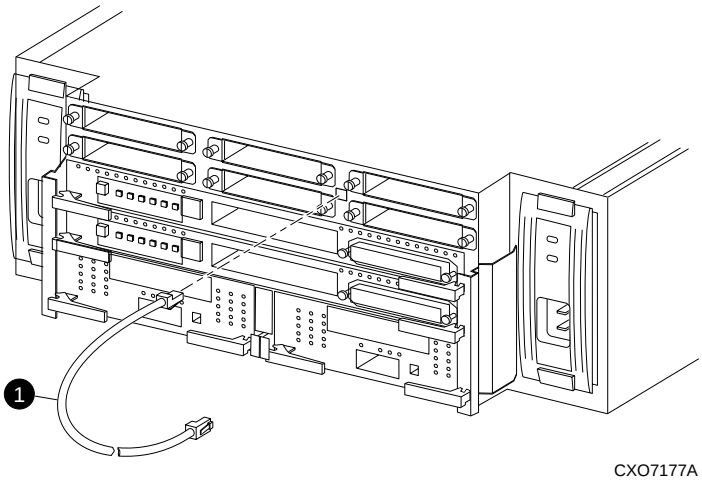


Figure 1–3. UPS communication cable connection

Table 1–3 Model 2200 Enclosure UPS Communication Cable

Item	Description	6–3 Part Number	2–5–2 Part Number
❶	UPS communication cable, 3 meter	133516–001	17–04875–01

HSJ80 Array Controller

Figure 1–4 and Table 1–4 identify an HSJ80 array controller, where to connect a host cable and maintenance port cable, and the location of the program card. This setup applies to the DS–BA356–MW enclosure and Model 2200 enclosure.

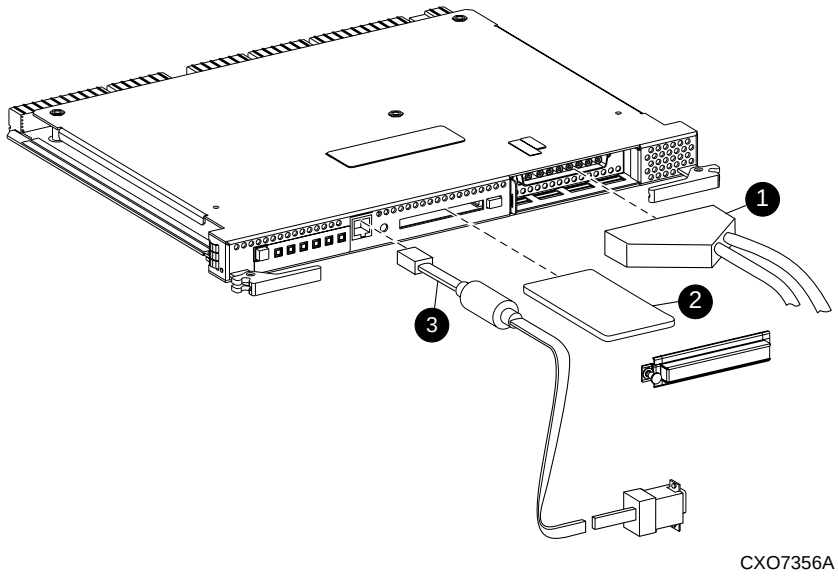


Figure 1–4. HSJ80 array controller—cabling and program card

Table 1–4 HSJ80 Array Controller

Item	Description	6–3 Part Number	2–5–2 Part Number
❶	Internal CI cable	158414-004	17–03427–04
❷	Program (PCMCIA) card:		
	- ACS V8.5J	216354–001	BG–RKVFA–BA
	- ACS V8.5J-2	216354–002	BG–RKVFB–BA
❸	Maintenance port cable to a PC	173408–001	17–04074–04
	Optional adapters, 9-pin D-sub to 25-pin D-sub (not shown):		
	- Male to female (null modem)	173407–001	12–45238–01
	- Male to male (null modem)	173407–002	12–45238–02
	- Male to male (modem)	173407–003	12–45238–03

Cache Module

Figure 1–5 and Table 1–5 identify the cache module and the location of dual inline memory module (DIMM). The bezel of the upgraded cache module is labeled "HSx80 CACHE." The HSJ80 array controller *requires* 512 MB of cache memory (four 128 MB DIMMs) to be installed in the cache module.

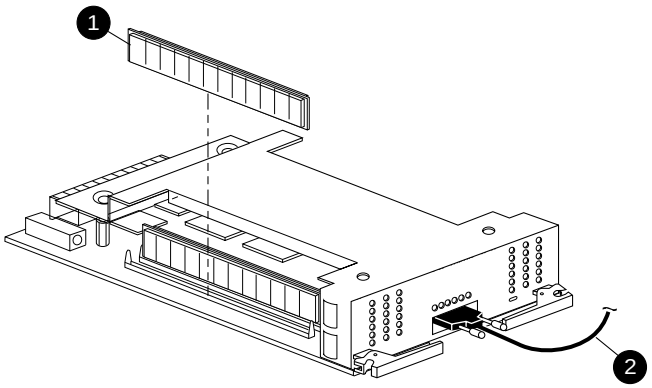


Figure 1–5. Cache module

Table 1–5 Cache Module

Item	Description	6–3 Part Number	2–5–2 Part Number
❶	DIMM, 128 MB	400297–001	70–DIMS1–02
❷	DS–BA356–Mx enclosure only:		
	- ECB Y-cable, 1 meter	400298–001	17–04479–03
	- ECB Y-cable, 3 meters	401913–001	17–04479–04

Connectors, Switches, and LEDs

This section provides connector, switch, and LED information for the following components:

- HSJ80 array controller
- 180 W power supply
- Model 2200 enclosure EMU, ECBs, and fans
- DS–BA356–MW enclosure wide Ultra SCSI I/O module

NOTE: For detailed information pertaining to the power supply, EMU, ECB, fans, and I/O module, refer to the specific enclosure user guide.

HSJ80 Array Controller

This section describes the array controller front panel, OCP switches, and LEDs.

Front Panel

Figure 1–6 and Table 1–6 identify various physical parts of the HSJ80 array controller.

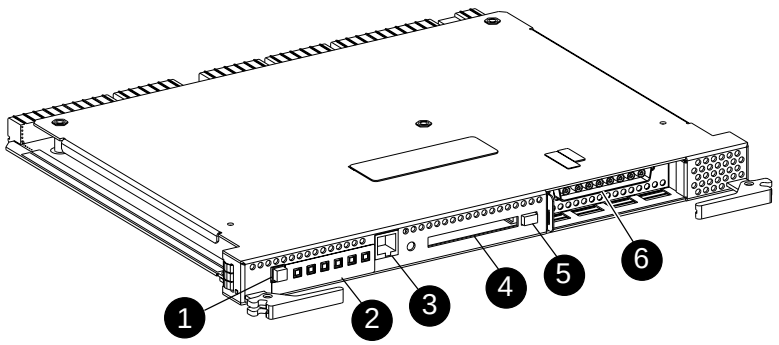


Figure 1–6. HSJ80 array controller front panel connectors, switches, and LEDs

Table 1–6 HSJ80 Array Controller Front Panel Connectors, Switches, and LEDs

Location	Description
❶	Controller reset button
❷	Operator control panel (OCP)
❸	Maintenance port
❹	Program card slot
❺	Program card ejection button
❻	Host port CI cable connections

OCP Switches and LEDs

Figure 1–7 and Table 1–7 identify the OCP switches and LEDs on the array controller.

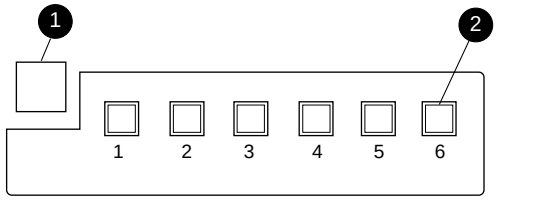


Figure 1–7. Array controller OCP switches and LEDs

Table 1–7 Array Controller OCP Switches and LEDs

Location	Description
❶	Controller reset button
❷	Port buttons/LEDs (1 through 6)

180 W Power Supply LEDs

Figure 1–8 and Table 1–8 identify power supply LEDs for the DS–BA356–Mx enclosure and Model 2200 enclosure.

NOTE: Refer to the specific enclosure user guide for detailed information.

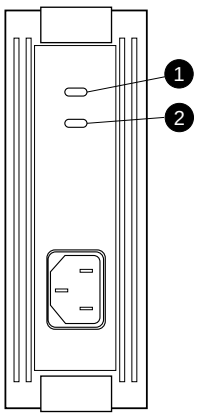


Figure 1–8. 180 W power supply LEDs

Table 1–8 180 W Power Supply LEDs

Location	Description
❶	Shelf (enclosure) status LED
❷	Power supply status LED

Model 2200 Enclosure EMU Switches and LEDs

Figure 1–9 and Table 1–9 identify EMU switches and LEDs for a Model 2200 enclosure.

NOTE: Refer to the Model 2200 enclosure user guide for detailed information.

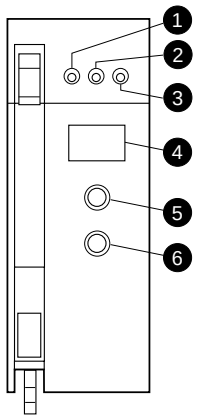


Figure 1–9. Model 2200 enclosure EMU switches and LEDs

Table 1–9 Model 2200 Enclosure EMU Switches and LEDs

Location	Description
❶	EMU status LED
❷	Power status LED
❸	Enclosure fault LED
❹	Alphanumeric display
❺	Increment switch/LED
❻	Group switch/LED

Model 2200 Enclosure ECB LEDs

Figure 1–10 and Table 1–10 identify ECB LEDs for a Model 2200 enclosure.

NOTE: Refer to the Model 2200 enclosure user guide for detailed information.

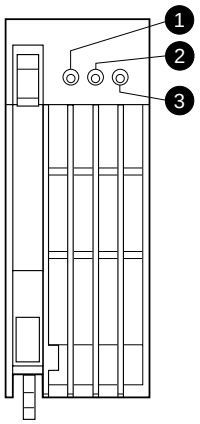


Figure 1–10. Model 2200 enclosure ECB LEDs

Table 1–10 Model 2200 Enclosure ECB LEDs

Location	Description
❶	ECB charged LED
❷	ECB charging LED
❸	ECB fault LED

Model 2200 Enclosure Fan LEDs

Figure 1–11 and Table 1–11 identify fan LEDs for a Model 2200 enclosure.

NOTE: Refer to the Model 2200 enclosure user guide for detailed information.

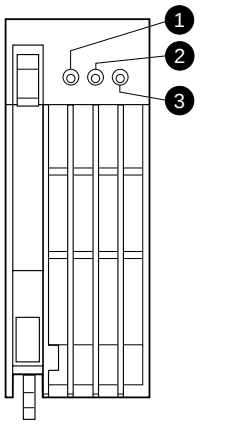


Figure 1–11. Model 2200 enclosure fan LEDs

Table 1–11 Model 2200 Enclosure Fan LEDs

Location	Description
❶	Power status LED
❷	Not used
❸	Fan fault LED

Chapter 2

Common Replacement Information and Procedures

This chapter contains the following replacement information and procedures:

- Required Tools
- Field Replacement Strategy
- Precautions
- Establishing a Local Connection to the Controller
- Replacing DIMMs
- Replacing a Program Card
- Replacing a Failed Storageset Member

Required Tools

The following tools are needed to service a controller, cache module, I/O module, tape drive, and solid state disk or CD ROM drive:

- a flathead screwdriver for loosening and tightening the I/O module retaining screws
- an antistatic wrist strap
- an antistatic mat on which to place modules during servicing

Field Replacement Strategy

Compaq authorized service providers will troubleshoot HSJ80 subsystem problems to the field replaceable unit (FRU) and replace the defective unit. Replacement procedures for Subsystem FRUs addressed in this guide include the array controller, cache module, DIMMs, and ECB. Replacing a program card is also covered in this guide.

Precautions

To prevent accidental damage to subsystem components, always follow the precautions in this section when carrying out the procedures in this guide.

Electrostatic Discharge Precautions

Static electricity collects on all nonconducting material, such as paper, cloth, and plastic. An electrostatic discharge (ESD) can easily damage a controller or other subsystem component even though the discharge might not be seen or felt. ESD is a common problem and might cause data loss, system down time, and other problems. The most common source of static electricity is the movement of people in contact with carpets and clothing. Low humidity increases the amount of static electricity.

Observe the following precautions whenever servicing a subsystem or subsystem component:

- Always use an ESD wrist strap when servicing the controller or other components in the subsystem. Make sure that the strap contacts bare skin, fits snugly, and that the strap grounding lead is attached to a bus with a verified earth ground.
- Before touching any circuit board or component, always touch a verified earth ground to discharge any static electricity that might be present in clothing.
- Always keep circuit boards and components away from nonconducting material.

- Always keep clothing away from circuit boards and components.
- Always use antistatic bags and grounding mats for storing circuit boards or components during replacement procedures.
- Always keep the ESD cover over the program card when the card is in the controller. If a card is removed, put the card in the original carrying case.
- Never touch the contacts or twist or bend the card.
- Never touch the connector pins of a cable when one end is attached to a component or host.

Very-High-Density Cable Interface (VHDCI) Cable Precautions

All cables that connect to the controller, cache module and ECB use VHDCI connectors. VHDCI connectors have extraordinarily small mating surfaces that can be damaged by dust and cable movement. Always take the following VHDCI precautions when servicing any subsystem component.

- Clean the mating surfaces with a blast of compressed air or freon only.
- Mate the connectors by hand, then tighten the retaining screws to 1.5 in/lb (0.17 N-m), approximately 1/4 of an additional turn after the connectors mate.
- Test the cable assembly by gently pulling on the cable. There should be no visible separation between the cable and connector.

Component Precautions

System components referenced in this manual comply with regulatory standards documented herein. Use of other components in their place might violate country standards, negate regulatory compliance, or invalidate the product warranty.

Maintenance Port Precautions

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

Establishing a Local Connection to the Controller

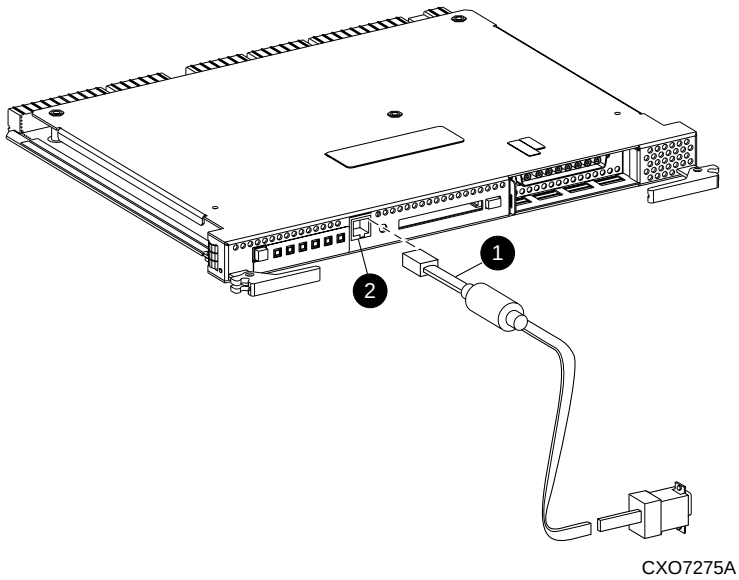
Communication with a controller is done locally or remotely. Use a local connection to configure the controller for the first time. Use a remote connection to the host system for all subsequent configuration tasks. Refer to the controller installation and configuration guide that came with the platform kit for details.

A maintenance port, located on the front of the controller, provides a convenient way to connect a PC or terminal to the controller for troubleshooting or configuring the controller. This port accepts a standard RS-232 jack from any EIA-423 compatible terminal or a PC with a terminal-emulation program. The maintenance port supports serial communications with a default value of 9600 baud (using 8 data bits, 1 stop bit, and no parity bit).

> **NOTE:** A maintenance port cable (see Figure 2–1) is provided for connecting to a PC. This cable has a 9-pin connector molded onto one end, to which three optional adapters can be attached for making a maintenance terminal connection.

Use the following steps to establish a local connection for setting the initial controller configuration:

1. Turn off the PC or terminal, and connect the maintenance port cable to the controller, as shown in Figure 2–1.
   a. For a PC connection, plug one end of the maintenance port cable into the communication port of the PC; plug the other end into the controller maintenance port.
   b. For a terminal connection, refer to Figure 2–1 for cabling information. Adapter part numbers are provided in Chapter 1, in section "*Subsystem Components — Exploded Views*" under the specific subsystem type.



❶ Maintenance port cable for a PC connection

❷ Maintenance port

Optional Maintenance Port Cable Adapters for a Terminal Connection

Adapters (not shown), 9-pin D-sub to 25-pin D-sub:

- Male to female (null modem)
- Male to male (null modem)
- Male to male (modem)

Figure 2–1. PC/terminal to maintenance port connection

CAUTION: Connecting a maintenance port cable between the controller and the PC (or terminal) might cause radio and television interference. *Do not* leave a maintenance port cable connected to the controller via the maintenance port unless communication with the controller is necessary.

2. Turn on the PC or terminal.
3. Configure the terminal emulation software for 9600 baud, 8 data bits, 1 stop bit, and no parity bit.
4. Press the **Enter** or **Return** key. The command line interface (CLI) prompt appears, indicating that a local connection was established with the controller.

   NOTE: The default data transfer rate of a new controller is 9600 baud. The maximum transfer rate is 19200. If the current configuration uses 19200, use step 5 to establish this rate.

5. Optional step: To increase the data transfer rate to 19200 baud:
   a. Set the controller to 19200 baud with one of the following commands:

      ```
      SET THIS_CONTROLLER TERMINAL SPEED=19200
      SET OTHER_CONTROLLER TERMINAL SPEED=19200
      ```

b. Configure the terminal emulation software for 19200 baud.

When entering CLI commands in a dual-redundant controller configuration, remember that the controller connected to is “this controller” and the remaining controller is the “other controller.”

Replacing DIMMs

This section shows how to replace DIMMs in a cache module. DIMM locations are shown in Figure 2–2. The HSJ80 controller requires a DIMM in all four locations, for a total of 512 MB of cache memory.

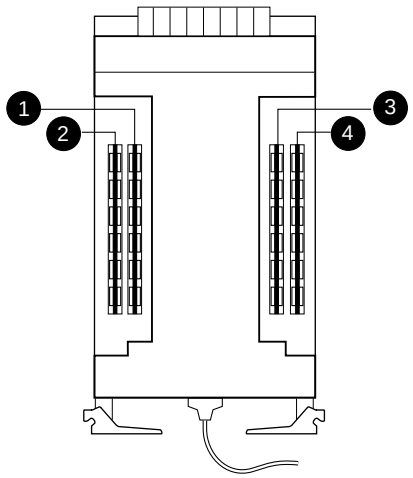


Figure 2–2. Cache module DIMM locations

CAUTION: ESD can easily damage a cache module or a DIMM. Wear a snug-fitting, grounded ESD wrist strap.

NOTE: If a DIMM fails, note which DIMM needs replacement based on the diagram displayed on the console.

Use Figure 2–3 during the removal and installation procedures for component clarification.

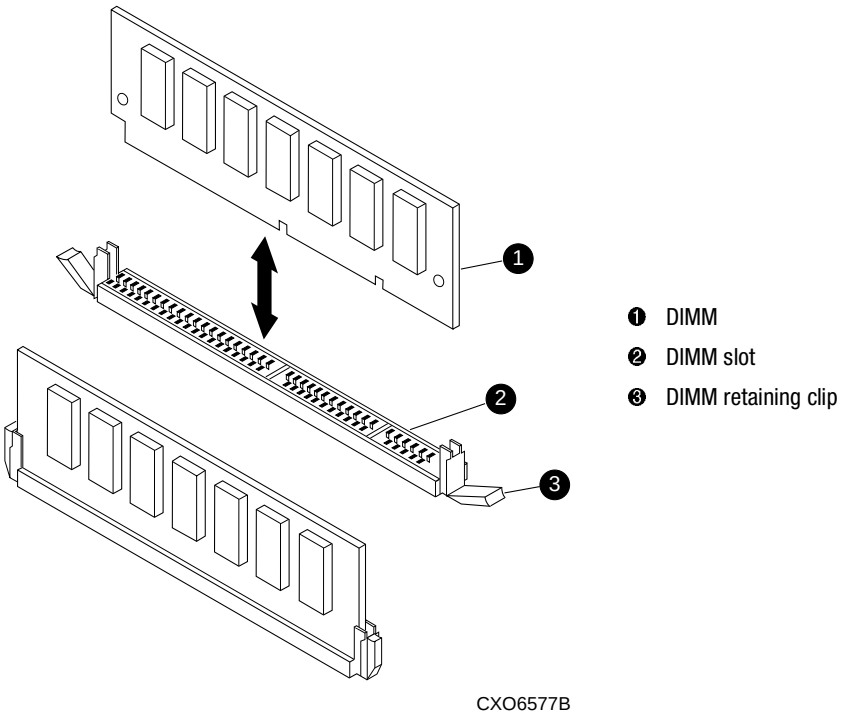


Figure 2–3. DIMM components

Removing DIMMs

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

1. Remove the cache module using steps in either Chapter 3 or Chapter 4.
2. Press the DIMM retaining clip ❸ down at both ends of the DIMM ❶ being removed (see Figure 2–3).

   NOTE: To make pressing down on the DIMM retaining clips easier, consider using the eraser end of a pencil or a small screwdriver.

3. Gently remove the DIMM from the DIMM slot ❷ and place the DIMM on an antistatic bag or grounded antistatic mat.
4. Repeat step 2 and step 3 for each DIMM.

Installing DIMMs

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

IMPORTANT: For all HSJ80 installations, a 512 MB cache memory configuration is required.

1. Insert each DIMM ❶ straight into the appropriate slot ❷ of the cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 2–3).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage both retaining clips ❸ for the DIMM.
4. Double-check to make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.
5. Repeat step 1 through step 4 for each DIMM.
6. Install the cache module using steps in either Chapter 3 or Chapter 4.

Replacing a Program Card

This section shows how to replace a program (Personal Computer Memory Card Industry Association—PCMCIA) card in a single or dual controller configuration. Two methods are provided for replacing a program card:

- **Shutdown upgrade** — This method shuts down both controllers and requires taking the storage devices off-line while the software is being installed.

  NOTE: Compaq recommends the shutdown upgrade method for all controller configurations.

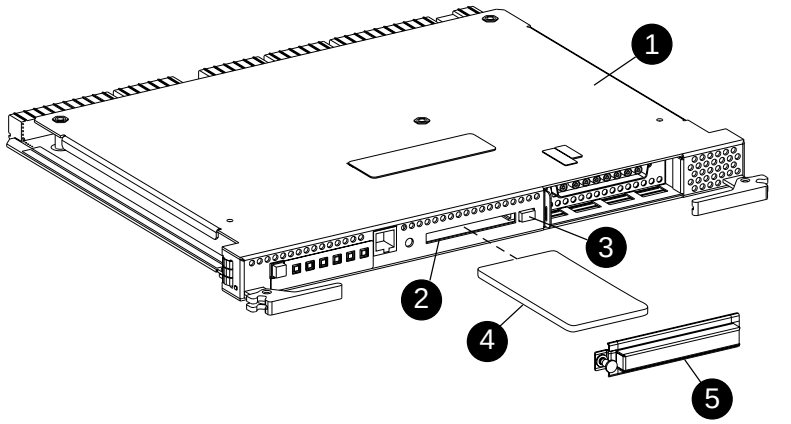
- **Rolling upgrade** — This method shuts down only one of the controllers at a time in a dual-redundant controller configuration, and allows the storage devices to remain on-line while the software is being installed. Controller failover capabilities must be used to allow continued storage device activity during this upgrade.

Single-controller configurations require the shutdown upgrade method to be used. Dual-redundant controller configurations can use either method. Use Figure 2–4 as needed to locate needed system components during the replacement procedure.

NOTE: Before installing a new program card in a dual-redundant controller configuration, ensure that all applicable software patches, if any, are installed. Both controllers must be at the same software level—this also applies when reverting to an older software release.

If installing a new major software release, the software might not work properly if the applicable software patches for the existing major software release are not installed prior installing the next major software release.

See Chapter 5 for details about installing software patches.



❶ Controller
❷ Program card slot
❸ Program card ejection button
❹ Program (PCMCIA) card
❺ Program card ESD cover

Figure 2–4. Program (PCMCIA) card location and components

Shutdown Upgrade

Use the following steps to replace a program card:

CAUTION: The replacement program card must have the same software version as the original program card being replaced. See Chapter 5 for new software upgrades.

1. Connect a PC or terminal to a controller maintenance port.
2. From a host console, stop all host activity to the controller and dismount the logical units in the subsystem.
3. Shut down the controllers.
   - In single-controller configurations, shut down “this controller” with the following command:

     SHUTDOWN THIS_CONTROLLER

- In dual-redundant controller configurations, shut down the "other controller" first, then shut down "this controller" with the following commands:

  SHUTDOWN OTHER_CONTROLLER

  SHUTDOWN THIS_CONTROLLER

IMPORTANT: After the controllers shut down, the reset buttons and the first three LEDs turn ON (see Figure 2–5). This might take several minutes to happen, depending on the amount of data that needs to be flushed from the cache modules.

Proceed only after the reset buttons stop FLASHING and remain ON.

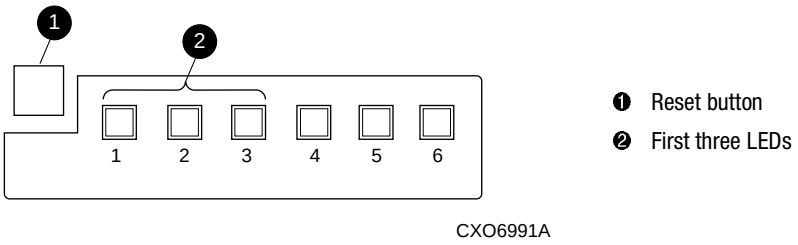


Figure 2–5. Controller reset button and first three LEDs

CAUTION: Do not change the subsystem configuration or replace any subsystem modules until this procedure for upgrading the controller software is completed.

---

4. Remove the program card ESD cover ❺ on both controllers.
5. Eject the program card ❹ from the controllers by pressing the appropriate program card eject button ❸.
6. Press and hold the reset button on both controllers while inserting both replacement program cards, then release the buttons.

   The controllers automatically restart and are ready to handle I/O once the CLI becomes responsive.
7. Install the program card ESD cover on "this controller."
8. Mount the logical units on the host.
9. Disconnect the PC or terminal from the controller maintenance port.

Rolling Upgrade

Use the following steps to replace a program card in a dual-redundant controller configuration:

> **CAUTION:** *The steps in this procedure must be followed carefully for the upgrade procedure to work properly.* Review this entire procedure for clarity before proceeding.

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

> **IMPORTANT:** In the following step, the cache flush timer values are located in the Caching Parameters section of the display. This value is modified during this procedure and must be restored before completing the procedure.

2. Using the following command to display and record the current CACHE_FLUSH_TIMER values:

   ```
   SHOW THIS_CONTROLLER
   ```

3. Set the cache flush timers to the minimum value to minimize the failover time, using the following commands:

   ```
   SET THIS_CONTROLLER CACHE_FLUSH_TIMER=1
   SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=1
   ```

4. Wait 2 minutes to allow write-back cache data to be flushed to the disks.
5. Shut off the host port paths, using the following command:

   ```
   SET THIS_CONTROLLER NOPORT_1_PATH_A NOPORT_1_PATH_B
   NOPORT_2_PATH_A NOPORT_2_PATH_B
   ```

   NOTE: Wait 10 seconds to allow for processing.

6. Restart "this controller" using the following command, to make sure all units and cached data are failed over to the "other controller":

   ```
   RESTART THIS_CONTROLLER IMMEDIATE
   ```

   NOTE: Wait until "this controller" restarts.

7. Enable the host port paths using the following command to make the paths available after the software upgrade:

   ```
   SET THIS_CONTROLLER PORT_1_PATH_A PORT_1_PATH_B PORT_2_PATH_A
   PORT_2_PATH_B
   ```

8. Disconnect the PC or terminal from “this controller” maintenance port and connect to the “other controller” maintenance port.

IMPORTANT: Connecting to the “other controller” changes the controller reference to “this controller.”

---

9. Disable failover using the following command to shut down the “other controller” and allow the software upgrade to take place:

   ```
   SET NOFAILOVER
   ```

10. Remove the program card ESD cover ❺ on the “other controller.”
11. On the “other controller,” press the program card ejection button ❸ to remove the current program (PCMCIA) card.
12. Press and hold the controller reset button while inserting the new program card containing the new software.
13. Release the controller reset button.

IMPORTANT: Wait for the “other controller” to restart and the CLI prompt to be displayed before proceeding.

---

14. On “this controller,” shut off the host port paths using the following command:

    ```
    SET THIS_CONTROLLER NOPORT_1_PATH_A NOPORT_1_PATH_B
    NOPORT_2_PATH_A NOPORT_2_PATH_B
    ```

    NOTE: Shutting off the host port paths forces all units to the available state within approximately 5 seconds—during this small time period, all units will be unavailable to the host systems.

15. Shut down “this controller” using the following command:

    ```
    SHUTDOWN THIS_CONTROLLER IMMEDIATE
    ```

16. On “this controller,” press the program card ejection button ❸ to remove the current program card.
17. Press and hold the controller reset button while inserting the new program card containing the new software.
18. Release the controller reset button.

IMPORTANT: Wait for "this controller" to restart and the CLI prompt to be displayed before proceeding.

19. Enable failover using the following command:

    SET FAILOVER COPY=OTHER

20. After "this controller restarts, restore the CACHE_FLUSH_TIMER values recorded in step 3 using the following commands:

    SET THIS_CONTROLLER CACHE_FLUSH_TIMER=*number*

    SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=*number*

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

Replacing a Failed Storageset Member

If a disk drive fails in a RAIDset or mirrorset, the controller automatically places the disk drive into the failedset. If the spareset contains a replacement drive that satisfies the storageset replacement policy, the controller automatically replaces the failed member with the replacement drive. If the spareset is empty or does not contain a satisfactory drive, the controller simply "reduces" the storageset so that the storageset can operate without one of the members.

The storageset remains in this "reduced" state until the spareset contains a satisfactory drive. If the controller senses a satisfactory drive in the spareset, the controller automatically places the drive into the storageset and restores the storageset to normal. Therefore, *replacing a failed storageset member means putting a satisfactory drive into the spareset.*

Removing a Failed RAIDset or Mirrorset Member

Use the following steps to remove a failed RAIDset or mirrorset member:

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

   ```
   SET FAILEDSET AUTOSPARE
   ```

   With AUTOSPARE enabled, any new disk drive—one that has not been in an array before—inserted into the Port-Target-LUN (PTL) location of a failed disk drive is automatically initialized and placed into the spareset.
3. Remove the failed disk drive.

Installing the New Member

To install a new member, insert a new disk drive that satisfies the replacement policy of the reduced storageset into the PTL location of the failed disk drive.

NOTE: The controller automatically initializes a new disk drive and places this drive into the spareset. As soon as the disk drive becomes a member of the spareset, the controller automatically uses the drive to restore the reduced RAIDset or mirrorset. If initialization of the new disk drive fails, the drive is placed into the failedset.

Chapter 3

Replacement Procedures for DS–BA356–MW Enclosure Elements

This chapter provides procedures for shutting down and restarting the subsystem and procedures for replacing the following DS–BA356–MW enclosure elements:

- Array controller
- Cache module
- ECB
- Tape drives
- Solid state disk, optical, or CD ROM drives

Refer to enclosure documentation for information about replacing power supplies, power cables, cooling fans, bus cables, and the I/O module.

IMPORTANT: See Chapter 2 to review the list of required tools and the precautions to follow prior to performing any procedure within this chapter.

Shutting Down the Subsystem

Use the following steps to shut down a subsystem.

1. From a host console, stop all host activity to the controllers and dismount the logical units in the subsystem.
2. Connect a PC or terminal to the maintenance port of one of the controllers in the subsystem.
3. Shut down the controllers.
   - In single-controller configurations, shut down "this controller" with the following command:

     SHUTDOWN THIS_CONTROLLER

   - In dual-redundant controller configurations, shut down the "other controller" first, then shut down "this controller" with the following commands:

     SHUTDOWN OTHER_CONTROLLER

     SHUTDOWN THIS_CONTROLLER

IMPORTANT: After the controllers shut down, the reset buttons and the first three LEDs turn ON (see Figure 3–1). This might take several minutes to happen, depending on the amount of data that needs to be flushed from the cache modules.

Proceed only after the reset buttons stop FLASHING and remain ON.

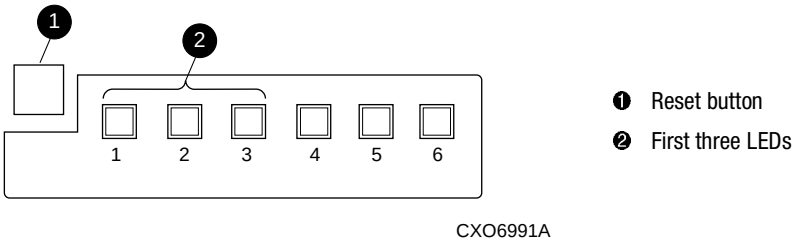


Figure 3–1. Controller reset button and first three LEDs

4. Remove power to the subsystem.

CAUTION: When shutting down the controller for longer than one day, perform the steps in the next section, "Disabling and Enabling the External Cache Batteries" to prevent these write-back cache batteries from discharging.

Disabling and Enabling the External Cache Batteries—Use the following steps to disable the ECBs.

NOTE: An ECB might contain one or two batteries, depending on the configuration (single ECB or dual ECB).

1. Press and hold the battery disable switch on the ECB, labeled SHUT OFF (see Figure 3–2) for approximately 5 seconds.

   The ECB status LED will FLASH once and then turn OFF.

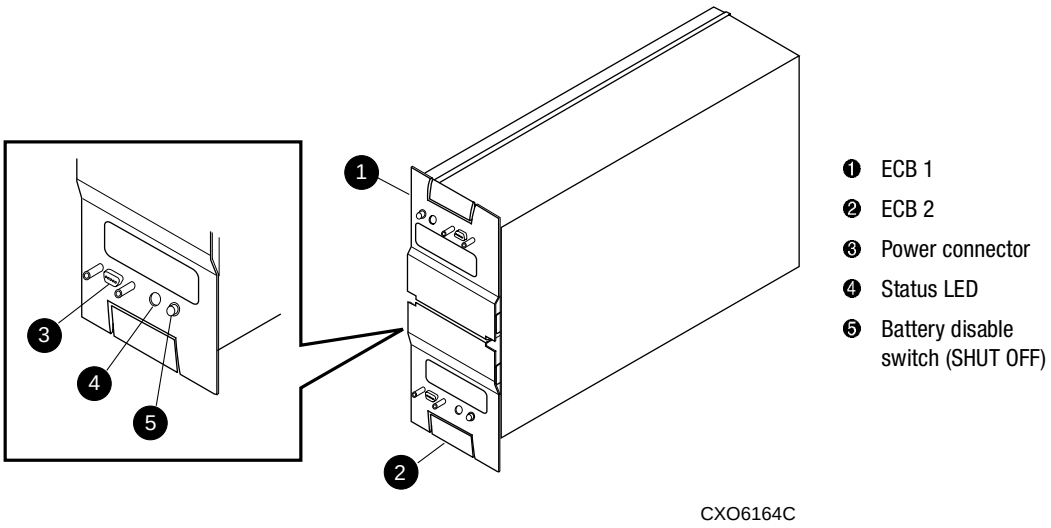


Figure 3–2. ECB battery disable switch location (dual ECB example)

2. Repeat step 1 for all ECBs in the subsystem.

NOTE: The batteries are no longer protecting the cache module memory.

Restarting the Subsystem

Use the following steps to restart a subsystem.

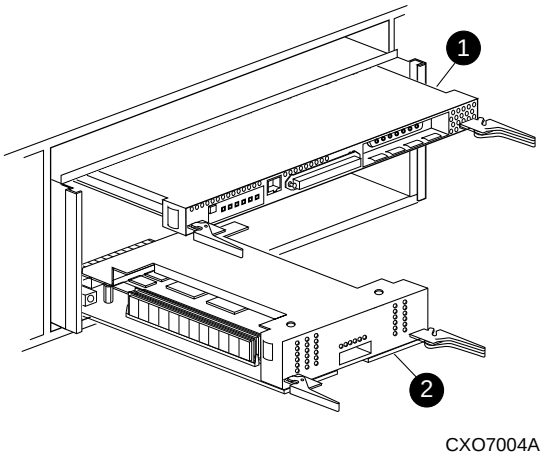
1. Refer to enclosure documentation for specific procedures to follow for restarting the subsystem.

   NOTE: Applying power to the subsystem automatically starts the controllers and turns ON the ECBs. A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

2. Mount the logical units on the host.

Replacement Procedures for Controller and Cache Modules in a Single-Controller Configuration

This section shows how to replace modules in a single-controller configuration (see Figure 3–3). To upgrade a single-controller configuration to a dual-redundant controller configuration, see Chapter 5.



❶ Controller in Controller A bay

❷ Cache module in Cache A bay

Figure 3–3. Single-controller configuration

The following sections show how to replace both the controller and cache module, replace only the controller, and replace only the cache module.

CAUTION: In a single-controller configuration, always shut down the subsystem before removing or replacing any modules. Otherwise, data loss might occur.

IMPORTANT: For single-controller configurations, the only supported controller and cache module bays are Controller A and Cache A. *Do not* use Controller B and Cache B bays instead of Controller A and Cache A bays.

Replacing the Controller and Cache Module in a Single-Controller Configuration

If both the controller and cache module need to be replaced, replace the controller first and then the cache module. The following sections contain steps for replacing each module in a single-controller configuration.

Replacing the Controller in a Single-Controller Configuration

To replace the controller in a single-controller configuration, follow the instructions in this section for removing and installing the controller.

Removing the Controller

Use the following steps to remove the controller in a single-controller configuration.

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

1. Is the controller operating?
   - Yes. Connect a PC or terminal to the controller maintenance port.
   - No. Go to step 6.
2. From the host console, dismount the logical units in the subsystem.
3. Run the fault management utility (FMU) to obtain the last failure codes, if desired.
4. Is a disk initialized with the SAVE_CONFIGURATION switch?
   - Yes. Use the following command to save the current device configuration for "this controller:"

     ```
     CONFIGURATION SAVE
     ```

   - No. Locate existing information that will support the manual configuration of the subsystem. The new controller must be manually configured as described in controller CLI reference guide.
5. Shut down the controller with the following command:

   ```
   SHUTDOWN THIS_CONTROLLER
   ```

IMPORTANT: After the controller shuts down, the reset button and the first three LEDs turn ON (see Figure 3–1). This might take several minutes to happen, depending on the amount of data that needs to be flushed from the cache module.

Proceed only after the reset buttons stop FLASHING and remain ON.

CAUTION: The cache module might contain unwritten data if the controller crashes and the controller cannot be shut down with the SHUTDOWN THIS_CONTROLLER command. Loss of data might occur.

6. Remove the program card ESD cover and program card. Save them in a static-free place for the replacement controller.
7. Disconnect the host bus cable from the controller.
8. If connected, disconnect the PC or terminal from the controller maintenance port.
9. Disengage both retaining levers and remove the controller, then place the controller in an antistatic bag or on a grounded antistatic mat.

Installing the Controller

Use the following steps to install the controller in a single-controller configuration.

CAUTION: Carefully align the controller in the appropriate guide rails. Misaligning the module might damage the backplane.

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

1. Insert the new controller into the Controller A bay (see Figure 3–3, ❶), and engage the retaining levers.
2. Connect a PC or terminal to the controller maintenance port.
3. Press and hold the reset button while inserting the program card into the new controller.
4. Release the reset button and install the program card ESD cover.

5. From the CLI prompt, display details about the configured controller using the following command:

   SHOW THIS_CONTROLLER FULL

   NOTE: If the controller being installed was previously used in another subsystem, the controller will need to be purged of the old configuration (Refer to CONFIG RESET in the controller CLI reference guide).

6. Refer to the controller CLI reference guide to configure the controller.
7. Is the current device configuration saved on a disk drive?
   - Yes. Automatically restore the configuration as follows:

   IMPORTANT: In the following step, hold the Port #6 button until the Port Buttons start FLASHING, before releasing the button.

   a. Press and hold the Port #6 button (see Figure 3–4, ❷) and then press and release the reset button ❶.

      Continue holding the Port #6 button until the port buttons start FLASHING.

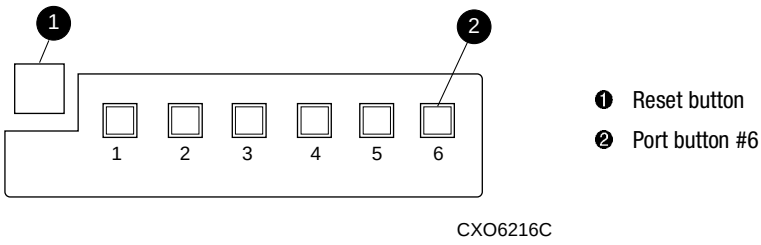


Figure 3–4. Location of array controller reset and port #6 buttons on the OCP

   b. Release the Port #6 button to initiate the configuration restore.

   - No. Manually restore the current device configuration using existing information and the controller CLI reference guide.

8. Using code-load/code-patch utility (CLCP), install any patches that were installed on the previous controller (see Chapter 5).
9. Reconnect the host bus cable to the controller.
10. Mount the logical units on the host.
11. Disconnect the PC or terminal from the controller maintenance port.

Replacing the Cache Module in a Single-Controller Configuration

To replace the cache module in a single-controller configuration, follow the instructions in this section for removing and installing the cache module.

Removing the Cache Module

Use the following steps to remove the cache module in a single-controller configuration.

> **CAUTION:** ESD can easily damage the cache module or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

1. Is the controller operating?
   - Yes. Connect a PC or terminal to the controller maintenance port.
   - No. Go to step 5.
2. From the host console, dismount the logical units in the subsystem.
3. Run FMU to obtain the last failure codes, if desired.
4. Shut down the controller with the following command:

   ```
   SHUTDOWN THIS_CONTROLLER
   ```

> **IMPORTANT:** After the controller shuts down, the reset button and the first three LEDs turn ON (see Figure 3–1). This might take several minutes to happen, depending on the amount of data that needs to be flushed from the cache module.
>
> Proceed only after the reset buttons stop FLASHING and remain ON.

> **CAUTION:** The ECB must be disabled—the status light is not lit and is not blinking—before disconnecting the ECB cable from the cache module. Failure to disable the ECB might damage the cache module.

5. Disable the ECB by pressing the battery disable switch until the status light stops blinking—approximately 5 seconds.
6. Disconnect the ECB cable from the cache module.
7. Disengage both retaining levers and remove the cache module, and then place the cache module in an antistatic bag or on a grounded antistatic mat.

8. Remove the DIMMs from the cache module for use within the replacement cache module.
   a. Press down on the DIMM retaining clips ❸ at both ends of the DIMM ❶ being removed (see Figure 3–5).

      NOTE: To make pressing down on the DIMM retaining clips easier, consider using the eraser end of a pencil or a small screwdriver.

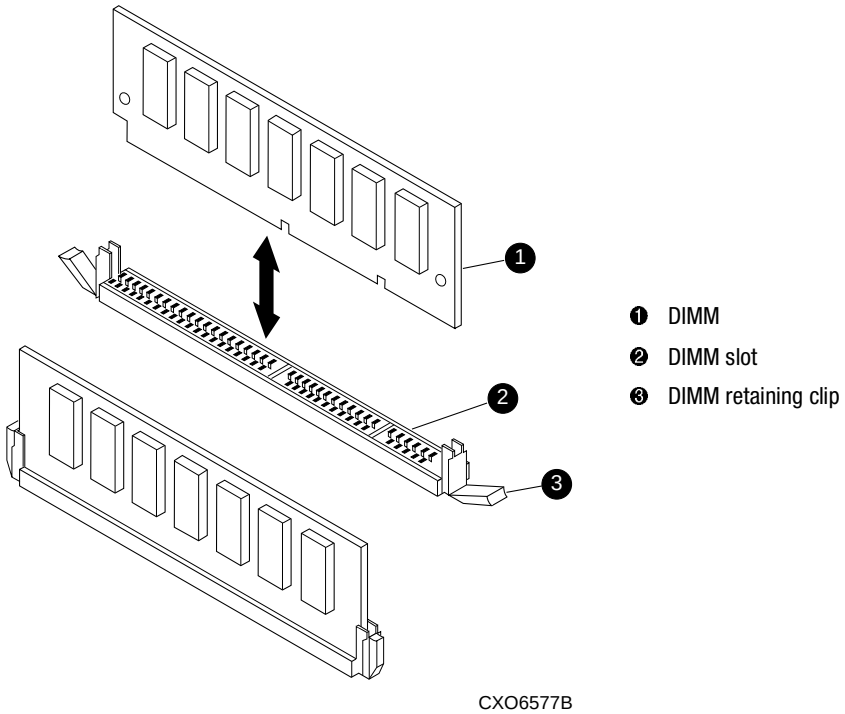


Figure 3–5. DIMM components

   b. Gently remove the DIMM from the DIMM slot ❷ and place the DIMM on an antistatic bag or grounded antistatic mat.
   c. Repeat step a and step b for each DIMM.

Installing the Cache Module

Use the following steps to install the cache module in a single-controller configuration.

> **CAUTION:** ESD can easily damage the cache module or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

1. Insert each DIMM ❶ straight into the appropriate slot ❷ of the new cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3–5).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage two retaining clips ❸ for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.
5. Repeat step 1 through step 4 for each DIMM.

> **CAUTION:** Carefully align the cache module in the appropriate guide rails. Misaligning the module might damage the backplane.

6. Insert the new cache module into the appropriate bay and engage the retaining levers.

> **CAUTION:** The ECB must be disabled—the status light is not lit and is not blinking—before connecting the ECB cable to the cache module. Failure to disable the ECB might result in cache module damage.

7. Disable the ECB by pressing the battery disable switch until the status light stops blinking—approximately 5 seconds.
8. Connect the ECB cable to the new cache module.
9. If not already connected, connect a PC or terminal to the controller maintenance port.
10. Restart “this controller” by pressing the reset button.

    NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

11. From the CLI prompt, display details about the configured controller using the following command:

    ```
    SHOW THIS_CONTROLLER FULL
    ```

12. Mount the logical units on the host.
13. Disconnect the PC or terminal from the controller maintenance port.

Replacement Procedures for Controller and Cache Modules in a Dual-Redundant Controller Configuration

Follow the instructions in this section to replace modules in a dual-redundant controller configuration (see Figure 3–6).

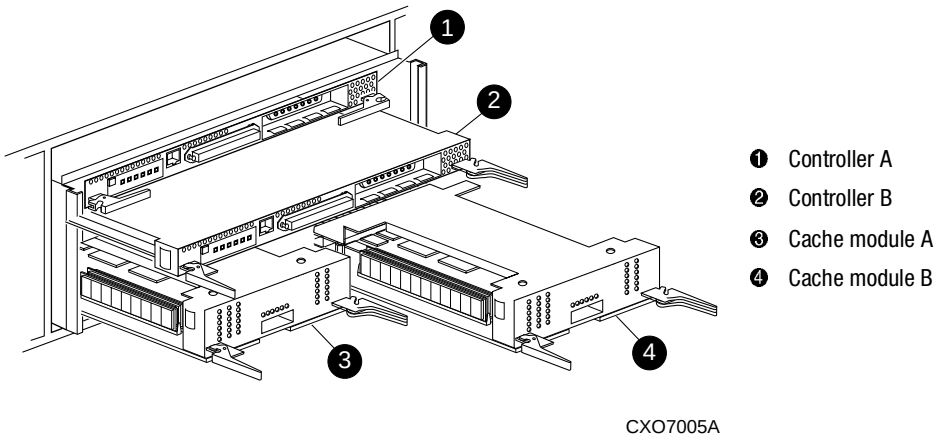


Figure 3–6. Dual-redundant controller configuration

The following sections provide procedures for:

- Replacing both the controller and cache module
- Replacing a controller
- Replacing a cache module

IMPORTANT: Note the following before starting the replacement procedures:

- The new controller hardware must be compatible with the remaining controller hardware. Refer to the product-specific release notes that accompanied the software release for information regarding hardware compatibility.
- The software versions and patch levels must be the same on both controllers.
- The new cache module *must* contain 512 MB of cache memory.

Replacing a Controller and Cache Module in a Dual-Redundant Controller Configuration

To replace a controller and supporting cache module in a dual-redundant controller configuration, follow the instructions in this section for removing and installing a controller and cache module.

Removing a Controller and Cache Module

Use the following steps to remove a controller and supporting cache module in a dual-redundant controller configuration.

CAUTION: ESD can easily damage the controller, cache module, or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

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

   The controller connected to the PC or terminal becomes “this controller;” the controller being removed becomes the “other controller.”

2. Prefer all units to “this controller” with the following command:

   SET *unit-number* PREFERRED_PATH=THIS_CONTROLLER

3. Disable the CI paths with the following commands:

```
SET OTHER_CONTROLLER NOPORT_1_PATH_A
SET OTHER_CONTROLLER NOPORT_1_PATH_B
SET OTHER_CONTROLLER NOPORT_2_PATH_A
SET OTHER_CONTROLLER NOPORT_2_PATH_B
```

NOTE: The display of an error message, indicating that the subsystem was unable to run down certain units on the "other controller," is a timing issue. If this occurs, repeat these SET commands.

4. Disable failover with the following command:

```
SET NOFAILOVER
```

5. Remove the program card ESD cover and program card from the "other controller." Save them in a static-free place for the replacement controller.
6. Start field replacement utility (FRUTIL) with the following command:

```
RUN FRUTIL
```

7. Enter **N**(o) to the question about replacing the cache battery.
8. Enter **1** for the remove a controller or cache module option.
9. Enter **1** for the remove the "other controller" and cache module option.
10. Enter **Y**(es) to confirm the intent to remove the "other controller" and cache module.

CAUTION: Wait for FRUTIL to quiesce the device ports—indicated by an "All device ports quiesced" message. Failure to allow the ports to quiesce might result in data loss. Quiescing might take several minutes.

IMPORTANT: A countdown timer allows a total of 4 minutes to remove both the controller and cache module. After 4 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 6 and proceed.

11. Remove the "other controller":
    a. Disconnect the host bus cable from the controller.
    b. Disengage both retaining levers and remove the controller from the enclosure.
    c. Place the controller in an antistatic bag or on a grounded antistatic mat.

12. Disengage both retaining levers and partially remove the “other controller” cache module—about halfway.

> **CAUTION:** The ECB must be disabled—the ECB status light is OFF—before connecting the ECB cable to the cache module. Failure to disable the ECB might result in cache module damage.

13. Disable the ECB by pressing the battery disable switch until the status light stops blinking—approximately 5 seconds.
14. Remove the cache module:
    a. Disconnect the ECB Y-cable from the “other controller” cache module.
    b. Remove the cache module from the enclosure.
    c. Place the cache module on a grounded antistatic mat or on an antistatic bag.
15. Is a replacement controller and cache module available now?

- No. Enter **N**(o) and disconnect the PC or terminal from the controller maintenance port.

  FRUTIL will exit.

  NOTE: If reverting to a single-controller configuration, fill the vacant controller and cache module bays with blank bezels to prevent the enclosure from developing a potential overtemperature condition.

- Yes. Use the following steps to remove the DIMMs from the cache module for installation in the replacement cache module.
  a. Press the DIMM retaining clips ❸ at both ends of the DIMM ❶ being removed (see Figure 3–5).

  NOTE: To make pressing down on the DIMM retaining clips easier, consider using the eraser end of a pencil or a small screwdriver.

  b. Gently remove the DIMM from the DIMM slot ❷ and place the DIMM in an antistatic bag or on a grounded antistatic mat.
  c. Repeat step a and step b for each DIMM.
  d. Insert each DIMM ❶ straight into the appropriate slot ❷ of the cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3–5).
  e. Press the DIMM gently into the slot until seated at both ends.
  f. Engage two retaining clips ❸ for the DIMM.

g. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.

h. Repeat step d through step g for each DIMM.

i. Go to step 11 on page 3–16.

Installing a Controller and Supporting Cache Module

Use the following steps to install a controller and supporting cache module in a dual-redundant controller configuration.

CAUTION: ESD can easily damage the controller, cache module, or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

Each cache module *must* contain 512 MB of cache memory.

---

1. Insert each DIMM ❶ straight into the appropriate slot ❷ of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3–5).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage two retaining clips ❸ for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.
5. Repeat step 1 through step 4 for each DIMM.
6. Connect a PC or terminal to the maintenance port of the operational controller.

   The controller connected to the PC or terminal becomes “this controller;” the controller being installed becomes the “other controller.”
7. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```
8. Enter **N**(o) to the question about replacing the cache battery.
9. Enter **2** for the install a controller or cache module option.
10. Enter **1** for the install the “other controller” and cache module option.
11. Enter **Y**(es) to confirm the intent to install the “other controller” and cache module.

IMPORTANT: A countdown timer allows a total of 4 minutes to install both the controller and cache module. After 4 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 7 and proceed.

CAUTION: The ECB must be disabled—the ECB status light is OFF—before connecting the ECB cable to the cache module. Failure to disable the ECB might result in cache module damage.

12. Disable the ECB by pressing the battery disable switch until the status light stops blinking—approximately 5 seconds.
13. Connect the ECB Y-cable to the new cache module.

CAUTION: Carefully align the cache module and controller in the appropriate guide rails. Misalignment might damage the backplane.

14. Insert the new cache module into the vacant cache bay and engage the retaining levers.
15. Install the controller:
    a. Make sure that the program card is seated in the replacement controller.
    b. Insert the new controller into the appropriate bay, and engage the retaining levers.

    NOTE: When fully seated, the replacement controller restarts automatically—the reset LED turns ON.
16. Press **Enter**/**Return** to continue.

    The "other controller" restarts and FRUTIL exits.

    NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

IMPORTANT: If the "other controller" did not restart, use the following steps:

1. Press and hold the "other controller" reset button.
2. Reseat the "other controller" program card.
3. Release the reset button.

NOTE: In mirrored mode, FRUTIL initializes the mirrored portion of the new cache module, checks for old data on the cache module, then restarts all device ports. After the device ports restart, FRUTIL tests the cache module and the ECB. After the test completes, the device ports are quiesced and a mirror copy of the cache module data is created on the newly installed cache module.

17. Install the program card ESD cover.
18. Refer to the controller CLI reference guide to configure the controller.

    NOTE: If the controller being installed was previously used in another subsystem, purge the controller of the old configuration (refer to CONFIG RESET in the controller CLI reference guide).

19. Enable failover and re-establish the dual-redundant controller configuration with the following command:

    ```
    SET FAILOVER COPY=THIS_CONTROLLER
    ```

    This command copies the subsystem configuration from “this controller” to the new controller.

20. If desired, verify the failover configuration with the following command:

    ```
    SHOW THIS_CONTROLLER FULL
    ```

21. Reconnect the host bus cable to the controller.
22. Enable CI paths with the following commands:

    ```
    SET THIS_CONTROLLER PORT_1_PATH_A
    SET THIS_CONTROLLER PORT_1_PATH_B
    SET THIS_CONTROLLER PORT_2_PATH_A
    SET THIS_CONTROLLER PORT_2_PATH_B
    ```

23. Remove the preferred path on all units with the following command:

    SET *unit-number* NOPREFERRED_PATH

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

Replacing a Controller in a Dual-Redundant Controller Configuration

To replace a controller in a dual-redundant controller configuration, follow the instructions in this section for removing and installing a controller.

Removing a Controller

Use the following steps to remove a controller in a dual-redundant controller configuration.

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

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

   The controller connected to the PC or terminal becomes “this controller;” the controller being removed becomes the “other controller.”

2. Prefer all units to “this controller” with the following command:

   ```
   SET unit-number PREFERRED_PATH=THIS_CONTROLLER
   ```

3. Disable the CI paths with the following commands:

   ```
   SET OTHER_CONTROLLER NOPORT_1_PATH_A
   SET OTHER_CONTROLLER NOPORT_1_PATH_B
   SET OTHER_CONTROLLER NOPORT_2_PATH_A
   SET OTHER_CONTROLLER NOPORT_2_PATH_B
   ```

   NOTE: The display of an error message, indicating that the subsystem was unable to run down certain units on the “other controller,” is a timing issue. If this occurs, repeat these SET commands.

4. Disable failover with the following command:

   ```
   SET NOFAILOVER
   ```

5. Remove the program card ESD cover and program card from the “other controller.” Save them in a static-free place for the replacement controller.

6. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```

7. Enter **N**(o) to the question about replacing the cache battery.

8. Enter **1** for the remove a controller or cache module option.
9. Enter **2** for the remove the "other controller" option.
10. Enter **Y**(es) to confirm the intent to remove the "other controller."

CAUTION: Wait for FRUTIL to quiesce the device ports—indicated by an "All device ports quiesced" message. Failure to allow the ports to quiesce might result in data loss. Quiescing might take several minutes.

IMPORTANT: A countdown timer allows a total of 2 minutes to remove the controller. After 2 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 6 and proceed.

11. Remove the "other controller":
    a. Disconnect the host bus cable from the controller.
    b. Disengage both retaining levers and remove the controller from the enclosure.
    c. Place the controller in an antistatic bag or on a grounded antistatic mat.
12. Is a replacement controller available now?

- No. Enter **N**(o) and disconnect the PC or terminal from the controller maintenance port.

  FRUTIL will exit.

  NOTE: If reverting to a single-controller configuration, fill the vacant controller bay with a blank bezel to prevent the enclosure from developing an potential overtemperature condition.

- Yes. Enter **Y**(es). Go to step 6 on page 3–21 and proceed.

  NOTE: When fully seated, the replacement controller restarts automatically—the reset LED turns ON.

Installing a Controller

Use the following steps to install a controller in a dual-redundant controller configuration.

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

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

   The controller connected to the PC or terminal becomes "this controller;" the controller being installed becomes the "other controller."

2. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```

3. Enter **N**(o) to the question about replacing the cache battery.
4. Enter **2** for the install a controller and cache module option.
5. Enter **2** for the install the "other controller" option.
6. Enter **Y**(es) to confirm the intent to install the "other controller."

IMPORTANT: A countdown timer allows a total of 2 minutes to install the controller. After 2 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 2 and proceed.

7. Install the controller:
   a. Make sure that the program card is seated in the replacement controller.
   b. Insert the new controller into the appropriate bay, and engage the retaining levers.

   NOTE: When fully seated, the replacement controller restarts automatically—the reset LED turns ON.

8. Press **Enter**/**Return** to continue.

   The "other controller" restarts and FRUTIL exits.

   NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

IMPORTANT: If the "other controller" did not restart, use the following steps:

1. Press and hold the "other controller" reset button.
2. Reseat the "other controller" program card.
3. Release the reset button.

NOTE: In mirrored mode, FRUTIL initializes the mirrored portion of the new cache module, checks for old data on the cache module, then restarts all device ports. After the device ports restart, FRUTIL tests the cache module and the ECB. After the test completes, the device ports are quiesced and a mirror copy of the cache module data is created on the newly installed cache module.

9. Install the program card ESD cover.
10. Refer to the controller CLI reference guide to configure the controller.

    NOTE: If the controller being installed was previously used in another subsystem, purge the controller of the old configuration (refer to CONFIG RESET in the controller CLI reference guide).

11. Enable failover and re-establish the dual-redundant controller configuration with the following command:

    ```
    SET FAILOVER COPY=THIS_CONTROLLER
    ```

    This command copies the subsystem configuration from "this controller" to the new controller.

12. If desired, verify the failover configuration with the following command:

    ```
    SHOW THIS_CONTROLLER FULL
    ```

13. Reconnect the host bus cable to the controller.
14. Enable CI paths with the following commands:

    ```
    SET THIS_CONTROLLER PORT_1_PATH_A
    SET THIS_CONTROLLER PORT_1_PATH_B
    SET THIS_CONTROLLER PORT_2_PATH_A
    SET THIS_CONTROLLER PORT_2_PATH_B
    ```

15. Remove the preferred path on all units with the following command:

    SET *unit-number* NOPREFERRED_PATH

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

Replacing a Cache Module in a Dual-Redundant Controller Configuration

To replace a cache module in a dual-redundant controller configuration, follow the instructions in this section for removing and installing a cache module.

Removing a Cache Module

Use the following steps to remove a cache module in a dual-redundant controller configuration.

CAUTION: ESD can easily damage the cache module or a DIMM. Wear a snug-fitting, grounded ESD wrist strap.

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

   The controller connected to the PC or terminal becomes "this controller;" the controller for the cache module being removed becomes the "other controller."

2. Prefer all units to the "this controller" with the following command:

   SET *unit-number* PREFERRED_PATH=THIS_CONTROLLER

3. Disable the CI paths with the following commands:

   SET OTHER_CONTROLLER NOPORT_1_PATH_A

   SET OTHER_CONTROLLER NOPORT_1_PATH_B

   SET OTHER_CONTROLLER NOPORT_2_PATH_A

   SET OTHER_CONTROLLER NOPORT_2_PATH_B

   NOTE: The display of an error message, indicating that the subsystem was unable to run down certain units on the "other controller," is a timing issue. If this occurs, repeat these SET commands.

4. Disable failover with the following command:

   SET NOFAILOVER

5. Start FRUTIL with the following command:

   RUN FRUTIL

6. Enter **N**(o) to the question about replacing the cache battery.
7. Enter **1** for the remove a controller or cache module option.
8. Enter **3** for the remove the "other controller" cache module option.

9. Enter **Y**(es) to confirm the intent to remove the "other controller" cache module.

CAUTION: Wait for FRUTIL to quiesce the device ports—indicated by an "All device ports quiesced" message. Failure to allow the ports to quiesce might result in data loss. Quiescing might take several minutes.

IMPORTANT: A countdown timer allows a total of 2 minutes to remove the cache module. After 2 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 5 and proceed.

10. Disengage both retaining levers and partially remove the "other controller" cache module—about halfway.

CAUTION: The ECB must be disabled—the ECB status light is OFF—before connecting the ECB cable to the cache module. Failure to disable the ECB might result in cache module damage.

11. Disable the ECB by pressing the battery disable switch until the status light stops blinking—approximately 5 seconds.
12. Remove the cache module:
    a. Disconnect the ECB cable from the "other controller" cache module.
    b. Remove the cache module from the enclosure.
    c. Place the cache module on a grounded antistatic mat or in an antistatic bag.
13. Is a replacement cache module available now?
    - No. Enter **N**(o) and disconnect the PC or terminal from the controller maintenance port.

      FRUTIL will exit.

      NOTE: If reverting to a single-controller configuration, fill the vacant cache module bay with a blank bezel to prevent the enclosure from developing a potential overtemperature condition.

- Yes. Use the following steps to remove the DIMMs from the cache module for installation in the replacement cache module.

  a. Press the DIMM retaining clips ❸ at both ends of the DIMM ❶ being removed (see Figure 3–5).

NOTE: To make pressing down on the DIMM retaining clips easier, consider using the eraser end of a pencil or a small screwdriver.

  b. Gently remove the DIMM from the DIMM slot ❷ and place the DIMM in an antistatic bag or on a grounded antistatic mat.

  c. Repeat step a and step b for each DIMM.

  d. Insert each DIMM ❶ straight into the appropriate slot ❷ of the cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3–5).

  e. Press the DIMM gently into the slot until seated at both ends.

  f. Engage two retaining clips ❸ for the DIMM.

  g. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.

  h. Repeat step d through step g for each DIMM.

  i. Go to step 11 on page 3–26.

Installing a Cache Module

Use the following steps to install a cache module in a dual-redundant controller configuration.

CAUTION: ESD can easily damage a cache module or a DIMM. Wear a snug-fitting, grounded ESD wrist strap.

The new cache module *must* contain 512 MB of cache memory.

1. Insert each DIMM ❶ straight into the appropriate slot ❷ of the cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3–5).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage two retaining clips ❸ for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.

5. Repeat step 1 through step 4 for each DIMM.
6. Connect a PC or terminal to the maintenance port of the operational controller.

   The controller connected to the PC or terminal becomes "this controller;" the controller for the cache module being installed becomes the "other controller."
7. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```
8. Enter **N**(o) to the question about replacing the cache battery.
9. Enter **2** for the install a controller or cache module option.
10. Enter **3** for the install the "other controller" cache module option.
11. Enter **Y**(es) to confirm the intent to install the "other controller" cache module.

IMPORTANT: A countdown timer allows a total of 2 minutes to install the cache module. After 2 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 7 and proceed.

CAUTION: The ECB must be disabled—the ECB status light is OFF—before connecting the ECB cable to the cache module. Failure to disable the ECB might result in cache module damage.

---

12. Disable the ECB by pressing the battery disable switch until the status light stops blinking—approximately 5 seconds.
13. Connect the ECB cable to the new cache module.

CAUTION: Carefully align the cache module and controller in the appropriate guide rails. Misalignment might damage the backplane.

---

14. Insert the new cache module into the appropriate bay and engage the retaining levers.

    The "other controller" restarts and FRUTIL exits.

    NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

IMPORTANT: If the “other controller” did not restart, use the following steps:

1. Press and hold the “other controller” reset button.
2. Reseat the “other controller” program card.
3. Release the reset button.

NOTE: In mirrored mode, FRUTIL initializes the mirrored portion of the new cache module, checks for old data on the cache module, then restarts all device ports. After the device ports restart, FRUTIL tests the cache module and the ECB. After the test completes, the device ports are quiesced and a mirror copy of the cache module data is created on the newly installed cache module.

15. Enable failover and re-establish the dual-redundant controller configuration with the following command:

    ```
    SET FAILOVER COPY=THIS_CONTROLLER
    ```

    This command copies the subsystem configuration from “this controller” to the new controller.

16. If desired, verify the failover configuration with the following command:

    ```
    SHOW THIS_CONTROLLER FULL
    ```

17. Reconnect the host bus cable to the controller.

18. Enable CI paths with the following commands:

    ```
    SET THIS_CONTROLLER PORT_1_PATH_A
    SET THIS_CONTROLLER PORT_1_PATH_B
    SET THIS_CONTROLLER PORT_2_PATH_A
    SET THIS_CONTROLLER PORT_2_PATH_B
    ```

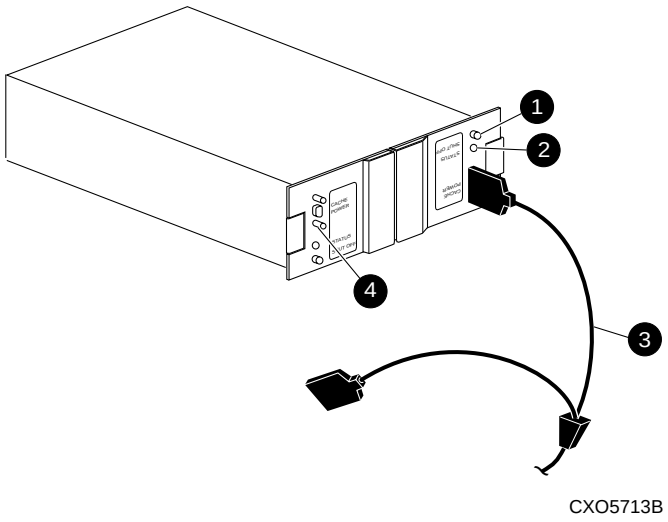
19. Remove the preferred path on all units with the following command:

    SET *unit-number* NOPREFERRED_PATH

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

Replacing an ECB

The ECB can be replaced with subsystem power on or off. A dual ECB is shown in Figure 3–7 and contains two batteries. A single ECB contains only one battery—half of a dual ECB.



❶ Battery disable switch (SHUT OFF)
❷ Status LED
❸ ECB Y-cable
❹ Faceplate and controls for second battery (dual ECB configuration only)

Figure 3–7. Dual ECB configuration

Replacing an ECB With the DS–BA356–MW Subsystem Powered On

Use the following steps to replace the ECB with the DS–BA356–MW subsystem powered on.

> **NOTE:** The FRUTIL procedure for a dual-redundant controller configuration assumes that a single ECB with a dual battery is installed and an empty bay is available for the replacement ECB. If an empty bay is not available, place the new ECB on the top of the enclosure. After removing the old ECB, carefully insert the new ECB into the empty bay.

1. Connect a PC or terminal to the maintenance port of the controller with the ECB that needs replacement.

   The controller connected to the PC or terminal becomes “this controller.”

2. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```

3. Enter **Y**(es) to confirm the intent to replace the "this controller" ECB with power on.

WARNING: Make sure that at least one ECB is connected to the ECB Y-cable at all times during this procedure. Otherwise, cache memory data is not protected and is subject to loss.

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

NOTE: When upgrading to a dual-redundant controller configuration, if an empty power supply or disk drive bay, or ECB enclosure bay is not available, place the new ECB on the top of the enclosure.

4. Replace the ECB:

IMPORTANT: Do not wait for the battery status light on the new ECB to turn solid green.

- For a single ECB:
  a. Remove the old ECB and insert the new ECB into the same location.
  b. Connect the new ECB to the open end of the ECB Y-cable attached to the old ECB and then quickly disconnect the Y-cable from the old ECB.
- For dual ECBs:
  a. Connect the new ECB to the open end of the ECB Y-cable attached to the old ECB and then quickly disconnect the Y-cable from the old ECB.
  b. Place the new dual ECB in a temporary location.

5. Press **Enter**/**Return**.
   - The ECB expiration date and deep discharge history are updated.
   - FRUTIL exits.
6. Disconnect the PC or terminal from the controller maintenance port.

7. For a dual-redundant controller configuration with a dual ECB installed:
   a. If the other cache module is also to be connected to the new ECB, connect the PC or terminal to the "other controller" maintenance port.

      The connected controller now becomes "this controller."

   b. Repeat step 2 through step 6.
   c. Remove the old dual ECB.

Replacing an ECB With the DS–BA356–MW Subsystem Powered OFF

Use the following steps to replace the ECB with the DS–BA356–MW subsystem powered off.

1. If the controller and cache module are not operating, go to step 4. Otherwise, proceed to step 2.
2. Connect a PC or terminal to the maintenance port of the operational controller.

   The controller connected to the PC or terminal becomes "this controller;" a second controller becomes the "other controller."
3. Shut down the controllers.
   - In single-controller configurations, shut down "this controller" with the following command:

     ```
     SHUTDOWN THIS_CONTROLLER
     ```

   - In dual-redundant controller configurations, shut down the "other controller" first, then shut down "this controller" with the following commands:

     ```
     SHUTDOWN OTHER_CONTROLLER
     SHUTDOWN THIS_CONTROLLER
     ```

IMPORTANT: After the controllers shut down, the reset buttons and the first three LEDs turn ON (see Figure 3–1). This might take several minutes to happen, depending on the amount of data that needs to be flushed from the cache modules.

Proceed only after the reset buttons stop FLASHING and remain ON.

---

4. Remove power to the subsystem by unplugging the AC input cords to the DS–BA356–MW enclosure.

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

5. Replace the ECB:
   - For a single ECB:
     a. Remove the old ECB and insert the new ECB into the same location.
     b. Connect the new ECB to the open end of the ECB Y-cable attached to the old ECB and then quickly disconnect the Y-cable from the old ECB.
   - For dual ECBs:
     a. Connect the new ECB to the open end of the ECB Y-cable attached to the old ECB and then quickly disconnect the Y-cable from the old ECB.
     b. Place the new dual ECB in a temporary location.
6. Restore power to the subsystem. The controllers automatically restart.

   NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

7. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```

8. Enter **Y**(es) to confirm the intent to replace the “this controller” ECB with power off.
9. Press **Enter**/**Return**.
   - The ECB expiration date and deep discharge history are updated.
   - FRUTIL exits.
10. Disconnect the PC or terminal from the controller maintenance port.
11. For a dual-redundant controller configuration to replace the ECB for both cache modules:
    a. If the other cache module is also to be connected to the new ECB, connect the PC or terminal to the “other controller” maintenance port.

       The connected controller now becomes “this controller.”
    b. Repeat step 2 through step 10.
    c. For dual ECB configurations, remove the old dual ECB.

Replacing Tape Drives or Tape Loaders

Use the pluggable method to replace tape drives or tape loaders. This method quiesces the specific SCSI bus that corresponds to the drive being replaced.

IMPORTANT: Replace the tape drive or tape loader with an identical type unit using the same device address; otherwise configuration errors will develop.

If adding a different tape device or installing the device using a new address, refer to the tape configuration manual for procedures on removing and adding a tape device.

---

1. From the host console, halt all I/O activity to the appropriate port (SCSI bus).
2. Quiesce the port by pressing the OCP button for that port.

IMPORTANT: The quiesced device port is indicated by a FLASHING OCP port LED. For example, quiescing device Port 3 causes the OCP port LEDs to FLASH in an alternating pattern as shown in Figure 3–8 — the display alternates between the top and bottom graphic.

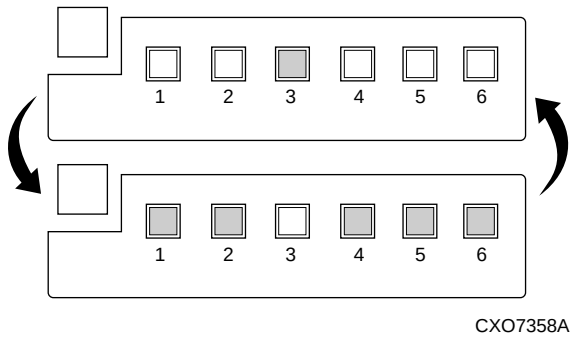


Figure 3–8. Alternating OCP port LED pattern with device port 3 quiesced

---

WARNING: Some tape devices are heavy and, if dropped, the drive might cause personal injury and damage to the device.

When removing a tape device, make sure to use both hands to prevent dropping the device.

---

3. Remove the tape cartridge from the tape device using tape device documentation.

4. Using both hands, remove the tape device from the DS–BA356–MW enclosure.

   NOTE: Follow the tape device documentation for any special handling requirements pertaining to the device.

5. If necessary, using tape device documentation, ensure that the replacement tape device is assigned the identical device address as the old tape device.

   NOTE: The port quiesced will time-out in approximately 50 sec. If this occurs, repeat step 2 and continue with step 6.

6. Align the replacement drive with the enclosure bay opening and insert the drive until the drive locking tabs securely engage the enclosure.

   IMPORTANT: Using tape device documentation, verify that the device initialized correctly.

   When the controller recognizes the replacement device, the port LED turns OFF and the subsystem returns to normal operation.

7. Reinstall the tape cartridge removed in step 3.
8. Resume host port activity to the appropriate port (SCSI bus).

Replacing a Solid-State Disk, Optical, or CD-ROM Drive

To replace a solid-state, optical, or CD-ROM drive, enclosure power must be removed—which means that the controllers must be shut down before removing enclosure power. Use the following steps to replace a drive:

1. Connect a PC or terminal to a controller maintenance port.
2. From a host console, stop all host activity to the controller and dismount the logical units in the subsystem.
3. Shut down the controllers.
   - In single-controller configurations, shut down “this controller” with the following command:

     ```
     SHUTDOWN THIS_CONTROLLER
     ```

- In dual-redundant controller configurations, shut down the "other controller" first, then shut down "this controller" with the following commands:

  SHUTDOWN OTHER_CONTROLLER

  SHUTDOWN THIS_CONTROLLER

IMPORTANT: After the controllers shut down, the reset buttons and the first three LEDs turn ON (see Figure 3–1). This might take several minutes to happen, depending on the amount of data that needs to be flushed from the cache modules.

Proceed only after the reset buttons stop FLASHING and remain ON.

---

4. Disconnect the power cords from the DS–BA356–MW enclosure that contains the failed drive.
5. Remove the drive from the enclosure.
6. Align the replacement drive with the enclosure bay opening and insert the drive until the drive locking tabs securely engage the enclosure.
7. Connect the power cords to the DS–BA356–MW enclosure.

IMPORTANT: Verify that the drive fault status LED is OFF. If this amber LED is ON, the replacement drive is also defective and must be replaced.

When the controller recognizes the device, the port LED turns OFF and the subsystem returns to normal operation.

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

Chapter 4

Replacement Procedures for Model 2200 Enclosure Elements

This chapter provides procedures for shutting down and restarting the subsystem and procedures for replacing the following Model 2200 enclosure elements:

- Array controller
- Cache module
- ECB
- I/O module

Refer to enclosure documentation for information about replacing power supplies, cooling fans, bus cables, and power cables.

IMPORTANT: See Chapter 2 to review the list of required tools and the precautions to follow prior to performing any procedure within this chapter.

Shutting Down the Subsystem

Use the following steps to shut down a subsystem.

1. From a host console, stop all host activity to the controller and dismount the logical units in the subsystem.
2. Connect a PC or terminal to the maintenance port of one of the controllers in the subsystem.
3. Shut down the controllers.
   - In single-controller configurations, shut down "this controller" with the following command:

     SHUTDOWN THIS_CONTROLLER
   - In dual-redundant controller configurations, shut down the "other controller" first, then shut down "this controller" with the following commands:

     SHUTDOWN OTHER_CONTROLLER

     SHUTDOWN THIS_CONTROLLER

IMPORTANT: After the controllers shut down, the reset buttons and the first three LEDs turn ON (see Figure 4–1). This might take several minutes to happen, depending on the amount of data that needs to be flushed from the cache modules.

Proceed only after the reset buttons stop FLASHING and remain ON.

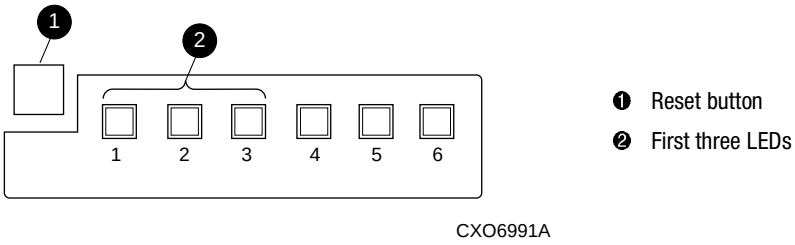


Figure 4–1. Controller reset button and first three LEDs

4. Remove power to the subsystem.

> **CAUTION:** When shutting down the controller for longer than one day, reseat each ECB to stop the ECB fault LED from FLASHING and prevent the ECB battery from discharging.

Restarting the Subsystem

Use the following steps to restart a subsystem.

1. Refer to enclosure documentation for specific procedures to follow for restarting the subsystem.

   NOTE: Applying power to the subsystem automatically starts the controllers and turns ON the ECBs. A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

   NOTE: Mount the logical units on the host.

Replacement Procedures for Controller and Cache Modules in a Single-Controller Configuration

This section shows how to replace modules in a single-controller configuration (see Figure 4–2). To upgrade a single-controller configuration to a dual-redundant controller configuration, see Chapter 5.

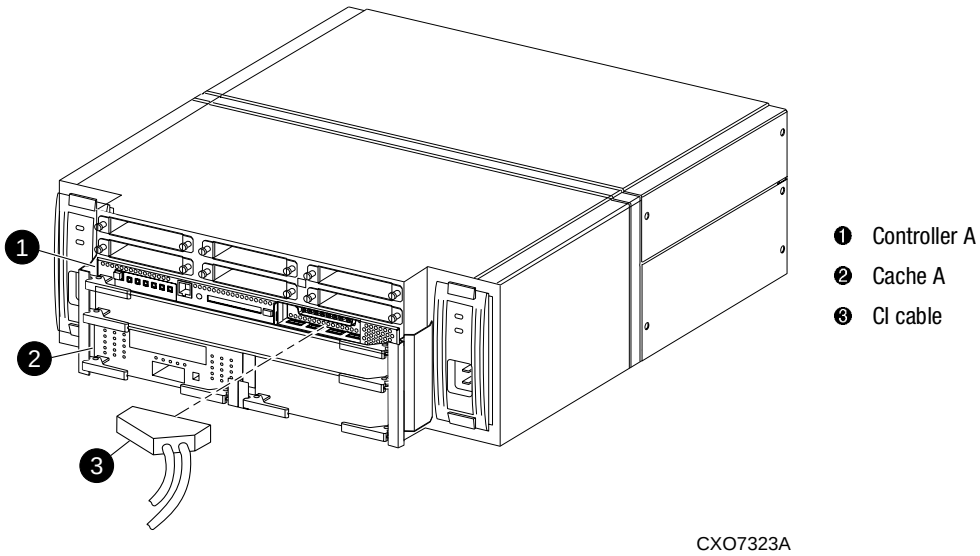


Figure 4–2. Single-controller configuration

The following sections show how to replace both the controller and cache module, replace only the controller, and replace only the cache module.

CAUTION: In a single-controller configuration, always shut down the subsystem before removing or replacing any modules. Otherwise, data loss might occur.

IMPORTANT: For single-controller configurations, the only supported controller and cache module bays are Controller A and Cache A. *Do not* use Controller B and Cache B bays instead of Controller A and Cache A bays.

Replacing the Controller and Cache Module in a Single-Controller Configuration

If both the controller and cache module need to be replaced, replace the controller first and then the cache module. The following sections contain steps for replacing each module in a single-controller configuration.

Replacing the Controller in a Single-Controller Configuration

This section shows how to replace an array controller in a single-controller configuration.

Removing the Controller

To replace the controller in a single-controller configuration, follow the instructions in this section for removing and installing the controller.

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

1. Is the controller operating?
   - Yes. Connect a PC or terminal to the controller maintenance port.
   - No. Go to step 6.
2. From the host console, dismount the logical units in the subsystem.
3. Run FMU to obtain the last failure codes, if desired.
4. Is a disk initialized with the SAVE_CONFIGURATION switch?
   - Yes. Use the following command to save the current device configuration for "this controller:"

     ```
     CONFIGURATION SAVE
     ```

   - No. Locate existing information that will support the manual configuration of the subsystem. The new controller must be manually configured as described in controller CLI reference guide.

5. Shut down the controller with the following command:

   SHUTDOWN THIS_CONTROLLER

IMPORTANT: After the controller shuts down, the reset button and the first three LEDs turn ON (see Figure 4–1). This might take several minutes to happen, depending on the amount of data that needs to be flushed from the cache module.

Proceed only after the reset buttons stop FLASHING and remain ON.

CAUTION: The cache module might contain unwritten data if the controller crashes and the controller cannot be shut down with the SHUTDOWN THIS_CONTROLLER command. Loss of data might occur.

6. Remove the program card ESD cover and program card. Save them in a static-free place for the replacement controller.
7. Disconnect the host bus cable from the controller.
8. If connected, disconnect the PC or terminal from the controller maintenance port.
9. Disengage both retaining levers and remove the controller, and then place the controller in an antistatic bag or on a grounded antistatic mat.

Installing the Controller

Use the following steps to install the controller in a single-controller configuration.

CAUTION: Carefully align the controller in the appropriate guide rails. Misaligning the module might damage the backplane.

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

1. Insert the new controller into the Controller A bay (see Figure 4–2, ❶), and engage the retaining levers.
2. Connect a PC or terminal to the controller maintenance port.
3. Press and hold the reset button while inserting the program card into the new controller.
4. Release the reset button and install the program card ESD cover.

5. From the CLI prompt, display details about the configured controller using the following command:

   SHOW THIS_CONTROLLER FULL

IMPORTANT: If the controller being installed was previously used in another subsystem, purging the controller of the old configuration is *required* (refer to CONFIG RESET in the controller CLI reference guide).

---

6. Refer to the controller CLI reference guide to configure the controller.
7. Is the current device configuration saved on a disk drive?
   - Yes. Automatically restore the configuration as follows:

IMPORTANT: In the following step, hold the Port #6 button until the Port Buttons start FLASHING, before releasing the button.

---

   a. Press and hold the Port #6 button (see Figure 4–3, ❷) and then press and release the reset button ❶.

      Continue holding the Port #6 button until the port buttons start FLASHING.

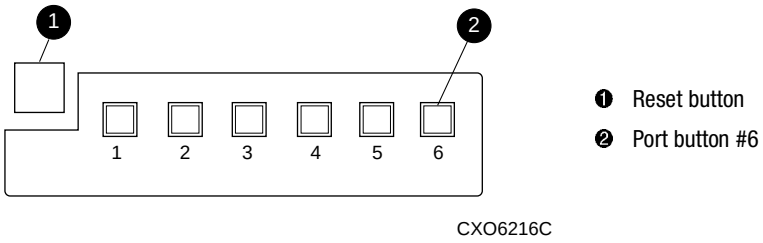


Figure 4–3. Location of array controller reset and port #6 buttons on the OCP

   b. Release the Port #6 button to initiate the configuration restore.

   - No. Manually restore the current device configuration using existing information and the controller CLI reference guide.

8. Using CLCP, install any patches that were installed on the previous controller (see Chapter 5).
9. Reconnect the host bus cable to the controller.

10. Mount the logical units on the host.
11. Disconnect the PC or terminal from the controller maintenance port.

Replacing the Cache Module in a Single-Controller Configuration

To replace the cache module in a single-controller configuration, follow the instructions in this section for removing and installing the cache module.

Removing the Cache Module

Use the following steps to remove the cache module in a single-controller configuration.

CAUTION: ESD can easily damage the cache module or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

1. Is the controller operating?
   - Yes. Connect a PC or terminal to the controller maintenance port.
   - No. Go to step 5.
2. From the host console, dismount the logical units in the subsystem.
3. Run FMU to obtain the last failure codes, if desired.
4. Shut down the controller with the following command:

   ```
   SHUTDOWN THIS_CONTROLLER
   ```

IMPORTANT: After the controller shuts down, the reset button and the first three LEDs turn ON (see Figure 4–1). This might take several minutes to happen, depending on the amount of data that needs to be flushed from the cache module.

Proceed only after the reset buttons stop FLASHING and remain ON.

5. Disengage both retaining levers and remove the cache module, and then place the cache module in an antistatic bag or on a grounded antistatic mat.

6. Remove the DIMMs from the cache module for use within the replacement cache module.
   a. Press down on the DIMM retaining clips ❸ at both ends of the DIMM ❶ being removed (see Figure 4–4).

      NOTE: To make pressing down on the DIMM retaining clips easier, consider using the eraser end of a pencil or a small screwdriver.

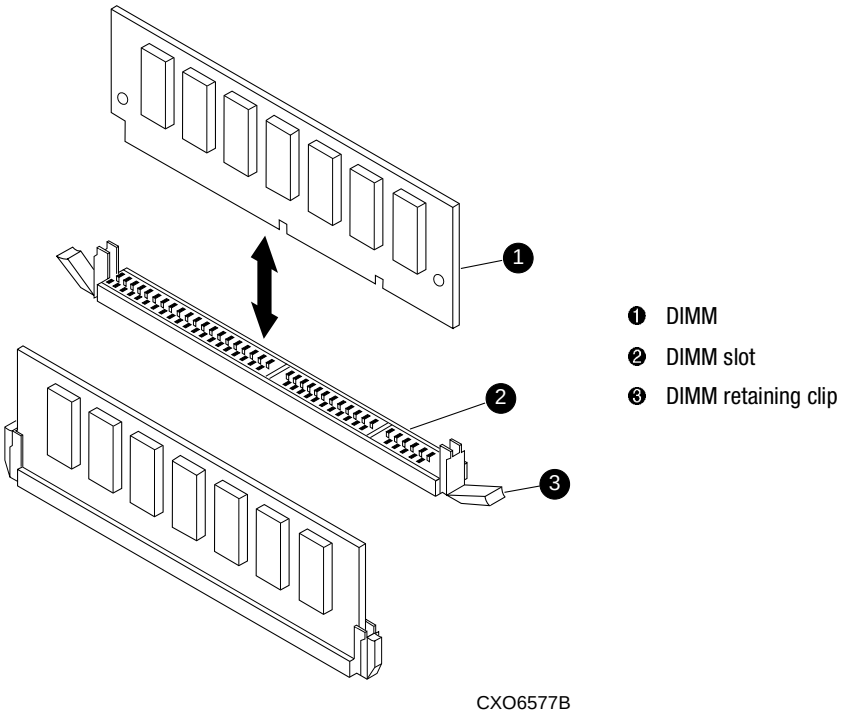


Figure 4–4. DIMM components

   b. Gently remove the DIMM from the DIMM slot ❷ and place the DIMM on an antistatic bag or grounded antistatic mat.
   c. Repeat step a and step b for each DIMM.

Installing the Cache Module

Use the following steps to install the cache module in a single-controller configuration.

> **CAUTION:** ESD can easily damage the cache module or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

1. Insert each DIMM ❶ straight into the appropriate slot ❷ of the new cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 4–4).
2. Press the DIMM gently into the slot ❷ until seated at both ends.
3. Engage two retaining clips ❸ for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.
5. Repeat step 1 through step 4 for each DIMM.

> **CAUTION:** Carefully align the cache module in the appropriate guide rails. Misaligning the module might damage the backplane.

6. Insert the new cache module into appropriate bay and engage the retaining levers.
7. If not already connected, connect a PC or terminal to the controller maintenance port.
8. Restart “this controller” by pressing reset button.

   NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

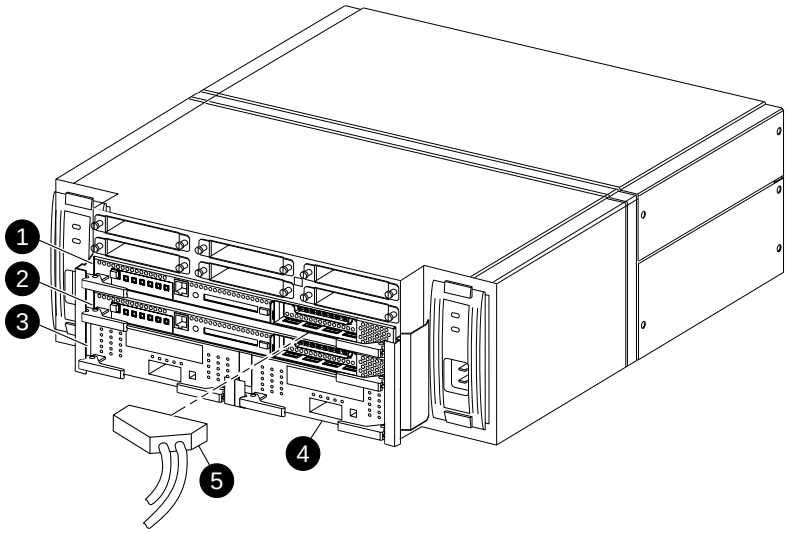
9. From the CLI prompt, display details about the configured controller using the following command:

   ```
   SHOW THIS_CONTROLLER FULL
   ```

10. Mount the logical units on the host.
11. Disconnect the PC or terminal from the controller maintenance port.

Replacement Procedures for Controller and Cache Modules in a Dual-Redundant Controller Configuration

Follow the instructions in this section to replace modules in a dual-redundant controller configuration (see Figure 4–5).



❶ Controller A
❷ Controller B
❸ Cache module A
❹ Cache module B
❺ Dual CI cable

Figure 4–5. Dual-redundant controller configuration (Model 2200 example)

The following sections provide procedures for:

- Replacing both the controller and cache module
- Replacing a controller
- Replacing a cache module

IMPORTANT: Note the following before starting the replacement procedures:

- The new controller hardware must be compatible with the remaining controller hardware. Refer to the product-specific release notes that accompanied the software release for information regarding hardware compatibility.
- The software versions and patch levels must be the same on both controllers.
- The new cache module must contain the same memory configuration as the module being replaced.

Replacing a Controller and Cache Module in a Dual-Redundant Controller Configuration

To replace a controller and supporting cache module in a dual-redundant controller configuration, follow the instructions in this section for removing and installing a controller and cache module.

Removing a Controller and Cache Module

Use the following steps to remove a controller and supporting cache module in a dual-redundant controller configuration.

CAUTION: ESD can easily damage the controller, cache module, or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

Both cache modules *must* contain the same cache memory configuration.

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

   The controller connected to the PC or terminal becomes “this controller;” the controller being removed becomes the “other controller.”

2. Prefer all units to “this controller” with the following command:

   SET *unit-number* PREFERRED_PATH=THIS_CONTROLLER

3. Disable the CI paths with the following commands:

   ```
   SET OTHER_CONTROLLER NOPORT_1_PATH_A
   SET OTHER_CONTROLLER NOPORT_1_PATH_B
   SET OTHER_CONTROLLER NOPORT_2_PATH_A
   SET OTHER_CONTROLLER NOPORT_2_PATH_B
   ```

   NOTE: The display of an error message, indicating that the subsystem was unable to run down certain units on the "other controller," is a timing issue. If this occurs, repeat these SET commands.

4. Disable failover with the following command:

   ```
   SET NOFAILOVER
   ```

5. Remove the program card ESD cover and program card from the "other controller." Save them in a static-free place for the replacement controller.
6. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```

7. Enter **N**(o) to the question about replacing the cache battery.
8. Enter **1** for the remove a controller or cache module option.
9. Enter **1** for the remove the "other controller" and cache module option.
10. Enter **Y**(es) to confirm the intent to remove the "other controller" and cache module.

CAUTION: Wait for FRUTIL to quiesce the device ports—indicated by an "All device ports quiesced" message. Failure to allow the ports to quiesce might result in data loss. Quiescing might take several minutes.

IMPORTANT: A countdown timer allows a total of 4 minutes to remove both the controller and cache module. After 4 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 6 and proceed.

11. Remove the "other controller":
    a. Disconnect the host bus cable from the controller.
    b. Disengage both retaining levers and remove the controller from the enclosure.
    c. Place the controller in an antistatic bag or on a grounded antistatic mat.

12. Remove the cache module:
    a. Disengage both retaining levers and remove the “other controller” cache module.
    b. Place the cache module on a grounded antistatic mat or on an antistatic bag.
13. Is a replacement controller and cache module available now?

■ No. Enter **N**(o) and disconnect the PC or terminal from the controller maintenance port.

FRUTIL will exit.

NOTE: If reverting to a single-controller configuration, fill the vacant controller and cache module bays with blank bezels to prevent the enclosure from developing an potential overtemperature condition.

■ Yes. Use the following steps to remove the DIMMs from the cache module for installation in the replacement cache module.

a. Press the DIMM retaining clips ❸ down at both ends of the DIMM ❶ being removed (see Figure 4–4).

NOTE: To make pressing down on the DIMM retaining clips easier, consider using the eraser end of a pencil or a small screwdriver.

b. Gently remove the DIMM from the DIMM slot ❷ and place the DIMM in an antistatic bag or on a grounded antistatic mat.
c. Repeat step a and step b for each DIMM.
d. Insert each DIMM ❶ straight into the appropriate slot ❷ of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 4–4).
e. Press the DIMM gently into the slot ❷ until seated at both ends.
f. Engage two retaining clips ❸ for the DIMM.
g. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.
h. Repeat step d through step g for each DIMM.
i. Enter **Y**(es).
j. Go to step 12 on page 4–16.

Installing a Controller and Cache Module

Use the following steps to install a controller and supporting cache module in a dual-redundant controller configuration.

> **CAUTION:** ESD can easily damage the controller, cache module, or DIMM. Wear a snug-fitting, grounded ESD wrist strap.
>
> Each cache module *must* contain 512 MB of cache memory.

1. Insert each DIMM ❶ straight into the appropriate slot ❷ of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 4–4).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage two retaining clips ❸ for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.
5. Repeat step 1 through step 4 for each DIMM.
6. Connect a PC or terminal to the maintenance port of the operational controller.

   The controller connected to the PC or terminal becomes "this controller;" the controller being installed becomes the "other controller."
7. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```
8. Enter **N**(o) to the question about replacing the cache battery.
9. Enter **2** for the install a controller or cache module option.
10. Enter **1** for the install the "other controller" and cache module option.
11. Enter **Y**(es) to confirm the intent to install the "other controller" and cache module.

> **IMPORTANT:** A countdown timer allows a total of 4 minutes to install both the controller and cache module. After 4 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 7 and proceed.

> **CAUTION:** Carefully align the cache module and controller in the appropriate guide rails. Misalignment might damage the backplane.

12. Insert the new cache module into the appropriate bay and engage the retaining levers.
13. Install the controller:
    a. Make sure that the program card is seated in the replacement controller.
    b. Insert the new controller into the appropriate bay, and engage the retaining levers.

    NOTE: When fully seated, the replacement controller restarts automatically—the reset LED turns ON.

14. Press **Enter/Return** to continue.

    The "other controller" restarts and FRUTIL exits.

    NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

    IMPORTANT: If the "other controller" did not restart, use the following steps:

    1. Press and hold the "other controller" reset button.
    2. Reseat the "other controller" program card.
    3. Release the reset button.

    NOTE: In mirrored mode, FRUTIL initializes the mirrored portion of the new cache module, checks for old data on the cache module, then restarts all device ports. After the device ports restart, FRUTIL tests the cache module and the ECB. After the test completes, the device ports are quiesced and a mirror copy of the cache module data is created on the newly installed cache module.

15. Install the program card ESD cover.
16. Refer to the controller CLI reference guide to configure the controller.

    NOTE: If the controller being installed was previously used in another subsystem, purge the controller of the old configuration (refer to CONFIG RESET in the controller CLI reference guide).

17. Enable failover and re-establish the dual-redundant controller configuration with the following command:

    ```
    SET FAILOVER COPY=THIS_CONTROLLER
    ```

    This command copies the subsystem configuration from "this controller" to the new controller.

18. If desired, verify the failover configuration with the following command:

    ```
    SHOW THIS_CONTROLLER FULL
    ```

19. Reconnect the host bus cable to the controller.

20. Enable CI paths with the following commands:

    SET THIS_CONTROLLER PORT_1_PATH_A

    SET THIS_CONTROLLER PORT_1_PATH_B

    SET THIS_CONTROLLER PORT_2_PATH_A

    SET THIS_CONTROLLER PORT_2_PATH_B

21. Remove the preferred path on all units with the following command:

    SET *unit-number* NOPREFERRED_PATH

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

Replacing a Controller in a Dual-Redundant Controller Configuration

To replace a controller in a dual-redundant controller configuration, follow the instructions in this section for removing and installing a controller.

Removing a Controller

Use the following steps to remove a controller in a dual-redundant controller configuration.

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

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

   The controller connected to the PC or terminal becomes “this controller;” the controller being removed becomes the “other controller.”

2. Prefer all units to “this controller” with the following command:

   SET *unit-number* PREFERRED_PATH=THIS_CONTROLLER

3. Disable the CI paths with the following commands:

```
SET OTHER_CONTROLLER NOPORT_1_PATH_A
SET OTHER_CONTROLLER NOPORT_1_PATH_B
SET OTHER_CONTROLLER NOPORT_2_PATH_A
SET OTHER_CONTROLLER NOPORT_2_PATH_B
```

NOTE: The display of an error message, indicating that the subsystem was unable to run down certain units on the "other controller," is a timing issue. If this occurs, repeat these SET commands.

4. Disable failover with the following command:

```
SET NOFAILOVER
```

5. Remove the program card ESD cover and program card from the "other controller." Save them in a static-free place for the replacement controller.
6. Start FRUTIL with the following command:

```
RUN FRUTIL
```

7. Enter **N**(o) to the question about replacing the cache battery.
8. Enter **1** for the remove a controller or cache module option.
9. Enter **2** for the remove the "other controller" option.
10. Enter **Y**(es) to confirm the intent to remove the "other controller."

CAUTION: Wait for FRUTIL to quiesce the device ports—indicated by an "All device ports quiesced" message. Failure to allow the ports to quiesce might result in data loss. Quiescing might take several minutes.

IMPORTANT: A countdown timer allows a total of 2 minutes to remove the controller. After 2 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 6 and proceed.

11. Remove the "other controller":
    a. Disconnect the host bus cable from the controller.
    b. Disengage both retaining levers and remove the controller from the enclosure.
    c. Place the controller in an antistatic bag or on a grounded antistatic mat.

12. Is a replacement controller available now?

    - No. Enter **N**(o) and disconnect the PC or terminal from the controller maintenance port.

      FRUTIL will exit.

      NOTE: To revert to a single-controller configuration, fill the vacant controller bay with a blank bezel to prevent the enclosure from developing an potential overtemperature condition.

    - Yes. Enter **Y**(es). Go to step 7 on page 4–20.

      NOTE: When fully seated, the replacement controller restarts automatically—the reset LED turns ON.

Installing a Controller

Use the following steps to install a controller in a dual-redundant controller configuration.

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

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

   The controller connected to the PC or terminal becomes “this controller;” the controller being installed becomes the “other controller.”

2. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```

3. Enter **N**(o) to the question about replacing the cache battery.
4. Enter **2** for the install a controller and cache module option.
5. Enter **2** for the install the “other controller” option.
6. Enter **Y**(es) to confirm the intent to install the “other controller.”

IMPORTANT: A countdown timer allows a total of 2 minutes to install the controller. After 2 minutes, “this controller” will exit FRUTIL and resume operations. If this happens, return to step 2 and proceed.

CAUTION: Carefully align the controller in the appropriate guide rails. Misalignment might damage the backplane.

7. Install the controller:
   a. Make sure that the program card is seated in the replacement controller.
   b. Insert the new controller into the appropriate bay, and engage the retaining levers.

   NOTE: When fully seated, the replacement controller restarts automatically—the reset LED turns ON.

8. Press **Enter/Return** to continue.

   The "other controller" restarts and FRUTIL exits.

   NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

IMPORTANT: If the "other controller" did not restart, use the following steps:

1. Press and hold the "other controller" reset button.
2. Reseat the "other controller" program card.
3. Release the reset button.

NOTE: In mirrored mode, FRUTIL initializes the mirrored portion of the new cache module, checks for old data on the cache module, then restarts all device ports. After the device ports restart, FRUTIL tests the cache module and the ECB. After the test completes, the device ports are quiesced and a mirror copy of the cache module data is created on the newly installed cache module.

9. Install the program card ESD cover.
10. Refer to the controller CLI reference guide to configure the controller.

    NOTE: If the controller being installed was previously used in another subsystem, purge the controller of the old configuration (refer to CONFIG RESET in the controller CLI reference guide).

11. Enable failover and re-establish the dual-redundant controller configuration with the following command:

    ```
    SET FAILOVER COPY=THIS_CONTROLLER
    ```

    This command copies the subsystem configuration from "this controller" to the new controller.

12. If desired, verify the failover configuration with the following command:

    SHOW THIS_CONTROLLER FULL

13. Reconnect the host bus cable to the controller.
14. Enable CI paths with the following commands:

    SET THIS_CONTROLLER PORT_1_PATH_A

    SET THIS_CONTROLLER PORT_1_PATH_B

    SET THIS_CONTROLLER PORT_2_PATH_A

    SET THIS_CONTROLLER PORT_2_PATH_B

15. Remove the preferred path on all units with the following command:

    SET *unit-number* NOPREFERRED_PATH

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

Replacing a Cache Module in a Dual-Redundant Controller Configuration

To replace a cache module in a dual-redundant controller configuration, follow the instructions in this section for removing and installing a cache module.

Removing a Cache Module

Use the following steps to remove a cache module in a dual-redundant controller configuration.

CAUTION: ESD can easily damage a cache module or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

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

   The controller connected to the PC or terminal becomes “this controller;” the controller for the cache module being removed becomes the “other controller.”

2. Prefer all units to “this controller” with the following command:

   SET *unit-number* PREFERRED_PATH=THIS_CONTROLLER

3. Disable the CI paths with the following commands:

   ```
   SET OTHER_CONTROLLER NOPORT_1_PATH_A
   SET OTHER_CONTROLLER NOPORT_1_PATH_B
   SET OTHER_CONTROLLER NOPORT_2_PATH_A
   SET OTHER_CONTROLLER NOPORT_2_PATH_B
   ```

   NOTE: The display of an error message, indicating that the subsystem was unable to run down certain units on the "other controller," is a timing issue. If this occurs, repeat these SET commands.

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

   ```
   SET NOFAILOVER
   ```

5. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```

6. Enter **N**(o) to the question about replacing the cache battery.
7. Enter **1** for the remove a controller or cache module option.
8. Enter **3** for the remove the "other controller" cache module option.
9. Enter **Y**(es) to confirm the intent to remove the "other controller" cache module.

CAUTION: Wait for FRUTIL to quiesce the device ports—indicated by an "All device ports quiesced" message. Failure to allow the ports to quiesce might result in data loss. Quiescing might take several minutes.

IMPORTANT: A countdown timer allows a total of 2 minutes to remove the cache module. After 2 minutes, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 5 and proceed.

10. Remove the cache module:
    a. Disengage both retaining levers and remove the "other controller" cache module.
    b. Place the cache module on a grounded antistatic mat or on an antistatic bag.

11. Is a replacement cache module available now?

- No. Enter **N**(o) and disconnect the PC or terminal from the controller maintenance port.

  FRUTIL will exit.

  NOTE: If reverting to a single-controller configuration, fill the vacant cache module bay with a blank bezel to prevent the enclosure from developing a potential overtemperature condition.

- Yes. Use the following steps to remove the DIMMs from the cache module for installation in the replacement cache module.

  a. Press the DIMM retaining clips ❸ down at both ends of the DIMM ❶ being removed (see Figure 4–4).

  NOTE: To make pressing down on the DIMM retaining clips easier, consider using the eraser end of a pencil or a small screwdriver.

  b. Gently remove the DIMM from the DIMM slot ❷ and place the DIMM in an antistatic bag or on a grounded antistatic mat.

  c. Repeat step a and step b for each DIMM.

  d. Insert each DIMM ❶ straight into the appropriate slot ❷ of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 4–4).

  e. Press the DIMM gently into the slot until seated at both ends.

  f. Engage two retaining clips ❸ for the DIMM.

  g. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.

  h. Repeat step d through step g for each DIMM.

  i. Enter **Y**(es).

  j. Go to step 12 on page 4–25.

Installing a Cache Module

Use the following steps to install a cache module in a dual-redundant controller configuration.

CAUTION: ESD can easily damage a cache module or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

The new cache module *must* contain 512 MB of cache memory.

---

1. Insert each DIMM ❶ straight into the appropriate slot ❷ of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 4–4).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage two retaining clips ❸ for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.
5. Repeat step 1 through step 4 for each DIMM.
6. Connect a PC or terminal to the maintenance port of the operational controller.

   The controller connected to the PC or terminal becomes “this controller;” the controller for the cache module being installed becomes the “other controller.”
7. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```
8. Enter **N**(o) to the question about replacing the cache battery.
9. Enter **2** for the install a controller or cache module option.
10. Enter **3** for the install the “other controller” cache module option.
11. Enter **Y**(es) to confirm the intent to install the “other controller” cache module.

IMPORTANT: A countdown timer allows a total of 2 minutes to install the cache module. After 2 minutes, “this controller” will exit FRUTIL and resume operations. If this happens, return to step 7 and proceed.

CAUTION: Carefully align the cache module in the appropriate guide rails. Misalignment might damage the backplane.

---

12. Insert the new cache module into the appropriate bay and engage the retaining levers.

    The "other controller" and then FRUTIL exits.

    NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

    IMPORTANT: If the "other controller" did not restart, use the following steps:

    1. Press and hold the "other controller" reset button.
    2. Reseat the "other controller" program card.
    3. Release the reset button.

    NOTE: In mirrored mode, FRUTIL initializes the mirrored portion of the new cache module, checks for old data on the cache module, then restarts all device ports. After the device ports restart, FRUTIL tests the cache module and the ECB. After the test completes, the device ports are quiesced and a mirror copy of the cache module data is created on the newly installed cache module.

13. Enable failover and re-establish the dual-redundant controller configuration with the following command:

    ```
    SET FAILOVER COPY=THIS_CONTROLLER
    ```

    This command copies the subsystem configuration from "this controller" to the new controller.

14. If desired, verify the failover configuration with the following command:

    ```
    SHOW THIS_CONTROLLER FULL
    ```

15. Reconnect the host bus cable to the controller.

16. Enable CI paths with the following commands:

    ```
    SET THIS_CONTROLLER PORT_1_PATH_A
    SET THIS_CONTROLLER PORT_1_PATH_B
    SET THIS_CONTROLLER PORT_2_PATH_A
    SET THIS_CONTROLLER PORT_2_PATH_B
    ```

17. Remove the preferred path on all units with the following command:

    SET *unit-number* NOPREFERRED_PATH

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

Replacing an ECB

Model 2200 enclosures contain four ECB bays. Two bays support cache module A (A1 and A2) and two bays support cache module B (B1 and B2)—see the relationship in Figure 4–6. When replacing an ECB (see Figure 4–7), match the vacant ECB bay with the cache module the ECB will support.

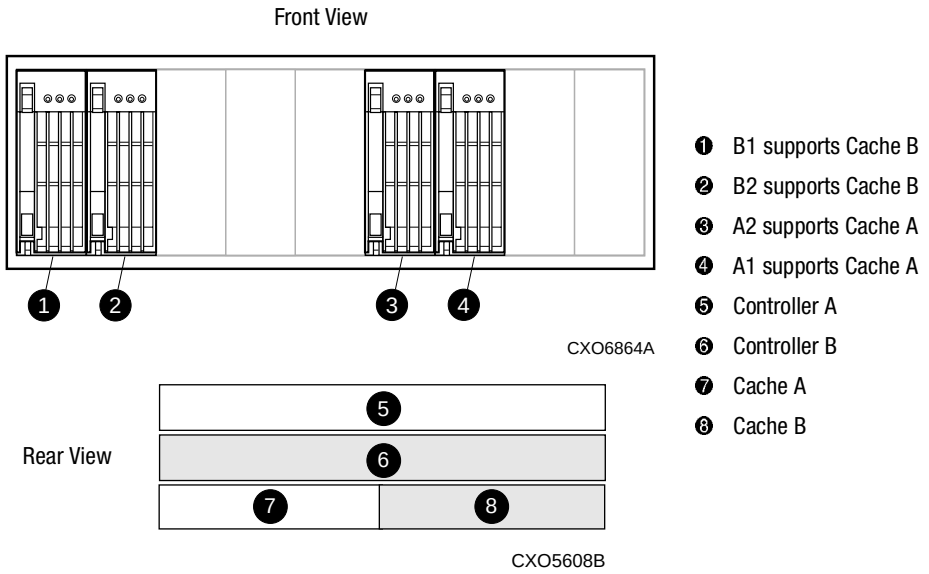


Figure 4–6. ECB and cache module locations in the Model 2200 enclosure

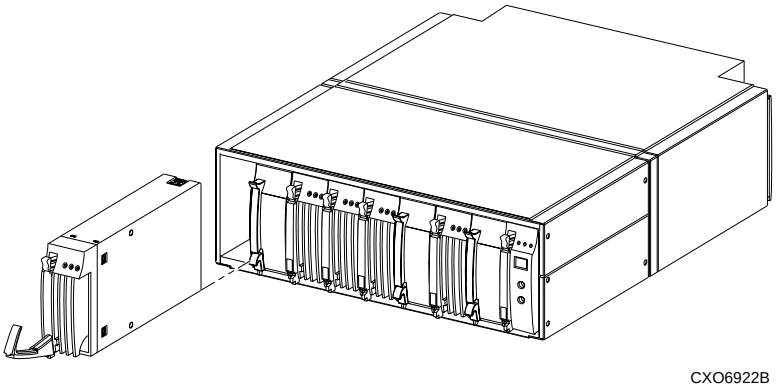


Figure 4–7. Removing an ECB that supports cache module B

Use the following steps to replace the ECB.

1. Connect a PC or terminal to the maintenance port of the controller with the ECB that needs replacement.

   The controller connected to the PC or terminal becomes “this controller.”

2. Enter the following command to verify that system time is set:

   ```
   SHOW THIS_CONTROLLER FULL
   ```

3. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```

4. Enter **Y**(es) to confirm the intent to replace the “this controller” ECB.

CAUTION: Make sure to install the replacement ECB in a bay that supports the same cache module as the current ECB being removed—ECB bay A1 and A2 are paired and ECB bay B1 and B2 are paired.

Remove the blank bezel from this replacement bay and reinstall the blank bezel in the bay vacated by the ECB being replaced. Failure to reinstall the blank bezel might cause an overtemperature condition and damage the enclosure.

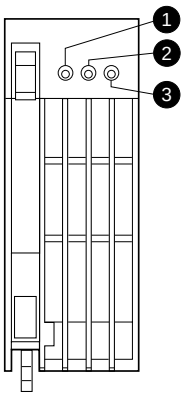
---

5. Install a Battery Service Label on the replacement ECB as described by the *Compaq StorageWorks Battery Service Label Placement* installation card.

   NOTE: The Battery Service Label indicates the installation date (MM/YY) for the replacement ECB.

6. Remove the blank bezel from the appropriate bay and insert the replacement ECB.

IMPORTANT: *Do not* remove the old ECB until the ECB charged LED on the replacement ECB turns ON (see Figure 4–8, ❶).



❶ ECB charged LED
❷ ECB charging LED
❸ ECB fault LED

Figure 4–8. ECB status LEDs

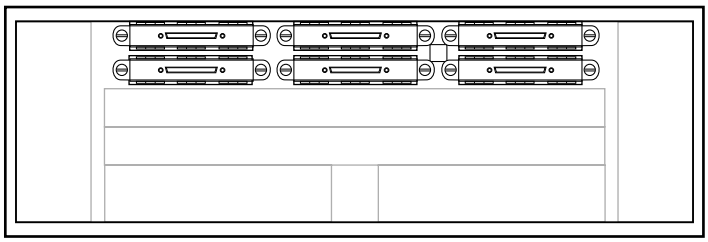
7. Remove the old ECB and install the blank bezel in this vacant bay.
8. Press **Enter**/**Return**.
   - The ECB expiration date and deep discharge history are updated.
   - FRUTIL exits.
9. Disconnect the PC or terminal from the controller maintenance port.
10. Repeat step 1 through step 9 to replace another ECB for the “other controller” in a dual-redundant controller configuration.

Replacing an I/O Module

Figure 4–9 shows a rear view of the Model 2200 enclosure and the relative location of the six I/O modules (also referred to as ports), their connectors and securing screws. Figure 4–10 shows the SCSI bus correlation for each I/O module.

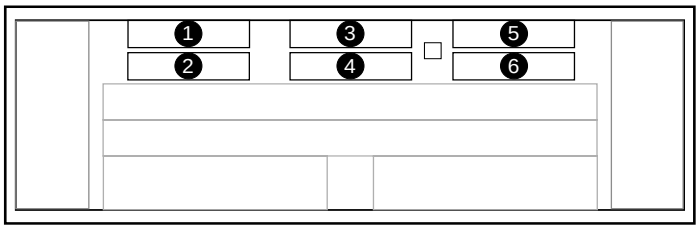
NOTE: Model 2200 enclosures use HSJ80 array controllers, which support all six I/O modules.

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



CXO7182A

Figure 4–9. I/O module locations



❶ SCSI bus 1
❷ SCSI bus 2
❸ SCSI bus 3
❹ SCSI bus 4
❺ SCSI bus 5
❻ SCSI bus 6

CXO7183A

Figure 4–10. I/O module bay to SCSI bus number correlation

NOTE: A controller can function with only one operational I/O module.

Use the following steps to replace any number of I/O modules.

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

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

   ```
   SET NOFAILOVER
   ```

3. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```

4. Enter **N**(o) to the question about replacing the cache battery.
5. Enter **4** for the replace an I/O module option.
6. Enter **Y**(es) to confirm the intent to replace the I/O module.

CAUTION: Wait for FRUTIL to quiesce the device ports—indicated by an "All device ports quiesced" message. Failure to allow the ports to quiesce might result in data loss. Quiescing might take several minutes.

---

7. Replace any number of enclosure I/O modules using the following steps:
   a. Disconnect the SCSI bus cable from the appropriate I/O modules (see Figure 4–10).
   b. Remove all failed I/O modules.
   c. Install all replacement I/O modules.
   d. Reconnect the appropriate SCSI bus cable to each replacement I/O module.
8. Press **Enter**/**Return** to resume device port activity and restart the "other controller."

   NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

IMPORTANT: If the "other controller" did not restart, press the controller reset button.

---

9. Enable failover and re-establish the dual-redundant configuration with the following command:

   ```
   SET FAILOVER COPY=THIS_CONTROLLER
   ```

   This command copies the subsystem configuration from "this controller" to the "other controller."

10. If desired, verify the failover configuration with the following command:

    ```
    SHOW THIS_CONTROLLER FULL
    ```

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

Chapter 5

Upgrading the Subsystem

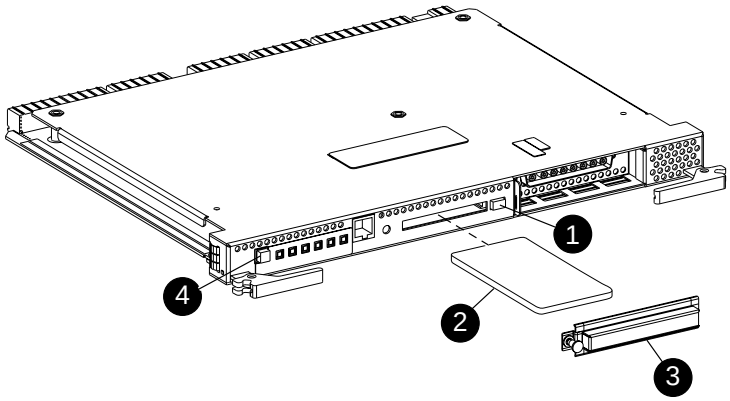
This chapter provides instructions for upgrading the controller software, installing software patches, upgrading firmware on a device, upgrading from a single-controller configuration to a dual-redundant controller configuration, and upgrading an HSJ40 or HSJ50 controller enclosure subsystem to an HSJ80 subsytem.

IMPORTANT: See Chapter 2 to review the list of required tools and the precautions to follow prior to performing any procedure within this chapter.

Upgrading Controller Software

Upgrade controller software using one of two ways:

- Install a new program card (see Figure 5–1) that contains the new software.
- Download a new software image, and use the menu-driven CLCP utility to write this image onto the existing program card. Use this utility to also install, delete, and list patches to the controller software.



❶ Program card ejection button

❷ Program (PCMCIA) card

❸ Program card ESD cover

❹ Controller reset button

Figure 5–1. Program (PCMCIA) card installation

Installing a New Program Card

The procedures for installing a new program card with new software are the same as for replacing a program card (see Chapter 2, “Replacing a Program Card” section).

Downloading New Software

Use the CLCP utility to download new software to the program card while installed in the controller. Use the following steps to upgrade the software with CLCP.

NOTE: There is space for approximately 10 patches, depending upon their size.

Also, the image file can be loaded using the StorageWorks Command Console (SWCC) (refer to SWCC documentation).

1. Obtain the new software image file from a customer service representative.
2. Load the image onto a PC or workstation using the file- or network-transfer capabilities.
3. From a host console, quiesce all port activity and dismount the logical units in the subsystem.
4. Connect a PC or terminal to the “this controller” maintenance port.
5. Remove the program card ESD cover on “this controller.”

IMPORTANT: Do not remove the program card during this procedure.

6. If the “this controller” program card is equipped with a write-protection switch (as shown in Figure 5–2), disable write-protection by sliding the switch to the “write” position.

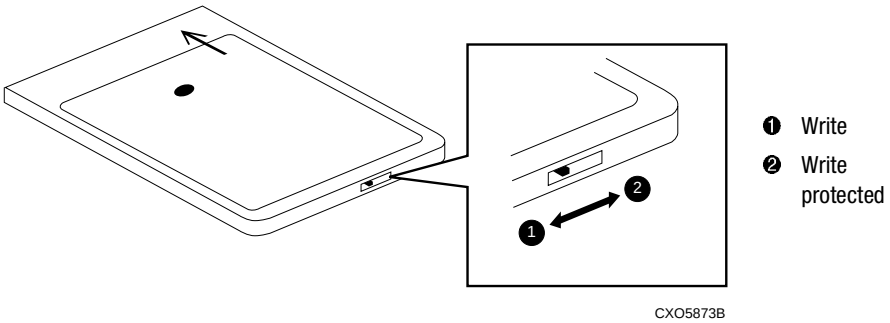


Figure 5–2. Location of write-protection switch

7. Start CLCP with the following command:

   ```
   RUN CLCP
   ```

8. Enter **1** for the enter code LOAD local program option.

   NOTE: Enter **Ctrl-Y** or **Ctrl-C** and then **Enter**/**Return** at any time to abort code load.

   Use either the SCSI host port (if the operating system supports this port) or the maintenance port to load the new software.

9. Select the option to follow:

   ■ Maintenance port option:

   NOTE: Allow approximately the specified amount of minutes on the display for performing the code load operation using the maintenance terminal port.

   a. Enter option **1**.

   CAUTION: Proceeding with the Controller Code Load will overwrite the current controller code image with a new image.

   Do you want to continue (y/n) [n]: ?

   b. Enter **Y**(es).

   c. Configure the KERMIT transfer protocol on the PC or terminal to 19200 baud, eight bits, one stop bit, and no parity bit.

d. Use KERMIT to transfer the binary image from the PC or terminal to the controller.

When the download is complete, CLCP automatically writes the new image to the program card and restarts the controller.

NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

- Image saved on disk option:

CAUTION: The new software image must be one contiguous file when downloaded to the controller; otherwise the new image might not load properly or function correctly.

---

a. From the host, make sure the new software image is loaded on a mounted disk that is accessible to the controller and host.

b. From the host, use the following steps to verify that the new image on the mounted disk is one contiguous file.

1) Enter the following command:

DUMP/HEADER/BLOCK=COUNT=0 *device_#*[*directory*] *imagefile*;*version_#*

2) Does more than one LBN position exist?

- Yes.

a) Enter the following command to create a contiguous file:

COPY/CONTIG *device_#*[*directory*] *imagefile*;*version_#, device_#*[*directory*] *imagefile*;*newversion_#*

b) Repeat step 1).

- No. Note the LBN position and continue.

c. Enter option **2**.

CAUTION: Proceeding with the Controller Code Load will overwrite the current controller code image with a new image.

Do you want to continue (y/n) [n]: ?

---

d. Enter **Y**(es).

e. Enter the disk unit number that contains the new image.

f. Enter the new image file LBA (same as LBN) position noted in step b.

CLCP automatically writes the new image to the program card and restarts the controller.

NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

10. Verify that "this controller" is running the new software version with the following command:

```
SHOW THIS CONTROLLER
```

11. If the program card is equipped with a write-protection switch (see Figure 5–2), enable write-protection by sliding the switch to the "write protected" position.
12. Install the program card ESD cover.
13. In a dual-redundant controller configuration, repeat step 4 through step 12 to upgrade the "other controller."

    Connecting to the "other controller" in step 4 changes the controller reference to "this controller."
14. Mount the logical units in the subsystem.
15. Disconnect the PC or terminal from the controller maintenance port.

Using CLCP to Install, Delete, and List Software Patches

Use CLCP to manage software patches on the controller. Software patches are placed into the non-volatile memory of the controller and become active upon restarting the controller.

NOTE: There is space for approximately 10 patches, depending upon their size.

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

- Patches are associated with specific software versions. CLCP verifies the patch against the currently installed version.
- Patches are sequential: patch one must be entered before patch two, and so on.
- Deleting a patch deletes all higher-numbered patches. For example, when patch two is deleted, all patches above patch two are automatically deleted (patches three, four, and so on).
- Controllers in a dual-redundant configuration must have the same patches installed. Install all patches into each controller separately.

Installing a Software Patch

Use the following steps to install a software patch.

1. Obtain the patch file from either a customer service representative or the Compaq website at http://www.compaq.com/support/storage/open_vendor/support/patches.html.
2. Connect a PC or terminal to the "this controller" maintenance port.
3. From the host console, quiesce all port activity in the subsystem.
4. Start CLCP with the following command:

   ```
   RUN CLCP
   ```

5. Enter **2** for the enter code PATCH local program option.

   NOTE: Enter **Ctrl**-**Y** or **Ctrl**-**C** and then **Enter**/**Return** at any time to abort code patch.

6. Enter **1** for the enter a patch option.

   NOTE: This program provides prompts for patch information, one line at time. Be careful to enter the information exactly as displayed on the patch release. Patches can be installed for any version of software; however, patches entered for software versions other than what is expected, are not applied until the matching version of software is installed.

   To enter any patch, first install all patches with lower patch numbers than the patch being entered—beginning with patch number 1—for a specific software version. If a patch is incorrectly entered, an option is displayed to review the patch one line at a time.

   Remember, enter **Ctrl**-**Y** or **Ctrl**-**C** and then **Enter**/**Return** at any time to abort code patch.

7. Enter **Y**(es) and follow the on-screen prompts.
8. After the patch is installed, press the "this controller" reset button to restart the controller.

   NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

9. Repeat step 2 through step 8 to install a patch for the "other controller" in a dual-redundant controller configuration.

Deleting a Software Patch

Use the following steps to delete a software patch.

1. Connect a PC or terminal to the “this controller” maintenance port.
2. From a host console, quiesce all port activity in the subsystem.
3. Start CLCP with the following command:

   ```
   RUN CLCP
   ```

4. Enter **2** for the enter code PATCH local program option.

   NOTE: Enter **Ctrl**-**Y** or **Ctrl**-**C** and then **Enter**/**Return** at any time to abort code patch.

5. Enter **2** for the delete patches option.

   A list of current patches is displayed by software version number and patch number.

   NOTE: The program prompts for the software version and patch number to delete. If the patch selected for deletion is required for another patch, all dependent patches are also selected for deletion. The program lists your deletion selections and asks if you wish to continue.

   Remember, enter **Ctrl**-**Y** or **Ctrl**-**C** and then **Enter**/**Return** at any time to abort delete patch.

6. From the list, enter the *software version* of the patch to delete and press **Enter**/**Return**.
7. From the list, enter the *patch number* to delete and press **Enter**/**Return**.
8. Enter **Y**(es) to confirm the deletion of selected patch.

   The selected patch and all dependent patches are deleted.

9. Enter **0** for the exit option and CLCP exits.
10. Press the “this controller” reset button to restart the controller.

    NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

11. Repeat step 1 through step 10 to delete a patch for the “other controller” in a dual-redundant controller configuration.
12. Disconnect the PC or terminal from the controller maintenance port.

Listing Software Patches

Use the following steps to list software patches.

1. Connect a PC or terminal to the “this controller” maintenance port.
2. Start CLCP with the following command:

   ```
   RUN CLCP
   ```

3. Enter **2** for the enter code PATCH local program option.

   NOTE: Enter **Ctrl**-**Y** or **Ctrl**-**C** and then **Enter**/**Return** at any time to abort code patch.

4. Enter **3** for the list patches option.

   A list of current patches is displayed by software version number and patch number.

5. Enter **0** for the exit option and CLCP exits.
6. Repeat step 1 through step 5 to list patches for the “other controller” in a dual-redundant controller configuration.
7. Disconnect the PC or terminal from the controller maintenance port.

Using HSUTIL to Upgrade Firmware on a Device

Use the format and device code load utility (HSUTIL) to upgrade a device with firmware located in contiguous blocks at specific logical block numbers (LBNs) on a source disk drive configured as a unit on the same controller. Upgrading firmware on a disk is a two-step process.

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

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

- HSUTIL has been tested with the qualified devices listed in the product-specific release notes that accompanied the software release. Firmware can be installed on unsupported devices—HSUTIL will not prevent this—but if the upgrade fails, the device might be rendered unusable and therefore require the manufacturer's attention.
- If the power fails or the bus is reset while HSUTIL is installing the new firmware, the device might become unusable. To minimize this possibility, secure a reliable power source and suspend all I/O to the bus that services the device being upgraded.
- HSUTIL cannot install firmware on devices configured as single-disk drive units or as members of a storageset, spareset, or failedset. If installing firmware on a device previously configured as a single-disk drive, delete the unit number and storageset name associated with the device.
- During the installation, the source disk drive is not available for other subsystem operations.
- Some devices might not reflect the new firmware version number when viewed from the "other controller" in a dual-redundant controller configuration. If this occurs, enter the following CLI command: CLEAR_ERRORS *device-name* UNKNOWN.
- Do not issue any device-level CLI commands that access or inspect devices that are being formatted; commands such as:

CLEAR_ERRORS *device-name* UNKNOWN	SHOW TAPES
SET *unit-number*	SHOW UNITS
SET *device-name*	SHOW *storageset-name*
SHOW DEVICES	SHUTDOWN *controller*
SHOW DISKS	RESTART *controller*

Use the following steps to upgrade firmware with HSUTIL.

1. Connect a PC or terminal to the controller maintenance port that accesses the device being upgraded.
2. Configure a single-disk unit.

   NOTE: In the next steps, the firmware image is copied to this unit and HSUTIL is used to distribute the image to the devices being upgraded. This unit must be a newly initialized disk with no label or file structure to ensure that the firmware image resides in contiguous blocks starting from LBN 0 or another known LBN. Additionally, write-back caching must be disabled (refer to the controller installation and configuration guide).

3. Copy the firmware image to the single-disk unit configured in step 2. The firmware image must begin at a known LBN—usually 0—and must be contiguous.

   Refer to the documentation that accompanied the host operating system for instructions on copying firmware images to a disk drive.

CAUTION: The host load must be quiesced before running HSUTIL; otherwise, damage to the storage device can occur.

4. Start HSUTIL with the following command:

   ```
   RUN HSUTIL
   ```

5. Enter **2** for the disk device code load option.
6. Choose the single-disk unit as the source disk for the download.
7. Enter the starting LBN of the firmware image—usually LBN 0.
8. Enter the product ID of the device to upgrade.

   NOTE: This ID corresponds to the product information reported in the Type column when issuing a SHOW DISK FULL command.

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

9. Enter the disk or tape name of the device to upgrade.
10. Confirm or enter the byte count of the firmware image.
11. Confirm the download.

    NOTE: Some disk firmware releases require reformatting the disk after upgrading the firmware. Refer to the documentation that accompanied the firmware to determine if device reformatting is required.

    When HSUTIL finishes downloading the firmware, the new firmware revision for the disk drive is displayed.

Upgrading to a Dual-Redundant Controller Configuration

This section contains instructions for upgrading a single-controller configuration subsystem to a dual-redundant configuration subsystem. To replace failed components, see Chapter 3 for more information. Before beginning this procedure, obtain the following items:

- A second HSJ80 controller with the same software version and patch level as installed in the current single-controller configuration
- A second cache module with the same memory configuration as installed in the current cache module
- A second ECB
- For DS–BA356–MW enclosures only, a second ECB Y-cable

Use the following steps to install a second controller, cache module and ECB.

CAUTION: ESD can easily damage a controller, cache module, or DIMM. Wear a snug-fitting, grounded ESD wrist strap.

Each cache module *must* contain 512 MB of cache memory.

1. Insert each DIMM ❶ straight into the appropriate slot ❷ of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 5–3).

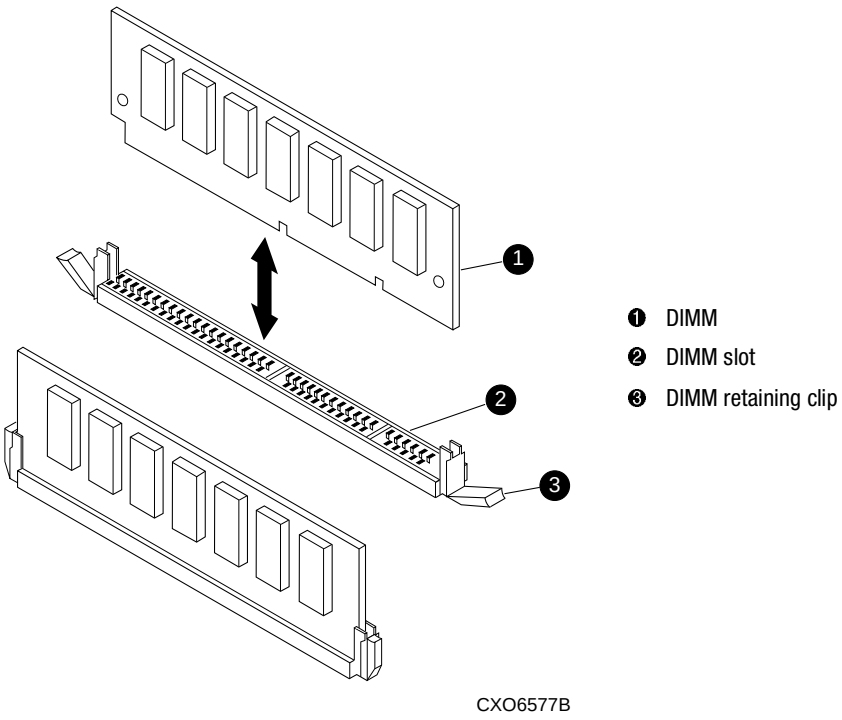


Figure 5–3. DIMM components

2. Press the DIMM gently into the slot until seated at both ends.
3. Engage two retaining clips ❸ for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining levers engage the DIMM.

5. Repeat step 1 through step 4 for each DIMM.
6. Connect a PC or terminal to the maintenance port of the operational controller.

   The controller connected to the PC or terminal becomes “this controller;” the controller being added becomes the “other controller.”
7. Start FRUTIL with the following command:

   ```
   RUN FRUTIL
   ```
8. Enter **N**(o) to the question about replacing the cache battery.
9. Enter **2** for the install a controller or cache module option.
10. Enter **1** for the install the “other controller” and cache module option.
11. Enter **Y**(es) to confirm the intent to install the “other controller” and cache module.

CAUTION: Wait for FRUTIL to quiesce the device ports—indicated by an “All device ports quiesced” message. Failure to allow the ports to quiesce might result in data loss. Quiescing might take several minutes.

12. Install the new ECB:

IMPORTANT: A countdown timer allows a total of 4 minutes to install both the controller and cache module. After 4 minutes, “this controller” exits FRUTIL and resumes operations. If this happens, return to step 7 and proceed.

- For DS–BA356–MW enclosures:
  a. Insert the ECB into an empty bay or on top of the enclosure.

CAUTION: The ECB must be disabled—the status light is not lit and is not blinking—before connecting the ECB cable to the cache module. Failure to disable the ECB might result in cache module damage.

  b. Disable the ECB by pressing the battery disable switch until the status light stops blinking—approximately 5 seconds.
  c. Connect the new ECB cable to the new cache module.

- For Model 2200 enclosures, install the new ECB into ECB bay B1 (see Figure 5–4).

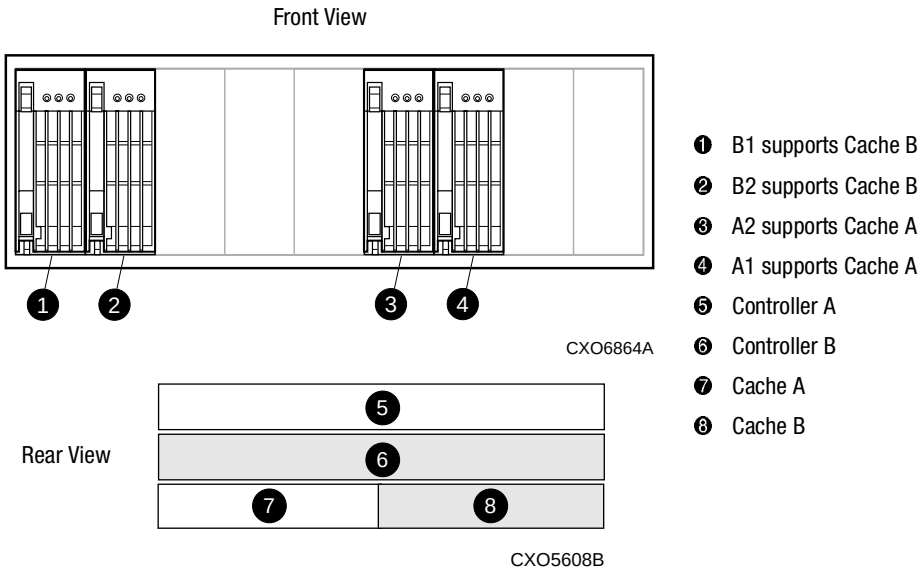


Figure 5–4. ECB and cache module locations in the Model 2200 enclosure

CAUTION: Carefully align the cache module in the appropriate guide rails. Misalignment might damage the backplane.

9. Install the new cache module in the Cache B bay ❻, and engage the retaining levers.
10. Install the controller:

IMPORTANT: A countdown timer is displayed that indicates the allotted time remaining for installing the controller. If time expires, "this controller" exits FRUTIL and resumes operations. If this happens, return to step 7 and proceed.

a. Make sure that the program card is seated in the replacement controller.

b. Insert the new controller into the Controller B bay ❽, and engage the retaining levers.

11. Press **Enter**/**Return** to continue.

    The "other controller" restarts and FRUTIL exits.

    NOTE: A controller restart can take as long as 60 sec, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

    IMPORTANT: If the "other controller" did not restart, use the following steps:

    1. Press and hold the "other controller" reset button.
    2. Reseat the "other controller" program card.
    3. Release the reset button.

    NOTE: In mirrored mode, FRUTIL initializes the mirrored portion of the new cache module, checks for old data on the cache module, then restarts all device ports. After the device ports restart, FRUTIL tests the cache module and the ECB. After the test completes, the device ports are quiesced and a mirror copy of the cache module data is created on the newly installed cache module.

12. Install the program card ESD cover.
13. Refer to the controller CLI reference guide to configure the controller.
14. Enable failover, and establish the dual-redundant controller configuration with the following command:

    ```
    SET FAILOVER COPY=THIS_CONTROLLER
    ```

    This command copies the subsystem configuration from "this controller" to the new controller.

15. If desired, verify the failover configuration with the following command:

    ```
    SHOW THIS_CONTROLLER FULL
    ```

16. Configure the host port parameters.
17. Reconnect the host bus cable to the new controller.
18. Enable CI paths with the following commands:

    ```
    SET THIS_CONTROLLER PORT_1_PATH_A
    SET THIS_CONTROLLER PORT_1_PATH_B
    SET THIS_CONTROLLER PORT_2_PATH_A
    SET THIS_CONTROLLER PORT_2_PATH_B
    ```

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

IMPORTANT: For HSJ80 installations, a 512 MB cache memory configuration is required in each cache module.

How to Upgrade an HSJ40 or HSJ50 Subsystem to an HSJ80 Subsystem

To upgrade to the performance and dual-host capabilities of the HSJ80 subsystem from an HSJ40 or HSJ50 subsystem, any BA350–M*x* controller enclosure with an HSJ40 or HSJ50 controller must be upgraded to a DS–BA356–MW controller enclosure—before installing an HSJ80 array controller.

DS–BA356–MW Enclosure Attributes

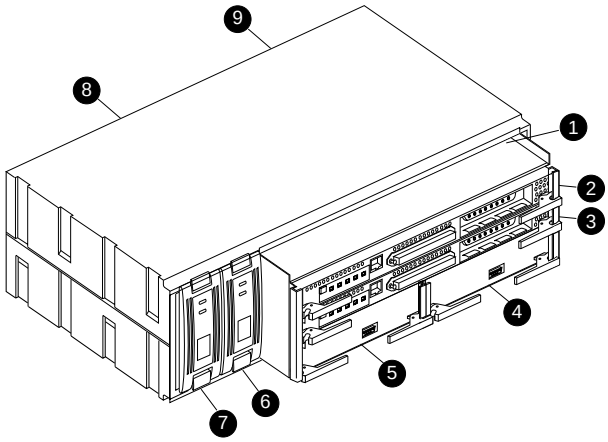
The DS–BA356–MW enclosure is a Wide Ultra SCSI version of the BA350–M*x* controller enclosure. Figure 5–5 shows the placement of the DS–BA356–MW enclosure components and a block diagram of the controller component locations. The DS–BA356–MW enclosure supports Ultra SCSI (Fast 20 and Wide) device ports, allowing the HSJ80 controller to take full advantage of the Ultra SCSI capabilities offered by the controller and newer storage devices. A total of 36 drives are supported per controller enclosure, using six drives per device port (SCSI bus).

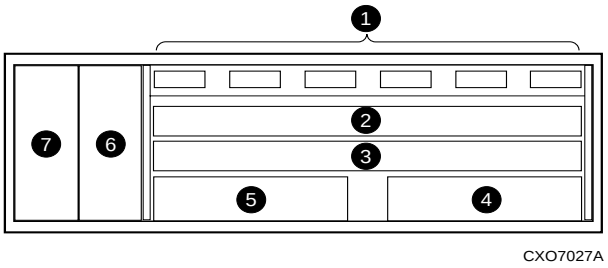
No limitations exist on the type of SCSI devices (Narrow, Wide, slow, fast, Ultra, and tape drives) supported by the DS–BA356–MW enclosure.

Besides upgrading the controller enclosures, the BA356–M*x* device enclosures must also be upgraded to take advantage of the new HSJ80 functionality. Upgrading a BA356-S*x* device enclosure to a DS–BA356–S*x* device enclosure involves upgrading the following elements:

- Personality card to Ultra SCSI capable
- Power supplies to 180 W
- SCSI bus cables to BN37A bus cables

Refer to the *Compaq StorageWorks HSJ80 Array Controller ACS V8.5J Upgrade/Add-On Kits Installation Guide* for specific upgrade procedures.





❶ I/O module
❷ Controller A
❸ Controller B
❹ Cache B
❺ Cache A
❻ 180 W power supply
❼ 180 W power supply
❽ Enclosure fan
❾ Enclosure fan

Figure 5–5. DS–BA356–MW enclosure elements

Mounting Orientations

Refer to Figure 5–6 to see the mounting orientations for a DS–BA356–MW enclosure.

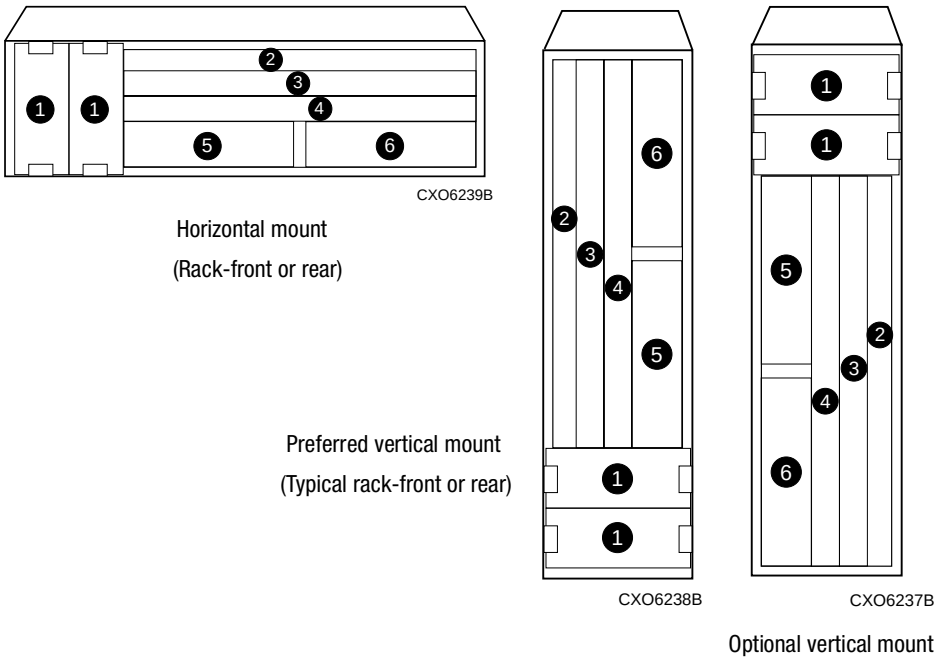


Figure 5–6. Controller enclosure mounting orientations

Upgrade Paths

The possible upgrade paths include:

- Basic Upgrade — Upgrades an existing BA350–M*x* controller enclosure to a DS–BA356–MW controller enclosure. Includes replacing existing SCSI bus cables.
- Ultra Upgrade — Upgrades any existing BA350–M*x* controller enclosure to a DS–BA356–MW controller enclosure. Also, upgrades any existing BA356–S*x* device enclosure to a DS–BA356–S*x* Ultra SCSI device enclosure, and replaces the existing SCSI bus cables with VHDCI cables.
- Ultra SCSI Upgrade — Upgrades any existing BA350–M*x* controller enclosure to a DS-BA356-MW controller enclosure. Also, replaces any existing BA350–S*x* device enclosure with a DS–BA356–S*x* device enclosure, and replaces the existing SCSI bus cables with VHDCI cables.
- Add-On Upgrade — Adds a DS–BA356–MW controller enclosure containing an HSJ80 controller and adds up to six DS-BA356-Sx device enclosures to create a new subsystem or to upgrade an existing subsystem.

Refer to the *Compaq StorageWorks HSJ80 Array Controller ACS V8.5J Upgrade/Add-On Kits Installation Guide* for specific upgrade paths and associated upgrade procedures.

Appendix A

Array Controller Specifications

This appendix contains physical, electrical, and environmental specifications for enclosures that use the HSJ80 array controllers.

Physical and Electrical Specifications for the HSJ80 Array Controllers and Cache Modules

Table A–1 lists the physical and electrical specifications for the controller and cache modules. Voltage measurements in Table A–1 are nominal measurements without tolerances.

Table A–1 Controller Specifications

Hardware	Width	Depth	Power	Current at +5 VDC	Current at +12 VDC
HSJ80 array controller	305 mm (12 in)	241 mm (9.5 in)	25.0 W	5.0 A	0.010 A
Cache module, 512 MB	138 mm (5.5 in)	241 mm (9.5 in)	8.52 W		Cache running diagnostics and fully charged battery (400 mA)
			10.5 W		Cache running and battery charging (880 mA)

Environmental Specifications

The HSJ80 array controllers are intended for installation in a Class A environment.

The operating environmental specifications are listed in Table A–2 and the nonoperating environmental specifications are listed in Table A–3. These specifications are the same for all Compaq storage devices.

Table A–2 Operating Environmental Specifications

Condition	Specification
Ambient temperature	+10 °C to +35 °C (+50 °F to +95 °F) Derate for altitude 0.5 °C per 300 m to 3000 m (1 °F per 1000 ft to 10,000 ft)
Relative humidity	10% to 90% at a maximum wet bulb temperature of 28 °C (82 °F)
Air quality	Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air

Table A–3 Nonoperating Environmental Specifications

Condition	Specification
Storage (Up to 1 Year)	
Ambient temperature	-20 °C to +60 °C (-4 °F to +140 °F) up to 3000 m (10,000 ft)
Relative humidity	10% to 95% at a maximum wet bulb temperature of 29 °C (84 °F)
Shipping (Up to 72 Hours)	
Ambient temperature	-40 °C to +60 °C (-40 °F to +140 °F) up to 9100 m (30,000 ft)
Relative humidity	10% to 90% at a maximum wet bulb temperature of 30 °C (86 °F)

Glossary

This glossary defines terms pertaining to the HSJ80 array controller maintenance and service guide. This glossary is not a comprehensive glossary of computer terms.

ACS Array controller software. Software contained on a removable ROM program card that provides the operating system for the array controller.

adapter A device that converts the protocol and hardware interface of one bus type into another without changing the function of the bus.

array controller *See* controller.

array controller software *See* ACS.

autospare A controller feature that automatically replaces a failed disk drive. To aid the controller in automatically replacing failed disk drives, enable the AUTOSPARE switch for the failedset—causing physically replaced disk drives to be automatically placed into the spareset. Also called "autonewspare."

backplane The electronic printed circuit board into which subsystem devices are plugged—for example, the SBB or power supply.

bit A single binary digit having a value of either 0 or 1. A bit is the smallest unit of data a computer can process.

byte A binary character string made up of 8 bits operated on as a unit.

cache memory A portion of memory used to accelerate read and write operations.

cache module A fast storage buffer.

channel An interface which allows high speed transfer of large amounts of data. Another term for a SCSI bus.

See also SCSI.

CLCP Code-load code-patch utility.

CLI Command line interpreter. The configuration interface to operate the controller software.

command line interpreter *See* CLI.

container 1) Any entity that is capable of storing data, whether the container is a physical device or a group of physical devices, or (2) a virtual, internal controller structure representing either a single disk or a group of disk drives linked as a storageset. Stripesets and mirrorsets are examples of storageset containers the controller uses to create units.

controller A hardware device that, with proprietary software, facilitates communications between a host and one or more devices organized in an array. HS family controllers are examples of array controllers.

data center cabinet A generic reference to large Compaq subsystem cabinets (racks), such as the SW600-series and SW800-series racks in which StorageWorks components can be mounted.

device *See* node and peripheral device.

DIMM Dual inline memory module.

dirty data The write-back cached data that has not been written to storage media, even though the host operation processing the data has completed.

driver A hardware device or a program that controls or regulates another device. For example, a device driver is a driver developed for a specific device that allows a computer to operate with the device, such as a printer or a disk drive.

dual-redundant configuration A controller configuration consisting of two active controllers operating as a single controller. If one controller fails, the other controller assumes control of the failing controller devices.

ECB External cache battery. The unit that supplies backup power to the cache module in the event the primary power source fails or is interrupted.

EIA Electronic Industries Association. EIA is a standards organization specializing in the electrical and functional characteristics of interface equipment.

EMU Environmental monitoring unit. A unit that provides increased protection against catastrophic failures. Some subsystem enclosures include an EMU which works with the controller to detect conditions such as failed power supplies, failed blowers, elevated temperatures, and external air sense faults. In some instances, the EMU also controls certain rack hardware such as extender chips, alarms, and fan speeds.

ESD Electrostatic discharge. The discharge of potentially harmful static electrical voltage as a result of improper grounding.

external cache battery *See* ECB.

failedset A group of failed mirrorset or RAIDset devices automatically created by the controller.

failover The process that takes place when one controller in a dual-redundant configuration assumes the workload of a failed companion controller. Failover continues until the failed controller is repaired or replaced.

flush The act of writing dirty data from cache to a storage media.

FMU Fault management utility.

FRU Field replaceable unit. A hardware component that can be replaced at the customer location by Compaq authorized service providers.

FRUTIL Field replacement utility.

giga A prefix indicating a billion (10^9) units.

gigabyte A value normally associated with a storage device capacity, meaning a billion (10^9) bytes.

host The primary or controlling computer to which a storage subsystem is attached.

host adapter A device that connects a host system to a CI bus. The host adapter usually performs the lowest layers of the SCSI protocol. This function may be logically and physically integrated into the host system.

HSUTIL Format and device code load utility.

I/O Refers to input and output functions.

I/O interface *See* interface.

I/O module A device that integrates an enclosure with either an 8-bit single-ended, 16-bit single-ended, or 16-bit differential SCSI bus.

I/O operation The process of requesting a transfer of data from a peripheral device to memory (or vice versa), the actual transfer of the data, and the processing and overlaying activity to make both of those happen.

interface A set of protocols used between components, such as cables, connectors, and signal levels.

LBN Logical block number. The logical address for a block of data.

LED Light emitting diode.

local connection A connection to the subsystem using either a controller serial maintenance port or the host CI bus. A local connection enables the connection to a subsystem controller within the physical range of the serial or host CI cable.

local terminal A terminal plugged into the EIA-423 maintenance port located on the front bezel of the controller.

See also maintenance terminal.

logical block number *See* LBN.

logical unit number A value that identifies a specific logical unit belonging to a SCSI target ID number. A number associated with a physical device unit during task I/O operations. Each task in the system must establish correspondence between logical unit numbers and physical devices.

maintenance terminal An EIA-423-compatible terminal used with the controller. This terminal is used to identify the controller, enable host paths, enter configuration information, and check the controller status. The maintenance terminal is not required for normal operations.

See also local terminal.

member A container that is a storage element in a RAID array.

mirroring The act of creating an exact copy or image of data.

mirrorset — *See* RAID level 1.

network — In data communication, a configuration in which two or more terminals or devices are connected to enable information transfer.

N-m — Newton-meter. The metric equivalent to inch-pounds of torque.

node — In data communications, the point at which one or more functional units connect transmission lines.

nonredundant controller configuration — (1) A single controller configuration, or (2) a controller configuration that does not include a second controller.

OCP — Operator control panel. The control or indicator panel associated with an array controller. The OCP is usually mounted on the device and is accessible to the operator.

other controller — The controller in a dual-redundant pair that is connected to the controller serving the current CLI session.

See also this controller.

parity — A method of checking if binary numbers or characters are correct by counting the ONE bits. In odd parity, the total number of ONE bits must be odd; in even parity, the total number of ONE bits must be even. Parity information can be used to correct corrupted data. RAIDsets use parity to improve the availability of data.

parity bit — A binary digit added to a group of bits that checks to see if errors exist in the transmission.

PCMCIA — Personal Computer Memory Card Industry Association. An international association formed to promote a common standard for PC card-based peripherals to be plugged into notebook computers. The card, commonly known as a PCMCIA card or program card, is about the size of a credit card.

See also program card.

peripheral device — Any unit, distinct from the CPU and physical memory, that can provide the system with input or accept any output from the unit. Terminals, printers, tape drives, and disks are peripheral devices.

port (1) In general terms, a logical channel in a communications system, or (2) the hardware and software used to connect a host controller to a communications bus, such as a SCSI bus or serial bus.

Regarding the controller, the port is (1) the logical route for data in and out of a controller that can contain one or more channels, all of which contain the same type of data, or (2) the hardware and software that connects a controller to a SCSI device.

program card The PCMCIA card containing the controller operating software.

See also PCMCIA.

protocol The conventions or rules for the format and timing of messages sent and received.

PTL Port-target-LUN. The controller method of locating a device on the controller device bus.

PVA module Power verification and addressing module.

quiesce The act of rendering bus activity inactive or dormant. For example, “quiesce the SCSI bus operations during a device warm swap.”

RAID Redundant array of independent disks. Represents multiple levels of storage access developed to improve performance or availability or both.

RAID level 0 A RAID storageset that stripes data across an array of disk drives. A single logical disk spans multiple physical disks, allowing parallel data processing for increased I/O performance. While the performance characteristics of RAID level 0 is excellent, this RAID level is the only one that does not provide redundancy. Raid level 0 storagesets are sometimes referred to as stripesets.

RAID level 0+1 A RAID storageset that stripes data across an array of disks (RAID level 0) and mirrors the striped data (RAID level 1) to provide high I/O performance and high availability. Raid level 0+1 storagesets are sometimes referred to as striped mirrorsets.

RAID level 1 A RAID storageset of two or more physical disks that maintains a complete and independent copy of the entire virtual disk's data. This type of storageset has the advantage of being highly reliable and extremely tolerant of device failure. Raid level 1 storagesets are sometimes referred to as mirrorsets.

RAID level 3 A RAID storageset that transfers data parallel across the array disk drives a byte at a time, causing individual blocks of data to be spread over several disks serving as one enormous virtual disk. A separate redundant check disk for the entire array stores parity on a dedicated disk drive within the storageset.

See also RAID level 5.

RAID level 3/5 A Compaq-developed RAID storageset that stripes data and parity across three or more members in a disk array. Raid level 3/5 storagesets are sometimes referred to as RAIDsets. A RAIDset combines the best characteristics of RAID level 3 and RAID level 5. A RAIDset is the best choice for most applications with small to medium I/O requests, unless the application is write-intensive. A RAIDset is sometimes called parity RAID.

RAID level 5 A RAID storageset that, unlike RAID level 3, stores the parity information across all of the disk drives within the storageset.

See also RAID level 3.

RAIDset *See* RAID level 3/5.

reduced Indicates that a mirrorset or RAIDset is missing one member because the member has failed or has been physically removed.

redundancy The provision of multiple interchangeable components to perform a single function in order to cope with failures and errors. A RAIDset is considered to be redundant when user data is recorded directly to one member and all of the other members include associated parity information.

replacement policy The policy specified by a switch with the SET FAILEDSET command indicating whether a failed disk from a mirrorset or RAIDset is to be automatically replaced with a disk from the spareset. The two switch choices are AUTOSPARE and NOAUTOSPARE.

SBB StorageWorks building block. (1) A modular carrier plus the interface required to mount the carrier into a standard StorageWorks enclosure, or (2) any device conforming to enclosure mechanical and electrical standards installed in a 3.5-inch or 5.25-inch carrier (typically a storage device or power supply).

See also StorageWorks.

SCSI Small computer system interface. (1) An ANSI interface standard defining the physical and electrical parameters of a parallel I/O bus used to connect initiators to devices, (2) a processor-independent standard protocol for system-level interfacing between a computer and intelligent devices including hard drives, floppy disks, CD-ROMs, printers, scanners, and others.

SCSI device (1) A host computer adapter, a peripheral controller, or an intelligent peripheral that can be attached to the SCSI bus, or (2) any physical unit that can communicate on a SCSI bus.

SCSI ID number The representation of the SCSI address that refers to one of the signal lines numbered 0 through 15.

single-ended I/O module A 16-bit I/O module.

See also I/O module.

single-ended SCSI bus An electrical connection where one wire carries the signal and another wire or shield is connected to electrical ground. Each signal logic level is determined by the voltage of a single wire in relation to ground. This is in contrast to a differential connection where the second wire carries an inverted signal.

spareset A collection of disk drives made ready by the controller to replace failed members of a storageset.

storage array An integrated set of storage devices.

storage array subsystem *See* storage subsystem.

storage subsystem The controllers, storage devices, enclosures, cables, and power supplies used to form a mass storage subsystem.

storage unit The general term that refers to storagesets, single-disk units, and all other storage devices that are installed in the subsystem and accessed by the host. A storage unit can be any entity that is capable of storing data, whether the storage unit is a physical device or a group of physical devices.

storageset (1) A group of devices configured with RAID techniques to operate as a single container, or (2) any collection of containers, such as stripesets, mirrorsets, striped mirrorsets, and RAIDsets.

StorageWorks A family of Compaq modular data storage products that allow customers to design and configure their own storage subsystems. Components include power, packaging, cabling, devices, controllers, and software. Customers can integrate devices and array controllers in StorageWorks enclosures to form storage subsystems.

StorageWorks systems include integrated Storageworks building blocks (devices) and array controllers to form storage subsystems. System-level enclosures to house the enclosure chassis and standard mounting devices for these building blocks are also included.

See also SBB.

stripe The data divided into blocks and written across two or more member disks in an array.

striped mirrorset *See* RAID level 0+1.

stripeset *See* RAID level 0.

tape A storage device supporting sequential access to variable sized data records.

target (1) A SCSI device that performs an operation requested by an initiator, or (2) designates the target ID number of the device.

target ID number The address a bus initiator uses to connect with a bus target. Each bus target is assigned a unique target address.

See also SCSI device ID number.

this controller The controller that is serving a current CLI session through a local or remote terminal.

See also other controller.

transfer rate The speed at which data may be exchanged with the central processor, expressed in thousands of bytes per second.

Ultra SCSI bus A wide, Fast-20 SCSI bus.

unit A container made accessible to a host. A unit may be created from a single disk drive or tape drive. A unit may also be created from a more complex container such as a RAIDset. The controller supports a maximum of eight units on each target.

See also target and target ID number.

UPS Uninterruptible power supply. A battery-powered power supply guaranteed to provide power to an electrical device in the event of an unexpected interruption to the primary power supply. Uninterruptible power supplies are usually rated by the amount of voltage supplied and the length of time the voltage is supplied.

VHDCI Very high-density-cable interface. A 68-pin interface. Required for Ultra SCSI connections.

virtual terminal A software path from an operator terminal on the host to the controller CLI interface, sometimes called a host console. The path can be established via the host port on the controller or via the maintenance port through an intermediary host.

See also maintenance terminal.

write-back cache *See* cache module.

write-back caching A cache management method used to decrease the subsystem response time to write requests by allowing the controller to declare the write operation "complete" as soon as the data reaches the controller cache memory. The controller performs the slower operation of writing the data to the disk drives at a later time.

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