

Compaq StorageWorks

HSG80 Array Controller ACS Version 8.6

Maintenance and Service Guide

First Edition (June 2001)
Part Number: EK-G80MS-SA. A01
Compaq Computer Corporation

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About This Guide

This guide is designed to be used as step-by-step instructions for installation and as a reference for operation, troubleshooting, and future upgrades.

Text Conventions

This document uses the following conventions to distinguish elements of text:

Keys	Keys appear in boldface. A plus sign (+) between two keys indicates that they should be pressed simultaneously.
USER INPUT	User input appears in a different typeface and in uppercase
<i>FILENAMES</i>	File names appear in uppercase italics.
Menu Options, Command Names, Dialog Box Names	These elements appear in initial capital letters.
COMMANDS, DIRECTORY NAMES, and DRIVE NAMES	These elements appear in upper case. NOTE: UNIX commands are case sensitive and will not appear in uppercase.
Type	When you are instructed to <i>type</i> information, type the information without pressing the Enter key.

Enter	When you are instructed to enter information, type the information and then press the Enter key.
“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.

Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.



WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or loss of life.



CAUTION: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or loss of information.

IMPORTANT: Text set off in this manner presents clarifying information or specific instructions.

NOTE: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Symbols on Equipment

These icons may be located on equipment in areas where hazardous conditions may exist.



Any surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.

WARNING: To reduce the risk of injury from electrical shock hazards, do not open this enclosure.



Any RJ-45 receptacle marked with these symbols indicates a Network Interface Connection.

WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.



Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. If this surface is contacted, the potential for injury exists.

WARNING: To reduce the risk of injury from a hot component, allow the surface to cool before touching.



Power Supplies or Systems marked with these symbols indicate the equipment is supplied by multiple sources of power.

WARNING: To reduce the risk of injury from electrical shock, remove all power cords to completely disconnect power from the system.



Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

WARNING: To reduce the risk of personal INJURY or damage to the equipment, observe local occupational health and safety requirements and guidelines for manual material handling.

Rack Stability



WARNING: To reduce the risk of personal injury or damage to the equipment, be sure that:

- The leveling jacks are extended to the floor.
 - The full weight of the rack rests on the leveling jacks.
 - The stabilizing feet are attached to the rack if it is a single rack installations.
 - The racks are coupled together in multiple rack installations.
 - A rack may become unstable if more than one component is extended for any reason. Extend only one component at a time.
-

Getting Help

If you have a problem and have exhausted the information in this guide, you can get further information and other help in the following locations.

Compaq Technical Support

You are entitled to free hardware technical telephone support for your product for as long you own the product. A technical support specialist will help you diagnose the problem or guide you to the next step in the warranty process.

In North America, call the Compaq Technical Phone Support Center at 1-800-OK-COMPAQ. This service is available 24 hours a day, 7 days a week.

NOTE: For continuous quality improvement, calls may be recorded or monitored.

Outside North America, call the nearest Compaq Technical Support Phone Center. Telephone numbers for worldwide Technical Support Centers are listed on the Compaq website. Access the Compaq website by logging on to the Internet at <http://www.compaq.com>.

Be sure to have the following information available before you call Compaq:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level
- Detailed, specific questions

Compaq Website

The Compaq website has the latest information on this product as well as the latest drivers. You can access the Compaq website by logging on to the Internet at <http://www.compaq.com/storage>.

Compaq Authorized Reseller

For the name of your nearest Compaq authorized reseller:

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.

Chapter 1

General Description

This chapter illustrates and describes, in general terms, the BA370 enclosure and Model 2200 enclosure subsystems and their major components, plus connectors, switches, and LEDs.

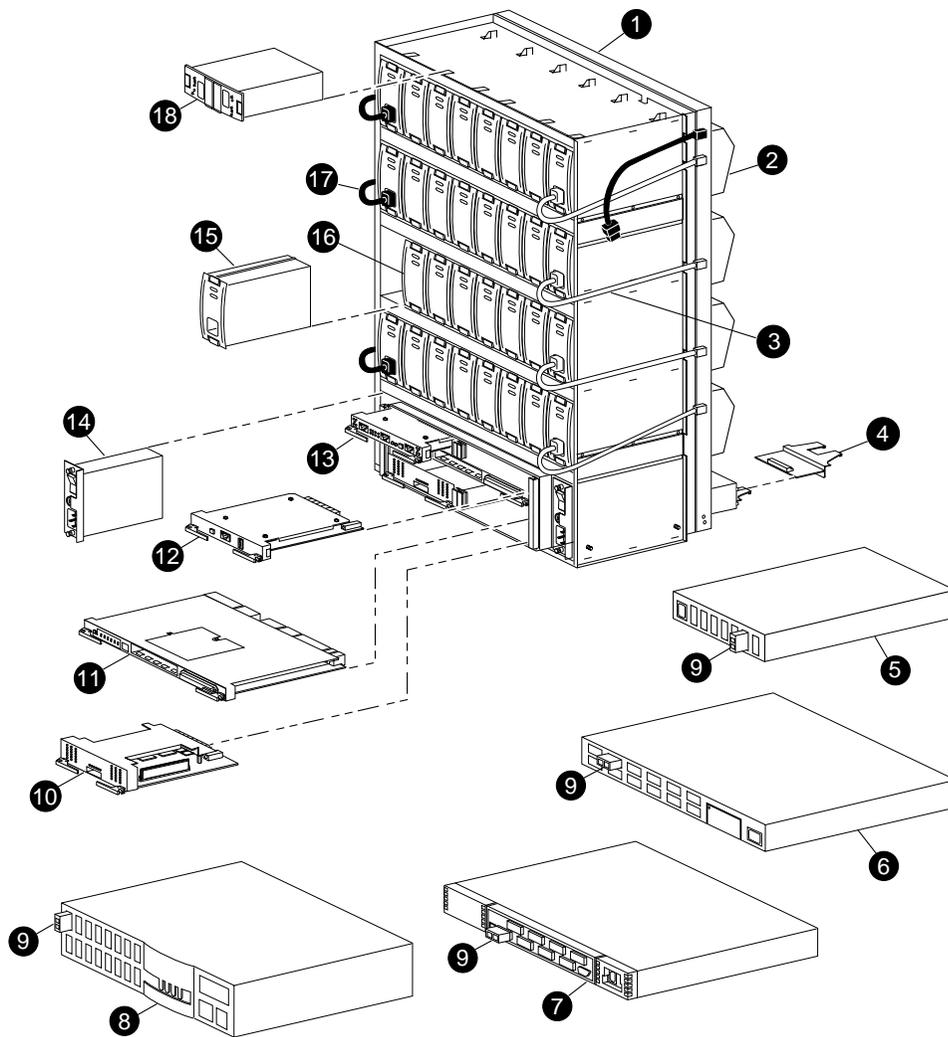
Refer to the Fibre Channel switch documentation that came with the switch kit for specifics about how the switch operates. Refer to the *KGPSA PCI-to-Fibre Channel Host Adapter User Guide* for information about the adapter that connects the subsystem to the host.

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 (the 6-3 system and the 2-5-2 system).

HSG80 Subsystem in a BA370 Enclosure

Figure 1-1 and Table 1-1 identify an HSG80 subsystem in a BA370 enclosure.



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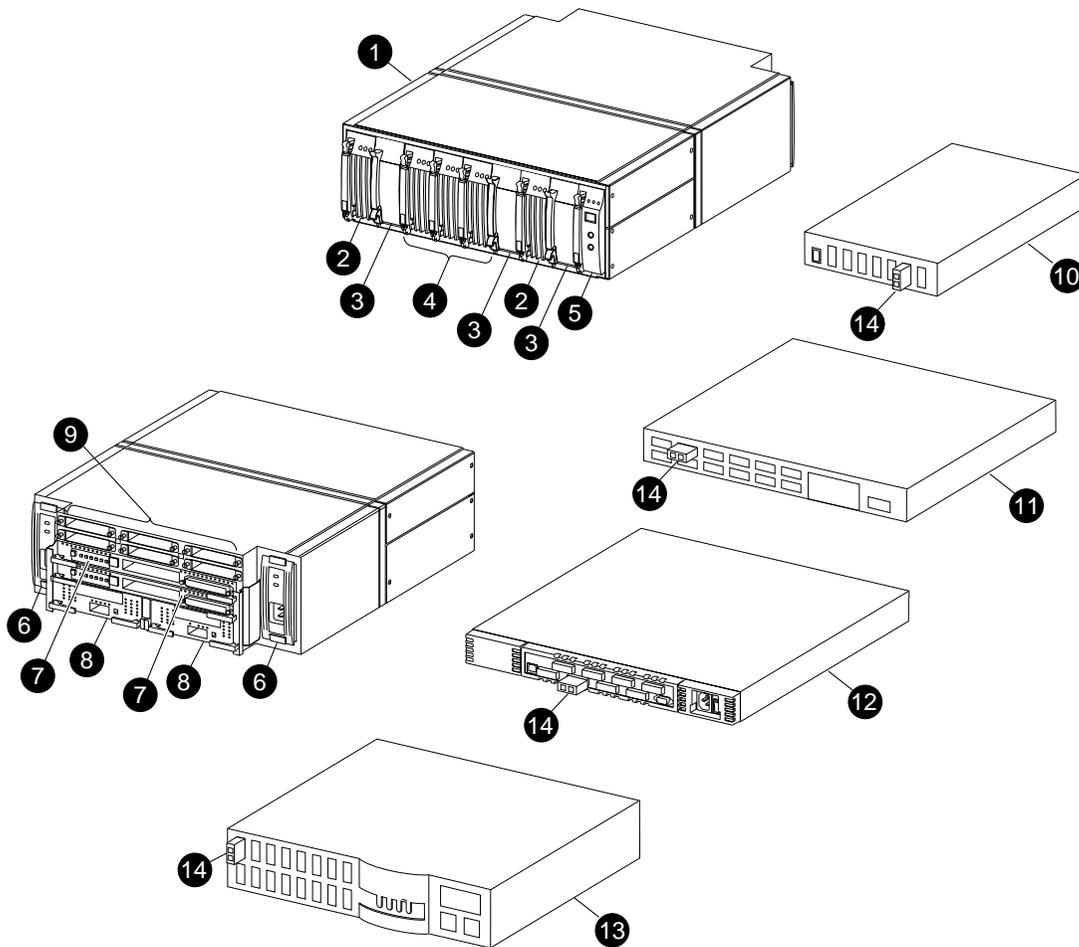
Figure 1-1. HSG80 subsystem in a BA370 enclosure

Table 1-1 HSG80 Subsystem in a BA370 Enclosure

Item	Description	6-3	2-5-2
		Part Number	Part Number
①	BA370 rack-mountable enclosure	401914-001	DS-BA370-MA
②	Cooling fan, blue	400293-001	FC-BA35X-MK
	Cooling fan, gray	402602-001	FC-BA35X-ML
③	Power cable kit, white	401916-001	17-03718-10
④	Input/output (I/O) module, blue	400294-001	FC-BA35X-MN
	I/O module, gray	401911-001	70-32856-S2
⑤	Fibre Channel hub, 7-port	234454-001	FE-09061-01
⑥	Fibre Channel hub, 12-port	340858-001	30-50549-01
⑦	Fibre Channel switch, 8-port	127660-001	30-56042-S1
		167649-001	30-56132-S1
⑧	Fibre Channel switch, 16-port	127660-002	30-56042-S2
		167650-001	30-56132-S2
⑨	Gigabit interface converter (GBIC), short wave	234458-001	FE-09086-01
	GBIC, long wave	340420-001	FD-89504-01
⑩	Cache module (original)	400295-001	70-33256-S1
	Cache module (upgraded)	400295-002	70-33256-S2
⑪	HSG80 controller	400285-001	70-33259-S1
⑫	Power verification and addressing (PVA) module — with uninterruptible power supply (UPS) support	155057-003	70-33253-S3
⑬	Environmental monitoring unit (EMU)	400286-001	FC-BA35X-EB
⑭	AC input box	400287-001	FC-BA35X-HE
⑮	180-watt power supply	400288-001	FC-BA35X-HH
⑯	Disk drive, 4 GB, 7200 rpm	402153-001	FC-RZ1CF-VW
	Disk drive, 9 GB, 7200 rpm	400289-001	FC-RZ1DF-VW
	Disk drive, 18 GB, 7200 rpm	400290-001	FC-RZ1EF-VW
	Disk drive, 36 GB, 7200 rpm	147599-001	DS-RZ1FB-VW
	Disk drive, 9 GB, 10K rpm	402154-001	FC-RZ1DD-VW
	Disk drive, 18 GB, 10K rpm	402229-001	FC-RZ1ED-VW
⑰	Power cable, gray	401915-001	17-03718-09
	Power cable, black	401916-001	17-03718-10
⑱	External cache battery (ECB), dual (shown)	400291-001	FC-HS35X-BD
	ECB, single (not shown)	400292-001	FC-HS35X-BC

HSG80 Subsystem in a Model 2200 Enclosure

Figure 1-2 and Table 1-2 identify an HSG80 subsystem in a Model 2200 enclosure.



CX07176A

Figure 1-2. HSG80 subsystem in a Model 2200 enclosure

Table 1-2 HSG80 Subsystem in a Model 2200 Enclosure

Item	Description	6-3 Part Number	2-5-2 Part Number
①	Model 2200 rack-mountable enclosure	126314-001	70-33725-S1
②	ECB without a battery pack	126312-001	70-33547-S1
	ECB battery pack	147514-001	12-44670-S4
③	Blank bezel	173406-001	74-60460-01
④	Fan	126310-001	70-33538-S1
⑤	EMU	126315-001	70-40081-S1
⑥	180 W Power supply	400288-001	FC-BA35X-HH
⑦	HSG80 controller	400285-001	70-33259-S1
⑧	Cache module (upgraded)	400295-002	70-33256-S2
⑨	I/O modules	126313-001	70-33724-S1
⑩	Fibre Channel hub, 7-port	234454-001	FE-09061-01
⑪	Fibre Channel hub, 12-port	340858-001	30-50549-01
⑫	Fibre Channel switch, 8-port	127660-001	30-56042-S1
		167649-001	30-56132-S1
⑬	Fibre Channel switch, 16-port	127660-002	30-56042-S2
		167650-001	30-56132-S2
⑭	GBIC, short wave	234458-001	FE-09086-01
	GBIC, long wave	340420-001	FD-89504-01

BA370 Enclosure EMU

Figure 1-3 and Table 1-3 identify the Environmental Monitoring Unit (EMU) and EMU-EMU communication cable for a BA370 enclosure.

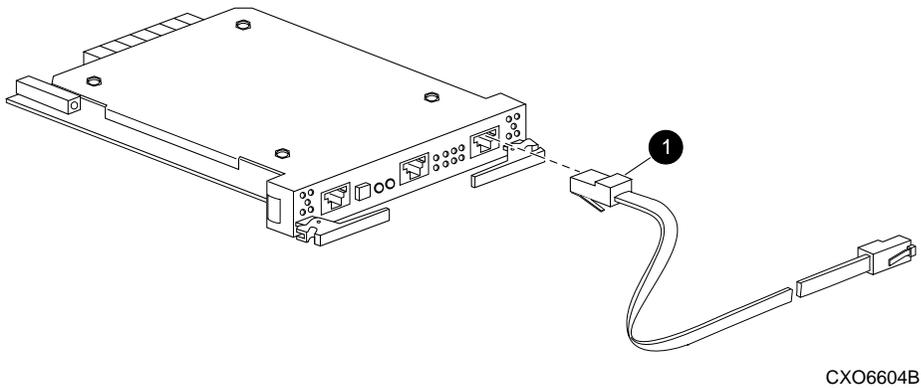


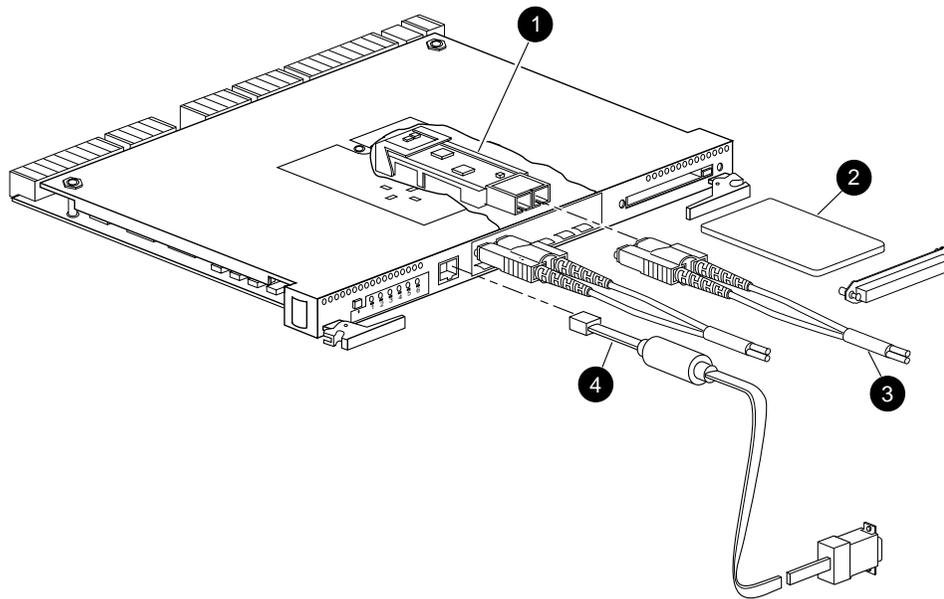
Figure 1-3. BA370 enclosure EMU and EMU-EMU communication cable

Table 1-3 BA370 Enclosure EMU Communication Cable

Item	Description	6-3 Part Number	2-5-2 Part Number
1	EMU-EMU communication cable, 4 meter	401949-001	17-03194-04

HSG80 Array Controller

Figure 1-4 and Table 1-4 identify an HSG80 array controller, the location of the program card, and how to connect a fiber optic cable and maintenance port cable. This setup applies to the BA370 enclosure and Model 2200 enclosure.



CXO6691B

Figure 1-4. HSG80 array controller—GLM, cabling, and program card

Table 1-4 HSG80 Fibre Channel Array Controller

Item	Description	6-3 Part Number	2-5-2 Part Number
❶	Gigabit link module (GLM)	402603-001	70-GLMS1-02
❷	Program card: - ACS version 8.6F - ACS version 8.6G - ACS version 8.6L - ACS version 8.6P - ACS version 8.6S	170569-001 170570-001 170571-001	BG-RHQEB-BA BG-RFNUB-BA BG-RMC5A-BA BG-RHQDB-BA BG-RKEGA-BA
❸	Fiber optic cable, 2 meter Fiber optic cable, 5 meter Fiber optic cable, 15 meter Fiber optic cable, 30 meter Fiber optic cable, 50 meter	242796-001 242796-002 242796-003 401937-001 401938-001	17-04820-03 17-04820-05 17-04820-13 17-04820-08 17-04820-09
❹	Maintenance port cable to a PC Optional adapters, 9-pin D-sub to 25-pin D-sub (not shown): - Male to female (null modem) - Male to male (null modem) - Male to male (modem)	173408-001 173407-001 173407-002 173407-003	17-04074-04 12-45238-01 12-45238-02 12-45238-03

Cache Module

Figure 1-5 and Table 1-5 identify the cache module and the location of the dual inline memory module (DIMM). The bezel of the upgraded cache module is labeled “HSx80 CACHE.”



CAUTION: An older version of the StorageWorks cache module (70-33256-01) cannot be used in the Model 2200 enclosure. These enclosures require the updated version (70-33256-11, spare part number 70-33256-S1) to function properly. Failure to use the updated version causes the controller to crash upon starting.

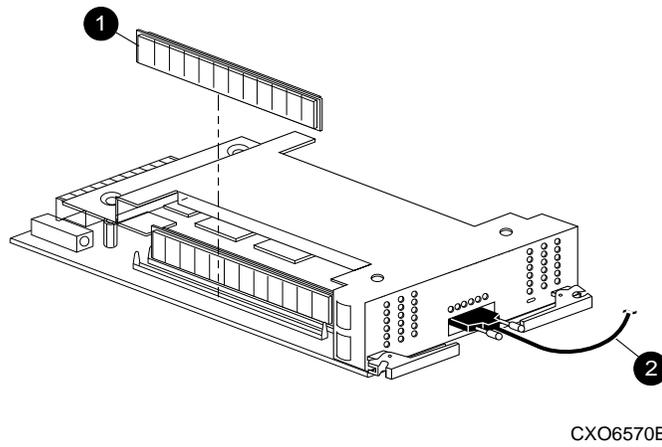


Figure 1-5. Cache module

Table 1-5 Cache Module

Item	Description	6-3	2-5-2
		Part Number	Part Number
❶	DIMM, 32 MB	400296-001	70-DIMS1-01
	DIMM, 128 MB	400297-001	70-DIMS1-02
❷	BA370 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:

- HSG80 array controller
- 180 watt power supply
- BA370 enclosure PVA module and EMU
- Model 2200 enclosure EMU, external cache batteries (ECBs), and fans

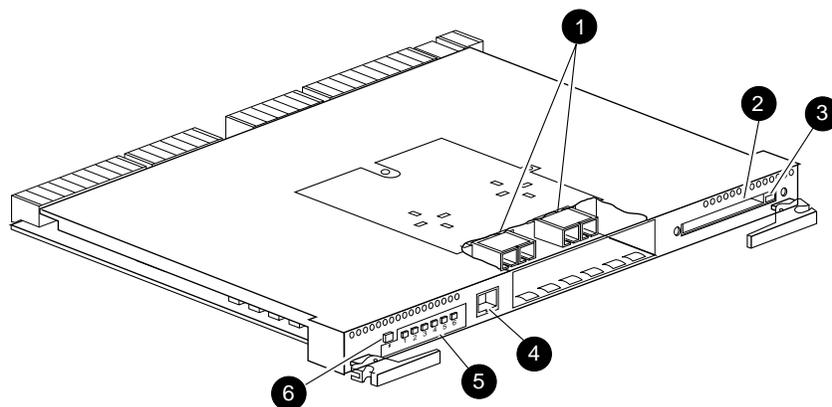
NOTE: For detailed information pertaining to the power supply, PVA, EMU, ECBs, fans, and I/O module, refer to the specific enclosure user guide.

HSG80 Array Controller

This section describes the array controller front panel, operator control panel (OCP) switches and LEDs, and gigabit link module (GLM) components.

Front Panel

Figure 1-6 and Table 1-6 identify various physical parts of the HSG80 array controller.



CXO6582B

Figure 1-6. HSG80 array controller front panel connectors, switches, and LEDs

Table 1-6 HSG80 Array Controller Front Panel Connectors, Switches, and LEDs

Item	Description
①	GLM connection ports
②	Program card slot
③	Program card ejection button
④	Maintenance port
⑤	Operator control panel (OCP)
⑥	Controller reset button

OCP Switches and LEDs

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

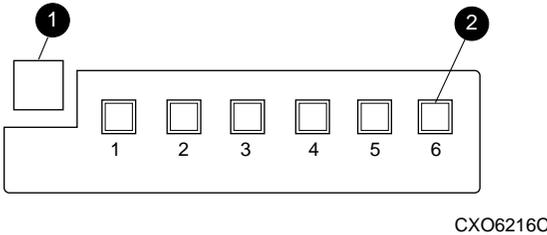


Figure 1-7. Array controller OCP switches and LEDs

Table 1-7 Array Controller OCP Switches and LEDs

Item	Description
①	Controller reset button
②	Port buttons/LEDs (1 through 6)

GLM Connectors and Components

Figure 1-8 and Table 1-8 identify various GLM connectors and components on the array controller.

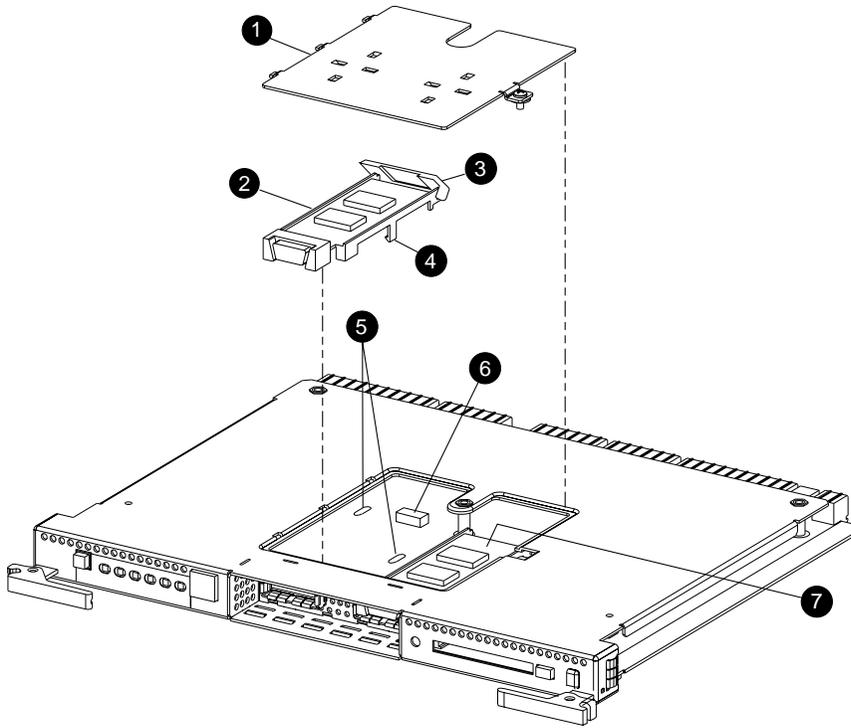


Figure 1-8. GLM connectors and components

Table 1-8 GLM Connectors and Components

Item	Description
❶	Access door
❷	Port 1 GLM
❸	Release lever
❹	Locking tab
❺	Guide holes
❻	GLM connector
❼	Port 2 GLM

180 Watt Power Supply LEDs

Figure 1-9 and Table 1-9 identify power supply LEDs for the BA370 enclosure and Model 2200 enclosure.

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

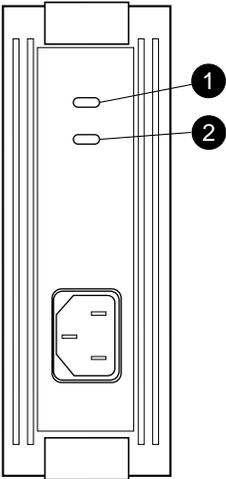


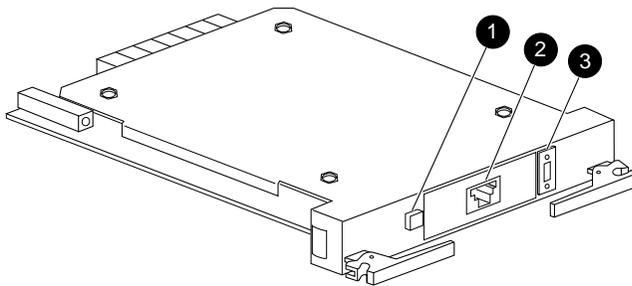
Figure 1-9. 180 watt power supply LEDs

Table 1-9 180 Watt Power Supply LEDs	
Item	Description
①	Shelf (enclosure) status LED
②	Power supply status LED

BA370 Enclosure PVA Module Connector and Switches

Figure 1-10 and Table 1-10 identify power verification and addressing (PVA) module connector and switches for a BA370 enclosure.

NOTE: Refer to the BA370 enclosure user guide for detailed information.



CXO5821B

Figure 1-10. BA370 enclosure PVA module connector and switches

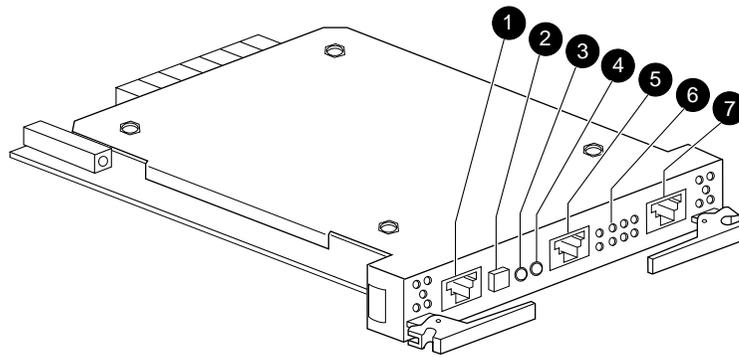
Table 1-10 BA370 Enclosure PVA Module Connector and Switches

Item	Description
①	Standby power switch
②	Communications port
③	SCSI ID switch

BA370 Enclosure EMU Connectors, Switches, and LEDs

Figure 1-11 and Table 1-11 identify EMU connectors, switches, and LEDs for a BA370 enclosure.

NOTE: Refer to the BA370 enclosure user guide for detailed information.



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Figure 1-11. BA370 enclosure EMU connectors, switches, and LEDs

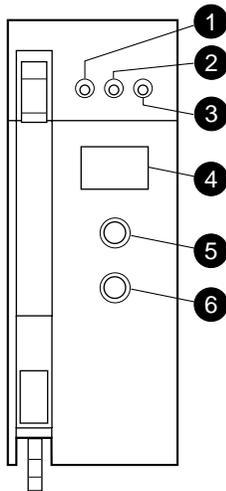
Table 1-11 BA370 Enclosure EMU Connectors, Switches, and LEDs

Location	Description
①	EMU communications connector (labeled IIC)
②	System fault LED and alarm control switch
③	Temperature fault LED
④	Power status LED
⑤	Maintenance terminal connector
⑥	Fan fault LEDs (eight LEDs)
⑦	EMU communications connector (labeled IIC)

Model 2200 Enclosure EMU Switches and LEDs

Figure 1-12 and Table 1-12 identify EMU switches and LEDs for a Model 2200 enclosure.

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



CXO6355A

Figure 1-12. Model 2200 enclosure EMU switches and LEDs

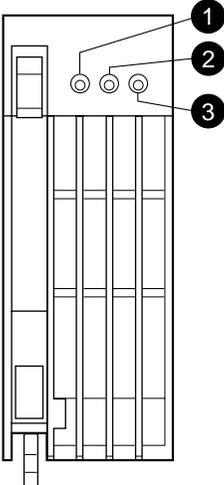
Table 1-12 Model 2200 Enclosure EMU Switches and LEDs

Item	Description
①	EMU status LED
②	Power status LED
③	Enclosure fault LED
④	Alphanumeric display
⑤	Increment switch/LED
⑥	Group switch/LED

Model 2200 Enclosure ECB LEDs

Figure 1-13 and Table 1-13 identify ECB LEDs for a Model 2200 enclosure.

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



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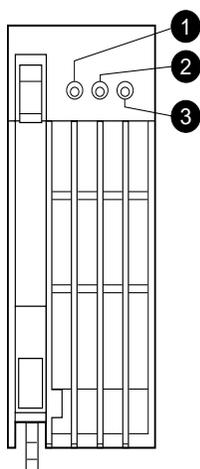
Figure 1-13. Model 2200 enclosure ECB LEDs

Table 1-13 Model 2200 Enclosure ECB LEDs	
Item	Description
①	ECB charged LED
②	ECB charging LED
③	ECB fault LED

Model 2200 Enclosure Fan LEDs

Figure 1-14 and Table 1-14 identify fan LEDs for a Model 2200 enclosure.

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



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Figure 1-14. Model 2200 enclosure fan LEDs

Table 1-14 Model 2200 Enclosure Fan LEDs	
Location	Description
①	Power status LED
②	Not used
③	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
- Fiber Optic Cable Cleaning Instructions
- Cleaning a GLM
- Replacing a GLM
- Replacing a Fiber Optic Cable, Switch, or Hub
- Replacing DIMMs
- Replacing a Failed Stageset Member

Required Tools

The following tools are needed to service a controller, cache module, BA370 enclosure ECB, BA370 enclosure PVA module, GLM, and I/O module:

- a flathead screwdriver for loosening and tightening the I/O module retaining screws
- a small phillips screwdriver for loosening and tightening the GLM access door screws
- a pair of thin needle-nose pliers to remove fiber optic cables from the controller
- an antistatic wrist strap
- an antistatic mat on which to place modules during servicing

Field Replacement Strategy

Compaq authorized service providers will troubleshoot HSG80 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, ECB, and GLM.

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 non-conducting 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 non-conducting 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 program 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.

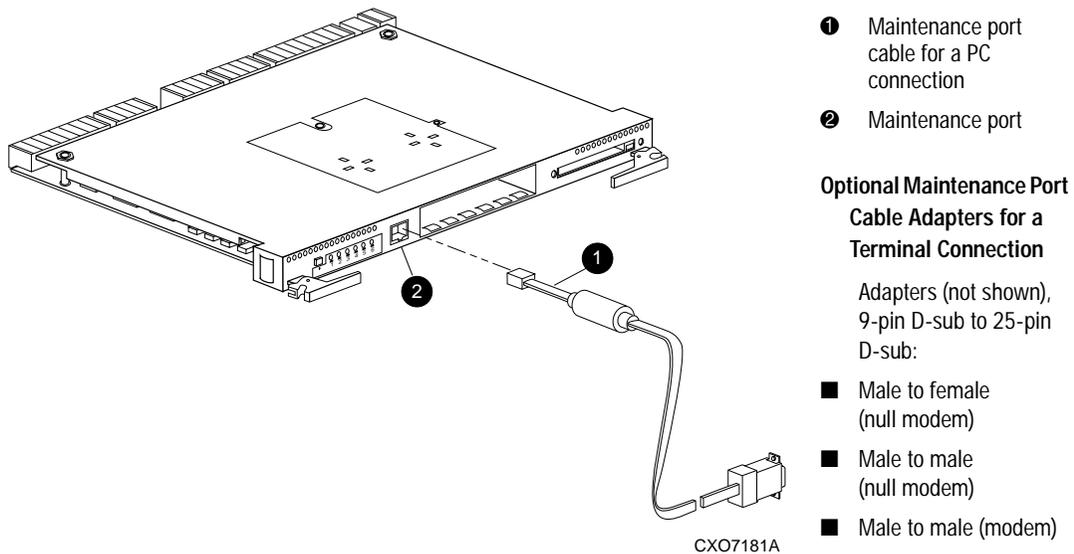


Figure 2-1. PC/terminal to maintenance port connection



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.”

Fiber Optic Cable Cleaning Instructions

To ensure optimum performance and lifespan of the cable, it is essential that you clean the fiber optic cables when replacing the controller. Use the polyester cloth from the cleaning kit that came with the cable. Figure 2-2 shows the ferrule on a fiber optic cable.

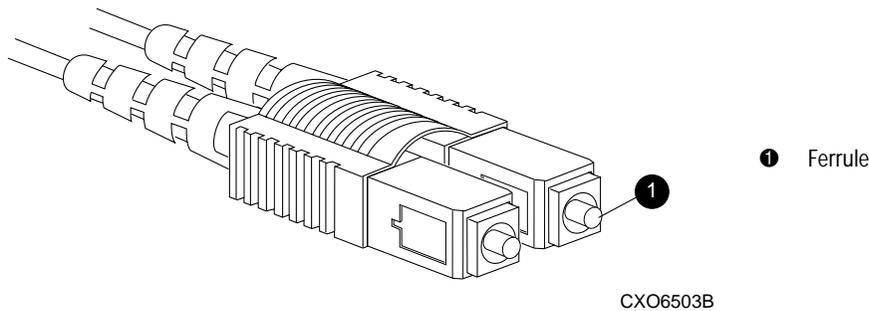


Figure 2-2. Ferrule on a fiber optic cable



CAUTION: Compaq recommends cleaning the fiber optic cable only when replacing a controller. Overcleaning might cause damage to the ferrules.

NOTE: When installing a fiber optic cable for the first time, this procedure can be omitted.

1. Using the polyester cleaning cloth that came with the cable cleaning kit, cover your fingers and squeeze one ferrule between two fingers.
2. Rotate the cloth around the ferrule one or two times.
3. When the first ferrule is clean, move your fingers to a different area of the cloth and repeat step 1 and step 2 for the remaining ferrule.

Cleaning a GLM

When replacing a GLM, make sure to clean the GLM receptacles to ensure optimum performance. Use the following steps to clean a GLM:

1. Take the polyester swab from the cleaning kit that came with the fiber optic cable.



CAUTION: Do not exert excessive force when the swab reaches a stopping point, and do not repeat this procedure frequently. Failure to comply with this caution might cause scratching on the GLM and ultimately damage the fiber optic connection. Overcleaning might cause damage to the GLM.

2. Gently insert the lint-free polyester swab into the transmit-side of the optical GLM cavity (see Figure 2-3).

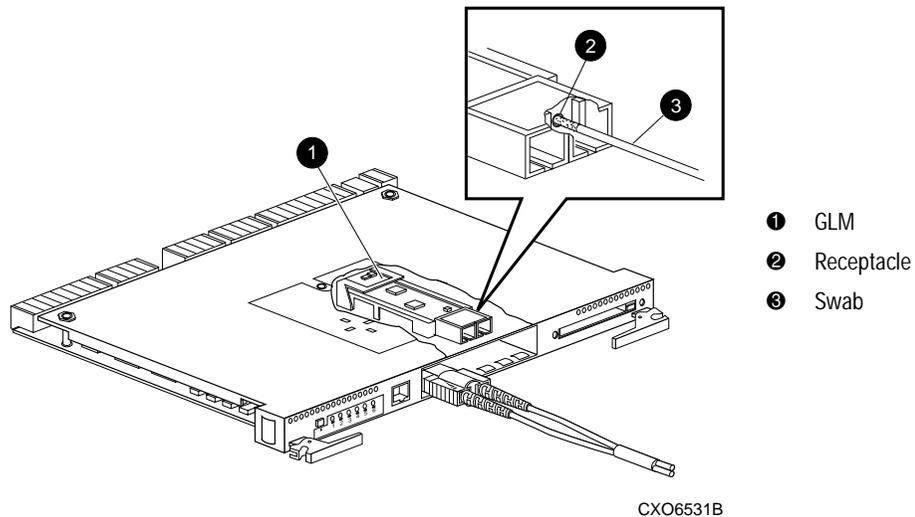


Figure 2-3. Cleaning procedure for GLM

3. Carefully remove dust from the cavity by rotating the swab tip back and forth one or two times.
4. Repeat step 1 through step 3 for the receiving side of the optical GLM cavity.

Replacing a GLM

This section shows how to replace a GLM in a controller. Figure 2-4 shows the location and orientation of the GLMs.

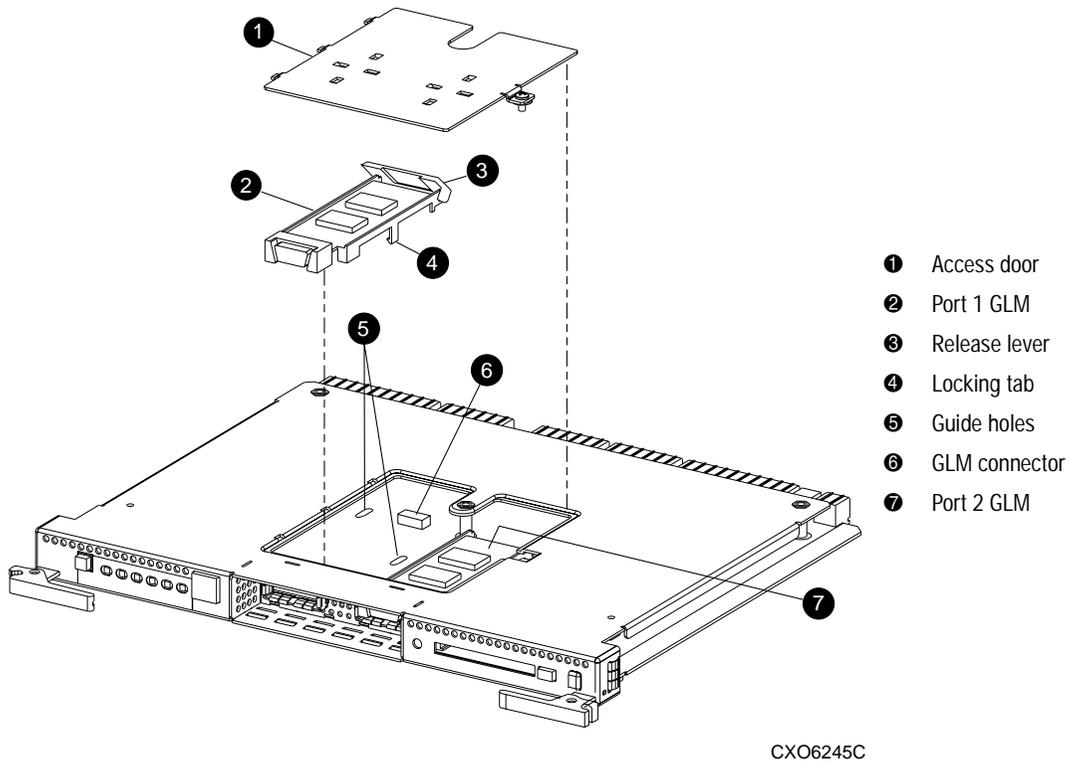


Figure 2-4. Location of GLMs inside a controller



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

Removing a GLM

Use the following steps and Figure 2-4 to remove a GLM:

1. Remove the controller using steps in either Chapter 3.
2. Remove the screw that secures the access door ❶ on top of the controller.
3. Remove the access door and set the door aside.
4. Disengage the GLM locking tabs ❷ that protrude through the guide holes ❸ on the bottom side of the controller.
5. Operate the release lever ❹ on the exposed end of the GLM by pressing the lower end of the release lever with your index finger while pulling the raised end up with your thumb.
6. Remove the GLM.

Installing a GLM

Use the following steps and Figure 2-4 to install a GLM:

NOTE: Before inserting the replacement GLM, note the holes in the board where the GLM will reside.

1. Place the cable connection end of the GLM through the opening on the front of the controller.
2. Line up the locking tab ❷ on the bottom of the replacement GLM with the guide holes ❸ in the board, and press firmly to seat the GLM.
3. Press the release lever ❹ firmly into place to secure the GLM.
4. Install the access door ❶ on top of the controller and secure the door with a screw.
5. Install the controller using steps in either Chapter 3.

Replacing a Fiber Optic Cable, Switch, or Hub

This section shows how to replace a fiber optic cable, switch, or hub.

Removing a Fiber Optic Cable, Switch, or Hub

Use the following steps to remove a fiber optic cable connected to either side of your switch or hub, or to remove the switch or hub:

1. Shut down the host system using host documentation.
2. 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

NOTE: 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.

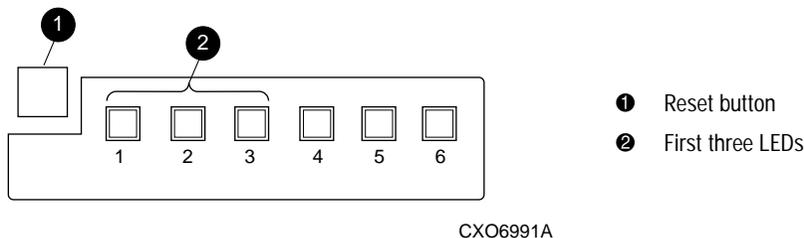
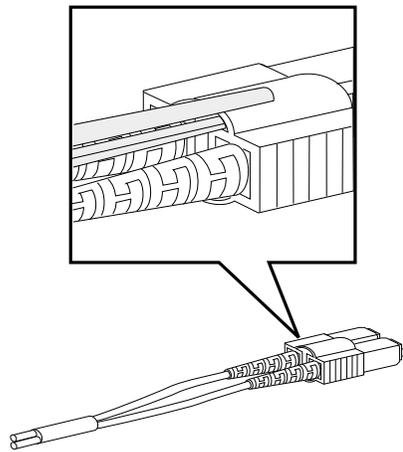


Figure 2-5. Controller reset button and first three LEDs

IMPORTANT: When replacing several cables, a switch, or a hub, label each cable to facilitate installation of the replacement item. Otherwise, subsystem errors will develop from improper connections.

3. If replacing a fiber optic cable without extender clips, disconnect the failed cable at each end using thin needle-nose pliers (see inset on Figure 2-6).

If replacing a switch or hub, disconnect all cables connected to the switch or hub.



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Figure 2-6. Using thin needle-nose pliers to disconnect a fiber optic cable

Installing a Fiber Optic Cable, Switch, or Hub

Use the following steps to install a fiber optic cable connected to either side of a switch or hub, or to install a switch or hub:

1. If replacing a cable, connect the replacement cable into the ports previously used by the old cable.

If replacing a switch or hub, reconnect all cables removed from the old switch or hub.

2. Restart each controller by pressing the reset button.

The controllers automatically restart and the subsystem is now ready for operation.

IMPORTANT: If a controller did not restart, use step a through step c.

- a. Press and hold the controller reset button.
 - b. Reseat the controller program card.
 - c. Release the reset button.
3. Restart the host system using host documentation.

Replacing DIMMs

This section shows how to replace DIMMs in a cache module. DIMM locations are shown in Figure 2-7 and supported configurations are shown in Table 2-1.

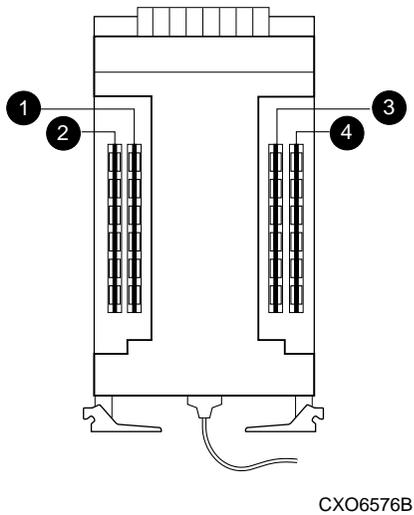


Figure 2-7. Cache module DIMM locations

Table 2-1 Cache Module Memory Configurations

Memory	DIMMs	Quantity	Location
128 MB	32 MB	4	1 2 3 4
256 MB	128 MB	2	1 3
512 MB	128 MB	4	1 2 3 4



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 2-8 during the removal and installation procedures for component clarification.

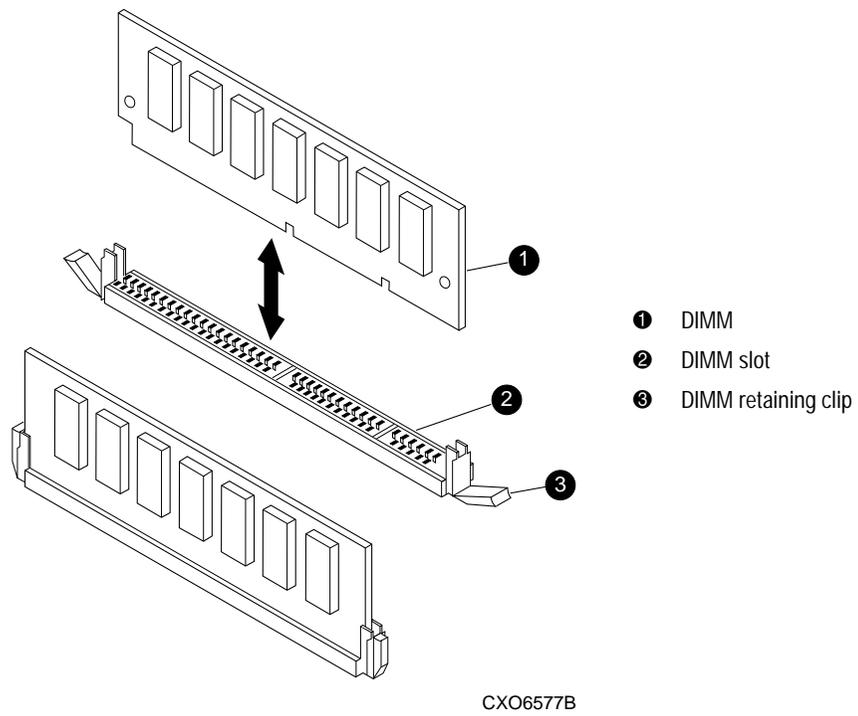


Figure 2-8. DIMM components

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.
2. Press down on the DIMM retaining clips ③ at both ends of the DIMM ① being removed (see Figure 2-8).
NOTE: To make pressing down on the DIMM retaining clips easier, use the eraser end of a pencil or a small screwdriver.
3. Gently remove the DIMM from the DIMM slot ② and place the DIMM in an antistatic bag or on a 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 ACS version 8.6P and 8.6S installations, a 512 MB cache memory configuration is required.

1. Insert each DIMM ① straight into the appropriate slot ② of the cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 2-8).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage the two retaining clips ③ for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining clips engage the DIMM.
5. Repeat step 1 through step 4 for each DIMM.
6. Install the cache module using steps in either Chapter 3.

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 a New RAIDset or Mirrorset Member

To install a new RAIDset or mirrorset 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 BA370 Enclosure Elements

This chapter provides procedures for shutting down and restarting the subsystem and procedures for replacing the following BA370 enclosure elements:

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

Refer to enclosure documentation for information about replacing power supplies, power cables, AC input boxes, cooling fans, and bus 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 BA370 subsystem.

1. Connect a PC or terminal to the maintenance port of one of the controllers in the subsystem.
2. From a host console, stop all host activity to the controllers and dismount the logical units in the subsystem.
3. If using a Windows NT or Windows 2000 platform, shut down the server.
4. 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
```

NOTE: 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.

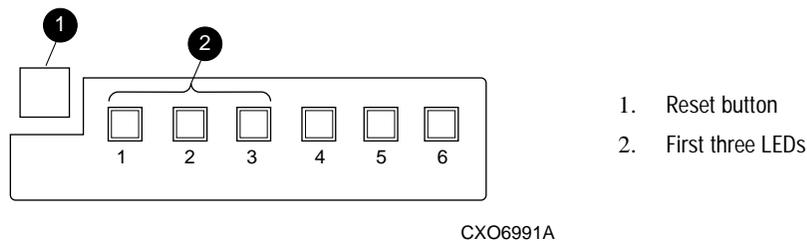


Figure 3-1. Controller reset button and first three LEDs

5. Remove power to the subsystem.



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

Disabling 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 (labeled SHUT OFF, see Figure 3-2) on the ECB for approximately 5 seconds.

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

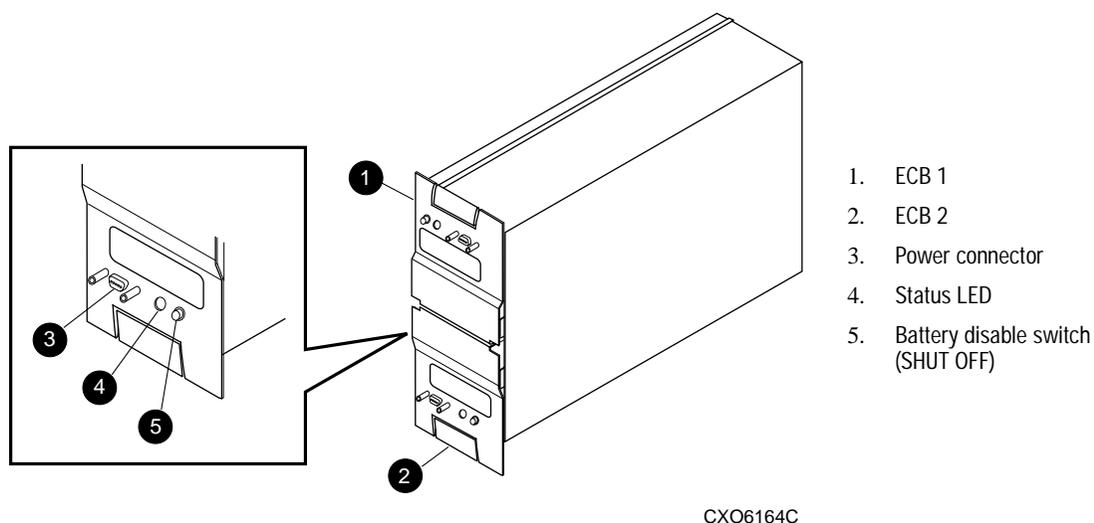


Figure 3-2. ECB battery disable switch location (dual ECB example)

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

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

Enabling the External Cache Batteries

To return the subsystem to normal operation, apply power to the subsystem. The ECB will be enabled when the subsystem is powered on.

Restarting the Subsystem

Use the following steps to restart a BA370 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 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

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

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

2. Mount the logical units on the host.
3. If using a Windows NT or Windows 2000 platform, restart the server.

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 include: replacing both the controller and cache module, replacing only the controller, and replacing only the cache module. To upgrade a single-controller configuration to a dual-redundant controller configuration, see Chapter 5.

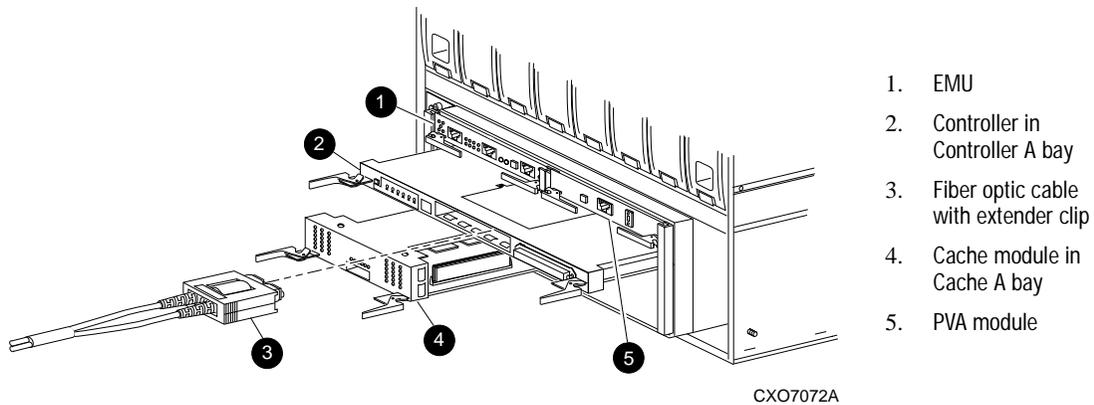


Figure 3-3. Single-controller configuration in a BA370 enclosure



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

For fiber optic cables without extender clips, thin needle-nose pliers must be used to remove the cable from the controller without potentially damaging the cable (see Figure 3-4).

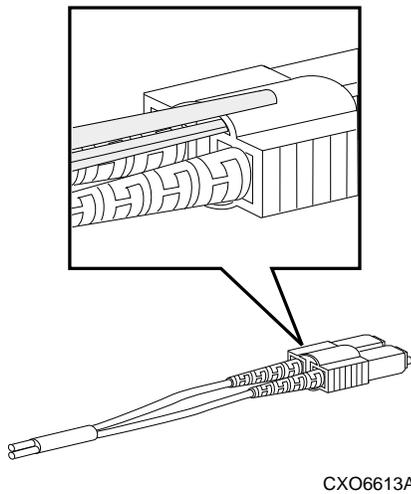


Figure 3-4. Using thin needle-nose pliers to disconnect a fiber optic cable

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 8.
2. From the host console, dismount the logical units in the subsystem.
3. If using a Windows NT or Windows 2000 platform, shut down the server.
4. Run the fault management utility (FMU) to obtain the last failure codes, if desired.
5. 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 replacement controller must be manually configured as described in the controller CLI reference guide.
6. Shut down the controller with the following command:


```
SHUTDOWN THIS_CONTROLLER
```

NOTE: 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 button stops FLASHING and remains ON.
7. Power off BA370.



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.

8. Remove the program card ESD cover and program card. Save them in an antistatic bag or on a grounded antistatic mat for use with the replacement controller.



CAUTION: For fiber optic cables without extender clips, thin needle-nose pliers must be used to remove the cable from the controller without potentially damaging the cable (see Figure 3-4).

9. Disconnect all host bus cables from the controller.
10. If connected to the operational controller, disconnect the PC or terminal from the controller maintenance port.
11. 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 Controller A guide rails. Misaligning the module might damage the backplane.
ESD can easily damage the controller. Wear a snug-fitting, grounded ESD wrist strap.

IMPORTANT: Ensure the program card is *not* installed in the replacement controller.

1. Insert the replacement controller into the Controller A bay (see Figure 3-3, 2), 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 replacement controller.
4. Release the reset button and install the program card ESD cover on the controller.

5. From the CLI prompt, display details about the configured controller using the following command:
SHOW THIS_CONTROLLER FULL
6. 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 the CONFIGURATION RESET command description in the controller CLI reference guide).
7. Is the current device configuration saved on a disk drive?
 - No. Manually restore the current device configuration using existing information and the controller CLI reference guide.
 - Yes. Automatically restore the configuration as follows:

IMPORTANT: In the following step, if all port buttons *do not* begin FLASHING when the program card is inserted, continue holding the Port #6 button and then eject and reinsert the program card.

- a. Shut down the controller.
- b. Press and hold the Port #6 button (see Figure 3-5, 2).
- c. While continuing to hold the Port #6 button, press and release the Reset button until the port LEDs stop flashing.
- d. Release the Port #6 button to initiate the configuration restore.

The controller will load the saved configuration from disk and restart.

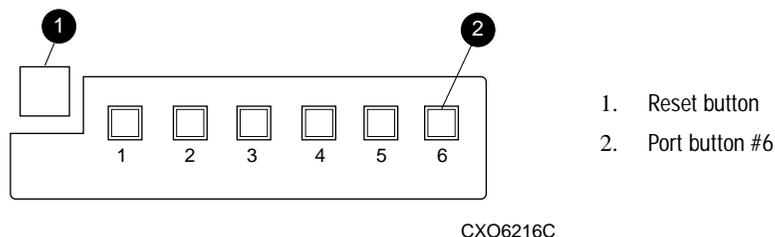


Figure 3-5. Location of array controller reset and port #6 buttons on the OCP

8. Using the code-load/code-patch utility (CLCP), install any patches that were installed on the previous controller (see Chapter 5).
9. Set the date and time using the following command:
SET THIS_CONTROLLER TIME=*dd-mmm-yyyy:hh:mm:ss*

10. Reconnect all host bus cables to the controller.
11. Mount the logical units on the host.
12. If using a Windows NT or Windows 2000 platform, restart the server.
13. 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 6.
2. From the host console, dismount the logical units in the subsystem.
3. If using a Windows NT or Windows 2000 platform, shut down the server.
4. Run FMU to obtain the last failure codes, if desired.
5. Shut down the controller with the following command:

SHUTDOWN THIS_CONTROLLER

NOTE: 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 button stops FLASHING and remains ON.



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

6. Disable the ECB by pressing the battery disable switch until the status light stops FLASHING—approximately 5 seconds.
7. Disconnect the ECB cable from the cache module.
8. 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.
9. Remove all DIMMs from the cache module for use within the replacement cache module.
 - a. Press down on the DIMM retaining clips 3 at both ends of the DIMM 1 being removed (see Figure 3-6).

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

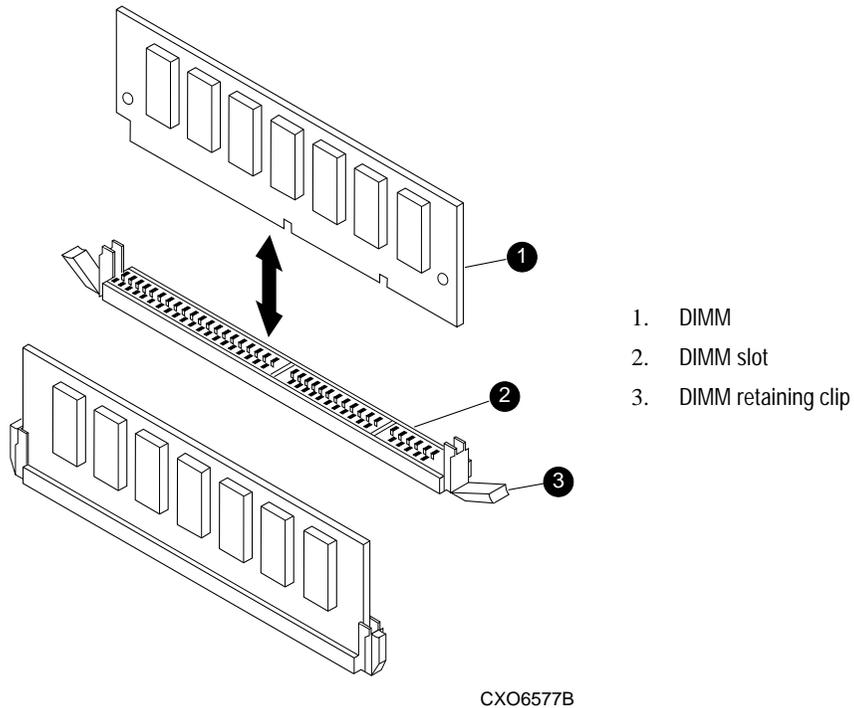


Figure 3-6. DIMM components

- b. Gently remove the DIMM from the DIMM slot 2 and place the DIMM in an antistatic bag or on a 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.

IMPORTANT: The replacement cache module *must* contain the same cache memory configuration as the module being replaced.

1. Insert each DIMM 1 straight into the appropriate slot 2 of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3-6).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage the two retaining clips 3 for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining clips engage the DIMM.
5. Repeat step 1 through step 4 for each DIMM.



CAUTION: Carefully align the cache module in the Cache A guide rails. Misaligning the module might damage the backplane.

6. Insert the replacement cache module into the Cache A bay and engage the retaining levers.



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

The ECB Y-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.

7. Disable the ECB by pressing the battery disable switch until the status light stops FLASHING—approximately 5 seconds.
8. Connect the ECB Y-cable to the replacement 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 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

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

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

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

```
SHOW THIS_CONTROLLER FULL
```

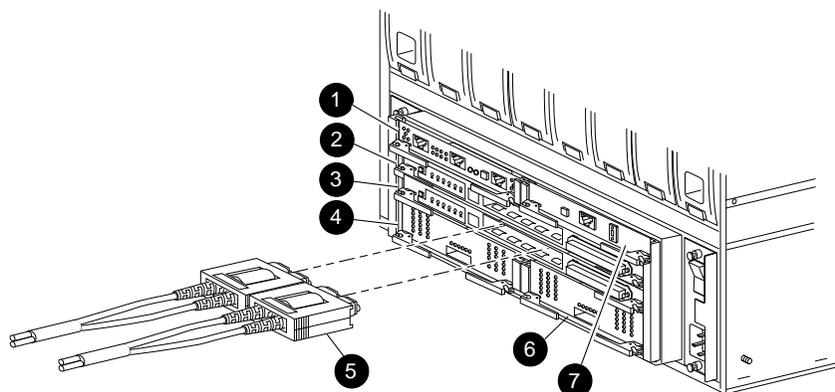
12. Set the subsystem date and time using the following command:

```
SET THIS_CONTROLLER TIME=dd-mmm-yyyy:hh:mm:ss
```

13. Mount the logical units on the host.
14. If using a Windows NT or Windows 2000 platform, restart the server.
15. 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 3-7).



CXO6990A

- | | |
|-------------------|---|
| 1. EMU | 5. Fiber optic cables with extender clips |
| 2. Controller A | 6. Cache module B |
| 3. Controller B | 7. PVA module |
| 4. Cache module A | |

Figure 3-7. Dual-redundant controller configuration in a BA370 enclosure

The following sections provide procedures for:

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

IMPORTANT: Note the following provisions before starting the replacement procedures:

- The replacement 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 replacement cache module *must* contain the same cache 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.

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. Disable failover and take the controllers out of dual-redundant configuration with one of the following commands:

```
SET NOFAILOVER  
or  
SET NOMULTIBUS_FAILOVER
```
3. Remove the program card ESD cover and program card from the “other controller.” Save them in an antistatic bag or on a grounded antistatic mat for use with the replacement controller.

4. Start the field replacement utility (FRUTIL) with the following command:
RUN FRUTIL
5. Enter **N(o)** to the question about replacing the cache battery.
6. Enter **1** for the remove a controller or cache module option.
7. Enter **1** for the remove the “other controller” and cache module option.
8. 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 4 and proceed.

9. Remove the “other controller”:



CAUTION: For fiber optic cables without extender clips, thin needle-nose pliers must be used to remove the cable from the controller without potentially damaging the cable (see Figure 3-4).

- a. Disconnect all host bus cables 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.
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 disconnecting the ECB Y-cable. 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 FLASHING—approximately 5 seconds.

12. 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 in 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 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 down on the DIMM retaining clips 3 at both ends of the DIMM 1 being removed (see Figure 3-6).

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

- b. Gently remove the DIMM from the DIMM slot 2 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 1 straight into the appropriate slot 2 of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3-6).
- e. Press the DIMM gently into the slot until seated at both ends.
- f. Engage the two retaining clips 3 for the DIMM.
- g. Make sure both ends of the DIMM are firmly seated in the slot and both retaining clips engage the DIMM.
- h. Repeat step d through step g for each DIMM.
- i. Go to step 11 on page 3-18.

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.

IMPORTANT: The replacement cache module *must* contain the same cache memory configuration as the module being replaced.

1. Insert each DIMM 1 straight into the appropriate slot 2 of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3-6).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage the two retaining clips 3 for the DIMM.
4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining clips 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.



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.

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

The ECB Y-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.

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.

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



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

14. Insert the replacement 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 replacement controller into the appropriate bay, and engage the retaining levers.

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

A controller restart can take as long as 60 seconds, 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.
-

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

FRUTIL exits.

NOTE: In mirrored mode, FRUTIL initializes the mirrored portion of the replacement 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 on the “other controller.”

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 CONFIGURATION RESET command description in the controller CLI reference guide).

19. Enable failover and reestablish the dual-redundant controller configuration with one of the following commands:

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

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

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

```
SHOW THIS_CONTROLLER FULL
```

21. Reconnect all host bus cables to the controller.

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. Disable failover and take the controllers out of the dual-redundant configuration with one of the following commands:
SET NOFAILOVER
or
SET NOMULTIBUS_FAILOVER
3. Remove the program card ESD cover and program card from the “other controller.” Save them in an antistatic bag or on a grounded antistatic mat for use with the replacement controller.
4. Start FRUTIL with the following command:
RUN FRUTIL
5. Enter **N**(o) to the question about replacing the cache battery.
6. Enter **1** for the remove a controller or cache module option.
7. Enter **2** for the remove the “other controller” option.
8. 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 4 and proceed.

9. Remove the “other controller”:



CAUTION: For fiber optic cables without extender clips, thin needle-nose pliers must be used to remove the cable from the controller without potentially damaging the cable (see Figure 3-4).

- a. Disconnect all host bus cables 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.

10. 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 a potential overtemperature condition.

- Yes. Enter **Y(es)**. Go to step 6 on page 3-23 and proceed.

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.”



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.

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

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 replacement controller into the appropriate bay, and engage the retaining levers.

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

A controller restart can take as long as 60 seconds, 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.
-

8. Press **Enter/Return** to continue.
FRUTIL exits.
9. Install the program card ESD cover on the “other controller.”
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 the CONFIGURATION RESET command description in the controller CLI reference guide).

11. Enable failover and reestablish the dual-redundant controller configuration with one of the following commands:

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

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

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

```
SHOW THIS_CONTROLLER FULL
```

13. Reconnect all host bus cables to the controller.
14. 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. Disable failover and take the controllers out of dual-redundant configuration with one of the following commands:

```
SET NOFAILOVER  
or  
SET NOMULTIBUS_FAILOVER
```
3. Start FRUTIL with the following command:

```
RUN FRUTIL
```

4. Enter **N(o)** to the question about replacing the cache battery.
5. Enter **1** for the remove a controller or cache module option.
6. Enter **3** for the remove the “other controller” cache module option.
7. 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 3 and proceed.

8. 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 disconnecting the ECB Y-cable. Failure to disable the ECB might result in cache module damage.

9. Disable the ECB by pressing the battery disable switch until the status light stops **FLASHING**—approximately 5 seconds.
10. 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 in 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 down on the DIMM retaining clips 3 at both ends of the DIMM 1 being removed (see Figure 3-6).

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

- b. Gently remove the DIMM from the DIMM slot 2 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 1 straight into the appropriate slot 2 of the cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3-6).
- e. Press the DIMM gently into the slot until seated at both ends.
- f. Engage the two retaining clips 3 for the DIMM.
- g. Make sure both ends of the DIMM are firmly seated in the slot and both retaining clips engage the DIMM.
- h. Repeat step d through step g for each DIMM.
- i. Go to step 11 on page 3-27.

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.

IMPORTANT: The replacement cache module *must* contain the same cache memory configuration as the module being replaced.

1. Insert each DIMM 1 straight into the appropriate slot 2 of the cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 3-6).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage the two retaining clips 3 for the DIMM.

4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining clips 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.



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.

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.

The ECB Y-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.

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.

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



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

14. Insert the replacement 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 seconds, 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 replacement 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 reestablish the dual-redundant controller configuration with one of the following commands:

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

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

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

```
SHOW THIS_CONTROLLER FULL
```

17. 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 3-8 and contains two batteries. A single ECB contains only one battery.

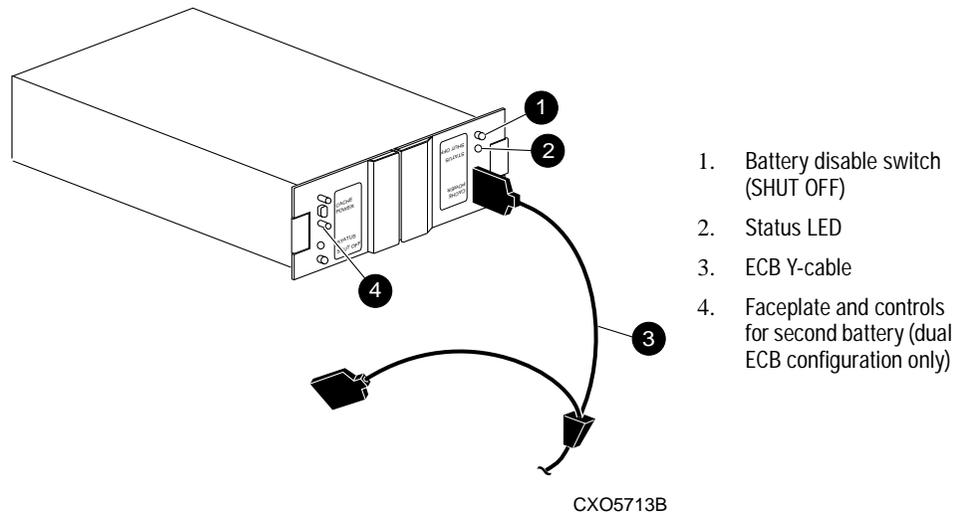


Figure 3-8. Dual ECB configuration



WARNING: The ECB is a sealed, rechargeable, lead acid battery that must be recycled or disposed of properly according to local regulations or policies after replacement. *Do not* incinerate the battery. The ECB displays the following label:



Replacing an ECB With the BA370 Subsystem Powered On

Use the following steps to replace the ECB with the BA370 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 replacement ECB on top of the enclosure. After removing the old ECB, carefully insert the replacement ECB into the empty bay.

1. Connect a PC or terminal to the maintenance port of the controller that requires an ECB 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.



CAUTION: 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.

The ECB Y-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 replacement ECB on top of the enclosure.

4. Replace the ECB:

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

- ❑ For a single ECB:
 - a. Remove the old ECB and insert the replacement ECB into the same location.
 - b. Connect the replacement 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 replacement 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 replacement dual ECB in a temporary location.
- 5. Press **Enter/Return**.
 - The ECB expiration date and deep discharge history are updated.
 - FRUTIL exits.
- 6. For a dual-redundant controller configuration with a dual ECB installed:
 - a. If the “other controller” cache module is also to be connected to the replacement 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 5.
 - c. Remove the old dual ECB and place the replacement ECB in that location.
- 7. Disconnect the PC or terminal from the controller maintenance port.

Replacing an ECB With the BA370 Subsystem Powered Off

Use the following steps to replace the ECB with the BA370 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

NOTE: 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 turning OFF both AC input boxes for all BA370 enclosures and disable the ECBs.



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 replacement ECB into the same location.
- b. Connect the replacement 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 replacement 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 replacement 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 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

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

7. Set the controller's time.

8. Start FRUTIL with the following command:

```
RUN FRUTIL
```

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

10. Press **Enter/Return**.

- The ECB expiration date and deep discharge history are updated.
- FRUTIL exits.

11. For a dual-redundant controller configuration, when replacing the ECB for both cache modules:
 - a. If the “other controller” cache module is also to be connected to the replacement 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 and place the replacement ECB in that location.
12. Disconnect the PC or terminal from the controller maintenance port.

Replacing a PVA Module

Use the following steps to replace a PVA module in a master enclosure or expansion enclosure. The master enclosure contains the array controllers and cache modules; expansion enclosures do not.

NOTE: This procedure is not applicable to the BA350-MA enclosure.

The HSG80 controller can support up to three BA370 enclosures: a master enclosure and two expansion enclosures.

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

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 second controller becomes the “other controller.”

2. In a dual-redundant controller configuration, disable failover and take the controllers out of dual-redundant configuration with one of the following commands:

```
SET NOFAILOVER
```

or

```
SET NOMULTIBUS_FAILOVER
```

3. Start FRUTIL with the following command:

```
RUN FRUTIL
```

4. Enter **N**(o) to the question about replacing the cache battery.
5. Enter **3** for the replace the PVA option.

NOTE: The FRUTIL PVA replacement menu provides options for three enclosures regardless of how many enclosures are actually connected.

6. Select *one* of the following options:

- Enter **1** for the replace the PVA in a master enclosure option.
- Enter **2** for the replace the PVA in the first expansion enclosure option.
- Enter **3** for the replace the PVA in the second expansion enclosure option.

7. Enter **Y**(es) to confirm the intent to install the PVA module.

8. Set the replacement PVA SCSI ID address (if necessary, refer to the *Compaq StorageWorks Ultra SCSI RAID Enclosure (BA370-Series) User Guide* for instructions):

- Set to 0 for a master enclosure.
- Set to 2 for the first expansion enclosure.
- Set to 3 for the second expansion enclosure.

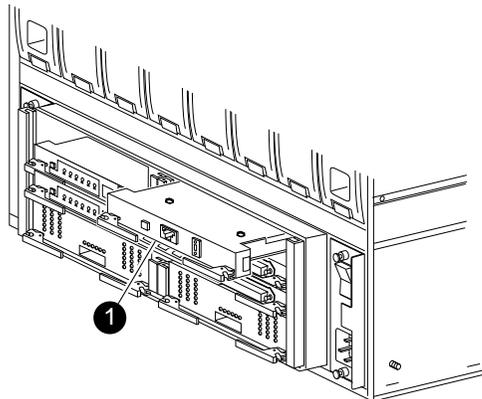
9. Press **Enter/Return**.



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.

10. Replace the PVA:

- a. Disengage both retaining levers on the old PVA (see Figure 3-9) and remove the PVA.



1. PVA module

CXO7318A

Figure 3-9. PVA module location



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

- b. Insert the replacement PVA and engage both retaining levers.

11. Press **Enter/Return** to resume device port activity and restart the “other controller.”

NOTE: A controller restart is indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

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

12. Enable failover and reestablish the dual-redundant configuration with one of the following commands:

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

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

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

```
SHOW THIS_CONTROLLER FULL
```

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

Replacing an I/O Module

Figure 3-10 shows a rear view of the BA370 enclosure and the relative location of the six I/O modules (also referred to as ports). Figure 3-11 shows the six I/O modules, the location of the connectors and securing screws, and a bay-to-bus numbering correlation.

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

This procedure is not applicable for a DS-BA356-Mx-series enclosure.

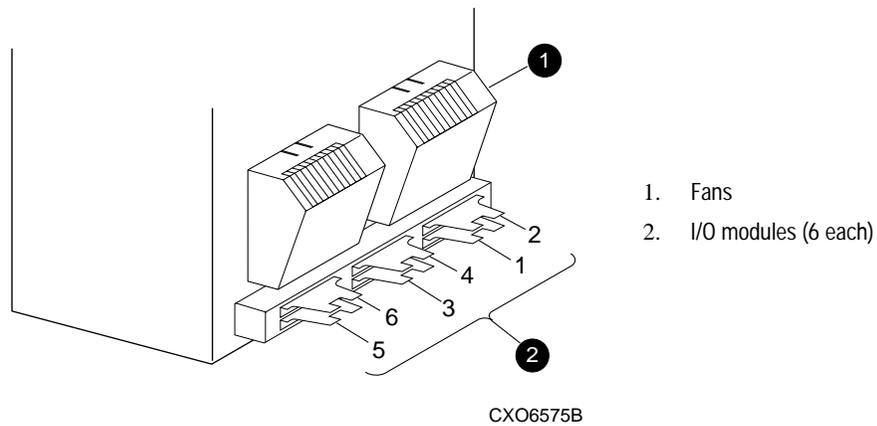


Figure 3-10. I/O module locations in a BA370 enclosure

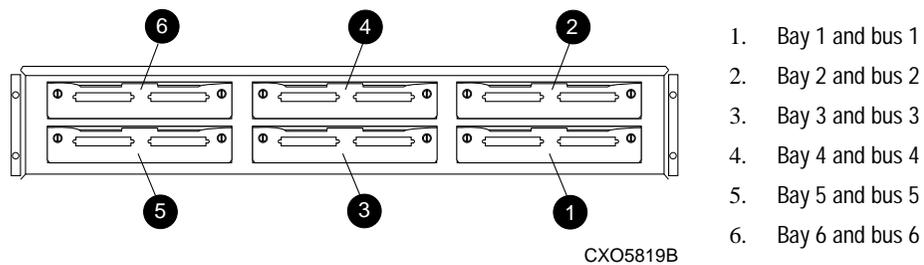


Figure 3-11. I/O module bay and bus numbering in a BA370 enclosure

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

Use the following steps to replace an I/O module.

1. Connect a PC or terminal to the maintenance port of an operational controller.
2. In a dual-redundant controller configuration, disable failover and take the controllers out of dual-redundant configuration with one of the following commands:

```
SET NOFAILOVER
or
SET NOMULTIBUS_FAILOVER
```

3. Start FRUTIL with the following command:

```
RUN FRUTIL
```

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

NOTE: The HSG80 controller supports up to three enclosures. The I/O module status can show the following states:

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

5. Enter **4** for the replace an I/O module option. Figure 3-12 shows an example of the generated I/O module status display and indicates cabinet 0, port 5 as missing or bad.

```
I/O Module Status:
      Cabinet 0          Cabinet 2          Cabinet 3
      -----          -
Port 1: Single Ended - OK          N/A          N/A
Port 2: Single Ended - OK          N/A          N/A
Port 3: Single Ended - OK          N/A          N/A
Port 4: Single Ended - OK          N/A          N/A
Port 5: Missing or bad          N/A          N/A
Port 6: Single Ended - OK          N/A          N/A

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

Figure 3-12. Example of an I/O module status display

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.

If the incorrect I/O module is removed, the controller will crash. Loss of data might occur.

7. Replace the appropriate I/O module (see Figure 3-11):
 - a. Disconnect all bus cables from the I/O module.
 - b. Remove the failed I/O module.
 - c. Install a replacement I/O module.
 - d. Reconnect all bus cables to the I/O module.
8. Press **Enter/Return** to resume device port activity and restart the “other controller.”

NOTE: A controller restart is 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 reestablish the dual-redundant configuration with one of the following commands:

```
SET FAILOVER COPY=THIS_CONTROLLER
```

or

```
SET MULTIBUS_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 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 Model 2200 subsystem.

1. Connect a PC or terminal to the maintenance port of one of the controllers in the subsystem.
2. From a host console, stop all host activity to the controller and dismount the logical units in the subsystem.
3. If using a Windows NT or Windows 2000 platform, shut down the server.
4. 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

NOTE: 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.

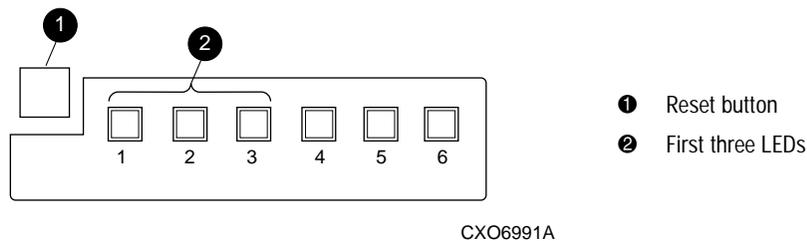


Figure 4-1. Controller reset button and first three LEDs

5. Remove power to the subsystem.



CAUTION: When shutting down the controller for longer than one day, reseal 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 Model 2200 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 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button.

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

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

-
2. Mount the logical units on the host.
 3. If using a Windows NT or Windows 2000 platform, restart the server.

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 include: replacing both the controller and cache module, replacing only the controller, and replacing only the cache module. To upgrade a single-controller configuration to a dual-redundant controller configuration, see Chapter 5.

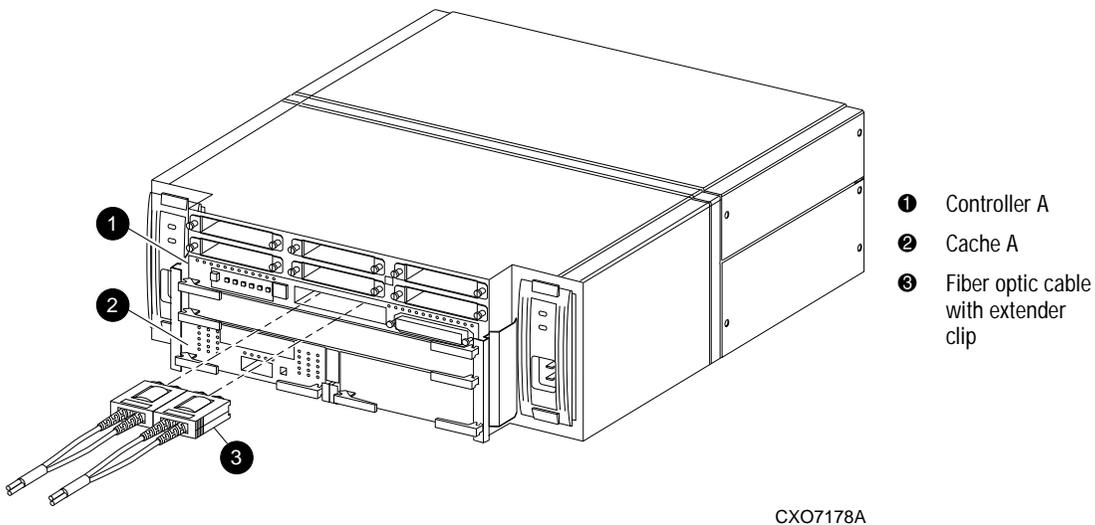
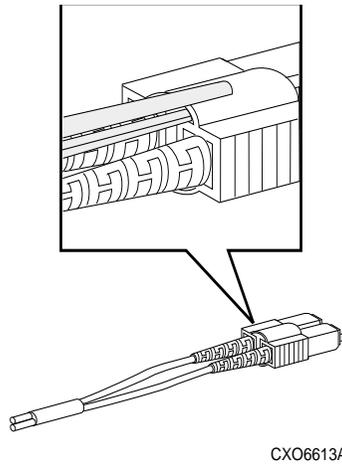


Figure 4-2. Single-controller configuration in a Model 2200 enclosure



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

For fiber optic cables without extender clips, thin needle-nose pliers must be used to remove the cable from the controller without potentially damaging the cable (see Figure 4-3).



CXO6613A

Figure 4-3. Using thin needle-nose pliers to disconnect a fiber optic cable

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 7.
2. From the host console, dismount the logical units in the subsystem.
3. If using a Windows NT or Windows 2000 platform, shut down the server.
4. Run the fault management utility (FMU) to obtain the last failure codes, if desired.
5. 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 replacement controller must be manually configured as described in the controller CLI reference guide.
6. Shut down the controller with the following command:
SHUTDOWN THIS_CONTROLLER

NOTE: 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 button stops FLASHING and remains 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.

7. Remove the program card ESD cover and program card. Save them in an antistatic bag or on a grounded antistatic mat for use with the replacement controller.



CAUTION: For fiber optic cables without extender clips, thin needle-nose pliers must be used to remove the cable from the controller without potentially damaging the cable (see Figure 4-3).

8. Disconnect all host bus cables from the controller.
9. If connected, disconnect the PC or terminal from the controller maintenance port.
10. 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 Controller A guide rails. Misaligning the module might damage the backplane.
ESD can easily damage the controller. Wear a snug-fitting, grounded ESD wrist strap.

IMPORTANT: Ensure the program card is not installed in the replacement controller.

1. Insert the replacement controller into the Controller A bay (see Figure 4-2, 1), and engage the retaining levers.
2. Connect a PC or terminal to the replacement controller maintenance port.
3. Press and hold the reset button while inserting the program card into the replacement 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 CONFIGURATION 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?
 - No. Manually restore the current device configuration using existing information and the controller CLI reference guide.
 - Yes. Automatically restore the configuration as follows:

IMPORTANT: In the following step, if all port buttons *do not* begin FLASHING when the program card is inserted, continue holding the Port #6 button and then eject and reinsert the program card.

- a. Shut down the controller.
- b. Press and hold the Port #6 button (see Figure 4-4, ②).
- c. While continuing to hold the Port #6 button, press and release the Reset button until the port LEDs stop flashing.
- d. Release the Port #6 button to initiate the configuration restore.

The controller will load the saved configuration from disk and restart.

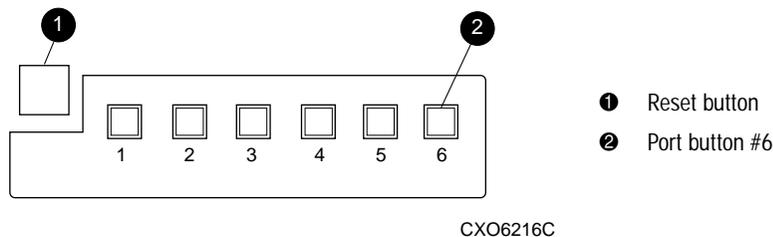


Figure 4-4. Location of array controller reset and port #6 buttons on the OCP

- e. Release the Port #6 button to initiate the configuration restore.
8. Using the code-load/code-patch utility (CLCP), install any patches that were installed on the previous controller (see Chapter 5).
9. Set the subsystem date and time using the following command:


```
SET THIS_CONTROLLER TIME=dd-mmm-yyyy:hh:mm:ss
```

10. Reconnect all host bus cables to the controller.
11. Mount the logical units on the host.
12. If using a Windows NT or Windows 2000 platform, restart the server.
13. 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 6.
2. From the host console, dismount the logical units in the subsystem.
3. If using a Windows NT or Windows 2000 platform, shut down the server.
4. Run FMU to obtain the last failure codes, if desired.
5. Shut down the controller with the following command:
`SHUTDOWN THIS_CONTROLLER`

NOTE: 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 button stops FLASHING and remains ON.
6. 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.
7. Remove the DIMMs from the cache module for use within the replacement cache module.

- a. Press down on the DIMM retaining clips 3 at both ends of the DIMM 1 being removed (see Figure 4-5).

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

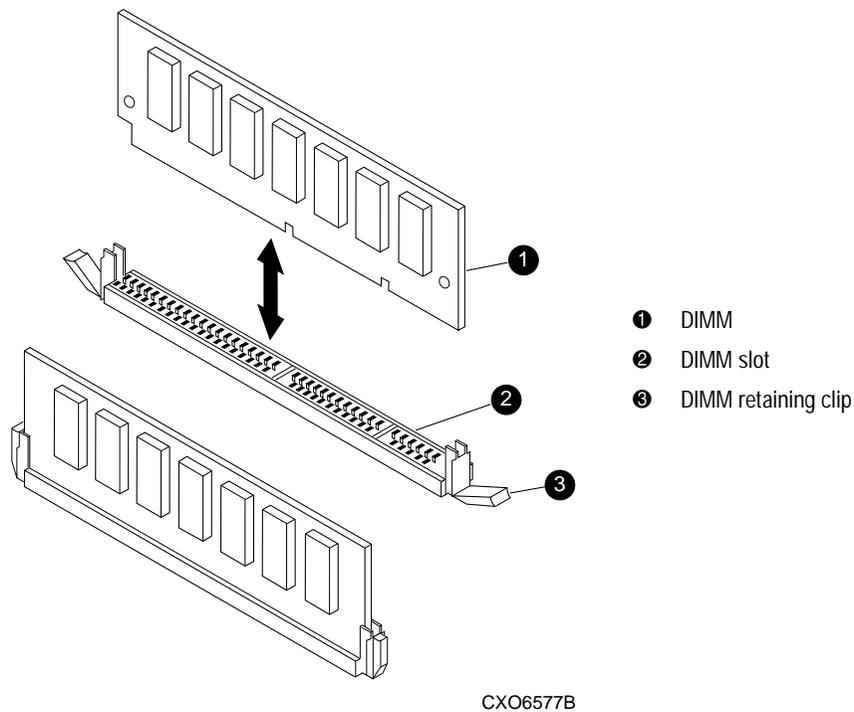


Figure 4-5. DIMM components

- b. Gently remove the DIMM from the DIMM slot 2 and place the DIMM in an antistatic bag or on a 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.

IMPORTANT: The replacement cache module *must* contain the same cache memory configuration as the module being replaced.

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



CAUTION: Carefully align the cache module in the Cache A guide rails. Misaligning the module might damage the backplane.

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

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

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

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

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

```
SHOW THIS_CONTROLLER FULL
```

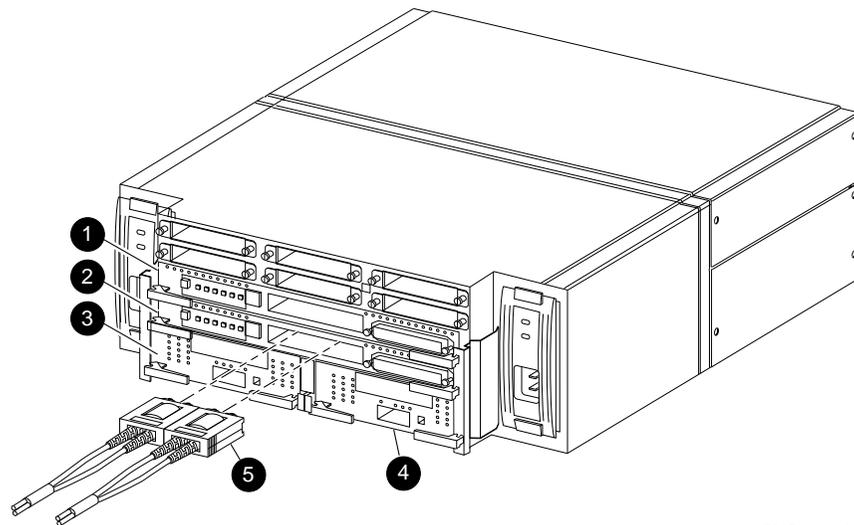
10. Set the subsystem date and time using the following command:

```
SET THIS_CONTROLLER TIME=dd-mmm-yyyy:hh:mm:ss
```

11. Mount the logical units on the host.
12. If using a Windows NT or Windows 2000 platform, restart the server.
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 4-6).



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- | | |
|----------------|--|
| ❶ Controller A | ❷ Cache B |
| ❸ Controller B | ❹ Fiber optic cables with extender clips |
| ❺ Cache A | |

Figure 4-6. Dual-redundant controller configuration in a Model 2200 enclosure

The following sections provide procedures for:

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



CAUTION: For fiber optic cables without extender clips, thin needle-nose pliers must be used to remove the cable from the controller without potentially damaging the cable (see Figure 4-3).

IMPORTANT: Note the following provisions before starting the replacement procedures:

- The replacement 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 replacement 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. Disable failover and take the controllers out of dual-redundant configuration with one of the following commands:
SET NOFAILOVER
or
SET NOMULTIBUS_FAILOVER
3. Remove the program card ESD cover and program card from the “other controller.” Save them in an antistatic bag or on a grounded antistatic mat for use with the replacement controller.

4. Start the field replacement utility (FRUTIL) with the following command:
RUN FRUTIL
5. Enter **N(o)** to the question about replacing the cache battery.
6. Enter **1** for the remove a controller or cache module option.
7. Enter **1** for the remove the “other controller” and cache module option.
8. 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.

9. Remove the “other controller”:



CAUTION: For fiber optic cables without extender clips, thin needle-nose pliers must be used to remove the cable from the controller without potentially damaging the cable (see Figure 4-3).

- a. Disconnect all host bus cables from the controller.
 - b. Disengage both retaining levers and remove the controller from the enclosure.
 - c. Place the controller in an antistatic bag or in a grounded antistatic mat.
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 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 down on the DIMM retaining clips 3 at both ends of the DIMM 1 being removed (see Figure 4-5).

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

- b. Gently remove the DIMM from the DIMM slot 2 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 1 straight into the appropriate slot 2 of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 4-5).
- e. Press the DIMM gently into the slot 2 until seated at both ends.
- f. Engage the two retaining clips 3 for the DIMM.
- g. Make sure both ends of the DIMM are firmly seated in the slot and both retaining clips engage the DIMM.
- h. Repeat step d through step g for each DIMM.
- i. Go to step 11 on page 4-17.

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.

IMPORTANT: The replacement cache module *must* contain the same cache memory configuration as the module being replaced.

1. Insert each DIMM 1 straight into the appropriate slot 2 of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 4-5).
2. Press the DIMM gently into the slot until seated at both ends.
3. Engage the two retaining clips 3 for the DIMM.

4. Make sure both ends of the DIMM are firmly seated in the slot and both retaining clips 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.



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.

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

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

12. Insert the replacement cache module into the appropriate bay and engage the retaining levers.
13. Install the replacement controller:
 - a. Make sure that the program card is seated in the controller.
 - b. Insert the controller into the appropriate bay, and engage the retaining levers.
NOTE: When fully seated, the controller starts automatically—the reset LED turns ON. A controller restart can take as long as 60 seconds, 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.
-

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

FRUTIL exits.

NOTE: In mirrored mode, FRUTIL initializes the mirrored portion of the replacement 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 on the “other controller.”

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 the CONFIGURATION RESET command in the controller CLI reference guide).

17. Enable failover and reestablish the dual-redundant controller configuration with one of the following commands:

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

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

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

```
SHOW THIS_CONTROLLER FULL
```

19. Reconnect all host bus cables to the controller.

20. 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. Disable failover and take the controllers out of dual-redundant configuration with one of the following commands:
SET NOFAILOVER
or
SET NOMULTIBUS_FAILOVER
3. Remove the program card ESD cover and program card from the “other controller.” Save them in an antistatic bag or on a grounded antistatic mat for use with the replacement controller.
4. Start FRUTIL with the following command:
RUN FRUTIL
5. Enter **N(o)** to the question about replacing the cache battery.
6. Enter **1** for the remove a controller or cache module option.
7. Enter **2** for the remove the “other controller” option.
8. 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.

9. Remove the “other controller”:



CAUTION: For fiber optic cables without extender clips, use thin needle-nose pliers to remove the cable from the controller without potentially damaging the cable (see Figure 4-3).

- a. Disconnect all host bus cables 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.

10. 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 a potential overtemperature condition.

- Yes. Go to step 6 on page 4-21.

Installing a Controller



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

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.”



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.

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

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.

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

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

A controller restart can take as long as 60 seconds, 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.
-

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

FRUTIL exits.

9. Install the program card ESD cover on the replacement controller.
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 the CONFIGURATION RESET command in the controller CLI reference guide).

11. Enable failover and reestablish the dual-redundant controller configuration with one of the following commands:

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

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

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

```
SHOW THIS_CONTROLLER FULL
```

13. Reconnect all host bus cables to the controller.
14. 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. Disable failover and take the controllers out of dual-redundant configuration with one of the following commands:

```
SET NOFAILOVER  
or  
SET NOMULTIBUS_FAILOVER
```
3. Start FRUTIL with the following command:

```
RUN FRUTIL
```

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

8. 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 in an antistatic bag.
9. 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 down on the DIMM retaining clips 3 at both ends of the DIMM 1 being removed (see Figure 4-5).
NOTE: To make pressing down on the DIMM retaining clips easier, use the eraser end of a pencil or a small screwdriver.
 - b. Gently remove the DIMM from the DIMM slot 2 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 1 straight into the appropriate slot 2 of the replacement cache module, ensuring that the notches in the DIMM align with the tabs in the slot (see Figure 4-5).

- e. Press the DIMM gently into the slot until seated at both ends.
- f. Engage the two retaining clips 3 for the DIMM.
- g. Make sure both ends of the DIMM are firmly seated in the slot and both retaining clips engage the DIMM.
- h. Repeat step d through step g for each DIMM.
- i. Go to step 11 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.

IMPORTANT: The replacement cache module *must* contain the same cache memory configuration as the module being replaced.

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



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.

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

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.

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

NOTE: The “other controller” restarts and then FRUTIL exits.

NOTE: A controller restart can take as long as 60 seconds, 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 replacement 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 reestablish the dual-redundant controller configuration with one of the following commands:

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

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

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

```
SHOW THIS_CONTROLLER FULL
```

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

Replacing an ECB

Model 2200 enclosure 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 4-7. When replacing an ECB (see Figure 4-8), match the vacant ECB bay with the cache module the ECB will support.

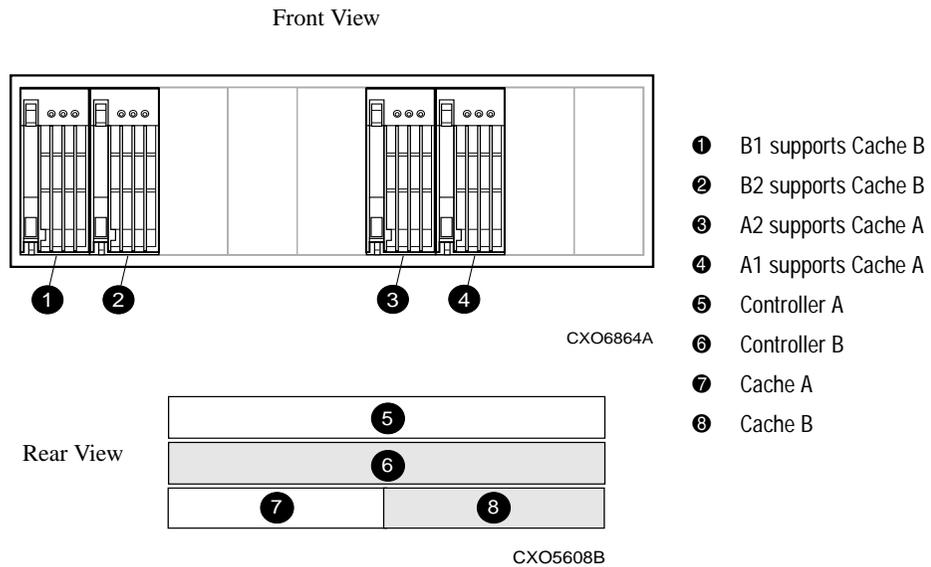


Figure 4-7. ECB and cache module locations in the Model 2200 enclosure

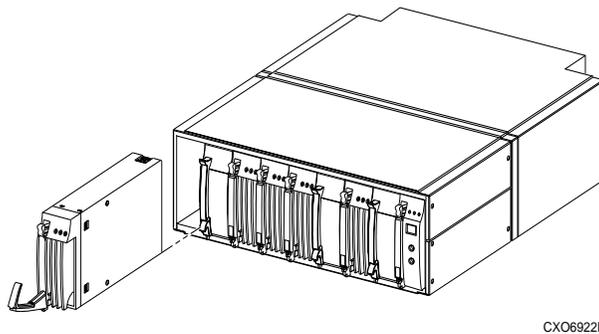


Figure 4-8. Removing an ECB that supports cache module B in the Model 2200 enclosure



WARNING: The ECB is a sealed, rechargeable, lead acid battery that must be recycled or disposed of properly according to local regulations or policies after replacement. *Do not* incinerate the battery. The ECB displays the following label:



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
```

If system time is not set or current, enter the current time using the following command:

```
SET THIS_CONTROLLER TIME=dd-mmm-yyyy:hh:mm:ss
```

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 4-9, 1).

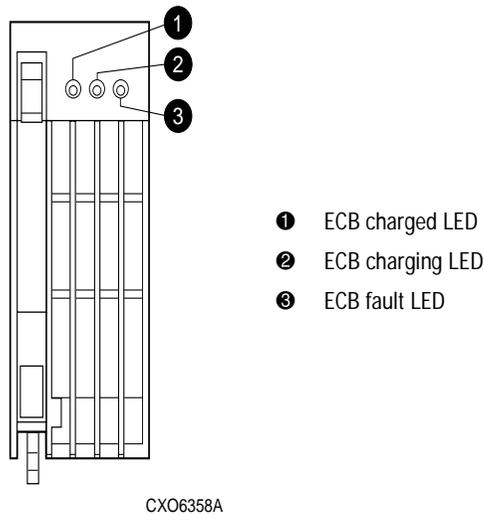


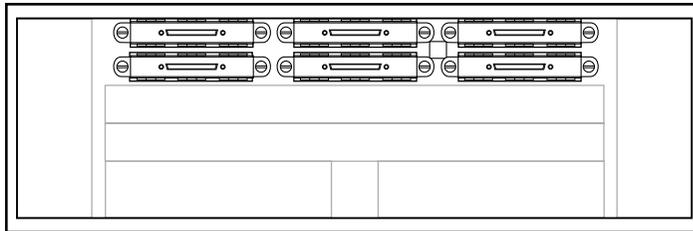
Figure 4-9. ECB status LEDs

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

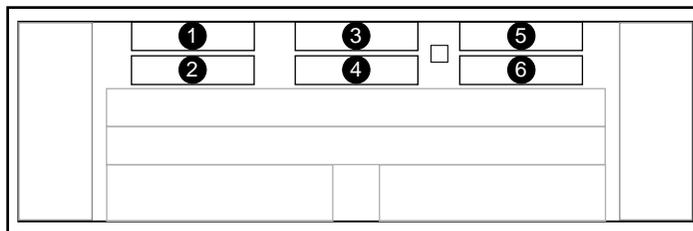
Figure 4-10 shows a rear view of the Model 2200 enclosure and the relative location of the six I/O modules (also referred to as ports), their connectors and securing screws. Figure 4-11 shows the SCSI bus correlation for each I/O module.

NOTE: Model 2200 enclosures with an HSG80HSJ80HSZ80 array controller provides support for 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. A controller can function with only one operational I/O module.



CXO7182A

Figure 4-10. I/O module locations in a Model 2200 enclosure



CXO7183A

Figure 4-11. I/O module bay to SCSI bus number correlation

Use the following steps to replace any number of failed 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 and take the controllers out of their dual-redundant configuration with one of the following commands:

```
SET NOFAILOVER
or
SET NOMULTIBUS_FAILOVER
```

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 the failed I/O modules:
 - a. Disconnect the SCSI bus cable from each failed I/O module (see Figure 4-11).
 - 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 seconds, 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.

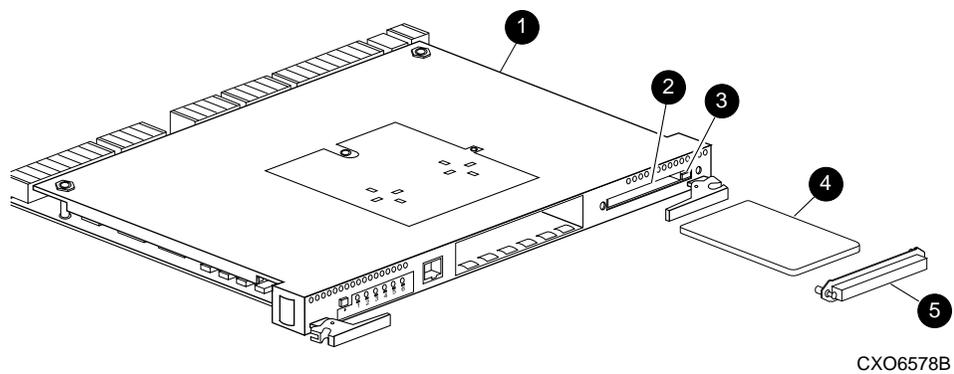
9. Enable failover and reestablish the dual-redundant configuration with one of the following commands:
SET FAILOVER COPY=THIS_CONTROLLER
or
SET MULTIBUS_FAILOVER COPY=THIS_CONTROLLER
This command copies the subsystem configuration from “this controller” to the “other controller.”
10. If desired, verify the failover configuration with the following command:
SHOW THIS_CONTROLLER FULL
11. Disconnect the PC or terminal from the controller maintenance port.

Chapter 5

Upgrade and Downgrade Procedures for ACS Version 8.6

Upgrading Controller Software

Upgrade controller software by installing a new program card (see Figure 5–1) that contains the new software.



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

Figure 5–1. Program (PCMCIA) card installation

Upgrading the Software Image

This section describes the supported upgrade methods and procedures required to successfully upgrade an HSG80 array controller ACS from Version 8.5 to Version 8.6. ACS Version 8.6 supports both dual-redundant controller rolling upgrade and dual-redundant controller shutdown upgrade methods. The rolling upgrade method allows the host system to continue I/O activity, with minimal impact, while each controller is upgraded. The shutdown upgrade method takes the storage devices offline for a period of time while the software is upgraded simultaneously on both controllers.



CAUTION: Failure to follow these upgrade procedures could result in the loss of data, or the controller could be left in an unusable state. Completely read and understand all of the required steps prior to beginning an upgrade procedure.

Do not use the procedures in this guide in an attempt to upgrade from ACS Version 8.3 or 8.4 to ACS Version 8.6. Significant down-time and data loss can result.

IMPORTANT: *Rolling upgrades* are supported when upgrading using any of the following scenarios:

- 8.5F to 8.6F, 8.6S, or 8.6P
- 8.5G to 8.6G, 8.6F, 8.6S, or 8.6P
- 8.5S to 8.6S or 8.6P
- 8.5P to 8.6P
- 8.5L to 8.6L

Shutdown upgrades are supported when transitioning from any ACS version supported by rolling upgrades, plus the following:

- 8.5S to 8.6F or 8.6G
- 8.5P to 8.6S

Any other ACS version upgrade is not supported.

Before beginning an upgrade procedure, determine which upgrade method to use:

- **Rolling Upgrade**—This method allows I/O activity to continue during the upgrade by using the failover capabilities of the controllers. Only one controller at a time is shut down to perform the upgrade, allowing the host system full access to the disk devices during the upgrade with minimal impact to the host systems.

- **Shutdown Upgrade**—This method requires the halting of I/O activity to the controllers during the upgrade. Both controllers are shut down during the upgrade procedure. Units are not available to the host system during this time. Before upgrading the controller software, the host system must be prepared for this by dismounting units or by shutting down the host system.

After determining the upgrade method, carefully follow the procedure for this method.



CAUTION: Failure to follow the selected upgrade procedure as presented could result in the loss of data, or leave the controller in an unusable state.

Upgrading to ACS Versions 8.6F, 8.6G, 8.6L, and 8.6S

Use this section only when upgrading to ACS Version 8.6G, 8.6F, 8.6L, and 8.6S. ACS Version 8.6P is upgraded using the procedures in the “Upgrading to ACS Version 8.6P Software.”

Rolling Upgrade Procedure

This upgrade procedure applies to dual-redundant controller configurations only, and allows the disk to be accessible during the upgrade process with minimal disruption. For single-controller configurations, see the “Shutdown Upgrade Procedure.” Specific controllers are referred to as Controller A or Controller B during the procedure. For clarity, the CLI prompts illustrated in the procedure use *HSGA*> and *HSGB*> to indicate which controller (A or B) is used.

IMPORTANT: The steps *must* be followed carefully for the upgrade procedure to work properly.

This procedure will take approximately 5 to 10 minutes depending upon the complexity of the configuration. The units involved will be briefly unavailable twice during the procedures for approximately 10 to 20 seconds in step 11 and step 13.

1. Connect a PC or terminal to the maintenance port of Controller A.
2. If the controller is running in SCSI-2 mode and the Command Console LUN (CCL) is enabled, you must disable the CCL prior to upgrading.

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- a. Determine if the controller is in SCSI-2 mode and the CCL is enabled using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following test is only a portion of the resulting display - arrows point to the pertinent status indication.

Controller:

```
HSG80                (C) DEC ZG80200258 Software V85P-0, Hardware E01
NODE_ID              = 5000-1FE1-0007-B780
ALLOCATION_CLASS      = 1
→ SCSI_VERSION       = SCSI-2
Configured for MULTIBUS_FAILOVER with ZG92810098
    In dual-redundant configuration
Device Port SCSI address 7
Time: 14-MAR-2001    15:44:25
→ Command Console LUN is lun 0 (IDENTIFIER = 0)
```

- b. If the controller is in SCSI-2 mode and the CCL is enabled, record the status for restoration in step .
- c. Disable the CCL using the following command:
HSGA> SET THIS_CONTROLLER NOCOMMAND_CONSOLE_LUN
3. If upgrading from ACS Version 8.5S to 8.6S, delete all snapshot units.
 - a. Identify all snapshot units using the following command:
HSGA> SHOW UNITS FULL
 - b. Record the configuration for each snapshot unit for restoration in step 18.
 - c. Individually delete all snapshot units using the following command:
HSGA> DELETE *snapshot-unit-name*
4. Verify that all appropriate units were deleted using the following command:
HSGA> SHOW UNITS FULL

IMPORTANT: If any snapshot unit exists, repeat step 3.

5. Identify and record the current `CACHE_FLUSH_TIMER` value using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

```
256 megabyte write cache, version 0022
```

```
Cache is GOOD
```

```
No unflushed data in cache
```

```
→ CACHE_FLUSH_TIMER=DEFAULT (10 seconds)
```

NOTE: The `CACHE_FLUSH_TIMER` value is displayed in the caching parameters section. This parameter is modified during the procedure and must be restored in step 16.

6. For each unit, identify and record the unit `WRITEBACK_CACHE` and `PREFERRED_PATH` characteristics using the following command:

```
HSGA> SHOW UNITS FULL
```

These characteristics are modified during the upgrade procedure and must be restored in step 17.

NOTE: The Preferred Path switch is only available with a multiple-bus configuration. It is not available in the transparent failover mode.

7. Set the `CACHE_FLUSH_TIMER` to 1 second using the following commands:

```
HSGA> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=1
```

```
HSGA> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=1
```

8. Clear any unit with `PREFERRED_PATH` set, using the following command as required for each unit:

```
HSGA> SET unit-name NOPREFERRED_PATH
```

9. Disable writeback caching on all units using the following command as required for each unit:

```
HSGA> SET unit-name NOWRITEBACK_CACHE
```

10. Determine if all data has been flushed from the cache module, using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

256 megabyte write cache, version 0022



Cache is GOOD

No unflushed data in cache

CACHE_FLUSH_TIMER=1 SECOND

IMPORTANT: Repeat step 10 on both controllers (THIS_CONTROLLER and OTHER_CONTROLLER) until no unwritten data remains in either cache module memory.

If unwritten data is present after several minutes, verify that WRITEBACK_CACHE was disabled on all units using the SHOW UNITS FULL command. For any units with WRITEBACK_CACHE enabled, return to step 9 and proceed.

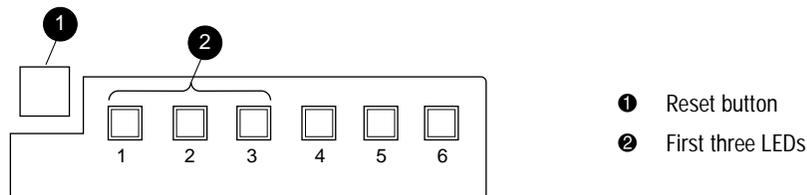
11. Shut down Controller B using the following command:

HSGA> SHUTDOWN OTHER_CONTROLLER

IMPORTANT: Disregard any messages pertaining to misconfigured controllers or failover status.

NOTE: After Controller B shuts down, the reset button and the first three LEDs turn ON (see Figure 5-2).

Proceed only after the reset button stops FLASHING and remains ON.



CXO6991A

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

12. Verify that all units failed over to Controller A by using the following command to show the status of each unit:

HSGA> SHOW UNITS FULL

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

State:

- ONLINE to this controller
- Not reserved
- NOPREFERRED_PATH

13. Upgrade the software on Controller B by performing the following steps:

IMPORTANT: Once step 13 is successfully performed, the previous ACS version cannot be restored to this subsystem.

- a. Remove the program card ESD cover from Controller B.
- b. Press and hold the controller reset button while ejecting the old program card.
- c. After ejecting the program card, release the reset button.
- d. Press and hold the reset button while inserting the new program card.
- e. After the card is fully inserted, release the button. Controller B restarts.

NOTE: A controller restart can take as long as 60 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button. Disregard messages pertaining to misconfigured controllers or failover status. When controller B has restarted, it will automatically shutdown controller A.

- f. Install the program card ESD cover on Controller B.

14. Verify that Controller B completed initialization:

- a. Connect the PC or terminal to the maintenance port of Controller B.
- b. Make sure that the CLI prompt for Controller B appears.

IMPORTANT: Wait for the CLI prompt before proceeding.

- c. Verify controller A is shutdown, the reset button and the first three LEDs turn on (See Figure 5-2). Proceed only after the reset button stops flashing and remains on.

15. Upgrade the software on controller A by performing the following steps:

- a. Remove the program card ESD cover from Controller A.
- b. Press and hold the controller reset button while ejecting the old program card.
- c. After ejecting the program card, release the reset button.
- d. Press and hold the reset button while inserting the new program card.

- e. After the card is fully inserted, release the button.
NOTE: A controller restart can take as long as 60 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button. Disregard messages pertaining to misconfigured controllers or failover status.
 - f. Install the program card ESD cover on Controller A.
16. After Controller A restarts, restore the `CACHE_FLUSH_TIMER` to the value recorded in step 5 using the following commands:
- ```
HSGA> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=n
HSGA> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=n
```
17. For each unit, restore the `PREFERRED_PATH` and `WRITEBACK_CACHE` settings as recorded in step 6 using the following command:
- ```
HSGA> SET unit-name PREFERRED_PATH=THIS_CONTROLLER WRITEBACK_CACHE
```
18. Restore all snapshot units removed in step 3.
19. If the CCL was disabled in step 2, enable it using the following command:
- ```
HSGA> SET THIS_CONTROLLER COMMAND_CONSOLE_LUN
```
20. Disconnect the PC or terminal from the maintenance port of Controller A.

## Shutdown Upgrade Procedure

This upgrade procedure applies to dual-redundant controller configurations and all single-controller configurations. Specific controllers are referred to as Controller A or Controller B during the procedure. For clarity, the CLI prompts illustrated in this procedure use `HSGA>` and `HSGB>` to indicate which controller (A or B) is used.

---

**IMPORTANT:** The following steps *must* be followed carefully for the upgrade procedure to work properly.

The procedure will take approximately 5 minutes.

---

**NOTE:** This procedure is written for dual-redundant controller configurations. If upgrading a single-controller configuration, disregard references to multiple controllers and Controller B.

1. From a host console, stop all host activity to the controllers and dismount the logical units in the subsystem.
2. If the controller is running in SCSI-2 mode and the Command Console LUN (CCL) is enabled, you must disable the CCL prior to upgrading.

- a. Determine if the controller is in SCSI-2 mode and the CCL is enabled using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following test is only a portion of the resulting display - arrows point to the pertinent status indication.

Controller:

```
HSG80 (C) DEC ZG80200258 Software V85P-0, Hardware E01
NODE_ID = 5000-1FE1-0007-B780
ALLOCATION_CLASS = 1
→ SCSI_VERSION = SCSI-2
Configured for MULTIBUS_FAILOVER with ZG92810098
 In dual-redundant configuration
Device Port SCSI address 7
Time: 14-MAR-2001 15:44:25
→ Command Console LUN is lun 0 (IDENTIFIER = 0)
```

- b. If the controller is in SCSI-2 mode and the CCL is enabled, record the status for restoration in step .
- c. Disable the CCL using the following command:  
HSGA> SET THIS\_CONTROLLER NOCOMMAND\_CONSOLE\_LUN
3. Connect a PC or terminal to the maintenance port of Controller A.
4. If upgrading from ACS Version 8.5S to 8.6S, delete all snapshot units.
  - a. Identify all snapshot units using the following command:  
HSGA> SHOW UNITS FULL
  - b. Record the configuration for each snapshot unit for restoration in step 12.
  - c. Individually delete all snapshot units using the following command:  
HSGA> DELETE *snapshot-unit-name*
5. Verify that all appropriate units were deleted using the following command:  
HSGA> SHOW UNITS FULL

---

**IMPORTANT:** If any snapshot unit exists, repeat step 4.

---

6. Identify and record the current `CACHE_FLUSH_TIMER` value using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

```
256 megabyte write cache, version 0022
```

```
Cache is GOOD
```

```
No unflushed data in cache
```

```
→ CACHE_FLUSH_TIMER=DEFAULT (10 seconds)
```

**NOTE:** The `CACHE_FLUSH_TIMER` value is displayed in the caching parameters section. This parameter is modified during the procedure and must be restored in step 11.

7. Set the `CACHE_FLUSH_TIMER` to 1 second using the following commands:

```
HSGA> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=1
```

```
HSGA> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=1
```

8. Determine if all data has been flushed from the cache module, using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

```
256 megabyte write cache, version 0022
```

```
Cache is GOOD
```

```
→ No unflushed data in cache
```

```
CACHE_FLUSH_TIMER=1 SECOND
```

---

**IMPORTANT:** Repeat step 8 on both controllers (`THIS_CONTROLLER` and `OTHER_CONTROLLER`) until no unwritten data remains in either cache module memory.

---

9. Shut down both controllers using the following commands:

```
HSGA> SHUTDOWN OTHER_CONTROLLER
```

```
HSGA> SHUTDOWN THIS_CONTROLLER
```

**NOTE:** After the controllers shut down, the reset buttons and the first three LEDs turn ON (see Figure 5-2).

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

10. Upgrade the software on both controllers:

- a. Remove the program card ESD cover from Controller A.
- b. Press and hold the reset button while ejecting the old program card.
- c. After the program card is ejected, release the reset button.
- d. Repeat step a through step c for Controller B.

---

**IMPORTANT:** In step e and step f, the simultaneous release of the reset buttons is critical to make sure that both controllers are restarted and upgraded simultaneously.

---

- e. Simultaneously press and hold the reset button on both controllers, and insert a new program card into each controller.
- f. Simultaneously release the reset buttons. Both controllers restart.

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

- g. Install a program card ESD cover on each controller.

11. After the controllers restart, restore the `CACHE_FLUSH_TIMER` to the value recorded in step 6 using the following commands:

```
HSGB> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=n
HSGB> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=n
```

12. Restore all snapshot units removed in step 4.

13. If the CCL was disabled in step 2, enable it using the following command:

```
HSGA> SET THIS_CONTROLLER COMMAND_CONSOLE_LUN
```

14. Mount the logical units on the host.

15. Disconnect the PC or terminal from the maintenance port of Controller A.

## Upgrading to ACS Version 8.6P Software

ACS Version 8.6P implements the Data Replication Manager (DRM) feature, which can also be upgraded using either a rolling or shutdown upgrade method. These upgrade methods apply only to dual-redundant controller configurations.

## Rolling Upgrade Procedure for 8.6P

The rolling upgrade procedure allows the disk to be accessible during the upgrade process with minimal disruption. Specific controllers are referred to as Controller A or Controller B during the procedure. For clarity, the CLI prompts illustrated in the procedure use *HSGA>* and *HSGB>* to indicate which controller (A or B) is used.

---

**IMPORTANT:** The following steps *must* be followed carefully for the upgrade procedure to work properly.

This procedure will take approximately 10 to 20 minutes depending upon the complexity of the configuration. The units involved will be briefly unavailable twice during the procedures for approximately 10 to 20 seconds in step 12 and step 16.

---

**NOTE:** The rolling upgrade procedure upgrades the initiator site controllers to a specific point and then fully upgrades the target site controllers before finalizing the upgrade for the initiator site controllers.

Begin the rolling upgrade by using the following procedure on the initiator site controllers:

1. Connect a PC or terminal to the maintenance port of Controller A, at the initiator site.
2. If the controller is running in SCSI-2 mode and the Command Console LUN (CCL) is enabled, you must disable the CCL prior to upgrading.
  - a. Determine if the controller is in SCSI-2 mode and the CCL is enabled using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following test is only a portion of the resulting display - arrows point to the pertinent status indication.

Controller:

```
HSG80 (C) DEC ZG80200258 Software V85P-0, Hardware E01
NODE_ID = 5000-1FE1-0007-B780
ALLOCATION_CLASS = 1
→ SCSI_VERSION = SCSI-2
Configured for MULTIBUS_FAILOVER with ZG92810098
 In dual-redundant configuration
Device Port SCSI address 7
Time: 14-MAR-2001 15:44:25
→ Command Console LUN is lun 0 (IDENTIFIER = 0)
```

b. If the controller is in SCSI-2 mode and the CCL is enabled, record the status for restoration in step .

c. Disable the CCL using the following command:

```
HSGA> SET THIS_CONTROLLER NOCOMMAND_CONSOLE_LUN
```

3. Delete any snapshot units using the following commands:

a. Identify all snapshot units using the following command:

```
HSGA> SHOW UNITS FULL
```

b. Record the configuration for each snapshot unit for later restoration.

c. Individually delete all snapshot units using the following command:

```
HSGA> DELETE snapshot-unit-name
```

4. Verify that all snapshot units were deleted using the following command:

```
HSGA> SHOW UNITS FULL
```

---

**IMPORTANT:** If any snapshot unit exists, repeat step 3.

---

5. Identify and record the current `CACHE_FLUSH_TIMER` value using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

```
256 megabyte write cache, version 0022
```

```
Cache is GOOD
```

```
No unflushed data in cache
```

```
→ CACHE_FLUSH_TIMER=DEFAULT (10 seconds)
```

**NOTE:** The `CACHE_FLUSH_TIMER` value is displayed in the caching parameters section. This parameter is modified during the procedure and must be restored later.

6. For each unit, identify and record the unit `WRITEBACK_CACHE` characteristics using the following command:

```
HSGA> SHOW UNITS FULL
```

**NOTE:** This is modified during the upgrade procedure and must be restored later.

7. Set the `CACHE_FLUSH_TIMER` to 1 second using the following commands:

```
HSGA> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=1
HSGA> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=1
```

8. Disable writeback caching on all units using the following command as required for each unit:

```
HSGA> SET unit-name NOWRITEBACK_CACHE
```

9. Determine if all data has been flushed from the cache module, using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

```
 256 megabyte write cache, version 0022
 Cache is GOOD
 → No unflushed data in cache
 CACHE_FLUSH_TIMER=1 SECOND
```

---

**IMPORTANT:** Repeat step 9 on both controllers (`THIS_CONTROLLER` and `OTHER_CONTROLLER`) until no unwritten data remains in either cache module memory.

If unwritten data is present after several minutes, verify that `WRITEBACK_CACHE` was disabled on all units using the `SHOW UNITS FULL` command. For any units with `WRITEBACK_CACHE` enabled, return to step 8 and proceed.

---

10. Shut down Controller B using the following command:

```
HSGA> SHUTDOWN OTHER_CONTROLLER
```

---

**IMPORTANT:** Disregard any messages pertaining to misconfigured controllers or failover status.

---

**NOTE:** After Controller B shuts down, the reset button and the first three LEDs turn ON (see Figure 5-3).

Proceed only after the reset button stops FLASHING and remains ON.

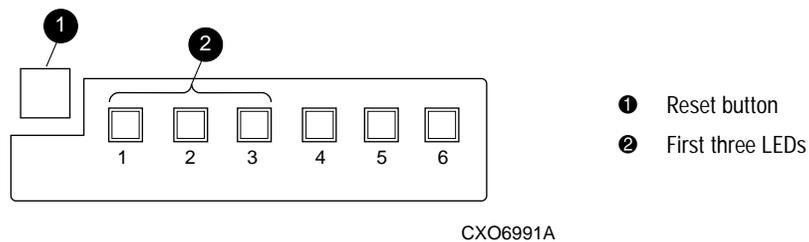


Figure 5-3. Controller reset button and first three LEDs

11. Verify that all units failed over to Controller A by using the following command to show the status of each unit:

```
HSGA> SHOW UNITS FULL
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

State:

```
→ ONLINE to this controller
 Not reserved
```

12. Upgrade the software on Controller B by performing the following steps:

---

**IMPORTANT:** Once step 12 is performed, the previous ACS version cannot be restored to this subsystem.

---

- a. Remove the program card ESD cover from Controller B.
- b. Press and hold the controller reset button while ejecting the old program card.
- c. After ejecting the program card, release the reset button.
- d. Press and hold the reset button while inserting the new program card.
- e. After the card is fully inserted, release the button. Controller B restarts.

**NOTE:** A controller restart can take as long as 60 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button. Disregard messages pertaining to misconfigured controllers or failover status. When controller B has restarted, it will automatically shutdown Controller A.

- f. Install the program card ESD cover on Controller B.

13. Verify that Controller B completed initialization:

- a. Connect the PC or terminal to the maintenance port of Controller B.

- b. Make sure that the CLI prompt for Controller B appears.

---

**IMPORTANT:** Wait for the CLI prompt before proceeding.

---

- c. Verify Controller A is shutdown, the reset button and the first three LEDs turn on (See Figure 5-2). Proceed only after the reset button stops flashing and remains on.

14. Upgrade the software on Controller A by performing the following steps:

- a. Remove the program card ESD cover from Controller A.
- b. Press and hold the controller reset button while ejecting the old program card.
- c. After ejecting the program card, release the reset button.
- d. Press and hold the reset button while inserting the new program card.
- e. After the card is fully inserted, release the button.

**NOTE:** A controller restart can take as long as 60 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button. Disregard messages pertaining to misconfigured controllers or failover status.

- f. Install the program card ESD cover on Controller A.



**CAUTION:** Stop at this point when upgrading the initiator site controllers and proceed to upgrade the target site controllers.

Failure to stop at this point, without fully upgrading the target site controllers, could cause the initiator and target site controllers to crash and prevent the host from accessing data storage in these subsystems.

---

Continue the rolling upgrade by using the following procedure on the target site controllers:

**NOTE:** During the target site upgrade, one of the initiator site controllers could restart with an instance code of 0xE096980. This potential restart is expected and the associated instance code can be disregarded.

1. Connect a PC or terminal to the maintenance port of Controller A, at the target site.
2. Delete any snapshot units using the following commands:
  - a. Identify all snapshot units using the following command:  
HSGA> SHOW UNITS FULL
  - b. Record the configuration for each snapshot unit for later restoration.

- c. Individually delete all snapshot units using the following command:

```
HSGA> DELETE snapshot-unit-name
```

3. Verify that all snapshot units were deleted using the following command:

```
HSGA> SHOW UNITS FULL
```

---

**IMPORTANT:** If any snapshot unit exists, repeat step 3.

---

4. Identify and record the current `CACHE_FLUSH_TIMER` value using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

```
256 megabyte write cache, version 0022
```

```
Cache is GOOD
```

```
No unflushed data in cache
```

```
→ CACHE_FLUSH_TIMER=DEFAULT (10 seconds)
```

**NOTE:** The `CACHE_FLUSH_TIMER` value is displayed in the caching parameters section. This parameter is modified during the procedure and must be restored in step 15.

5. For each unit, identify and record the unit `WRITEBACK_CACHE` characteristic using the following command:

```
HSGA> SHOW UNITS FULL
```

**NOTE:** This is modified during the upgrade procedure and must be restored in step 16.

6. Set the `CACHE_FLUSH_TIMER` to 1 second using the following commands:

```
HSGA> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=1
```

```
HSGA> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=1
```

7. Disable writeback caching on all units to help minimize the failover time, using the following command as required for each unit:

```
HSGA> SET unit-name NOWRITEBACK_CACHE
```

8. Determine if all data has been flushed from the cache module, using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

256 megabyte write cache, version 0022

Cache is GOOD

→ No unflushed data in cache

CACHE\_FLUSH\_TIMER=1 SECOND

---

**IMPORTANT:** Repeat step 9 on both controllers (THIS\_CONTROLLER and OTHER\_CONTROLLER) until no unwritten data remains in either cache module memory.

If unwritten data is present after several minutes, verify that WRITEBACK\_CACHE was disabled on all units using the SHOW UNITS FULL command. For any units with WRITEBACK\_CACHE enabled, return to step 8 and proceed.

---

9. Shut down Controller B using the following command:

```
HSGA> SHUTDOWN OTHER_CONTROLLER
```

---

**IMPORTANT:** Disregard any messages pertaining to misconfigured controllers or failover status.

---

**NOTE:** After Controller B shuts down, the reset button and the first three LEDs turn ON (see Figure 5-3).

Proceed only after the reset button stops FLASHING and remains ON.

10. Verify that all units failed over to Controller A by using the following command to show the status of each unit:

```
HSGA> SHOW UNITS FULL
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

State:

→ ONLINE to this controller

Not reserved

11. Upgrade the software on Controller B by performing the following steps:

---

**IMPORTANT:** Once step 12 is performed, the previous ACS version cannot be restored to this subsystem.

---

- a. Remove the program card ESD cover from Controller B.
- b. Press and hold the controller reset button while ejecting the old program card.
- c. After ejecting the program card, release the reset button.
- d. Press and hold the reset button while inserting the new program card.
- e. After the card is fully inserted, release the button. Controller B restarts.

**NOTE:** A controller restart can take as long as 60 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button. Disregard messages pertaining to misconfigured controllers or failover status. When controller B has restarted, it will automatically shutdown Controller A.

- f. Install the program card ESD cover on Controller B.

Controller A shuts down.

12. After Controller B restarts, verify that Controller B completed initialization:

- a. Connect the PC or terminal to the maintenance port of Controller B.
- b. Make sure that the CLI prompt for Controller B appears.

---

**IMPORTANT:** Wait for the CLI prompt before proceeding.

---

- c. Verify controller A is shutdown, the reset button and the first three LEDs turn on (See Figure 5-2). Proceed only after the reset button stops flashing and remains on.

13. Upgrade the software on controller A by performing the following steps:

- a. Remove the program card ESD cover from Controller A.
- b. Press and hold the controller reset button while ejecting the old program card.
- c. After ejecting the program card, release the reset button.
- d. Press and hold the reset button while inserting the new program card.
- e. After the card is fully inserted, release the button.

**NOTE:** A controller restart can take as long as 60 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button. Disregard messages pertaining to misconfigured controllers or failover status.

- f. Install the program card ESD cover on Controller A. Controller A shuts down.

14. After Controller A restarts, restore the `CACHE_FLUSH_TIMER` to the value recorded in step 5 using the following commands:

```
HSGA> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=n
HSGA> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=n
```

15. For each unit, restore the `WRITEBACK_CACHE` settings as recorded in step 6 using the following command:

```
HSGA> SET unit-name WRITEBACK_CACHE
```

16. Restore all snapshot units removed in step 3.

17. If the CCL was disabled in step 2, enable it using the following command:

```
HSGA> SET THIS_CONTROLLER COMMAND_CONSOLE_LUN
```

18. Disconnect the PC or terminal from the maintenance port of Controller A.

After upgrading the target site controllers, return to step 15 and proceed to complete the initiator site controllers upgrade.

## Shutdown Upgrade Procedure for 8.6P

Specific controllers are referred to as Controller A or Controller B during the procedure. For clarity, the CLI prompts illustrated in this procedure use `HSGA>` and `HSGB>` to indicate which controller (A or B) is used.

---

**IMPORTANT:** The following steps *must* be followed carefully for the upgrade procedure to work properly.

This procedure will take approximately 5 to 10 minutes. The units involved will be unavailable during the upgrade procedure.

---

Begin the shutdown upgrade using the following procedure on the initiator site controllers:

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 Controller A, at the initiator site.
3. If the controller is running in SCSI-2 mode and the Command Console LUN (CCL) is enabled, you must disable the CCL prior to upgrading.
  - a. Determine if the controller is in SCSI-2 mode and the CCL is enabled using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following test is only a portion of the resulting display - arrows point to the pertinent status indication.

Controller:

```

HSG80 (C) DEC ZG80200258 Software V85P-0, Hardware E01
NODE_ID = 5000-1FE1-0007-B780
ALLOCATION_CLASS = 1
→ SCSI_VERSION = SCSI-2
Configured for MULTIBUS_FAILOVER with ZG92810098
 In dual-redundant configuration
Device Port SCSI address 7
Time: 14-MAR-2001 15:44:25
→ Command Console LUN is lun 0 (IDENTIFIER = 0)

```

b. If the controller is in SCSI-2 mode and the CCL is enabled, record the status for restoration in step .

c. Disable the CCL using the following command:

```
HSGA> SET THIS_CONTROLLER NOCOMMAND_CONSOLE_LUN
```

4. If upgrading from ACS Version 8.5P to 8.6P or 8.6S, delete all snapshot units.

a. Identify all snapshot units using the following command:

```
HSGA> SHOW UNITS FULL
```

b. Record the configuration for each snapshot unit for later restoration.

c. Individually delete all snapshot units using the following command:

```
HSGA> DELETE snapshot-unit-name
```

5. Verify that all snapshot units were deleted using the following commands, as required:

```
HSGA> SHOW UNITS FULL
```

---

**IMPORTANT:** If any snapshot unit exists, repeat step 4.

---

6. Identify and record the current CACHE\_FLUSH\_TIMER value using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

256 megabyte write cache, version 0022

Cache is GOOD

No unflushed data in cache

→ CACHE\_FLUSH\_TIMER=DEFAULT (10 seconds)

**NOTE:** The CACHE\_FLUSH\_TIMER value is displayed in the caching parameters section. This parameter is modified during the procedure and must be restored later.

7. Set the CACHE\_FLUSH\_TIMER to 1 second to minimize the flush time, using the following commands:

```
HSGA> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=1
```

```
HSGA> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=1
```

8. Determine if all data has been flushed from the cache module, using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

256 megabyte write cache, version 0022

Cache is GOOD

→ No unflushed data in cache

CACHE\_FLUSH\_TIMER=1 SECOND

---

**IMPORTANT:** Repeat step 8 on both controllers (THIS\_CONTROLLER and OTHER\_CONTROLLER) until no unwritten data remains in either cache module memory.

---

9. Shut down both controllers using the following commands:

```
HSGA> SHUTDOWN OTHER_CONTROLLER
```

```
HSGA> SHUTDOWN THIS_CONTROLLER
```

**NOTE:** After the controllers shut down, the reset buttons and the first three LEDs turn ON (see Figure 5-3). This could take several minutes, 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.

10. Upgrade the software on both controllers:

- a. Remove the program card ESD cover from Controller A.
- b. Press and hold the reset button while ejecting the old program card.
- c. After the program card is ejected, release the reset button.
- d. Repeat step a through step c for Controller B.

---

**IMPORTANT:** In step e and step f, the simultaneous release of the reset buttons is critical to make sure that both controllers are restarted and upgraded simultaneously.

---

- e. Simultaneously press and hold the reset button on both controllers, and insert a new program card into each controller.
- f. Simultaneously release the reset buttons. Both controllers restart.

**NOTE:** A controller restart can take as long as 60 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button. Disregard messages pertaining to misconfigured controllers or failover status.

- g. Install a program card ESD cover on each controller.



**CAUTION:** Stop at this point when upgrading the initiator site controllers and proceed to upgrade the target site controllers.

Failure to stop at this point, without fully upgrading the target site controllers, could cause the initiator and target site controllers to crash and prevent the host from accessing data stored in these subsystems.

---

Continue the shutdown upgrade procedure using the following procedure on the target site controllers:

**NOTE:** During the target site upgrade, one of the initiator site controllers could restart with an instance code of 0xE096980. This potential restart is expected and the associated instance code can be disregarded.

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 Controller A, at the target site.
3. Delete all snapshot units.
  - a. Identify all snapshot units using the following command:  
HSGA> SHOW UNITS FULL
  - b. Record the configuration for each snapshot unit for restoration in step 12.

- c. Individually delete all snapshot units using the following command:

```
HSGA> DELETE snapshot-unit-name
```

4. Verify that all snapshot units were deleted using the following commands, as required:

```
HSGA> SHOW UNITS FULL
```

---

**IMPORTANT:** If any snapshot unit exists, repeat step 4.

---

5. Identify and record the current `CACHE_FLUSH_TIMER` value using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

```
256 megabyte write cache, version 0022
```

```
Cache is GOOD
```

```
No unflushed data in cache
```

```
→ CACHE_FLUSH_TIMER=DEFAULT (10 seconds)
```

**NOTE:** The `CACHE_FLUSH_TIMER` value is displayed in the caching parameters section. This parameter is modified during the procedure and must be restored in step 11.

6. Set the `CACHE_FLUSH_TIMER` to 1 second using the following commands:

```
HSGA> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=1
```

```
HSGA> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=1
```

7. Determine if all data has been flushed from the cache module, using the following command:

```
HSGA> SHOW THIS_CONTROLLER
```

The following text is only a portion of the resulting display—an arrow points to the pertinent status indication:

Cache:

```
256 megabyte write cache, version 0022
```

```
Cache is GOOD
```

```
→ No unflushed data in cache
```

```
CACHE_FLUSH_TIMER=1 SECOND
```

---

**IMPORTANT:** Repeat step 8 on both controllers (THIS\_CONTROLLER and OTHER\_CONTROLLER) until no unwritten data remains in either cache module memory.

---

8. Shut down both controllers using the following commands:

```
HSGA> SHUTDOWN OTHER_CONTROLLER
HSGA> SHUTDOWN THIS_CONTROLLER
```

**NOTE:** After the controllers shut down, the reset buttons and the first three LEDs turn ON (see Figure 5-3). This could take several minutes, 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.

9. Upgrade the software on both controllers:

- a. Remove the program card ESD cover from Controller A.
- b. Press and hold the reset button while ejecting the old program card.
- c. After the program card is ejected, release the reset button.
- d. Repeat step a through step c for Controller B.

---

**IMPORTANT:** In step e and step f, the simultaneous release of the reset buttons is critical to make sure that both controllers are restarted and upgraded simultaneously.

---

- e. Simultaneously press and hold the reset button on both controllers, and insert a new program card into each controller.
- f. Simultaneously release the reset buttons. Both controllers restart.

**NOTE:** A controller restart can take as long as 60 seconds, indicated by the temporary cycling of the port LEDs and a FLASHING reset button. Disregard messages pertaining to misconfigured controllers or failover status.

- g. Install a program card ESD cover on each controller.

10. After the controllers restart, restore the CACHE\_FLUSH\_TIMER to the value recorded in step 6 using the following commands:

```
HSGB> SET THIS_CONTROLLER CACHE_FLUSH_TIMER=n
HSGB> SET OTHER_CONTROLLER CACHE_FLUSH_TIMER=n
```

11. Restore all snapshot units removed in step 4.

12. If the CCL was disabled in step 2, enable it using the following command:

```
HSGA> SET THIS_CONTROLLER COMMAND_CONSOLE_LUN
```

13. Mount the logical units on the host.

14. Disconnect the PC or terminal from the maintenance port of Controller A.
15. After upgrading the target site controllers, return to step 11 and proceed to complete the initiator site controllers upgrade.

## Downgrading Controller Software

This document describes the procedures necessary to downgrade the HSG80 controller from the Array Controller Software (ACS) Version 8.6 to Version 8.5. Downgrading controllers to the previous version should be done only by Compaq authorized service personnel. Failure to properly follow the downgrade procedures may result in the loss of data.

Prior to downgrading, all units must be dismantled from the host operating system. There must not be any I/O activity to the controller pair that is to be downgraded. All raidsets, mirrorsets, and remote copysets must be normalized. Any snapshot units must be deleted prior to beginning the downgrade procedure.

The following controller information will be lost during the downgrade procedure:

1. Host information that is stored in the expanded area of the host definition tables.
2. The HBA reservation style information will be converted to the standard reservation style.



**CAUTION:** Any storage sets or disk devices created or initialized while running V8.6 will be inaccessible after the downgrade to Version 8.5. The associated units will have MEDIA FORMAT ERROR as the state of the unit. These units must be deleted and added again while running the downgraded Version 8.5.

---

Both controllers will need to be downgraded prior to starting V8.5. In other words, both controllers must be stopped with a 39 LED code on the port buttons, before restarting them with V8.5.

## Running the Program

Enter the following command to run the program:

```
HSG80> run dwngrd
```

The following is displayed:

Downgrade Program Invoked

This program will reconfigure the controller's memory to permit the controller to run ACS Version 8.5.

Before the procedure can be run, all units must be dismounted from the host operating system.

Both controllers must be downgraded prior to restarting ACS Version 8.5.

Are you sure that you want to run the downgrade procedure (Y/[N]) ?

This is the first point that you can exit the program without making any changes to the controllers' configuration. The program will only continue if you answer **yes** to this prompt, all other responses are assumed to be **no**, and the program exits.

The downgrade program will test for snapshot units on the controller. If snapshot units are found, the program will display the following message and exit:

The following snapshot units exist on this controller:

D20  
D40

The controller cannot downgrade to ACS V8.5 until all snapshot units have been deleted.

Downgrade program exiting.

If the host configuration expands into the new area for the enlarged host support table, the information on those host systems will be lost. The downgrade program will display the information about those hosts and will give you the opportunity to exit before continuing.

The following host information will be lost during this downgrade:

| Name    | Host Id             | Adapter Id          | Control | Port | Offset | RStyle |
|---------|---------------------|---------------------|---------|------|--------|--------|
| -----   | -----               | -----               | -----   | ---- | -----  | -----  |
| Alpha1  | 0123-4567-8901-1234 | 0123-4567-8901-1234 | this    | 1    | 0      | Std    |
| NtSrv05 | 9876-5432-0543-1234 | 9876-5432-0543-1234 | this    | 1    | 0      | Std    |

You can exit if you need to reconfigure your systems or record this information.

Do you want to continue the downgrade procedure (Y/ [N]) ?

ACS Version 8.6 adds a new switch to the connection to modify the behavior of Persistent Reservations. Since this switch does not exist in V8.5, it will be removed from all connections that have it defined. The following will be displayed if there are connections using the new reservation style and you will be given the opportunity to exit before continuing.

The following connections will have the reservation style changed:

| Name   | Host Id             | Adapter Id          | Control | Port | Offset | RStyle |
|--------|---------------------|---------------------|---------|------|--------|--------|
| -----  | -----               | -----               | -----   | ---- | -----  | -----  |
| Alpha2 | 1003-4527-8001-1434 | 1003-4527-8001-1434 | this    | 1    | 0      | HBA    |
| NtSrv  | 2106-5432-0543-1234 | 2106-5432-0543-1234 | this    | 1    | 0      | HBA    |

You can exit if you need to reconfigure your systems or record this information.

Do you want to continue the downgrade procedure (Y/ [N] ) ?

There is one final opportunity to exit the program before the downgrade occurs. The following is displayed:

This controller will now be downgraded to run ACS Version 8.5.

You must also downgrade the other controller. When both controllers have been downgraded, install the ACS Version 8.5 program cards and restart both controllers at the same time.

Continue (Y/N) ?

Downgrade procedure complete. Halting.

```
%FLL--HSG> --22-NOV-2000 10:33:24-- OCP Code: 39
NVPM configuration inconsistent.
```

Both controllers must be stopped with the 39 fault LED code before restarting with V8.5.

Remove the ACS V8.6 program cards while holding the controller reset buttons. Insert both ACS V8.5 program cards and release the reset buttons at the same time.

**NOTE:** Any storage added while running V8.6 will not be accessible after the downgrade to V8.5. The storage must be deleted and re-added. Be sure to use the NODESTROY switch when adding the storagesets back to the system.

# Appendix A

## Array Controller Specifications

This appendix contains physical, electrical, and environmental specifications for enclosures that use the HSG80 array controller.

### Physical and Electrical Specifications for the HSG80 Array Controller 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.

| Hardware               | Width              | Depth              | Power  | Current at +5 VDC | Current at +12 VDC                                           |
|------------------------|--------------------|--------------------|--------|-------------------|--------------------------------------------------------------|
| HSG80 array controller | 305 mm<br>(12 in)  | 241 mm<br>(9.5 in) | 29.0 W | 5.8 A             |                                                              |
| Cache module, 512 MB   | 138 mm<br>(5.5 in) | 241 mm<br>(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 HSG80 array controller is 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)<br>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                                                 |
|----------------------------------|---------------------------------------------------------------|
| <b>Storage (Up to 1 Year)</b>    |                                                               |
| 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) |
| <b>Shipping (Up to 72 Hours)</b> |                                                               |
| 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 this controller maintenance and service guide. This glossary is not a comprehensive glossary of computer terms.

## **ACS**

Array Controller Software. The software component of the HS-series array controller storage systems. ACS executes on the controller and processes input/output requests from the host, performing the device-level operations required to satisfy the requests.

## **adapter**

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

## **array controller**

*See* controller

## **array controller software**

*See* ACS

## **autospare**

A controller feature that automatically replaces a failed disk drive. Autospare aids the controller in automatically replacing failed disk drives. You can 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 you plug subsystem devices—for example, a controller or power supply.

**battery hysteresis**

The ability of the software to allow write-back caching during the time a battery is charging, but only when a previous down time has not drained more than 50 percent of rated battery capacity.

**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. The objective of caching data in a system is to improve performance by placing the most frequently used data in the highest performance memory.

**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.

**chunk**

In any form of RAID that stripes data, data is stored in pieces called chunks. One chunk is stored on each member device in the unit. Taken together, the chunks make up a stripe. The chunk size can be used in some controllers to tune the stripeset for a specific application.

**CI bus**

Computer Interconnect bus. A serial 70 MHz, dual path, party-line, bus. It is the host bus for the HSJ-series controller-based storage systems. The CI bus is used by OpenVMS hosts to connect the nodes in a clustered subsystem.

**CLCP**

Code-Load Code-Patch utility. This utility can be used to download patches to the ACS software.

**CLI**

Command Line Interpreter. A command line entry utility used to interface with the HS-series controllers. CLI enables the configuration and monitoring of a storage subsystem through textual commands.

**code-load code-patch utility**

*See* CLCP

**command line interpreter**

*See* CLI

**computer interconnect bus**

*See* CI bus

**container**

(1) Any entity that is capable of storing data, whether it is a physical device or a group of physical devices. (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 that the controller uses to create units.

*See also* storage unit.

**controller**

A hardware device that, with proprietary software, facilitates communications between a host and one or more storage devices organized in a storage array. The HS-series of the StorageWorks family of controllers are all array controllers.

**data center cabinet (rack)**

A generic reference to large subsystem racks, such as those in which StorageWorks products can be mounted.

**DDL**

Dual data link. The ability to operate on the CI bus using both paths simultaneously to the same remote node.

**device**

In its physical form, a magnetic disk that can be attached to a SCSI bus. The term is also used to indicate a physical device that has been made part of a controller configuration; that is, a physical device that is known to the controller. Units (virtual disks) can be created from devices, once the devices have been made known to the controller.

The targets, initiators, hubs, converters, adapters, and similar items interconnected to form a SCSI bus. Connectors, expanders, and hubs do not use a SCSI bus ID. *See also* 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.

**DOC**

DWZZA-on-a-chip. An SYM53C120 SCSI bus extender chip used to connect a SCSI bus in one enclosure to the corresponding SCSI bus in another enclosure.

**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 data link**

*See* DDL

**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. The EMU also controls certain rack hardware including DOC chips, alarms, and fan speeds.

**environmental monitoring unit**

*See* EMU

**ESD**

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

**extended subsystem**

A subsystem in which one or two enclosures are connected to the primary enclosure.

**external cache battery**

*See* ECB

**failedset**

A group of disk drives that have been removed from RAIDsets due to a failure or a manual removal. Disk drives in the failedset should be considered defective and should be tested and repaired before being placed back into the spareset. *See also* spareset.

**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. *See also* failback.

**fault management utility**

*See* FMU

**fiber**

A fiber or optical strand. Spelled *fib*re in Fibre Channel.

**fiber optic cable**

A transmission medium designed to transmit digital signals in the form of pulses of light. Fiber optic cable is noted for its properties of electrical isolation and resistance to electrostatic contamination.

**flush**

The act of writing dirty data from cache to a storage media. *See also* dirty data.

**FMU**

Fault Management Utility. A utility that is run to provide fault or error reporting information.

**FRU**

Field Replaceable Unit. A hardware component that can be replaced at a customer location by Compaq authorized service providers.

**FRUTIL**

Field Replacement Utility.

**GBIC**

Gigabit Interface Converter. The devices that are inserted into the ports of the Fibre Channel switch and that hold the Fibre Channel cables.

**giga**

A prefix indicating a billion ( $10^9$ ) units, as in gigabaud or gigabyte.

**gigabyte**

A value normally associated with disk drive storage capacity, meaning a billion ( $10^9$ ) bytes. The decimal value 1024 is usually used for one thousand.

**GLM**

Gigabit Link Module.

**host**

The primary or controlling computer to which a storage subsystem is attached.

**host adapter**

A device that connects a host system to a SCSI 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.

**host compatibility mode**

A setting used by the controller to provide optimal controller performance with specific operating systems. This improves the controller performance and compatibility with the specified operating system.

**hot-pluggable**

A replacement method that allows normal I/O activity on a device bus to remain active during device removal and insertion. The device being removed or inserted is the only device that cannot perform operations during this process. *See also* pluggable.

**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 SCSI bus, 16-bit single-ended SCSI bus, 16-bit differential SCSI bus, or Fibre Channel bus.

**I/O operation**

The process of requesting a transfer of data from a peripheral device to memory (or visa 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. A volume-relative address of a block on a mass storage device. The blocks that form the volume are labeled sequentially starting with LBN 0.

**LED**

Light-emitting diode.

**link**

A connection between two Fibre Channel ports consisting of a transmit fibre and a receive fibre.

**local connection**

A connection to the subsystem, by way of the controller serial maintenance port, to a maintenance terminal or the host terminal. A local connection enables you to connect to one subsystem controller to perform maintenance tasks. *See also* maintenance terminal and local terminal.

**local terminal**

A terminal plugged into the EIA-423 maintenance port located on the front bezel of the controller. *See also* maintenance terminal and local connection.

**logical block number**

*See* LBN

**logical bus**

A single-ended bus connected to a differential bus by a SCSI bus signal converter.

**logical unit**

A physical or virtual device addressable through a target ID number. LUNs use their target's bus connection to communicate on the SCSI bus. *See also* unit.

**logical unit number**

*See* LUN

**LUN**

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 a task's I/O operations. Each task in the system must establish its own correspondence between logical unit numbers and physical devices. *See also* logical unit.

**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's status. The maintenance terminal is not required for normal operations. *See also* local terminal and local connection.

**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**

A 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. In Fibre Channel, a device that has at least one N\_Port or NL\_Port.

## **nonredundant controller configuration**

(1) A single controller configuration. (2) A controller configuration that does not include a second controller.

## **OCP**

Operator control panel. The control and indicator panel associated with an array controller. The OCP is mounted on the controller and is accessible to the operator

## **operator control panel**

*See* OCP

## **“other controller”**

The controller in a dual-redundant pair that is connected to the controller serving your 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.

## **parity check**

A method of detecting errors when data is sent over a communications line. With even parity, the number of ones in a set of binary data should be even. With odd parity, the number of ones should be odd.

## **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 it. Terminals, printers, tape drives, and disks are peripheral devices.

## **pluggable**

A replacement method that allows the complete system to remain online during device removal or insertion. The system bus must be halted, or quiesced, for a brief period of time during the replacement procedure. *See also* hot-pluggable.

## **port**

In general terms, the port is:

- A logical channel in a communications system.
- 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:

- 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.
- The hardware and software that connects a controller to a SCSI device.

## **primary enclosure**

The primary enclosure is the subsystem enclosure that contains the controllers, cache modules, external cache batteries, and the PVA module.

## **program card**

The PCMCIA card containing the controller operating software. *See also* PCMCIA card.

## **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 storage set 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 storage sets are sometimes referred to as stripesets.

**RAID level 0+1**

A RAID storage set 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 storage sets are sometimes referred to as striped mirrorsets.

**RAID level 1**

A RAID storage set of two or more physical disks that maintains a complete and independent copy of the entire virtual disk's data. This type of storage set has the advantage of being highly reliable and extremely tolerant of device failure. RAID level 1 storage sets are sometimes referred to as mirrorsets.

**RAID level 3**

A RAID storage set that transfers data parallel across the array's 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 storage set. *See also* RAID level 5.

### **RAID level 3/5**

A specially developed RAID storage set that stripes data and parity across three or more members in a disk array. A RAID set combines the best characteristics of RAID level 3 and RAID level 5. A RAID set is the best choice for most applications with small to medium I/O requests, unless the application is write intensive. A RAID set is sometimes called parity RAID. RAID level 3/5 storage sets are sometimes referred to as RAID sets.

### **RAID level 5**

A RAID storage set that, unlike RAID level 3, stores the parity information across all of the disk drives within the storage set. *See also* RAID level 3.

### **RAID set**

*See* RAID level 3/5

### **reconstruction**

The process of regenerating the contents of a failed member's data. The reconstruct process writes the data to a spare set disk and then incorporates the spare set disk into the mirror set, striped mirror set, or RAID set from which the failed member came. *See also* regeneration.

### **reduced**

A term that indicates that a mirror set or RAID set 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 RAID set is considered to be redundant when user data is recorded directly to one member and all of the other members include associated parity information.

### **regeneration**

(1) The process of calculating missing data from redundant data. (2) The process of recreating a portion of the data from a failing or failed drive using the data and parity information from the other members within the storage set.

The regeneration of an entire RAID set member is called reconstruction. *See also* reconstruction.

### **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*.

### **SCSI**

Small Computer System Interface. (1) An American National Standards Institute (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. (2) Any physical unit that can communicate on a SCSI bus.

### **SCSI device ID number**

A bit-significant representation of the SCSI address referring to one of the signal lines, numbered 0 through 7 for an 8-bit bus, or 0 through 15 for a 16-bit bus. *See also* target ID number.

### **SCSI ID number**

The representation of the SCSI address that refers to one of the signal lines numbered 0 through 15.

### **SCSI port**

(1) Software: The channel controlling communications to and from a specific SCSI bus in the system. (2) Hardware: The name of the logical socket at the back of the system unit to which a SCSI device is connected.

### **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 used 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, shelves, 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 your subsystem and accessed by the host. A storage unit can be any entity that is capable of storing data, whether it is a physical device or a group of physical devices. *See also* container.

**storageset**

- (1) A group of devices configured with RAID techniques to operate as a single container.
- (2) Any collection of containers, such as stripesets, mirrorsets, striped mirrorsets, and RAIDsets.

**StorageWorks**

A family of modular data storage products that allows customers to design and configure their own storage subsystems. Components include power, packaging, cabling, devices, controllers, and software. Customers can integrate devices and array controllers in StorageWorks enclosures to form storage subsystems. StorageWorks systems include integrated devices and array controllers to form storage subsystems.

**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. (2) Designates the target identification (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.

**“this controller”**

The controller that is serving your current CLI session through a local or remote terminal.  
*See also* “other controller.”

**transfer data rate**

The speed at which data may be exchanged with the central processor, expressed in thousands of bytes per second.

**Ultra SCSI bus**

A Fast-20 SCSI bus.

**uninterruptible power supply**

*See* UPS

### **unit**

A container made accessible to a host. A unit may be created from a single disk 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 that is 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's response time to write requests by allowing the controller to declare the write operation "complete" as soon as the data reaches its cache memory. The controller performs the slower operation of writing the data to the disk drives at a later time.

### **write-through cache**

A cache management technique for retaining host write requests in read cache. When the host requests a write operation, the controller writes data directly to the storage device. This technique allows the controller to complete some read requests from the cache, greatly improving the response time to retrieve data. The operation is complete only after the data to be written is received by the target storage device.

This cache management method may update, invalidate, or delete data from the cache memory accordingly, to ensure that the cache contains the most current data.

**write-through caching**

A cache management method used to decrease the subsystem's response time to a read. This method allows the controller to satisfy the request from the cache memory rather than from the disk drives.

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