StorageWorks by Compaq

Enterprise Virtual Array Hardware Configuration Guide

Part Number: AA-RS28A-TE

First Edition (July 2002)

Product Version: 2.0

This guide describes the various hardware configurations used for the *StorageWorks* ™ Enterprise Virtual Array by Compaq. It discusses the quantity of various hardware components in each configuration and how the hardware components are connected to each other. The expansion of existing racks is also discussed.

For the latest version of this document and other storage system documentation, visit the Compaq storage website at:
http://www.compaq.com/products/strorageworks

COMPAQ

Printed in the U.S.A.

Enterprise Virtual Array Hardware Configuration Guide
First Edition (July 2002)
Part Number: AA-RS28A-TE

Contents

Tables

About this Guide

This Hardware Configuration guide provides information to help you:

- Learn about the Enterprise Virtual Array hardware components.
- Understand the supported storage rack configurations.
- Convert an Enterprise Virtual Array V1.0 storage rack configuration into an Enterprise Virtual Array V2.0 storage rack configuration.
- Expand an Enterprise Virtual Array with drive enclosures.
- Understand the supported Fibre Channel cable configurations.
- Contact technical support for additional assistance.

Intended Audience

This book is intended for use by Enterprise Virtual Array administrators who are experienced with the following:

- Working with Fibre Channel cables.
- Working with Fibre Channel Loop Switches.
- Maintaining and operating Storage Area Networks (SANs).

Related Documentation

Additional documentation is available from the Compaq website at: http://www.compaq.com/products/storageworks/enterprise/documentation.html.

Document Conventions

The conventions included in Table 1 apply in most cases.

Table 1: Document Conventions

Element	Convention
Key names, menu items, buttons, and dialog box titles	**Bold**
File names and application names	*Italics*
User input, command names, system responses (output and messages)	`Monospace font` `COMMAND NAMES` are uppercase unless they are case sensitive
Variables	*`Monospace, italic font`*
Website addresses	Sans serif font (http://www.compaq.com)

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 data.

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

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

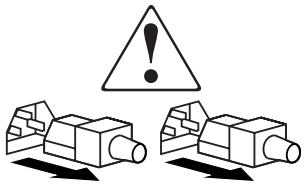
WARNING: To reduce the risk of injury from electrical shock hazards, do not open this enclosure.

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. Contact with this surface could result in injury.

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 presence of multiple sources of power.

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

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 manually handling material.

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.**
- **In single rack installations, the stabilizing feet are attached to the rack.**
- **In multiple rack installations, the racks are coupled.**
- **Only one rack component is extended at any time. A rack may become unstable if more than one rack component is extended for any reason.**

Getting Help

If you still have a question after reading this guide, contact service representatives or visit our website.

Compaq Technical Support

In North America, call Compaq technical support at 1-800-354-9000, available 24 hours a day, 7 days a week.

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

Outside North America, call Compaq technical support at the nearest location. Telephone numbers for worldwide technical support are listed on the Compaq website: http://www.compaq.com.

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- 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. Access the Compaq website at: http://www.compaq.com/storage. From this website, select the appropriate product or solution.

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.

1

Enterprise Virtual Array Hardware

This chapter briefly discusses the hardware components in the Enterprise Virtual Array. The following topics are discussed:

- Storage Racks
- Fibre Channel Drive Enclosures
- HSV Controllers
- Fibre Channel Loop Switches

Storage Racks

The Enterprise Virtual Array can be housed in two different storage racks: the 42U Rack or the 41U Rack. Both storage racks can hold a maximum of 12 Fibre Channel Drive Enclosures (FC Drive Enclosures) and two HSV Controllers.

41U Rack

The 41U Rack is graphite in color and 993 mm (39.1 inches) deep. The storage rack features standard 19-inch mounting rails. The 41U Rack can support Enterprise Virtual Array configurations that include Fibre Channel Loop Switches (FC Loop Switches).

Figure 1–1 shows the front and rear views of a 41U Rack.

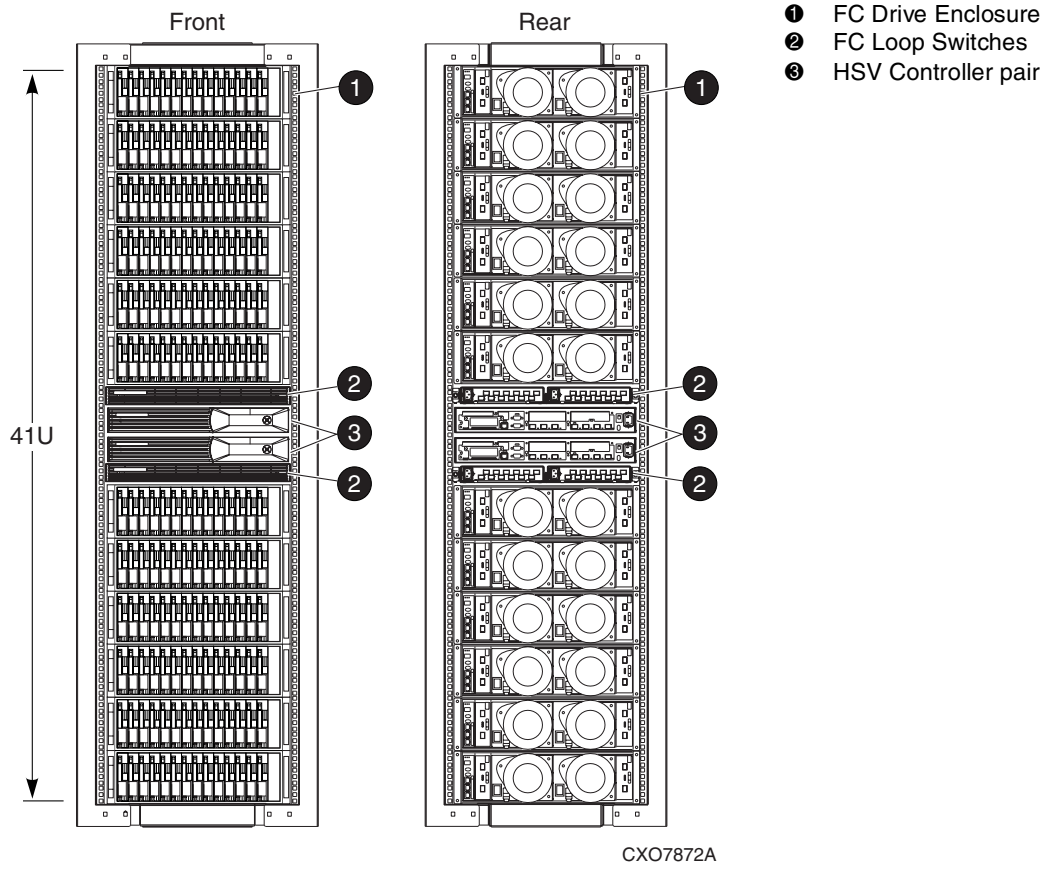


Figure 1–1: 41U Rack—front and rear views

42U Rack

The 42U Rack is opal in color and 909 mm (35.8 inches) deep. The storage rack features standard 19-inch mounting rails. The 42U Rack can support Enterprise Virtual Array configurations that include FC Loop Switches or expansion panels.

Figure 1–2 shows the front and rear views of a 42U Rack.

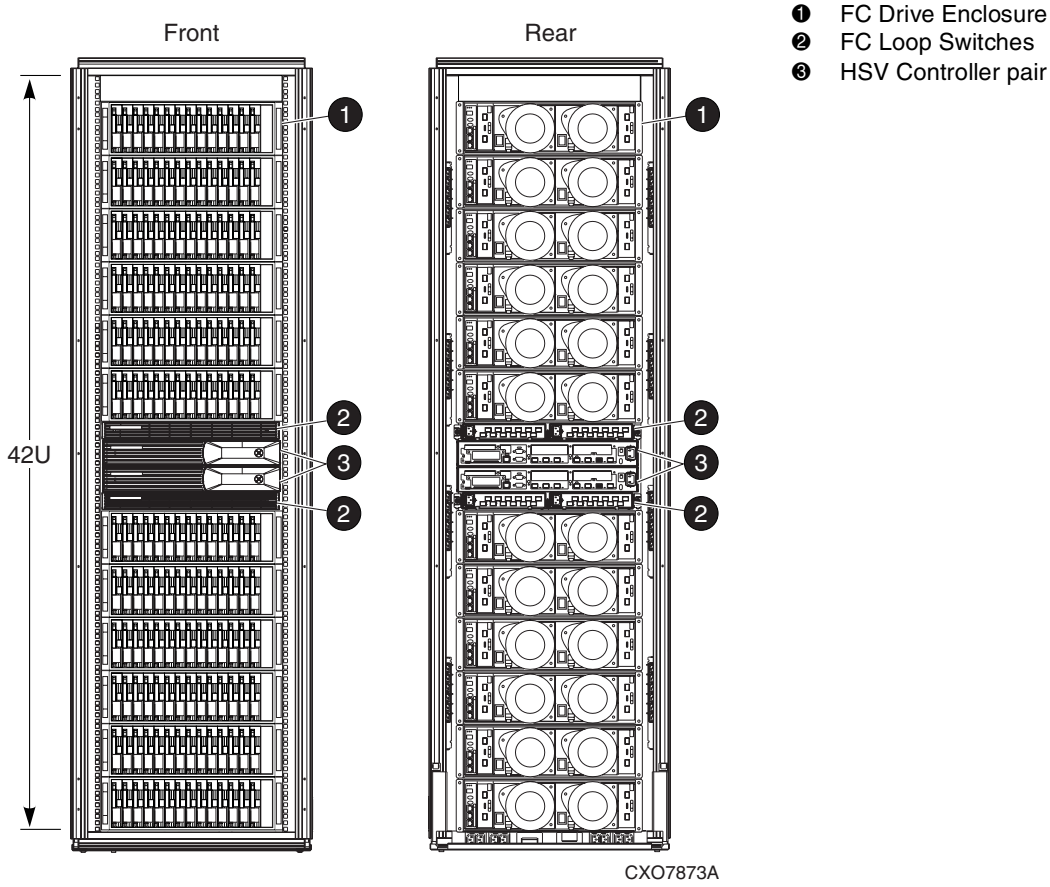


Figure 1–2: 42U Rack—front and rear views

2C6D Features

The following features are included in the 2C6D configuration:

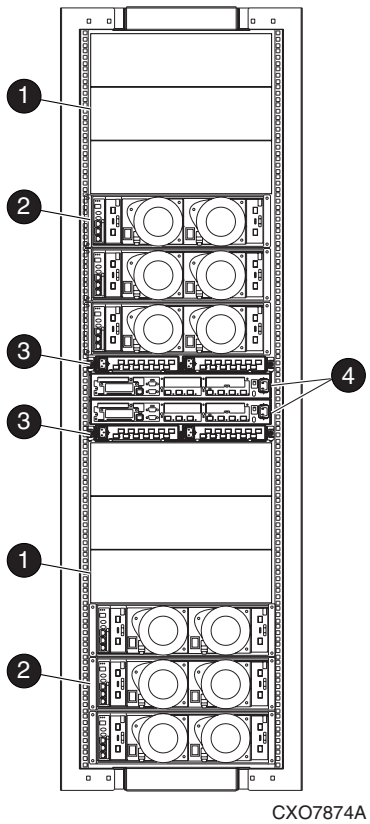
- One storage rack
- Two HSV Controllers
- Six 14-bay FC Drive Enclosures
- Four FC Loop Switches
- Sixteen internal Fibre Channel cables
- Seven 2-port enclosure address bus junction boxes
- Eight AC strips
- Two 0U PDUs

NOTE: Disks must be ordered separately.

The 2C6D configurations can contain a maximum of 3.1 TB (84 36.4-GB disks) or 6.1 TB (84 72.8-GB disks) of storage capacity.

NOTE: The 2C6D configuration can be expanded to increase storage capacity. However, there is a limit to expansion; each controller pair can support a maximum of 240 disks.

Figure 1–3 shows the rear view of the 2C6D configuration.



❶ 3U blank
❷ FC Drive Enclosure
❸ FC Loop Switch
❹ HSV Controller pair

Figure 1–3: 2C6D configuration—rear view

2C12D Features

The following features are included in the 2C12D:

- One storage rack
- Two HSV Controllers
- Twelve 14-bay FC Drive Enclosures
- Four FC Loop Switches
- Thirty-two internal Fibre Channel cables
- Seven 2-port enclosure address bus junction boxes
- Eight AC strips
- Two 0U PDUs

NOTE: Disks must be ordered separately.

The 2C12D configuration can contain a maximum of 6.1 TB (168 36.4-GB disks) or 12.2 TB (168 72.8-GB disks) of storage capacity.

NOTE: The 2C12D configuration can be expanded to increase storage capacity. However, there is a limit to expansion; each controller pair can support a maximum of 240 disks.

Figure 1–4 shows the 2C12D configuration.

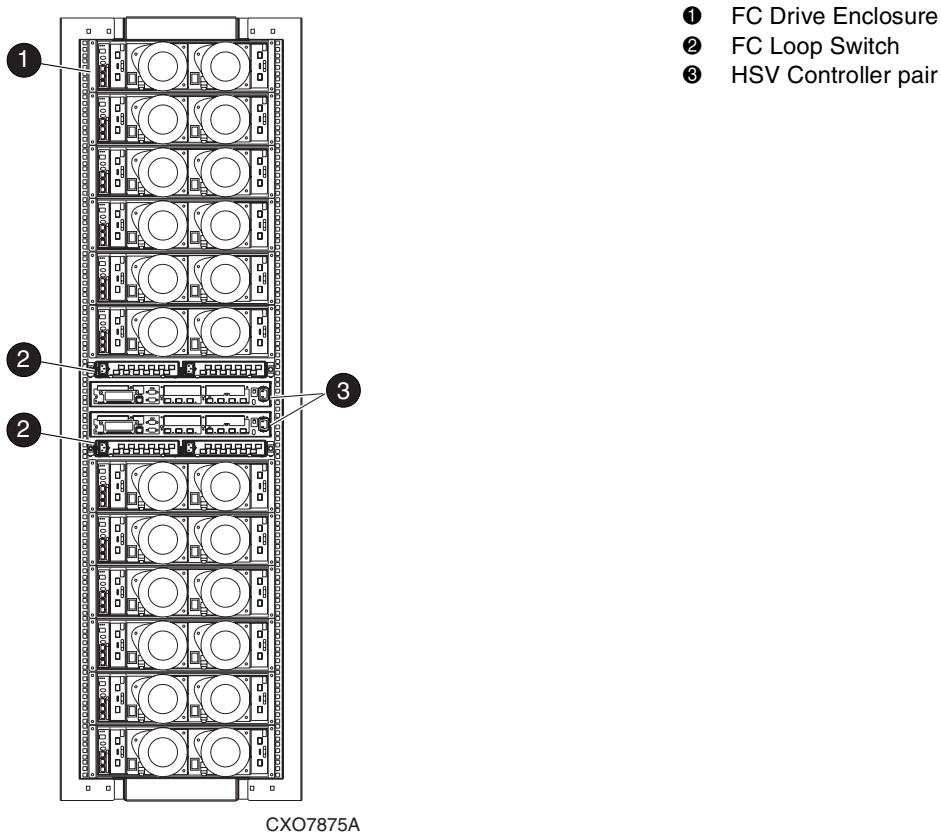


Figure 1–4: 2C12D configuration—rear view

8C8D Features

The following features are included with the 8C8D configuration:

- One storage rack
- Eight HSV Controllers
- Eight 14-bay FC Drive Enclosures
- Thirty-two internal Fibre Channel cables
- Seven 2-port enclosure address bus junction boxes
- Eight AC strips
- Two 0U PDUs

NOTE: Disks must be ordered separately.

The 8C8D configuration can contain a maximum of 4.1 TB (112 36.4-GB disks) or 8.2 TB (112 72.8-GB disks) of storage capacity.

Figure 1–5 shows the 8C8D configuration.

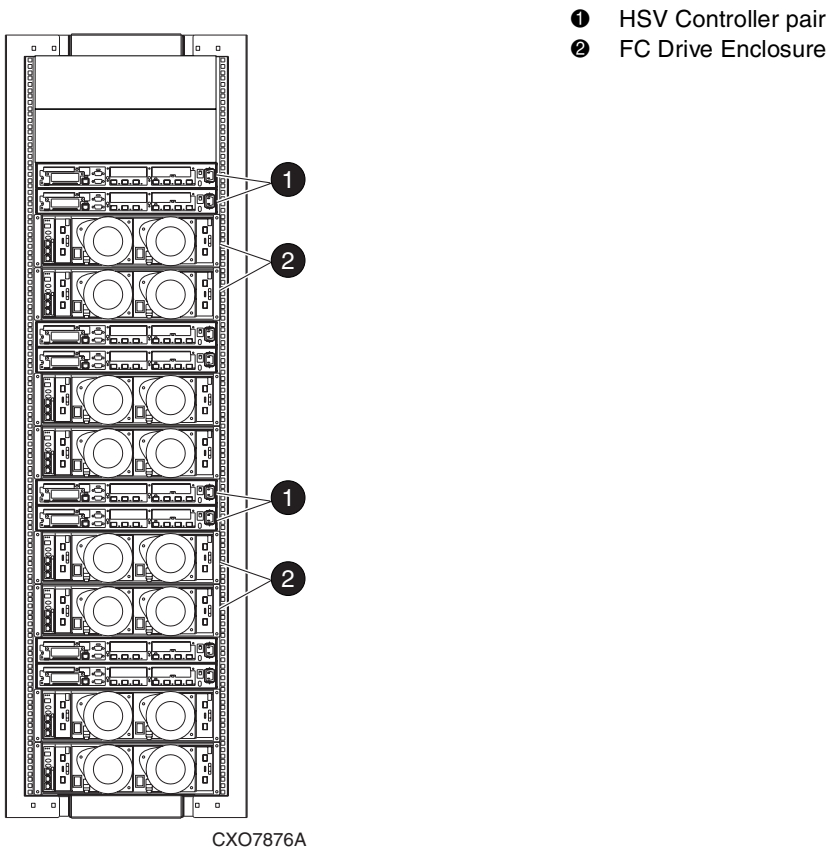


Figure 1–5: 8C8D configuration—rear view

0C6D Features

The following features are included with the 0C6D configuration:

- One storage rack
- Six 14-bay FC Drive Enclosures
- Twelve 5-meter rack-to-rack Fibre Channel cables
- Six 2-port enclosure address bus junction boxes
- Eight AC strips
- Two 0U PDUs

NOTE: Disks must be ordered separately.

The 0C6D configuration can add a maximum of 2.6 TB (72 36.4-GB disks) or 5.2 TB (72 72.8-GB disks) of storage capacity to an existing Enterprise Virtual Array. If the 0C6D is added to a 2C12D, the Enterprise Storage System storage capacity would increase to 8.7 TB (240 36.4-GB disks) or 17.5 TB (240 72.8-GB disks).

Figure 1–6 shows the rear view of the 0C6D configuration.

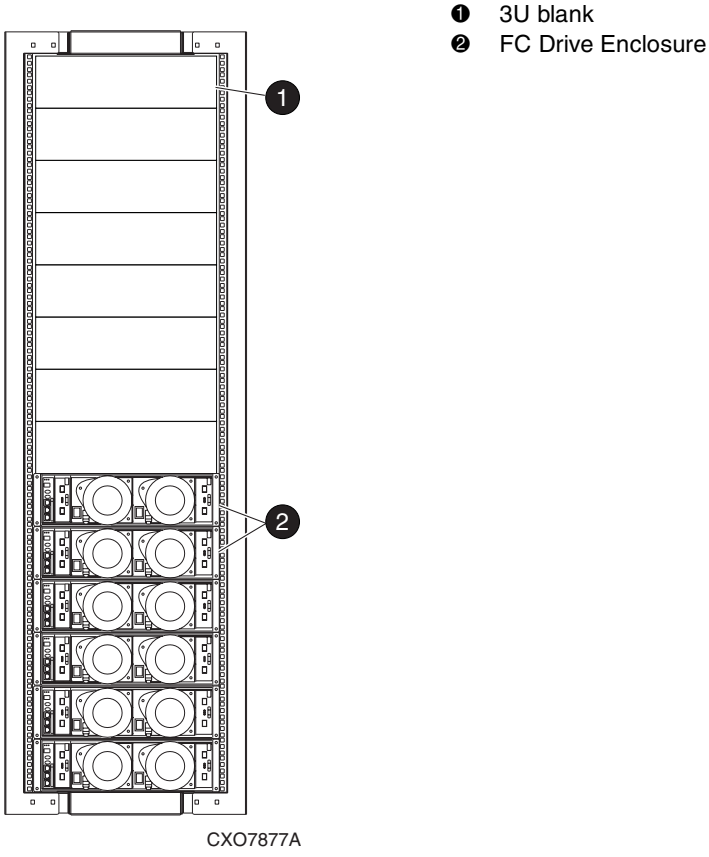


Figure 1–6: 0C6D configuration—rear view

0C12D Features

The following features are included with the 0C12D configuration:

- One storage rack
- Twelve 14-bay FC Drive Enclosures
- Twenty-four 5-meter rack-to-rack Fibre Channel cables
- Six 2-port enclosure address bus junction boxes
- Eight AC strips
- Two 0U PDUs

NOTE: Disks must be ordered separately.

The 0C12D configuration can add a maximum of 5.2 TB (144 36.4-GB disks) or 10.5 TB (144 72.8-GB disks) of storage capacity. Typically, this storage capacity is evenly divided between two Enterprise Storage Systems (2C12D). If the 0C12D is added to two 2C12Ds, the storage capacity for each 2C12D would increase to 8.7 TB (240 36.4-GB disks) or 17.5 TB (240 72.8-GB disks).

Figure 1–7 shows the rear view of the 0C12D configuration.

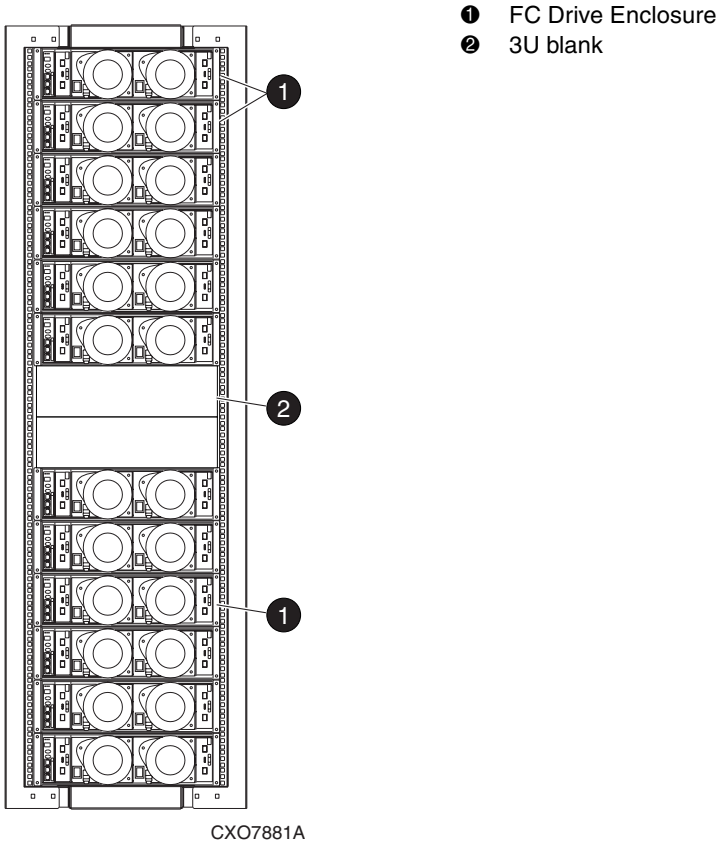


Figure 1–7: 0C12D configuration—front and rear views

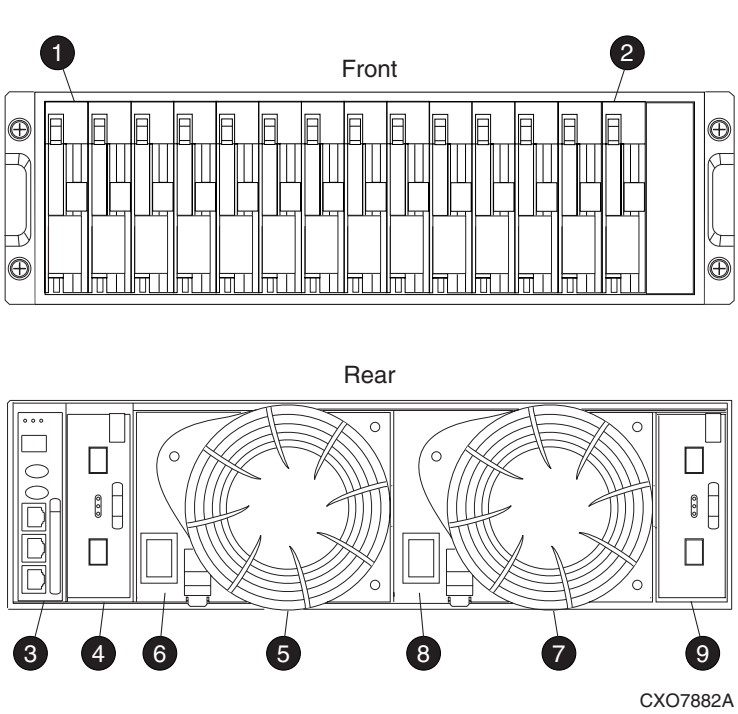
Fibre Channel Drive Enclosures

Each FC Drive Enclosure includes the following features:

- 3U drive enclosure
- Dual redundant active-to-active 2Gb/s Fibre Channel loops
- Fourteen 1-inch Fibre Channel disks per enclosure
- Environmental Monitor Unit
- Dual 2 Gb/s Fibre Channel I/O module—A and B
- Dual 500-W redundant hot-plug power supplies and fans

For ease of reference, the disk drives are usually referred to by their physical location, the drive bay number.

Figure 1–8 shows the front and rear views of the FC Drive Enclosure and the physical location of each drive bay.



❶ Drive bay 1
❷ Drive bay 14
❸ EMU
❹ I/O module B
❺ Blower 1
❻ Power supply 1
❼ Blower 2
❽ Power supply 2
❾ I/O module A

Figure 1–8: FC Drive Enclosure—front and rear views

HSV Controllers

One high performance HSV Controller is contained in a controller enclosure. Each controller features:

- High performance power PC microprocessor
- An Operator Control Panel (OCP) for easy operation
- Two 2 Gb/s “ready” Fibre Channel-Switch Fabric host ports
- Four 2 Gb/s FC-AL device ports
  - — Arranged in redundant pairs
  - — Data load / performance is balanced across a pair
  - — Supports up to 240 disks (120 disks per pair)
- 1 GB cache per controller, mirrored, with battery backup
- 2 Gb/s FC cache mirroring port with device ports backups for mirroring

The HSV Controller is the interface between the HSV Element Manager and a storage system. A storage system is composed of one HSV Controller pair and either 6 or 12 disk drive enclosures.

Figure 1–9 shows the front and rear views of the HSV Controller.

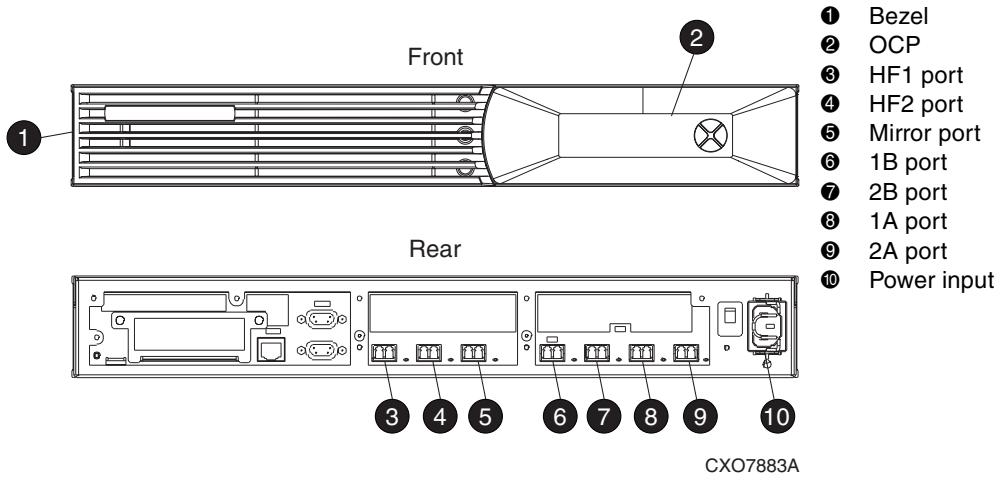


Figure 1–9: HSV Controller—front and rear views

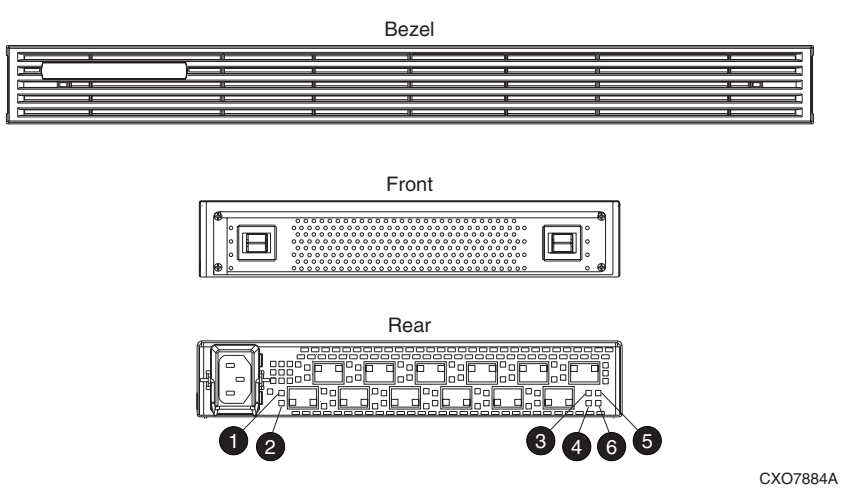
Fibre Channel Loop Switches

The V2.0 Enterprise Virtual Array uses four FC Loop Switches to connect all of the drive enclosures to the controller pair via Fibre Channel cables. Each FC Loop Switch acts as a central point of interconnection and establishes a fault-tolerant physical loop topology.

The major features of the FC Loop Switch are:

- 2.125 Gb/s operating speed
- Twelve ports
- Half-width, 1U size
- System and port status LED indicators
- Universal power supply that operates between 100 to 250 VAC (or 50 to 60 Hz)
- Small Form-factor Profile (SFP) transceivers

Figure 1–10 shows the front and rear views of the Fibre Channel Loop Switch.



❶ SFP Status LED
❷ Port Bypassed LED
❸ POST Fault LED
❹ Over Temp LED
❺ Power LED
❻ Loop Operational LED

Figure 1–10: FC Loop Switch—front and rear views

2

Enterprise Virtual Array Configurations

This chapter briefly discusses various Enterprise Virtual Array configurations. Each section describes the placement of controllers, drive enclosures, FC Loop Switches, enclosure address bus junction boxes and cables, and Fibre Channel cables.

This chapter contains the following sections:

- 2C12D Configuration
- 2C6D Configuration
- 8C8D Configuration
- 2C12D + 0C6D Configuration
- 2 x 2C12D + 0C12D Configuration

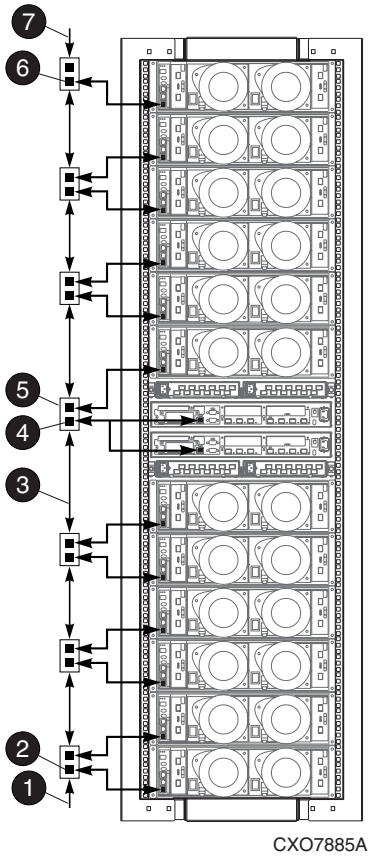
2C12D Configuration

The 2C12D configuration is a single-rack configuration that provides a maximum of 6.1 TB (168 36.4-GB disks) or 12.2 TB (168 72.8-GB disks) of storage capacity. This configuration can contain a maximum of 168 disks.

The 2C12D configuration is available in either the 41U Rack or the 42U Rack. The 2C12D can contain four FC Loop Switches or one expansion panel.

Enclosure Address Bus Configuration

The 2C12D configuration contains seven enclosure address bus junction boxes at 6U increments in the left rear rail of the rack. The FC Drive Enclosures and controller pair in the 2C12D configuration use all seven enclosure address bus junction boxes. Each FC Drive Enclosure should be connected to an enclosure address bus junction box. The FC Drive Enclosures connect to each enclosure address bus junction box in pairs. The controller pair connects to the enclosure address bus junction box with a Y cable. Figure 2–1 shows the enclosure address bus cable configuration for the 2C12D configuration.



❶ Bottom Terminator
❷ Enclosure address 1
❸ Enclosure address bus cable
❹ Enclosure address 7
❺ Enclosure address bus junction box
❻ Enclosure address 13
❼ Top Terminator

Figure 2–1: 2C12D configuration—enclosure address bus cables

Fibre Channel Loop Configurations

The 2C12D configuration contains four Fibre Channel loops. A Fibre Channel loop is formed when the FC Drive Enclosures and the HSV Controller pair are connected by Fibre Channel cables. The 2C12D configuration can use an FC Loop Switch or an expansion panel to achieve the desired Fibre Channel loop configuration.

When a configuration uses FC Loop Switches, each FC Drive Enclosure in a loop is directly connected to the associated FC Loop Switch. The HSV Controller pair is also connected directly to the associated FC Loop Switch. When the FC Loop Switch is powered on, it completes a Fibre Channel loop.

When a configuration uses an expansion panel, a Fibre Channel loop is accomplished by connecting two FC Drive Enclosures directly to the HSV Controllers and linking each FC Drive Enclosure together in a chain.

Table 2–1 provides the locations for the Fibre Channel loops in a storage rack.

Table 2–1: Fibre Channel Loop Locations in Rack

Fibre Channel Loop	Location in Rack (viewed from rear)
1A	lower right side
1B	lower left side
2A	upper right side
2B	upper left side

Figure 2–2, Figure 2–3, Figure 2–4, and Figure 2–5 show the 2C12D Fibre Channel loop configurations with the FC Loop Switches. Figure 2–6, Figure 2–7, Figure 2–8, and Figure 2–9 show the 2C12D Fibre Channel loop configurations with expansion panels.

Figure 2–2 shows Fibre Channel loop 1A and the associated FC Loop Switch.

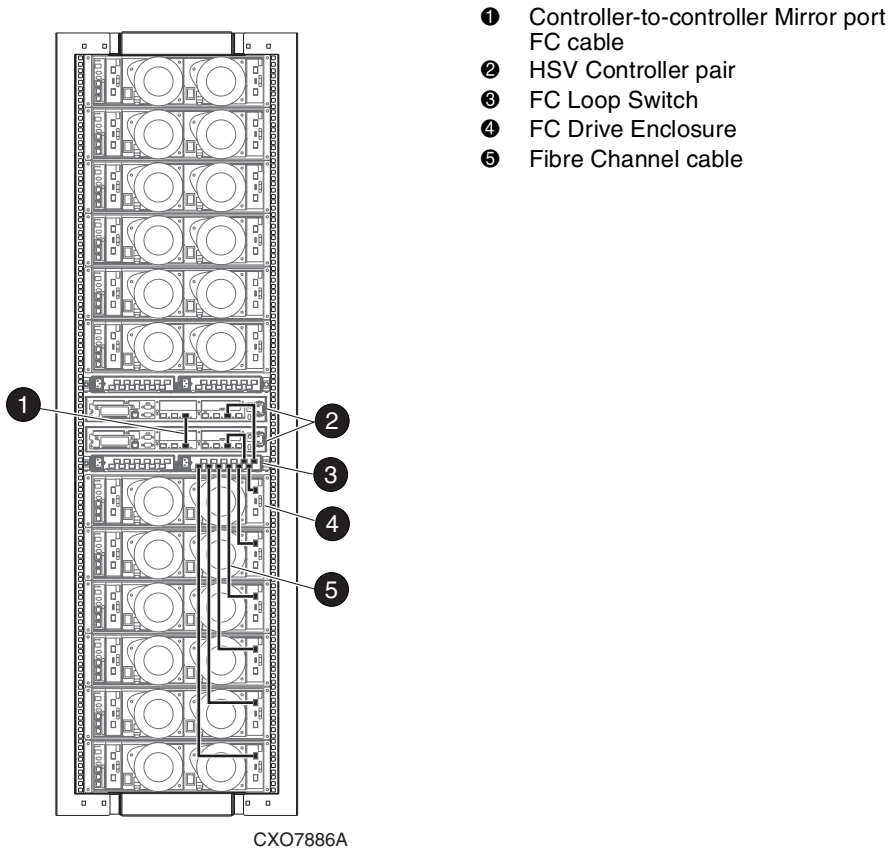


Figure 2–2: 2C12D configuration—Fibre Channel loop 1A with FC Loop Switch

Figure 2–3 shows Fibre Channel loop 1B and the associated FC Loop Switch.

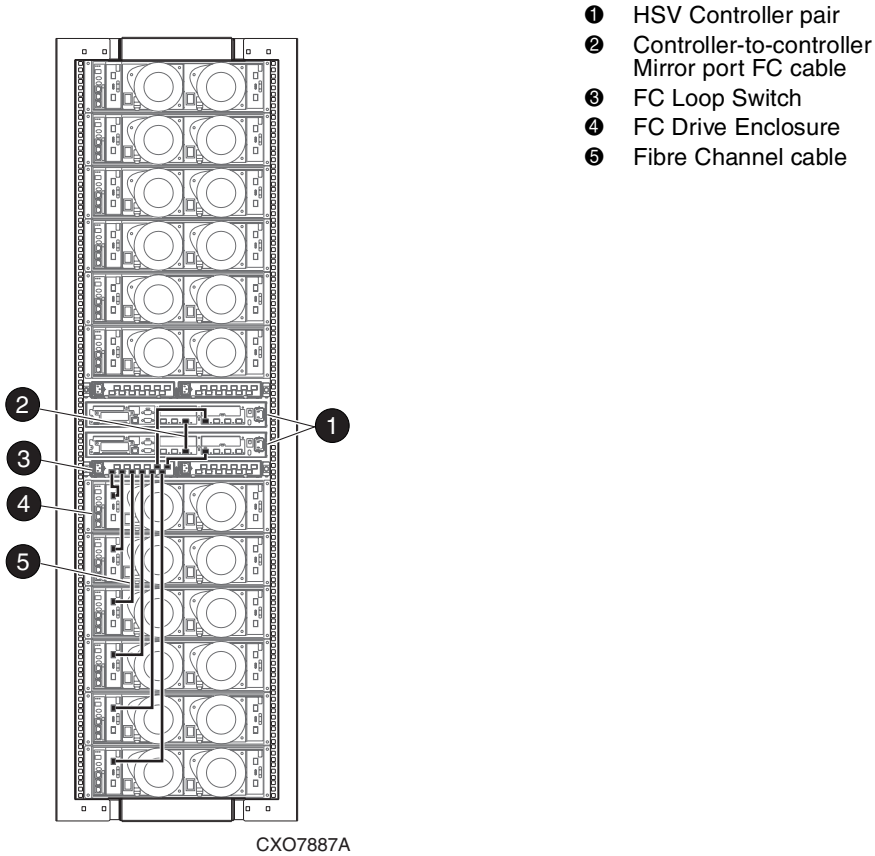


Figure 2–3: 2C12D configuration—Fibre Channel loop 1B with FC Loop Switch

Figure 2–4 shows Fibre Channel loop 2A and the associated FC Loop Switch.

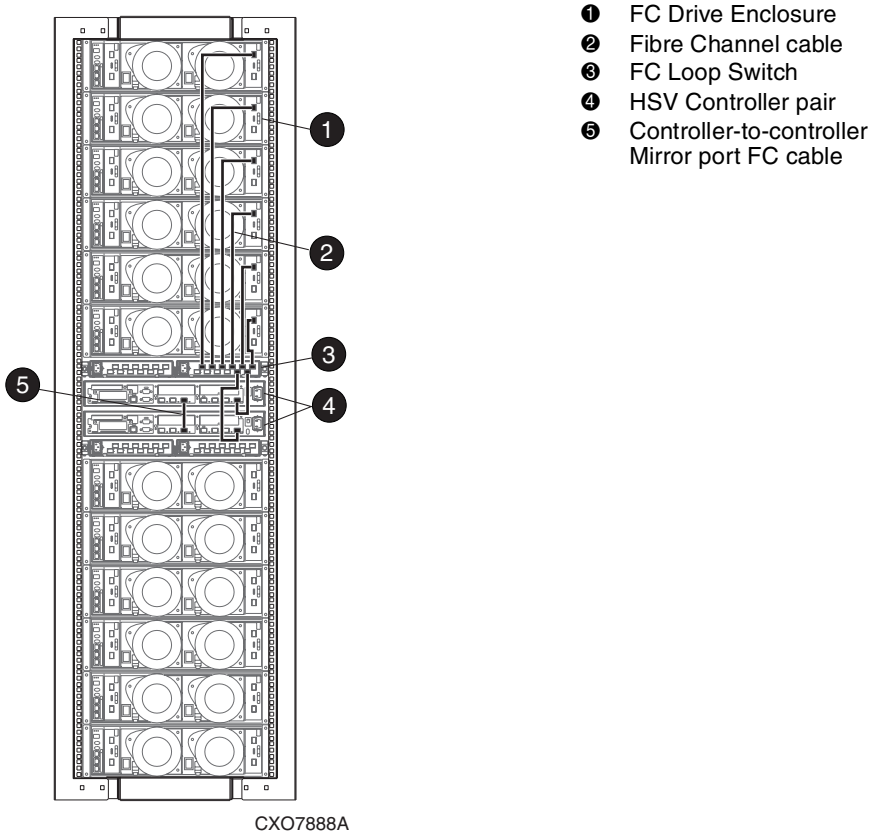


Figure 2–4: 2C12D configuration—Fibre Channel loop 2A with FC Loop Switch

Figure 2–5 shows Fibre Channel loop 2B and the associated FC Loop Switch.

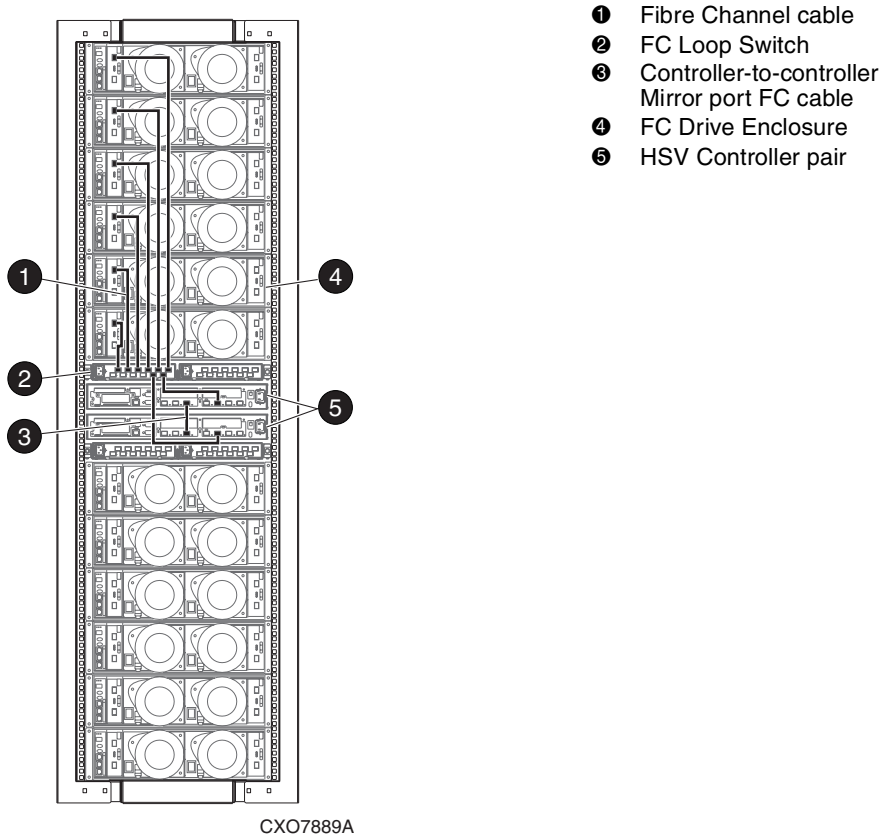


Figure 2–5: 2C12D configuration—Fibre Channel loop 2B with FC Loop Switch

Figure 2–6 shows Fibre Channel loop 1A in the 42U Rack with the expansion panel.

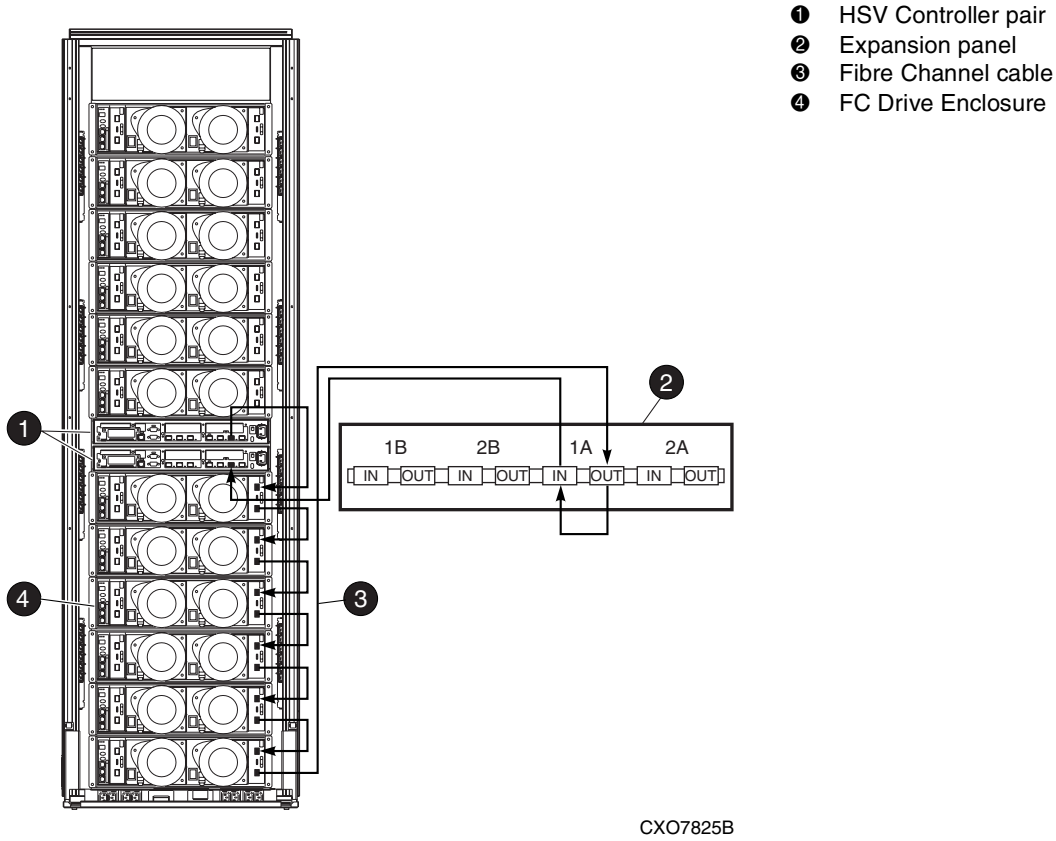


Figure 2–6: 2C12D configuration—Fibre Channel loop 1A with expansion panel

Figure 2–7 shows Fibre Channel loop 1B in the 42U Rack with the expansion panel.

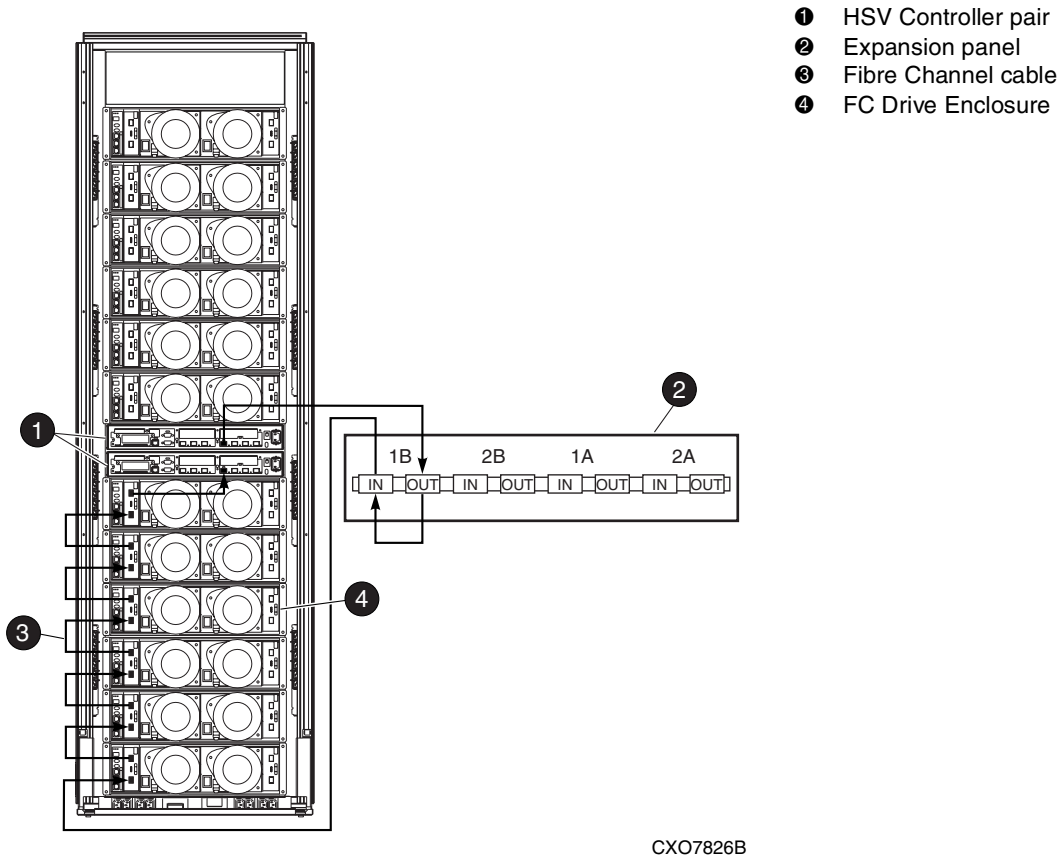


Figure 2–7: 2C12D configuration—Fibre Channel loop 1B with expansion panel

Figure 2–8 shows Fibre Channel loop 2A in the 42U Rack with the expansion panel.

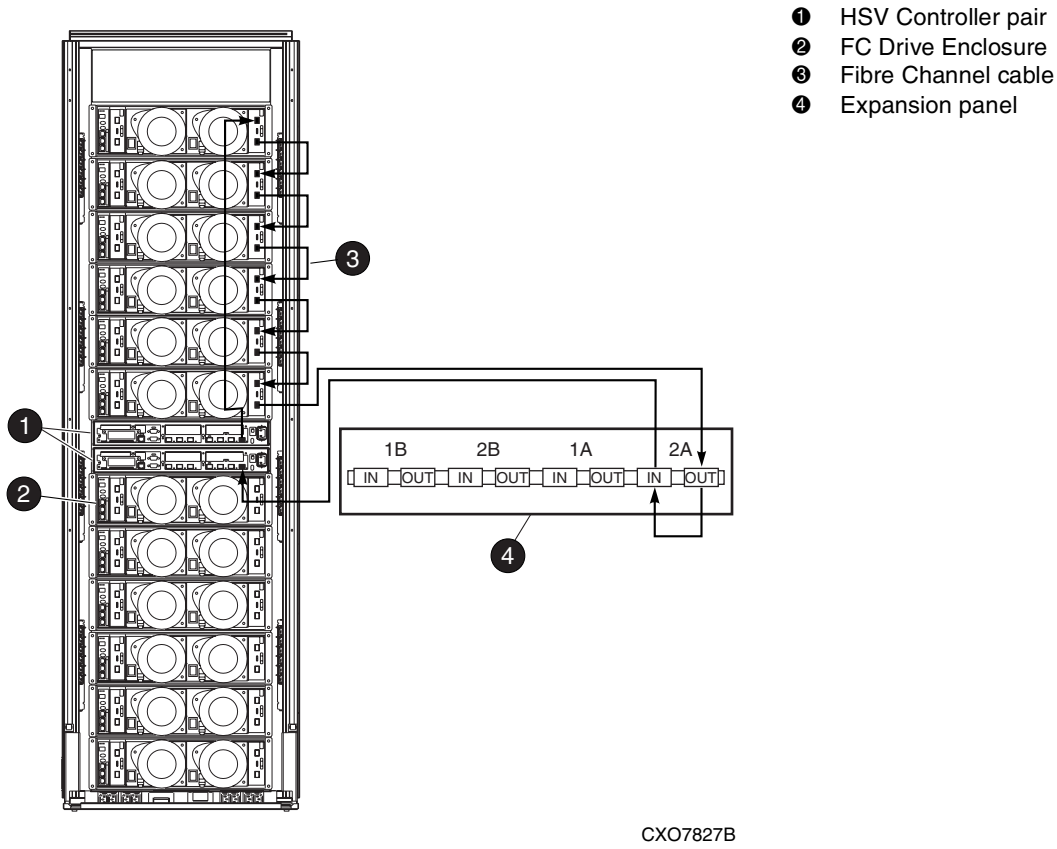


Figure 2–8: 2C12D configuration—Fibre Channel loop 2A with expansion panel

Figure 2–9 shows Fibre Channel loop 2B in the 42U Rack with the expansion panel.

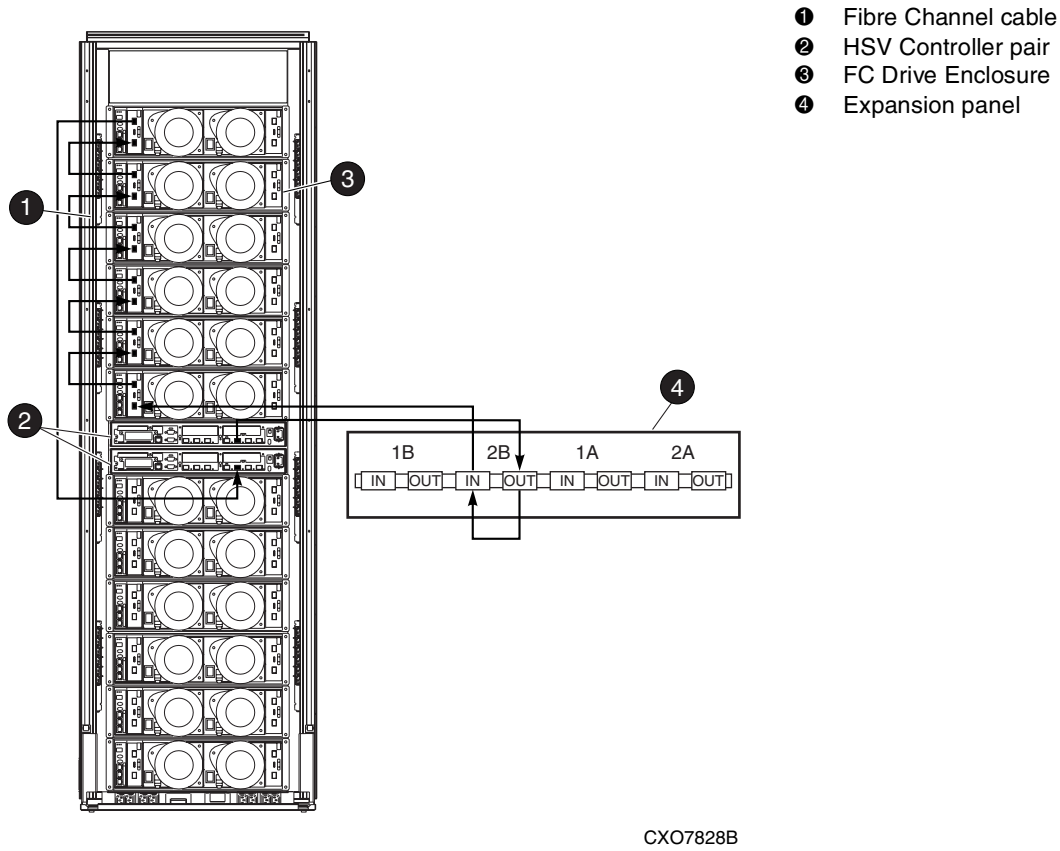


Figure 2–9: 2C12D configuration—Fibre Channel loop 2B with expansion panel

Cable Management Configurations

A configuration can have two different cable management configurations. If the configuration uses FC Loop Switches, the configuration uses a combination of cable containment spools and a cable management arm to organize the Fibre Channel cables. If the configuration uses expansion panels, the configuration uses cable containment spools to organize the Fibre Channel cables.

Cable Management Arms

When the configuration uses FC Loop Switches, the configuration contains two cable management arms. All of the Fibre Channel cables in the configuration pass through one of the cable management arms. Each cable management arm can hold several radial clips. Each radial clip can hold a maximum of seven Fibre Channel cables. The cable management arms can hold all of the Fibre Channel cables within a storage system configuration.

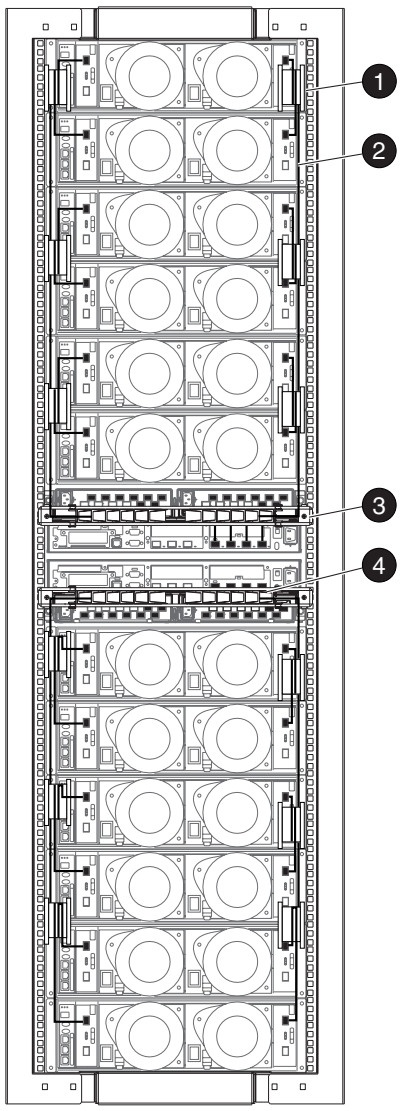
Each rack contains four flumes. These flumes are placed next to the cable management arms on the left and right sides of the rack. Each flume guides the Fibre Channel cables from the cable containment spools to the cable management arms.

Cable Containment Spools

The cable containment spools hold the Fibre Channel cables. These cable containment spools gather up extra cable length and guide the Fibre Channel cables from the FC Drive Enclosures to the flumes located on the sides of the rack.

The number of cable containment spools varies by rack configuration. Racks with more FC Drive Enclosures contain more cable containment spools.

The 2C12D configuration contains 12 cable containment spools and two cable management arms. Figure 2–10 shows the cable management configuration for the 2C12D configuration.



❶ Cable containment spool
❷ Fibre Channel cable
❸ Cable management arm
❹ Radial clip

Figure 2–10: 2C12D cable management configuration

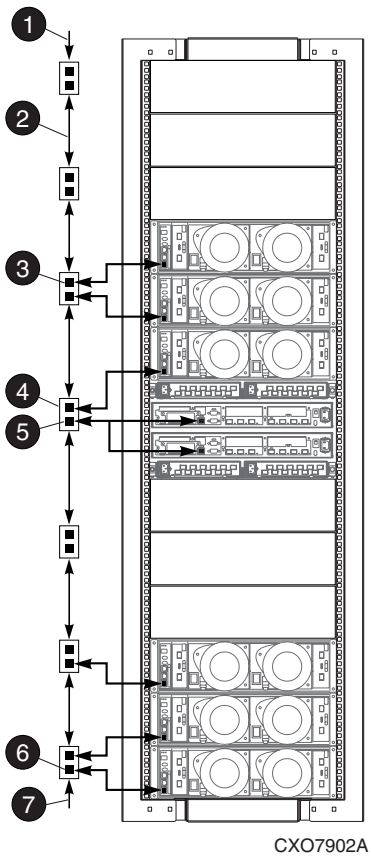
2C6D Configuration

The 2C6D configuration is a single-rack configuration that provides a maximum of 3.1 TB (84 36.4-GB disks) or 6.1 TB (84 72.8-GB disks) of storage capacity. This configuration can contain a maximum of 84 disks.

The 2C6D configuration is available in either the 41U Rack or the 42U Rack. The 2C6D can contain four FC Loop Switches or one expansion panel.

Enclosure Address Bus Configuration

The 2C6D configuration contains seven enclosure address bus junction boxes at 6U increments in the left rear rail of the rack. Each FC Drive Enclosure should be connected to an enclosure address bus junction box. The FC Drive Enclosures connect to each enclosure address bus junction box in pairs. The controller pair connects to the enclosure address bus junction box with a Y cable. Figure 2–11 shows the enclosure address bus cable configuration for the 2C6D configuration.



❶ Top terminator
❷ Enclosure address bus cable
❸ Enclosure address 10
❹ Enclosure address bus junction box
❺ Enclosure address 7
❻ Enclosure address 1
❼ Bottom terminator

Figure 2–11: 2C6D configuration—enclosure address bus cables

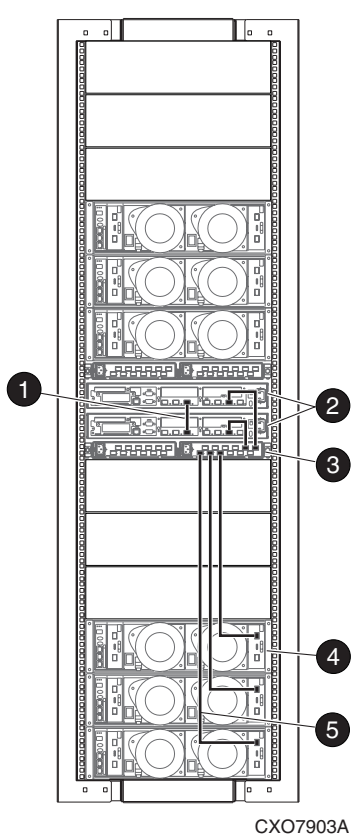
Fibre Channel Loop Configurations

The 2C6D configuration contains four Fibre Channel loops. A Fibre Channel loop is formed when the FC Drive Enclosures and the HSV Controller pair are connected by Fibre Channel cables. The 2C6D configuration can use an FC Loop Switch or an expansion panel to achieve the desired Fibre Channel loop configuration. (Refer to "Fibre Channel Loop Configurations" on page 2–2 for more information about the use of FC Loop Switches and expansion panels in the FC loop configurations.)

Refer to Table 2–1 for locations of Fibre Channel loops in a storage rack.

Figure 2–12, Figure 2–13, Figure 2–14, and Figure 2–15 show the 2C6D Fibre Channel loop configurations with the FC Loop Switches. Figure 2–16, Figure 2–17, Figure 2–18, and Figure 2–19 show the 2C6D Fibre Channel loop configurations with an expansion panel.

Figure 2–12 shows Fibre Channel loop 1A and the associated FC Loop Switch.



❶ Controller-to-controller Mirror port FC cable
❷ HSV Controller pair
❸ FC Loop Switch
❹ FC Drive Enclosure
❺ Fibre Channel cable

Figure 2–12: 2C6D configuration—Fibre Channel loop 1A with FC Loop Switch

Figure 2–13 shows Fibre Channel loop 1B and the associated FC Loop Switch.

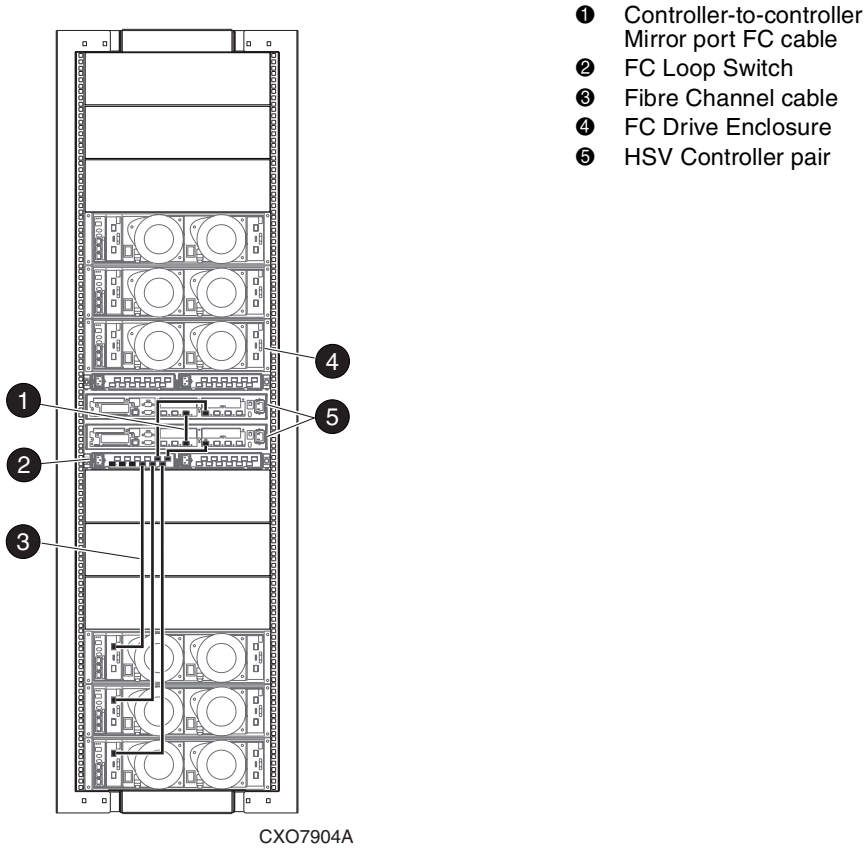


Figure 2–13: 2C6D configuration—Fibre Channel loop 1B with FC Loop Switch

Figure 2–14 shows Fibre Channel loop 2A and the associated FC Loop Switch.

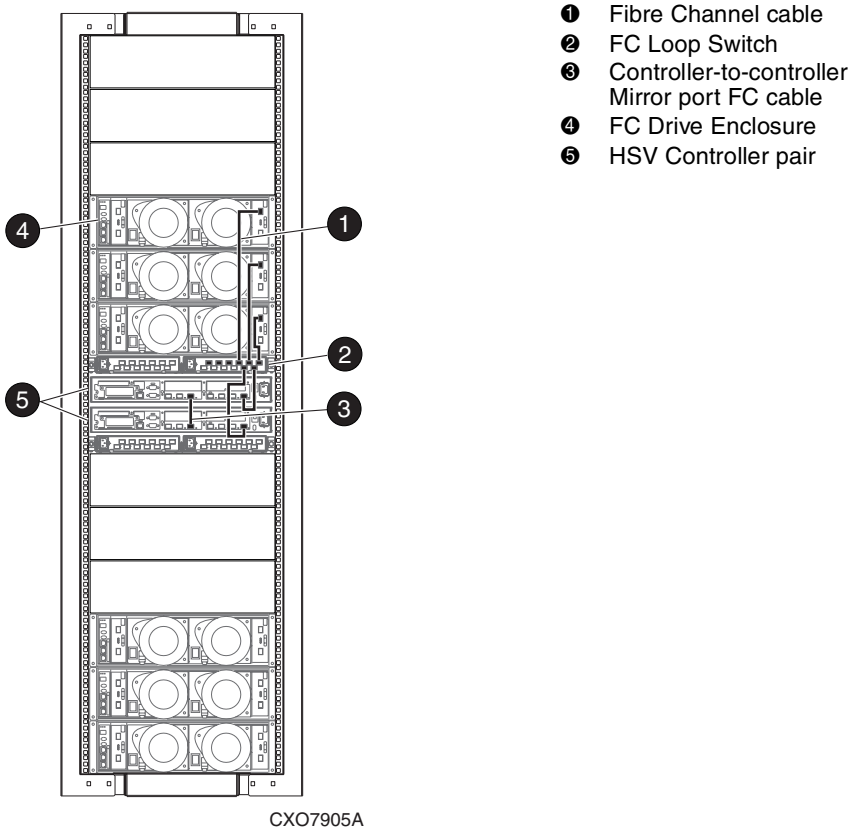


Figure 2–14: 2C6D configuration—Fibre Channel loop 2A with FC Loop Switch

Figure 2–15 shows Fibre Channel loop 2B and the associated FC Loop Switch.

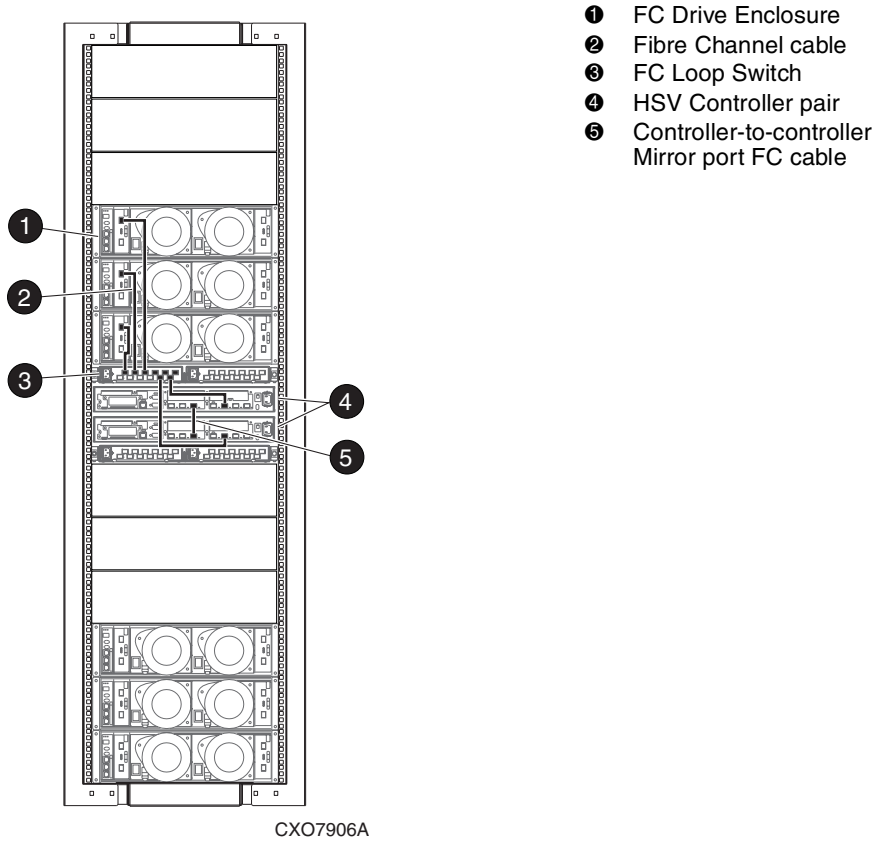


Figure 2–15: 2C6D configuration—Fibre Channel loop 2B with FC Loop Switch

Figure 2–16 shows Fibre Channel loop 1A in the 42U rack with the expansion panel.

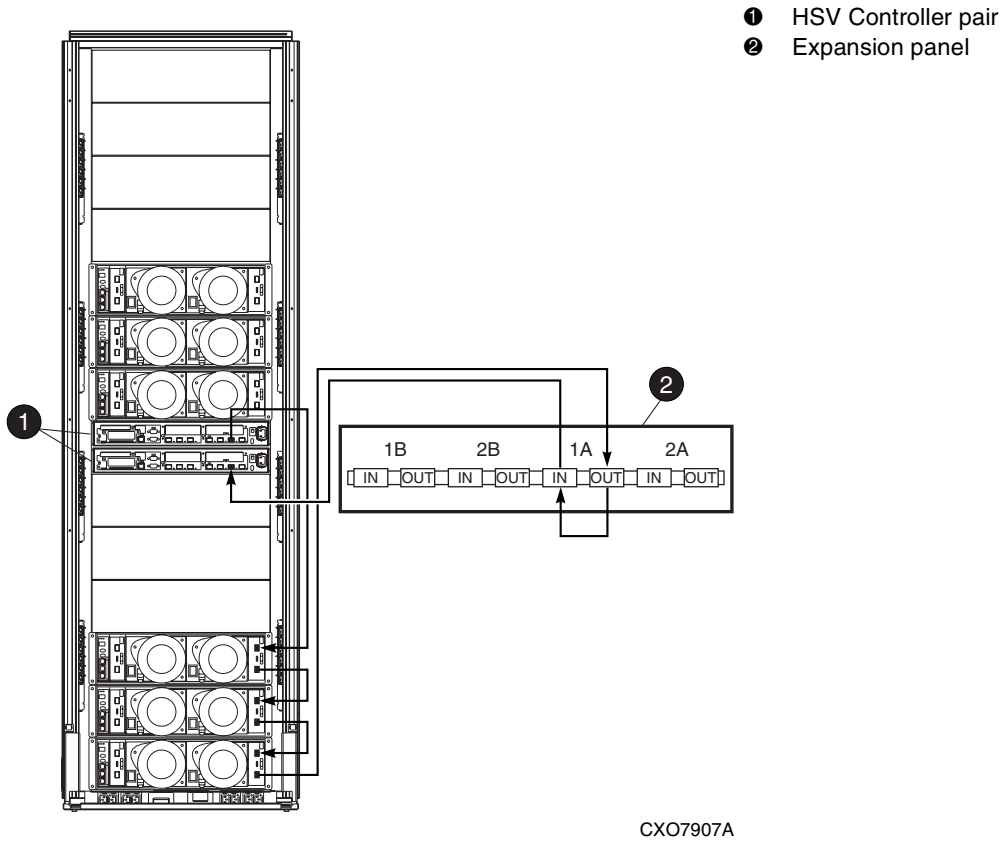


Figure 2–16: 2C6D configuration—Fibre Channel loop 1A with expansion panel

Figure 2–17 shows Fibre Channel loop 1B in the 42U rack with the expansion panel.

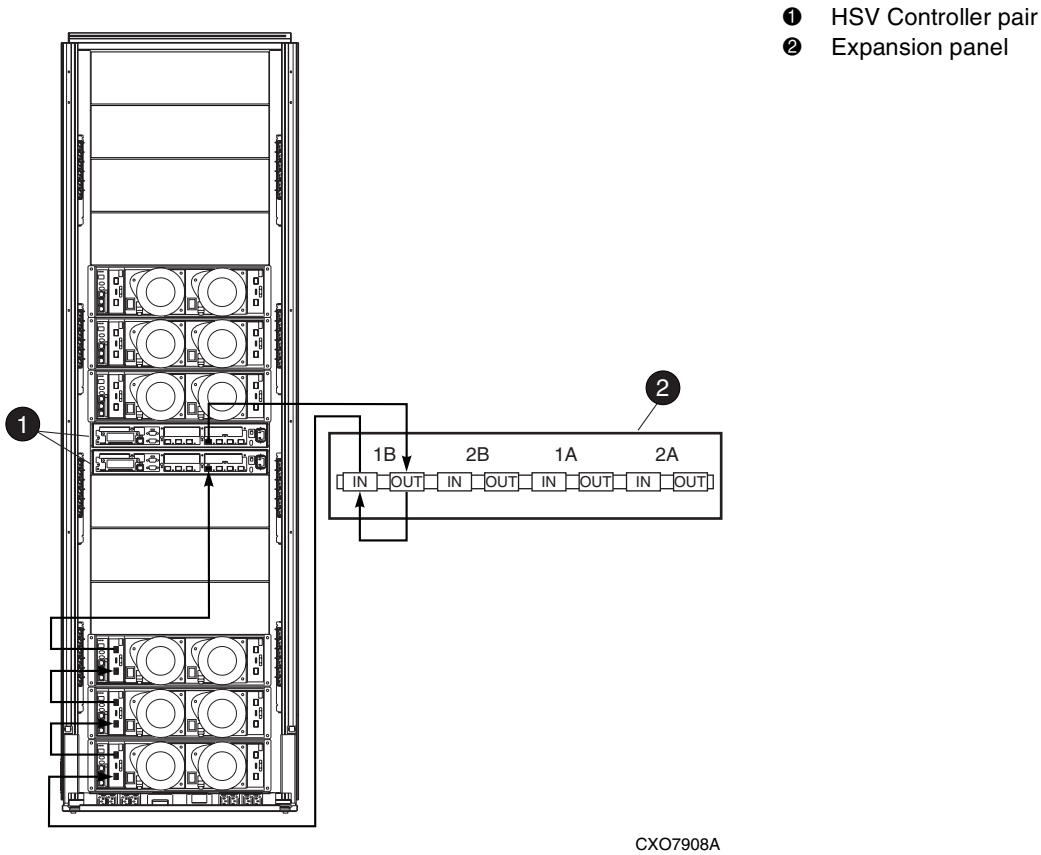


Figure 2–17: 2C6D configuration—Fibre Channel loop 1B with expansion panel

Figure 2–18 shows Fibre Channel loop 2A in the 42U rack with the expansion panel.

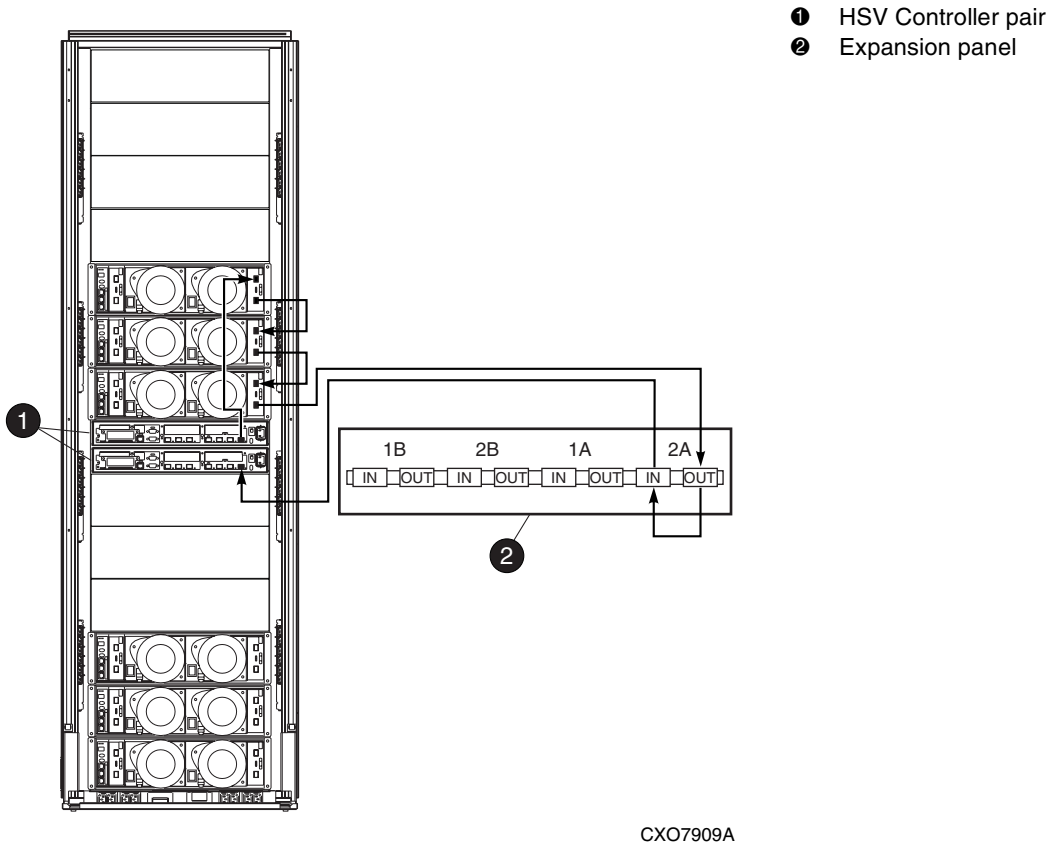


Figure 2–18: 2C6D configuration—Fibre Channel loop 2A with expansion panel

Figure 2–19 shows Fibre Channel loop 2B in the 42U rack with the expansion panel.

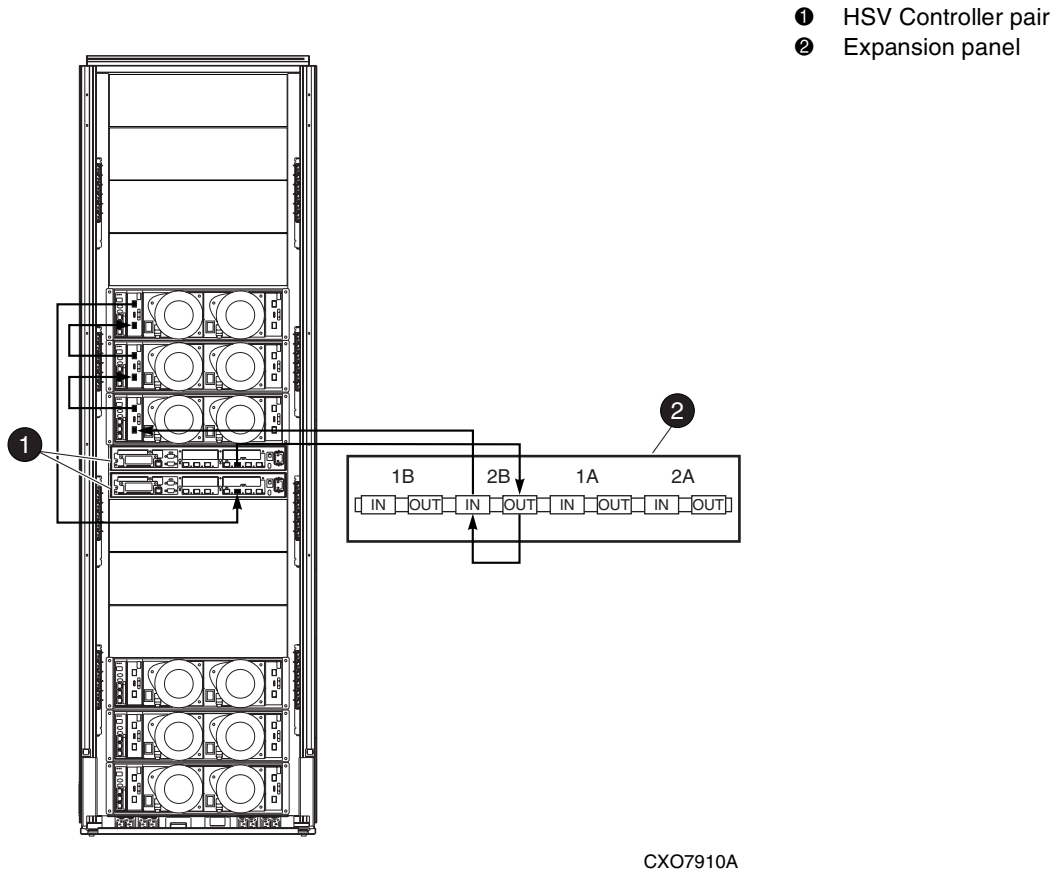


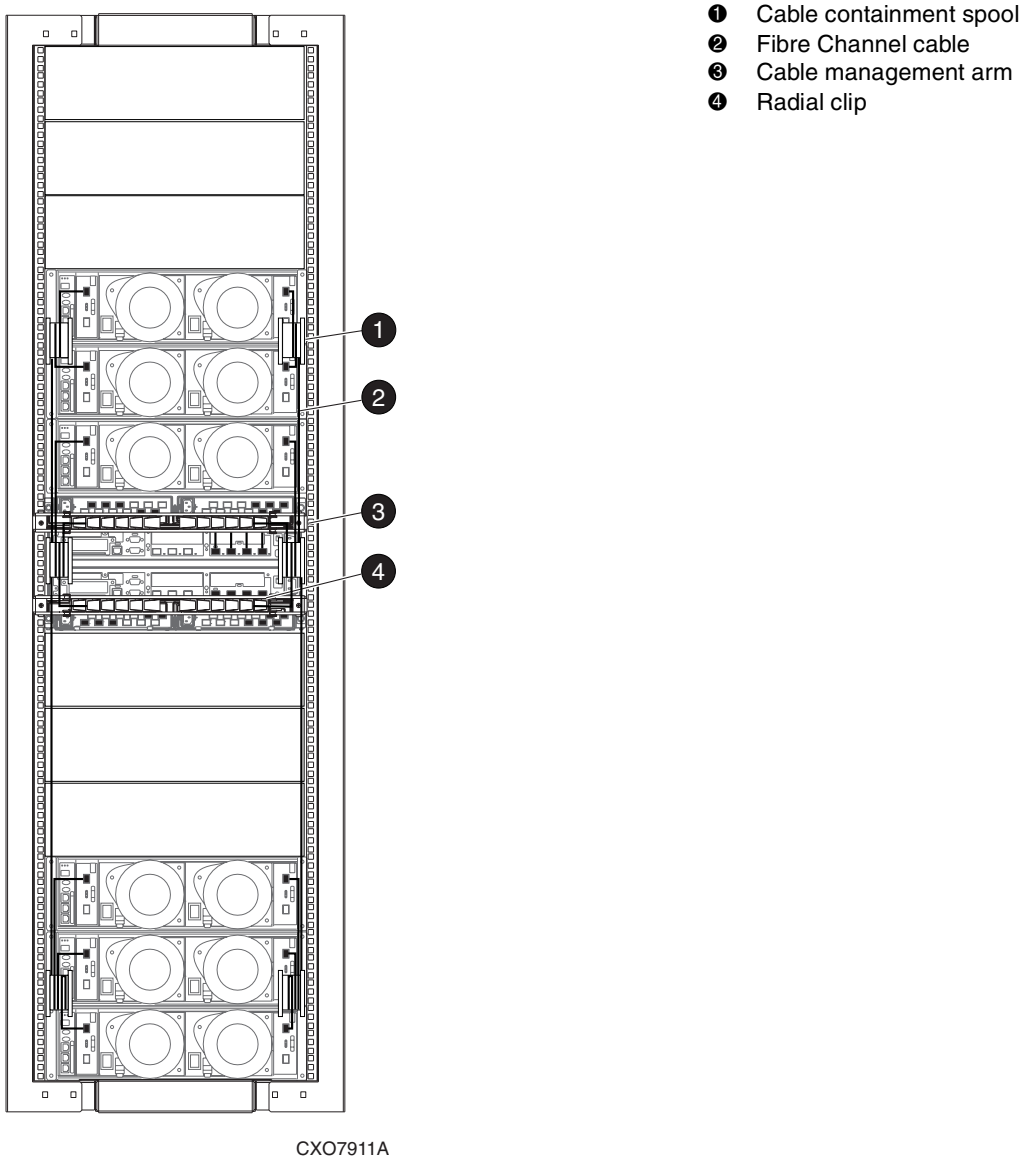
Figure 2–19: 2C6D configuration—Fibre Channel loop 2B with expansion panel

Cable Management Configurations

The 2C6D configuration contains six cable containment spools and two cable management arms.

Please see “Cable Management Configurations” on page 2–10 for more information about cable containment spools and cable management arms.

Figure 2–20 shows the cable management configuration in the 2C6D configuration.



❶ Cable containment spool
❷ Fibre Channel cable
❸ Cable management arm
❹ Radial clip

Figure 2–20: 2C6D cable management configuration

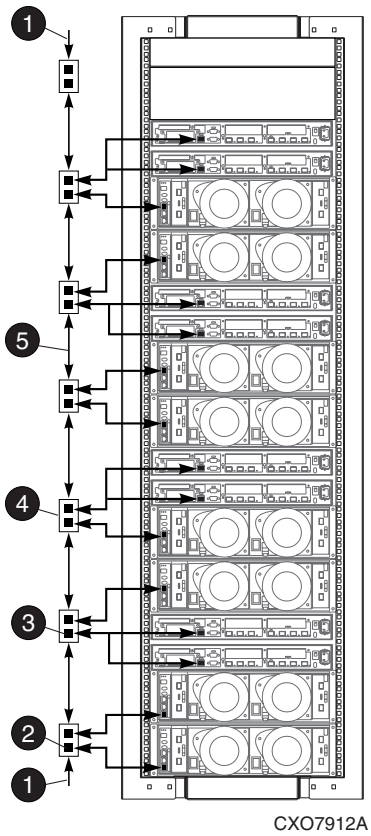
8C8D Configuration

The 8C8D configuration is a single-rack configuration that provides a maximum of 4.1 TB (112 36.4-GB disks) or 8.2 TB (112 72.8-GB disks) of storage capacity. This configuration can contain a maximum of 112 disks.

The 8C8D configuration is available in either the 41U Rack or the 42U Rack.

Enclosure Address Bus Configuration

The 8C8D configuration contains seven enclosure address bus junction boxes at 6U increments in the left rear rail of the rack. Each FC Drive Enclosure should be connected to an enclosure address bus junction box. The FC Drive Enclosures connect to each enclosure address bus junction box in pairs. The controller pairs connect to the enclosure address bus junction boxes with a Y cable. Figure 2–21 shows the enclosure address bus cable configuration for the 8C8D configuration.



❶ Terminator
❷ Enclosure address 1
❸ Enclosure address 3
❹ Enclosure address bus junction box
❺ Enclosure address bus cable

Figure 2–21: 8C8D configuration—enclosure address bus cables

Fibre Channel Loop Configurations

The 8C8D configuration contains 16 Fibre Channel loops. A Fibre Channel loop is formed when the FC Drive Enclosures and the HSV Controller pair are connected by Fibre Channel cables. The 8C8D configuration does not use FC Loop Switches or expansion panels. Instead, each I/O port on an FC Drive Enclosure is connected directly to an HSV Controller with a Fibre Channel cable.

Figure 2–22 shows the four 1A Fibre Channel loops.

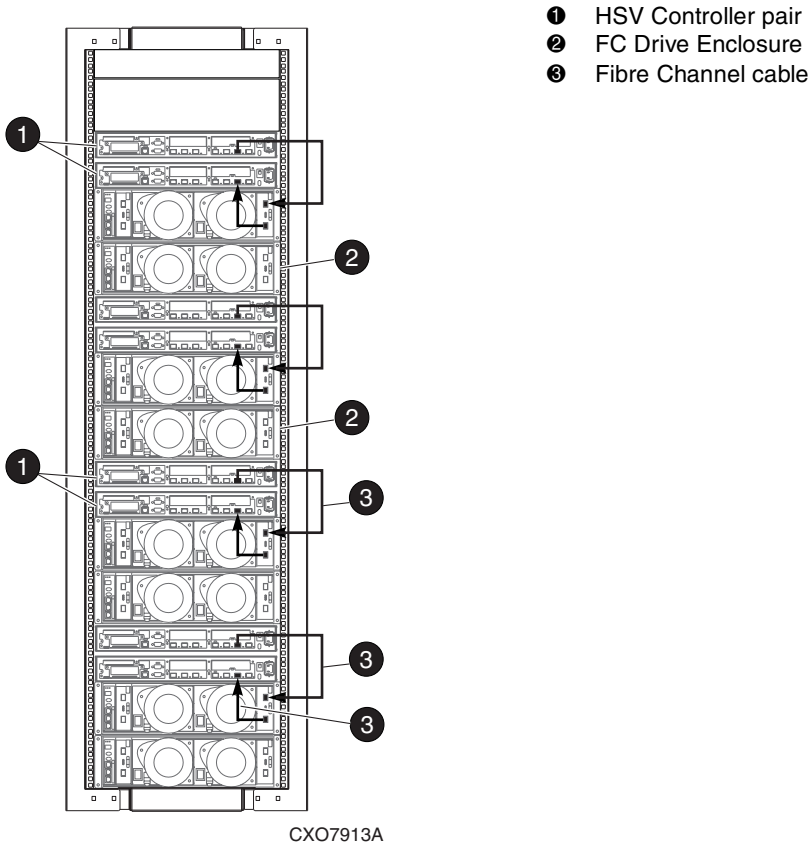


Figure 2–22: 8C8D configuration—Fibre Channel loop 1A

Figure 2–23 shows the four 1B Fibre Channel loops.

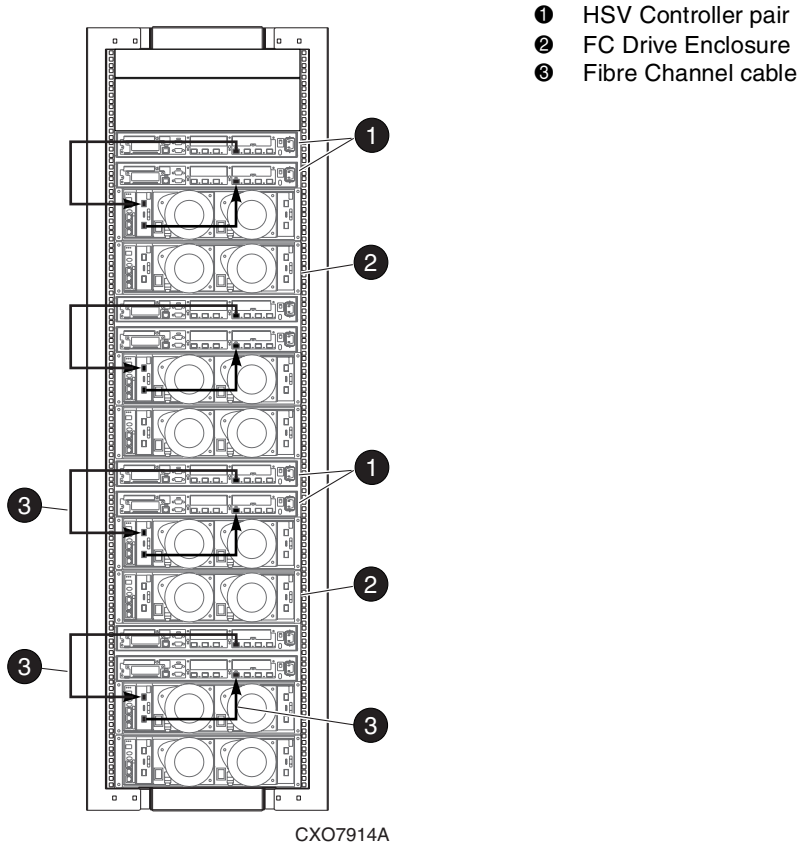


Figure 2–23: 8C8D configuration—Fibre Channel loop 1B

Figure 2–24 shows the four 2A Fibre Channel loops.

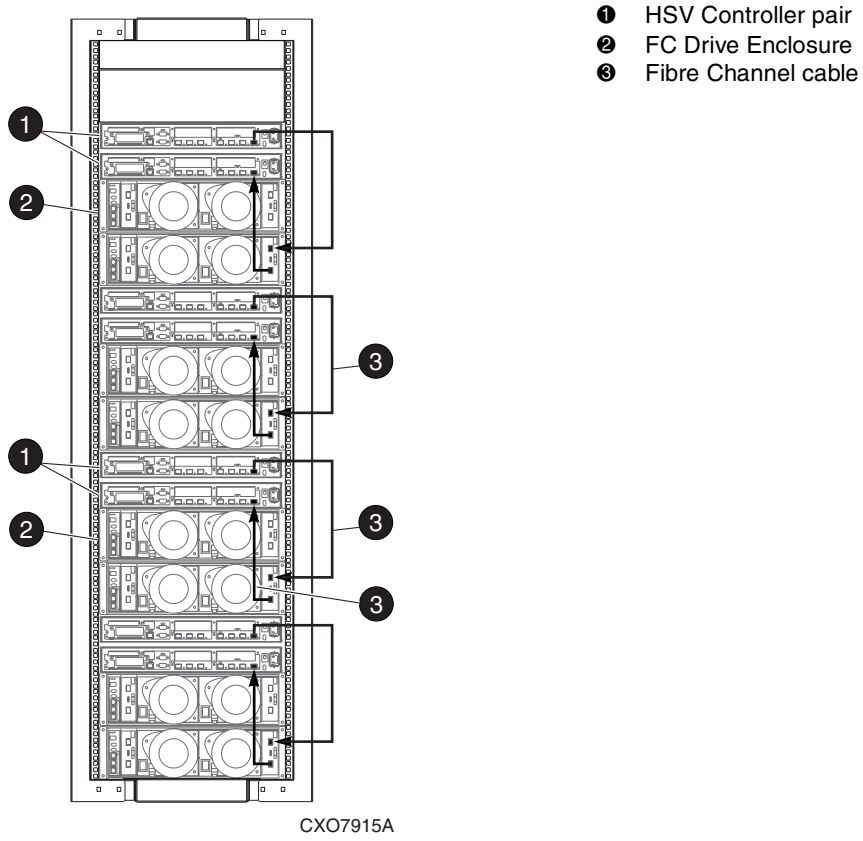


Figure 2–24: 8C8D configuration—Fibre Channel loop 2A

Figure 2–25 shows the four 2B Fibre Channel loops.

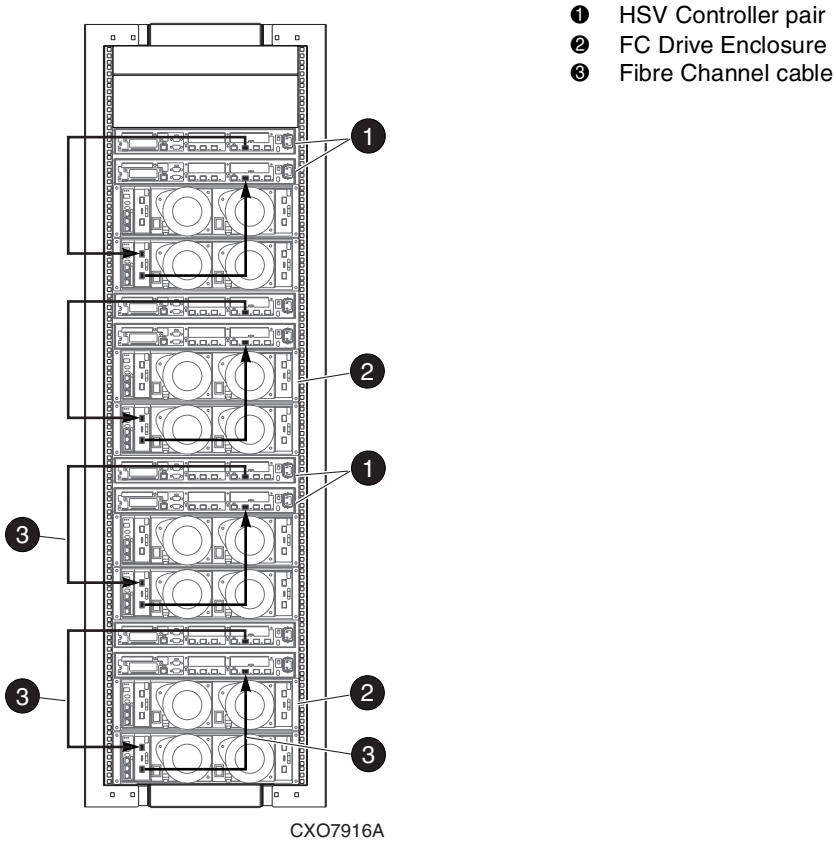


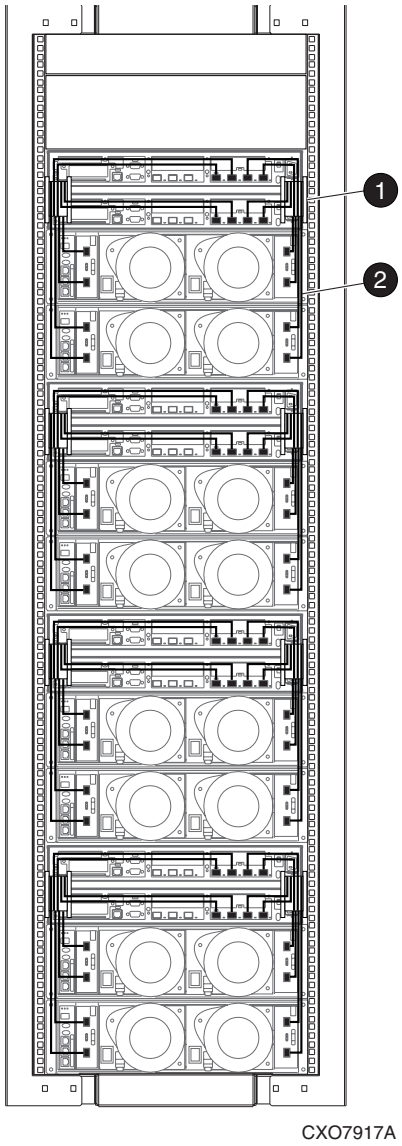
Figure 2–25: 8C8D configuration—Fibre Channel loop 2B

Cable Management Configurations

The 8C8D configuration contains eight cable containment spools and no cable management arms.

Please see “Cable Management Configurations” on page 2–10 for more information about cable containment spools and cable management arms.

Figure 2–26 shows the cable management configuration in the 8C8D configuration.



❶ Cable containment spool
❷ Fibre Channel cable

Figure 2–26: 8C8D cable management configuration

2C12D + 0C6D Configuration

The 2C12D + 0C6D configuration is a dual-rack configuration that provides up to 17.5 TB of storage by expanding from 168 disks to 240 disks. The 0C6D rack connects to the 2C12D rack with enclosure address bus cables and Fibre Channel cables.

Enclosure Address Bus Configuration

Each rack contains enclosure address bus junction boxes at 6U increments in the left rear rail of the rack. The 0C6D rack contains six enclosure address bus junction boxes; however, the FC Drive Enclosures use only three of the enclosure address bus junction boxes. The 2C12D rack contains seven enclosure address bus junction boxes. The FC Drive Enclosures and controller pair in the 2C12D rack use all seven enclosure address bus junction boxes.

The two racks are connected by one enclosure address bus cable, which connects to the bottom enclosure address bus junction box on each rack. The enclosure address bus cable between the racks is polarized. The P1 end of the cable connects to the bottom enclosure address bus junction box on the 2C12D rack. The P2 end of the cable connects to the bottom enclosure address bus junction box on the 0C6D rack.

IMPORTANT: Make sure the P1 end of the enclosure address bus cable is plugged into the 2C12D rack and the P2 end of the enclosure address bus cable is plugged into the 0C6D rack. If the cable is connected to the racks incorrectly, you will not be able to access the drive enclosures or data.

In order to connect two racks with an enclosure address bus cable, the Compaq Authorized Service Representative will have to remove the bottom terminator on the Master rack (2C12D rack).

Figure 2–27 shows the enclosure address bus cable configuration in the 2C12D + 0C6D configuration.

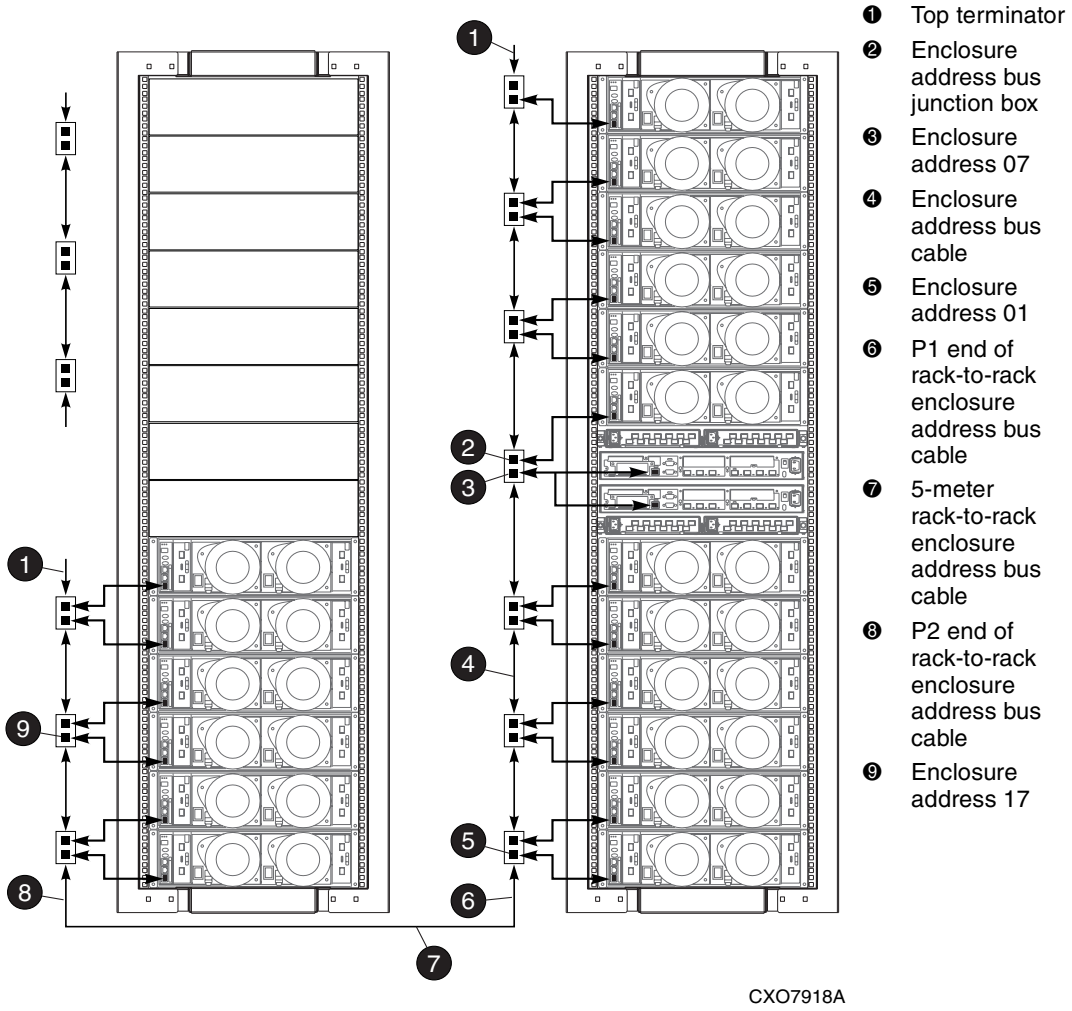


Figure 2–27: 2C12D + 0C6D configuration—enclosure address bus cables

Fibre Channel Loop Configurations

The 2C12D + 0C6D configuration contains four Fibre Channel loops. A Fibre Channel loop is formed when the FC Drive Enclosures and the HSV Controller pair are connected by Fibre Channel cables. The 2C12D configuration can use an FC Loop Switch or expansion panels to achieve the desired Fibre Channel loop configuration.

When the 2C12D + 0C6D configuration uses FC Loop Switches, each FC Drive Enclosure in a loop is directly connected to the associated FC Loop Switch. The HSV Controller pair is also connected directly to the associated FC Loop Switch. When the FC Loop Switch is powered on, it completes a Fibre Channel loop.

When the 2C12D + 0C6D configuration uses expansion panels, all of the FC Drive Enclosures in a loop are connected to the controller pair in the Master rack. The 2C12D + 0C6D configuration uses expansion panels to achieve this configuration.

Refer to Table 2–1 for locations of Fibre Channel loops in a storage rack.

Figure 2–28 shows Fibre Channel loop 1A and the associated FC Loop Switch.

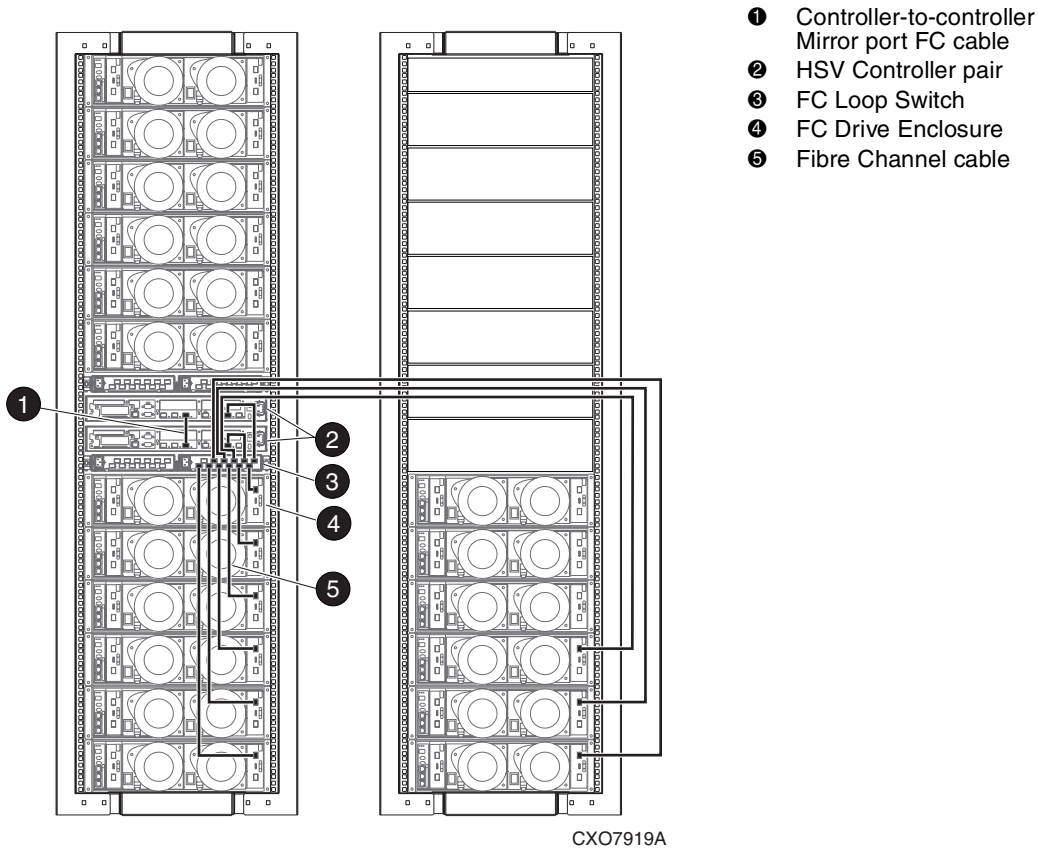


Figure 2–28: 2C12D + 0C6D configuration—Fibre Channel loop 1A with FC Loop Switch

Figure 2–29 shows Fibre Channel loop 1B and the associated FC Loop Switch.

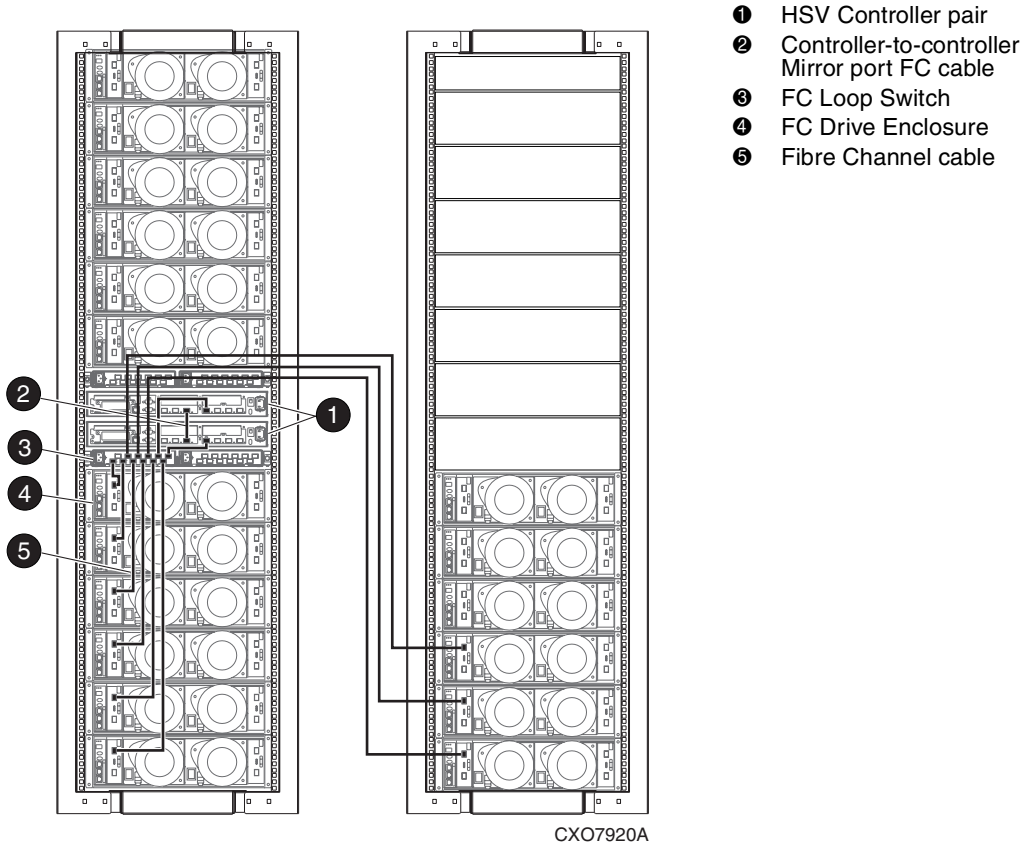


Figure 2–29: 2C12D + 0C6D configuration—Fibre Channel loop 1B with FC Loop Switch

Figure 2–30 shows Fibre Channel loop 2A and the associated FC Loop Switch.

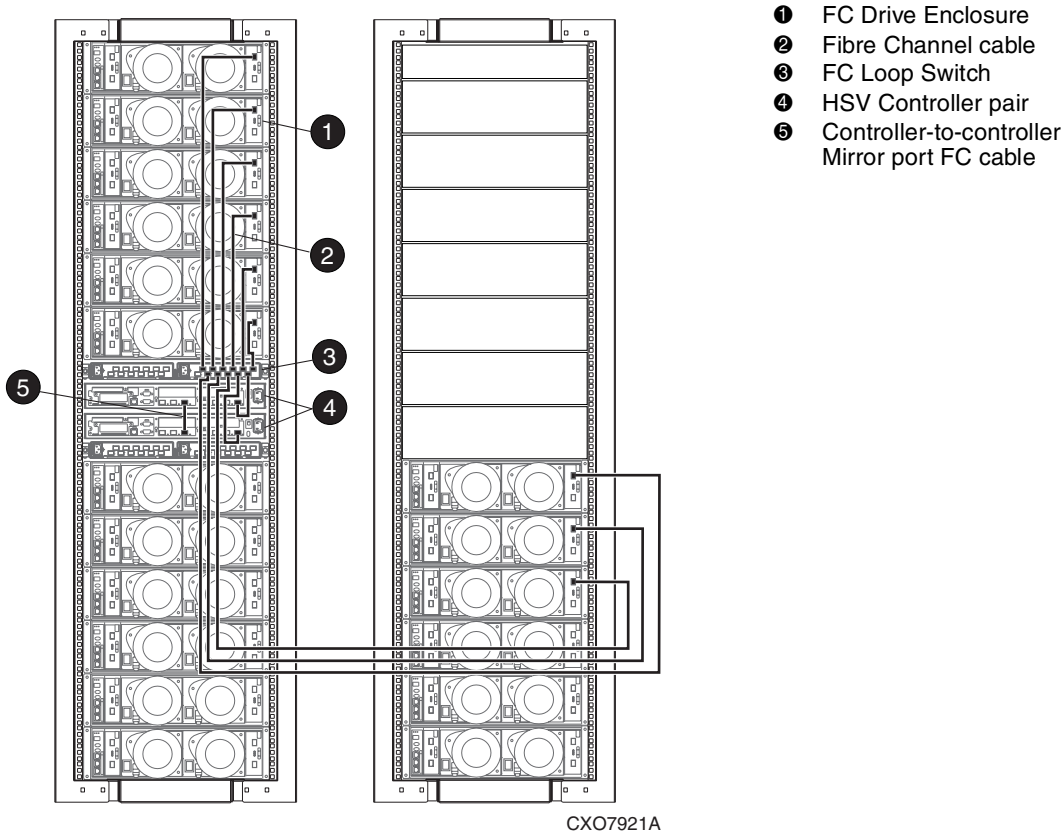


Figure 2–30: 2C12D + 0C6D configuration—Fibre Channel loop 2A with FC Loop Switch

Figure 2–31 shows Fibre Channel loop 2B and the associated FC Loop Switch.

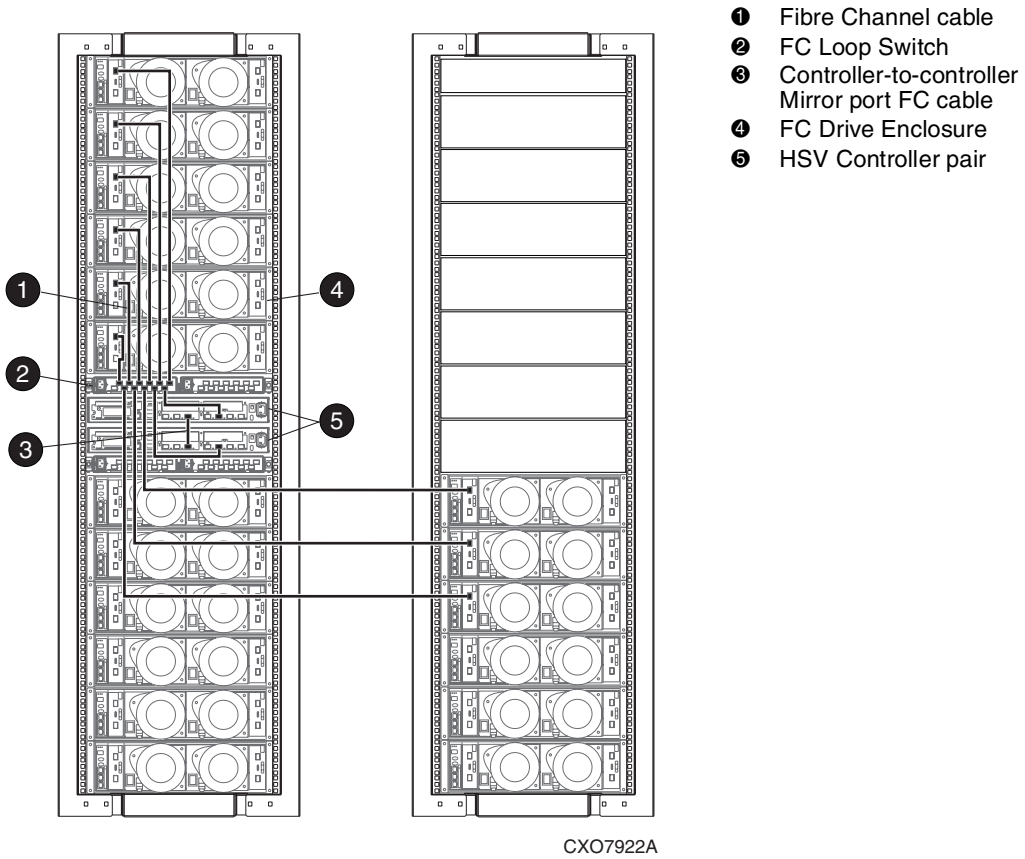
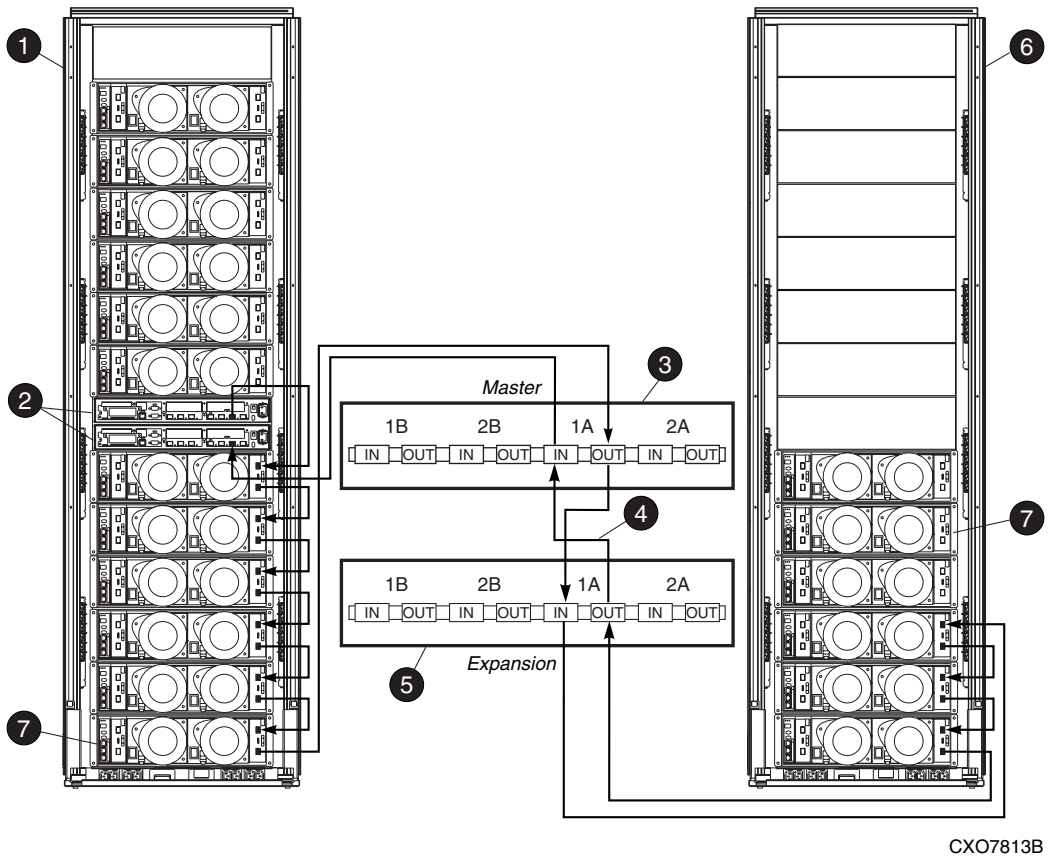


Figure 2–31: 2C12D + 0C6D configuration—Fibre Channel loop 2B with FC Loop Switch

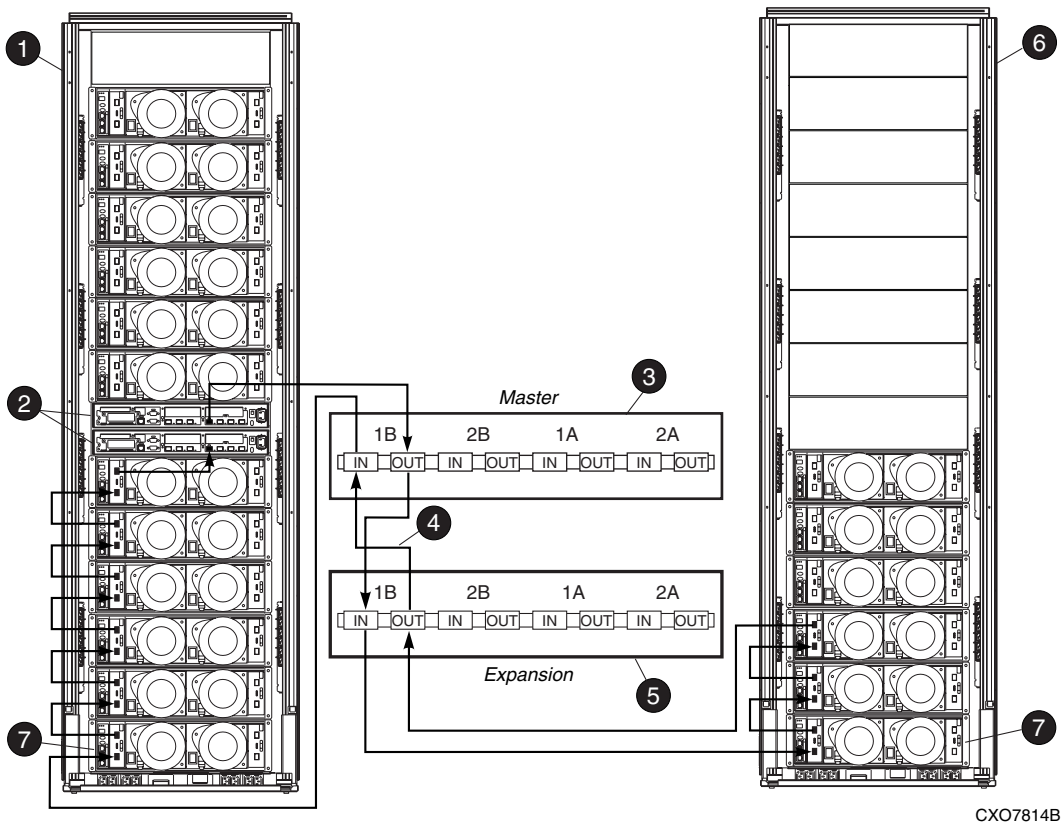
Figure 2–32 shows Fibre Channel loop 1A with expansion panels.



❶ Master rack
❷ HSV Controller pair
❸ Master rack expansion panel
❹ 5-meter rack-to-rack Fibre Channel cables
❺ Expansion rack expansion panel
❻ Expansion rack
❼ FC Drive Enclosure

Figure 2–32: 2C12D + 0C6D configuration—Fibre Channel loop 1A with expansion panels

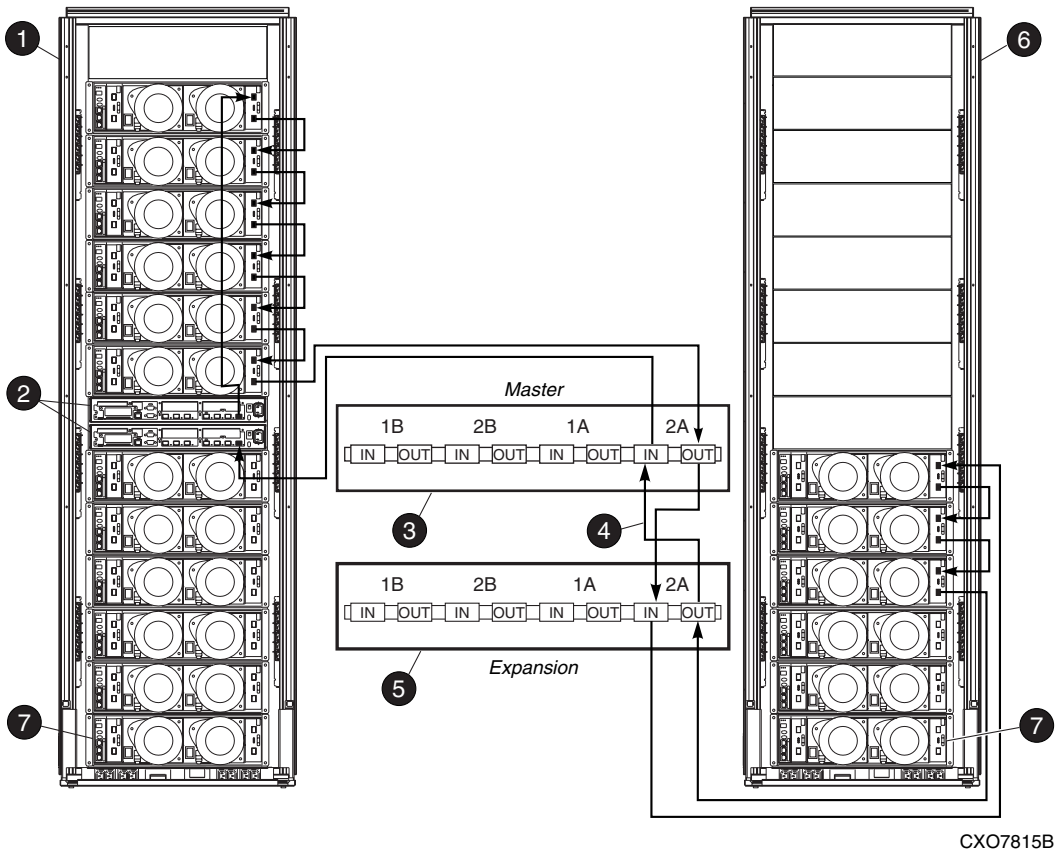
Figure 2–33 shows Fibre Channel Loop 1B with expansion panels.



❶ Master rack
❷ HSV Controller pair
❸ Master rack expansion panel
❹ 5-meter rack-to-rack Fibre Channel cables
❺ Expansion rack expansion panel
❻ Expansion rack
❼ FC Drive Enclosure

Figure 2–33: 2C12D + 0C6D configuration—Fibre Channel Loop 1B with expansion panels

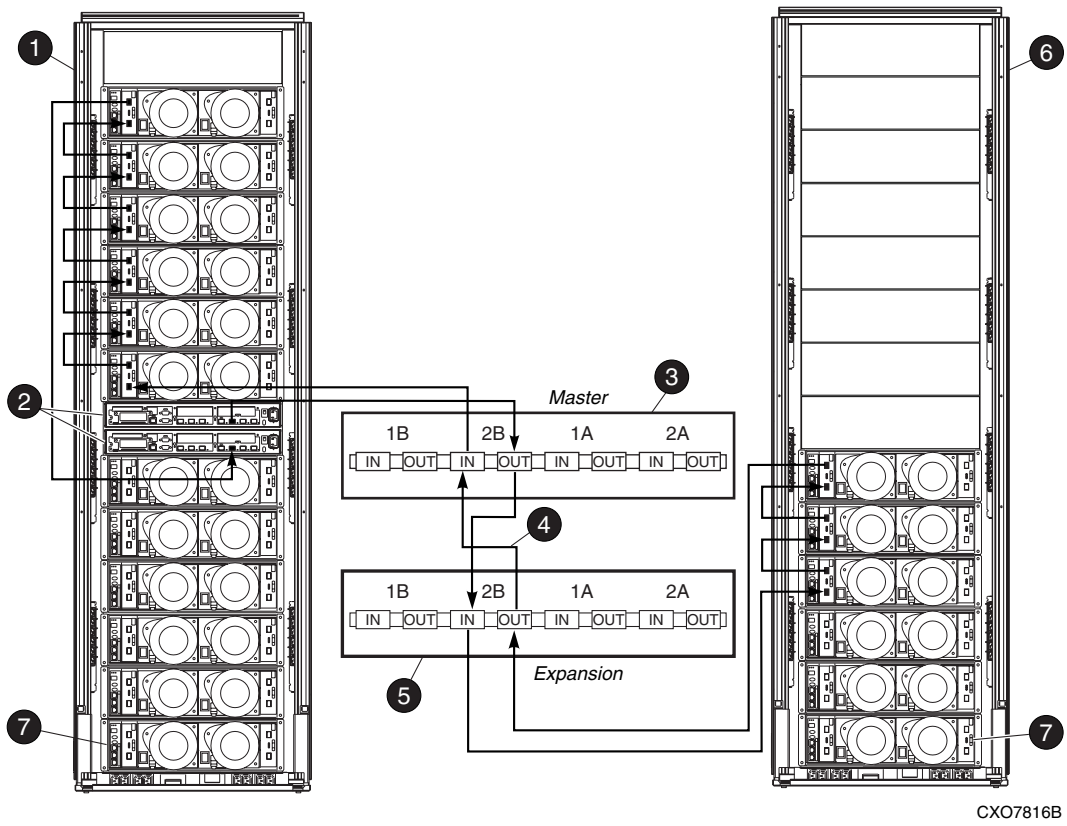
Figure 2–34 shows Fibre Channel Loop 2A with expansion panels.



❶ Master rack
❷ HSV Controller pair
❸ Master rack expansion panel
❹ 5-meter rack-to-rack Fibre Channel cables
❺ Expansion rack expansion panel
❻ Expansion rack
❼ FC Drive Enclosure

Figure 2–34: 2C12D + 0C6D configuration—Fibre Channel loop 2A with expansion panels

Figure 2–35 shows Fibre Channel Loop 2B with expansion panels.



❶ Master rack
❷ HSV Controller pair
❸ Master rack expansion panel
❹ 5-meter rack-to-rack Fibre Channel cables
❺ Expansion rack expansion panel
❻ Expansion rack
❼ FC Drive Enclosure

Figure 2–35: 2C12D + 0C6D configuration—Fibre Channel loop 2B with expansion panels

2 x 2C12D + 0C12D Configuration

The 2 x 2C12D + 0C12D configuration is a triple-rack configuration that provides up to 35 TB of storage capacity by expanding each Enterprise Virtual Array to 240 disks each for a total of 480 disks. The two 2C12D Master racks connect to the 0C12D Expansion rack with enclosure address bus and Fibre Channel cables.

Enclosure Address Bus Configuration

Each rack contains enclosure address bus junction boxes at 6U increments in the left rear rail of the rack. The 0C12D rack contains six enclosure address bus junction boxes. The FC Drive Enclosures in the 0C12D rack use all six enclosure address bus junction boxes. The 2C12D rack contains seven enclosure address bus junction boxes. The FC Drive Enclosures and controller pair in the 2C12D rack use all seven enclosure address bus junction boxes.

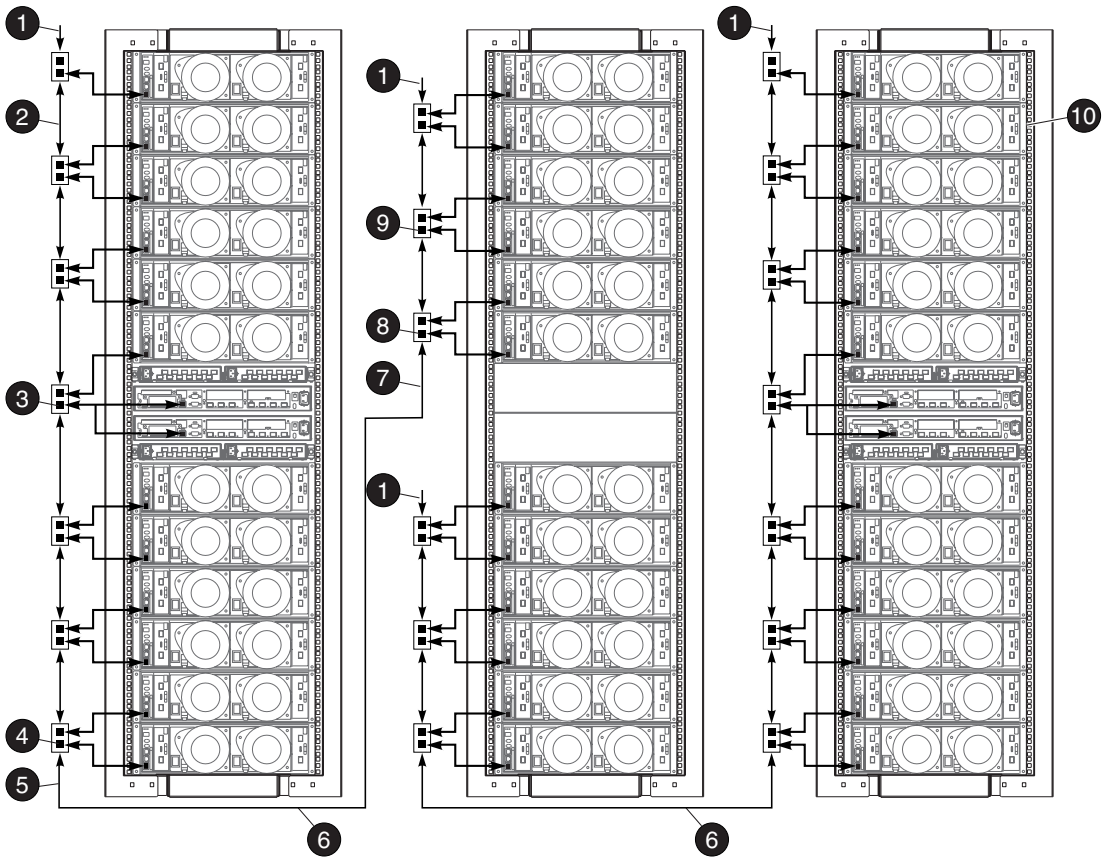
The three racks are connected by two enclosure address bus cables. Each Master rack is connected to the Expansion rack by one enclosure address bus cable. One Master rack runs an enclosure address bus cable to the bottom enclosure address bus junction box on the Expansion rack; the other Master rack runs an enclosure address bus cable to the fourth enclosure address bus junction box (from the bottom) on the Expansion rack.

The enclosure address bus cables are polarized. The P1 end of the cable connects to the bottom enclosure address bus junction box on the 2C12D rack. The P2 end of the cable connects to the enclosure address bus junction box on the Expansion rack.

IMPORTANT: Make sure the P1 end of the enclosure address bus cable is plugged into the 2C12D rack and the P2 end of the enclosure address bus cable is plugged into the Expansion rack. If the cable is connected to the racks incorrectly, you will not be able to access the drive enclosures or data.

In order to connect the racks with an enclosure address bus cable, the Compaq Authorized Service Representative will have to remove the bottom terminator on the Master racks (2C12D rack).

Figure 2–36 shows the enclosure address bus cable configuration in the 2C12D + 0C12D configuration.



❶ Top terminator
❷ Enclosure address bus cable
❸ Enclosure address 7
❹ Enclosure address 1
❺ P1 end of rack-to-rack enclosure address bus cable
❻ 5-meter rack-to-rack enclosure address bus cable
❼ P2 end of rack-to-rack enclosure address bus cable
❽ Enclosure address 15
❾ Enclosure address junction box
❿ FC Drive Enclosure

Figure 2–36: 2 x 2C12D + 0C12D configuration—enclosure address bus cables

Fibre Channel Loop Configurations

The 2 x 2C12D + 0C12D configuration contains eight Fibre Channel loops. A Fibre Channel loop is formed when the FC Drive Enclosures and the HSV Controller pair are connected by Fibre Channel cables. The 2 x 2C12D + 0C12D configuration can use an FC Loop Switch or expansion panels to achieve the desired Fibre Channel loop configuration.

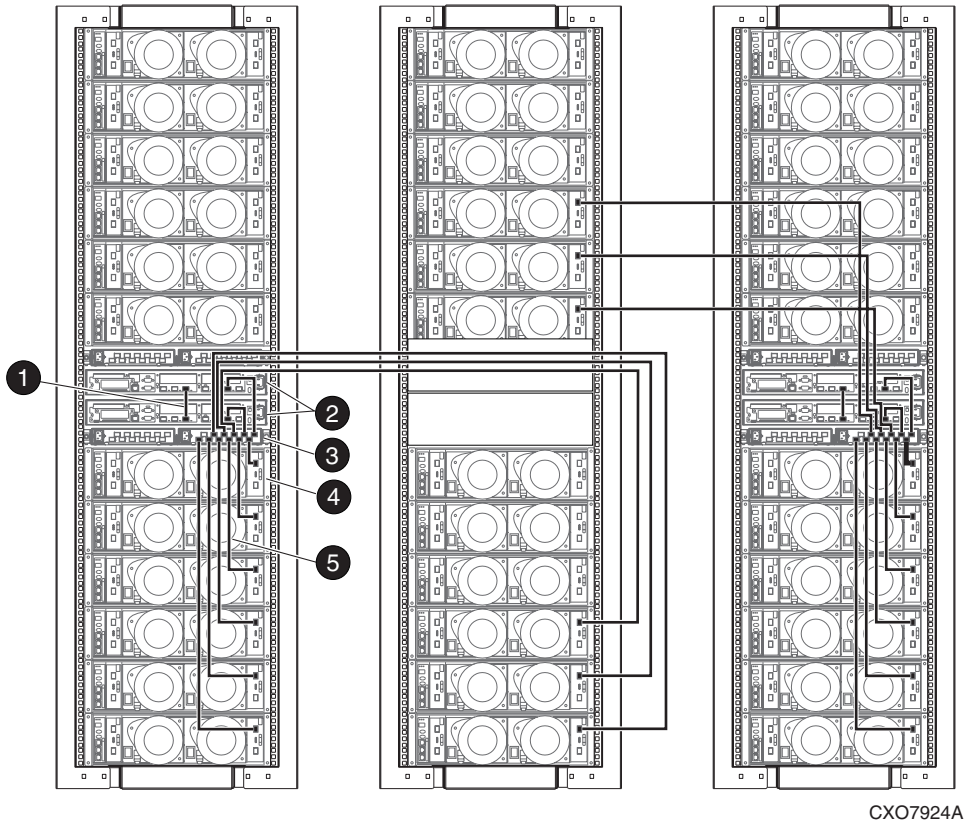
The 0C12D rack is divided into an upper and lower half. The upper half of the 0C12D rack connects to the Master rack on the right (when viewed from the rear), and the lower half of the 0C12D rack connects to the Master rack on the left (when viewed from the rear).

When the 2 x 2C12D + 0C12D configuration uses FC Loop Switches, each FC Drive Enclosure in a loop is directly connected to the associated FC Loop Switch. The HSV Controller pair is also connected directly to the associated FC Loop Switch. When the FC Loop Switch is powered on, it completes a Fibre Channel loop.

When the 2 x 2C12D + 0C12D configuration uses expansion panels, all of the FC Drive Enclosures in a loop are connected to the controller pair in the Master rack. The 2 x 2C12D + 0C12D configuration uses expansion panels to achieve this configuration.

Refer to Table 2–1 for locations of Fibre Channel loops in a storage rack.

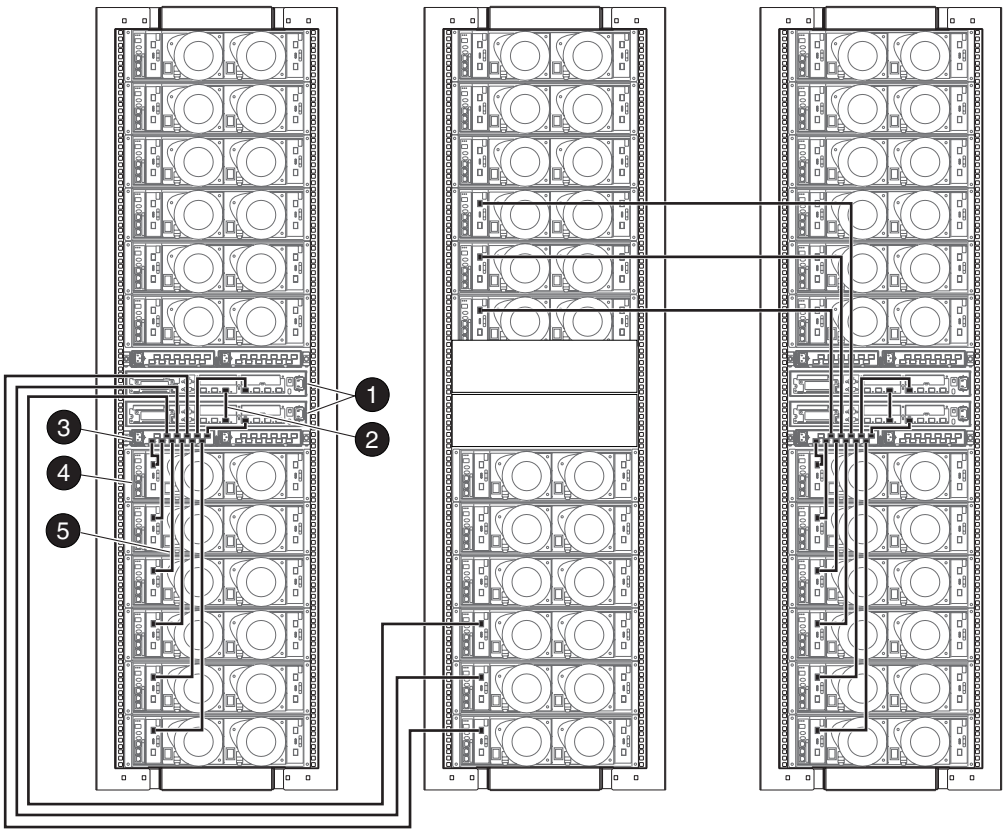
Figure 2–37 shows the two 1A Fibre Channel loops and the associated FC Loop Switches.



❶ Controller-to-controller Mirror port FC cable
❷ HSV Controller pair
❸ FC Loop Switch
❹ FC Drive Enclosure
❺ Fibre Channel cable

Figure 2–37: 2 x 2C12D + 0C12D configuration—Fibre Channel loop 1A with FC Loop Switch

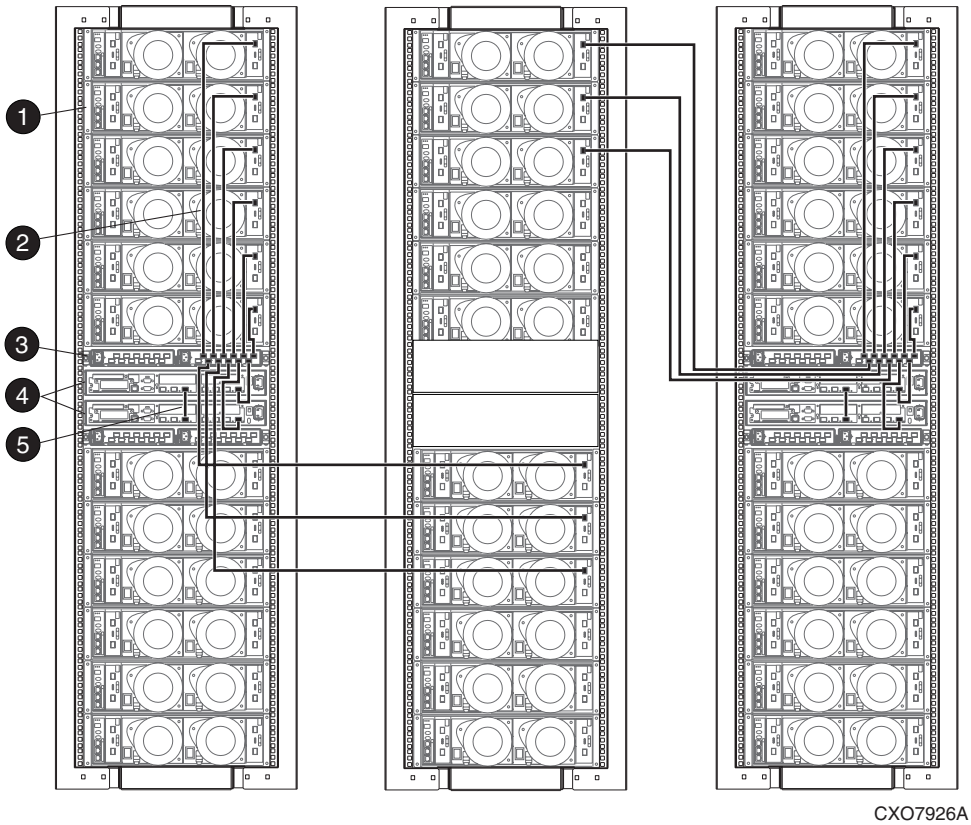
Figure 2–38 shows the two 1B Fibre Channel loops and the associated FC Loop Switches.



❶ HSV Controller pair
❷ Controller-to-controller Mirror port FC cable
❸ FC Loop Switch
❹ FC Drive Enclosure
❺ Fibre Channel cable

Figure 2–38: 2 x 2C12D + 0C12D configuration—Fibre Channel loop 1B with FC Loop Switch

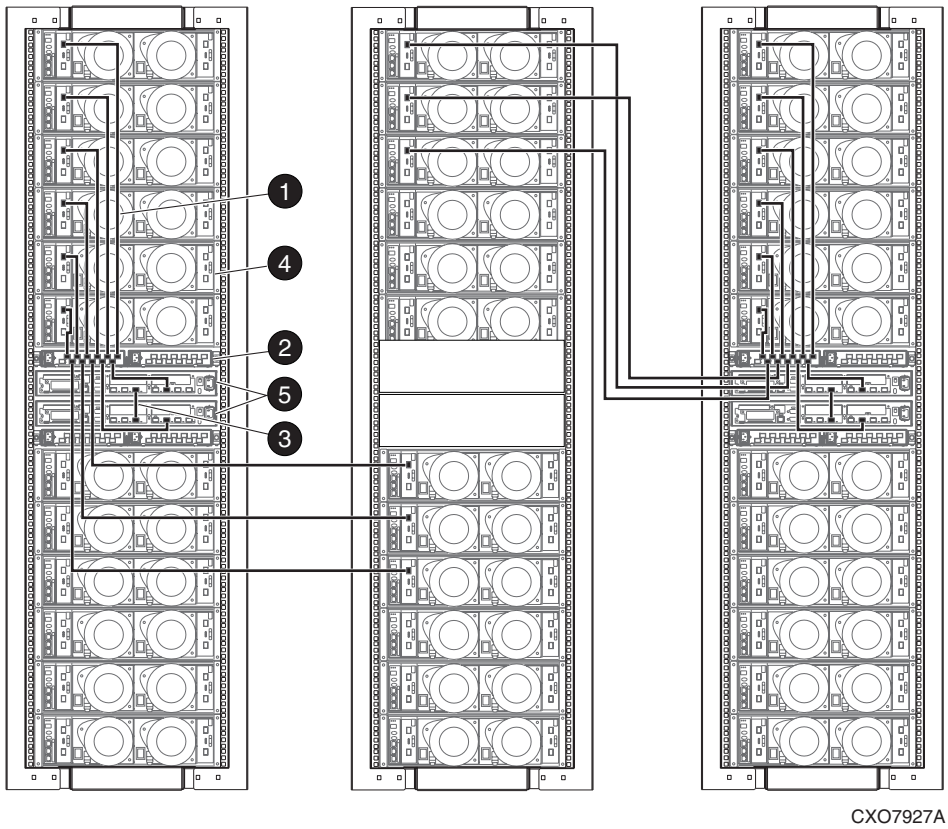
Figure 2–39 shows the two 2A Fibre Channel loops and the associated FC Loop Switches.



❶ FC Drive Enclosure
❷ Fibre Channel cable
❸ FC Loop Switch
❹ HSV Controller pair
❺ Controller-to-controller Mirror port FC cable

Figure 2–39: 2 x 2C12D + 0C12D configuration—Fibre Channel loop 2A with FC Loop Switch

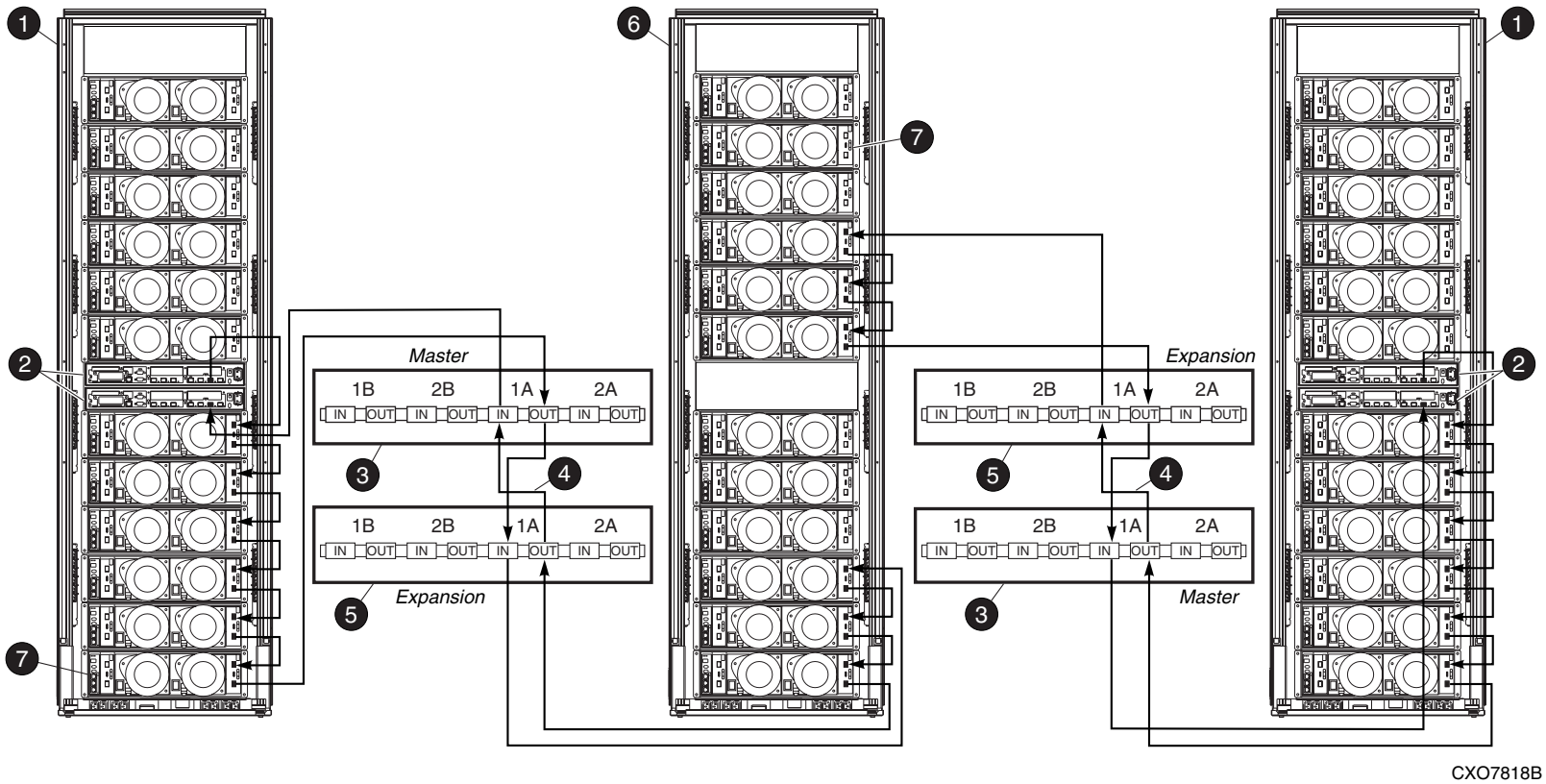
Figure 2–40 shows the two 2B Fibre Channel loops and the associated FC Loop Switches.



❶ Fibre Channel cable
❷ FC Loop Switch
❸ Controller-to-controller Mirror port FC cable
❹ FC Drive Enclosure
❺ HSV Controller pair

Figure 2–40: 2 x 2C12D + 0C12D configuration—Fibre Channel loop 2B with FC Loop Switch

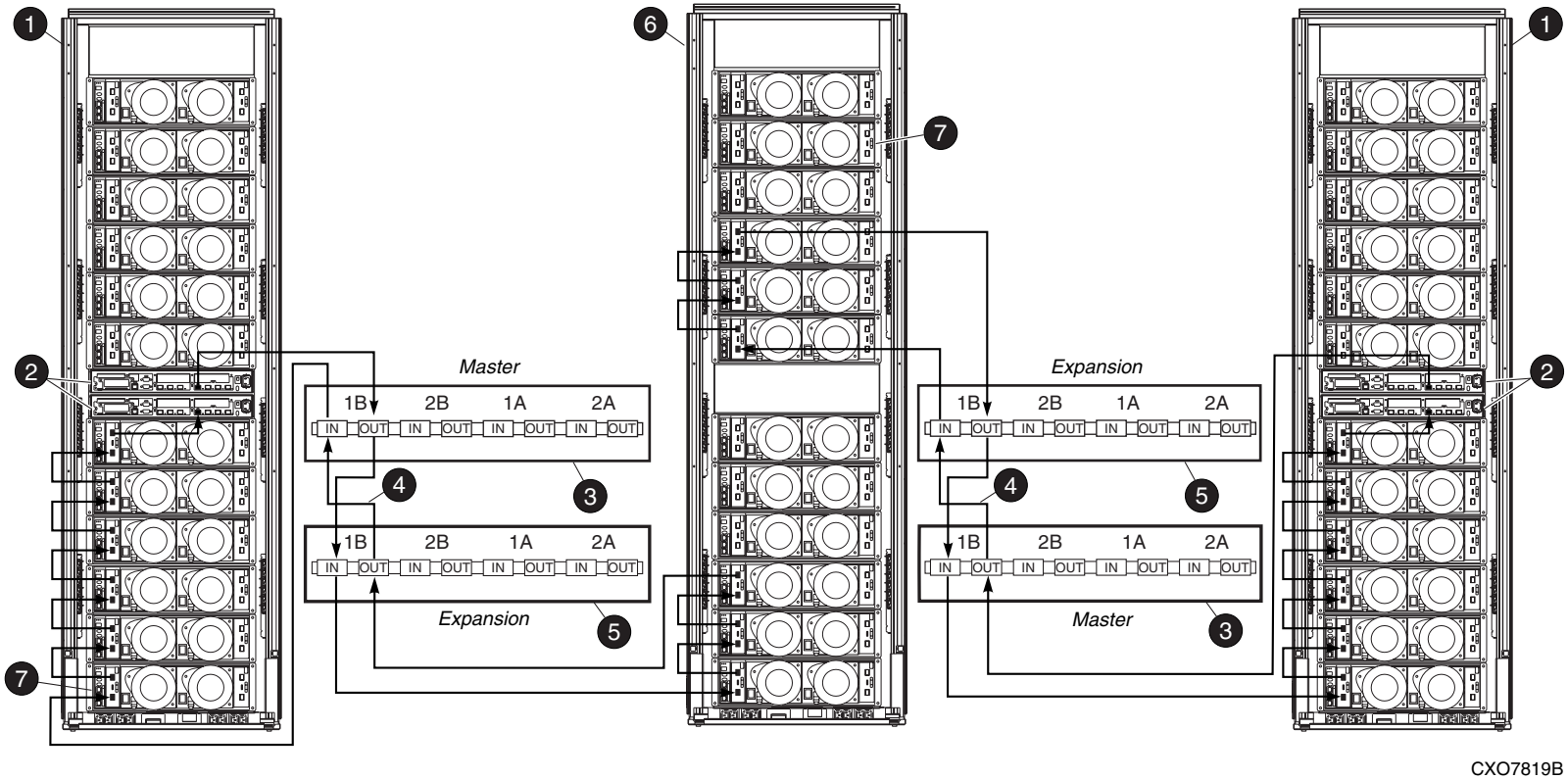
Figure 2–41 shows the two 1A Fibre Channel loops with expansion panels.



❶ Master rack
❷ HSV Controller pair
❸ Master rack expansion panel
❹ 5-meter rack-to-rack Fibre Channel cables
❺ Expansion rack expansion panel
❻ Expansion rack
❼ FC Drive Enclosure

Figure 2–41: 2 x 2C12D + 0C12D configuration—Fibre Channel loop 1A with expansion panels

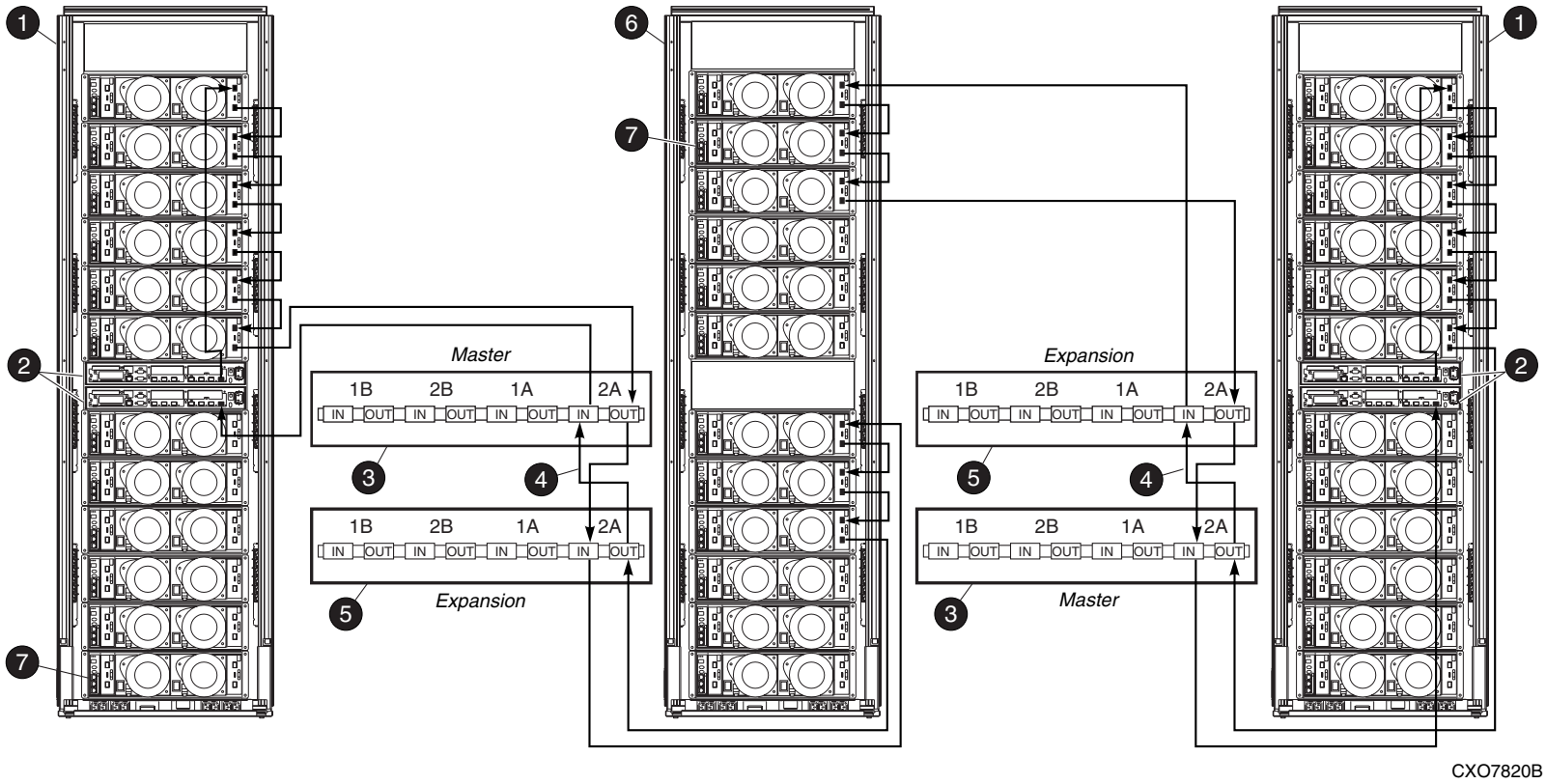
Figure 2–42 shows the two 1B Fibre Channel loops with expansion panels.



❶ Master rack
❷ HSV Controller pair
❸ Master rack expansion panel
❹ 5-meter rack-to-rack Fibre Channel cables
❺ Expansion rack expansion panel
❻ Expansion rack
❼ FC Drive Enclosure

Figure 2–42: 2 x 2C12D + 0C12D configuration—Fibre Channel loop 1B with expansion panels

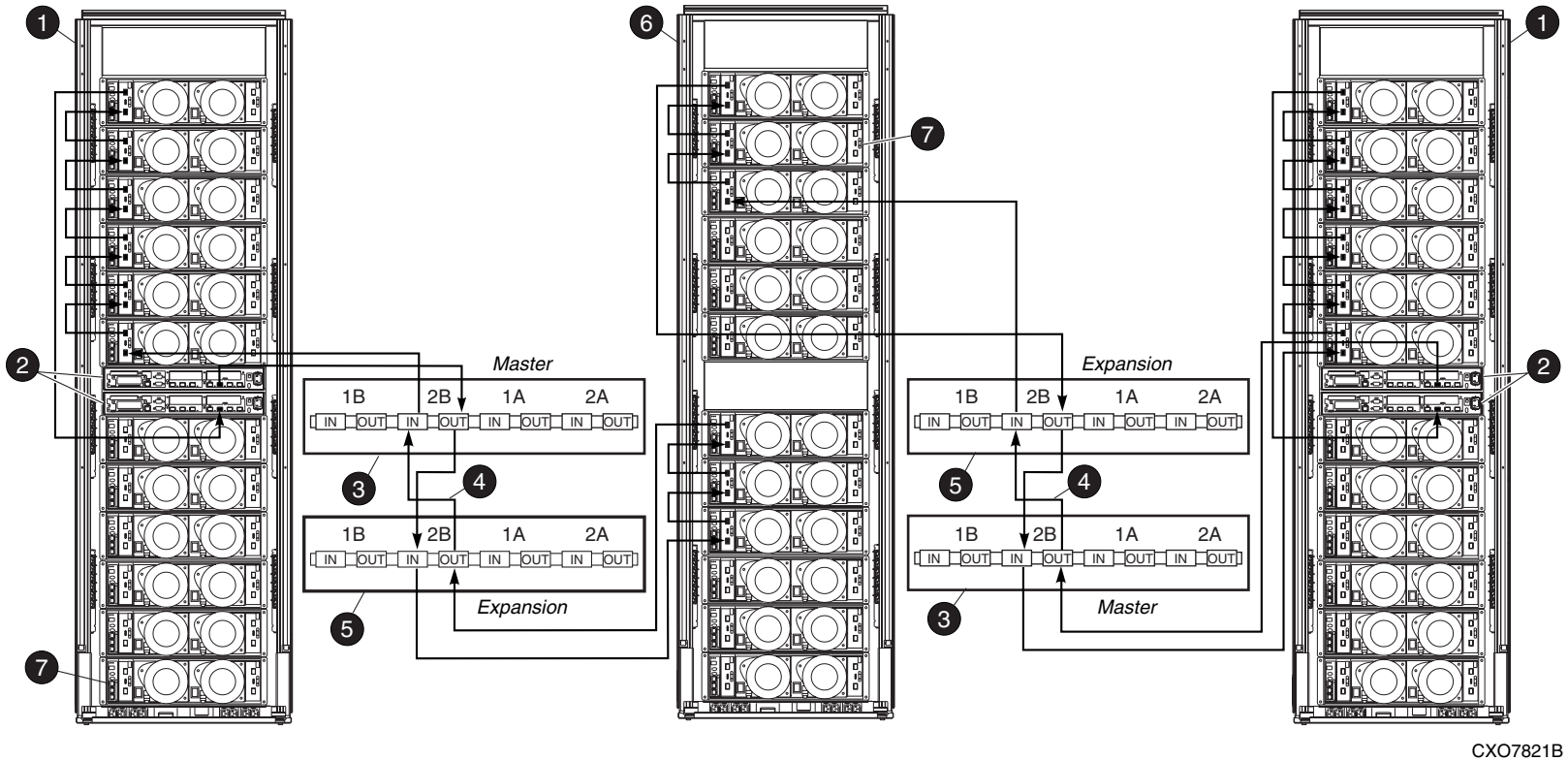
Figure 2–43 shows the two 2A Fibre Channel loops with expansion panels.



❶ Master rack
❷ HSV Controller pair
❸ Master rack expansion panel
❹ 5-meter rack-to-rack Fibre Channel cables
❺ Expansion rack expansion panel
❻ Expansion rack
❼ FC Drive Enclosure

Figure 2–43: 2 x 2C12D + 0C12D configuration—Fibre Channel loop 2A with expansion panels

Figure 2–44 shows the two 2B Fibre Channel loops with expansion panels.



❶ Master rack
❷ HSV Controller pair
❸ Master rack expansion panel
❹ 5-meter rack-to-rack Fibre Channel cables
❺ Expansion rack expansion panel
❻ Expansion rack
❼ FC Drive Enclosure

Figure 2–44: 2 x 2C12D + 0C12D configuration—Fibre Channel loop 2B with expansion panels

3

Upgrading Existing Racks to Enterprise V2.0

This chapter summarizes how to upgrade an Enterprise Virtual Array V1.0 configuration to an Enterprise Virtual Array V2.0 configuration. The key differences between an Enterprise Virtual Array V1.0 configuration and an Enterprise Virtual Array V2.0 configuration are the absence of expansion panels, the addition of FC Loop Switches, and the reconfiguration of the Fibre Channel cables.

This chapter contains the following sections:

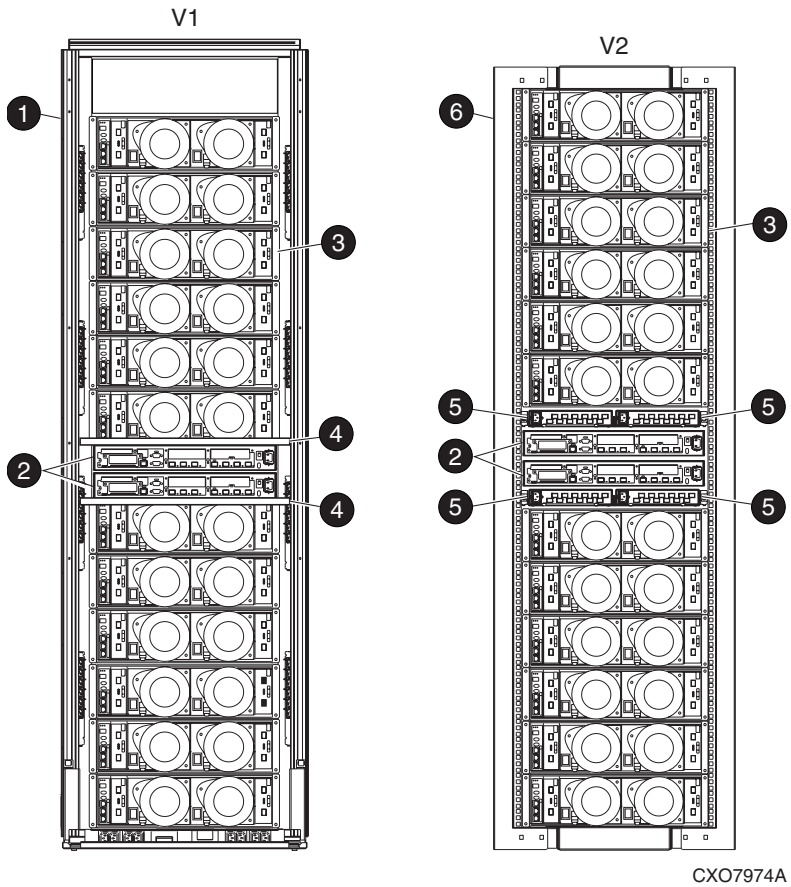
- Expansion Panels
- FC Loop Switches
- Fibre Channel Cable Reconfiguration

IMPORTANT: Only Compaq Authorized Service Representatives may upgrade Enterprise Virtual Array V1.0 configurations to Enterprise Virtual Array V2.0 configurations.

Before you upgrade an Enterprise Virtual Array V1.0 configuration to an Enterprise Virtual Array V2.0 configuration, ensure that you have the correct Enterprise Virtual Array software and firmware.

Refer to *SANworks by Compaq Upgrade Instructions for Enterprise Virtual Array* for more information.

Figure 3–1 shows the 2C12D configuration for the Enterprise Virtual Array V1.0 and the for Enterprise Virtual Array V2.0. In general, Version 2.0 racks are characterized by the presence of the FC Loop Switches. Version 1.0 racks are 42U, while Version 2.0 racks can be either 41U or 42U.



❶ 42U rack
❷ HSV Controller pair
❸ FC Drive Enclosure
❹ Expansion panels
❺ FC Loop Switches
❻ 41U rack

Figure 3–1: Expansion panels versus FC Loop Switches

Expansion Panels

In Version 1.0 of the Enterprise Virtual Array, expansion panels were added to racks to allow you to expand the storage capacity of the Enterprise Virtual Array. In Version 2.0 of the Enterprise Virtual Array, the presence of FC Loop Switches has made the expansion panels obsolete. You can easily expand an Enterprise Virtual Array configuration by directly connecting additional FC Drive Enclosures to the FC Loop Switches.

Your Compaq Authorized Service Representative is responsible for removing expansion panels.

FC Loop Switches

An Enterprise Virtual Array Master rack contains four FC Loop Switches. Typically, two FC Loop Switches are mounted on a rack shelf above the HSV Controller pair, and two FC Loop Switches are mounted on a rack shelf below the HSV Controller pair.

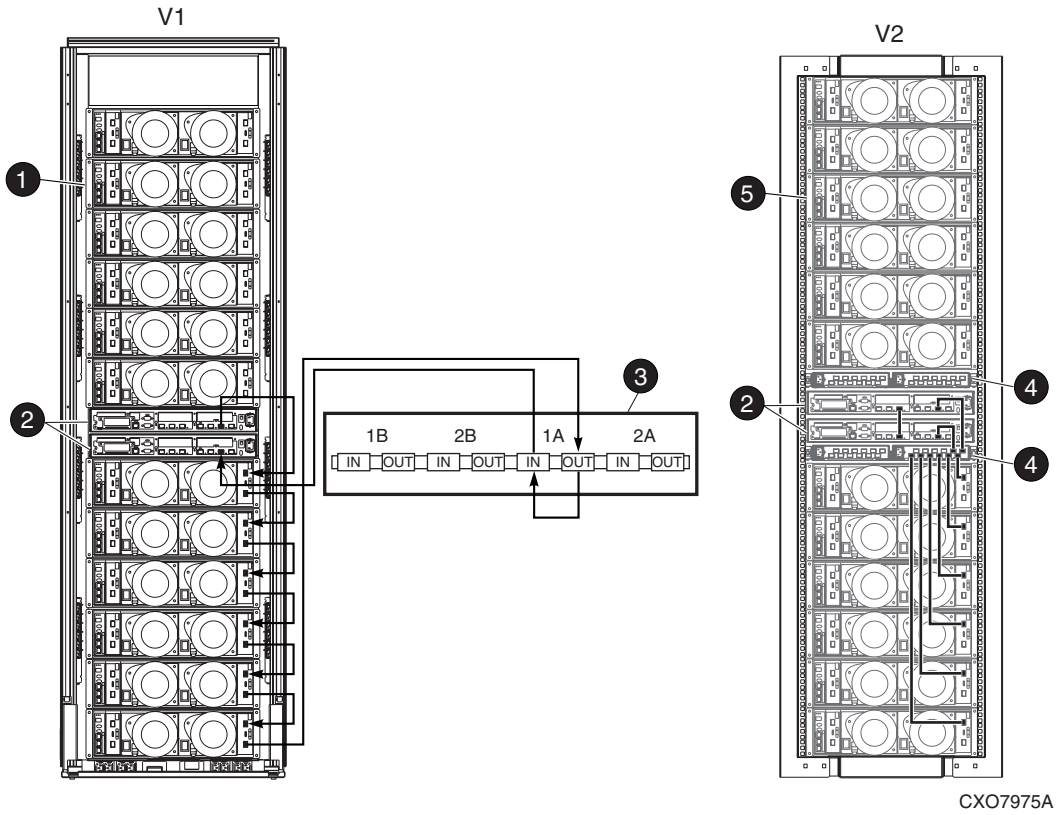
Your Compaq Authorized Service Representative is responsible for installing FC Loop Switches.

Fibre Channel Cable Reconfiguration

The Fibre Channel cable configuration on a rack that uses FC Loop Switches differs from the Fibre Channel cable configuration on a rack that uses expansion panels. When a rack uses an expansion panel, the FC Drive Enclosures are linked together in a chain and connected to the HSV Controllers via the expansion panel. When a rack uses FC Loop Switches, the FC Drive Enclosures and the HSV Controllers are linked directly to the FC Loop Switch.

Your Compaq Authorized Service Representative is responsible for reconfiguring the Fibre Channel loops.

Figure 3–2 shows the 2C12D Fibre Channel loop 1A configurations for both a V1.0 configuration and a V2.0 configuration.



❶ 42U rack
❷ HSV Controller pair
❸ Expansion panel
❹ FC Loop Switch
❺ 41U rack

Figure 3–2: Fibre Channel cabling comparison— Enterprise V1.0 to Enterprise V2.0

4

Expanding a Rack

This chapter summarizes how to add new FC Drive Enclosures to a storage rack and describes the placement of controllers, FC Drive Enclosures, FC Loop Switches, enclosure address bus junction boxes and cables, and Fibre Channel cables.

This chapter contains the following sections:

- Adding FC Drive Enclosures to a Rack
- 2C6D + 6D Configuration
- 0C6D + 6D Configuration

Only Compaq Authorized Service Representatives may expand the 2C6D and 0C6D racks. The 2C6D and 0C6D racks may be expanded by adding FC Drive Enclosures, Fibre Channel cables, and enclosure address bus cables to the existing racks. In general, the FC Drive Enclosures are added in pairs.

The 2C6D rack can be expanded to the following:

- 2C6D + 2D (expands the 2C6D rack to 112 disks)
- 2C6D + 4D (expands the 2C6D rack to 140 disks)
- 2C6D + 6D (expands the 2C6D rack to 168 disks)

The 0C6D rack can be expanded to the 0C12D rack.

Adding FC Drive Enclosures to a Rack

A Compaq Authorized Service Representative can add FC Drive Enclosures to a rack while the Enterprise Virtual Array is on or off. Compaq highly recommends that the Enterprise Virtual Array is turned off, while adding FC Drive Enclosures to a rack. If the Compaq Authorized Service Representative would like to add an FC Drive Enclosure to the rack with the power on, the service representative should take care to disconnect and connect one Fibre Channel loop at a time.

The following steps outline the process for adding FC Drive Enclosures to a rack:

IMPORTANT: A Compaq Authorized Service Representative must add the FC Drive Enclosures to the rack. Do not attempt to do this without first seeking guidance and assistance from a Compaq Authorized Service Representative.

1. Install the shelf rails. Use the opening directly above the top-most FC Drive Enclosure in the rack.
2. Place the FC Drive Enclosures on the rails.

   Repeat Steps 1 and 2 for each FC Drive Enclosure.

   NOTE: The 2C6D configuration usually stacks three FC Drive Enclosures on the bottom of the rack and three FC Drive Enclosures directly above the controller pair. Alternate between the lower and upper portions of the rack as you add FC Drive Enclosures to the rack.

3. Connect the EMU on each FC Drive Enclosure to the enclosure address bus junction box.
4. Connect each FC Drive Enclosure to the appropriate power outlets.

   IMPORTANT: Because this procedure involves breaking Fibre Channel cable loops, Compaq highly recommends that new FC Drive Enclosures be connected to the loops while the power is off.

5. If your configuration contains FC Loop Switches, refer to step 6, step 7 and step 8.
   If your configuration includes expansion panels, refer to step 9 and step 10.
6. Connect an FC cable from the top I/O port of an FC Drive Enclosure in loop A to the FC Loop Switch (either 1A or 2A, depending on the location in the rack). Repeat for each FC Drive Enclosure in loop A.

   NOTE: For the 0C12D rack, refer to Figure 4–12 through Figure 4–15 for the FC cabling configuration. For 2C8D, 2D10D, and 2C12D rack expansions, refer to Figure 4–3 through Figure 4–6 for the related FC cabling configuration.

7. Connect an FC cable to the top I/O port of an FC Drive Enclosure in loop B to the FC Loop Switch (either 1B or 2B, depending on the location in the rack). Repeat for each FC Drive Enclosure in loop B.
8. Verify that the HSV Element Manager recognizes the new FC Drive Enclosures.
9. Reconfigure the cables on loop A to include the new FC Drive Enclosures.

   NOTE: For the 0C12D rack, refer to Figure 4–16 through Figure 4–19 for the FC cabling configuration. For 2C8D, 2D10D, and 2C12D rack expansions, refer to Figure 4–7 through Figure 4–10 for the related FC cabling configuration.

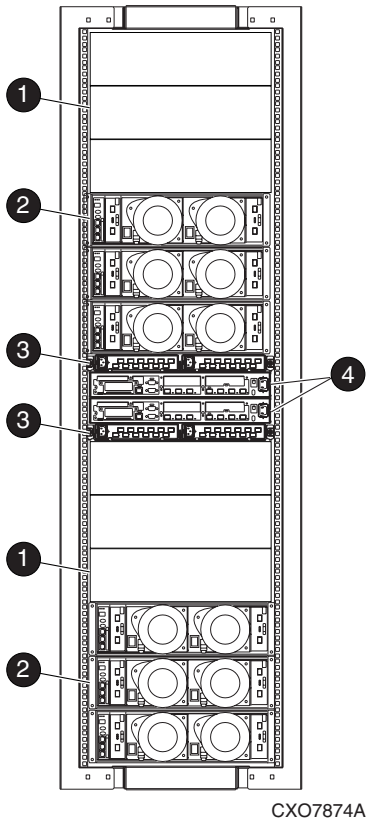
   a. Disconnect the host-to-enclosure FC cable from I/O port 1 (loop A) on the top FC Drive Enclosure in the original stack.
   b. Connect an enclosure-to-enclosure FC cable from I/O port 1 (loop A) of the lower enclosure to the I/O port 2 (loop A) of the enclosure directly above it.
   c. Connect the host-to-enclosure FC cable to the I/O port 1 (loop A) of the top FC Drive Enclosure.
   d. Verify that the HSV Element Manager recognizes the new FC Drive Enclosures.

10. Reconfigure the cables on Loop B to include the new FC Drive Enclosures.

    a. Disconnect the host-to-enclosure FC cable from I/O port 1 (loop B) on the top FC Drive Enclosure in the original stack.
    b. Connect an enclosure-to-enclosure FC cable from I/O port 1 (loop B) of the lower enclosure to the I/O port 2 (Loop B) of the enclosure directly above it.
    c. Connect the host-to-enclosure FC cable to the I/O port 1 (loop B) of the top FC Drive Enclosure.
    d. Verify that the HSV Element Manager recognizes the new FC Drive Enclosures.

2C6D Configuration

The 2C6D configuration contains up to six FC Drive Enclosures (84 disks). This configuration is shown in Figure 4–1.



❶ 3U blank
❷ FC Drive Enclosure
❸ FC Loop Switch
❹ HSV Controller pair

Figure 4–1: 2C6D configuration

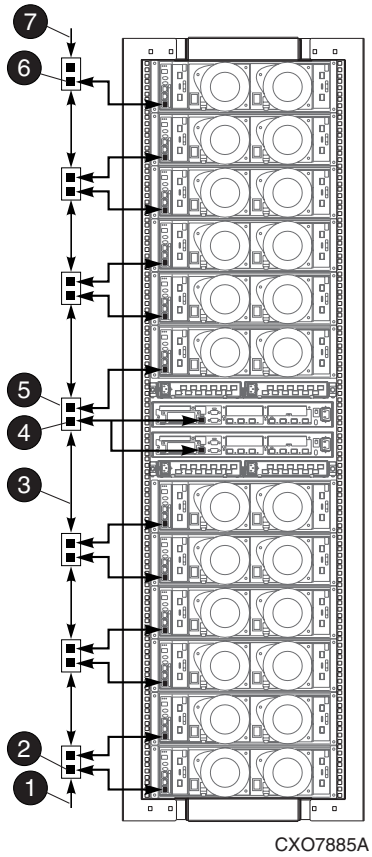
2C6D + 6D Configuration

The 2C6D + 6D configuration provides up to twelve FC Drive Enclosures (168 disks). It upgrades a 2C6D configuration to a 2C12D configuration.

IMPORTANT: This configuration is only available with assistance from a Compaq Authorized Service Representative.

Enclosure Address Bus Configuration

Each FC Drive Enclosure should be connected to an enclosure address bus junction box. The FC Drive Enclosures connect to each enclosure address bus junction box in pairs. The controller pair connects to the enclosure address bus junction box with a Y cable. Figure 4–2 shows the enclosure address bus cable configuration for the 2C6D + 6D configuration.



❶ Bottom terminator
❷ Enclosure address 1
❸ Enclosure address bus cable
❹ Enclosure address 7
❺ Enclosure address bus junction box
❻ Enclosure address 13
❼ Top terminator

Figure 4–2: 2C6D + 6D configuration—enclosure address cables

Fibre Channel Loop Configurations

The 2C6D + 6D configuration contains four Fibre Channel loops. A Fibre Channel loop is formed when the FC Drive Enclosures and the HSV Controller pair are connected by Fibre Channel cables. The 2C6D + 6D configuration can use an FC Loop Switch or an expansion panel to achieve the desired Fibre Channel loop configuration.

When the 2C6D + 6D configuration uses FC Loop Switches, each FC Drive Enclosure in a loop is directly connected to the associated FC Loop Switch. The HSV Controller pair is also connected directly to the associated FC Loop Switch. When the FC Loop Switch is powered on, it completes a Fibre Channel loop.

When the 2C6D + 6D configuration uses an expansion panel, a Fibre Channel loop is accomplished by connecting two FC Drive Enclosures directly to the HSV Controllers and linking each FC Drive Enclosure together in a chain.

Table 4–1 provides the locations for the Fibre Channel loops in a storage rack.

Table 4–1: Fibre Channel Loop Locations in Rack

Fibre Channel Loop	Location in Rack (viewed from rear)
1A	lower right side
1B	lower left side
2A	upper right side
2B	upper left side

Figure 4–3 shows Fibre Channel loop 1A and the associated FC Loop Switch.

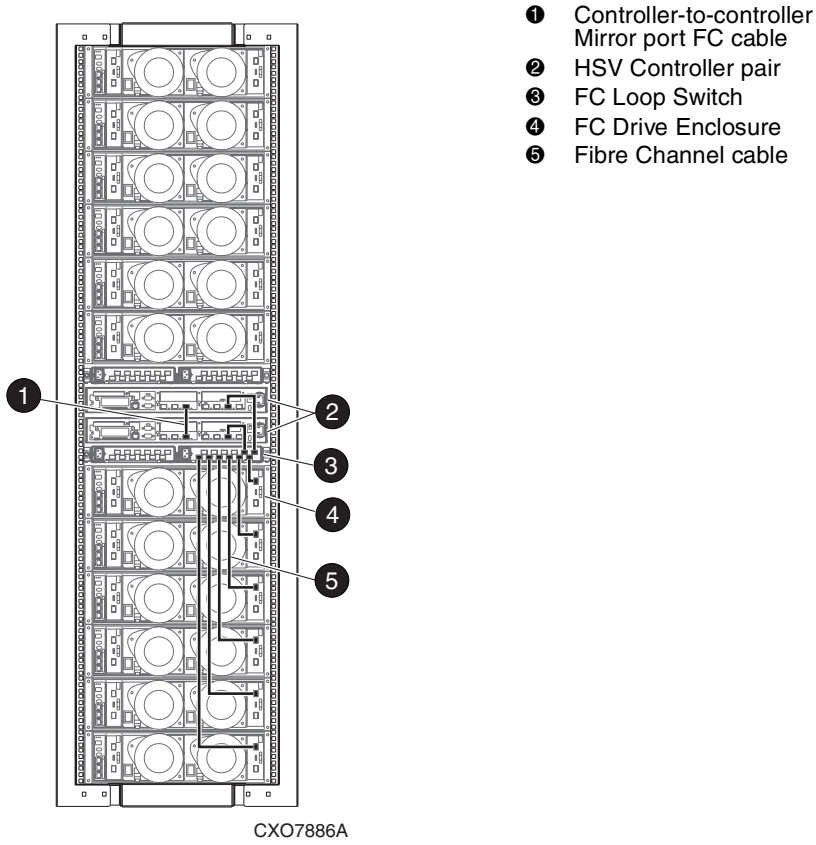


Figure 4–3: 2C6D + 6D configuration—Fibre Channel loop 1A with FC Loop Switch

Figure 4–4 shows Fibre Channel loop 1B and the associated FC Loop Switch.

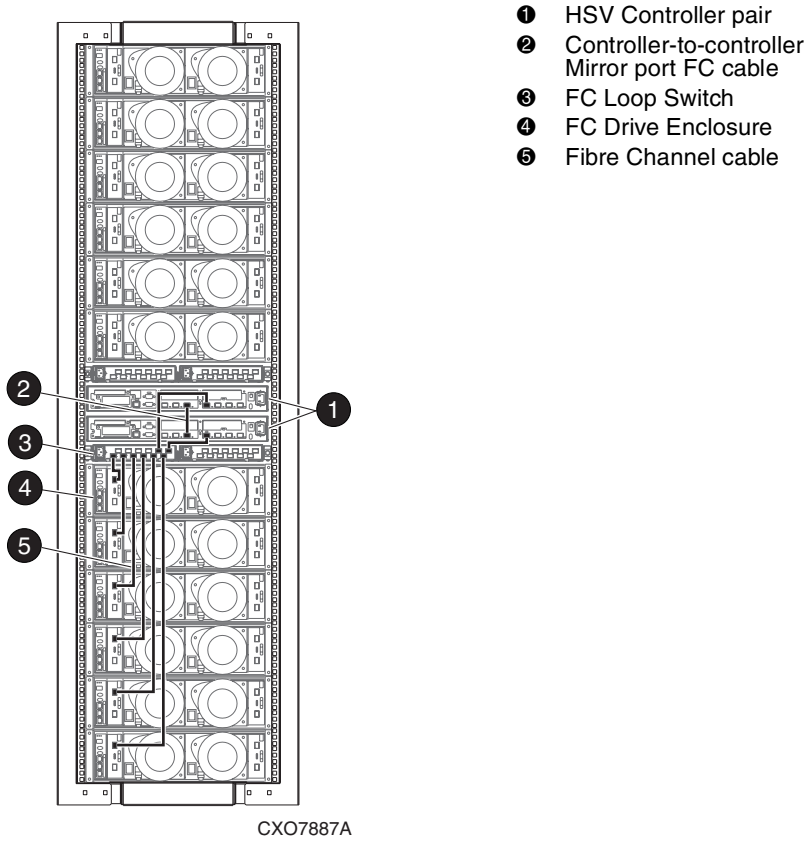


Figure 4–4: 2C6D + 6D configuration—Fibre Channel loop 1B with FC Loop Switch

Figure 4–5 shows Fibre Channel loop 2A and the associated FC Loop Switch.

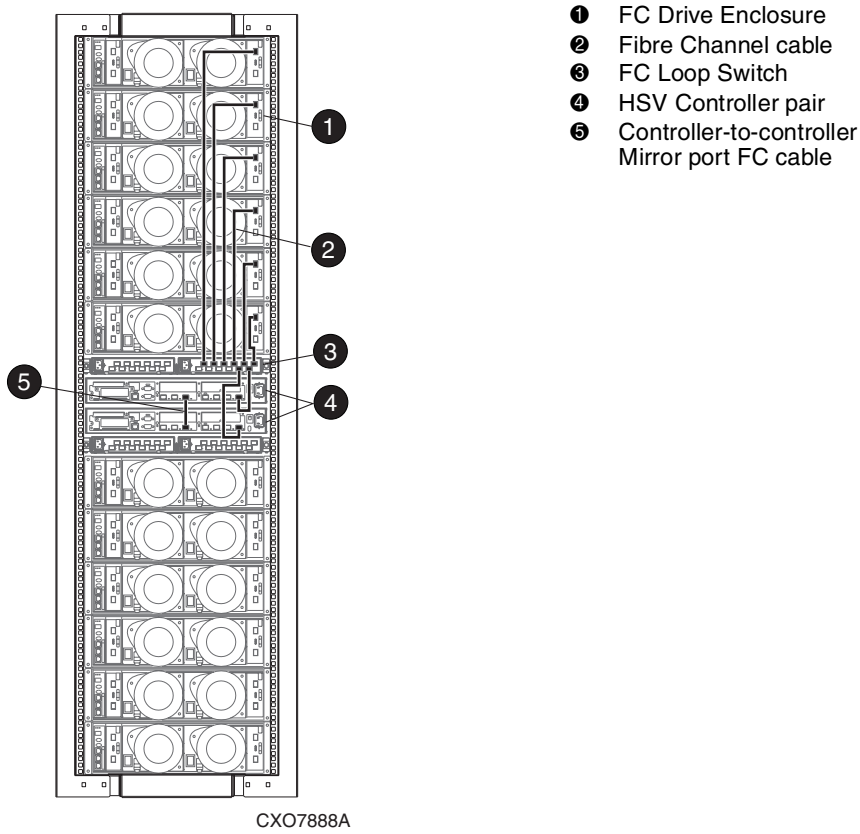


Figure 4–5: 2C6D + 6D configuration—Fibre Channel loop 2A with FC Loop Switch

Figure 4–6 shows Fibre Channel loop 2B and the associated FC Loop Switch.

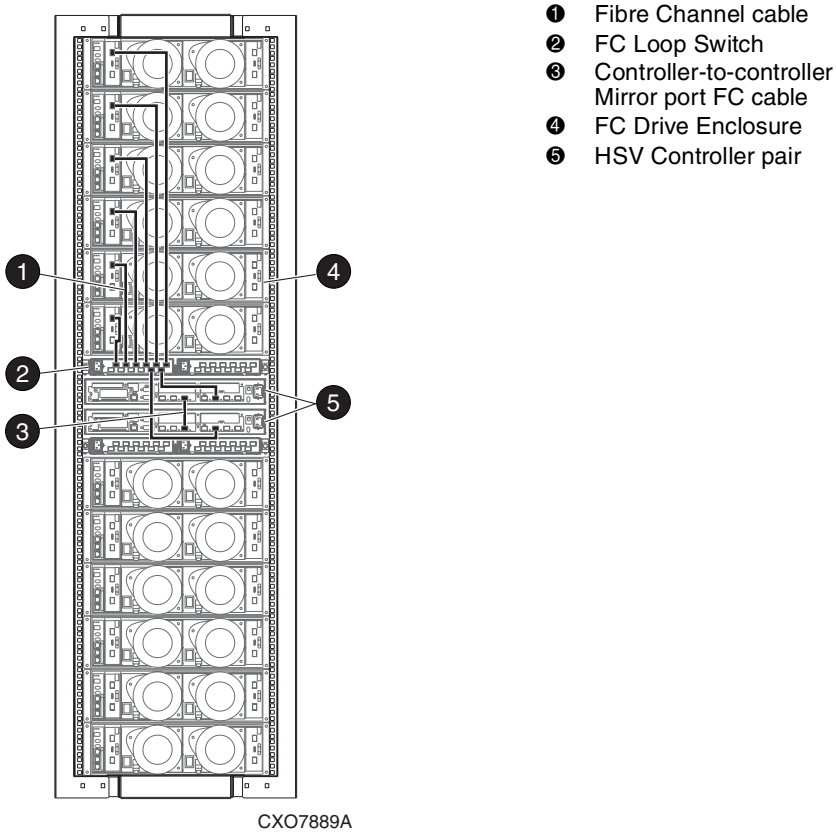


Figure 4–6: 2C6D + 6D configuration—Fibre Channel loop 2B with FC Loop Switch

Figure 4–7 shows Fibre Channel loop 1A with the expansion panel.

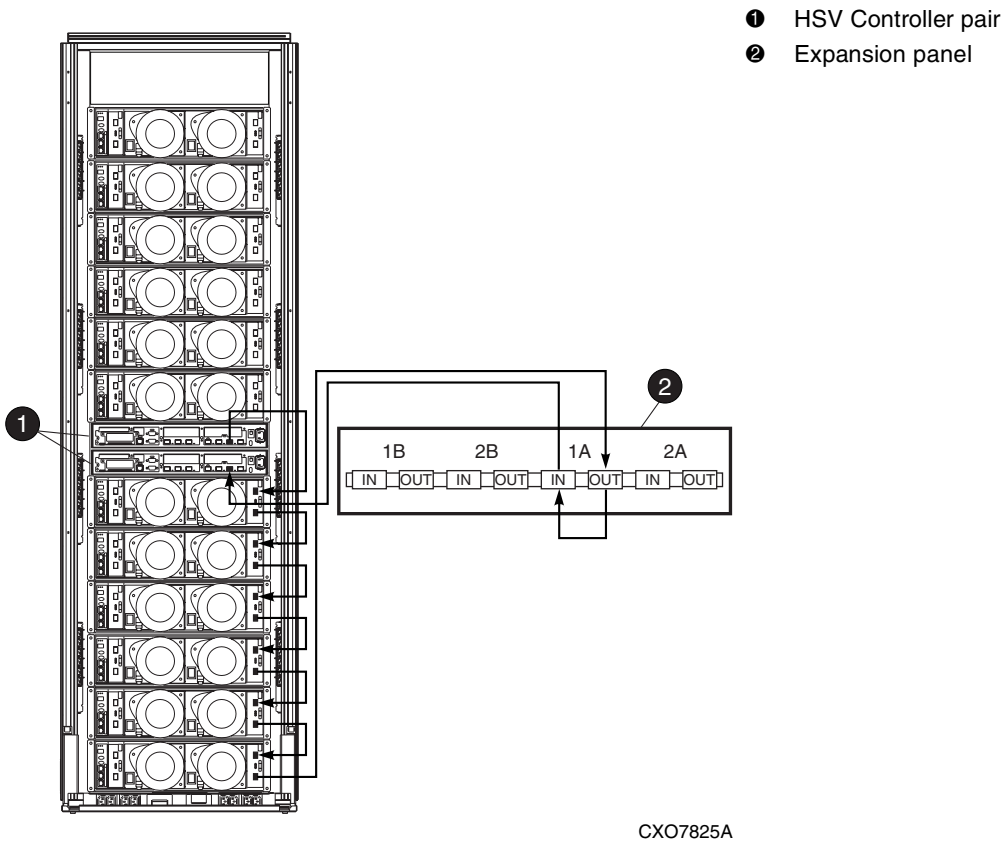


Figure 4–7: 2C6D + 6D configuration—Fibre Channel loop 1A with expansion panel

Figure 4–8 shows Fibre Channel loop 1B with an expansion panel.

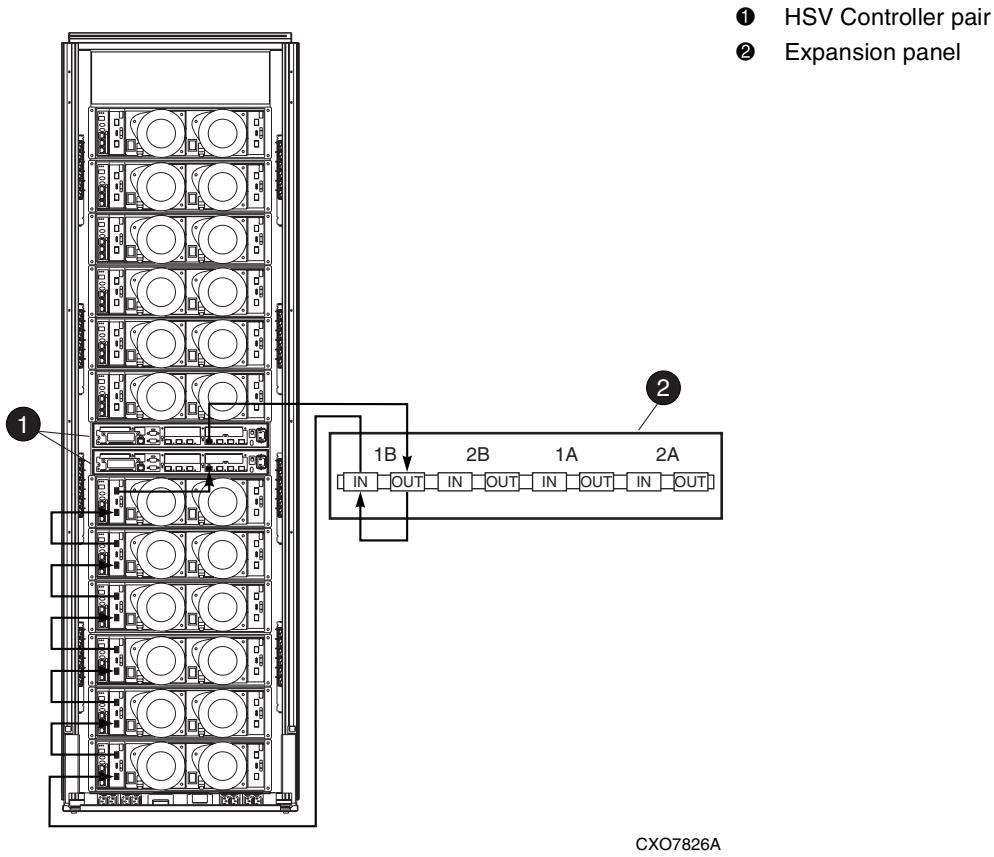


Figure 4–8: 2C6D + 6D configuration—Fibre Channel loop 1B with expansion panel

Figure 4–9 shows Fibre Channel loop 2A with an expansion panel.

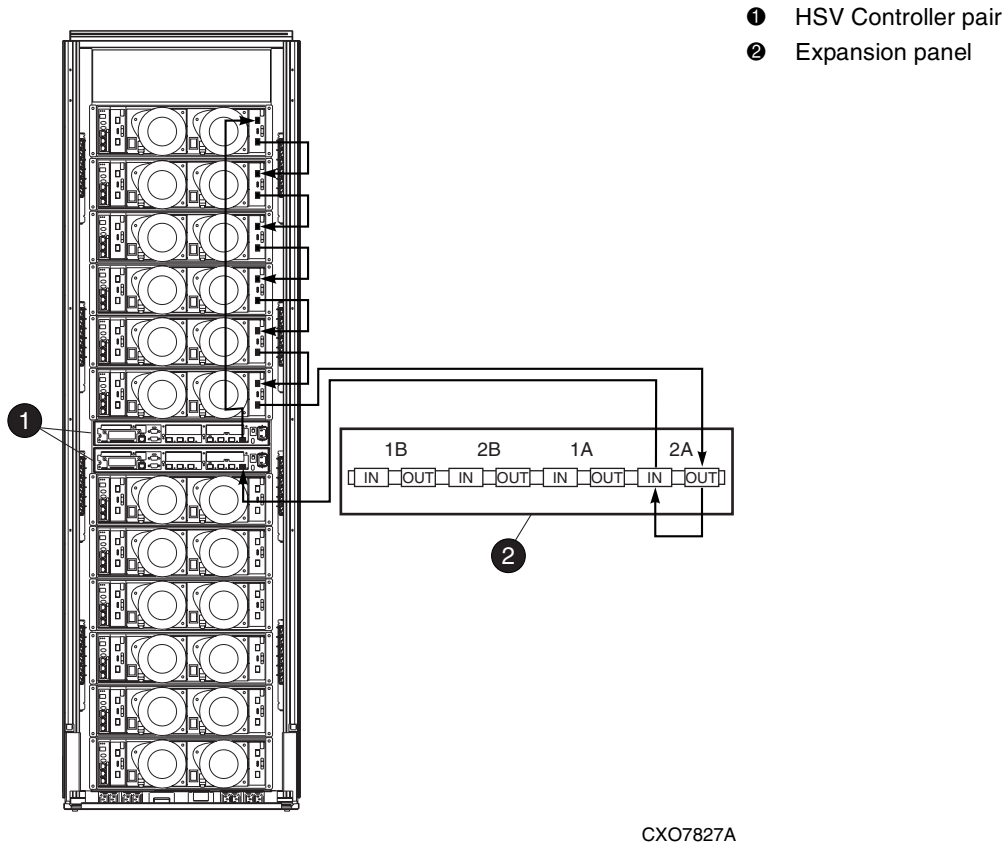


Figure 4–9: 2C6D + 6D configuration—Fibre Channel loop 2A with expansion panel

Figure 4–10 shows Fibre Channel loop 2B with an expansion panel.

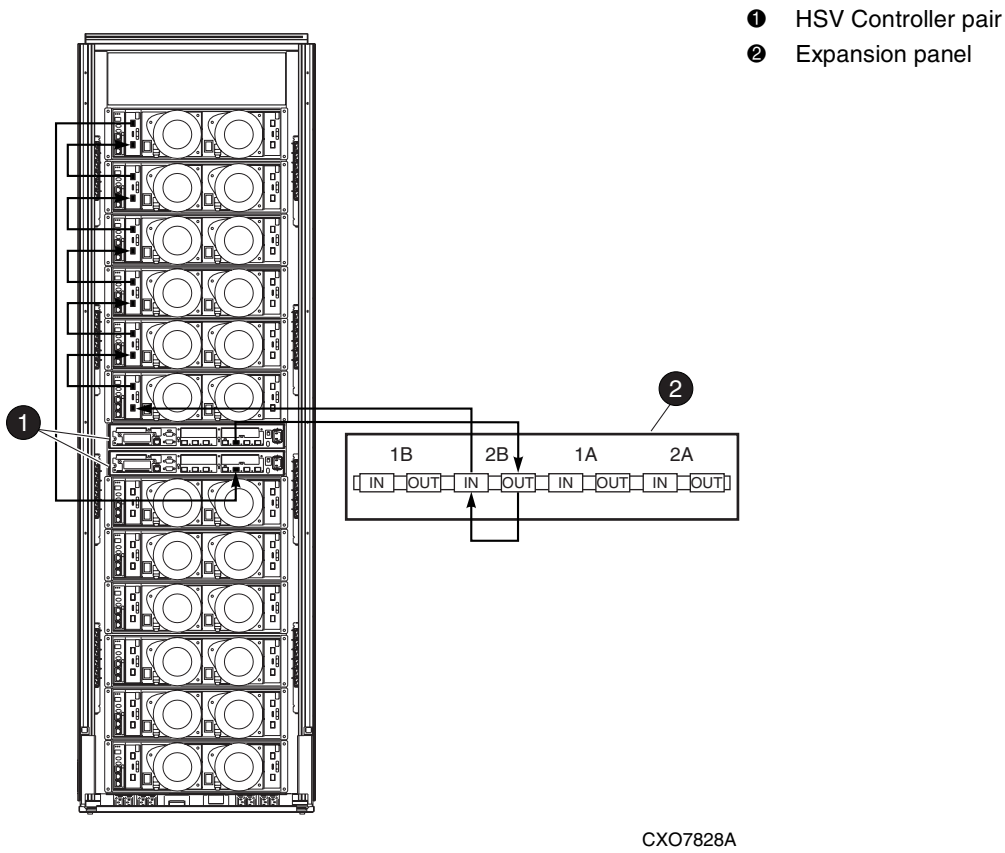


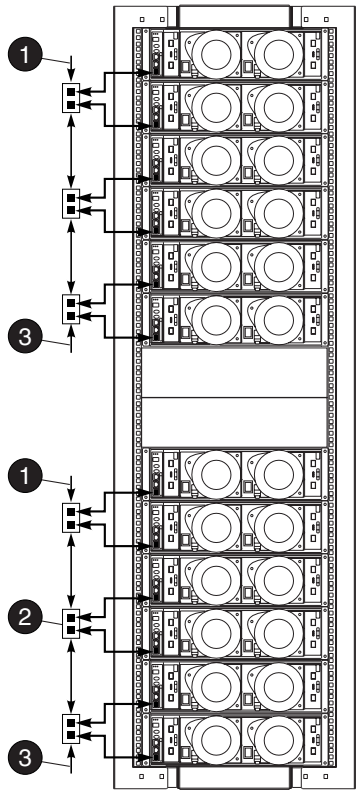
Figure 4–10: 2C6D + 6D configuration—Fibre Channel loop 2B with expansion panel

0C6D + 6D Configuration

The 0C6D + 6D configuration can support two HSV Controller pairs, and allows each HSV Controller pair to support a maximum of 240 disks.

Enclosure Address Bus Configuration

Each FC Drive Enclosure should be connected to an enclosure address bus junction box. The FC Drive Enclosures connect to each enclosure address bus junction box in pairs. Figure 4–11 shows the enclosure address bus cable configuration for the 0C6D + 6D configuration.



❶ Terminator

❷ Enclosure address bus junction box

❸ Bottom terminator (This terminator is removed to connect the Expansion rack to the Master rack.)

Figure 4–11: 0C6D + 6D configuration—enclosure address bus cables

Fibre Channel Loop Configurations

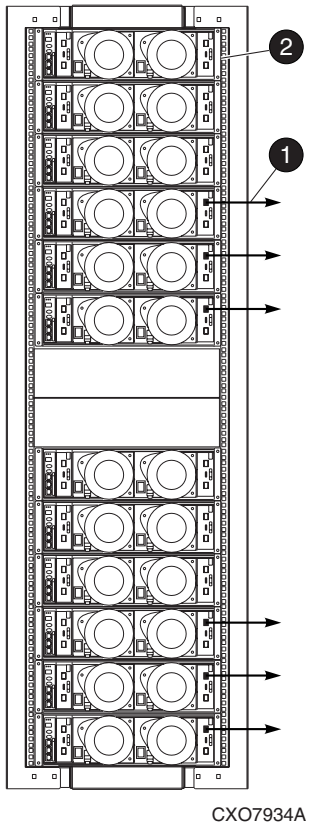
The 0C6D + 6D configuration contains eight Fibre Channel loops. A Fibre Channel loop is formed when the FC Drive Enclosures and the HSV Controller pair are connected by Fibre Channel cables. The 0C6D + 6D configuration can use an FC Loop Switch or expansion panels to achieve the desired Fibre Channel loop configuration.

The 0C6D + 6D rack is divided into an upper and lower half. The upper half of the 0C12D rack connects to one Master rack, and the lower half of the 0C12D rack connects to another Master rack.

When the 0C6D + 6D configuration uses FC Loop Switches, each FC Drive Enclosure in a loop is directly connected to the associated FC Loop Switch on the Master rack. The HSV Controller pair is also connected directly to the associated FC Loop Switch. When the FC Loop Switch is powered on, it completes a Fibre Channel loop.

When the 0C6D + 6D configuration uses expansion panels, all of the FC Drive Enclosures in a loop are connected to the controller pair in the Master rack. The 0C6D + 6D configuration uses expansion panels to achieve this configuration.

Figure 4–12 shows the two 1A Fibre Channel loops.



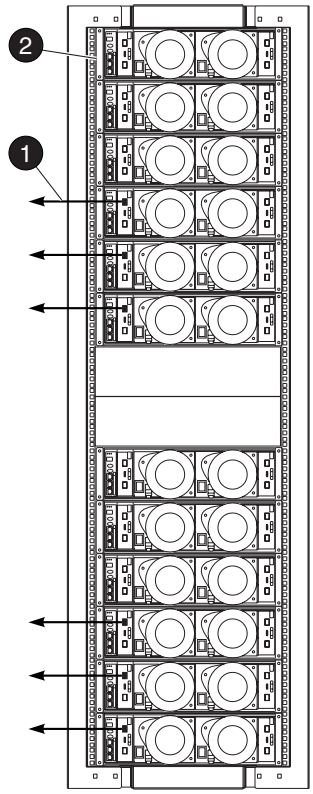
❶ FC cable

Each FC cable is connected to the 1A FC Loop Switch in the Master rack.

❷ FC Drive Enclosure

Figure 4–12: 0C6D + 6D configuration—Fibre Channel loop 1A

Figure 4–13 shows the two 1B Fibre Channel loops.



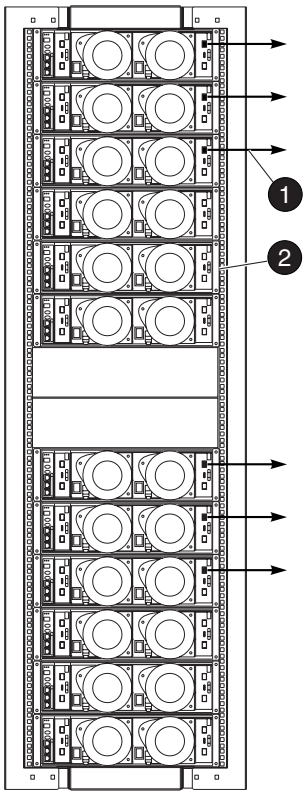
❶ FC cable

Each FC cable is connected to the 1B FC Loop Switch in the Master rack.

❷ FC Drive Enclosure

Figure 4–13: 0C6D + 6D configuration—Fibre Channel loop 1B

Figure 4–14 shows the two 2A Fibre Channel loops.



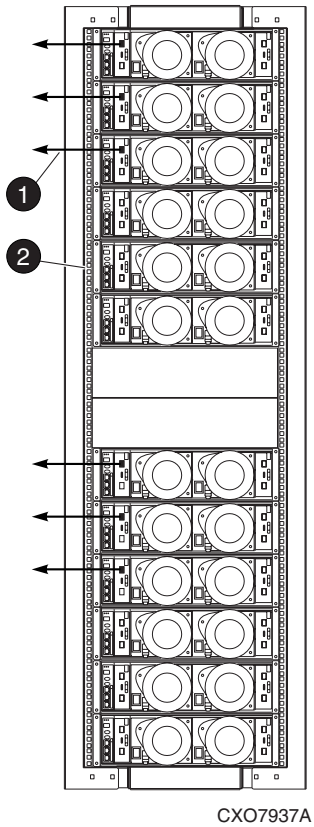
❶ FC cable

Each FC cable is connected to the 2A FC Loop Switch in the Master rack.

❷ FC Drive Enclosure

Figure 4–14: 0C6D + 6D configuration—Fibre Channel loop 2A

Figure 4–15 shows the two 2B Fibre Channel loops.



❶ FC cable

Each FC cable is connected to the 2B FC Loop Switch in the Master rack.

❷ FC Drive Enclosure

Figure 4–15: 0C6D + 6D configuration—Fibre Channel loop 2B

Figure 4–16 shows the two 1A Fibre Channel loops and the expansion panels.

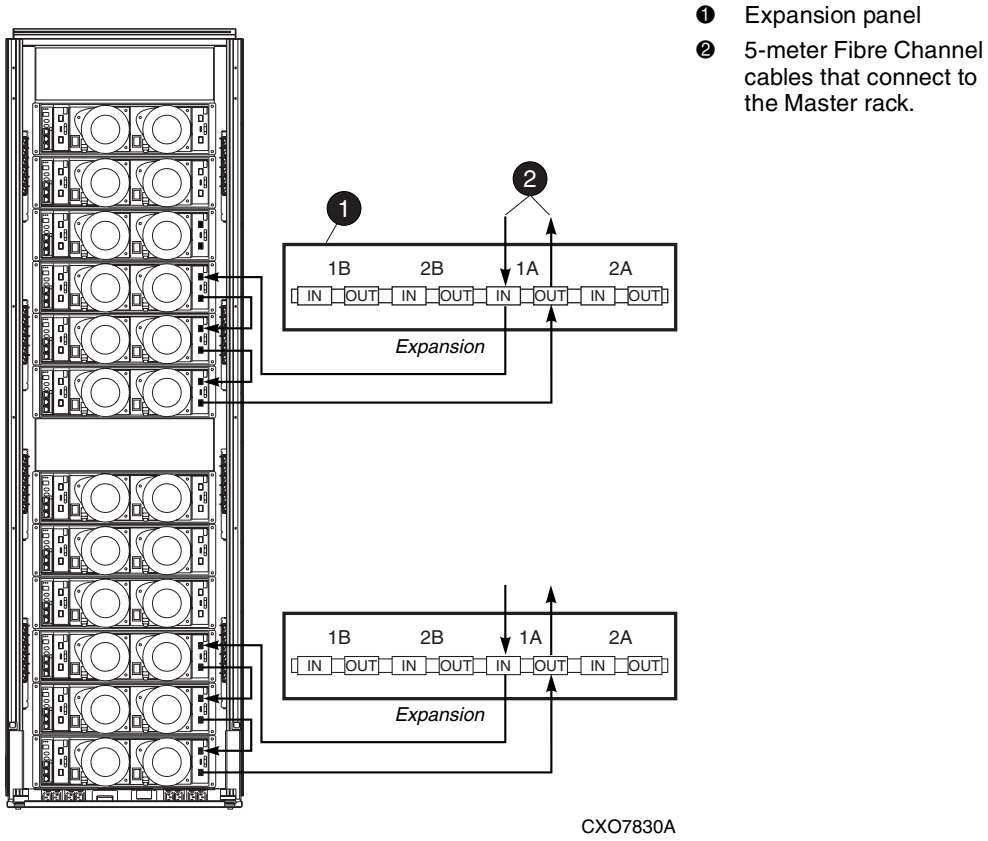


Figure 4–16: 0C6D + 6D configuration—Fibre Channel loop 1A with expansion panels

Figure 4–17 shows the two 1B Fibre Channel loops and the expansion panels.

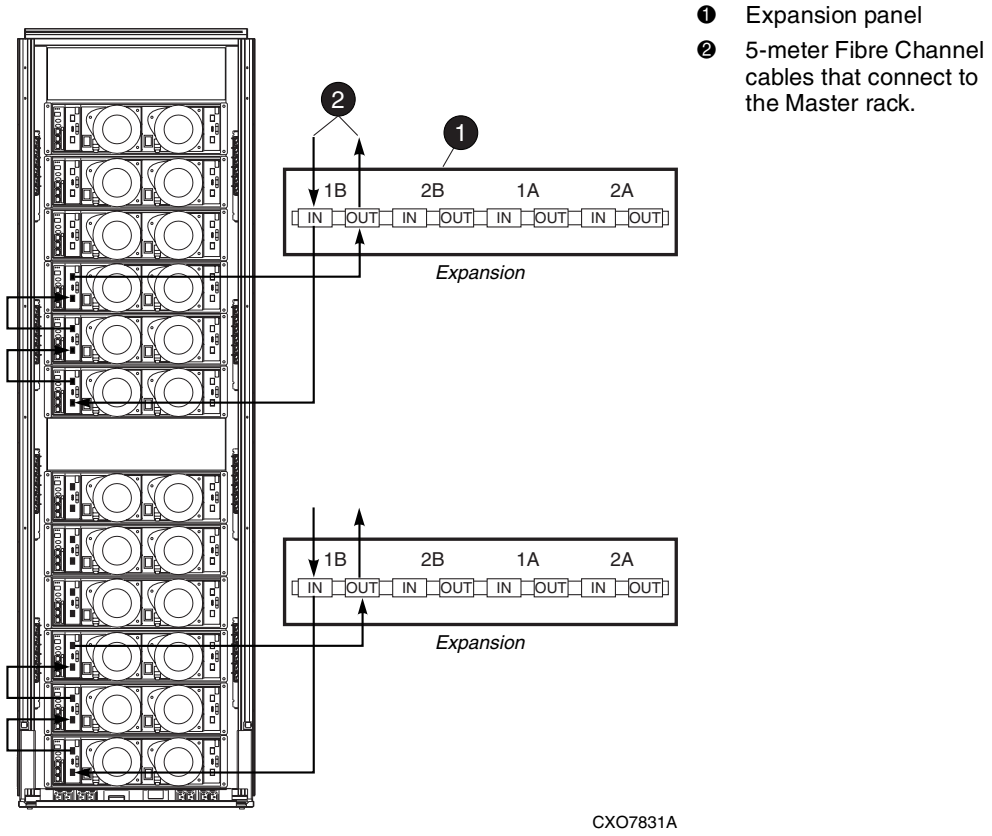


Figure 4–17: 0C6D + 6D configuration—Fibre Channel loop 1B with expansion panels

Figure 4–18 shows the two 2A Fibre Channel loops and the expansion panels.

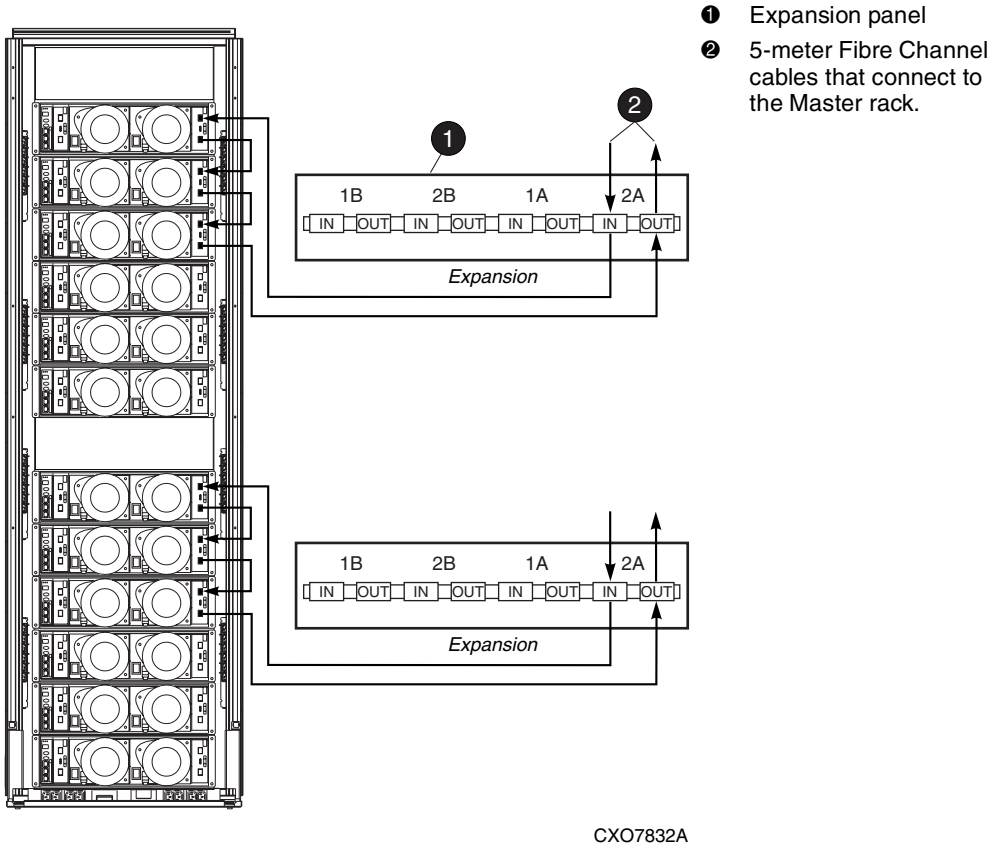


Figure 4–18: 0C6D + 6D configuration—Fibre Channel loop 2A with expansion panels

Figure 4–19 shows the two 2B Fibre Channel loops and the expansion panels.

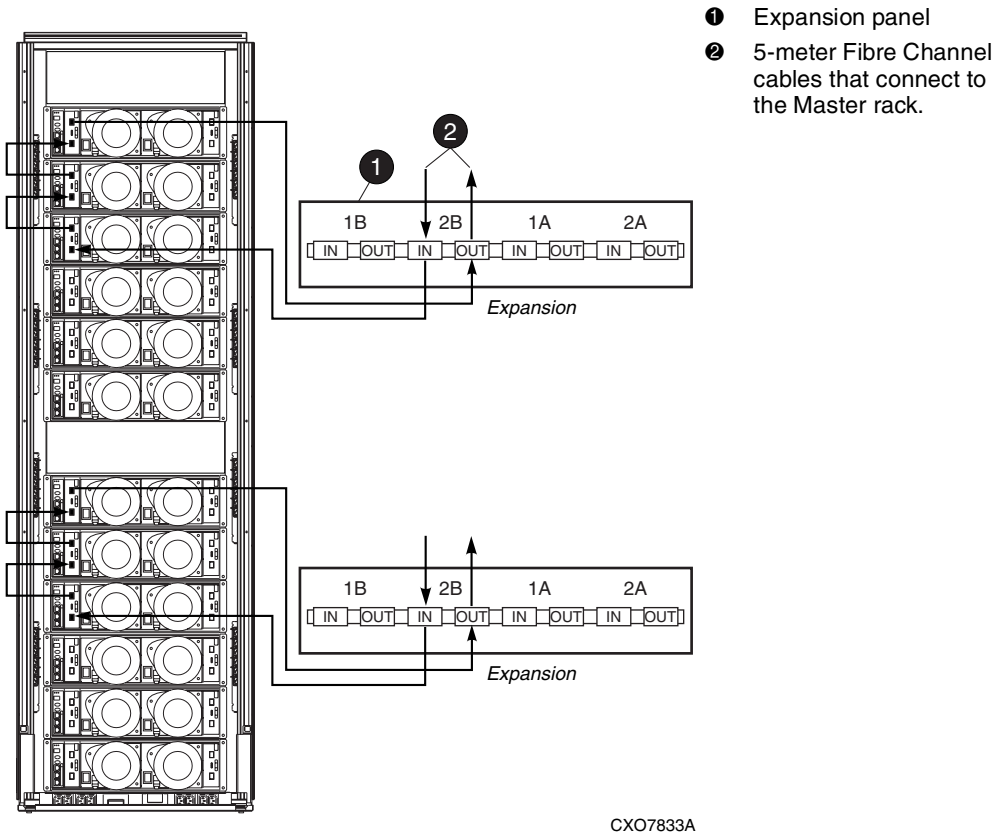


Figure 4–19: 0C6D + 6D configuration—Fibre Channel loop 2B with expansion panels

A

Regulatory Notices and Specifications

FCC Class A Certification

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

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

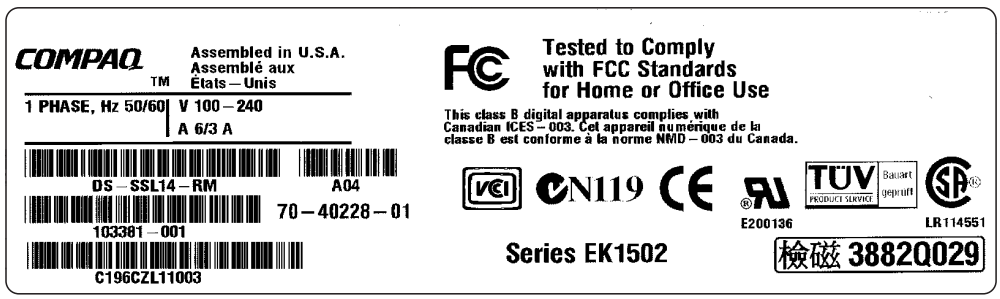
Any modifications to this device—unless approved by the manufacturer—can void the user's authority to operate this equipment under Part 15 of the FCC rules.

IMPORTANT: Additional information on the need to interconnect the device with shielded (data) cables or the need for special devices, such as ferrite beads on cables, is required if such means of interference suppression was used in the qualification test for the device. This information will vary from device to device and needs to be obtained from the Compaq EMC group or the product manager.

Country-Specific Certifications

Compaq tests electronic products for compliance with country-specific regulatory requirements, as an individual item or as part of an assembly. The product label (see Figure A–1) specifies the regulations with which the product complies.

NOTE: Elements without an individual product certification label are qualified as part of the *next higher* assembly (for example, enclosure, rack, or tower).



CXO7084A

Figure A–1: Typical enclosure certification label

NOTE: The certification symbols on the label depend upon the certification level. For example, the FCC Class A certification symbol is not the same as the FCC Class B certification symbol.

Fibre Channel Drive Enclosure Specifications

This appendix defines the physical, environmental, and power specifications of the Fibre Channel Drive Enclosure and the elements.

Physical Specifications

This section describes the physical specifications of the drive enclosure and elements.

CAUTION: An assembled enclosure (all elements installed) weighs more than 65 lb (29.5 kg) and requires a minimum of two individuals to move.

Table A–1 defines the dimensions and weights of the enclosure.

Table A–1: Drive Enclosure Physical Specifications

	Empty	Installed	Shipping	
			Carton	Carton & Pallet
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.				
Height	131 mm (5.16 in)	131 mm (5.16 in)	641 mm (25.25 in)	768 mm (30.25 in)
Width	505 mm (19.875 in)	505 mm (19.875 in)	318 mm (12.5 in)	610 mm (24 in)
Depth	448 mm (17.625 in)	448 mm (17.625 in)	597 mm (23.5 in)	1016 mm (40 in)
Weight	10.9 kg (24 lb)	30.9 kg (68 lb)	43.6 kg (96 lb)	49 kg (108 lb)

Table A–2 defines the dimensions of the elements (that is, EMU, blowers, I/O module, drives, and power supply).

Table A–2: Drive Enclosure Elements Physical Specifications

Specification	Installed	Shipping Carton
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.		
Environmental Monitoring Unit (EMU)		
Height	114 mm (4.5 in)	210 mm (8.25 in)
Width	241 mm (9.5 in)	330 mm (13.5 in
Depth	35 mm (1.375 in)	108 mm (4.25 in)
Weight	0.6 kg (1.3 lb)	0.91 lb (2.0 lb)
Blower		
Height	140 mm (5.5 in)	191 mm (7.5 in)
Width	159 mm (6.25 in)	203 mm (8.0 in)
Depth	83 mm (3.25 in)	229 mm (9.0 in)
Weight	0.45 kg (1.0 lb)	0.91 kg (2.0 lb)

Table A–2: Drive Enclosure Elements Physical Specifications (Continued)

Specification	Installed	Shipping Carton
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm. Millimeter dimensions are always expressed in whole numbers.		
I/O Module		
Height	114 mm (4.5 in)	210 mm (8.25 in)
Width	41 mm (1.625 in)	108 mm (4.25 in)
Depth	241 mm (9.5 in)	330 mm (13.0 in)
Weight	0.59 kg (1.3 lb)	0.77 kg (1.7 lb)
Disk Drive		
Height	114 mm (4.5 in)	216 mm (8.5 in)
Width	26 mm (1.025 in)	114 mm (4.5 in)
Depth	241 mm (9.5 in)	330 mm (13.0 in)
Weight	0.59 kg (1.3 lb)	1.0 kg (2.3 lb)
Power Supply (without blower)		
Height	114 mm (4.5 in)	286 mm (11.25 in)
Width	159 mm (6.25 in)	330 mm (13.0 in)
Depth	241 mm (9.5 in)	419 mm (16.5 in)
Weight	1.82 kg (4.0 lb)	3.86 kg (8.5 lb)

Environmental Specifications

To ensure optimum product operation you must maintain the operational environmental specifications listed in Table A–3. The ambient temperature, that is the enclosure air intake or room temperature, is especially critical.

Table A–3: Environmental Operating Specifications

Ambient temperature: +10 °C to +35 °C (+50 °F to +95 °F) with an average rate of change of 1 °C/hour maximum and a step change of 3 °C or less. Maintaining the *optimum ambient temperature* within the specified range ensures that the internal operating temperatures support the drive manufacturer's MTBF specifications.
Relative humidity: 40% to 60% (noncondensing) with a step change of 10% or less (noncondensing)
Air quality: Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air.
Heat dissipation: 1600 BTUs per hour

When shipping, or placing this product in short term storage, Compaq recommends maintaining the environmental conditions listed in Table A–4.

Table A–4: Environmental Shipping or Short-Term Storage Specifications

Ambient temperature: –40 °C to +66 °C (–40 °F to +151 °F)
Relative humidity: 10% to 80% noncondensing
Altitude: 15,240 m (50,000 ft)

Power Specifications

The input voltage to the drive enclosure power supplies is a function of the country-specific input voltage to Enterprise Storage System rack power distribution units (PDUs). Table A–5 defines the AC input power available to the drive enclosure power supplies.

CAUTION: The AC power distribution within a rack ensures a balanced load to each PDU and reduces the possibility of an overload condition. Changing the cabling to or from a PDM could cause an overload condition.

Table A–5: Enterprise Storage System AC Input Line Voltages

Specification	Minimal	Nominal	Maximum
60 Hz Service			
AC Line Frequency	57 Hz	60 Hz	63 Hz
AC Line Voltage–Japan	180 VAC	202 VAC	220 VAC
AC Line Voltage–North America	180 VAC	208 VAC	220 VAC
AC Line Voltage–Europe	208 VAC	240 VAC	254 VAC
50 Hz Service			
AC Line Frequency	47 Hz	50 Hz	53 Hz
AC Line Voltage–Japan	180 VAC	202 VAC	220 VAC
AC Line Voltage–North America	190 VAC	220 VAC	235 VAC
AC Line Voltage–North America	200 VAC	230 VAC	244 VAC
AC Line Voltage–Europe	208 VAC	240 VAC	254 VAC

Table A–6 defines the AC input current and wattage to the drive enclosure power supplies.

Table A–6: AC Input Current and Wattage

Nominal			Maximum	
Input Voltage	**Amps**	**Watts**	**Amps**	**Watts**
60-Hz Input				
100 VAC–JBOD	4.35	436	6.41	641
208 VAC–North America	2.03	419	2.94	609
50-Hz Input				
120 VAC–JBOD	3.59	419	5.27	633
220 VAC–North America	1.92	418	2.78	608
230 VAC–North America	1.92	418	2.78	608
240 VAC–Europe	1.76	416	2.55	607

Table A–7 and Table A–8 define the output voltage and current specifications of the drive enclosure power supply.

Table A–7: Output Voltage and Current Specifications

Specification	Range		
	Minimum	Nominal	Maximum
+5.1 VDC			
Initial Voltage Steady state current	+5.13 VDC 1.0 A	+5.18 VDC N/A	+5.23 VDC 26.0 A
+12.2 VDC (Disk Drive Voltage)			
Initial Voltage Steady state current	+12.13 VDC 1.0 A	+12,25 VDC N/A	+12.37 VDC 26.0 A
+12.5 VDC (Blower Voltage)			
Initial Voltage Steady state current	+12.25 VDC 0.0 A	+12.50 VDC N/A	+12.75 VDC 2.0 A

Table A–8: Dual Power Supply Configuration Power Specifications

Voltage	Current (A)	Power (W)
Maximum Continuous Current		
+5.1 VDC (with a minimum +12.2 VDC load of 0A) +12.2 VDC (with a minimum +5 VDC load of 4A) +12.5 VDC	26.0 A 28.0 A 2.0 A	132 W 342.0 W 25.0 W
	Total	499.0 W
Maximum Peak Current (Simultaneous Seek Activity)		
+5.1 VDC +12.2 VDC +12.5 VDC	26.0 A 43.0 A 2.0 A	132.0 W 524.0 W 25.0 W
	Total	681.0 W

Fibre Channel Switch Specifications

The Fibre Channel Switch requires a clean, dry environment for normal operation. Table A–9 lists the specifications for the Fibre Channel Switch.

Table A–9: Fibre Channel Switch Specifications

Weight	approximately 7.5 lbs.
Dimensions	8.50 x 1.57 x 16.00 inches (W x H x D) **NOTE:** The switch with extender is 21.66 in (depth).
Operating Temperature	0 °C to 40 °C for normal operation (ambient air temperature)
Storage Temperature	-40 °C to 80 °C noncondensing
Power	50 or 60 Hz 100–250 VAC 0.5–0.3 A

HSV Controller Specifications

This section defines the physical, power, and environmental specifications of the HSV Controller enclosure.

Physical Specifications

Table A–10 defines the dimensions of the controller and replaceable units.

Table A–10: HSV Controller Physical Specifications

Specification	Installed	Shipping
NOTE: Metric dimensions are expressed in whole numbers. For example, 10.795 cm is expressed as 108 mm.		
HSV Controller Enclosure		
Height Width Depth Weight	62 mm (2.45 in) 502 mm (19.75 in) 444 (17.49 in) 10.4 kg (23 lb)	267 mm (10.5 in) 762 mm (30 in) 762 mm (30 in) 12.7 kg (28 lb)
Cache Battery Assembly		
Height Width Depth Weight	57 mm (2.25 in) 184 mm (7.25 in) 83 mm (3.25 in) 1.3 kg (2.8 lb)	108 mm (4.25 in) 324 mm (12.75 in) 162 mm (6.375 in) 1.5 kg (3.4 lb)
Blower		
Height Width Depth Weight	55 mm (2.125 in) 116 mm (4.625 in) 105 mm (4.125 in) 0.4 kg (0.8 lb)	165 mm (6.5 in) 216 mm (8.5 in) 216 mm (8.5 in) 0.92 kg (2 lb)

Power Specifications

Table A–11 and Table A–12 define the HSV Controller power supply input power requirements and output power specifications.

Table A–11: Controller Power Supply AC Power Requirements

AC Input Voltage			Frequency		
Minimum	**Nominal**	**Maximum**	**Minimum**	**Nominal**	**Maximum**
180 VAC	202 VAC	220 VAC	47 Hz	50 Hz	53 Hz
	208 VAC		57 Hz	60 Hz	63 Hz
208 VAC	240 VAC	254 VAC			

Table A–12: Controller Power Supply Output Specifications

Voltage Specification	Minimum	Nominal	Maximum
+3.3 VDC			
Output Voltage Steady state current Power	3.23 VDC	3.30 VDC	3.36 VDC 18 A[1] 59.4W

Table A–12: Controller Power Supply Output Specifications (Continued)

Voltage Specification	Minimum	Nominal	Maximum
+5.0 VDC			
Output Voltage Steady state current Power	4.90 VDC	5.00 VDC	5.10 VDC 4 A 20.0W
+12.0 VDC			
Output Voltage Steady state current Power	11.4 VDC	12.0 VDC	12.6 VDC 2 A 4.0W
		Total Current **Total Power**	24 A 65.4W

1. +3.3 VDC steady state current requires a minimum 5.0-V load of 1 A.

Environmental Specifications

There are no HSV Controller environmental specifications. See the "Enterprise Rack" environmental specifications for this information in the next section.

Enterprise Rack

Physical Specifications

WARNING: The weight of the drive enclosure with the elements installed always requires at least two individuals to move. Compaq recommends using a fork lift or a hand truck to move an enclosure in the shipping container.

Table A–13 through Table A–16 defines the dimensions and weights of the Enterprise Storage System racks.

Table A–13: Enterprise 42U Storage System Rack Physical Dimensions

	Height in / mm	Width in / mm	Depth in / mm	Max Wt lbs / kg
Enterprise 2C6D	78.75 / 2000.0	23.7 / 602	35.8 / 909	918 / 416
Enterprise 2C12D	78.75 / 2000.0	23.7 / 602	35.8 / 909	1350 / 612
Enterprise 0C6D	78.75 / 2000.0	23.7 / 602	35.8 / 909	818 / 371
Enterprise 0C12D	78.75 / 2000.0	23.7 / 602	35.8 / 909	1250 / 567

Table A–14: Enterprise 42U Storage System Rack Shipping Dimensions

	Height in / mm	Width in / mm	Depth in / mm	Max Wt (with packaging) lbs / kg
Enterprise 2C6D	85.38 / 2169	36.0 / 914	48.0 / 1220	1111 / 504
Enterprise 2C12D	85.38 / 2169	36.0 / 914	48.0 / 1220	1543 / 700
Enterprise 0C6D	85.38 / 2169	36.0 / 914	48.0 / 1220	1011 / 459
Enterprise 0C12D	85.38 / 2169	36.0 / 914	48.0 / 1220	1443 / 654

Table A–15: Enterprise 41U Storage System Rack Physical Dimensions

	Height in / mm	Width in / mm	Depth in / mm	Max Wt lbs / kg
Enterprise 2C6D	78.75 / 2000.0	23.7 / 602	39.1 / 993	917 / 416
Enterprise 2C12D	78.75 / 2000.0	23.7 / 602	39.1 / 993	1349 / 612
Enterprise 0C6D	78.75 / 2000.0	23.7 / 602	39.1 / 993	817 / 371
Enterprise 0C12D	78.75 / 2000.0	23.7 / 602	39.1 / 993	1249 / 567

Table A–16: Enterprise 41U Storage System Rack Shipping Dimensions

	Height in / mm	Width in / mm	Depth in / mm	Max Wt (with packaging) lbs / kg
Enterprise 2C6D	85.38 / 2169	36.0 / 914	48.0 / 1220	1110 / 503
Enterprise 2C12D	85.38 / 2169	36.0 / 914	48.0 / 1220	1542 / 699
Enterprise 0C6D	85.38 / 2169	36.0 / 914	48.0 / 1220	1010 / 458
Enterprise 0C12D	85.38 / 2169	36.0 / 914	48.0 / 1220	1442 / 654

Environmental Specifications

To ensure optimum product operation, you must maintain the operational environmental specifications listed in Table A–17. The ambient temperature (the enclosure air intake or room temperature) is especially critical.

Table A–17: Environmental Operating Specifications

Ambient temperature: +10 °C to +35 °C (+50 °F to +95 °F) with an average rate of change of 1 °C/hour maximum and a step change of 3 °C or less. Maintaining the *optimum ambient temperature* within the specified range ensures that the internal operating temperatures support the drive manufacturer's MTBF specifications.
Relative humidity: 40% to 60% (noncondensing) with a step change of 10% or less (noncondensing).
Air quality: Not to exceed a maximum of 500,000 particles, 0.5 micron or larger, per cubic foot of air.
Heat dissipation: 12,708 BTUs per hour.

When shipping, or placing this product in short term storage, Compaq recommends maintaining the environmental conditions listed in Table A–18.

Table A–18: Environmental Shipping or Short Term Storage Specifications

Ambient temperature: –40 °C to +66 °C (–40 °F to +151 °F)
Relative humidity: 10% to 80% (noncondensing)
Altitude: 15,240 m (50,000 ft)

Power Specifications

Table A–19 defines the AC power specifications for the Enterprise Storage System PDUs, PDMs, drive enclosure power supplies, and controller enclosure power supplies.

Table A–19: Enterprise Storage System AC Power Specifications

Nominal Input Voltage	Specifications
60-Hz Service	
202 VAC Voltage Range Power Receptacle	**Japan** 180-220 VAC, 57-63Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309
208 VAC Voltage Range Power Receptacle	**North America** 180-220 VAC, 57-63Hz, 30 A, Single Phase 3-wire, 2-pole, NEMA L6-30
240 VAC Voltage Range Power Receptacle	**Europe** 208-254 VAC, 57-63 Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309
50-Hz Service	
202 VAC Voltage Range Power Receptacle	**Japan** 180-220 VAC, 47-63Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309
220 VAC Voltage Range Power Receptacle	**North America** 190-235 VAC, 47-63Hz, 30 A, Single Phase 3-wire, 2-pole, NEMA L6-30
230 VAC Voltage Range Power Receptacle	**North America** 200-244 VAC, 47-63Hz, 30 A, Single Phase 3-wire, 2-pole, NEMA L6-30
240 VAC Voltage Range Power Receptacle	**Europe** 208-254 VAC, 57-63 Hz, 32 A, Single Phase 3-wire, 2-pole, IEC 309

The power consumption of an Enterprise Storage System is 3,724 W.

Glossary

This glossary defines Compaq StorageWorks Enterprise Virtual Array terms used in this publication or related to this product and is not a comprehensive glossary of computer terms.

3U

A unit of measurement representing three "U" spaces. "U" spacing is used to designate panel or enclosure heights. Three "U" spaces is equivalent to 5.25 inches (133 mm).

See also **rack-mounting unit.**

AL_PA

Arbitrated Loop Physical Address. A 1-byte value the arbitrated loop topology uses to identify the loop ports. This value becomes the last byte of the address identifier for each public port on the loop.

ambient temperature

The air temperature in the area where a system is installed. Also, called intake temperature or room temperature.

ANSI

American National Standards Institute. A non-governmental organization that develops standards (such as SCSI I/O interface standards and Fibre Channel interface standards) used voluntarily by many manufacturers within the United States.

arbitrated loop

A Fibre Channel topology that links multiple ports (up to 126) together on a single shared simplex media. Transmissions can only occur between a single pair of nodes at any given time. Arbitration is the scheme that determines which node has control of the loop at any given moment.

arbitrated loop physical address

See **AL_PA.**

arbitrated loop topology

See **arbitrated loop.**

array controller

See **controller.**

array

All the physical disk drives in a storage system that are known to and under the control of a controller pair.

bail lock

Part of the power supply AC receptacle that engages the AC power cord connector to ensure that the cord cannot be accidentally disconnected.

baud

The maximum rate of signal state changes per second on a communication circuit. If each signal state change corresponds to a code bit, then the baud rate and the bit rate are the same. It is also possible for signal state changes to correspond to more than one code bit so the baud rate may be lower than the code bit rate.

bay

The physical location of an element, such as a drive, I/O module, EMU or power supply in a drive enclosure. Each bay is numbered to define its location.

cabinet

An alternate term used for a rack.

cable assembly

A fiber optic cable that has connectors installed on one or both ends. General use of these cable assemblies includes the interconnection of multimode fiber optic cable assemblies with either LC or SC type connectors.

- When there is a connector on only one end of the cable, the cable assembly is referred to as a pigtail.
- When there is a connector on both ends of the cable, the cable assembly is referred to as a jumper.

client

A software program that uses the services of another software program. The HSV Element Manager client is a standard internet browser.

Compaq SANworks HSV Element Manager

See **HSV Element Manager.**

Compaq StorageWorks

The Compaq trademarked name used to describe the set of rack-mounted enclosures containing controllers, transceivers, I/O modules, EMUs, disk drives, cables, blowers, and power supplies used to design and configure a solution-specific storage system.

controller

A hardware/firmware device that manages communications between host systems and other devices. Controllers typically differ by the type of interface to the host and provide functions beyond those the devices support.

controller enclosure

A unit that holds one or more controllers, power supplies, blowers, cache batteries, transceivers, and connectors.

controller pair

Two interconnected controller modules which together control a physical disk array. A controller pair and the disk array together constitute a storage system.

CRU

Customer Replaceable Unit. A storage system element that a user can replace without using special tools or techniques, or special training.

customer replaceable unit

See **CRU.**

device ports

Controller pair device ports connected to the storage system's physical disk drive array through the FC-AL. *Also* called a device-side port.

device-side ports

See **device ports.**

disk drive blank

A carrier that replaces a disk drive to control airflow within a drive enclosure whenever there is less than a full complement of storage devices.

disk drive enclosure

A unit that holds storage system devices such as disk drives, power supplies, fans, I/O modules, transceivers or EMUs.

disk drive

A carrier-mounted storage device supporting random access to fixed size blocks of data.

drive blank

See **disk drive blank.**

drive enclosure

See **disk drive enclosure.**

dual power supply configuration

See **redundant power configuration.**

dual-loop

A configuration where each drive is connected to a pair of controllers through two loops. These two Fibre Channel loops constitute a loop pair.

EIA

Electronic Industries Alliance. A standards organization specializing in the electrical and functional characteristics of interface equipment.

electromagnetic interference

See **EMI.**

electrostatic discharge

See **ESD.**

Element Manager GUI

The graphical user interface (GUI) through which a user can control and monitor a storage system. The HSV Element Manager software can be installed on more than one management appliance in a fabric. Each installation of the HSV Element Manager software is a management agent. The client for the agent is a standard browser.

element

1. In a disk drive enclosure, a device such as an EMU, power supply, disk, fan, or I/O module. The object can be controlled, interrogated, or described by the enclosure services process.
2. In the Compaq Open SAN Manager, a controllable object, such as the Compaq StorageWorks Enterprise Storage System.

EMI

Electromagnetic Interference. The impairment of a signal by an electromagnetic disturbance.

EMU

Environmental Monitoring Unit. An element which monitors the status of an enclosure, including the power, air temperature, and fan status. The EMU detects problems and displays and reports these conditions to a user and the controller. In some cases, the EMU implements corrective action.

enclosure

A unit used to hold various storage system devices such as disk drives, controllers, power supplies, fans, an EMU, or I/O modules.

enclosure address bus

An Enterprise Storage System bus that interconnects and identifies controller enclosures and disk drive enclosures by their physical location. Enclosures within a reporting group can exchange environmental data. This bus uses junction boxes and cables to assign enclosure numbers to each enclosure. Communications over this bus do not involve the FC-AL bus and are, therefore, classified as out-of-band communications.

Enclosure Services Interface

See **ESI.**

Enclosure Services Processor

See **ESP.**

Enterprise Virtual Array rack

A unit that holds controller enclosures, disk drive enclosures, power distribution supplies, and enclosure address buses that comprise an Enterprise Storage System solution. Also, called the Enterprise Storage System rack.

See also **rack.**

Enterprise Virtual Array

The Enterprise Virtual Array is a product that consists of one or more storage systems. Each storage system consists of a pair of HSV Controllers and the disk drives they manage. A storage system within the Enterprise Virtual Array can be formally referred to as an Enterprise Storage System, or generically referred to as the storage system.

environmental monitoring unit

See **EMU.**

ESD

Electrostatic Discharge. The emission of a potentially harmful static electric voltage as a result of improper grounding.

ESI

Enclosure Services Interface. The SCSI-3 engineering services interface implementation developed for Compaq StorageWorks products. A bus that connects the EMU to the drives.

ESP

Enclosure Services Processor. An EMU that implements an enclosure's services process.

fabric

A Fibre Channel fabric switch or two or more interconnected Fibre Channel switches allowing data transmission.

fabric port

A port which is capable of supporting an attached arbitrated loop. This port on a loop will have the AL_PA hexadecimal address 00 (loop ID 7E), giving the fabric the highest priority access to the loop. A loop port is the gateway to the fabric for the node ports on a loop.

fan

The variable speed airflow device that cools an enclosure or element by forcing ambient air into an enclosure or element and forcing heated air out the other side.

FC HBA

Fibre Channel Host Bus Adapter. An interchangeable term for Fibre Channel adapter.

See also **FCA.**

FCA

Fibre Channel Adapter. An adapter used to connect the host server to the fabric. Also, called a Host Bus Adapter (HBA) or a Fibre Channel Host Bus Adapter (FC HBA).

See also **FC HBA**

FC-AL

Fibre Channel Arbitrated Loop. The American National Standards Institute's (ANSI) document which specifies arbitrated loop topology operation.

FCC

Federal Communications Commission. The federal agency responsible for establishing standards and approving electronic devices within the United States.

FCP

Fibre Channel Protocol. The mapping of SCSI-3 operations to 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.

fiber optics

The technology where light is transmitted through glass or plastic (optical) threads (fibers) for data communication or signaling purposes.

fiber

The optical media used to implement Fibre Channel.

Fibre Channel adapter

See **FCA.**

Fibre Channel

A data transfer architecture designed for mass storage devices and other peripheral devices that require very high bandwidth.

Fibre

The international spelling that refers to the Fibre Channel standards for optical media.

field replaceable unit

See **FRU.**

frequency

The number of cycles that occur in one second expressed in Hertz (Hz). Thus, 1 Hz is equivalent to one cycle per second.

FRU

Field Replaceable Unit. A hardware element that can be replaced in the field. This type of replacement can require special training, tools, or techniques. Therefore, FRU procedures are usually performed only by an authorized service representative.

Gb

Gigabit. A measurement of the rate at which the transfer of bits of data occurs. Sometimes referred to as Gbps. Nominally, a Gb is a transfer rate of 1,000,000,000 (10^9) bits per second.

For Fibre Channel transceivers or FC loops the Gb transfer rates are:

- 1 Gb is a transmission rate of 1,062,500,000 bits per second.
- 2 Gb is a transmission rate of 2,125,000,000 bits per second.

GB

Gigabyte. A unit of measurement defining either:

- A data transfer rate.

  See also **GBps**
- A storage or memory capacity of 1,073,741,824 (2^{30}) bytes.

GBIC

Gigabit Interface Converter.

See **transceiver.**

Gbps

Gigabits per second. A measurement of the rate at which the transfer of bits of data occurs. Nominally, a Gb is a transfer rate of 1,000,000,000 (10^9) bits per second.

See also **Gb.**

GBps

Gigabytes per second. A measurement of the rate at which the transfer of bytes of data occurs. A GBps is a transfer rate of 1,000,000,000 (10^9) bits per second.

See also **GB.**

Giga (G)

The notation to represent 10^9 or 1 billion (1,000,000,000).

gigabaud

An encoded bit transmission rate of one billion (10^9) bits per second.

gigabit per second

See **Gbps.**

gigabit

See **Gb.**

graphical user interface

See **GUI.**

GUI

Graphical User Interface. Software that displays the status of a storage system and allows its user to control the storage system.

HBA

Host Bus Adapter.

See **FCA.**

Host Bus Adapter

See **FCA.**

host computer

See **host.**

host ports

A connection point to one or more hosts through a Fibre Channel fabric. A host is a computer that runs user applications and that uses (or can potentially use) one or more of the virtual disks that are created and presented by the controller pair.

host

A computer that runs user applications and uses (or can potentially use) one or more virtual disks created and presented by the controller pair.

host-side ports

See **host ports.**

hot-pluggable

A method of element replacement whereby the complete system remains operational during element removal or insertion. Replacement does not interrupt data transfers to other elements.

HSV Element Manager

See **Element Manager.**

hub

A communications infrastructure device to which nodes on a multi-point bus or loop are physically connected. It is used to improve the manageability of physical cables.

I/O module

Input/Output module. The enclosure element that is the FC-AL interface to the host or controller. I/O modules are bus speed specific; either 1 Gb or 2 Gb.

in-band communication

The method of communication between the EMU and controller that utilizes the FC-AL bus.

See also **out-of-band communication.**

input/output module

See **I/O module.**

intake temperature

See **ambient temperature.**

interface

A set of protocols used between components such as cables, connectors, and signal levels.

JBOD

Just a Bunch of Disks. A number of disks connected to one or more controllers.

just a bunch of disks

See **JBOD.**

KB

Kilobyte. A unit of measurement defining either storage or memory capacity.

1. For storage, a KB is a capacity of 1,000 (10^3) bytes of data.
2. For memory, a KB is a capacity of 1,024 (2^{10}) bytes of data.

K

Kilo. A scientific notation denoting a multiplier of one thousand (1,000).

laser

A device that amplifies light waves and concentrates them in a narrow, very intense beam.

LCD

Liquid Crystal Display. The indicator on a panel that is associated with an element. The LCD is usually located on the front of an element.

LED

Light Emitting Diode. A semiconductor diode, used in an electronic display, that emits light when a voltage is applied to it.

light emitting diode

See **LED.**

link

A connection between ports on Fibre Channel devices. The link is a full duplex connection to a fabric or a simplex connection between loop devices.

loop ID

Seven-bit values numbered contiguously from 0 to 126 decimal and represent the 127 valid AL_PA values on a loop (not all 256 hexadecimal values are allowed as AL_PA values per FC–AL).

loop pair

A Fibre Channel attachment between a controller and physical disk drives. Physical disk drives connect to controllers through paired Fibre Channel arbitrated loops. There are two loop pairs, designated loop pair 1 and loop pair 2. Each loop pair consists of two loops (called loop A and loop B) that operate independently during normal operation, but provide mutual backup in case one loop fails.

loop switch

A unit that acts as a central point of interconnection and establishes a fault-tolerant physical loop topology.

loop

See **arbitrated loop.**

management agent

The HSV Element Manager software that controls and monitors the Enterprise Storage System. The software can exist on more than one management appliance in a fabric. Each installation of the HSV Element Manager software is a management agent.

MB

Megabtye. A term defining either:

- A data transfer rate.

  See also **MBps.**

- A measure of either storage or memory capacity of 1,048,576 (2^{20}) bytes.

Mb

Megabit. A term defining a data transfer rate.

See also **Mbps.**

Mbps

Megabits per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 (10^6) bits per second.

MBps

Megabytes per second. A measure of bandwidth or data transfers occurring at a rate of 1,000,000 (10^6) bytes per second.

Mega

A notation denoting a multiplier of 1 million (1,000,000).

Network Storage Controller

See **NSC.**

node port

A device port that can operate on the arbitrated loop topology.

NSC

Network Storage Controller. The HSV Controllers used by the Enterprise Storage System.

OCP

Operator Control Panel. The element that displays the controller's status using LEDs and an LCD. Information selection and data entry is controlled by the OCP pushbuttons.

operator control panel

See **OCP.**

OSM

Open SAN Manager. A centralized, appliance-based monitoring and management interface that supports multiple applications, operating systems, hardware platforms, storage systems, tape libraries and SAN-related interconnect devices. It is included and resides on the SANworks Management Appliance, a single aggregation point for data management.

out-of-band communication

Communication between an enclosure and reporting group elements that does not use the FC-AL bus, such as the enclosure address bus.

See also **in-band communication.**

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.

PDM

Power Distribution Module. A thermal circuit breaker equipped power strip that distribute power from a PDU to Enterprise Storage System elements.

PDU

Power Distribution Unit. The rack device that distributes conditioned AC or DC power within a rack.

physical disk

A disk drive mounted in a disk drive enclosure that communicates with a controller pair through the device-side Fibre Channel loops. A physical disk is hardware with embedded software, as opposed to a virtual disk, which is constructed by the controllers. Only the controllers can communicate directly with the physical disks.

The physical disks, in aggregate, are called the array and constitute the storage pool from which the controllers create virtual disks.

physical disk array

See **array**.

port

A Fibre Channel connector on a Fibre Channel device.

power distribution module

See **PDM.**

power distribution unit

See **PDU.**

power supply

An element that develops DC voltages for operating the storage system elements from either an AC or DC source.

rack

A floor-standing structure primarily designed for, and capable of, holding and supporting storage system equipment. All racks provide for the mounting of panels per Electronic Industries Alliance (EIA) *Standard RS-310-C*.

rack-mounting unit

A measurement for rack heights based upon a repeating hole pattern. It is expressed as "U" spacing or panel heights. Repeating hole patterns are spaced every 1.75 inches (44.45 mm) and based on EIA's *Standard RS-310-C*. For example, a 3U unit is 5.25-inches (133.35 mm) high and a 4U unit is 7.0-inches (177.79 mm) high.

redundancy

1. Element Redundancy—The degree to which logical or physical elements are protected by having another element that can take over in case of failure. For example, each loop of a device-side loop pair normally work independently but can take over for the other in case of failure.
2. Data Redundancy—The level to which user data is protected. Redundancy is directly proportional to cost in terms of storage usage; the greater the level of data protection, the more storage space is required.

redundant power configuration

A capability of the Enterprise Storage System racks and enclosures to allow continuous system operation by preventing single points of power failure.

- For a rack, two AC power sources and two power conditioning units distribute primary and redundant AC power to enclosure power supplies.
- For a controller or disk drive enclosure, two power supplies ensure that the DC power is available even when there is a failure of one supply, one AC source, or one power conditioning unit. Implementing the redundant power configuration provides protection against the loss or corruption of data.

room temperature

See **ambient temperature.**

SCSI

1. Small Computer System Interface. An American National Standards Institute (ANSI) interface which defines the physical and electrical parameters of a parallel I/O bus used to connect computers and a maximum of 16 bus elements.
2. The communication protocol used between a controller pair and the hosts. Specifically, the protocol is FC-AL or SCSI on a Fibre Channel. SCSI is the higher command-level protocol and Fibre Channel is the low-level transmission protocol. The controllers have full support for SCSI-2; additionally, they support some elements of SCSI-3.

SCSI-3 Enclosure Services

See **SES.**

SCSI-3

The ANSI standard that defines the operation and function of Fibre Channel systems.

SES

SCSI-3 Enclosures Services. Those services that establish the mechanical environment, electrical environment, and external indicators and controls for the proper operation and maintenance of devices within an enclosure.

small computer system interface

See **SCSI.**

solutions rack

A rack containing controller enclosures, disk drive enclosures, power distribution, enclosure address buses, and so forth that provide a specific solution such as the Modula Solutions rack or the Enterprise Storage System rack.

See also **rack.**

storage system

The controllers, storage devices, enclosures, cables, and power supplies and their software.

switch

An electro-mechanical device that initiates an action or completes a circuit.

TBps

Terabytes per second. A data transfer rate of 1,000,000,000,000 (10^{12}) bytes per second.

TB

Terabyte. A term defining either:

- A data transfer rate.

  See also **TBps.**

- A measure of either storage or memory capacity of 1,099,5111,627,776 (2^{40}) bytes.

terminator

Interconnected elements that form the ends of the transmission lines in the enclosure address bus.

topology

An interconnection scheme that allows multiple Fibre Channel ports to communicate. Point-to-point, arbitrated loop, and switched fabric are all Fibre Channel topologies.

transceiver

The device that converts electrical signals to optical signals at the point where the fiber cables connect to the FC elements such as hubs, controllers, or adapters. *Also* called a Gigabit Interface Converter (GBIC).

units

See **rack-mounting units.**

Index

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

V

W

Y